WHAT IS NB IOT

Measurement technology In our meters

Summary

Syftar till att beskriva den mätteknik som används i våra elmätare

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Content

1 HISTORY 1

2 INTRODUCTION 2

2.1 Target audience 2

3 NB-IOT, CAT-M1, SIGFOX OR LORA -LPWAN FOR IOT 2

3.1 NB-IOT, LTE CAT-M1, SIGFOX OR LORA? 2

3.1.1 OPEN OR PRIVATE NETWORK? 2

3.1.2 NB-IOT AND CAT-M1/LTE-M 2

3.1.3 CAT-M1 OR LTE-M1 3

3.1.4 NB-IOT ALSO CALLED CAT-M2 4

3.1.5 SIGFOX 4

3.1.6 LORA 5

3.1.7 NB-IOT, CAT-M1, SIGFOX OR LORA? 5

3.1.8 BUT 5G AND IOT THEN? 6

1 History

Version	Author	Date	Description
1.o	Richard Frank	21 Nov 2023	Description of NB IoT

2 Introduction

2.1 Target audience

The guidance is primarily aimed at the project group.

3 NB-IOT, CAT-M1, SIGFOX OR LORA -LPWAN FOR IOT

IoT is predicted to connect millions of devices to the internet within a few years. A mass market that, unlike traditional systems, will need to transmit a limited amount of data more or less rarely. Several technologies for building so-called Low Power Wide Area (LPWA) are available for IoT (Internet of Things) applications. The wish is that they should have as low costs as possible and work for 5-10 years without battery replacement. In this post, we will take a closer look at the four largest, LoRa and SigFox as well as NB-IoT and LTE-M1.

3.1 NB-IOT, LTE CAT-M1, SIGFOX OR LORA?

When it comes to IoT, it's not just about choosing the right sensor node, the right router or gateway. It is first and foremost about deciding whether to use a public network provided by a mobile operator or by an operator that focuses on LoRa or SigFox or alternatively whether to build your own network, then LoRa is the alternative offered. In this guide, we focus on the publicly available technologies offered through mobile operators but also on technologies such as LoRa and SigFox. These are usually called LPWANs, LowPower Wide Area Network, a collective name for energy-efficient technology used in networks of sensors that cover a larger area.

IoT covers a wider range of applications day by day. Some applications need a high bandwidth or short response time for, for example, real-time monitoring of an ongoing process where data needs to be collected and analyzed in near real time. It can also be about tracking property where movements need to be quickly registered and communicated. Then there is the exact opposite. A meter that needs to send a single meter value a day. A collection value that can come in to the recipient with a delay without any problems arising. IoT has a number of different technologies that differ in performance, but since the needs of the applications are fragmented, it is an asset that it is that way. Once you have identified which technology is best suited for your application, it is important to find out which technologies are developed and whether your operator supports it. Because at dawn of the Internet of Things, not all operators support all technologies everywhere.

3.1.1 OPEN OR PRIVATE NETWORK?

Both NB-IoT and LTE CAT-M1/LTE-M, and for that matter SigFox and LoRA, are LPWAN technologies, but the first two use the mobile operators' frequency blocks and LoRa and SigFox networks use free frequencies depending on which country you are in. With LTE-M1 and NB-IoT, unlike LoRa and SigFox, you don't need a gateway to send data, so the implementation is fast.

Another advantage of the LTE-based technologies is that they are implemented globally. SigFox is available in around 38 countries with a limited rollout. For the big technologies, especially LTE-M1, you don't have to think about looking for an operator for every market, you can use the same product and the same network all over the world. The product will work as soon as it is commissioned. You automatically reach a larger volume market and become internationally competitive, by being able to scale up, you get a higher revenue and lower unit cost faster.

3.1.2 NB-IOT AND CAT-M1/LTE-M

If you're thinking about your upcoming IoT strategy with mobile network connectivity, you've probably heard of two terms: NB-IoT (narrowband IoT) and LTE CAT-M1. Both of these are being aggressively pushed to become the de facto standard used for IoT products. Both of these are 3GPP-standardized technologies (both standards were included in Release 13) and thus part of many mobile operators' portfolios. However, even though they share the same common platform, they are complementary to each other, they are intended for widely different uses and have their own strengths and limitations. The standards overlap and work well in different scenarios. It is rather a matter of those who want to invest in a solution not to compare both solutions against each other as equal, they have disadvantages and advantages.

NB-IoT and LTE CAT-M1 are optimized for low-power transmission, they are based on narrowband technology that can handle small amounts of data and transmit it bi-directionally in an efficient, secure and reliable way, providing both acceptable security and good battery life. Both of these technologies connect via existing 4G networks and many operators support it to a lesser or greater extent.

Both NB-IoT and CAT-M1 devices can sleep for extended periods of time, supporting both extended discontinuous reception (eDRX) and a sleep mode (PSM). These two factors reduce the device's power consumption and also provide better range, which further saves power.

	LTE CAT M1	NB-IOT
Frequency bands	LTE gang	LTE bands, LTE-Guard bands, standalone
Downlink modulation	OFDMA, 16 QAM	OFDMA
Downlink data rate	Up to 1 Mbps	250 kbps
Uplink modulation	SC-FDMA, 16 QAM	SC-FDMA
Uplink data rate	Up to 1 Mbps	250 kbps (multi-tone), 20 kbps (single tone)
Bandwidth	1.08 MHz	180 kHz
Duplex technology	Full duplex, half duplex, FDD & TDD	half duplex and FDD
Latency	10-15 milliseconds	1.6 to 10 seconds
Link budget	155.7 dB	164 dB
Transmitting power	23 dBm, 20 dBm	23 dBm, 20 dBm

3.1.3 CAT-M1 OR LTE-M1

CAT-M1 is the first LTE technology designed specifically for low-power and low-cost IoT applications. LTE category M1 (CAT-M1) is a power and cost-optimized LTE technology that operates with 1.4 MHz spectrum (reduced from 20 MHz). It has a range of features to provide the best possible battery life. Among other things, its output power is only 0.1 W and the speed is throttled to around 1 Mbit/s.

LTE-M has high data rates compared to NB-IoT which has about 20/200 kbps. LTE-M also has a lower latency, 15-20 ms, while NB-IoT has 1.6 to 10 seconds, making CAT-M1 a contender when you want decent real-time transmission.

It is also suitable for applications that need more precise positioning and it supports voice calls via Voice-over-LTE (VoLTE), which means that they can fit in, for example, home healthcare or similar sensors where you want to exchange both data and speech.

LTE-M also has better support for mobility because it handles hand-over between base stations in the same way as LTE. This is important when an object moves between two points and passes through the cells of several different base stations, an LTE-M device can handle a hand-over to a new base station without losing connection. An NB-IoT device connects to a single base station and then has to re-initiate its connection when it enters a new cell. Because CAT-M1 has a higher device complexity, the cost is also higher than for NB-IoT.

The real advantage of CAT-M over other options is that CAT-M is compatible with the existing LTE networks. It is basically a new piece of software in the base station. In other words, it can be said that it is probably an easy match to find an operator with both support for the technology and good coverage.

LTE CAT-M1 IN FIVE POINTS:
For medium data sets Good battery life Limited data rate Good surface coverage Works for mobile use

3.1.4 NB-IOT ALSO CALLED CAT-M2

At a glance, NB-IoT has the same basic characteristics as LTE Cat-M1, but with extreme coverage capacity, NB-IoT is ideal for very low data rate applications that have extremely challenging radio conditions. NB-IoT uses a different modulation (DSSS modulation). Thus, NB-IoT does not work in conjunction with LTE and it also means that the implementation costs are higher, the operator may probably have started the expansion but not completed it. NB-IoT has a throttled transmission rate, it can handle 200 kbit/s in downlink and 20 kbit/s in uplink.

NB-IoT has a number of other interesting features that also impress. It has a long range and therefore works for unpopulated areas, indoor sensors and the like where good range is needed.

The battery life also impresses, it is stated to be over 10 years without any problems thanks to the bandwidth, data transfer rate, being low. The updates are not very frequent and therefore you can see NB-IoT as a technology that is interesting for smart meters, agriculture, home automation or intelligent cities.

NB-IOT IN FIVE POINTS:

- Too small data sets
- Long battery life
- Low data rate
- Good coverage even in difficult conditions
- Low support for mobile applications

3.1.5 SIGFOX

SigFox, like LoRA, is dependent on the free frequencies 868/915 MHz with the advantages and disadvantages this provides. SigFox is an ultra-narrowband technology that divides spectrum into very narrow chunks to transmit and receive data. This allows the receiver to use a limited chunk of spectrum and block out the effect of noise. Each message is only 12 bytes to increase robustness against other transmitters on the same channel.

SigFox is a French company that owns most of the steps in the connection. It owns everything from cloud services, the base stations' technology all the way down to the nodes' software, but SigFox has an open market for its nodes where SigFox gives away its technology to producers of circuits as long as the manufacturer has entered into an agreement with SigFox. SigFox is based on a low-cost sensor node and a more advanced base station/gateway.

SigFox's strength to reach is more from the node and into the base station than the other way around. The radio in the node cannot do as advanced as the base station, therefore the nodes can transmit further than they can hear themselves.

SigFox's network is operated by an operator that builds coverage. These, as with LoRa operators, are smaller players who specialize in LPWANs. The SigFox network can be expanded by setting up its own base stations in collaboration with the operator, but the technology is not used to build private networks.

SIGFOX IN FIVE POINTS:
For smaller data sets Long battery life Moderate data rate Good coverage even in difficult conditions Link has different uplink and downlink performance

3.1.6 LORA

LoRa is a technology that you can either build on to develop your own networks or you can use a LoRa operator.

LoRa makes it possible to transmit data over long distances with very low power consumption. LoRa should be able to handle about 10 years of battery life and has a good range of at least 10-15 km depending on the built-up area. LoRa has an open ecosystem and is therefore best for private networks with slightly more niche or geographically restricted applications.

LoRa, unlike NB-IoT and LTE-M1, has no need for an operator with a paid frequency block. LoRa uses license-free frequencies such as 868 MHz (Europe) and 915 MHz (North America). The advantage of license-free frequencies is that they are free to use, the disadvantage is that you cannot guarantee any QoS or uptime as others can use the frequency at the same time. Customers who need guaranteed access can require SLAs which makes LoRa not that interesting.

LORA IN FIVE POINTS:
For smaller data volumes Long battery life Low data rate Good coverage even indoors Low support for mobile applications

3.1.7 NB-IOT, CAT-M1, SIGFOX OR LORA?

Which technology you ultimately choose will depend on your needs. Take help from my overview below. Consider whether security or data transfer speed is best for you. And last but not least, feel free to discuss with me, I (we) are happy to bounce ideas off you!

	LTE-M1	NB-IOT	LORA	SIGFOX
Range (ber)	10 km	15 km	15 km	10 km
Battery life (ber)	10 years	10 years	15 years	15 years
Speed uplink	1 Mbit/s	20 kbps	100 kbps	25 kbps
Two-way communication			Limited downlink	
QoS	Very high	High	Low	Low
Safety	Very high	High	Means	Low
Cost of connection	High	Means	Low	Low

3.1.8 BUT 5G AND IOT THEN?

You don't have to wait for 5G to invest in IoT. Although the Internet of Things is one of the most important components of 5G, you don't have to wait until 5G arrives, 4G offers interesting opportunities.

SUMMARY

What is LTE Cat M1? LTE category M1 is an LTE technology that is cost-optimized and power-efficient, it works with a limited spectrum. The output power is only 0.1 W and the speed is throttled to around 1 Mbit/s.
What is NB-IoT? NB-IoT has extreme coverage capacity and low data rate. NB-IoT has throttled transmission speed, it can handle 200 kbit/s in downlink and 20 kbit/s in uplink. NB-IoT uses a different modulation than LTE.
What is SigFox? The SigFox uses the free frequencies 868/915 MHz. The receiver can use a limited bit of spectrum and gets strong noise reduction. Each message is only 12 bytes. SigFox is a very narrowband (ultra-narrowband) technology that divides spectrum into very narrow parts to transmit and receive data.

What is LoRa? LoRa uses the free frequencies 868/915 MHz. Can transmit data long distances with very low power consumption. Can handle up to 10 years of battery life, good range of at least 10-15 km. LoRa has an open ecosystem of manufacturers of products.