WHITEPAPER

NB-IoT: Getting devices to market fast

A guide for operators and manufacturers

HAE Innovations
Pioneering Wireless Innovation

Published by
MOBILE WORLD LIVE

Executive Summary

The Internet of Things (IoT) is creating huge new opportunities for device manufacturers, application developers and operators alike – not to mention citizens and consumers.

NB-IoT is emerging as the leading connectivity backbone to support these large-scale IoT deployments.

Getting NB-IoT devices to market quickly and ensuring a seamless customer experience for end users are key to unlocking the value in this market.

In this report, we'll look at the market forecast, the unique properties of NB-IoT, the hurdles to device deployment and – crucially – the practical strategies for overcoming them.

NB-IoT is here to stay

The number of connected devices is expected to reach 125 billion globally by 2030, giving rise to new forms of IoT connectivity such as low-power wide-area networks (LPWANs) including NB-IoT and CAT-M (also known as LTE-M), which use licensed spectrum, and LoRa and SigFox, which run on unlicensed.

Wired, short-range communications are unable to deliver the necessary scale and deployment simplicity for the wide-scale roll-out of IoT connectivity, and traditional long-range wireless options are too expensive and power-hungry to justify a business case.

LPWANs have emerged as a cost-effective, viable alternative for services and applications that only transmit small and infrequent data messages.

Some low-power wide-area (LPWA) devices can last ten years or more on batteries, making them useful for a broader range of applications and opening up new business cases that would previously have been too expensive.

According to Analysys Mason, there will be 3.5 billion LPWA connections by 2026, and NB-IoT connections will form the largest share of connections in both LPWA and overall traditional cellular markets.

By 2022, the installed base of NB-IoT connections is expected to exceed 2 billion devices worldwide.

NB-IoT's unique characteristics

Standardised by 3GPP, NB-IoT can enable a wide range of IoT devices and services. NB-IoT minimises the power consumption of connected devices, while increasing system capacity and spectral efficiency, especially in locations that can't easily be covered by conventional cellular technologies.

NB-IoT employs a new physical layer with signals and channels to meet the demanding requirements of extended coverage in rural areas and deep indoors, while enabling very low device complexity. The underlying technology is relatively simple and inexpensive. Further, the cost of NB-IoT modules is likely to decrease rapidly as deployments increase.

In many use cases, NB-IoT connected devices can have a battery life of more than ten years, thanks to low-channel bandwidth (180Khz) and extended Discontinuous Reception (eDRX). eDRX was introduced in 3GPP Release 13 to accommodate applications with infrequent mobile terminated data and long delay tolerance requirements. The device can remain in sleep mode for longer, enabling significant power savings.

Supported by all major mobile equipment, chipset and module manufacturers, NB-IoT can co-exist with 2G, 3G, and 4G mobile networks. It also benefits from all the security and privacy features of mobile networks, such as support for user identity confidentiality, entity authentication, data integrity and mobile equipment identification.

Why NB-IoT?

LPWA technologies are often pitted as competitors, battling it out in a race to the top. However, each has its own role to play in the IoT landscape and these technologies are set to co-exist and often even work together. How and where they will be used is based on the application capabilities required.

For example, CAT-M can transmit large chunks of data with higher data rates so it is much more suitable for critical applications where real-time communication and very high reliability are required, such as digital health. It is also more appropriate for mobile applications, such as transportation use cases. NB-IoT is most useful for static assets, like meters and sensors in a fixed location.

Licensed or unlicensed?

Many operators are opting for licensed LPWA technology – NB-IoT or CAT-M – because of its banking-grade security. NB-IoT mutually authenticates the network and the device and encrypts traffic between the device and deep within the core network.

In addition, NB-IoT is faster to deploy than unlicensed technology such as LoRa and SigFox – operators can typically roll out cellular LPWA network services via a software upgrade to their existing infrastructure.

Another issue with unlicensed spectrum is the increased risk of interference.

	NB-IoT	CAT-M/LTE-M	LoRa	SigFox
Bandwidth	200 KHz 3GPP licensed	1.4 MHz 3GPP licensed	125kHz (500kHz d/l) unlicensed	100Hz (1.5kHz d/l) unlicensed
Standardisation	3GPP	3GPP	LoRa Alliance	Proprietary
Data rates	20-100 kbps downlink/up to 62.5kbps uplink	Up to 350 kbps downlink/up to 1mps uplink	50kbps downlink/ 50kbps uplink	600bps downlink/100bps uplink
Latency	1.5-10 seconds	50-100 milliseconds	1-10 seconds	1-30 seconds
Module cost	Low	Medium	Low	Very low
Use cases	Smart meters Pipeline management Home automation Agriculture Smart city Low-value asset monitoring	Smart grid Transportation Home security Health monitoring Industrial asset tracking Remote maintenance Wearables	Smart metering Smart parking Smart street lighting	Smart metering Smart parking Smart street lighting
Battery	10 years +	10 years +	10 years	10 years +
Ecosystem	Good	Good	Limited	Limited

Major operators are rolling out NB-IoT services in Asia, the Middle East, Latin America and Europe, with commercial launches now underway. China Mobile, China Telecom, China Unicom, Deutsche Telekom, Etisalat, KT, NOS, TDC, Telefónica, Telia and Vodafone are among the operators to be deploying NB-IoT.

The *Narrowband-IoT: pushing the boundaries of IoT* whitepaper from Vodafone notes: "A number of different technologies have been developed to fulfil LPWA requirements, and we believe NB-IoT not only offers enterprise-grade technical specifications, but is also the practical choice for carriers, device manufacturers and ultimately enterprise users."

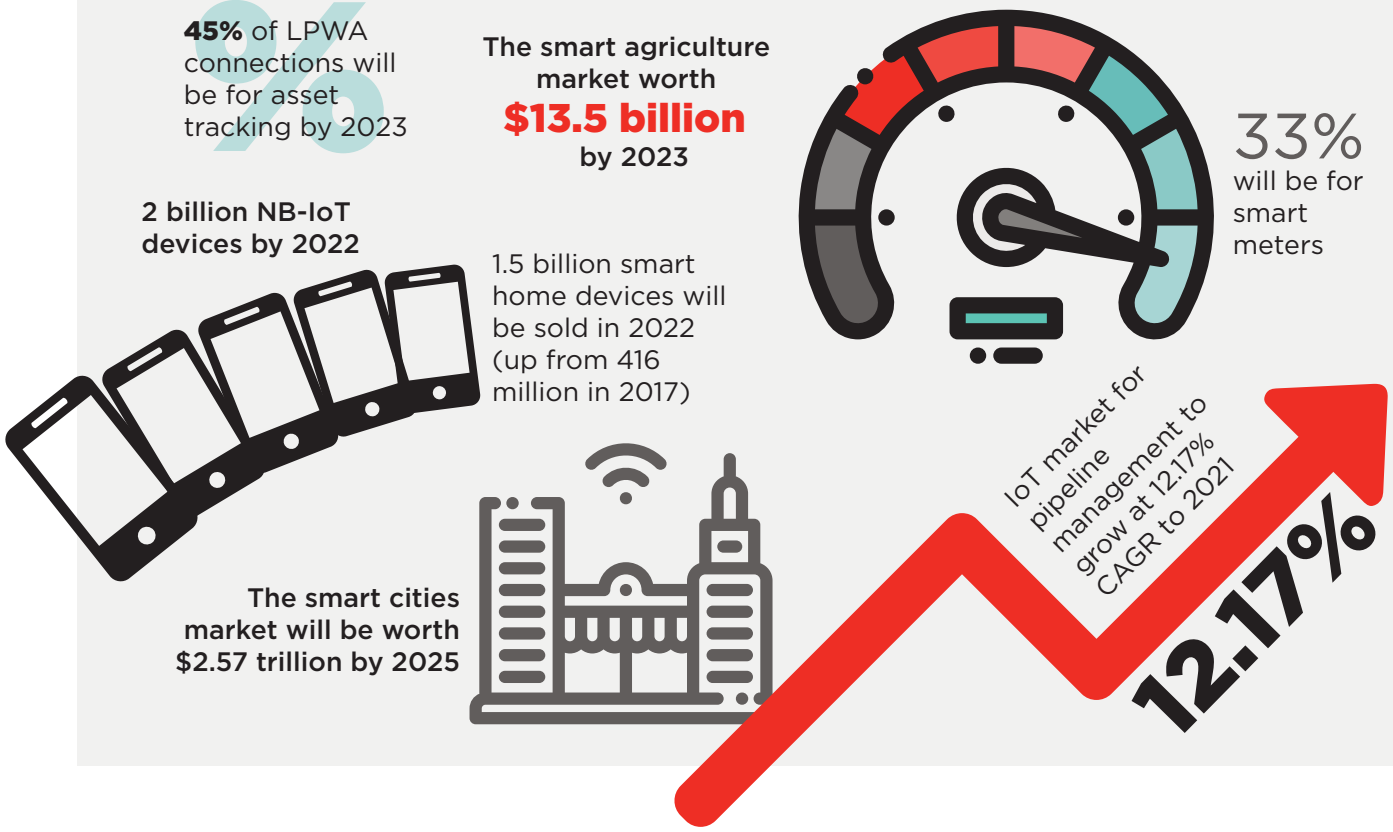
Vodafone particularly highlights the high security to NB-IoT, compared to unlicensed spectrum alternatives; its coverage in challenging conditions; fast data throughout; flexible power management; and simple design for cost-effectiveness.

NB-IoT opens up new business opportunities for operators not only for connectivity but also to offer the NB-IoT Network-as-a-Service, including security, billing and big data, etc., as well as even playing the role of the overall service integrator.

Given the market forecast for NB-IoT, as well as the growth in its application sectors (see NB-IoT market opportunities infographic), the majority of IoT developers and device-makers are interested in NB-IoT.

The key to capitalising on this for the whole ecosystem is getting devices to market quickly and cost-effectively, and ensuring those devices are secure, reliable and work on all networks.

NB-IoT market opportunities



Seize the NB-IoT opportunity

However good their idea or product, there are many hurdles for NB-IoT device manufacturers to clear before they can launch a device into the market and begin generating revenue.

Devices must go through a stringent certification process and be approved by regulators and operators. This certification process covers chips and software, etc. and NB-IoT devices must also be approved to access the licensed spectrum which the technology uses. Without this, devices could be blocked by operators to prevent them from jeopardising the network infrastructure.

Certification applies not only to new devices but also to upgrades or new modules on already accepted devices. Certification must show that a device performs safely and as expected when connected to an NB-IoT network, and that it operates seamlessly across different networks to ensure global interoperability.

Thorough testing is also essential for avoiding problems for manufacturers further down the line, such as dropped connections, short communications range and rising support costs.

Test challenges

IoT devices are highly dependent on a complex series of network connections between the device client, CPU (central processing unit), wireless modem, wireless network, cloud application and more. Each operator typically has different requirements. Further, NB-IoT has unique technical characteristics as we outlined in the previous chapter.

All of this combined makes it challenging for IoT manufacturers to thoroughly test their solutions while remaining competitive on price and agility.

These are just a few of the capabilities that NB-IoT device manufacturers must test before launch.

- Manufacturers will be required to analyse and optimise **power consumption** under various configurations and operational models to ensure the expected battery life of ten years or more is not compromised.

- **Firmware over-the-air updates**, often measured in megabytes, are critical to negotiate between operator and manufacturer – updates can take over 10 minutes to download to a remote device and this could have a significant impact on power consumption and therefore battery life.

- It's not just devices that need to be tested. Operators, manufacturers and app developers need to understand how **mobile applications** perform over a wide variety of conditions. Application data throughput, battery consumption, memory usage and push notifications (under standard and adversarial Internet Protocol and radio frequency conditions) all have a huge potential impact on customer experience.

- As billions of devices connect to networks around the world, operators are becoming increasingly wary of security or safety risks. As we have outlined, many operators choose NB-IoT for its security properties. **Device security** is something that operators can't afford to and won't compromise on.

- **Device antennas** must be tested to ensure they perform the way they're expected to, even in sometimes-extreme conditions.

- Understanding the impact of different **CE levels** (European conformity) on power consumption and latency is also important, as well as carrying out checks under different fading conditions – i.e. fluctuations in a received signal.

Speeding up deployment

The way developers go about testing their devices will have a significant impact on their success in the market and ultimate ROI. Traditional testing processes can be slow, time-consuming and potentially ineffective.

A lot of manufacturers and product developers create the device in their home country (particularly in Asia due to manufacturing costs) to market and sell to customers abroad – such as in the US or Europe. To test the devices and services against operators' networks, engineers typically have to travel to the country to trial the technology – sometimes multiple times to re-test revised software or hardware.

This constant travel isn't practical or sustainable. Neither is waiting until design nears completion to verify the performance on a live network. Testing and continuous improvement are required throughout the product design lifecycle.

Lab verification costs can be as high as $250 per hour –this could realistically add up to hundreds of thousands of dollars per product. Ongoing refinement in a repeatable simulated test network environment is essential before pushing to a live one.

One alternative to travel is investing in lab equipment but the financial layout for this can be very high – typically over $100,000. This is unrealistic for many device developers, particularly small companies and those that only require testing for a one-off device or very occasionally.

In addition to these issues, not all operators will offer developers access to their networks directly. For many operators, NB-IoT is still in trials or early stages.

To launch products that work quickly, manufacturers and developers need to be able to test and revise on the fly – trialling their devices against different operators' networks for maximum market appeal without individual configurations.

New tools are emerging for this, which help to slash costs and time to market.

Strategies for success: Smart testing

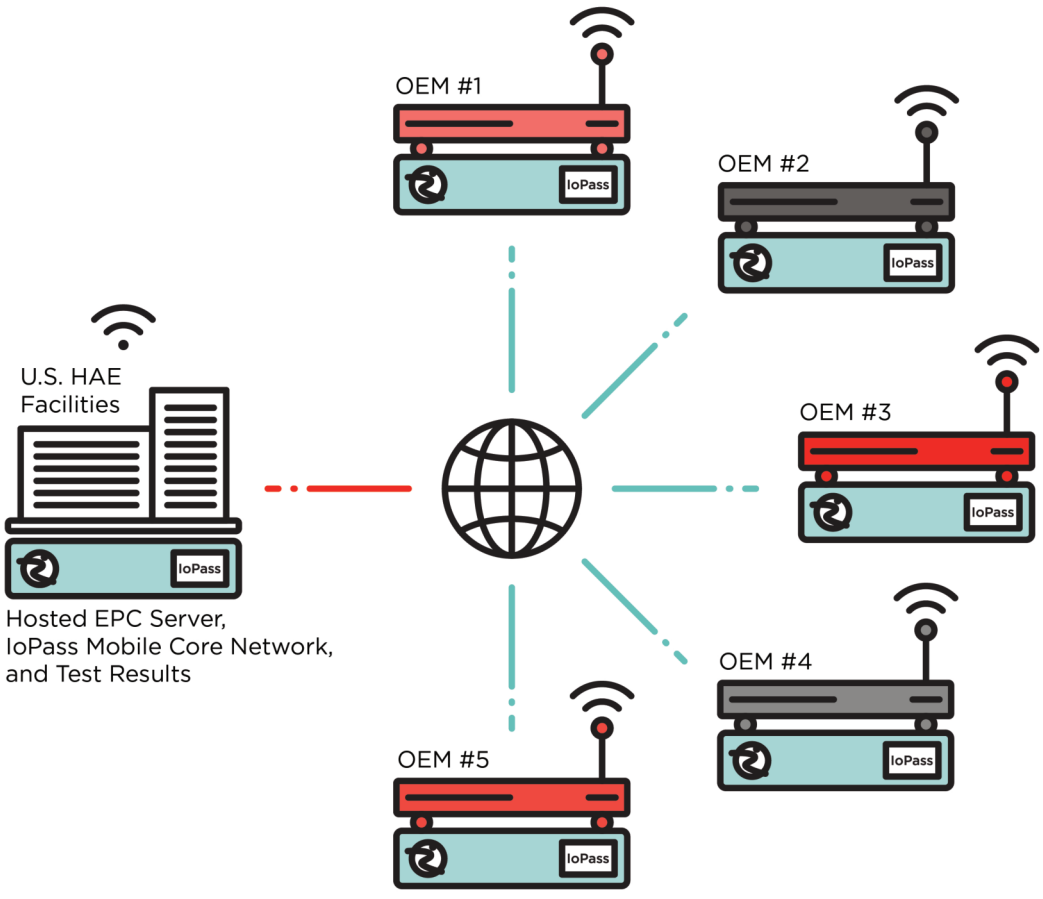
A growing trend is to test NB-IoT devices on a PaaS (Platform as a Service) using dedicated IoT testing platforms, such as IoPass from HAE Innovations. Rather than requiring manufacturers to invest in expensive equipment or travel, this new breed of tools creates a virtual replica of operators' networks so manufacturers can carry out the full testing process from their own premises.

IoPass, for example, allows manufacturers to test at all stages of development from chip design to global service deployment. The tool is designed to have an intuitive user interface for non-wireless engineers that want an easy-to-use and cost-effective test platform. It offers both a custom development environment as well as automated test suites that help ensure wireless connectivity, and battery and signalling performance.

Hesham ElHamahmy, CEO, HAE Innovations, comments: "Manufacturers and developers often have global ambitions. They can tune IoPass to any operator so they can be assured that their product is valid for more than one market. They can test any specific operator's requirements as well as mandatory industry standards and, crucially, they can also test applications."

He adds: "IoPass also tests applications. It's one thing for a device to connect but it's terrible to find out at the end of the design cycle that the application doesn't accept the data and you need to completely change the code. It could also be an awful experience for the end customer if applications are not properly tested.

"Being able to test all of that throughout the development lifecycle is the fastest way to get a product launched without wasted time and money."



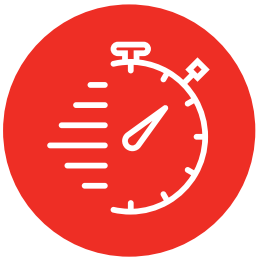
In action: Win-win for operator and manufacturers

- **Who?** Leading operator and NB-IoT device manufacturers
- **The challenge:** The operator's device certification plan was too costly and time-consuming for manufacturers.

The operator was losing revenue, the manufacturers couldn't launch devices fast enough.

- **Solution:** The operator deployed IoPass-R to enable manufacturers to test devices from their own premises.
- **Results:**

Savings of $10,000 +



Testing time halved

Faster device time to market

Faster revenue for the operator

Business viability and ROI for the manufacturer

The challenge

The operator's existing smartphone certification plan for evaluating devices to ensure they are safe for service was proving too expensive to attract new IoT device manufacturers to launch on the network. Despite significant improvements in the administrative process and reduction of tests required, the manufacturers still faced costly challenges.

These costs included paying for access to an NB-IoT network to pre-test their product design for compliance to operator requirements and travel costs of over $10,000 for an on-site engineer to test the device on the target network(s). There were then further unplanned costs and delays due to engineering work required to fix issues uncovered during testing.

For the operator, these costs represented a barrier to increased revenue from the millions of IoT devices launched each year. For the manufacturers, these costs often mean the difference between success or failure of the company.

The solution

The operator deployed IoPass-R with NB-IoT-capable technology. With IoPass-R, the operator sent the RF radio to the overseas manufacturer. The RF radio connected back to a vEPC (virtual evolved packet core) over a secure link back to the operator. As a result, the manufacturer was able to test their design in the comfort of their facility with access to all the engineering support on-site. The results were shared in an encrypted format and the device was declared safe for service on the network.

Results

The operator typically requires the manufacturer to plan for 30 days on-site to support unforeseen failures. With IoPass-R, the manufacturer was able to complete testing in two weeks, cutting this time in half and removing any travelling expense.

Through using smart testing solutions in this way, manufacturers get faster ROI on their development and gain first-mover advantage. By making it easy for manufacturers to test devices on a virtual version of their network, operators are more attractive for developers and can become the 'go to' for IoT launches.

Start testing your NB-IoT device to launch it much faster – find out more about IoPass now.

HAE Innovations
Pioneering Wireless Innovation

HAE Innovations was founded in 2015 with a vision to provide world-class services and solutions for measuring performance of connected devices and Internet of Things (IoT) services.

Their methods for measuring Internet of Things performance allows IoT manufacturers to test at all stages of development from chip design to service deployment globally.

To learn more, visit www.haeinnovations.com

MOBILE WORLD LIVE

Produced by the mobile industry for the mobile industry, Mobile World Live is the leading multimedia resource that keeps mobile professionals on top of the news and issues shaping the market. It offers daily breaking news from around the globe. Exclusive video interviews with business leaders and event reports provide comprehensive insight into the latest developments and key issues. All enhanced by incisive analysis from our team of expert commentators. Our responsive website design ensures the best reading experience on any device so readers can keep up-to-date wherever they are.

We also publish five regular eNewsletters to keep the mobile industry up-to-speed: The Mobile World Live Daily, plus weekly newsletters on Mobile Apps, Asia, Mobile Devices and Mobile Money.

What's more, Mobile World Live produces webinars, the Show Daily publications for all GSMA events and Mobile World Live TV – the award-winning broadcast service of Mobile World Congress and exclusive home to all GSMA event keynote presentations.

Find out more www.mobileworldlive.com