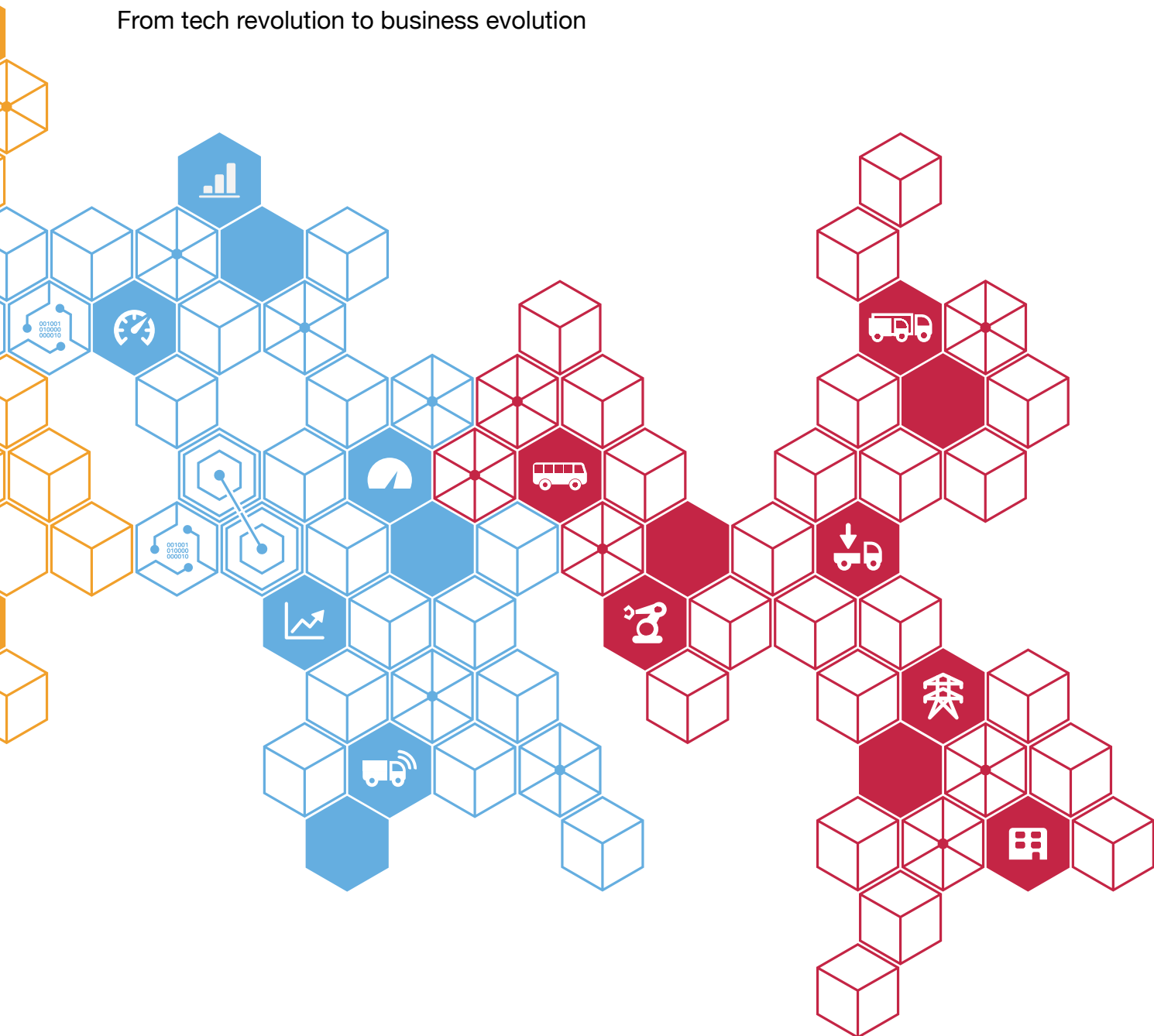# CONNECTED THINGS

From tech revolution to business evolution

Northstream™

Telia

Preface

In the 5 years we've been publishing the Connected Things report, we've seen perceptions about IoT changing from a tech revolution to a business evolution. That's where we are today – and it's a great place to be. Our customers are talking about real-world business cases rather than proof-of-concept. IoT discussions are moving off presentation slides and onto spreadsheets. And IoT decisions are moving from the tech lab to the boardroom as more and more companies realise the true value of IoT.

We believe the insights in this report paint a clear picture of the state of IoT in the Nordics and Baltics as well as some of the new possibilities that are emerging. We hope you enjoy the report and look forward to discussing these possibilities with you sometime soon.

Björn Hansen
Head of IoT, Telia Company

Bengt Nordström
CEO Northstream

Executive Summary

In the 5th edition of the Connected Things report, we see that IoT is getting down to business. Device and connectivity technologies have matured, but more importantly, so have the expectations of enterprises.

With this year's report we have undertaken primary research, reaching out to 750 companies across the region, in order to share deeper insights into the progress of IoT implementation across the regions.

Technical barriers continue to fall, enabling companies to focus on the needs that IoT can fulfill. We present a **needs-based segmentation** that identifies the different pace of adoption based on IoT implementation focus.

Growth is healthy, with 39% of Nordic and Baltic companies surveyed having implemented or considering implementing IoT.

The primary drivers identified are **lowering operational costs** and **enhanced customer experience**. In a good sign, these were also at the top of the list of tangible benefits being gained.

This adoption rate is still the highest in Europe. However, it falls short of the hype and expectation observed in the first Connected Things report 5 years ago. The main implementation challenges identified are: **lack of technology maturity, complexities in deploying the technology** and **lack of competence**.

The IoT ecosystem remains fragmented, with companies needing to navigate through various solution providers for each part of the IoT solution value chain. We look at the different partner and ecosystem models. We also take a look ahead to understand how complementary technologies such as AI and Blockchain will help **IoT fulfil its potential**.
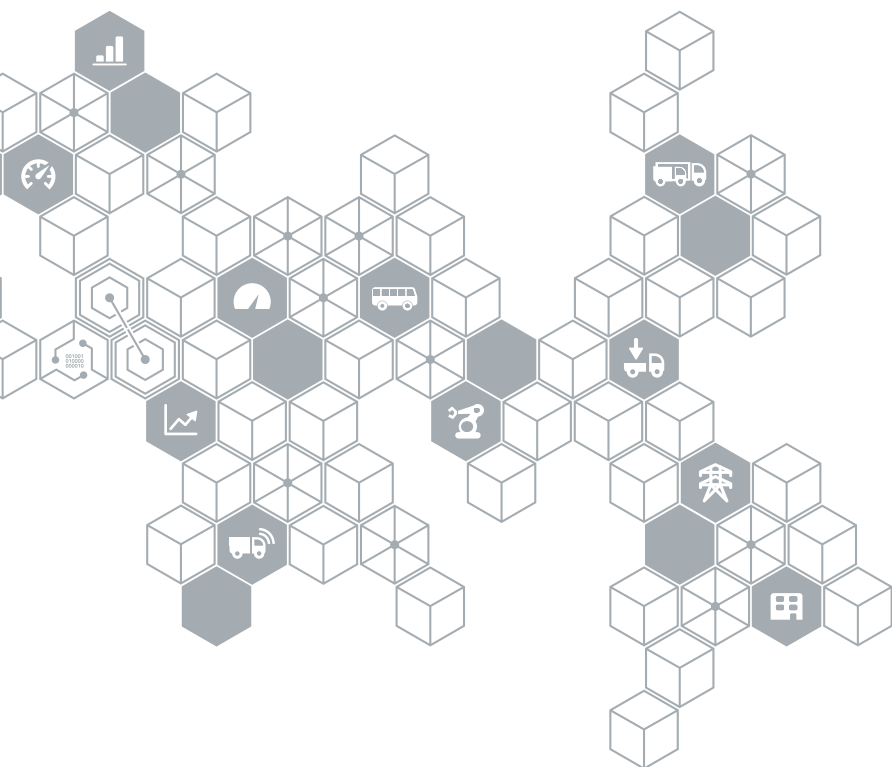
The analyst view is based on the result of a Telia Company survey of 299 respondents (from a total sample of 750) that have implemented or are considering implementing IoT solutions in their processes, services or products. These respondents represent different company sizes (micro, small, medium and large) in various industries across the Nordics and Baltics. The survey was conducted in April-May 2018 and has assessed the experiences of the companies that have adopted IoT, in order to identify the benefits, drivers and challenges they have faced, as well as the barriers they have encountered in the adoption of IoT.
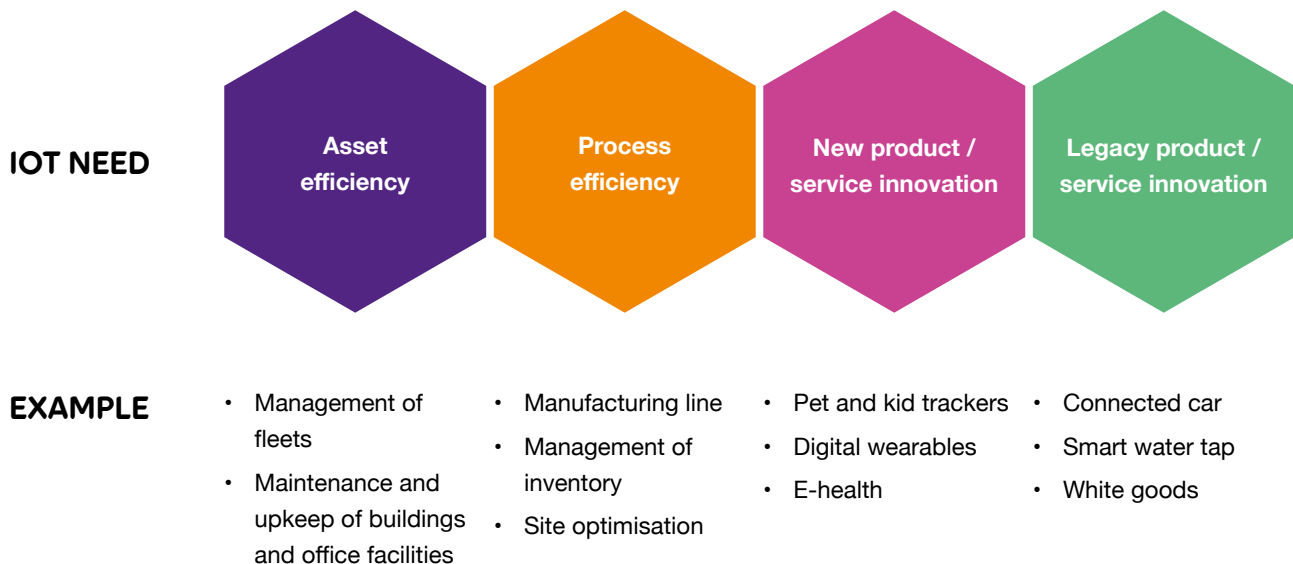
IOT IS GETTING DOWN TO BUSINESS
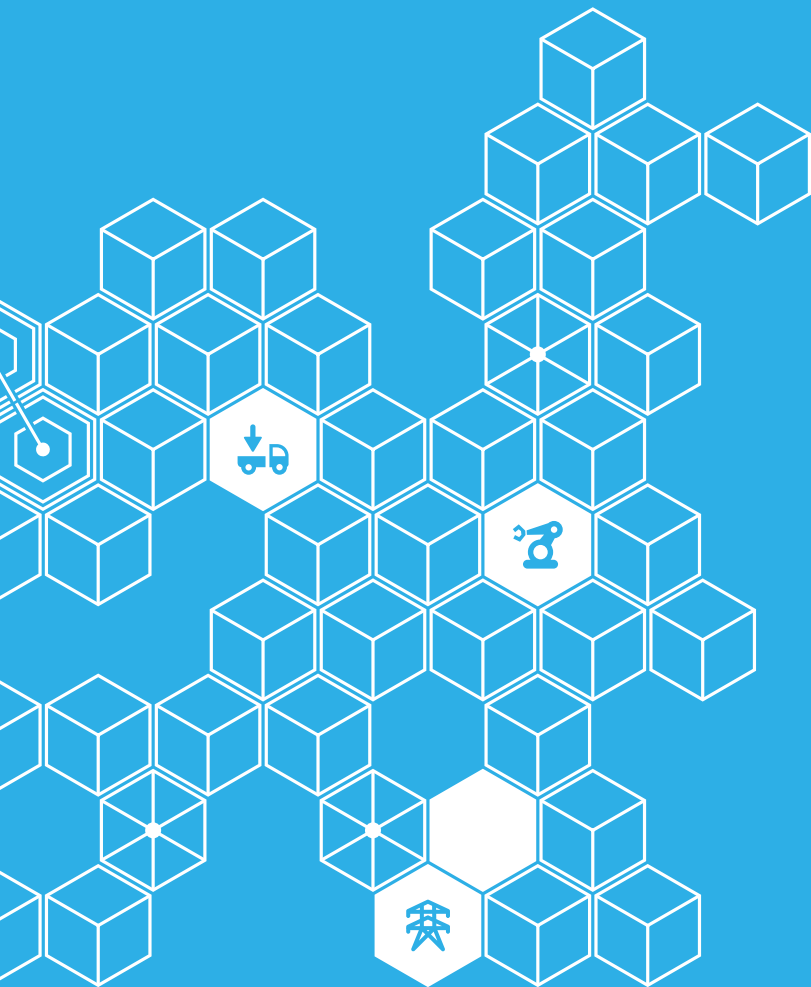
IoT continues to grow at a healthy rate in the Nordics and Baltics. In the 5 years since the first Connected Things report was published, it has grown at 15% per year. This growth is projected to continue over the next 5 years. In total, 39% of companies surveyed have implemented IoT in their businesses.

However, both achieved and projected growth figures fall short of the expectations we saw 5 years ago. We believe this hype was largely driven by an unrealistic understanding of the needs IoT can fulfill, and a failure to appreciate the implementation complexities. In 2018, We are seeing a much clearer understanding of both.

A CLEARER SEGMENTATION OF NEEDS

In the early hype of IoT, consumer applications such as weather-predicting-toasters and fridges that could tweet added to confusion about where the true value of IoT would come from. Now however, as the hype cloud begins to clear, we see a clearer understanding of the needs that IoT can fulfill and the value it delivers. In the development and support of IoT solutions over recent years, we have seen four broad categories of needs emerge that can be addressed by IoT:

The Internet of things (IoT) is a network of physical 'things' that are connected to the Internet to enable data to be collected and analysed. These 'things' can be electronic devices that have sensors built in or they can be physical objects, such as buildings, cars or pets that have sensors attached. The collected data can be analysed to generate business insights or processed in real-time to provide inputs for systems such as traffic guidance.

IOT NEED

| Asset efficiency | Process efficiency | New product / service innovation | Legacy product / service innovation |

EXAMPLE

- Management of fleets
- Maintenance and upkeep of buildings and office facilities

- Manufacturing line
- Management of inventory
- Site optimisation

- Pet and kid trackers
- Digital wearables
- E-health

- Connected car
- Smart water tap
- White goods

ASSET EFFICIENCY

From office equipment and trade tools to company cars and wheelchairs; tracking sensors make it possible to know where your assets are and if they're being used. On top of this, anything from indoor air quality to office energy consumption can be monitored. This gives enterprises insight into how their assets are being used and how to increase their availability and reliability.

At the same time, it makes it possible to reduce operating costs such as energy expenditure, insurance and maintenance costs.

A good example of this segment in the Nordic and Baltic countries is the Connected Buildings industry. This industry is today the biggest IoT vertical in the region in terms of revenue and is expected to remain so until 2022[1].

[1] Throughout the report, the number of connected things and revenues for the Nordics and Baltics per Connected Group, are based on Machina Research data, unless otherwise stated.

PROCESS EFFICIENCY

For enterprises with production sites – such as manufacturing, warehousing, construction, mining – IoT solutions can deliver the information and insights to optimize processes and workflows. This can lead to increased productivity and efficiency at the same time as reducing downtime.

In this segment, the fastest gains are achieved by focusing on those elements that are under the enterprise's control and which drive the greatest cost or inefficiency. In some environments, productive hours are regularly lost searching for misplaced tools, and equipment that is performing poorly can eat up excess fuel, or conversely, can be taken offline for scheduled maintenance that is not related to actual usage.

NEW PRODUCT INNOVATION

"Digital Native" products that are designed with connectivity at the heart can avoid the legacy issues and resistance to change that established companies often face when transforming physical-only products to product-and-digital-service offerings with a different business model. As a result of the introduction of Digital Native products, many times whole industries are disrupted by the new entrants that leapfrog the established companies in product innovation. This often forces established companies to make acquisitions in order to stay relevant. The Apple Watch is a good example of such a product, which has also disrupted the "everyday" segment of watches on the one hand, and the "somehow older" fitness trackers such as Fitbit, on the other hand. In the long run, the market leaders that emerge are typically not the first movers, but the fast followers that can understand the market and improve the product and business model to best match market needs.

Growing ecosystems around global network standards have lowered the cost and technology availability barriers considerably, and if development in South Korea is mirrored in the Nordics, we can expect an explosion of consumer devices such as child and pet trackers and more.

IOT MARKET SIZE IN THE NORDICS & BALTICS*

(in Billion EUR)

CAGR
14.6%
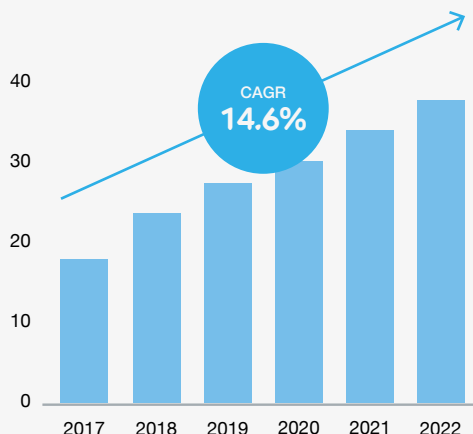
The IoT market in the Nordics and Baltics reached 19.1 billion euro in 2017. This growth is anticipated to continue, reaching approximately 37.7 billion euro by 2022.

* The total revenue in each year corresponds to four main elements; all income from the sales of IoT devices (e.g. modules), revenues from related services to the devices (e.g. installation, connectivity, etc.), revenues from IoT enabling services, and revenues from data monetization.

SMART LETTERBOXES IN FINLAND

Posti, a Finnish postal and logistics company, has adopted an overall digitalization strategy with the aim of improving their services. As a part of this strategy, Posti is collaborating with Telia to implement an IoT solution to monitor letterboxes - utilizing Telia's NB-IoT network. These smart letterboxes can provide real-time data and report when they should be emptied. As a part of the bigger solution, the IoT data gathered from the letterboxes will then be merged into Posti's reporting system to be used for other purposes as well. With this solution in place, Posti is aiming to connect all of its 5,000 letterboxes, in order to achieve cost reductions and an increased operational efficiency through time savings and logistical benefits.

LEGACY PRODUCT INNOVATION

Legacy companies have advantages and challenges. While they generally have existing user bases and brands to leverage, they need to transform their organizations from product companies to product- and digital-service companies. This means:

- New business models, such as Subscription based, rather than purely upfront payments, and hosted offerings
- Working with partners, often for the first time
- Impact on sales channels with competence and compensation implications
- New routines for onboarding customers, handling lifecycle management, software upgrades and support

When business models and routines change, so do key performance indicators and incentives across the business, with impacts on systems and people. This creates change-management challenges and the need for tight collaboration and coordination across the enterprise from product to operations, marketing, sales, IT, finance and HR.

Moving to subscription-and-services business can bring a richer customer intimacy. This can deliver to recurring revenues and upsell opportunities and enable product companies to bypass reseller channels and go directly to their customers.

Remote monitoring of product performance allows issues to be identified and product recalls to be reduced. It also reveals insights into user behavior that support continuous product development. Even if it is challenging and new, legacy product innovators have a lot to gain if they can make the transition.

The Connected Automotive industry is a good example in this segment. For instance, in recent years, many car manufacturers have started offering direct after sales services to the car owners, enabled by making the cars connected. The impact of such IoT advancements can be directly observed in the Nordics and Baltics Automotive sector where Volvo cars for example teamed with Mathem to enable food deliveries to the trunk, and innovated remote activation of car heating which is an extremely popular feature in winter months. – it is estimated that the Connected Car industry will reach 6.8 billion EUR by 2022, which amounts to revenue growth of 225%.

For established companies to drive change and transform legacy products and business models, it is usually a good strategy to start small and form a dedicated cross-functional team or unit that can lead the effort and test the updated product and business model with selected customers. Such a dedicated team with own budget can run and iterate faster, and a successful pilot makes it easier to get the green light and scale the model successfully to the rest of the product lines and organization.

EVOLVING NEEDS

The survey shows that enterprises' expectations of their technology vendors have evolved over the years. Companies now look for inspiration not only in their immediate field but also across industries and expect their technology vendors to deliver solutions that are vertical-specific, while utilizing global innovation and best practices.

IMPLEMENTATION WILL BE A 4 SPEED RACE

With this needs-based segmentation as a starting point, and looking at the gains and adoption barriers, we see four distinct levels of implementation complexity. This provides an indication of the pace at which each category of need fulfillment is likely to progress.

Of course, nothing's ever black or white, and companies will often be addressing more than one of these needs at a given time. For instance, a car manufacturer may simultaneously be working to increase the efficiency of its production line, while implementing new innovations and services in its cars.

IOT ADOPTION, A 4-SPEED RACE

L Low   M Medium   H High   - Not applicable

IOT NEED	Asset efficiency	Process efficiency	New product / service innovation (Digital Native products)	Legacy product / service innovation
EXAMPLE	• Management of fleet • Maintenance and upkeep of buildings and office facilities	• Manufacturing line • Management of inventory • Site optimisation	• Pet and kid trackers • Digital wearables • E-health	• Connected car • Smart water tap • White goods
MAJOR GAINS				
Cost reduction	M H	M H	-	L M
Utilization improvement	M H	H	-	M
Supply chain optimization	L	H	-	M H
Revenue generation (New & recurring)	L	L	H	M
Competitive advantage	L	M H	H	H
IOT ADOPTION BARRIERS				
Business Case	L	L M	M	H
Integration with existing systems	L	M	-	H
User training	M	M	L M	H
Market making	-	-	H	M H
Business model change	L	L	-	H
Organizational change	L	M	L	H

IMPLEMENTATION COMPLEXITY — LOW ➝ HIGH
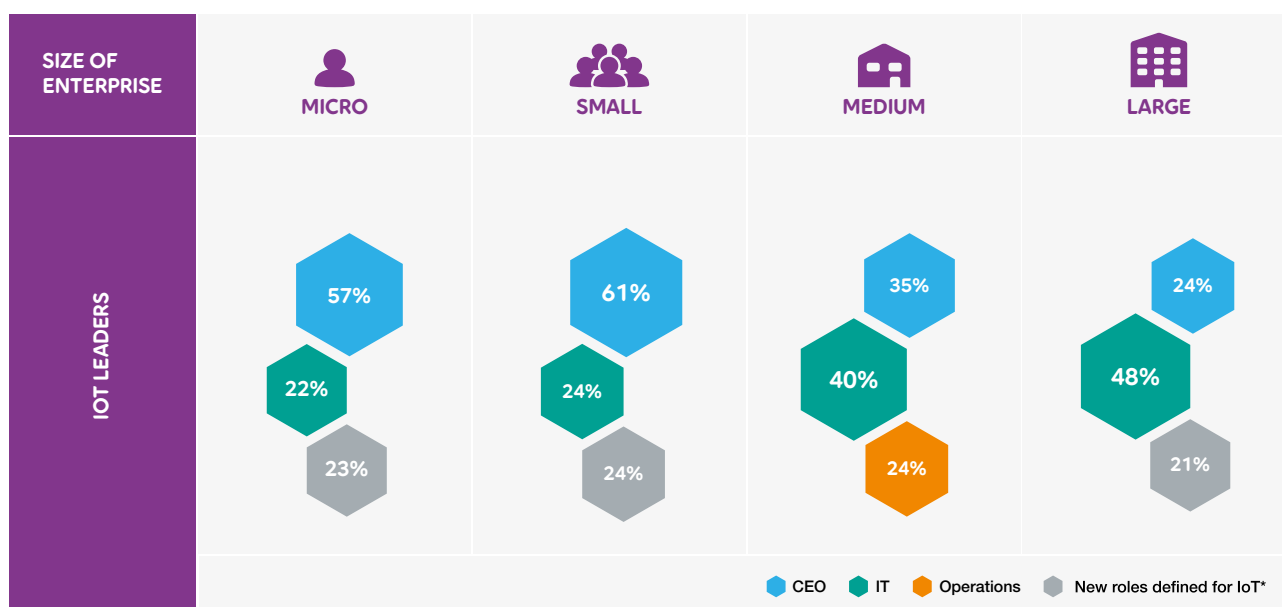
IOT IS NOTHING WITHOUT STRATEGY

In order for any company to address its IoT needs, it is important to have the right IoT strategy in place. The survey shows that among companies that have not yet adopted IoT but understand the value of addressing their needs with IoT, 42% do not know where to begin and do not have any IoT strategy. This indicates a high demand for increasing the knowledge and competence on IoT in order to develop the right strategy to begin adopting IoT.

But how should the IoT strategy be developed? Among IoT adopters, 40% of the companies consider IoT as the primary enabler of their digital transformation journey, which itself has become a focus in most enterprises' business strategy in recent years. This shows that IoT today has gained a high priority on many corporate agendas and has expanded its reach beyond merely connecting products to now being considered a tool for enabling company and industry Digitalization.

Since the digitalization journey typically entails complex transformation processes and requires significant investments and strategic decision-making, it requires active involvement from senior executives. Since IoT initiatives are driven cross-functionally between IT, Product and other departments, in large enterprises, often it is a member of the leadership team or even the CEO who is ultimately sponsoring IoT adoption. In micro and small businesses, 60% report having the CEOs driving the IoT strategies. This signals the importance companies place on IoT.

When it comes to implementation, in medium and large companies it is the IT department in 40% of cases that is in charge.

WHO LEADS IOT IN DIFFERENT TYPES OF COMPANIES

SIZE OF ENTERPRISE	MICRO	SMALL	MEDIUM	LARGE
IOT LEADERS	57% / 22% / 23%	61% / 24% / 24%	35% / 40% / 24%	24% / 48% / 21%

CEO   IT   Operations   New roles defined for IoT*

* Based on the extent of functions that get involved in the process of IoT adoption in the enterprise, some companies assign new roles to take charge for implementing IoT solutions.

CASE STUDY #1

EcoFleet is a leading fleet management provider in Denmark that offers a wide range of GPS-based fleet and team management solutions to help customers reduce costs and increase revenue. In order to collect real-time emission data, EcoFleet uses the Telia Sense platform to allow them to compile emission information and event reports for their customers. This solution is a good example of how Descriptive Analytics are being used by IoT adopters in order to increase the efficiency of existing processes.

As an example of implementing IoT to increase asset efficiency, EcoFleet also helps its customers to keep track of vehicle maintenance procedures, inform customers if specific procedures need to be done and manage the maintenance process systematically. Based on the collected data from the vehicles, EcoFleet also offers its customers a route optimization and booking solution that helps enterprises with large number of vehicles to optimize usage per vehicle. In the latter feature, the user only needs to enter their needs and the solution system will choose a vehicle accordingly.
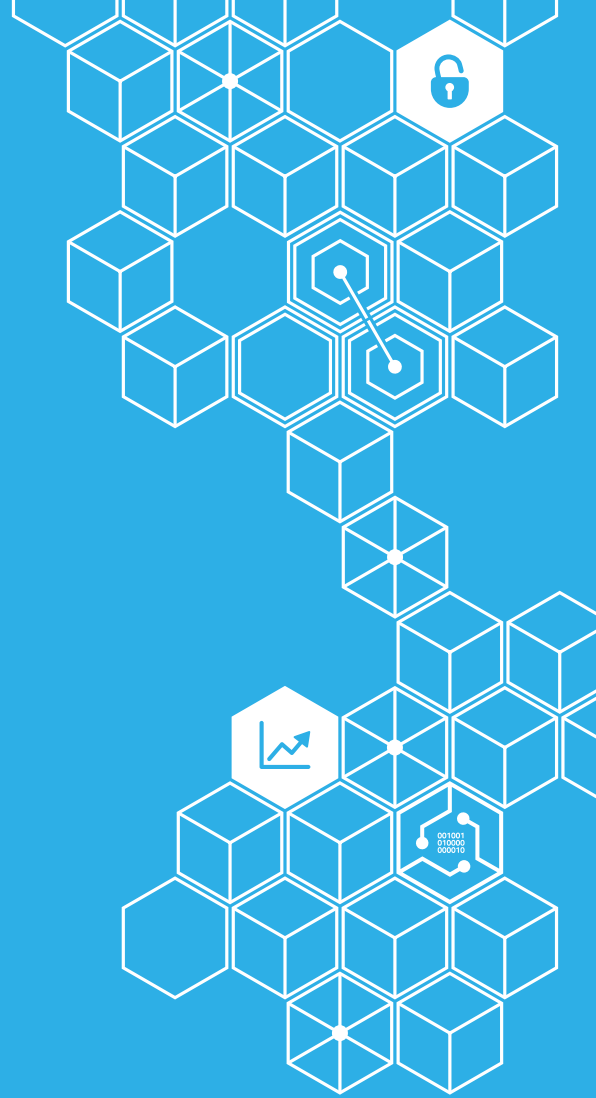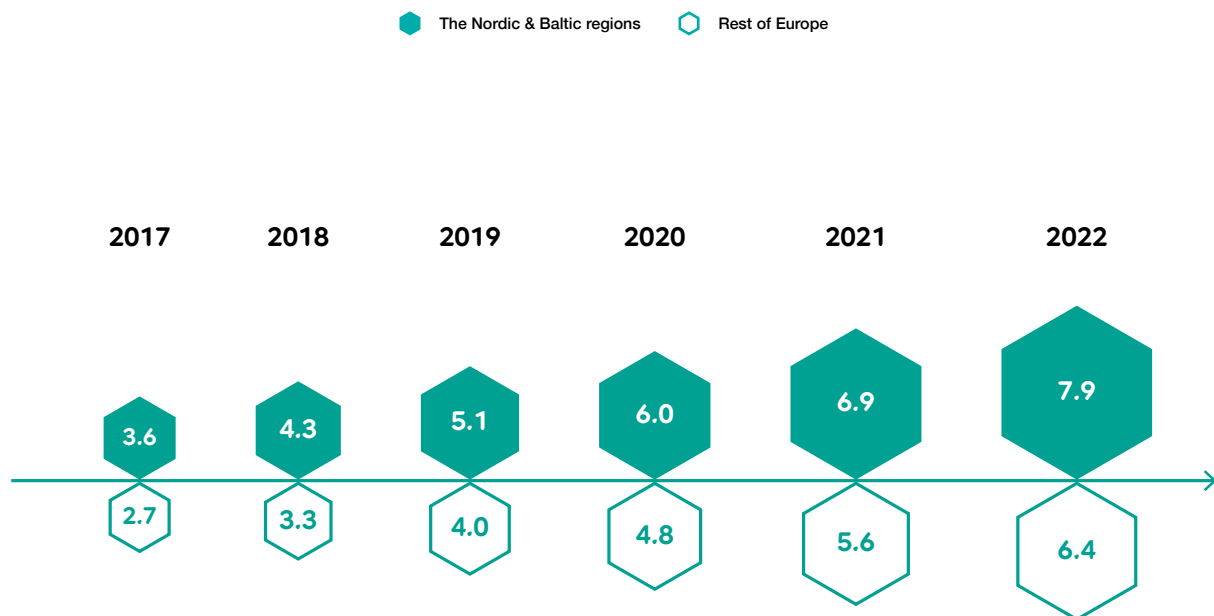
NORDICS AND BALTICS STILL IOT LEADERS IN EUROPE
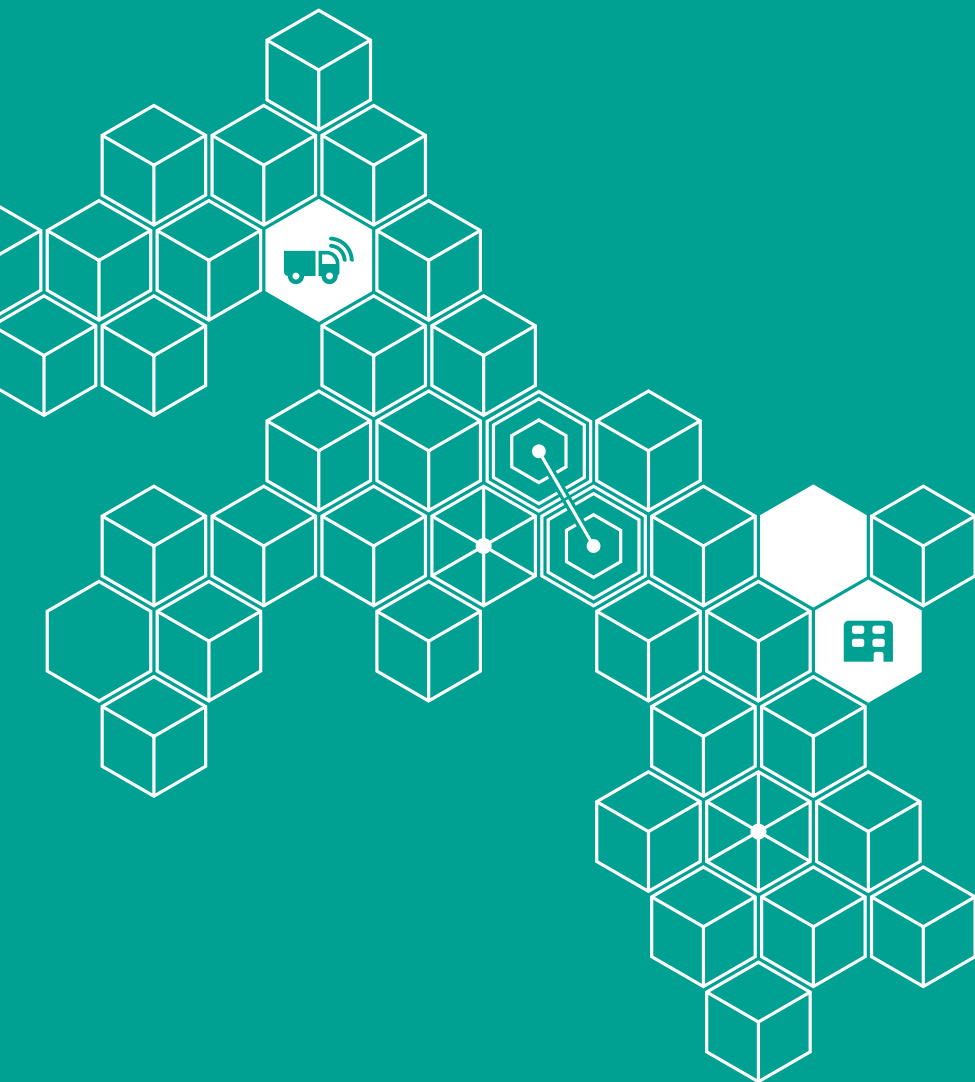
The Nordic and Baltic countries continue to be global showcases for IoT with up to eight connected things per person expected by 2022. This is 45% higher than the rest of Europe and four times as many as in the rest of the world. The highest CAGR between 2017-2022 in the region is expected in the Baltic countries – around 20%.

The higher level of IoT adoption in this region is mainly considered to be the result of having a technology-oriented mindset among enterprises. Many companies in this region have realized the potential that new technologies such as IoT can bring to their organizations and are experiencing considerable positive impact from implemented solutions. This is exhibited by the fact that 39% IoT companies across various industries are implenting or looking to implent IoT. IoT in the Nordics and Baltics is improving products, changing business models (e.g. from product to product-as-a-service), transforming customer interaction, processes and supply chains.

NUMBER OF IOT CONNECTIONS PER CAPITA

■ The Nordic & Baltic regions ⬡ Rest of Europe

2017	2018	2019	2020	2021	2022
3.6	4.3	5.1	6.0	6.9	7.9
2.7	3.3	4.0	4.8	5.6	6.4

GOVERNMENTS FOSTERING IOT INNOVATION

In Estonia, the government is building 'Business X-road', a secure software infrastructure to provide IoT data exchange between small and medium enterprises. This government-led initiative aims to reduce barriers to industry participation, such as lack of information or knowledge and lack of adequate infrastructure. The country has also launched the first smart marina of Northern Europe in Tallin, and smart city initiatives are quickly becoming a priority in urban development.

INDUSTRY-SPECIFIC NEEDS

Differences between industries mean some addressable needs will be more relevant than others. This is likely to affect the rate of IoT adoption in different industries.

Since the 4 aforementioned categories of IoT needs are not uniformly present in all industries, the rate of IoT adoption can vary across these industries. The current rates show that among the 4 categories, at the moment, IoT is more being used to address Asset efficiency and innovation needs.

CONNECTED AUTOMOTIVE
E.g. fleet management

CONNECTED CONSUMER ELECTRONICS
E.g. smart watches

CONNECTED INDUSTRY
E.g. process automation

CONNECTED UTILITIES
E.g. smart metering

CONNECTED CITIES
E.g. intelligent public transport system

CONNECTED HEALTH
E.g. remote patient monitoring

CONNECTED BUILDINGS
E.g. smart offices, commercial premises and connected homes

MAIN INDUSTRIES DEVELOPING IOT SOLUTIONS IN THE NORDICS AND BALTICS
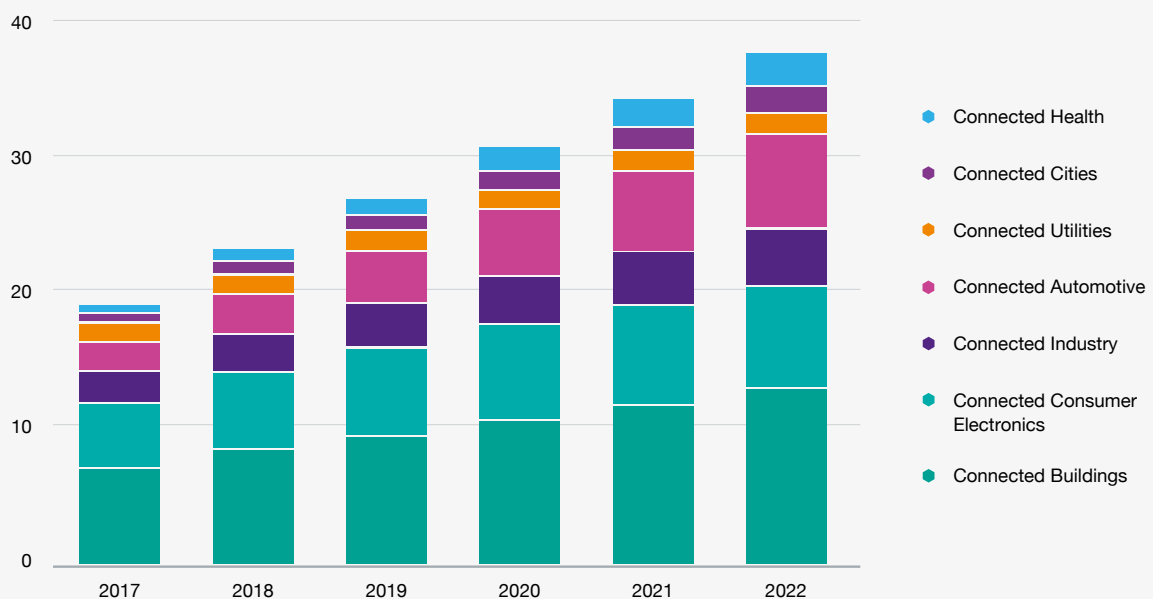
(Source: Machina Research data)

CONNECTED BUILDINGS LEADING GROWTH – BUT FAST MOVERS ON THE HORIZON

Due to different complexity barriers and speed-to-value, different industries adopt IoT at different rates. This can be observed in the projections of IoT market size by the end of 2022 in the region.

IoT devices have advanced considerably during recent years. For example, battery life has increased dramatically, sensors and modules have become smaller and devices are now more intelligent. As a result, enabled by **advancing connectivity solutions, advancements in sensor technology**, as well as **falling unit prices**, IoT modules can now be placed on almost anything.

IOT MARKET SIZE IN THE NORDICS AND BALTICS

in Bn EUR

Legend:
- Connected Health
- Connected Cities
- Connected Utilities
- Connected Automotive
- Connected Industry
- Connected Consumer Electronics
- Connected Buildings

In terms of market size, Connected Buildings is today the biggest IoT vertical in terms of revenue and is expected to remain the case until 2022 with a projected growth rate of 83%.

In terms of growth rate, Connected Health is predicted to lead the way with projected revenue growth of 289% by 2022. This is followed by Connected Automotive sector at 225% and Connected Cities with an estimated 140%
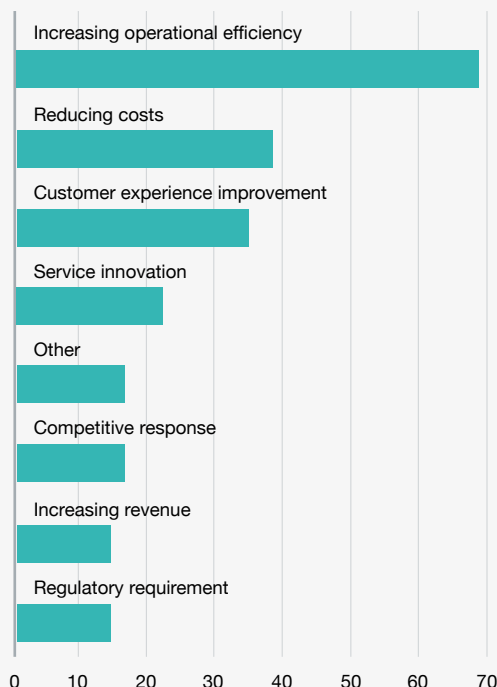
EXPECTATIONS MATCH BENEFITS – BUT NOT WITHOUT CHALLENGES

The drivers for adopting IoT vary across different markets and industries, but the one that clearly stands out is **increasing operational efficiency** at 69%. The next two are **lowering costs** at 39% and **enhancing customer experience** at 35%.

These drivers are aligned with the benefits being seen. Although adoption of IoT is still in an early stage for many companies, most early-adopters are already realizing benefits. **Cost reduction** is the highest with 32% while 27% experienced improved **customer satisfaction**. This indicates that the benefits are delivering on expectation.
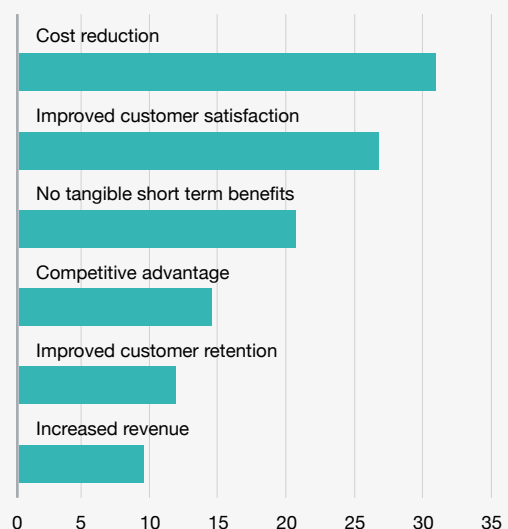
DRIVERS TO ADOPT IOT

% of respondents

Driver	Value
Increasing operational efficiency	~69
Reducing costs	~39
Customer experience improvement	~35
Service innovation	~22
Other	~17
Competitive response	~17
Increasing revenue	~15
Regulatory requirement	~15

MEASURED BENEFITS EXPERIENCED FROM IOT SOLUTIONS

% of respondents

Benefit	Value
Cost reduction	~31
Improved customer satisfaction	~27
No tangible short term benefits	~21
Competitive advantage	~15
Improved customer retention	~12
Increased revenue	~10

In the **retail industry**, enterprises are streamlining inventory and supply chain management with the aid of IoT. Moreover, IoT adoption has helped them better meet consumer expectation (e.g. by predicting consumer needs).
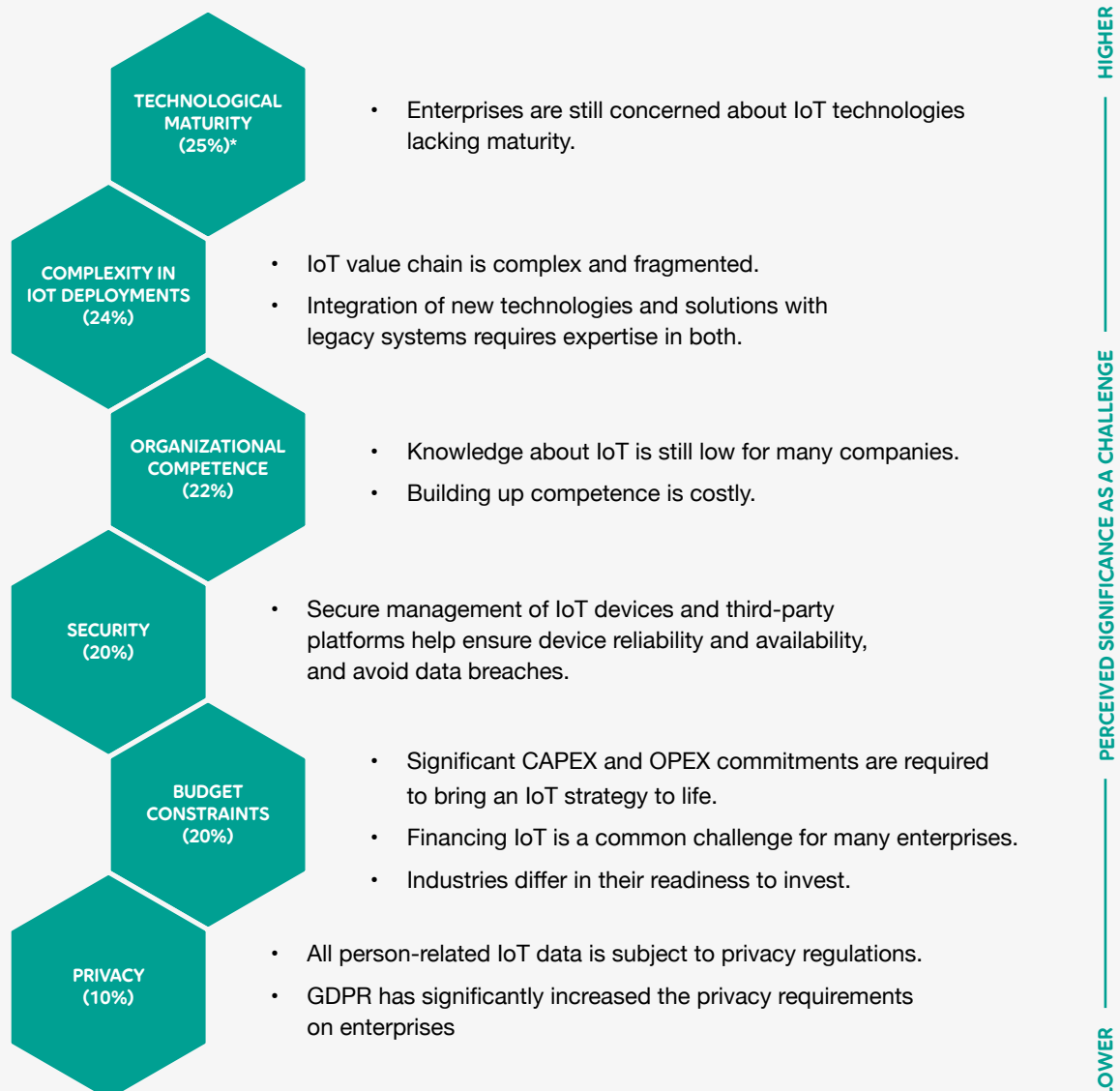
Smart garment tags with location tracking are enabling retailers to track item movement within stores; understanding what is picked up, tried on but not checked out, and further, being able to locate requested items that might be in storerooms or misplaced to improve sell-through and avoid unnecessary inter-store transfers. Further analytics help retailers understand the movement of customers within the store, and to and from the store to refine store layout, opening hours and promotion strategies. Innovation with smart connected mirrors, smart labels and augmented reality applications are enriching the shopping experience for customers that seek further information and visualization in interactive formats.

CHALLENGES EXPERIENCED BY ENTERPRISES IN THEIR IOT IMPLEMENTATIONS

As can be expected with any new technology, companies face a number of challenges in implementing their IoT initiatives.

CHALLENGES FOR IOT IMPLEMENTATION AS EXPERIENCED BY SURVEY RESPONDENTS

TECHNOLOGICAL MATURITY (25%)*

- Enterprises are still concerned about IoT technologies lacking maturity.

COMPLEXITY IN IOT DEPLOYMENTS (24%)

- IoT value chain is complex and fragmented.
- Integration of new technologies and solutions with legacy systems requires expertise in both.

ORGANIZATIONAL COMPETENCE (22%)

- Knowledge about IoT is still low for many companies.
- Building up competence is costly.

SECURITY (20%)

- Secure management of IoT devices and third-party platforms help ensure device reliability and availability, and avoid data breaches.

BUDGET CONSTRAINTS (20%)

- Significant CAPEX and OPEX commitments are required to bring an IoT strategy to life.
- Financing IoT is a common challenge for many enterprises.
- Industries differ in their readiness to invest.

PRIVACY (10%)

- All person-related IoT data is subject to privacy regulations.
- GDPR has significantly increased the privacy requirements on enterprises

HIGHER

PERCEIVED SIGNIFICANCE AS A CHALLENGE

LOWER

* The percentage of survey respondents that nominated each item as a major challenge while adopting IoT

TECHNOLOGICAL MATURITY

While IoT devices, connectivity technologies and enabling platforms have evolved tremendously, many enterprises still experience them to lack sufficient maturity. This perception we attribute largely to the current fragmentation in the IoT ecosystem with multiple value chain components and suppliers creating a layer of complexity. However, we believe that is more a matter of ecosystem maturity than technology maturity. In addition, the lack of sufficient IoT knowledge and understanding of existing technologies and capabilities within the enterprises can contribute to the perception that technologies are still immature.

COMPLEXITY IN IOT DEPLOYMENTS

Much of the complexity around IoT implementations comes from needing to integrate new solutions with legacy systems and hardware. For example, in the manufacturing industry, to install IoT enabled sensors on a legacy production-line requires understanding of existing systems (which may be years or even decades old) and their mechanisms in order to assess compatibility and integrate the new solution.

ORGANIZATIONAL COMPETENCE

The more IoT matures and moves from being a possibility to a necessity, the more crucial it becomes for enterprises to understand the ecosystem and their own role in it. It is important that management has this strategic understanding in order to establish a clear IoT vision and objectives for the organization. Awareness and knowledge levels about IoT in most companies are quite low. Building such an organizational competence in IoT is quite complex, time-consuming and expensive. It requires the establishment of clear objectives, a detailed plan, the necessary knowledge, efficient communication structures and co-operation across the organization. For most enterprises, digitalization and IoT are still completely new topics. Hence, internal education needs to continue alongside the digitalization journey in order to solidify the required in-house competence.

CHANGE MANAGEMENT - A KEY TO MANAGE IOT COMPLEXITY

IoT impacts enterprises in many different ways, including organizational structure, ways of working, etc. Comprehensive and effective change management structures and processes that accommodate and accompany the digital transformation are one of the key factors to success. Main challenges in this regard include overcoming old ways of thinking and working, defining new roles and organizational setups and finding representative KPIs to measure progress.

SECURITY

Among IoT adopters, it is important to establish authorization and authentication processes and manage security updates (poorly managed or non-upgradeable devices can expose customer data and become targets for malicious attacks). Subsequently, secure communication needs to be established, which entails the secure management of cloud servers and application platforms. Security concerns relate also to other aspects, such as the reliability and availability of IoT platforms in cases of connectivity or power outages that may cause loss of revenue, service interuptions and damage to equipment.

PRIVACY

IoT devices generate large amounts of data across different solutions. As part of these solutions, data is being gathered and stored on the systems of solution providers. This data can be solely machine- but also person- related. When it comes to the data that is related to individuals (e.g. personal data), privacy concerns have brought legal and regulatory challenges for enterprises. This has become of particular concern in Europe where the General Data Protection Regulation (GDPR) came into force in May 2018.

BUDGET CONSTRAINTS

IoT deployments typically require certain upfront investments and continuously dedicated operating costs. Many enterprises face budget constraints for radical business development, which makes it challenging to invest in new technologies. As a result, the majority of enterprises (around 70%) invest in the range of 1% to 4% of their CAPEX in IoT solutions. However, the investments differ across industries. For instance, more than 30% of the enterprises in the Manufacturing and Connected Buildings sectors typically invest higher than 5% of their CAPEX in IoT. IoT solutions are more heavily implemented in these industries since the substantial improvements in operations that can be achieved due to predictive maintenance and increased uptime present a strong business case and reduce overall operating costs.
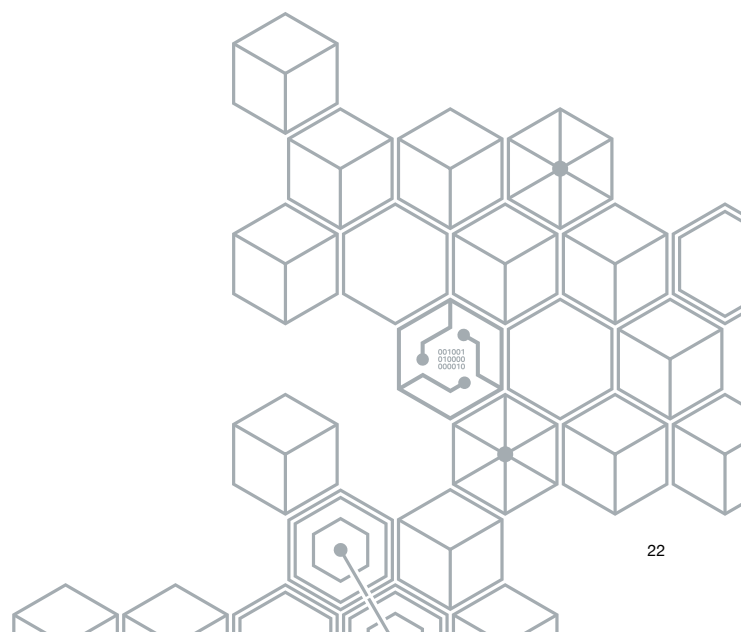
GDPR AS IT APPLIES TO IOT

In order to be fully compliant with GDPR, enterprises need to ensure they obtain the consent of every individual for the collection, storage and usage of any and all machine data that can potentially make that individual identifiable. Moreover, all IoT solutions have to comply with the "privacy by design" approach to comply with GDPR.

Since IoT devices can be perceived in the category of identifiers under GDPR, enterprises that implement IoT solutions need to assess whether their solutions comply with GDPR, and at the same time take necessary steps to ensure they adapt to the new regulations.

As an example, in a connected car setting, the collected data can purely relate to the driving of the car and the corresponding locations. However, when combined with the car ownership data, it is possible to connect the machine data to the owner/driver of the car. In such a case, the car manufacturer could be liable under GDPR for a breach.

CASE STUDY #2

Stockholm Exergi provides district heating for buildings throughout Stockholm. As part of their goal to use 100% renewable and recycled energy by 2030, they are implementing digital solutions to increase the effectiveness of the energy they generate.

This starts with understanding exactly what is happening in each building. To enable this, Telia will install 9,000 smart IoT units and provide an end-to-end IoT solution that Stockholm Exergi will be able to develop new applications on top of.

With greater insight into the real-time temperature and energy needs of each building, Stockholm Exergi will gain greater control over their energy generation. It will enable them to produce only what is needed and to allocate it exactly where it's needed. This will enable property owners to optimize their energy consumption. And for the residents, it will mean a more predictable and comfortable temperature to come home to.

NAVIGATING THE MAZE OF IOT PARTNERS AND ECOSYSTEMS
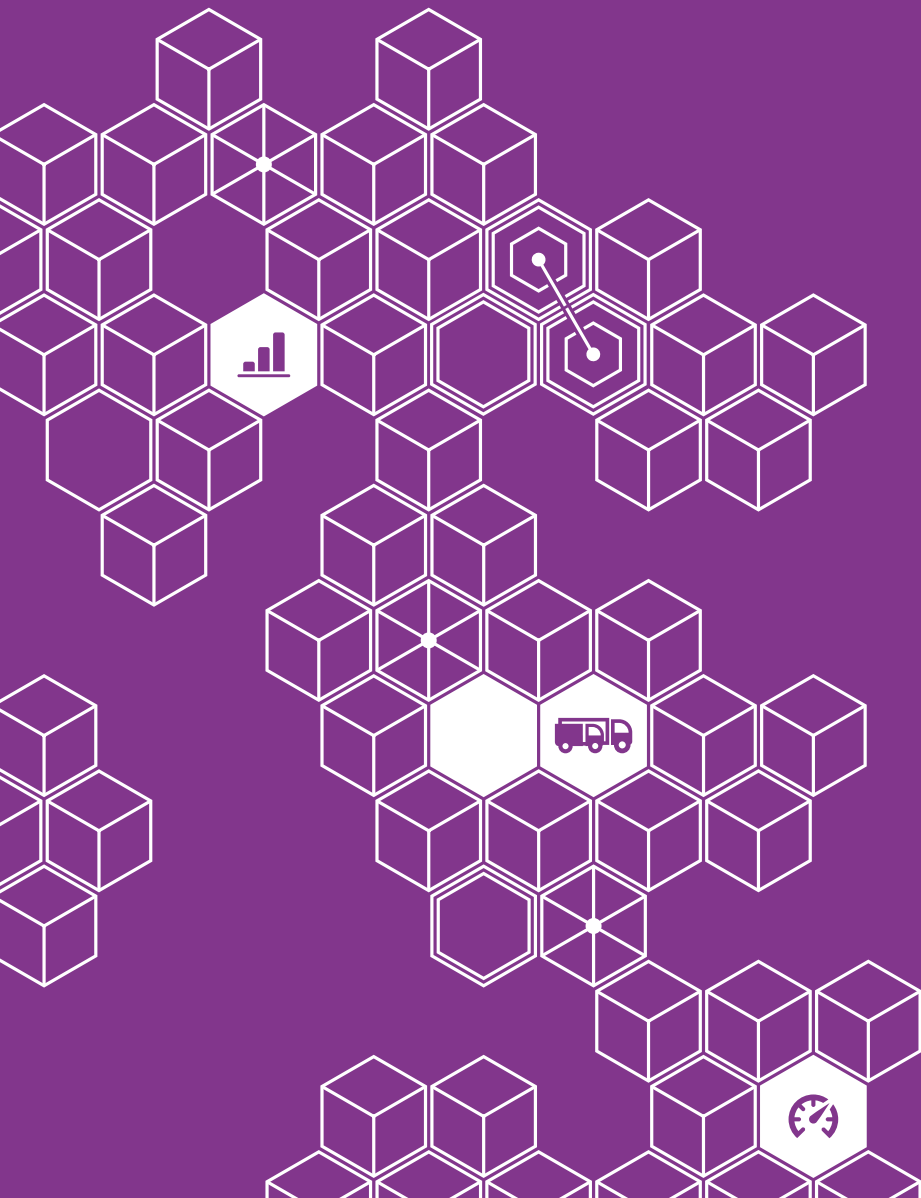
The IoT market is still in its early stage, but already, enterprises face many different options for IoT partners and suppliers. Choosing the right one is critical to a successful implementation.

THE IOT SOLUTION VALUE CHAIN

Industry-specific expertise was found to be the most important factor in choosing suppliers or partners, with 39% of IoT adopters selecting this as the most important. This was followed by **end-to-end IoT solution providers** with 24%.

Given the differences between each enterprise's needs and implementation complexity, off-the-shelf solutions for IoT implementation are not typically viable. Therefore, partnerships, and knowing how to find and form the right one, is one of the critical factors for success in IoT. Enterprises need to understand what the most suitable solutions and partnerships are for their specific situation.

Given the different levels of competence, needs, complexity and maturity, we have identified three ways to approach partnerships within IoT. The best fit depends on the level at which the enterprise is able and prepared to engage in the solution development.
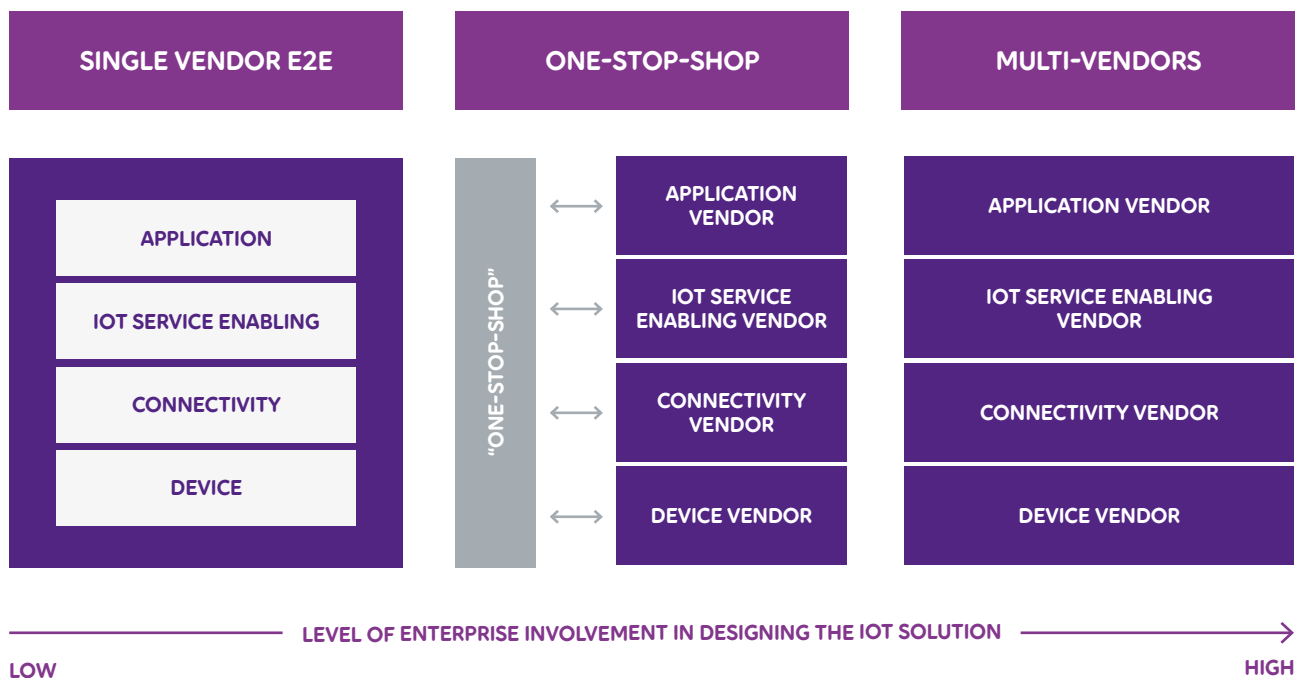
MOST IMPORTANT CONSIDERATIONS FOR CHOOSING THE IOT SUPPLIER/ PARTNER BY IOT ADOPTERS

- ● Industry specific expertise
- ● Total IoT provider
- ● Partnerships and partner ecosystem
- ● Other
- ● Global scale
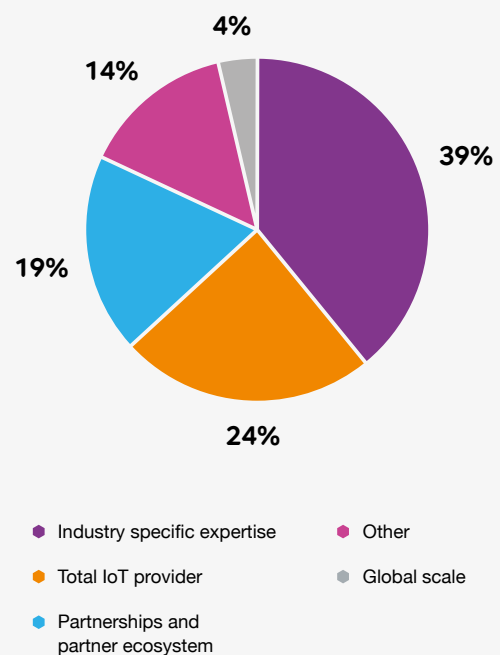
In developing IoT solutions, we see that 74% of the large enterprises in the Nordics and the Baltics who have implemented IoT solutions chose to have multiple partners for their IoT solutions. The main reasons for this strategy are: to avoid vendor lock-in and have more control over the implemented solution.

On the other hand, 58% of the Small and Medium sized enterprises chose to have fewer (in many cases just one end-to-end) IoT partners. The main drivers in this case are the lack of internal IoT competence and the need to manage the complexities of IoT deployment with limited resources.

THREE APPROACHES TO CARRYING OUT IOT PARTNERSHIPS

SINGLE VENDOR E2E	ONE-STOP-SHOP	MULTI-VENDORS

APPLICATION		APPLICATION VENDOR	APPLICATION VENDOR
IOT SERVICE ENABLING	"ONE-STOP-SHOP" ↔	IOT SERVICE ENABLING VENDOR	IOT SERVICE ENABLING VENDOR
CONNECTIVITY		CONNECTIVITY VENDOR	CONNECTIVITY VENDOR
DEVICE		DEVICE VENDOR	DEVICE VENDOR

LEVEL OF ENTERPRISE INVOLVEMENT IN DESIGNING THE IOT SOLUTION →

LOW   HIGH

SINGLE-VENDOR E2E SOLUTIONS

In this approach, a single supplier/partner provides a customized end-to-end solution. This often suits small and medium enterprises (SMEs) who have less complex legacy to integrate into and do not have the resources, time and capabilities to procure and integrate separate parts of the IoT solution.

ONE-STOP-SHOP

For best-of-breed solutions without single vendor lock in, a one-stop- shop can provide simplicity and flexibility for enterprises who lack sufficient knowledge to select all the right pieces of the value chain on their own. In this model, the enterprise works together with a partner who brings the best suited combination of components of the IoT solution and the knowledge and expertise to integrate them together.

MULTI-VENDOR SOLUTIONS

Larger and "IoT-mature" enterprises can prefer multi-vendor solutions where they engage and manage individual vendors directly. Enterprises can build a complete stack for their specific IoT solution taking a best-of-breed approach. Adopting a multi-vendor solution provides greater control over the solution, but this approach also requires enterprises to have the capability to manage, control and integrate different solutions into one functioning system. Given the overall complexity, even here it is advisable for enterprises to team up with at least one 'lead' partner to make sure the packaging and end-to-end solution will meet the expectations and that emerging in-house competence gaps are covered.

IOT CONNECTIVITY CHOICES CONTINUE TO EXPAND AND MATURE

When it comes to choosing the right connectivity solution, **Future-proofness** is the biggest consideration, chosen by 46% of respondents in our survey. This was followed by **Cost** (44%) and **Coverage** (38%).
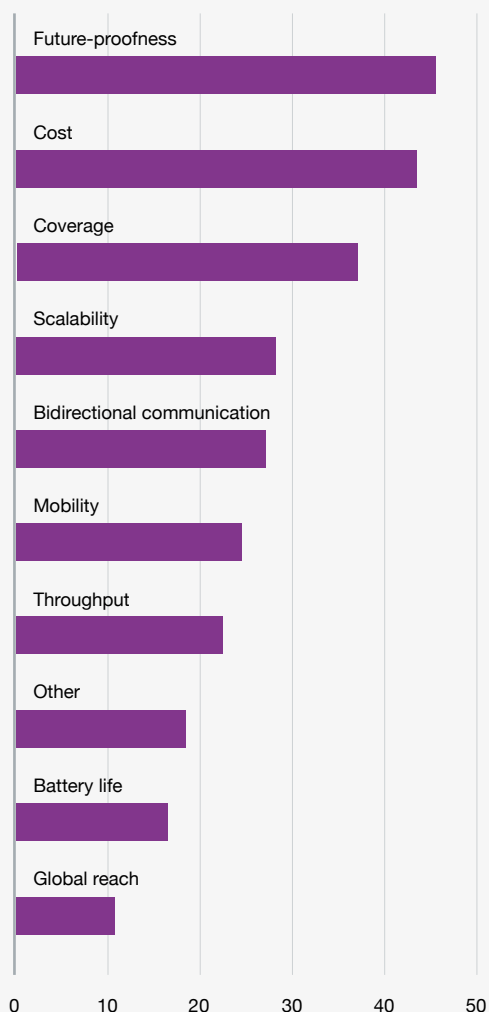
IoT connectivity technologies can be broadly separated into:

- **Low-Power Wide-Area**
  LPWA e.g. NB-IoT, LTE-M, LoRa, Sigfox
- **Traditional cellular connectivity**
  2G/3G/4G
- **Short-range technologies**
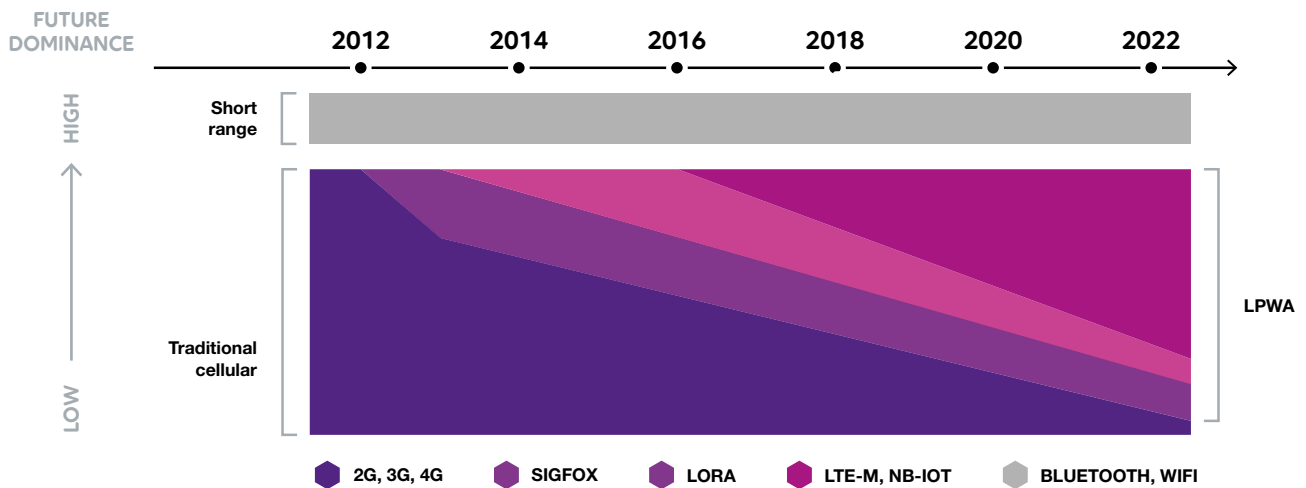 e.g. Wi-Fi, Zigbee and Bluetooth

Over the past 12 months, there has been increasing focus on **LPWA** technologies as module prices continue to fall and capabilities continue to rise. This is the category described as "Massive IoT" due to their suitability for use cases such as smart cities that need a high number of simultaneous and low data rate connections, wide-range coverage, and long device battery times.

MAIN CONSIDERATION FOR SELECTING IOT CONNECTIVITY TECHNOLOGY BY IOT ADOPTERS

% of respondents

TIMELINE OF MAJOR IOT CONNECTIVITY TECHNOLOGIES AND A FORECAST OF FUTURE

FUTURE DOMINANCE

2012 2014 2016 2018 2020 2022

HIGH / LOW

Short range

Traditional cellular

LPWA

● 2G, 3G, 4G ● SIGFOX ● LORA ● LTE-M, NB-IOT ● BLUETOOTH, WIFI

LoRa and Sigfox are IoT LPWA technologies that operate on unlicensed spectrum frequencies. First launched in 2013, LoRa initially grew in popularity, particularly for price-sensitive applications as the cost of connectivity per device is very low. Sigfox, launched in 2012, originally enjoyed similar growth, however more recently has experienced challenges, partly related to issues with over-the-air updates and their operating support systems.

Without depending on licensed or managed spectrum, certain LPWA technologies can be fast to deploy and avoid spectrum licensing costs. However since services operate on shared spectrum, they can be subject to interference, and quality of service cannot be assured, so these are suited to best effort services that are non-critical in nature.

In 2016, the main standardization body in telecommunications, 3GPP, completed the specifications for two LPWA cellular technologies designed specifically for IoT applications: LTE-M and NB-IoT. These two new standards mainly differ in that LTE-M offers a higher data-rate and allows for voice communications and mobility. In recent years, LTE-M has gained significant traction in the US where AT&T and Verizon have rolled out nationwide networks, while NB-IoT has become more prominent in Europe where many operators have or are in the process of implementing country-wide coverage.

In China both standards are widely deployed with upwards of 250M connections expected during 2018* supported by a massive investment in the electronics and devices sectors for both network techologies to drive economies of scale and needed range of connected devices for consumer and industrial use cases. Major deployments are also underway across APAC and Middle East.

In May 2018, GSMA recommended **NB-IoT and LTE-M as the first components of the 5G standard, covering the needs of Massive IoT. This , in combination with Telco investment around the world, is seen as a big step towards creating a future-proof IoT standard.**

In the Nordics, Telia was the first operator to launch nationwide NB-IoT in Norway in 2017, Finland in Q1 2018, Denmark and Sweden in Q2 2018, with the Baltics to follow.* Telia has also started implementing LTE-M, recognising that both technologies will be needed to support the range of use cases.

The Nordic countries will be among the leaders in Europe when it comes to LPWA, partly thanks to the underlying existing high-quality radio access networks, and the ability to work together with policy makers to quickly shape programs around the needs of digital connectivity.

Given the landscape of connectivity technologies available, enterprises need to select which one, or indeed which ones, to use based on their needs – no single technology is ideally suited to serve all potential IoT use cases. In fact, to have a connectivity partner that can provide a mix of complementing technologies will in many use cases be essential as many companies will have both "massive IoT" and "critical IoT" needs in parts of their business.

DIGITIZING THE CONSTRUCTION INDUSTRY WITH NB-IOT AND LTE-M

In April 2018, Telia Norway and platform developer Effera began deploying connected sensors on large construction sites.

The initiative will give companies greater control over various types of real-time information about the environment, machines and people; such as air quality, position and work load. Two of the main objectives are to increase the safety on construction sites and to reduce environmental pollution.

UNLOCKING THE FULL POTENTIAL OF IOT IN THE FUTURE
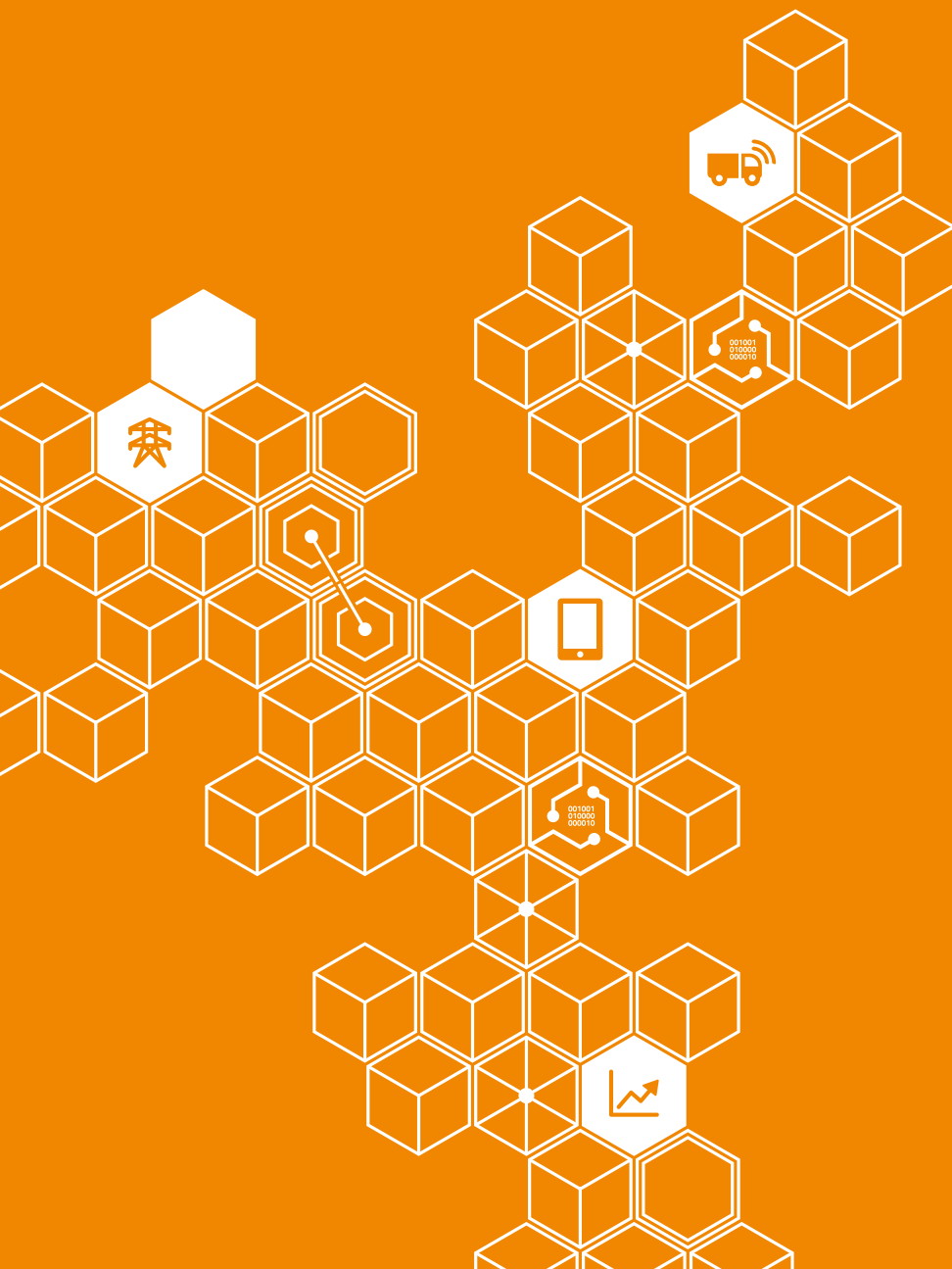
What developments can we expect in the IoT domain in the next 3-5 years? Many indications suggest that the use cases and business potential for enterprises will continue to evolve and new value will be unlocked thanks to maturing solutions and ecosystems. Enterprises will gain increased experience, and new technologies such as Artificial Intelligence, Blockchain and 5G will continue to pave the way for IoT.

The fragmentation in the IoT ecosystem, with multiple components that need to be pieced together for an end-to-end solution and an abundance of players has necessitated collaboration and partnerships. Going forward we expect to see more **consolidation** – especially in the IoT platform community where one can count several hundred IoT platforms on the market. Large software companies will make acquisitions and new joint ventures will be formed as scale is an important competitive advantage. Increased consolidation, adoption of more standard protocols (for how data is transmitted, what format it is in, etc.), and more specialized platforms tailored to certain markets or verticals will reduce IoT complexity, lower costs and accelerate adoption.

Enterprises will be also gaining increased experience and maturity in their IoT applications. So far companies have been constrained by shortage of talented staff with new skills (within software and data analytics) and organizational inertia due to lack of enough understanding and successful examples to follow. However, going forward use cases will mature, transformation best practices will emerge, and the proven benefits realized by early adopters will lead to shorter lead times and wider IoT deployment across organizations.

One example of utilizing Artificial Intelligence in IoT solutions is **Device Edge AI**. In this technique, a compact amount of processing power is integrated directly into the IoT device and the AI algorithms are processed locally on it. This increases the 'smartness' of the device by allowing it to decide and react on its own.

Device Edge AI also reduces the need for heavy data transmissions over IoT networks, and in some use-cases can improve battery life. Device Edge AI is of particular importance for mission-critical applications such as self-driving vehicles.

IOT AND OTHER EMERGING TECHNOLOGIES: CREATING NEW VALUE TOGETHER

Within the domain of network connectivity technology, there are new developments on the horizon with the deployment of **5G networks**, which is expected to start around 2019. 5G networks will offer improved capabilities in terms of capacity, data rates, latency and battery life and will be able to support the needs of Ultra Reliable Low Latency IoT use cases (for example, remote surgery in healthcare, real-time remote operation of heavy machinery in manufacturing) as well as massive IoT (connectivity for large numbers of low-cost and low- energy sensors within smart cities, agriculture and more). The arrival of 5G mobile networks will also boost the development and mainstream adoption of AR and VR technology, which can profoundly change experiences in entertainment, shopping and even business settings (such as training).

Unlocking new value from IoT will also come from **the converging use of IoT, AI and Distributed Ledger Technology (DLT)** such as Blockchain or the IoT-specific IOTA. IoT sensors are today embedded in devices and can collect and transmit data via internet connectivity to the cloud. These data sets can then be either processed at the Edge of the network (e.g. at gateways, mobile base stations) in what is referred to as Edge computing, or stored and processed at central location(s) in the cloud for more heavy computation. Data analytics, the process of applying various statistical models or algorithms, is used to detect patterns and derive insights – such as how to optimize electricity use and cost in a smart building. Most of the companies using IoT today have come this far in their maturity.

In the next years, Artificial Intelligence – and in particular Machine Learning as one form of AI – will be increasingly applied to IoT data. Machine Learning means computer systems can learn over time from the data provided (the way the human brain does) and act without being explicitly programmed. For example, the smart building will react to a resident's preferences and behavior and automatically take action to adjust the settings – instead of maintaining the same set temperature, the controller can understand where and when a resident is present and adjust the temperature in a room to their optimal comfort level (even adapting it in real time based on biometric data from their wristband activity tracker).

Blockchain is a distributed ledger technology that provides a digital record of transactions. Each transaction is recorded as a 'block' of information. These are linked together in single 'chain' that is simultaneously distributed to many thousands of computers on the Internet. This makes it impossible for anyone to go back and change a previous record without it being detected, because the altered record would no longer match the records on all the other computers.

THE CONVERGING USE OF IOT, DATA ANALYTICS, ARTIFICIAL INTELLIGENCE AND DISTRIBUTED LEDGER TECHNOLOGIES

ARTIFICIAL INTELLIGENCE

relates to the development of computer systems that can undertake tasks associated with human intelligence such as decision making, problem solving and visual perception.

EDGE COMPUTING

is when computation is largely or completely performed on smart devices or edge devices that are distributed in the network, rather than primarily taking place in a centralized cloud environment. It is favoured when ultra low latency/delay is required and tasks are largely localised.

MACHINE LEARNING

is often considered a subset of Artificial intelligence, where computers can learn without being explicitly programmed. This is done by using significant data sets to build and identify patterns, which get applied in predictive output models, typically geared towards specific problem solving.

Although AI is already applied in certain use cases – such as autonomous vehicles or financial systems designed to intelligently trade stocks and shares, the potential is largely unexplored when it comes to smart buildings and the connected home, smart cities, connected health, and more.

One of the biggest concerns with respect to IoT is security and safeguarding data privacy. Distributed Ledger Technologies such as **Blockchain** or **IOTA** can help solve many security challenges for IoT – it entails an encrypted, distributed computer filing system designed to allow the creation of tamper-proof, real-time records. A distributed ledger eliminates a single point of failure and protects devices from tampering. It also removes the need for an intermediary third party in order to establish trust, thus reducing complexity, deployment and operation cost.

Currently, blockchain is used in isolation by various companies and platforms. Examples are the cryptocurrency platform Ethereum and the open global trade platform announced by Maersk and IBM aimed at increasing efficiency across international supply chains. Going forward, to unlock further value it will be important to standardize the technology and develop connections between separate blockchains and integrate multiple blockchains to work together across a value chain.

DATA TRADING: MAXIMIZING THE VALUE OF DATA FOR INDUSTRIES AND SOCIETY

The data generated by connected devices can be valuable not only to the enterprise that collects the data but also other enterprises in the ecosystem. Partnerships can be formed between companies where customized data packages are exchanged in order to optimize existing services or create new ones – for example the partnership between Telia Sense, Folksam and Paydrive in Sweden that enables user-based insurance using collected data on driving behaviors through the Telia Sense platform. However, far bigger potential lies in the ability to trade anonymized data with any party, and Distributed Ledger Technologies with their ability to support smart contracts can help create such marketplaces for exchanging IoT data.

WHAT IS A "SMART CONTRACT"?

A key benefit of Distributed Ledger Technology such as Blockchain or IOTA is that it enables smart contracts – the software stores the terms that define how money should change hands and automatically executes the transfer when conditions are met.

An example application is in land registration. The Swedish National Land Survey (Lantmäteriet) is conducting a trial together with Telia and a number of other partners to demonstrate how blockchain technology and smart contracts can make land registration more secure by minimizing the risk associated with manual handling and transferring of land documents or contracts. This means that instead of the buyer and seller signing a bill of sale at the agent's office, this can be done with digital signatures that are verified automatically and there is no need for a centralized database to store and maintain land records.

WILL IOT ENABLE DATA TO BECOME A NEW CURRENCY?

IoT devices generate large volumes of diverse data. This data can create commercial value for its original owners when they resell it to other players. As a result, an inter-connected IoT ecosystem is emerging for data trading.

One example is the Otonomo Automotive Data Services Platform which serves to cleanse, normalize, aggregate, and enrich automotive data from various OEMs in order to match the needs of diverse app requirements.

REVENUES FROM IOT DATA MONETIZATION IN THE NORDICS AND BALTICS

(in Million EUR)
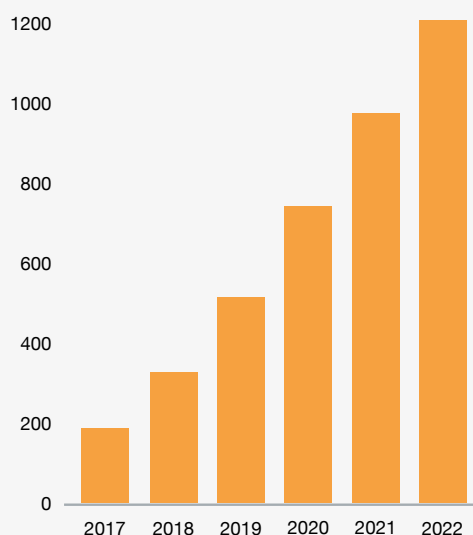
IOT: THE FUTURE IS BRIGHT

Will we see a higher rate of IoT adoption in the next few years and what can enterprises expect from IoT? The main barriers for adopting IoT that we discussed earlier in this report, such as expenditure justification and business model change, will remain. But the gains will become more evident to an extent that convinces decision makers to commit to overcoming these barriers. As a result, based on the presented IoT Needs segmentation, we predict that IoT solutions addressing Asset and Process Efficiency and New Product Innovation will gain much more traction in the near future. However, since the 4 IoT needs categories are not uniformly present in all industries, the rate of IoT adoption will be different across different industries.

At the same time, some of the challenges such as technological maturity and complexity in IoT deployment will over time decrease, while other challenges such as security, privacy and budget constraints will be ongoing battles that enterprises need to fight. Therefore, in order to improve agility in increasingly competitive markets, changes in organization setup and modernizing legacy systems become inevitable.

The Nordics and Baltics are among the most dynamic and advanced regions in IoT – both in terms of tech-oriented mindset as well as actual IoT implementations and benefits achieved. Going forward, we expect to see a lot of innovation, new start-ups and use cases being born in these regions.

With the maturing ecosystem and use cases, and new technologies such as 5G, AI and blockchain that complement and maximize the value of IoT, enterprises that are starting their IoT journey can look forward to new opportunities to improve customer experience, adopt new business models and improve operations. IoT is and will continue to be a key enabler for digital transformation.

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