NB-IoT

Protocol presentation

Sylvain Dupouy Léo Picou Mohan Selvarak

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Physical specs

Bands

Based on LTE, use the liscenced spectrum.

In Europe : B3, B8, B20 [1]

- Advantage : Use the widely implemented cellular network
- Incovenient : Price of spectrum

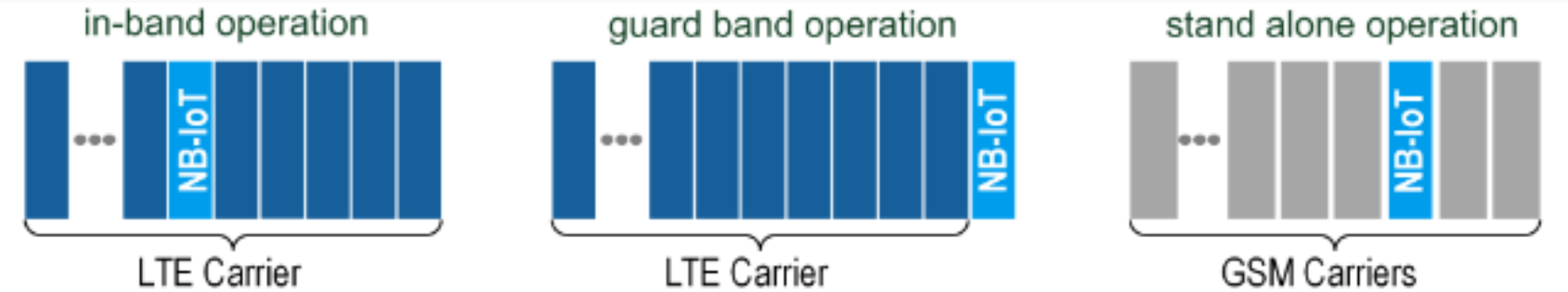


Figure 1: NB-IoT Deployment modes [3]

Modulation

Modulation : QPSK or $\frac{\pi}{2}$-BPSK

Access Method :

- Downlink : OFDMA
- Uplink : SC-FDMA [1]

Channel size and bandwidth :

- One LTE resource block : 180 kHz

[1] Can't use OFDMA in uplink due to high PAPR

Specs

Sensitivity

- NB-IoT : -141 dBm
- LTE-M : Up to $\approx$ -120 dBm

Data rate [2] :

- Downlink : 26 kbits/s
- Uplink : 16.9 kbits/s

[2] Depends heavily on release version (3GPP 13,14,15)

Protocols

Protocol stack

Reuse of LTE protocol stack :

- stripped of unnecessary features
- optimized stacks for user and control data

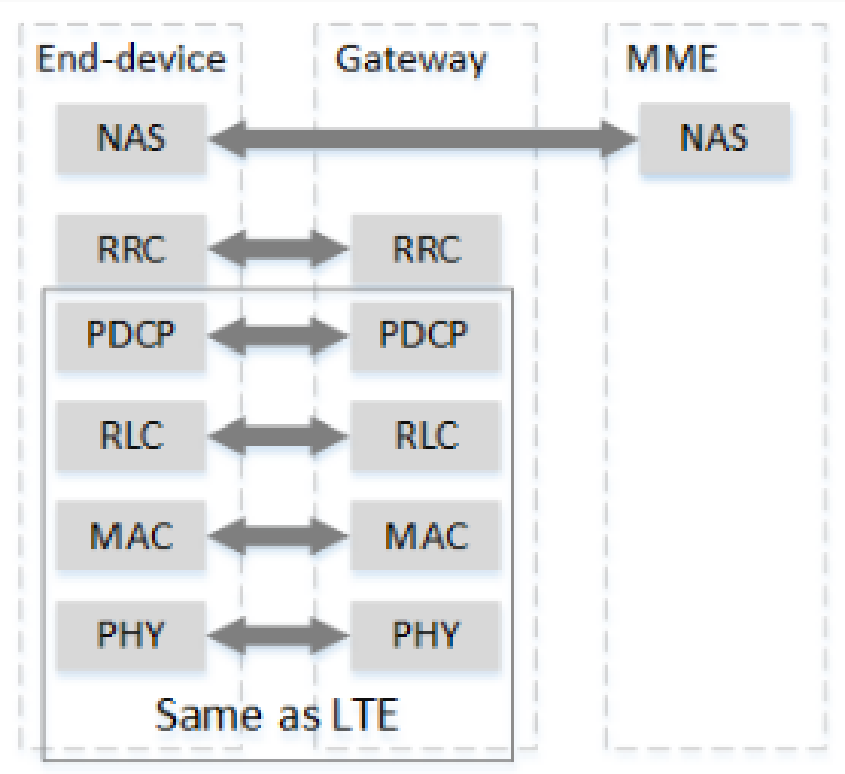


Figure 2: NB-IoT Protocol stack (taken from [2])

MAC Layer - RACH

Random Access CHannel

- Uplink synchronization between device (UE) and base station (eNodeB)
- Prepare resources for RRC Connection Request (higher layer protocol for LTE-based communication)

Provide a unique uplink synchronization and channel between the the UE and the eNB.

Mobility

No seamless mobility (like LTE handover) :

- No need : short and infrequent transmissions
- Reduced complexity

Device always scan for gateways when it wants to send data.

Gateways can share connection information to allow resuming a connection, preventing a new connection setup phase.

Mobility latency : 1.6 - 10s [2]

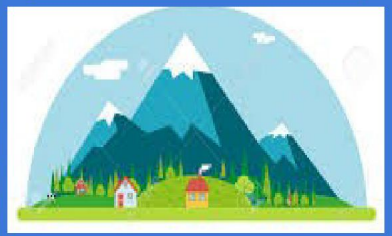
Study case

NETWORK COVERAGE

3 - 4 Km - URBAN

NB-IoT

10 - 15 Km - RURAL



LoRaWAN

NB-IoT

DASH7

DEPLOYMENT MODEL

CELLULAR

4G LTE

3G

GSM

LPWAN

SHORT WIRELESS

ZigBee

Wi Fi

BLE

DESTINATION

SOURCE

USE CASES

Pallet Tracking *Health Care* *Smart Vehicles*

Client Company

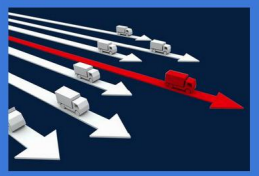
Health Care Center

City Corporation Management

NB-IoT LoRaWAN DASH7

Logistics Company

Elder Care Patient



Smart Vehicles

DEPLOYMENTS - ELECTRIC BIKE TRACKING

LOCATION	OPERATOR	DOMAIN	NETWORK SIZE	CUSTOMER
Zenghou, China	China Mobiles	Electric Bike Monitoring	3 Million Bikes	City Administration

PROBLEM

Bike Theft

Cycle Accident

Cycle Fire Accident

TECHNOLOGY

GPS

NB-IoT

BeiDou Navigation

SAFE & SECURE END PRODUCT

SOLUTION

Anti-Theft Tracking

PUBLIC SECURITY

Fire Warning

Traffic Violation Prevention

TRANSPORT DEPARTMENT

Battery life estimation

Battery life estimation

BATTERY LIFE CALCULATION		
Total energy consumption / day	0.0675	Wh / day
Standard battery	28.86	Wh
BATTERY LIFE	427.5555556	days

mangOH - TRANSMISSION MODE	
Current	0.1 A
Voltage	3.7 V
Power	0.5 W
Duration of transmission/day	400 s
Energy consumption in a day	0.056Wh/d

Questions?

References i

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