

NB-iot

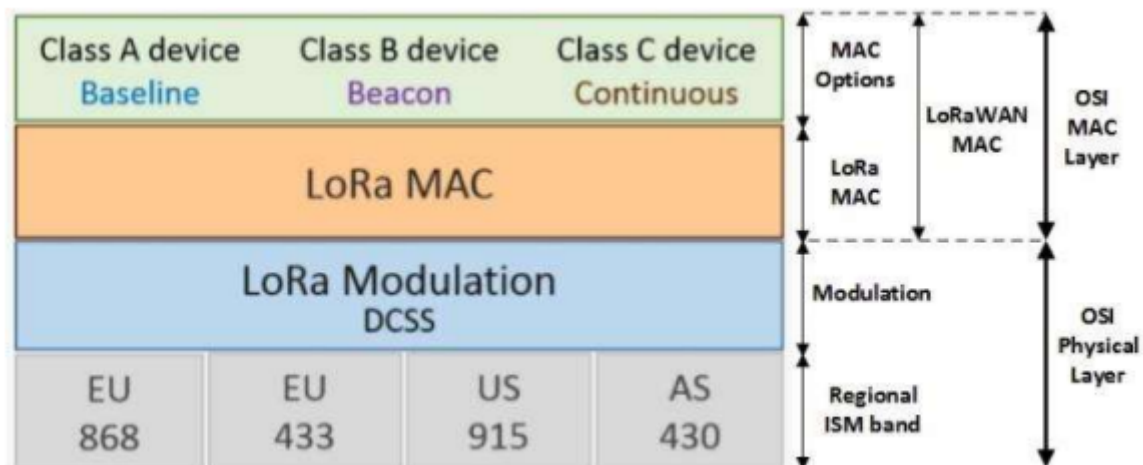
- NB-IoT (Narrow Band Internet of Things) is a low-cost, low-power, wide-area cellular connectivity for the Internet of Things
- NB-IoT is developed by 3GPP (3rd Generation Partnership Project) to enable a wide range of cellular devices and services
- The 3GPP Rel-13, published in June 2016, introduces NB-IoT. This system, based on Long Term Evolution (LTE) technology, supports most LTE functionalities, although with essential simplifications to reduce device complexity.
- The design objectives of NB-IoT include low complexity devices, high coverage, long device battery life, and massive capacity.
- Latency is relaxed although a delay budget of 10 seconds is the target for exception reports .

LTE / LTE-A

- LTE (Long-Term Evolution) is a standard wireless communication for high-speed data transfer between mobile phones based on GSM/UMTS network technologies
- It can cover fast travelling devices and provide multicasting and broadcasting services. LTE-A (LTE Advanced) is an improved version of LTE, including bandwidth extension, which supports
 - up to 100 MHz,
 - downlink and uplink spatial multiplexing,
 - extended coverage,
 - higher throughput
 - lower latencies.
- LTE-A encompasses a set of cellular communication protocols that fit well for Machine-Type Communications (MTC) and IoT infrastructures, especially for smart cities where long term durability of infrastructure is expected .
- At the physical layer, LTE-A uses orthogonal frequency division multiple access (OFDMA) by which the channel bandwidth is partitioned into smaller bands called physical resource blocks (PR B).

LoRa/LoRaWAN

- LoRa (Long Range) is a long-range wireless communications system, promoted by the LoRa Alliance.
- This system aims at being used in long-lived battery-powered devices, where the energy consumption is of paramount importance [32].
- LoRa refers to two distinct layers:
 - A physical layer using the Chirp Spread Spectrum (CSS) [33] radio modulation technique
 - A MAC layer protocol LoRaWAN (Long Range Wide-Area Network) [34].
- The LoRa physical layer, developed by Semtech, allows for long-range, low-power and low-throughput communications
- it operates at 433mhz
- the payload of each transition can range from 2 - 225 octates
- data rate up to 50kbps when channel aggregation is applied
- the LoRa modulation is proprietary technology by semtech



		NFC	BLE		Z-Wave	IEEE 802.11 ah
Standard		ISO/IEC 14443, 18092	IEEE 802.15.1		ITU G.9959	IEEE 802.11 ah
Frequency band		13.56 MHz	2.4 GHz		EU: 868 MHz NA: 908 MHz	900 MHz
Data rate		106 Kb/s or 212 Kb/s or 424 Kb/s	1 Mb/s		9 -40 kb/s	4 Mb/s
Range		0-10 cm	100 m (outdoors)		30m (indoors) 100m (outdoors)	100m
Transmission power		23 dBm	0-10 dBm		0 dBm	<10 mW - <1W (local regulations)
Transmission Technique		ASK	GFSK FHSS Star		FSK GFSK	BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, OFDM
Topology		Peer-to-Peer	Star – Bus Network		Mesh	Star
Packet length		Variable	8 to 47 bytes		255 bits	100 bytes
Security		Encryption Cryptographic, Secure Channel, Key Agreements	AES-128		AES-128	WPA
License		Free	Free		Free	Free


Common Applications	Tracking, Identification, Human Implantation 	Payment, Healthcare, Smart Environment, Mobile Ticketing and loyalty	Multimedia data exchange between nearby nodes	Home and industry monitoring and controlling	Automation in residential and light commercial	M2M, V2V applications and smart grids
----------------------------	---	--	---	--	--	---------------------------------------

Fig 5: Comparison of the short range protocols