Time to modernize your business

A guide for taking your IoT into the 5G era

Telia

Digitalization in a 5G world

We are at the beginning of the 5G era, which promises to transform businesses by taking the performance of mobile networks to a whole new level. Data speeds will be high enough to replace fiber. Latency will be lower and capacity high enough to support massive numbers of devices. But while this is true, it doesn't capture the full value of 5G.

The fifth generation of mobile networks is an evolution in mobile communications, enabling new ways to solve business challenges and digitalizing ways of working. It's time to modernize your business.

5G is designed to connect anything and everything. From the tiniest wearable keeping track of your health, to all cars, traffic lights, and even roads. With the next generation of networks, we will start to see more connected and interconnected things and with that an even smarter and more sustainable world.

New possibilities for business

The first step of the 5G IoT evolution started with the launch of our Low Power Wide Area (LPWA) networks. Businesses and organizations are already taking advantage of the new possibilities that NB-IoT and LTE-M bring, such as connecting industrial doors to streamline operations by reducing the need for site visits and connecting vibration sensors in industrial machines to optimize the use of their assets. It will also be possible to connect devices that monitor environments and conditions in much greater detail, bringing a new level of control and preventing problems.
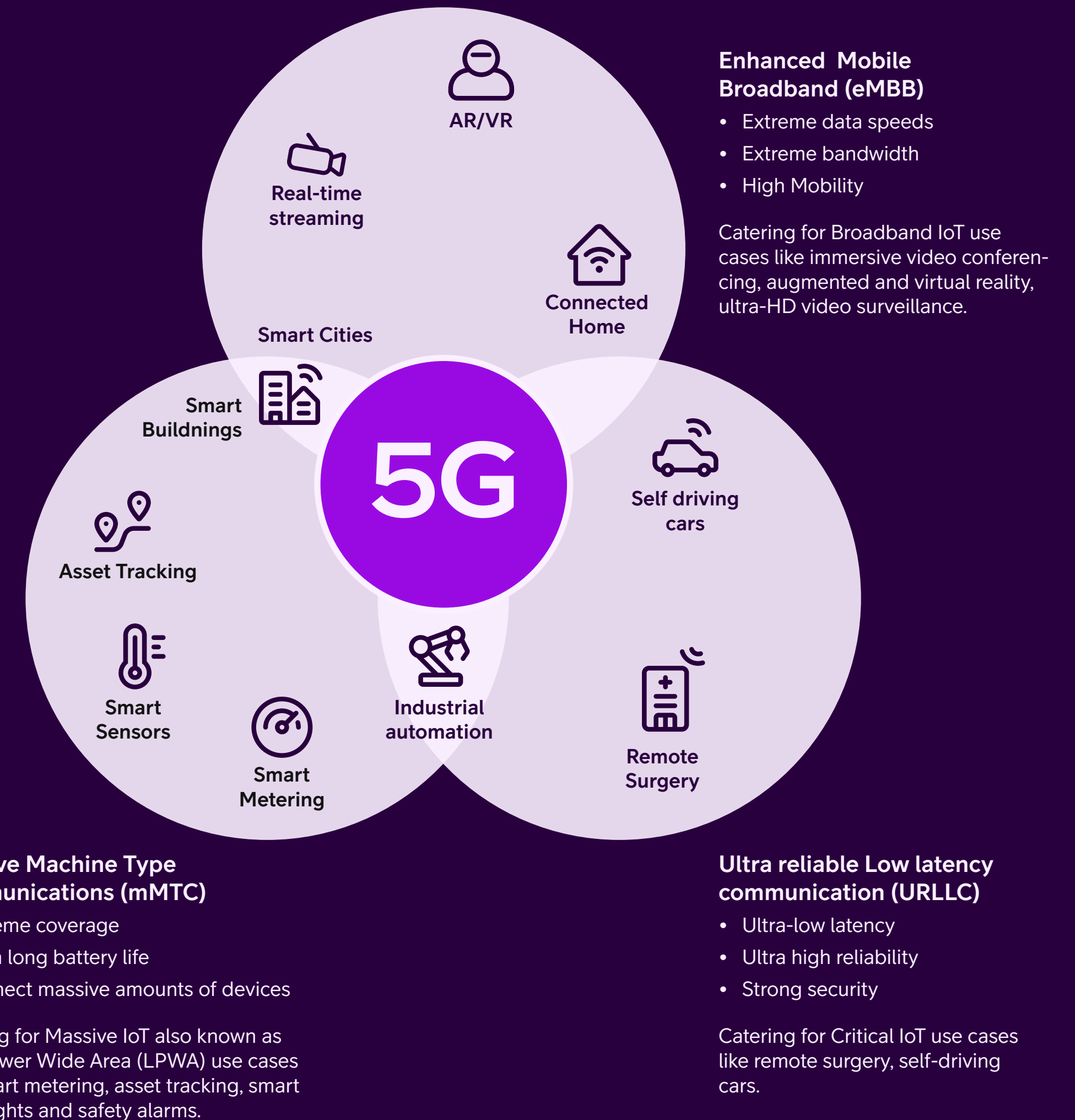
The fifth-generation mobile networks will continue to evolve, further enhancing IoT connectivity capabilities with even higher data speeds, lower latency, improved security, and extreme reliability. We are already today supporting cases like remotely controlled high-lift wheel loaders, autonomous field robots and automated port operations.

More 5G-powered network capabilities, like network slicing, edge computing as well as private networks will support new use cases with even more advanced applications that will enable autonomous vehicles, wireless factories and remote surgery. Use cases where extreme security, responsiveness and reliability is critical.

With this flexible and dynamic infrastructure, it will be possible to connect, interconnect and coordinate. 5G will become IoT´s best friend.

Examples of 5G use cases and applications

Most 5G use cases can be grouped under three main categories - enhanced Mobile Broadband (eMBB), massive Machine Type Communications (mMTC) and Ultra Reliable Low Latency Communication (URLLC). Each with its own speed, capacity and latency requirements.

Enhanced Mobile Broadband (eMBB)
- Extreme data speeds
- Extreme bandwidth
- High Mobility

Catering for Broadband IoT use cases like immersive video conferencing, augmented and virtual reality, ultra-HD video surveillance.

Massive Machine Type Communications (mMTC)
- Extreme coverage
- Extra long battery life
- Connect massive amounts of devices

Catering for Massive IoT also known as Low Power Wide Area (LPWA) use cases like smart metering, asset tracking, smart streetlights and safety alarms.

Ultra reliable Low latency communication (URLLC)
- Ultra-low latency
- Ultra high reliability
- Strong security

Catering for Critical IoT use cases like remote surgery, self-driving cars.

Diagram labels: AR/VR, Real-time streaming, Connected Home, Smart Cities, Smart Buildnings, 5G, Self driving cars, Asset Tracking, Smart Sensors, Smart Metering, Industrial automation, Remote Surgery

Almost one third of all cellular connected devices in the Nordic & Baltics affected

There are millions of cellular connected devices across the Nordics and Baltics. Between 21-39%, depending on country, rely on 2G and/or 3G. All of these devices will need to be updated or replaced.

Source: Transforma Insights' TAM Forecast for 2022.
Link to website

Making way for modern IoT

To enable new, wireless network technologies radio spectrum is needed, a range of frequencies used for transmitting data wirelessly. However, there is only room for a certain amount of traffic in the licensed radio spectrum.

Today, both 2G and 3G are taking up a lot of licensed radio spectrum. These technologies were developed long ago – 2G is some 30 years old, even older than the World Wide Web. These were not designed to support today's data-driven world.

New network technologies like LPWA, 4G and 5G are designed for data traffic, and can make far more efficient use of the same limited radio spectrum. Providing higher data speeds and room for more connected devices.

This is a reason why regulators across the globe have decided to modernize and close 2G and 3G networks to reassign their radio frequencies for more efficient use. This has already started to happen, but the exact timelines differ among different parts of the world, countries and operators. Making it difficult to provide a general time frame.

Several operators in North America and Asia have already closed their 2G networks. Others in Europe, Asia, and Latin America are in the process of doing

so. In the Nordics and Baltics, the general trend has been to shut down 3G before 2G.

Old technologies are making way for new ones – it's not a question of if, but when the networks will be gone completely.

Common examples of IoT devices that rely on 2G/3G

Today, a vast range of devices rely on 2G and/or 3G connectivity. Some common examples might be older point of sales terminals, fleet managements systems, emergency voice systems, security solutions and M2M installations.

Some of these products have been modernized already. But it's worth checking if your connected device will be affected by the change.

Security
Home alarms, safety and fire alarms, are often connected to 2G/3G.

Fleet management systems
Older fleet management systems often rely on 2G/3G for vehicle tracking.

Point of sales terminals
Many older payment terminals still use 2G/3G to communicate.

Emergency voice systems
2G is often used in standalone voice solutions, like emergency calling systems in elevators.

M2M installations
M2M is an older term for IoT and might be a sign that it uses 2G or 3G technology.

Making a smooth transition from 2G/3G and into the 5G era is easier with the right support. This guide outlines four key steps to ensure that your IoT solution is ready for the next generation of 5G networks. We have summarized the most important considerations in each step with a few useful tips to support the upgrade of your IoT solution.

Four steps to upgrade your IoT

1.

Act

Establish how much time is left before the current solution needs to be updated

2.

Assess

Evaluate the impact an upgrade will have on current set up and situation

3.

Identify

Explore and choose the right building blocks – connectivity, devices and software

4.

Explore

Consider security and scalability as well as easy management and deployment

4

Improved IoT solutions with new capabilities

Sweden-based company Light Systems have a long history of providing wireless control solutions for automotive, energy and lighting applications. Today, their main area of business is remote control of streetlights. Some of their early IoT solutions, using 2G equipment, have been in active use for over 20 years.

With the introduction of cellular Low Power Wide Area networks, new opportunities opened up to be able to offer improved solutions with new capabilities, at a fair price. Light System started their upgrade from 2G by assessing their requirements and evaluating different connectivity solutions. They considered a non-cellular option, since they mostly have stationary use cases, but rejected the idea since it would require them to build their own service organization to manage networks.

"Managing your own infrastructure is not profitable. For us it was far better to collaborate with Telia so we can provide a complete solution, fully managed by professio-

nals in every part.", says Leif Edh, CEO of Light Systems. Telia's experience in this field supported us in migrating our solution to LPWA. They have been more of our collaboration partner rather than a supplier", Edh continues.

LPWA connectivity also opened further opportunities for Light Systems. There is growing demand for solutions that can provide more than switching lighting on and off. Energy monitoring and more sophisticated coordination of lights over wide areas, to counter possible energy shortages or for improving sustainability, without affecting quality of life and safety negatively.

"LPWA allows us to create low-cost measuring and control units that can be built into equipment, allowing us to offer customer adapted solutions that are flexible and easy to use. These will help improve energy efficiency and are a crucial step towards a sustainable society", says Edh.

Read more about Lightsystem here

It's time to plan ahead

As 2G and 3G networks around the world are being closed down, as they already have in some regions, coverage will continue to gradually decline and finally disappear.

This means that all devices that current rely on these connections will eventually stop working. If your business relies on 2G and 3G devices, or embedded voice applications running on 2G, now is the time to make a well-planned migration to 5G ready alternatives, like the new Low Power Wide Area technologies.

Establish your timeline
The first thing to do is to determine a timeline. The exact date for closure will vary depending on the connectivity technology as well as the country and operator.

Telia Company has announced that 3G networks in the Nordic and Baltic countries will close first. 2G is to follow. Telia has stopped selling new 2G and 3G IoT subscriptions, with a few exceptions for highly specific use cases. The gradual shutdown of 3G has started in most of Telia's countries, with the aim to close the network in all countries by the end of 2023. In Norway 3G is no longer in use.

With 2G the ambition is to retire the network by the end of 2025, but this will vary depending on country and local circumstances.

How can you tell if your devices use 2G/3G?
The closure affects all devices that rely on 2G and 3G for voice or data connectivity. Sometimes these technologies are referred to in other terms.

GSM GPRS, EDGE	Terms often associated with 2G.
UMTS, HSPA, HSPA+	Terms often associated with 3G.

The hardware manufacturer will have accurate information of which technology is used in the device.

For up-to-date information on the closures of networks please visit our local Telia webpages.

Telia Sweden link to page   Telia Finland, link to page   Telia Denmark link to page

Telia Norway link to page   Telia Lithuania link to page   Telia Estonia link to page

Telia Latvia link to page

2. Assess

Evaluate your current situation

Before any detailed plans are made, we recommend doing a full assessment of your current situation and the implications an upgrade might have – both technical as well as the impact on your business and operations.

A deeper understanding of your needs and requirements as well as exploring new possibilities, will make it easier to narrow down the right options or buildings blocks for your updated IoT solution. This is to focus on that which provides most value to the organization.

Assess the business impact

Understanding how the devices might be affected and how that in turn could affect other systems and processes, will help understand how to prioritize and make the appropriate plans.

Questions to ask:

- Which connected devices does your business rely on?
- Which systems and processes are affected by your connected devices?
- What would the consequences be if the devices stopped working?
- Who is responsible for the different systems affected?

Assess the scope and scale of device replacement

Identifying the number of affected devices, the complexity of updating them as well as understanding the resources required for completing the update at an early stage will simplify planning. And allow you to make more efficient use of resources or detect the need for additional support.

Questions to ask:

- How many devices are running on 2G/3G?
- Will the SIM cards in use support new devices and technology?
- Where are the devices located? How difficult are they to access?
- How much work is needed to update/replace devices?
- What skills are required?
- Can the existing systems support the new devices?

Assess requirements and consider new possibilities

With new technology comes new possibilities. The final step in assessing your current situation is to look at new features or capabilities for your IoT solution while upgrading it. Look at the minimal functional requirements, areas of improvements over the previous solution and new opportunities that the business might want to address.

Questions to ask:

- What features do you want your IoT solution to have?
- Are there any areas to improve in the solution?
- Which improvements would offer the greatest benefit to your business?
- What are your requirements on connectivity?
- What is required from the replacement devices?
- Will the software systems need to be updated?
- Which partners do we need to support the upgrade?

Three areas to explore for a modern IoT solution

All IoT solutions have three vital components that need to be explored and evaluated: connectivity, devices and software. There are important choices to make that will have consequences for the whole life cycle.
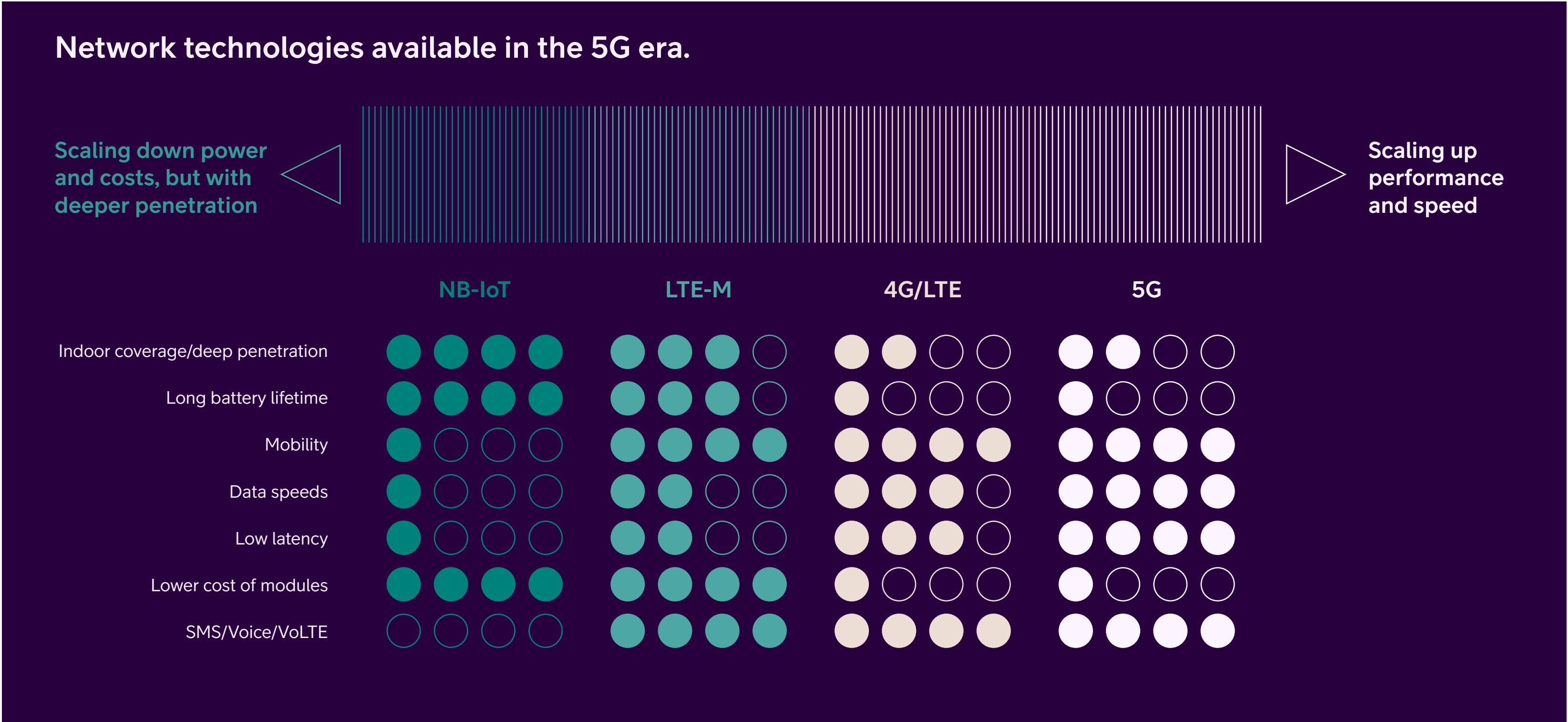
IoT Connectivity for today and tomorrow

Without connectivity there is no IoT. Reliable connectivity simplifies deployment, maintenance and lowers costs. Updating your 2G/3G devices to one of the modern cellular alternatives is the better option for a reliable and 5G ready IoT solution.

No one-size fits all

Ideally, everyone prefers the longest range, deepest penetration, highest data rates with minimum power consumption. No single technology fits all ambitions. More data requires more power. Lowering power consumption but still sending large amounts of data, will be at the expense of range. To achieve low power consumption but also having long communication range, data bandwidth must be limited.

Mobility, latency and the costs involved are other aspects that will help you determine your connectivity choice. The connectivity you need depends on what you want to do. A deciding factor must always be your use case.

Network technologies available in the 5G era.

Scaling down power and costs, but with deeper penetration ◁

▷ **Scaling up performance and speed**

	NB-IoT	LTE-M	4G/LTE	5G
Indoor coverage/deep penetration	●●●●	●●●○	●●○○	●●○○
Long battery lifetime	●●●●	●●●○	●○○○	●○○○
Mobility	●○○○	●●●○	●●●●	●●●●
Data speeds	●○○○	●●○○	●●●○	●●●●
Low latency	●○○○	●●○○	●●●○	●●●●
Lower cost of modules	●●●●	●●●●	●○○○	●○○○
SMS/Voice/VoLTE	○○○○	●●●●	●●●●	●●●●

3. Identify

Use cases and technology overview

LTE-M

Probably the closest replacement for both 2G and 3G, but far more flexible then the older technologies. It strikes a good balance between performance and efficiency, providing a well-rounded option for many IoT applications and use cases. With LTE-M you can both send and receive moderate amounts of data, but more than 2G or 3G. This allows you to collect data as well as carrying out more data-intensive actions such as remotely updating your devices. LTE-M also has great support for mobile use cases, while still being able to offer long battery life.

NB-IoT

A better option for less data-intense stationary use cases, that require reliable performance under the most difficult circumstances. This technology is the better choice when focus is on extreme efficiency. NB-IoT was designed for sending small amounts of data, like scheduled sensor readings. The lower data rates are, however, well compensated by its longer range, excellent underground and indoor coverage and ability to provide up to 10 years of battery life.

4G

4G, also known as LTE, is better suited for high-capacity solutions. This technology enables most of our day-to-day use of smartphones and is the better choice for complex use cases and devices. 4G was designed for handling data-intense use cases, such as video streaming or real-time monitoring, that need high-speed uploads and downloads of large amounts of data. While offering full mobility, voice and SMS applications, it may be most useful for cases where battery recharging is not an issue. LTE will co-exist with 5G.

5G

May not serve as a direct replacement for 2G/3G devices, but new network technologies like ultra-reliable low latency communication (URLLC) and enhanced mobile broadbrand (eMBB) will take IoT to new heights. Accommodating new use cases requiring next-level performance, security and reliability.

Designed to be able to connect anything and everything, and will also offer exceptional opportunities for customized connectivity.

Use cases suited for LTE-M.
- Smart Buildings
- Smart Cities
- Asset Tracking
- Wearables
- Retail POS (Point of Sale)
- Maintenance monitoring
- Payment terminals
- Safety and security alarms
- Traffic surveillance cameras

Use cases suited for NB-IoT
- Environmental monitoring
- Agricultural monitoring
- Water Metering
- Gas Metering
- Electricity Metering
- Waste management
- Smart Buildings
- Smoke and fire detectors

Use cases suited for 4G
- Transport
- Connected Home
- Digital Signage
- Remote health monitoring
- Video security
- Industrial sensors

Use cases suited for 5G
- Self driving cars
- Industry 4.0
- Remote surgery
- Remote vehicle control
- Virtual & Augmented reality
- Ultra HD video
- Infotainment in cars

Low Power Wide Area (LPWA)

Consists of two specialized IoT connectivity network technologies that provide a 5G ready replacement for 2G & 3G. Providing better reach, longer battery life and significantly lower cost modules, each with its own advantages. Already available and will continue to be developed within the 5G standard, catering to uses cases that require massive machine type communication.

5G architecture

5G can be deployed as Stand Alone (SA) and Non-Stand Alone (NSA).

5G NSA rely on the existing 4G infrastructure for control functions. It is the first stage of 5G, delivering ultra-high-speed mobile broadband and low latency.

5G SA is depending on the new core and will enable new use cases requiring the ultra reliable low latency communication that will be provided, as well as new network capabilities like slicing and edge computing.

LOW POWER WIDE AREA
A GUIDE TO MAKING THE RIGHT DECISIONS
ABOUT CELLULAR LPWA CONNECTIVITY

More detailed information on both NB-IoT and LTE-M, can be found Telia's LPWA Guide

3. Identify

IoT Devices

Not all devices will require replacement. Of those that do, some might be quite easy to replace, others more difficult.

Switching dual mode devices to 4G/LTE

Some newer devices could already be capable of using 4G connectivity but may simply not be running on it. A reboot may be all it takes. A viable option if the device specification shows that the device is 4G/LTE compatible.

Replacing with updated device version

Some manufacturers may already have upgraded their devices to handle 4G or possibly even 5G, to replace the older ones. If you don't intend to upgrade other parts of your IoT setup, this could be a simple option.

Partially re-design on existing devices

Switching the 2G/3G cellular module might be an option when replacing the whole device would be too costly. This can be quite complex but is an alternative for more advanced connected devices, like vehicles, machines and fixed installations, where only the connectivity module needs to be replaced.

Finding a new device or building your own

Companies that are not able to update or upgrade, may have to look for a completely new device or

even build their own. There is a wide range of off-the-shelf devices and communication modules that fit different use cases.

Test your device properly before large-scale deployment

Before making a final decision on new devices, we recommend conducting real-world deployment tests. Actual connectivity conditions can be far more complex than lab tests can simulate. Run test deployments of the new devices in locations with similar conditions and places that have been challenging in the past.

Changes to the device, like changing radio technology or cellular module, might affect the device software or the application logic. How the device selects, prioritizes and attaches to the network. This also involves fallback on 2G and 3G.

It is also important to take into account regulatory framework as for example the the Radio Equipment Directive (RED).

To find out if the device is affected by the 2G/3G closure and identify possible update or replacement options, we recommend contacting your hardware manufacturer.

SIM cards can be specific to 2G/3G and may also need to be replaced.

For the device to work on a network it is important to consider the network requirements. Radio frequencies and parameter settings will differ between networks and operators. Optional parameter settings, like power saving features, can be used to optimize connectivity for specific use cases.

If you need connectivity to run your test, we offer several IoT connectivity starter kits.

Software/firmware updates over-the-air (SOTA/FOTA) will simplify remote device management but require both a device and connectivity capable of the mechanism.

3. Identify

IoT Software and Solutions

A software solution interacting with the 2G/3G devices might also be impacted. To keep everything running you also need to explore what consequences the retirement of the old networks might have for your software solution.

Updating parts of the existing solutions

It may be possible to keep an existing solution running by switching specific components. Connectivity management and device management solutions are particularly vulnerable to switching devices. Updating these parts of the IoT solution with modern components may allow it to keep working together with the new devices.

Find a new standard solution
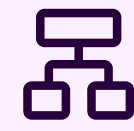
Standard solutions for common IoT use cases can be an alternative. With standard solutions the supplier operates and updates the solution, lowering the costs involved since it is shared between customers.

Building a custom solution

IoT solutions that cater to specific needs, might require developing a custom software solution. One advantage is that the solutions can be tailored and used for differentiation or competitive edge. Custom solutions are however costly to build and maintain.

At the heart of any IoT solution is an IoT platform and custom solutions are often built on top of one. IoT platforms provide ready to use components that can be combined in different ways to create custom software solutions with greater efficiency. Being able to use existing components and avoid replicating functionality will save both developing time and cost.

Common components of an IoT software solution

APIs & Integrations
Enables data and information from IoT solution to be integrated with other business systems.

Support functions
Other software solutions, like billing or other functions needed for running your IoT business.

User interface
Allows the user to interact with the solution to achieve the intended purpose and to visualize data.

Management interface
The interface that enables the solution, devices and connectivity for operational purposes.

Rules engine & analytics
Enables analysis of data and allows for setting data driven rules to create automatic responses.

Data storage
The database that the solution collects and stores the data sent from the IoT devices, for processing by other software functions.

Device management
Ensures that the devices are working properly and provides information about the device, software versions, battery level and so on.

Connectivity management
Enables to remotebly monitor, control and manage the connectivity/SIM cards.

Make your IoT Solution easy to live with

Finding the right connectivity, device and software are core parts of building a great future proof IoT solution. But there are a few additional areas that are worth considering. Especially if you want your IoT solution to grow and evolve over time.

Security is business critical

Security is vital within IoT and might easily be forgotten when wanting fast deployment. This can be very costly and have negative effects on the company brand and business. IoT security is a multi-faceted issue, where the weakest link can break the whole chain - the device itself, device firmware/software, the network, or any software solution that devices report their data to.

Installation and maintenance should be easy

Spending 15 minutes per installation versus five can make a great difference. A starting point for time-efficient deployment is reliable coverage. Minimizing the need for device configuration saves time and simplifies device logistics.

The more seldom you need to check on the devices manually, the more cost-efficient the solution will be to manage. Enabling remote management of tasks like security and performance upgrades through SOTA/FOTA will simplify the maintenance throughout the device life cycle.

For battery powered devices, the right choice of connectivity, combined with device energy optimization will help ensure long and consistent battery life.

Scalability

It's easy to connect one device, but as the number of devices grows, network congestion and other issues can prevent growth. Scalability and flexibility should always be considered. Modern, cloud native solutions were designed for scalability and if the solution will handle personal or sensitive data, the data storage solution needs to flexible enough to comply with the growing regulations.

Expanding to new markets can also create scaling issues. Coverage and connectivity technology can either prevent or enable quick expansion. Cellular technologies, both devices and networks, follow a global set of standards, making it easier to bring your solution across borders.

Security comes in several layers

- Tamper protection and hardware-based security prevents devices from having their software/firmware manipulated into providing system access.

- Software/firmware upgrades over the air (SOTA/FOTA) allow for remote upgrading of devices but requires connectivity capable of transferring update files to devices.

- Cellular networks operate on dedicated licensed spectrum, use hardware-based authentication through SIM-cards and encryption of all data traffic, which provides a great base level of security.

- For sensitive use cases, cellular networks can also offer additional layers of security, like Virtual Private Network (VPN) and private Access Point Names (APN).

Simplifying installation with LPWA

Danish customer Ratél used GSM technology to connect their rat traps underground, but 25% of their traps couldn't communicate due to poor penetration, making installation difficult.

With LPWA IoT Connectivity from Telia, Ratél can now reach deep underground with excellent signal, simplifying implementation, and with a 100% success rate.

Telia's harmonized network settings for LPWA enables the same device configuration to be used across the whole Nordics and Baltics.

Time to take the next step

We are moving into the world of 5G. That means new opportunities and new innovations that will make people's daily lives more convenient. It also means companies will have to change the way they do business and societies will have to increase their sustainability.

The time has come to modernize and make room for newer and more energy efficient networks. 2G and 3G networks are coming to an end. IoT solutions need to be upgraded for the 5G era. And the natural step towards a 5G-ready connectivity replacement is cellular Low Power Wide Area (LPWA).

Companies and organizations are already today using 5G standardized LPWA connectivity for IoT in hard-to-reach places, turning traditional products into as-a-service offerings, streamlining operations by reducing the need for site visits and optimizing the use of their assets.

In a few years we will see companies that have transformed and digitalized their business using IoT. They have had to learn to understand their customers better, improve their support and create new offerings – all while becoming more efficient and more sustainable. In the future we may not even be talking about IoT anymore. It will just be the way our modern world works.

The closest replacement for many of the IoT solutions that rely on 2G/3G today is cellular LPWA connectivity. LTE-M a more natural successor for many of the use cases. Both NB-IoT and LTE-M are available and part of the 5G family.