CONNECTING WITH NB-IOT

A NEW STANDARD FOR IOT CONNECTION

Cologne, 2021

AGENDA

INTRODUCTION

This playbook offers you a **summary** of the **features and functions** of the new mobile communications standard exclusively for the Internet of Things: NarrowBand IoT, NB-IoT for short.

1

We will show you the **potential behind NB-IoT**, the properties of the mobile radio standard and the use cases for which it is particularly suitable.

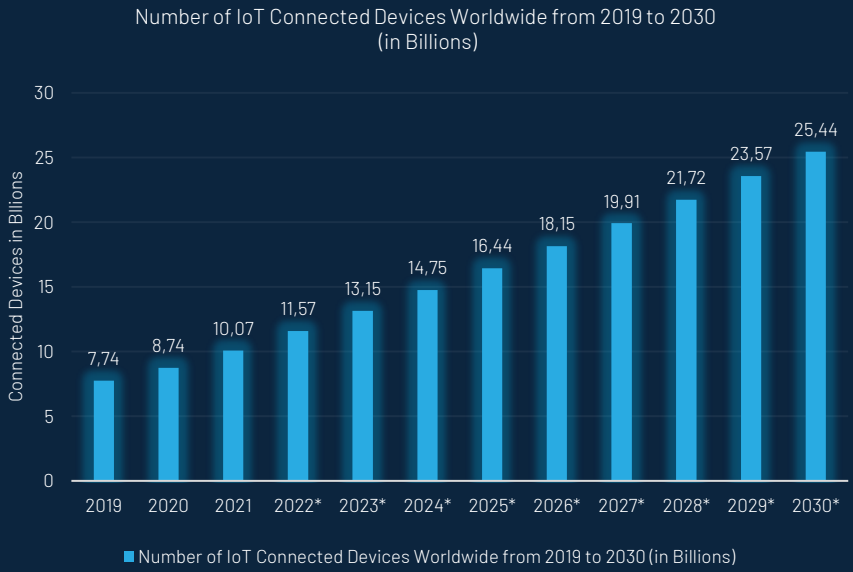
2

We will also show you **how 1NCE can enable you to easily enter the Internet of Things** via NB-IoT and how our customers use the mobile communication standard for their project or product.

3

1 THE POTENTIAL OF NB-IOT

NB-IOT: ENABLING THE NEXT BILLION CONNECTED DEVICES (1/2)



The Internet of Things (IoT) is a rapidly developing market, involving connecting devices to the internet to utilize the data they create.

Forecasts by Statista indicate **25.44 billions of connected devices in 2030.**

NB-IOT: ENABLING THE NEXT BILLION CONNECTED DEVICES (2/2)

So, where are they and how are they being connected?

NB-IoT (which stands for Narrowband IoT) is a new cellular technology – part of the group of technologies known as Low Power Wide Area (LPWA) – that is more and more to be launched by Mobile Operators worldwide.

The rapid development can be observed from day to day and the **advantages are enormous**. This is because it offers low data (narrowband) rates at low power over long distances. Low power consumption is achieved by much simpler silicon in the device electronics with fewer components and this results in lower costs, adding to the appeal of NB-IoT for customers.

It is also optimized for stationary or slow-moving applications, so in this respect different to all previous cellular technologies used for IoT connectivity which assume high mobility.

NB-IoT offers superior Indoor and In Ground connectivity compared with existing cellular technologies, enabling many applications that not been viable before.

SELECTING THE IDEAL CELLULAR IOT NETWORK

IOT CONNECTIVITY AND THE CHOICE OF STANDARDS

Power supply - a reason to chose NB-IoT

The durability of an IoT device is a crucial matter when it comes to independent solutions where no external power source is available. So is the choice of the cellular radio standard. While 2G, 3G or 4G might provide a maximum battery-lifetime of up to 3 years, NB-IoT can make your devices energy last twice or triple that time.

SIM module selection for ideal IoT connectivity

The IoT connectivity standards 2G and 3G are outdated standards that already are being shut down in various countries. If you design a new IoT device now, make sure to choose the technology that keeps your devices running over the next years. Use modules that support a wide range of standards, including NB-IoT, to develop a future-proof product.

NB-IoT: pros

NB-IoT is the cellular mobile standard especially designed for the Internet of Things. While its comprehensive availability on a worldwide scale is still in its infancy, it brings some advantages compared to the "classic" 4G in terms of device connectivity. This includes its "Power Saving Mode" and very good underground and indoor connection.

POWER SAVING MODE

Typical batterie life up to 10 years

HIGH NETWORK CAPACITY

Huge amount of connected devices

UNDERGROUND & INDOOR CONNECTION

Best network even isolated under the ground or indoor

UNLIMITED DEVICES

Billions of connected devices

COST EFFICIENT

Typical module costs < 10 Euros

PLUG & PLAY

Direct connectivity of each sensor without installation

HIGH SECURITY

High security provided due to established standards

NB-IOT FOR THE RIGHT INDUSTRY

URBAN

Includes applications such as **street lighting, smart parking, waste collection, car/bike sharing services and air quality monitoring.** These are typically stationary applications for monitoring purposes but assets being monitored may be changing location occasionally, or in the case of car or bike sharing, changing location frequently but stationary when these assets need to be located for a new share. These are all low data rate applications that are remotely located and where local power sources may not be easily accessible, making long battery life an important feature.

RURAL

Includes applications like **crop water management for agriculture, farm equipment monitoring, tank monitoring, water leak detection**. These are also all low data rate applications, usually far from any power source making long battery life and long range essential.

INDOOR / IN GROUND

Includes such diverse applications as **home energy management, home security, vending machine management, commercial building space utilization, personal health monitoring, vulnerable person fall monitoring and utility meter reading**. NB-IoT has particulary good Indoor and In Ground coverage capabilities, making it very suitable for smart meters in basements, underground pipe leak detection for gas or water and other similar applications.

MAIN VERTICALS (1/2)

Industry Vertical	Application & Description	Core Benefit	Benefits of Using NB-IoT
Water Utility & Industrial	**Leak Detection.** Remote monitoring of pipelines for detection of leaks.	Real-time alarm for operational response.	Superior Indoor and In Ground performance and long battery life.
Smart Meter	**Electric/Water/Gas Metering.** Remote monitoring of usage for billing and resource management purposes.	Accurate and timely billing. Supply/deman optimization.	Superior Indoor and In Ground performance. Autonomy from power supply for gas & water applications where required.
Smart City	**Smart Street Lighting.** Monitor and actively manage urban street lighting to optimize energy usage and maintenance.	Cost saving and safety after hours with proximity sensors to activate lighting in controlled pools.	Coverage in urban areas with option to be independent of lighting supply if required.
Smart City	**Parking.** Detection of space occupancy using a surface mounted or buried sensor.	Provision of real-time data on parkin occupancy, optimizing usage of spaces.	Long battery life, coverage in dense urban areas, In Ground penetration of signal. Widely available choice of compatible sensors.
Transport/ Logistics	**Asset Tracking.** In conjunction with sensors detecting temperature and movement of goods such as perishable foods.	Location, status and condition of goods in transit.	Network based location finding with no need for GPS. Long battery life with National and International Coverage.
Environmental	**Air Quality Monitoring.** Monitoring emissions of CO2, NO2 and other air pollutants.	More accurate reporting.	Low cost and reliable environmental monitoring in urban and rural locations. Supported by a growing range of compatible sensors.

MAIN VERTICALS (2/2)

Industry Vertical	Application & Description	Core Benefit	Benefits of Using NB-IoT
Industrial/ Agricultural.	**Tank Monitoring.** Real-time monitoring of fluid levels in tanks for utility, petro-chemical and agricultural applications.	Optimisation of stocks for refilling, fewer truck rolls required.	Autonomy from mains power with up to 10 years battery life. Widely available and reliable coverage paired with eco-system of monitoring devices.
Transport & Security	**Stolen Vehicle Recovery.** SIM and module hidden in the vehicle for independence from other vehicle systems. Vehicle is located using network triangulation, no need for GPS.	Rapic location of vehicle in the event of disconnection from main vehicle supply.	Long battery life with national and international coverage. Lower radio module costs.
Health & Life Sciences	**Equipment Monitoring.** Remote monitoring of equipment such as transformers in low voltage electricity grid and pumps in water distribution networks.	Changes in temperature and vibration provide warnings of failure.	Indoor coverage and network based location finding.
Buildings	**Buildings.** Sensors monitor utilization of space using motion and temperature sensors.	Office building owners and their clients can maximise space utilization.	Long battery life and indoor coverage.
Buildings	**Waste Management.** Sensors detect when re-cyclig bins reach a level for collecting.	Municipalities & waste management services can be optimized for travel costs.	Network based location finding with no need for GPS. Long battery life with National and International Coverage.

2 WHY TO CHOOSE MOBILE CONNECTIVITY FOR AN IOT SOLUTION

IOT CONNECTIVITY AND THE CHOICE OF STANDARDS (1/4)

When developing devices for the Internet of Things very soon the question is being raised, what IoT connectivity standards to implement. While unlicensed standards such as LoRa or SigFox can be implemented independently and without the need to pay additional fees for a mobile network operator, they lack important advantages licensed standards such as 2G, 3G, 4G or even 5G, NB-IoT or LTE-M bring along.

In this part we emphasize on licensed vs. unlicensed radio technology standards and dive into some common communication standards for Low Power Wide Area (LPWA) use cases to give you a better understanding what you should aim for, depending on the project you're developing.

Following in the next two pages:

IOT CONNECTIVITY AND THE CHOICE OF STANDARDS (2/4)

1 Licensed vs. unlicensed radio technology

When developing IoT devices for mobile or outdoor use, well known technologies like the classic WIFI or Zigbee are out of the question. These protocols are made for indoor communication and are established mainly in the field of smart home solutions for the consumer market. Their power consumption and bandwidth usage are not made for devices that need to function in remote places or without any external power source over a longer period.

That pretty much leaves us with established but unlicensed standards such as LoRa or SigFox (just to name two) both utilizing the 868 MHz Band in Europe. They reach far, even through buildings, and are designed for low power consumption. One of the main reasons to choose license-free solutions is to be able to independently enable private networks that can be deployed everywhere. There is no external operator needed, at least for LoRaWAn Networks no fees to pay or no contracts to worry about. But this freedom comes with restrictions.

IOT CONNECTIVITY AND THE CHOICE OF STANDARDS (3/4)

2 Licensed standards allow equal quality worldwide

If you're considering a global product, a product where reliability is crucial, you might want to consider going for licensed cellular communication. Besides the standards 2G, 3G, 4G which were mainly designed for human interaction or due to increasing bandwidth for multimedia purposes, there are also the new standards such as NB-IoT or LTE-M available specifically designed for communication between machines or devices.

The data capacity of NB-IoT or LTE-M is higher as with LoRa or SigFox. This is due to the previously mentioned limited number of messages that can be transmitted per day, especially in European networks. They are primarily designed to transport tens of bytes per hour rather than kilobytes. Still, NB-IoT or LTE-M can support similar device lifetimes of up to 5 to 10 years as well.

Finally, licensed cellular communication delivers a proven technology with high security standards. The existing licensed frequency spectrum enables higher QoS (Quality of Service).

IOT CONNECTIVITY AND THE CHOICE OF STANDARDS (4/4)

3 Pricing for licensed communication is becoming attractive

With prices going down for licensed mobile communication it gets more and more attractive for IoT developers. One of the last obstacles are the multiple and sometimes often complex pricing models offered by various mobile operators. 1NCE developed the 1NCE IoT Flat Rate, a low-cost and fixed pricing model that allows mobile connectivity for just 10 Euros over 10 years including 500 MB of data and 250 SMS. Partnering with German operator Deutsche Telekom and China Telecom Global we're capable of delivering high quality mobile connectivity in over 100 countries worldwide. The obstacle of complex tariffs is an obstacle of the past.

However, with all advantages NB-IoT and LTE-M brings in terms of long battery life its availability is still in its infancy and worldwide coverage, especially under equal pricing conditions has yet to be improved. Luckily there are the other mobile standards that can be very useful in the meantime.

OVERVIEW OF CELLULAR MOBILE NETWORK STANDARDS

When talking about cellular IoT connectivity you'll always stumble upon the abbreviations:

When choosing a cellular network standard for connecting your devices with the Internet of Things, what should you aim for?

This article aims to give you an overview of current cellular mobile network standards.

NB-IoT & LTE-M

In connection with 4G, two more technologies emerged: NB-IoT and LTE-M. Both specifically designed for machine 2 machine communication as mentioned in part one of this article. The NB in NB-IoT stands for Narrow Band and utilizes radio waves, which enable particularly large area coverage. At the same time, they can penetrate thick concrete walls and thus reach even remote corners of a building. NB-IoT is perfectly designed for constrained devices that usually transmit small data packets only once an hour or a day, making them perfect to run on batteries over a very long period. LTE-M however delivers higher bandwidths with lower latencies than NB-IoT but comes with a slightly higher energy consumption.

SELECTING THE IDEAL CELLULAR IOT NETWORK (1/2)

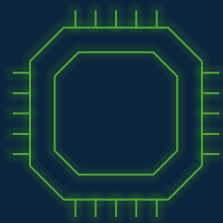
When using 1NCE as your mobile IoT connectivity provider you have one less worry about what cellular IoT network standard to use. The 1NCE Flexi SIM card as well as the eSIM for direct onboard use are multimode compatible and support any standard from 2G, 3G, 4G, NB-IoT, LTE-M and are even 5G ready. Concerning your IoT connectivity operator you are future proof with 1NCE. That leaves you with the choice of an adequate SIM module for ideal cellular IoT network connectivity.

Power supply

The durability of an IoT device is a crucial matter when it comes to independent solutions where no external power source is available. So is the choice of the cellular radio standard. While 2G, 3G or 4G might provide a maximum battery-lifetime of up to 3 years, NB-IoT or LTE-M can make your devices energy last twice or triple that time.

SIM module selection for ideal IoT connectivity

As we have learned in the previous part of our three-part blog series about IoT connectivity standards, 2G and 3G are outdated standards that already are being shut down in various countries. If you design a new IoT device now, make sure to choose the technology that keeps your devices running over the next years.
While the most convenient solution is to select a SIM module for your device that supports any or most of the aforementioned standards, you might have reasons to choose a more specific module. However, choosing modules that only support 2G and 3G standards does not make much sense anymore. So what is left?



SELECTING THE IDEAL CELLULAR IOT NETWORK (2/2)

NB-IoT: pros and cons

NB-IoT is the cellular mobile standard especially designed for the Internet of Things. While its comprehensive availability on a worldwide scale is still in its infancy, it brings some advantages compared to the "classic" 4G in terms of device connectivity.

✓ Ideal for battery powered devices

If your IoT solution heavily relies on battery power, you might want to go for NB-IoT. Typical use cases are asset tracking devices or devices that are being installed in plac-es where you need a reliable signal penetration, e.g. smart meter solutions that are usually installed deep within buildings.

✓ Cost efficient

Modules for NB-IoT connectivity are cheap and are often offered for as low as 10 euros already equipped with various sensors. It is very likely that the price will go down even further in the future.

✓ High network capacity

With NB-IoT it is possible to connect a huge amount of device just via one network cell tower. More than 100k are not a problem. That makes NB-IoT ideal for the use in areas with already a high network usage.

X No seamless cell handover with NB-IoT

For whatever application you plan to use NB-IoT keep in mind, that it does not support seamless handover when switching to another cell network tower. So, the ideal use case for NB-IoT devices would be a stationary. However, it is possible to use NB-IoT also on moving objects, only that after each cell switch, the connection must be re-established. That will of course influence the battery lifetime.

CHOOSING THE RIGHT NETWORK FOR THE RIGHT APPLICATION

	LICENSED SPECTRUM BASED STANDARDS			UNLICENSED	
	2G / 3G	LTE-M	NB-IoT	LoRa	SigFox
Frequency	GSM Band	LTE-Band	GSM / LTE Band	868 MHz (EU)	868 MHz (EU)
Link budget	144dB	156dB	164dB	150-168dB	156dB
Duplex mode	Full	Full or Half duplex	Half	Half	Half
Transmission (DL)	53,6-384 kbit/s	1000 kbit/s	250 kbit/s	50 kbit/s	0.1 kbit/s (EU)
Roaming	Yes	Yes	Yes	Not yet	Yes
Mobility	Cell handover	Cell handover	Cell reselection	Cell reselection	Cell reselection
Battery life time	~ 3 years	~up to 5years	~up to 10 years	~up to 10 years	~up to 10 years

To serve the requirements of the numerous and diverse use cases in the IoT sector, different technologies are needed. NB-IoT is the choice for extremely or highly cost-sensitive applications with low performance needs, termed "Massive IoT". In contrast, regular LTE is needed for high-end applications with maximum performance requirements such as high data rates and very low latency. This other end of the spectrum is referred to as "Critical IoT". LTE-M bridges the gap between these two extremes. It has distinct benefits because, although higher bandwidth and data rates are required when compared to NB-IoT, it delivers on the promise of longer battery lifetimes and better indoor penetration. Most importantly, it is considered the key substitute technology for 2G (GPRS) and 3G (UMTS) technology. Eventually, together with NB-IoT, LTE-M will displace the other two as the long-term option for all related Mobile IoT use cases.

PROS AND CONS OF UNLICENSED VS LICENSED STANDARDS

	LICENSED (NB-IOT/LTE-M)	UNLICENSED (LORA, SIGFOX)
PROS	✓ Proven technology, based on standardized cellular technology ✓ Better capacity and coverage, exceeds unlicensed standards ✓ Leverages existing mobile network infrastructure ✓ Better harmonization of spectrum across countries and regions ✓ Longevity: Owned and controlled by Mobile Operators ➔ stable entities that provide high assurance on business continuity over the device lifetime	✓ Allows to quickly establish private networks that can be deployed everywhere ✓ Already available in many European countries
CONS	× NB-IoT and LTE-M not yet available in all countries	× Non-harmonized regulation across different regions × Variety of spectrum bands limits harmonization × Reliability cannot be predicted and interference cannot be managed × Only suited for non-critical applications

MYTHS ABOUT NB-IOT - CLEANING UP UNTRUTHS (1/2)

NB-IoT has certainly proven many times what kind of scale it brings and how helpful and progressive it is for IoT projects. However, there are still some myths about the wireless standard that are not true.

"NB-IoT does not need a SIM card"

1

NB-IoT always uses a SIM, because the technology operates within the licensed LTE band of the operator's cellular network. This also means NB-IoT has a security benefit – compared to technologies working in an unlicensed spectrum – thanks to LTE's high security standards. However, classic plastic SIMs are not necessarily required: The form factor can vary from 2FF to 4FF, conventional soldered SIMs (MFF) to even eUICCs. There now is also an option of having just a profile without separate SIM hardware – an integrated SIM.

"NB-IoT is only suitable for fixed-location use cases"

2

NB-IoT as an access technology can be widely used for mobile use cases. While it is true that NB-IoT does not support seamless cell handovers, applications based on NB-IoT do not use streaming or voice calls and therefore handovers of continuous data streams are not necessary. As soon as a device has changed the camping cell, it can perform a cell reselection and immediately thereafter start sending and receiving data again seamlessly. It should be noted, however, that the extra signaling traffic associated with cell reselection requires additional power consumption of the device.

MYTHS ABOUT NB-IOT - CLEANING UP UNTRUTHS (2/2)

"NB-IoT applications are TCP/IP-based"

3

Common protocols like TCP/IP, UDP/IP or Non-IP are all supported by NB-IoT. Depending on the capabilities of modules and applications, users are free to choose any of these – however, TCP/IP is not recommended due to a resulting higher data volume. UDP/IP is the preferred and recommended transfer protocol for NB-IoT.

"Firmware updates are not supported"

4

Since NB-IoT has a reliable downlink channel, firmware over-theair (FOTA) is possible. We strongly recommend making devices capable of FOTA to receive future security updates. But again, the associated energy consumption should be factored in.

"NB-IoT always provides a ten-year battery lifetime"

5

It is important to note that ten years is by no means the default battery lifetime for any device using NB-IoT. Battery lifetime depends primarily on the use case requirements, i.e. the frequency of transmission and reception, the use of power-saving features or the Coverage Enhancement (CE) level – and, of course, battery capacity. So, provided the optimum parameters are met, an NB-IoT module could run up to ten years on one battery charge.

3 NB-IOT IN PRACTICE: HOW TO GET MAXIMUM PERFORMANCE OUT OF YOUR DEVICE

HOW TO GET MAXIMUM PERFORMANCE OUT OF YOUR DEVICE (1/3)

1 IoT Device Development

When its about IoT device design and choosing the perfect wireless technology, IoT product developers need to answer many questions upfront.

- Where will my devices be used?
- What about power supply?
- What ranges do I needed?
- What does the typical environment look like, open or shielded behind thick walls?

NB-IoT offers exactly what developers want for IoT devices, especially in difficult environments: it is low energy consumption and robust enough to transmit even from basements or containers.

NB-IOT

NB-IoT, also called Narrowband IoT or LTE CAT NB1/NB2, is the technology for communicating with even the smallest IoT devices in the Internet of Things. A radio technology so economical and robust that it brings connectivity to every streetlight or the last milk bottle. And indeed, as a technology, NB-IoT is the ideal solution for connectivity in Smart City, Smart Energy, Smart Farming and even logistics. In other words, everywhere where sensors need to be able to transmit data as reliably as possible for as long as possible. That is anywhere from the basement of a building, from the asphalted street canyons of large cities or from a container that is carried somewhere on a motorway.

HOW TO GET MAXIMUM PERFORMANCE OUT OF YOUR DEVICE (2/3)

2 IoT device design: Careful planning is crucial to success

How well an NB IoT device performs, can beside other factors, also depend largely on the device design itself. This includes the use of the right modem and an optimally tuned antenna design. Akoriot.com, a service from Germany-based Triptec HL UG and 1NCE Technology Partner, design antennas for radio transmission in the IoT. They also advise and train product developers to get the best out of IoT devices for customers.

NB-IoT product development: It all starts with the right casing 3

IoT expert Harald Naumann and author of the "IoT Cookbook" also publishes in the akorIoT blog. He gives practical tips and points out typical beginner's mistakes. Once such tip is to consider casing design frist: Many IoT product developers would first worry about their board design and only later realise that the necessary antenna can no longer be optimally integrated into the overall product. He advises to always start with the planning of the casing and antenna first before creating the PCB design around it.

4 NB-IoT Link budget and optimal battery life

The very long battery life is what makes NB-IoT so attractive, especially for small sensors. Naumann demonstrates in detaile, that a precise planning of antenna power has a direct impact on available bandwidth and battery life. Thus, NB-IoT rewards a system gain of +/- 3 dB with around 6 to 15 kbps data throughput. These 3 dB can easily be influenced by the IoT product developer with appropriate device design. And they make a difference: 3 dB more or less can already halve or double the battery life of a device, says Naumann. And battery life has a direct impact on maintenance intervals and operating costs.

HOW TO GET MAXIMUM PERFORMANCE OUT OF YOUR DEVICE (3/3)

5 NB-IoT goes underground

Sometimes Naumann also takes his experiments with NB-IoT building penetration to the extreme: Or more precisely, to the underground. The fact that LPWAN technologies are well suited for closed rooms or basements is, after all, old news. He wanted to know more and tested the penetration of NB-IoT in the Munich underground. Equipped with a laptop and an NB-IoT receiver with a monopole antenna, he measured field strengths between -89 dBm and -106 dBm on a hot summer day at Goetheplatz station. Even close to the ground, the NB-IoT device achieved good signal strengths, despite the fact that the near field of the antenna is already limited due to the positioning of the antenna close to the ground, which generally leads to higher losses.

Availability of NB-IoT 6

Now, the best device design is of little use if there is a lack of network availability. But here, too, there have been major steps forward in Germany and worldwide in recent months. 1NCE can currently offer NB-IoT in seven European countries (Austria, Germany, Italy, Spain, Netherlands, Greece and the United Kingdom) plus mainland China. More is about to come in the near future. The advantage here: 1NCE offers its connectivity services for the same price, no matter where and no matter what cellular technology in use. That makes the cross-border deployment of IoT solutions easier and economical.

4 NB-IOT IN PRACTICE: CUSTOMER USE CASES

FEBRIS CO2-SENSOR
THE SMART CORONA ALARM

Sentinum, based in Nuremberg, Germany, offers IoT solutions for municipalities and businesses, ranging from the development of its own sensors up to the implementation of intelligent web services for end users: Whether filling level sensors for modern waste management, level sensors for tank and water measurements or efficient room air monitoring.

In addition to the hardware, applications also play a decisive role for Sentinum as part of an overall IoT solution. Their solutions can be used on any device with internet access, such as a smartphone, desktop PC or tablet. Sentinum chose licensed LPWA technologies to fit the sensor's low power consumption needs. They trust in 1NCE IoT Flat Rate for the predictability in cost and reliability in availability over the lifespan of the sensor to monitor CO2 levels in enclosed rooms.

The Febris CO2 sensor is Sentinum's latest solution that helps municipalities and businesses create a COVID-safe working environment.

Industry	Location	RT-Standard
Sensors	Germany	NB-IoT

www.sentinum.de

THE DIGITAL PRICE TAG FOR THE 21ST CENTURY

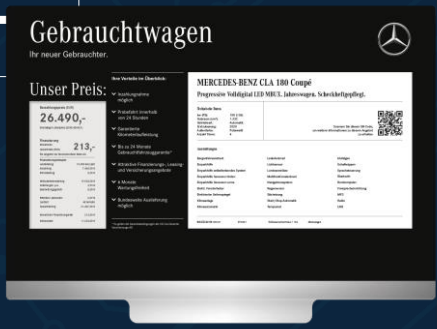
Founded in 1998, VISI/ONE started as a company with one product only: The VISI/ONE adhesive film for Automotive price labeling. But the world evolved rapidly into the digital age and so did VISI/ONE. With Cloud-to-Display solutions VISI/ONE developed the world's first cloud-based technology for digital price labelling with a special focus on the car dealer market.

The digital price tags are based on E-Ink's patented E-Paper technology and the new CSI Display is being connected to the cloud via cellular networks.

Remotely labelled car price tags are comfortable to manage. But not only that. With an integrated GPS-Tracker they help locating each car in no time. For the connectivity, VISI/ONE trusts in 1NCE

Industry	Location	RT-Standard
Automotive	Germany	NB-IoT

www.visi-one.com



THE LOW-POWER IOT SPECIALISTS

Embever helps companies developing highly-innovative battery-powered IoT devices – and promises to do it 'faster than ever before'. Working with large corporations, SMEs and start-ups, Embever has created a platform that enables seamless end-to-end integration.

Embever's management team focused early on energy efficient data transmission with a research grant from the Otto-von-Guericke-University in Magdeburg kickstarting the development of their innovative technology. The outcome: The Embever IoT Core, a platform especially designed to connect low-power NB-IoT devices. It didn't take long for early customers like Deutsche Bahn and VISI/ONE to come on board.

For their connectivity, Embever chose 1NCE's IoT Flat Rate for optimal NB-IoT coverage combined with a simple tariff.

Industry	Location	RT-Standard
IoT Development	Germany	NB-IoT

www.embever.com

HIGH-TECH SENSOR FOR DISPOSAL MANAGEMENT

GLA-intec from Bremen, Germany, is developing hard- and software for the Internet of Things. The company has specialized in smart city solutions, particularly in the field of waste management. One of their latest products is the IceBox Sensor.

A small and independent device for the reliable and precise measurement of disposal containers such as containers for old clothes or electronic waste.

For communication via NB-IoT GLA-intec trusts in mobile IoT connectivity by 1NCE.

Industry	Location	RT-Standard
Disposal Management	Germany	NB-IoT

www.gla-intec.de

SWAN 2: THE VERSATILE NB-IOT GATEWAY

The Landau-based company WEPTECH has been active in the production of high-quality electronic components since 1994 and specializes in the development of novel technologies and systems for wireless communication. Here the focus lies on the production & development of certified radio systems, antenna development but also own products. In these areas WEPTECH elektronik GmbH today holds a leading role. The company offers hard- & software solutions for wM-Bus/OMS, M-Bus, Mioty and Thread technologies as well as complex solutions with mobile radio technology from 2G over 4G up to NB-IoT.

With the NB-IoT gateway "SWAN 2", the company has developed a battery-powered gateway that can connect up to 100 wireless M-Bus devices directly to the mobile network. The gateway collects data from sensors such as those used in the fields of Smart Building, Smart Home or Smart Farming/Agriculture.

Industry	Location	RT-Standard
Electronic Engineering	Germany	NB-IoT

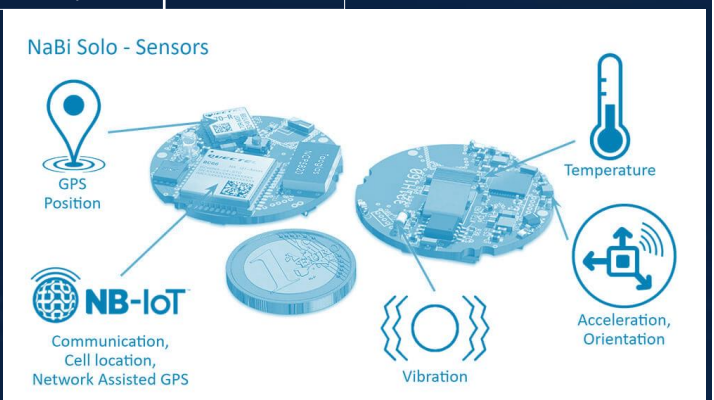
www.weptech.de

GENERAL TRACK NABI MONITORING WITHOUT MAINTENANCE

From Budapest, Hungary comes the NaBi. A tracking beacon that allows monitoring of assets of any kind without the need for maintenance over a long period of time. The tracker is developed by General Mechatronics, a young company specialised in IoT product development with close ties to the Budapest University of Technology and Economics. Initially, its field of activity was focusing on CNC machines and robotic control, which then gradually shifted towards IoT devices and the development of serial-produced electronic devices

Industry	Location	RT-Standard
Asset Tracking	Hungary, Germany	NB-IoT

www.nabitrack.com



LOW-CODE IOT PLATFORM

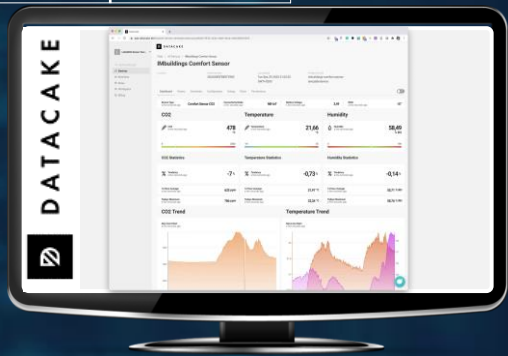
Germany-based Datacake GmbH offers a multi-purpose and low-code IoT platform that comes with a special promise: No programming skills are required, and it takes just minimal time to create custom IoT applications that can be brought into a white label IoT solution.

But software is not everything the company in Vreden, an idyllic town in the middle west of Germany, surrounded by plenty of nature, has to offer. In order to connect device setups in remote or rather difficult environments with the Internet of Things, Datacake offers its clients a LoRaWAN as well as an Industrial IoT Gateway that paves the way to the outside world.

Cellular Mobility plays a vital role in Datacakes connectivity solutions. Even a LoRaWAN Gateway at one point needs a flexible connectivity solution. For these tasks, Datacake chose 1NCE.

Industry	Location	RT-Standard
IoT Development	Germany	2G, 3G, 4G, NB-IoT, LTE-M

www.datacake.co



EFFICIENT AND COST-EFFECTIVE ENERGY SERVICES

The SOLUTIONS 30 group is the largest Cross-European solutions and services provider for Energy, IT & security and telecommunications. It is headquartered in Luxembourg. One of its key business lines is the maintenance and deployment of smart metering devices.

In France, SOLUTIONS 30, has been one of the leading partners for the utility companies since 2015, helping them with the installation of over 23 million LINKY smart electricity meters.

In 2019, SOLUTIONS 30 signed a contract with Germany's leading electricity and gas supplier to install new smart electricity meters in several areas across the country. The group is also best positioned to provide installation and maintenance services for electric vehicle charging stations throughout Europe.

SOLUTIONS 30 trusts in 1NCE when it comes to mobile cellular connectivity.

Industry	Location	RT-Standard
Energy & More	Luxemburg	2G, 3G, 4G, NB-IoT/LTE-M

www.solutions30.com

ENLIGHTING TOMORROW'S SMART CITIES

Flashnet develops and implements, among other things, intelligent systems for smart cities and better infrastructures. The inteliLIGHT® solution is an application for intelligent street lighting where the user is informed in real time of every change to the power grid. Thanks to the 1NCE Lifetime Fee, the systems of the inteliLIGHT® solution can be supplied directly with connectivity. This enables the testing and setting up of pilots in no time at all. Like this, Flashnet offers real-time street lighting control systems and supports the development of smarter cities.

Industry	Location	RT-Standard
Smart Street Lighting / Smart City / Smart Utility	Germany	2G, 3G, NB-IoT

www.intelilight.eu

SENSOR CONNECTIONS SIMPLIFIED WITH 1NCE

autosen offers a connected sensors solution for industrial automation. autosen's product io-key enables the networking of IO-Link-capable sensors with the cloud. For this purpose, the company has developed an IoT platform based on Cumulocity, which is operated in the AWS Cloud. Sensor data can be collected and automatically transmitted to the cloud for review and evaluation on a dashboard. 1NCE offers autosen a cost-effective connectivity solution for its product as well as NB-IoT to reliably connect sensors via the io-key.

Industry	Location	RT-Standard
Sensors & Automation	Germany	2G, NB-IoT

www.autosen.com

INTELLIGENT AND TOXIN-FREE PEST CONTROL

eMitter is the name of a smart way of pest control by German Futura GmbH. The family-owned business has rethought the use of spring traps in a professional environment. The eMitter technology connects the traps for mice and rats directly to the Internet of Things without the need for additional hardware.

The bait stations are connected via mobile radio using 1NCE SIM cards. As soon as an animal is caught in the trap, the respective station reports its status via e-mail or app. The Animal Protection Act obliges to regularly check all traps used – a usually laborious manual process. With eMitter the time-consuming individual inspection is no longer necessary. Traps can be specifically searched, cleaned and reactivated.

In addition, Futura supplies suitable reusable baits which are completely free of toxins. The traps are therefore not only smart, but also sustainable, environmentally friendly and compliant with leading food industry standards such as IFS and AIB. The company mainly supplies customers from the food industry, supermarkets and the pharmaceutical industry in more than 50 countries worldwide.

Industry	Location	RT-Standard
Pest Control	Germany	2G, 3G, 4G, NB-IoT, LTE-M

www.emitter.info

ENSURING THE PERFECT INDOOR WELL-BEING

Whether in offices, hotels, educational institutions or hospitals: Wherever there are many people, indoor hygiene must be given top priority. However, it is not only the air quality that plays an important role, but the entire indoor climate. Aircare, an Italian project that re-designs the indoor wellbeing paradigm, starts with a new type of IoT device that monitors and evaluates room environments according to a wide range of quality criteria. Up to 15 sensors create a holistic picture of the environment: whether particulates-, CO2 or VOC concentrations, humidity, temperature, noise, light and even electro smog. Aircare is therefore not just an air measuring device but evaluates the room climate based on three essential criteria: Air quality, ambient comfort, electro smog and it can be integrated in Building Management Systems of any company. Aircare fulfils the specifications of the WELL building standard for indoor climate. With the integrated 1NCE IoT Flex SIM, Aircare is also able to communicate at any time, independent of local building networks.

Industry	Location	RT-Standard
Building Automation	Italy	2G, 3G, 4G, NB-IoT

www.aircare.it

NB-IOT FOR INDUSTRY 4.0, SMART CITY AND SMART METERING

Lobaro is a full-service provider for industrial IoT projects. Data from M2M communication is collected, aggregated and securely made available using Lobaro's in-house developed hardware modules and customized IoT server software. Depending on accessibility and coverage, Lobaro deploys the most suitable transport technology for their clients. For its new sensor platform for Industry 4.0, Smart City and Smart Metering the company now relies on the 1NCE IoT Flat Rate.

Industry	Location	RT-Standard
IoT Hardware & Software	Germany	2G, 3G, NB-IoT

www.lobaro.com

REMOTE ANALYSIS OF BEE COLONIES

The Austrian company BeeAndme.com has developed an end-to-end solution that supports beekeepers in their daily work. Thanks to implemented sensors, the biodata of the beehive is tracked remotely and sent via the 1NCE network to the BeeAndme analytics portal. This allows beekeepers to not just monitor measured values in real time but also to receive notifications in case of anomalies in the bee colony. Furthermore, they can document the work of the beehive and make comparisons between colonies and locations.

Industry	Location	RT-Standard
Beehives Remote Analysis	Europe	2G, 3G, NB-IoT

www.beeandme.com

THE ALL-ROUNDER FOR MAMMOTH TASKS

The Berlin radio sensor and IT expert pikkerton is a medium-sized and owner-managed company. It specialises in the development and sale of various sensors for professional use. The product portfolio ranges from electronic assistance systems in the field of care, non-contact body temperature measurement for early detection of infections in times of the corona virus, energy recording, lighting control, room monitoring and storage technology. The sensors use a wide range of wireless technologies from ZigBee, wireless M-Bus, WiFi, Bluetooth, GSM to NB-IoT/LTE-M.

The "metrological jack-of-all-trades" at pikkerton is the multi-protocol multisensor XBS-200. With a wide range of sensors for temperature, humidity, air quality, CO2, brightness, motion, people counting, vibration or air pressure, it is literally suitable for mammoth tasks: For example, the XBS-200 is already being used in various museums, where it monitors the state of the indoor climate where sensitive mummies are displayed or triggers an alarm if, for example, sensitive tusks of mammoths are subjected to excessive vibrations in their storage place.

The XBS-200 also protects sensitive paintings from excessive exposure to UV light – and maintains a slight air pressure in the museum to minimize harmful dust in the building.
The range of applications of the XBS-200 is as flexible as the mobile connectivity solution from 1NCE.

Industry	Location	RT-Standard
Sensors	Germany	2G, 3G, 4G, NB-IoT/LTE-M

www.pikkerton.de

5 NB-IOT WITH 1NCE

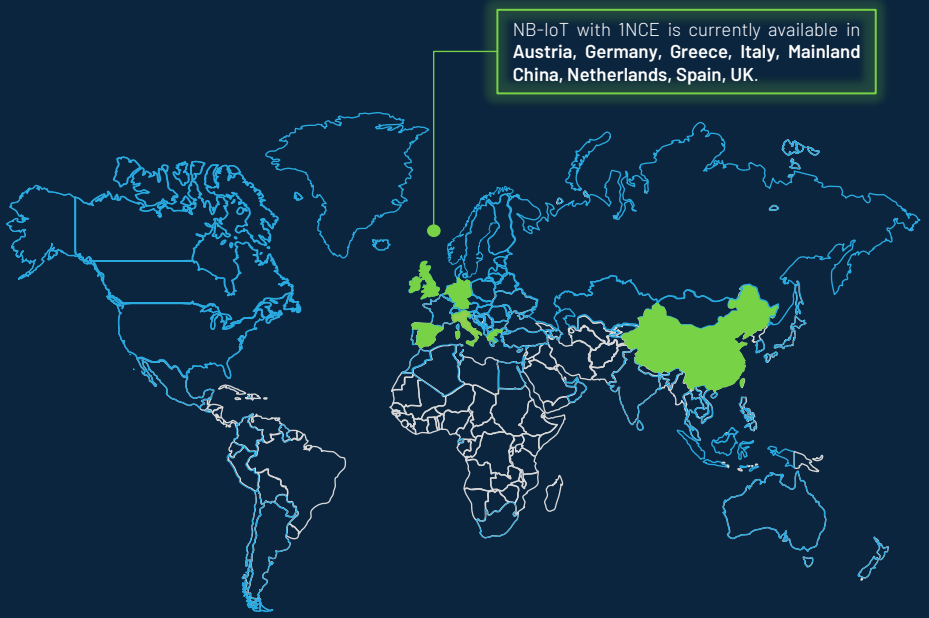
NB-IOT COVERAGE WITH THE 1NCE IOT SIM

1NCE offers NB-IoT coverage in various **European countries and Mainland China** via the 1NCE IoT Flat Rate. With the 1NCE IoT SIM, you can not only use NB-IoT, but also 2G, 3G, 4G and LTE-M in **over 100 countries** worldwide. All of this is possible with just one SIM and for **only 10 EUR for 10 years**.

THE ADVANTAGES OF NB-IOT COVERAGE WITH 1NCE

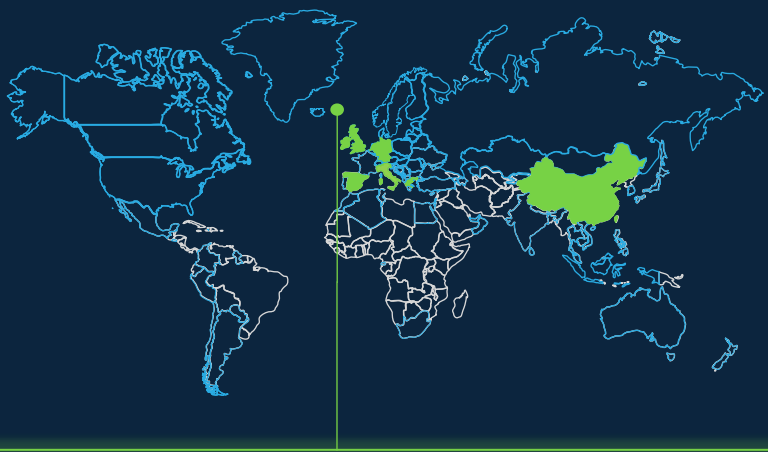
1	Low costs	✓	10 EUR for 10 years makes your IoT application profitable.
2	Minimal effort	✓	Order your SIM online, receive the card in a few days, manage the SIM in the Customer Portal. Plug & Play.
3	Best network	✓	NB-IoT in eight countries, further mobile standards in 100+ countries.
4	High penetration and coverage	✓	NB-IoT as the optimal choice for underground devices.
5	Energy-saving	✓	NB-IoT enables Power-Saving Mode to ensure a long lifetime of your devices.
6	Multi-mode functionality	✓	Seamlessly use 2G, 3G, 4G and LTE-M with one SIM in addition to NB-IoT.
7	All features included	✓	500 MB, 250 SMS, APN, VPN, API, Data Streamer, Connectivity Suite, Customer Portal, Customer Service.
8	Quality	✓	We are specialised in IoT. And we have strong partners like Deutsche Telekom AG and China Telekom on our side.

CONNECT YOUR APPLICATION VIA NB-IOT (1/2)



Use the NB-IoT coverage of the 1NCE IoT SIM as a smarter connectivity solution for your IoT application. You can commonly rely on such mobile radio standards as 2G, 3G, 4G and LTE-M, but there are also other use cases where NB-IoT is more suitable because of its key properties.

CONNECT YOUR APPLICATION VIA NB-IOT (2/2)



These two properties of NB-IoT are its high range and penetration rate as well as its energy-saving features. NB-IoT coverage means it should be used for devices that are located far below the earth's surface and for which no mobile radio connection could otherwise be established via the common radio standards. Furthermore, NB-IoT is also suitable for cases where devices are expected to have a long service life and they only need a connection to the network every now and then. With NB-IoT, devices can be put into a deep sleep during the times when they do not need to measure, send and receive data, in the so-called "power saving mode". This saves the device battery consumption, which means that the device can remain connected to the network and in use for a long time without external power supply or maintenance.

The big advantage of choosing the 1NCE IoT SIM is that **you do not have to decide on a single radio standard for your IoT application**. The 1NCE IoT SIM card has an innovative multi-mode functionality. This allows the SIM to connect to all available wireless standards (2G, 3G, 4G, LTE-M) in addition to NB-IoT and seamlessly switch between them as needed. All with a single SIM card and at a single price.

1NCE IOT FLAT RATE SUPPORTS NB-IOT IN 7 EUROPEAN COUNTRIES AND MAINLAND CHINA

Deployment of narrowband IoT solutions now easier and more economical across countries

Thanks to the extended NB-IoT coverage, cross-border deployment of IoT solutions with 1NCE is now even easier and more economical. Be it for metering applications, such as in gas, water or electricity supply, asset tracking in logistics or sensors in waste management, smart farming or building automation: wherever devices need to transmit data independently and regularly without an external power-source on consumption, position, movement, fill level or temperature, NB-IoT is the perfect choice thanks to its energy efficiency and optimised range and penetration.

"**NB-IoT is a core technology for the Internet of Things**," says Alexander P. Sator, CEO of 1NCE GmbH. "**The fact that we now also support NB-IoT across countries allows our customers to take full advantage of the benefits of NB-IoT technology combined with the simplicity of our offering**."

"**For us, this expansion comes just at the right time**," adds Wolfgang Vogl, Managing Director of BOX ID Systems GmbH, a German based provider of tracking solutions for monitoring industrial supply chains. "**We hardly have a use case that only takes place within national borders. With the new cross-country offer, we can now connect our solution very easily with 1NCE via NB-IoT or LTE-M and reach the most important markets in Europe**."

Markus Bullinger, Business Development Manager at Arrow Electronics, a global provider of products, services and solutions for commercial users of electronic components, confirms: " **We see a strongly growing demand for European-wide IoT solutions in logistics projects with our integration partners in the field of Operational Technologies. We can address this now perfectly with 1NCE and solutions from our partners such as BOX ID**."

NB-IOT FAQS

"Does 1NCE offer NB-IoT Roaming"

1

1NCE currently supports NB-IoT exclusively in Germany, Austria, the UK, Greece, Italy, the Netherlands, Spain and China with more than 90% coverage each.
Based on 1NCE technology, only Telekom Deutschland offers further NB-IoT roaming for selected European countries with its Business Smart Connect rates.

"Why is there no costant connection to NB-IoT"

2

NB-IoT is best suited for stationary devices since it does not support seamless cell handover, which means that the connection has to be re-established again when the devices attaches to a new cell network tower.

"Do 1NCE SIM cards also support seamless NB-IoT coverage across national borders?"

3

NB-IoT does not support seamless cell handover when switching cells. In this case, the connection is lost and has to be re-established. However, when looking at the further connectivity standards like 2G, 3G and 4G as offered by 1NCE, the 1NCE SIM card ensures seamless connectivity, when crossing a border between two countries covered by the 1NCE footprint.

THE 1NCE IOT FLAT RATE AT A GLANCE

STANDARD: 1NCE IoT Flat Rate – All-inclusive for 10 EUR

500 MB ✓	250 SMS ✓	SIM card ✓
OpenVPN ✓	REST API ✓	Data Streamer ✓
Connectivity Management Platform ✓	APN ✓	Connectivity Suite ✓

Coverage in 100+ countries

10 EUROS FOR 10 YEARS FLAT RATE

FLEXIBILITY: Automated top-up as your use case demands it

ADDITIONAL OPTIONS:

+ 2 EUR
eSIM (MFF2)

+ 0 EUR
China+ (local coverage)

+ 2 EUR
Blockchain on a SIM

GET IN CONTACT OR BUY DIRECTLY YOUR 1NCE IOT FLAT RATE TODAY!

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