NB-IoT (5G)

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Contents

Introduction

I. Physical layer of Nb-IoT
II. MAC layer
III. Power Consumption
IV. Security

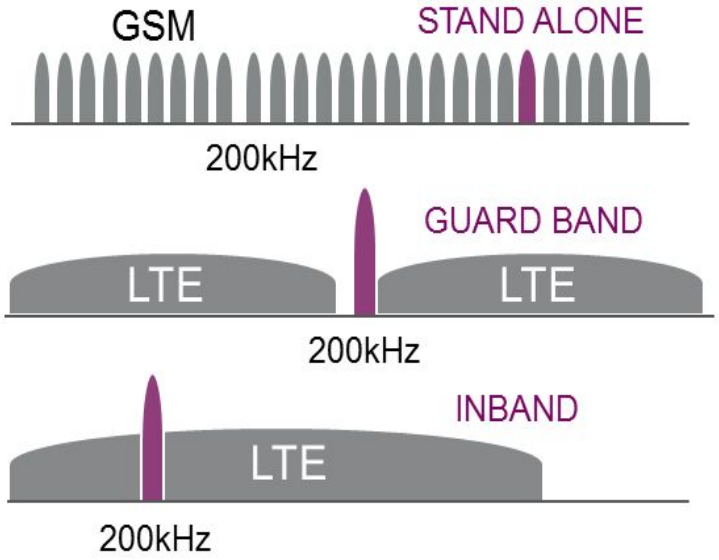
Conclusion

I. Physical layer :

The geographical representation of countries with the ongoing NB-IoT real-life deployments for diverse use cases (May 2019).

I. Physical layer :

NB-IoT



In Release 13 of Nb-IoT:

- Mode of operation: standalone, in-band, guard-band

NB-IoT operation mode.

I. Physical layer :

In Release 13 of Nb-IoT:

- Multi-tone transmission support:
  -Uplink: 3.75 kHz or 15 kHz of transmission bandwidth based on the SC-FDMA (Single Carrier Frequency Division Multiple Access) scheme
  -Downlink: 5 kHz of transmission bandwidth with OFDM (Orthogonal Frequency Division Multiplexing) scheme as LTE.

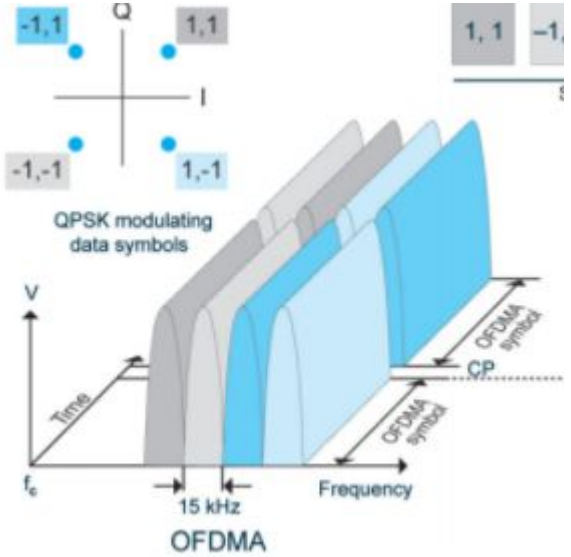
- Complexity and cost reduction technique:
  Nb-IoT uses Binary Phase Shift Keying (BPSK)
  and Quadrature Phase Shift Keying (QPSK) modulation

I. Physical layer :

Parameters	NB-IoT
Access Medium	• UL: SC-FDMA • DL: OFDMA
Carrier Spacing	• UL: QPSK, $\frac{\pi}{4}$ QPSK, $\frac{\pi}{2}$ BPSK • DL: QPSK
Modulation	• UL: 15kHz, 3.75kHz • DL: 15kHz
Max Payload	• UL: 1000 bits • DL: 680 bits
Bandwidth	• Standalone Mode: 200kHz • In-band Mode: 180 kHz in LTE spectrum • Guard-band mode: 180 kHz in LTE spectrum

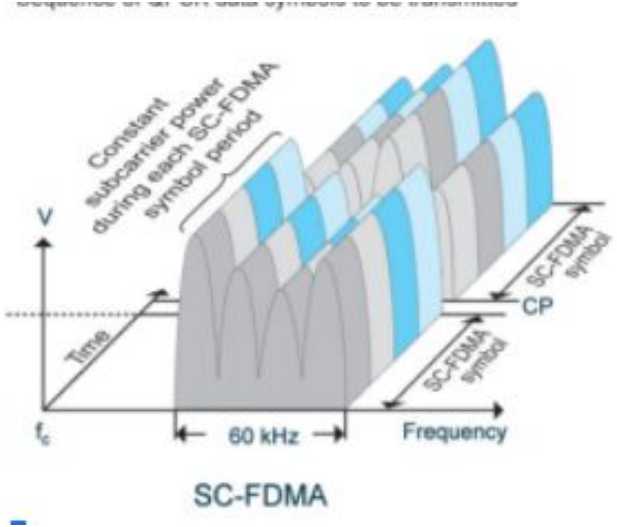
Summary table of layer 1 (Physical layer) of NB-IoT

II. MAC layer : Downlink



- OFDM
- 250 kb/s
- Data Channels (NPDSCH), System Control Channels (NPDCCH, NPBCH), Quality Control Channels (NRS) and Synchronization Channels (NSSS, NPSS)
- Synchronization
- Localization

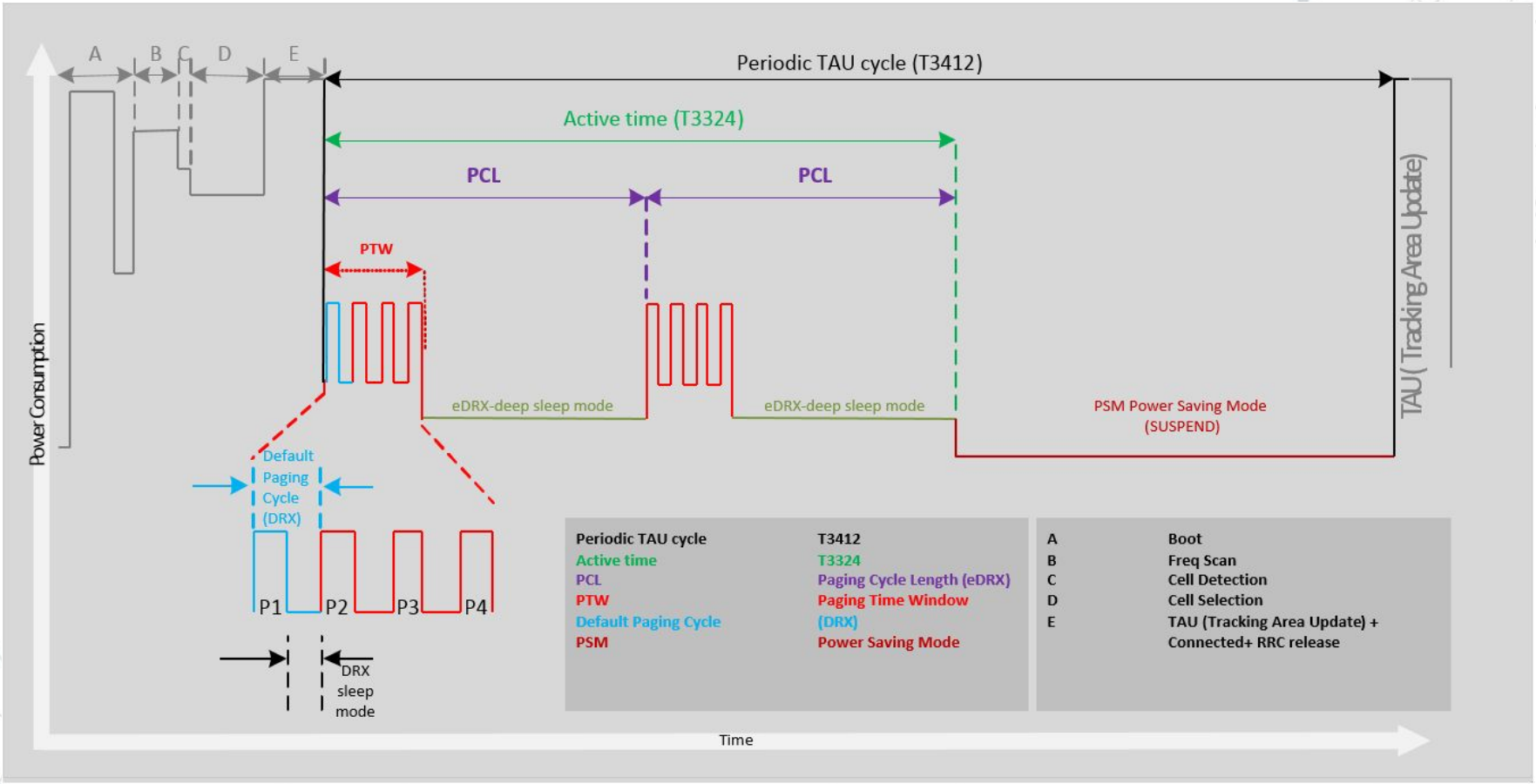
II. MAC layer : Uplink



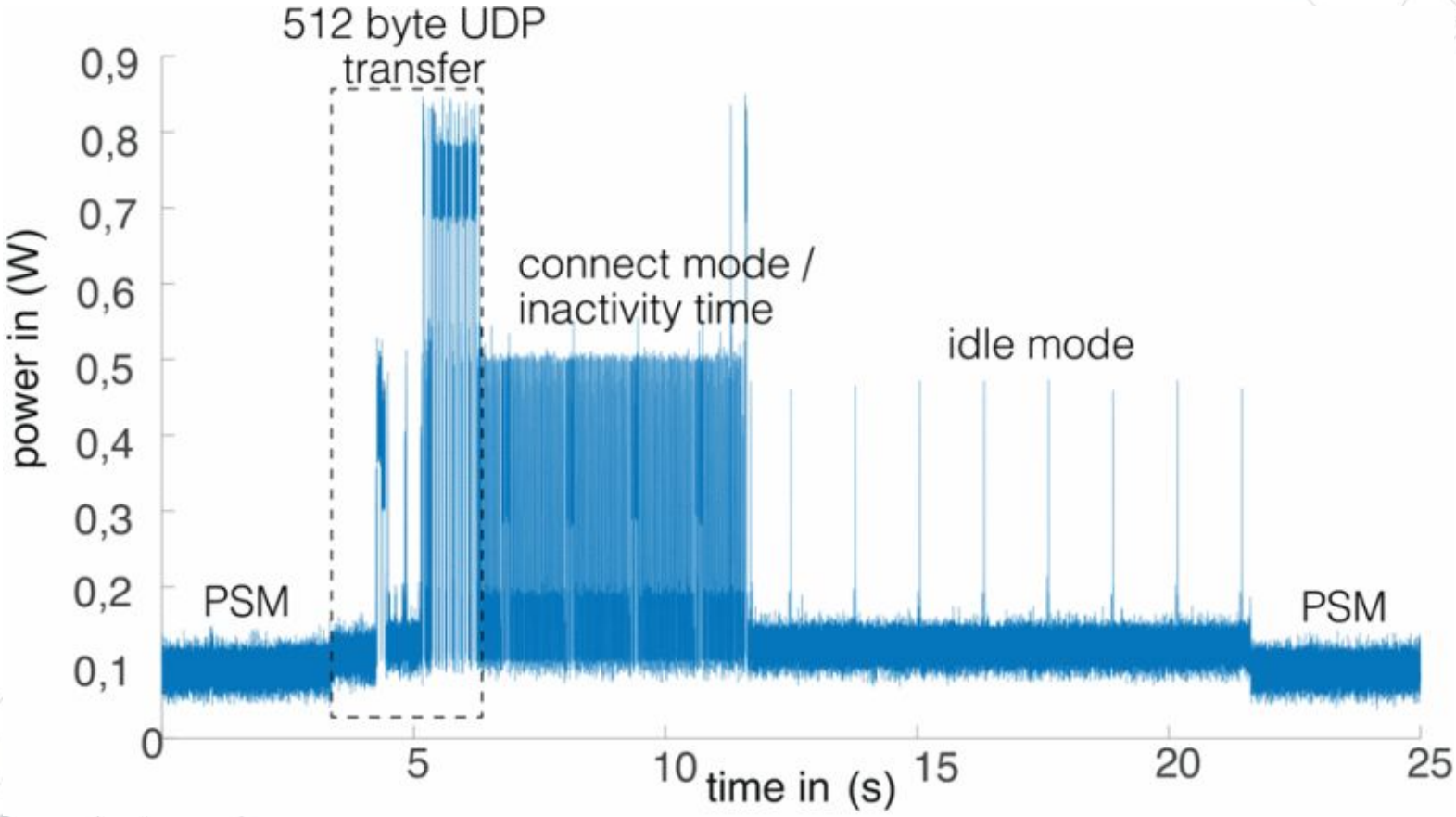
SC-FDMA

- SC-FDMA
- 2267 kb/s
- Data(NPUSCH), Quality (DMRS) and Control Channels (NP**RAC**H)
- Initial Access Channel and Slotted Aloha

III. Power consumption



III. Power consumption



III. Power consumption

Payload size (D)	100 Bytes
Battery capacity (C_{bat})	27.7 Wh (C-cell)
Sensor average power consumption (P_{device})	0 W
Safety factor (SF_{bat})	1/3
Data rate (R)	300 bps
Transmit interval (t_i)	[1 h, 24 h]

t_i	Technology	I-eDRX	PSM	Power cycle
1 h	3GPP [4]	88 d (0.2 y)	256 d (0.7 y)	108 d (0.3 y)
	Device A	17 d (0.0 y)	230 d (0.6 y)	103 d (0.3 y)
24 h	3GPP [4]	126 d (0.3 y)	4998 d (13.7 y)	2583 d (7.1 y)
	Device A	18 d (0.1 y)	4677 d (12.8 y)	2462 d (6.7 y)

IV. Security

¤ main NB-IoT/5G security characteristics:

- authorization/authentication process
- ensuring data integrity
- confidentiality
- encryption

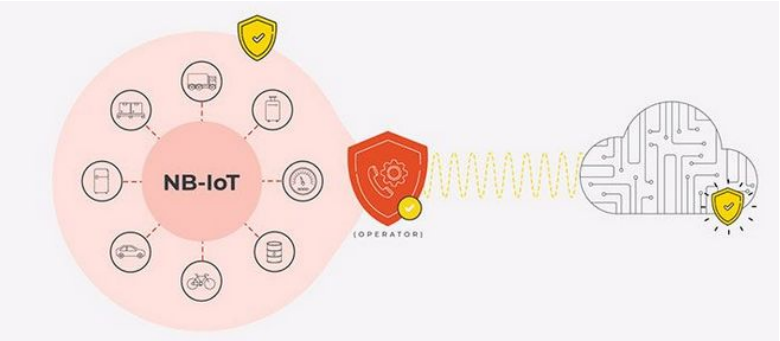
¤ NB-IoT net:

- secure data within the network
- UDP protocol
  - → low consumption
  - → non connected mode

IV. Security

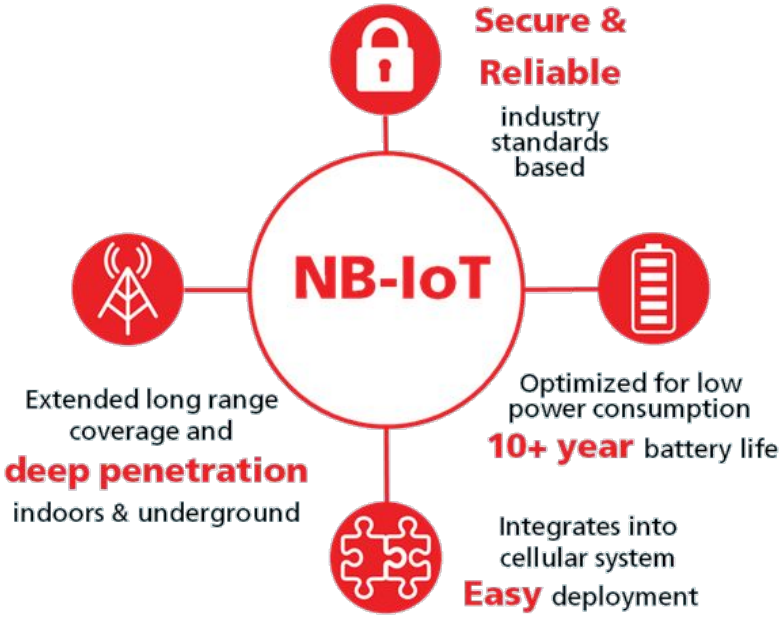
¤ Improving security methods:

- Access Point Name
  - ★ *Advantage*: security level increased
  - ★ *Drawback*: expensive



- Securing UDP : DTLS protocol to secured exchanged data

Conclusion


Secure &
Reliable
industry
standards
based
NB-IoT
Extended long range
coverage and
deep penetration
indoors & underground
Optimized for low
power consumption
10+ year battery life
Integrates into
cellular system
Easy deployment

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WE'VE FINISHED!
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