



# NARROWBAND IOT QUICK START GUIDE

Telekom Deutschland GmbH

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LIFE IS FOR SHARING.

# WELCOME



This Quick Start Guide for NarrowBand IoT is intended to help you set up and activate NarrowBand IoT connectivity and set up data transmission within the Telekom Cloud of Things.

The Quick Start Guide is aimed at all “NB-IoT Access” package users as well as “NB-IoT Access and Cloud of Things” users.



# GENERAL ACCESS INFORMATION

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## NB-IoT access

**APN:** internet.nbiot.telekom.de

(When using a private APN, this is transmitted separately.)

## NB-IoT Access and Cloud of Things

**APN:**

nb-cloud.ic.m2mportal.de

(Only access to the Telekom Cloud of Things is possible.)

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**Network Operator Code:** 26201 (for Germany)

## Telekom Deutschland Global SIM

When connecting to the network, the module selects parameter 5 ("Roaming") by default, even within Germany, as the global SIM has a country-independent profile.

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The SIM cards will be activated within 1-2 working days after delivery.

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# NB-IOT ACCESS EXAMPLE SESSION

The code shows an AT command session with a Neul NB-IoT toolkit and runs on all modules based on the Neul/HiSilicon chip set, such as those from the manufacturers U-Blox or Quectel.

## DISPLAY

The code displays all commands, comments and the feedback from the radio module. Command lines are distinguished from responses by `at+` at the start of the line. Comments start with a hashtag (`#`).

## SESSION

The session shows basic functions of the radio module, establishment of a connection to the network as well as data being sent and received. Communication with the Echo server only works with a SIM card from the “NB-IoT Access” package.

```
# Reboot the modem to ensure a clean state at the start of the
# session
at+nrb

REBOOTING
REBOOT_CAUSE_APPLICATION_AT
Neul
OK

# Check general functionality of the modem. A peculiarity of the
# chipset is the fact that the very first response may be "ERROR"
# instead of "OK". This is usually no reason for concern. The
# following "at" are then answered with "OK".

at

OK

# Query the firmware version. For connections to the Telekom network
# the version string has (currently) to end with: B656
at+cgmr

V100R100C10B656

OK

# Get the IMSI. This returns just "OK" when the radio circuits are
# not turned on already.
at+cimi

OK

# Query the state of the radio, which shows that the radio is turned off.
# Modules can be configured to connect automatically. In this case the
# radio is turned on automatically after booting.
at+cfun?

+CFUN:0

OK

# Turn the radio on.
```



```
at+cfun=1
OK
# Query radio state, now the radio is on.
at+cfun?
+CFUN:1
OK
# Query the IMSI. As the radio is on now, the IMSI is returned.
at+cimi
901405800005151
OK
# Set the network operator PLMN, or MCCMNC. In Germany use: 26201
# The command also initiates the attachment to the network. Even
# though the command returns immediately, attachment may take up to a
# minute.
at+cops=1,2,"26201"
OK
# Query attachment state. This can be done multiple times until
# attachment is ready. An alternative way is the use of unsolicited result
# by using "AT+CEREG=1", check the manual for more information.
at+cgatt?
+CGATT:0
OK
at+cgatt?
+CGATT:1
OK
# Now, that the module is attached, query radio statistics.
at+nuestats
Signal power:-1053
Total power:-875
TX power:23
TX time:822
RX time:30289
Cell ID:27184648
DL MCS:0
UL MCS:0
DCI MCS:1
ECL:1
SNR:-64
EARFCN:3740
PCI:471
OK
# Query the PDP context, which provides information on the APN
# used for the network connection. For the public APN this should
# result in "internet.nbiot.telekom.de.MNC040.MCC901.GPRS".
at+cgdcont?
+CGDCONT:0,"IP","internet.nbiot.telekom.de.MNC040.MCC901.GPRS",,0,0
OK
# Check the address within the local network.
at+cgpaddr
+CGPADDR:0,10.0.48.14
OK
```



```
# Check the bands supported by the module.
at+nband?

+NBAND:8

OK

# Ping an external server to check general connectivity.
at+nping=84.200.60.162

OK

# Unsolicited message indicating a successful ping response.
+NPING:84.200.60.162,56,1301

# Now, that everything is up and ready for ip communication a
# UDP socket can be opened. DGRAM and 17 are mandatory parameters.
# 16666 designates the listening port.

#
at+nsocr=DGRAM,17,16666

0

OK

# Send data on socket 0 to 84.200.60.162 on port 16666. Three
# bytes are sent. The data is specified in the hex-string
# format, i.e. "ABC" is sent. The port number is identical to
# the listening port to allow for receiving data from an echo
# server.
#
# Note, that this will work only with SIMs for a public APN.
#
at+nsost=0,84.200.60.162,16666,3,414243

0,3

OK

# Unsolicited message arrived notification. Indicating three
# bytes of data have been received on socket 0. These kind of
# unsolicited messages appear anytime data has been received.
+NSONMI:0,3
# Read three bytes of data available on socket 0.
at+nsorf=0,3

0,84.200.60.162,16666,3,414243,0

OK
```



# NB-IOT ACCESS AND CLOUD OF THINGS EXAMPLE SESSION

SIM cards with access to the Cloud of Things can only use this. Communication with the Echo server on the Internet is not possible.

## DISPLAY

The code displays all commands, comments and the feedback from the radio module. Command lines are distinguished from responses by `at+` at the start of the line. Comments start with a hashtag (`#`).

## DEVICE REGISTRATION

Each device respectively SIM card needs to be registered on Cloud of Things prior using. The registration is accomplished by uploading a CSV file comprising the device data on Cloud of things.

To connect a new device to your Cloud of Things account follow the steps below:

1. Login on Cloud of Things platform
2. Click "Device Registration" in the left-hand navigation bar under "Devices"
3. Go to "**Bulk device registration**".
4. Upload CSV file

The headlines for the **MQTT** CSV file are „ID“; „Credentials“; „Type“; „Name“; „ICCID“; „Shell“; „com\_Cumulocity\_model\_Agent“; „c8y\_Mobile.imsi“; „c8y\_Mobile.imei“.

The columns are used as follows:

- **ID**: ID of the device as referencing within Cloud of Things (always IMSI for Nb-IoT)
- **Credentials**: Password that is used by the device for the registration in Cloud of Things (have to be 8 letters and UTF-8 conform).
- **Type**: Type of the device. If the device should be connected via MQTT the type "nbiot" have to be registered.
- **Name**: Name of the device for the display within the device management.
- **ICCID**: Is used as the device's registration name for Cloud of Things.
- **Shell**: Is a flag (0 or 1) whether to allow the sending of operations to a device or not (1=yes).
- **com\_cumulocity\_model\_Agent**: necessary to display the device within the inventory. The curly brackets are empty "{}".
- **c8y\_Mobile .imsi**: IMSI that is assigned to your SIM card. You get the information with your SIM cards.
- **c8y\_Mobile.imei**: IMEI of the device.

An appropriate example could look like this:



```
ID;CREDENTIALS;TYPE;NAME;ICCID;SHELL;com_cumulocity_model_Agent;c8y_Mobile.imsi;c8y_Mobile.imei123456789123456;LF2PWJOL;nbiot;Device1;123456789123456;;1;{};123456789123456;987654321098765
```

**Note:** After the upload of the CSV in some cases it can take up to 10 minutes until the connection is successful.

## SESSION

The Cloud of Things uses MQTT-SN for communication. This protocol must be implemented for data exchange. The code shows a simple connection test. This consists of a connection request and receipt of a confirmation from the server.

```
# Reboot the modem to ensure a clean state at the start of the
# session
at+nrb

REBOOTING
REBOOT_CAUSE_APPLICATION_AT
Neul
OK

# Check general functionality of the modem. A peculiarity of the
# chipset is the fact that the very first response may be "ERROR"
# instead of "OK". This is usually no reason for concern. The
# following "at" are then answered with "OK".

at

OK

# Query the firmware version. For connections to the Telekom network
# the version string has (currently) to end with: B656
at+cgmrv

V100R100C10B656

OK

# Get the IMSI. This returns just "OK" when the radio circuits are
# not turned on already.
at+cimi

OK

# Query the state of the radio, which shows that the radio is turned off.
# Modules can be configured to connect automatically. In this case the
# radio is turned on automatically after booting.
at+cfun?

+CFUN:0

OK

# Turn the radio on.
at+cfun=1

OK

# Query radio state, now the radio is on.
at+cfun?

+CFUN:1
```



```
OK
# Query the IMSI. As the radio is on now, the IMSI is returned.
at+cimi

901405800005151

OK
# Set the network operator PLMN, or MCCMNC. In Germany use: 26201
# The command also initiates the attachment to the network. Even
# though the command returns immediately, attachment may take up to
# a minute.
at+cops=1,2,"26201"

OK
# Query attachment state. This can be done multiple times until
# attachment is ready. An alternative way is the use of unsolicited result
# by using "AT+CEREG=1", check the manual for more information.
at+cgatt?

+CGATT:0

OK
at+cgatt?

+CGATT:1

OK
# Now, that the module is attached, query radio statistics.
at+nuestats

Signal power:-1053
Total power:-875
TX power:23
TX time:822
RX time:30289
Cell ID:27184648
DL MCS:0
UL MCS:0
DCI MCS:1
ECL:1
SNR:-64
EARFCN:3740
PCI:471

OK
# Query the PDP context, which provides information on the APN
# used for the network connection. For the Cloud APN this should
# result in "nb-cloud.ic.m2mportal.de.MNC040.MCC901.GPRS".
at+cgdcont?

+CGDCONT:0,"IP","nb-cloud.ic.m2mportal.de.MNC040.MCC901.GPRS",,0,0

OK
# Check the address within the local network.
at+cgpaddr

+CGPADDR:0,10.0.48.14

OK
# Check the bands supported by the module.
at+nband?

+NBAND:8,20

OK
```



```
# Ping Cloud of Things gateway to check general connectivity.
at+nping=172.25.102.151

OK

# Unsolicited message indicating a successful ping response.
+NPING:172.25.102.151

# Now, that everything is up and ready for ip communication a
# UDP socket can be opened. DGRAM and 17 are mandatory parameters.
# 1883 designates the listening port. For communication with the Cloud # of things this
# has to be set to 1883
at+nsocr=DGRAM,17,1883

0

OK

#Now data is sent through the open socket to the gateway server with IP
#172.25.102.151 on port 1883. 29 bytes of data are sent. The sent data represents
#a MQTT-SN CONNECT query to the Cloud of Things gateway server. This should
#be acknowledged by the server by sending a CONNACK (hex: 030500). The data
#should be sent as usual in the hex string format. Exchanging <IMSI> and <PW> by
#one of your valid IMSI/Password combinations, formatted in hex strings, should
#result in the described behavior.
at+nsost=0,"172.25.102.151",1883,29,"1D0404010384<IMSI><PW>"

0,29

OK

# Unsolicited message arrived notification. Indicating three
# bytes of data have been received on socket 0. These kind of
# unsolicited messages appear anytime data has been received.
+NSONMI:0,3

# Read three bytes of data available on socket 0.
at+nsorf=0,3

0,172.25.102.151,1883,3,030500,0

OK

# Now the gateway considers the device as connected. To disconnect a
#DISCONNECT message can sent:
at+nsost=0,172.25.102.151,1883,2,0218

0,2

OK

#Which should be acknowledged by the gateway by sending a DISCONNECT as
#well:
+NSONMI:0,2

# Read three bytes of data available on socket 0.
at+nsorf=0,2

0,172.25.102.151,1883,2,0218,0

OK
```



# ASSESSMENT OF SIGNAL QUALITY

## COMMANDS TO ASSESS THE SIGNAL QUALITY

Command	Output	Function
AT+NUESTATS	Signal power: -1121 PCI: 502	Read out current RSRP of -112,1dBm Read out PCI of NB-IoT cell
AT+CSQ	+CSQ: <RSSI> , <BER>	Determine signal strength

## AT+NUESTATS

```
Signal power:-1148  
Total power:-1081  
TX power:23  
TX time:409  
RX time:25923  
Cell ID:36770309  
DL MCS:0  
UL MCS:0  
DCI MCS:2  
ECL:0  
SNR:130  
EARFCN:3740  
PCI:502
```

## PARAMETERS FOR ASSESSING THE SIGNAL QUALITY

Signal Power	RSRP (-114,8dBm)
Total Power	RSSI (-108,1dBm) = CSQ-RSSI
ECL	Coverage Level (0)
SNR	Signal Noise Ratio (13,0dB)
PCI	NB-IoT-Zell-PCI
EARFCN	NB-IoT DL-EARFCN (RB7)



## AT+CSQ

With the command `AT+CSQ` , you receive two outputs:

RSSI	dBm
0	-113
1	-111
2...30	-109...-59
31	>= -51
99	Cannot be detected

BER	
0	...
1	....
2	...
3	...
99	Cannot be detected

The BER value is not supported at present.

# WIRELESS MODULES/FIRMWARE UPGRADE

## ACTIVATION IN THE TELEKOM DEUTSCHLAND NETWORK

The firmware for the modules requires version **V100R100C10B656**. The relevant distributor or module manufacturer will provide the means for a firmware upgrade if the modules are running with non-compatible firmware.

The activation applies to all modules from the manufacturers Quectel and U-Blox.

## OPERATION IN THE DEUTSCHE TELEKOM NETWORK

In order for modules to work in the Telekom NB-IoT network, the following two parameters must be activated:

**CR\_0354\_0338\_SCRAMBLING**  
**CR\_0859\_SI\_AVOID**

This setting is usually configured at the factory. Following an upgrade, these settings need to be applied manually. To do this, proceed as follows:

1. Switch off the radio
2. Enter `AT+CFIN=0`.
3. Activate the parameters:  
`AT+NCONFIG=CR_0354_0338_SCRAMBLING,TRUE`  
`AT+NCONFIG=CR_0859_SI_AVOID,TRUE`
4. Perform a restart: `AT+NRB`
5. The values are now stored and remain in place following a restart.

In some cases, the modules support multiple frequency ranges. In the Telekom NB-IoT network, the modules should be set to **band 8 (900 Mhz)**. This setting only needs to be made once.

1. Enter `AT+NBAND=8`
2. Perform a restart: `AT+NRB`



## MORE INFORMATION

### WEBSITE

[iot.telekom.com](https://iot.telekom.com)

### TECHNICAL SUPPORT

Further assistance is provided by the NB-IoT Developer Community and can be reached via <https://iotbytelekom.com>. In this web forum comprehensive support material is resided. Besides it is possible to raise individual questions which are being answered by Telekom employees within a few days. Using the forum requires self-registration and is free of charge.

### DEVELOPER GUIDE

The Developer Guide for the “Cloud of Things MQTT Connector for NB-IoT” will be sent separately by e-mail when you book the package “NB-IoT Access and Cloud of Things”.

## PUBLICATION DETAILS

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