Introduction to NB-IoT

Ubiquitous sensor communication
Approching 5G/LTE

Robert Olsson Mats Nilson

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IoT classes overview

Device and sensor characterization

Proposed IoT classes:

1. Long-Lived IoT, Lower power, lower complexity Extended Coverage

2. Real-Time IoT, Critical IoT applications IoT with Sensors & Actuators. Need to reduce delay

3. Massive Device mIoT & Massive Access. Signal scalability challenges.

Background / IoT Era

Long-lived IoT connectivity. The Great IoT Era.

Limitations in all aspects.
Power, Service, Size & Cost

Vendors on market to become new Facebook/Google.
Get users sensor data and refine sell.
– Data (your) should be open and free!

Although interesting use cases exist.

Background / Uplink alternatives

Not easy to sort out all options and longtime trends.

3GPP/Licensed bands/SIM <–-> ISM unmanaged

ISM alternatives

LoRA, SigFOX, WiFi

Licensed alternatives

GPRS/2G/LTE/NB-IoT

Background / Connection Model

Connection models are different

Single device (Often via radio module protocol stack)
Network of devices. WSN.

Different challenges

- Protocol CoAP/MQTT/TCP/UDP
- Network synchronization
- Gateway/Routing/Redundancy

NB-IoT / Scope / 3GPP manifesto

the requirements of the Internet of Things (IoT). The technology provides improved indoor coverage, support of massive number of low throughput devices, low delay sensitivity, ultra-low device cost, low device power consumption and optimized network architecture.

The technology can be deployed “in-band”, utilizing resource blocks within a normal LTE carrier, or in the unused resource blocks within a LTE carrier’s guard-band, or

NB-IoT / Bands / Frequency

- Europe: B3 (1800), B8 (900) and B20 (800);
- Commonwealth of Independent States: B3 (1800), B8 (900) and B20 (800);
- North America: none
- Asia Pacific: B1(2100), B3(1800), B5(850), B8(900), B18(850), B20(800), B26(850) and B28(700);
- Sub-Saharan Africa: B3(1800) and B8(900);
- Middle East and North Africa: B8(900) and B20(800);
- Latin America: B2(1900), B3(1800), B5(850) and B28(700)

NB-IoT / Power Save – PSM

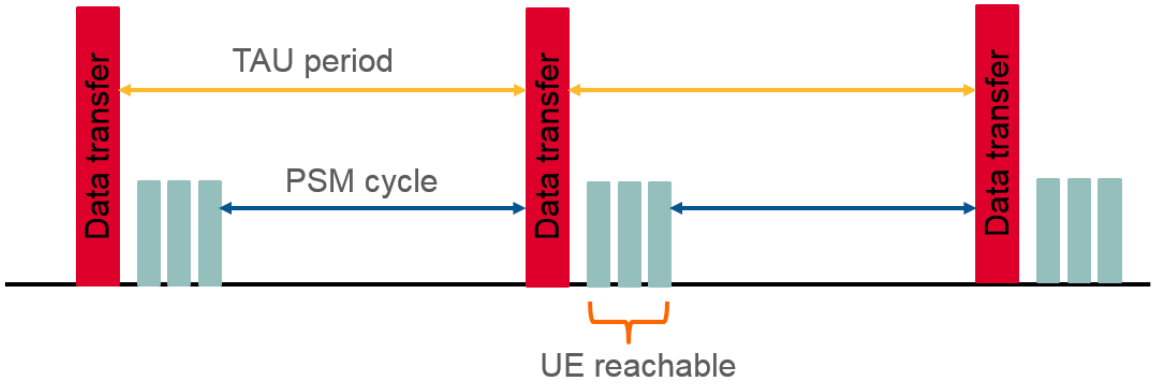

Figure 2: TAU (Tracking Area Updating) period and PSM cycle

When a device initiates PSM with the network, it provides two preferred timers (T3324 and T3412); PSM time is the difference between these timers (T3412-T3324). The network may accept these values or set different ones. The network then retains state information and the device remains registered with the network. If a device awakes and sends data before the expiration of the time interval it agreed with the network, a reattach procedure is not required.

NB-IoT / Power Save – PSM / SUMMARY

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- PSM mode is similar to power-off, but the *UE remains registered with the network.* When the UE becomes active again there is no need to re-attach or re-establish PDN connections.
- The PSM feature was introduced in 3GPP Release 12 and is available for all LTE device categories.
- UE requests the PSM simply by including a timer with the desired value in the attach, TAU or routing area update. The maximum time a device may sleep is approximately 413 days (set by 3GPP Release 13 for T3412). The maximum time a device may be reachable is 186 minutes (an equivalent of the maximum value of the Active timer T3324).

NB-IoT / Power Save – eDRX

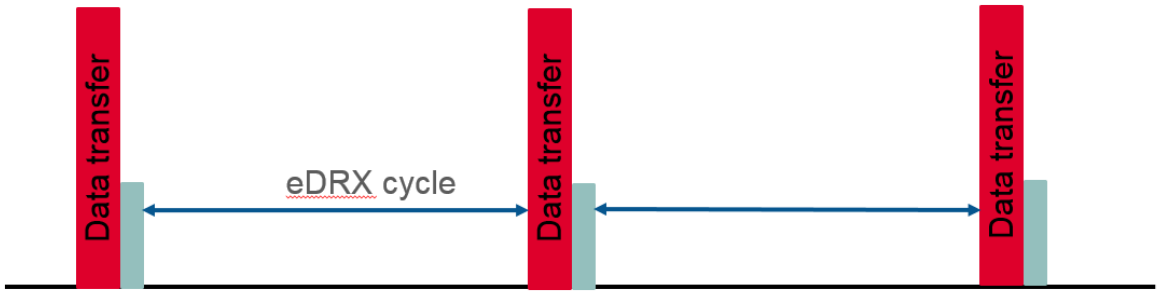


Figure 3: eDRX cycle

Extended Discontinuous Reception (eDRX) is an extension of an existing LTE feature which can be used by IoT devices to reduce power consumption. eDRX can be used without PSM or in conjunction with PSM to obtain additional power savings.

NB-IoT / HW modules

Examples 2019

AT – based commands
BAUD – 9600
UART
Own protocol stack. IP/IPV6/TCP/UDP/MQTT/CoAP
Price 200 SEK
SIM eSIM?

SIM7020e
U-Blox SARA N200

NB-IoT / SIM7020E / Data

Selected specifications

Feature	Implementation
Power supply	Power supply voltage 2.1~3.6V,Typ=3.3V
Power saving	Current in sleep mode: 236uA (at+cfun=0) Current in PSM mode: 3.4uA
Radio frequency bands	Please refer to the table 1
Transmitting power	LTE 23dBm
Data Transmission Throughput	LTE CAT NB1: 26.15Kbps (DL) LTE CAT NB1: 62.5Kbps (UL)

Operating band	Sensitivity dBm (95% throughput with repetitions)
1, 3,5, 8, 20, 28	-131

NB-IoT / SIM7020E / Data

Selected specifications V_BAT=3.3V

LTE-FDD B8	@23dbm Typical: 128mA @10dbm Typical: 35mA @0dbm Typical: 25mA
LTE-FDD B20	@23dbm Typical: 113mA @10dbm Typical: 34mA @0dbm Typical: 26mA
LTE-FDD B28	@23dbm Typical: 126mA @10dbm Typical: 38mA @0dbm Typical: 27mA

NB-IoT / ISP support / Sweden

Examples 2019

Telia in Kista
Telia activates NB-IoT on demand it says

ISP’s have web portals for control and monitoring

NB-IoT / SW support

Work-in-progess 2019

Generic AT driver GPRS/NB-IoT for Contiki
Developed using avr-rss2 platform
Lives in Peter Sjödins Contiki repo

Modems can be tested via UART/Minicom

IoT / WARNINGs

Consider before making data available

Security
Integrity
    AI systems, M2M use.
Cost
Data use and data quality
Legal issues, ownership, responsibility

References

Official Document CLP.28 - NB-IoT Deployment Guide to Basic Feature set Requirements NB-IoT Deployment Guide to Basic Feature set. Requirements Ver 1.0 02 August 2017

SIMCOM: SIM7020 _Hardware Design_V1.02

Life 3.0 Max Tegmark

Mobile spectrum for R&D

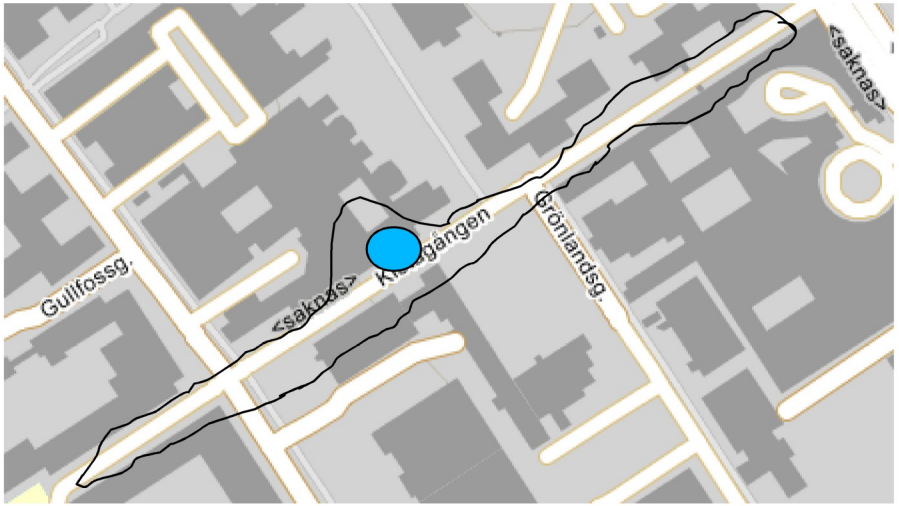
- Sweden and Netherlands only (UK shared)
- Unlicensed 3GPP spectrum: 1780-1785/1875-1880 MHz
- Indoor, max 100mW EIRP
- GSM/SMS/GPRS/EDGE
- LTE/NBIoT (max 3 MHz carrier)
- Open MNC’s (Mobile Network Codes): 65-68

UICTA – OPEN 1800 R&D test bed

GSM/SMS/GPRS/EDGE since summer 2016

Coverage: parts of Kistagången and Electrum

OMOCO BTS, position Mentorspace/KTH



Thank You!