



EUROPEAN UNION

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LoRa(WAN) Webinar

Introduction

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These slides present the most important parameters of LoRa(WAN) and compares it against Sigfox and LTE Narrowband IoT.



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- LoRa was invented 2009 in France by Nicolas Sornin and Olivier Seller
- Aim: modulation technology long range and low power
- Company Cycleo formed in 2010: wireless communication capabilities for gas, water and electricity meters
- Chirped Spread Spectrum Modulation (CSS)
- Semtech acquired Cycleo in 2012, MAC Protocol “LoRaMAC” was invented



- In 2015 LoRa Alliance was founded, “LoRaMAC” -> “LoRaWAN”

[History of LoRaWAN](#)



Long Range

- Deep indoor coverage
- Star Topology



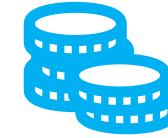
Low Energy Consumption

- Low Power optimized
- Up to 10-year lifetime



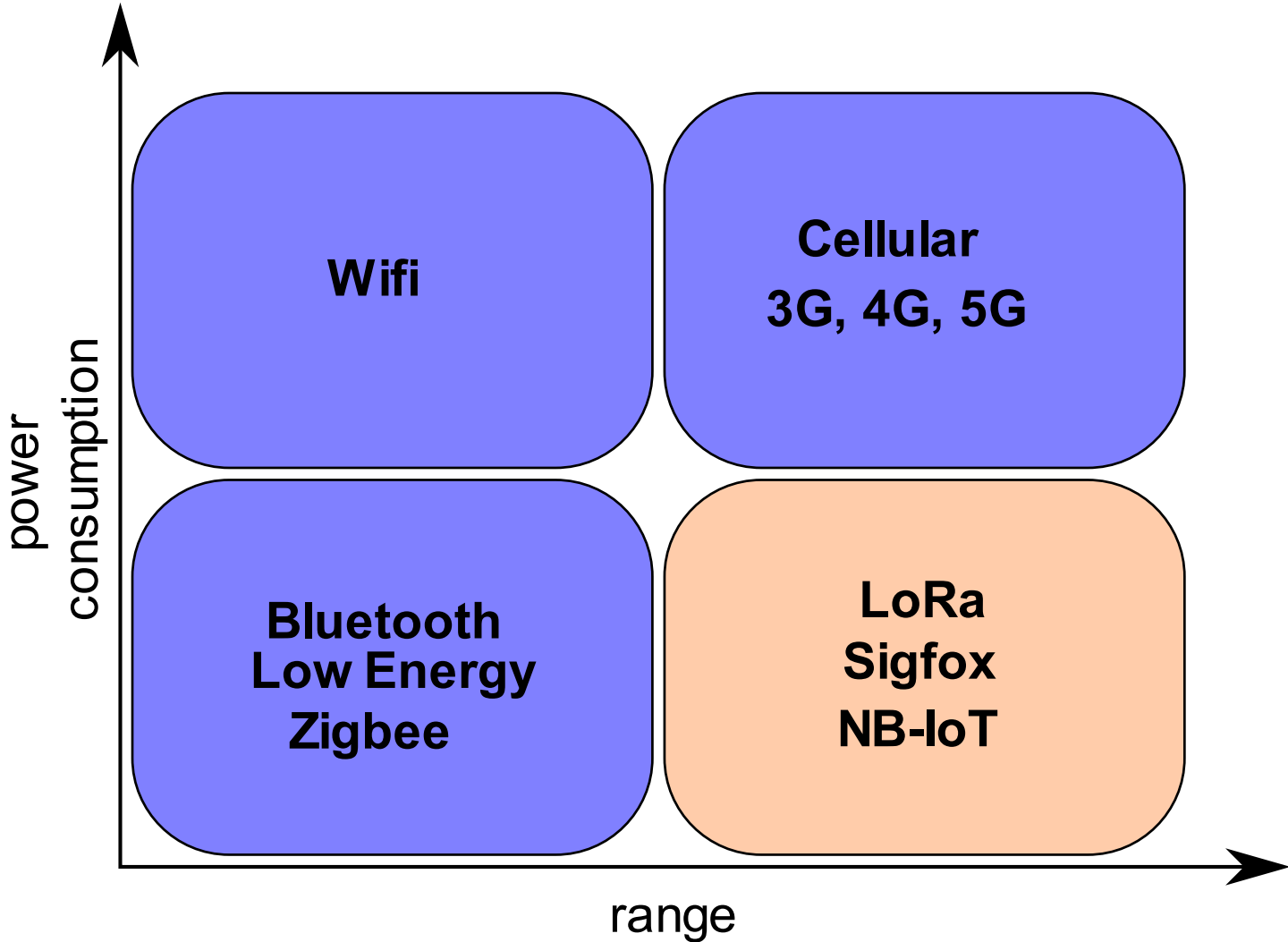
High Capacity

- High capacity per base station
- Public or private network



Low Cost

- Minimal infrastructure
- Low cost end-node
- Open source software



	LoRa	Sigfox	NB-IoT
Modulation	CSS (Chirped Spread Spectrum)	UNB (Ultra Narrow Band)	DSSS
RX Bandwidth	125/250/500 kHz	100 Hz	200 kHz
Data Rate	250 bps – 0 kbps	100 bps	200 kbps
Max. Messages per Day	unlimited	6 messages per hour	unlimited
Max. Output Power	20 dBm	20 dBm	20 dBm
Link Budget	155 dB	155 dB	164 dB
Battery lifetime – 2000mAh	105 months	145 months	3 months
Range	5 – 20 km	10 – 50 km	1 – 1 km
Frequency	433/868MHz band	868MHz band	Licensed LTE bands in-band

- Spreading factor: determines “spread” in time
SF = 7 ... 12
- Bandwidth: 125 kHz, 250 kHz, 500 kHz
- Code Rate: CR = $\frac{4}{5}$, $\frac{4}{6}$, $\frac{4}{7}$, $\frac{4}{8}$

Spreading Factor	Bandwidth	Data Rate
	kHz	kbits/sec
12	125	0.293
11	125	0.537
10	125	0.977
9	125	1.758
8	125	3.125
7	125	5.469
7	250	10.938
7	500	21.875

- LoRaWAN operates in the unlicensed ISM (Industrial, Scientific and Medical) radio band that are available worldwide
- ISM band advantages: Anyone can use these frequencies; no license fee is required.
- ISM band disadvantages: Low data rate; lots of interference because anyone can use these frequencies.

Region	Frequency (MHz)
Asia	433
Europe, Russia, India, Africa	433, 863 – 870
US	902 – 928
Australia	915 – 928
Canada	779 – 787
China	779 – 787, 470 - 510

Frequency bands in different regions