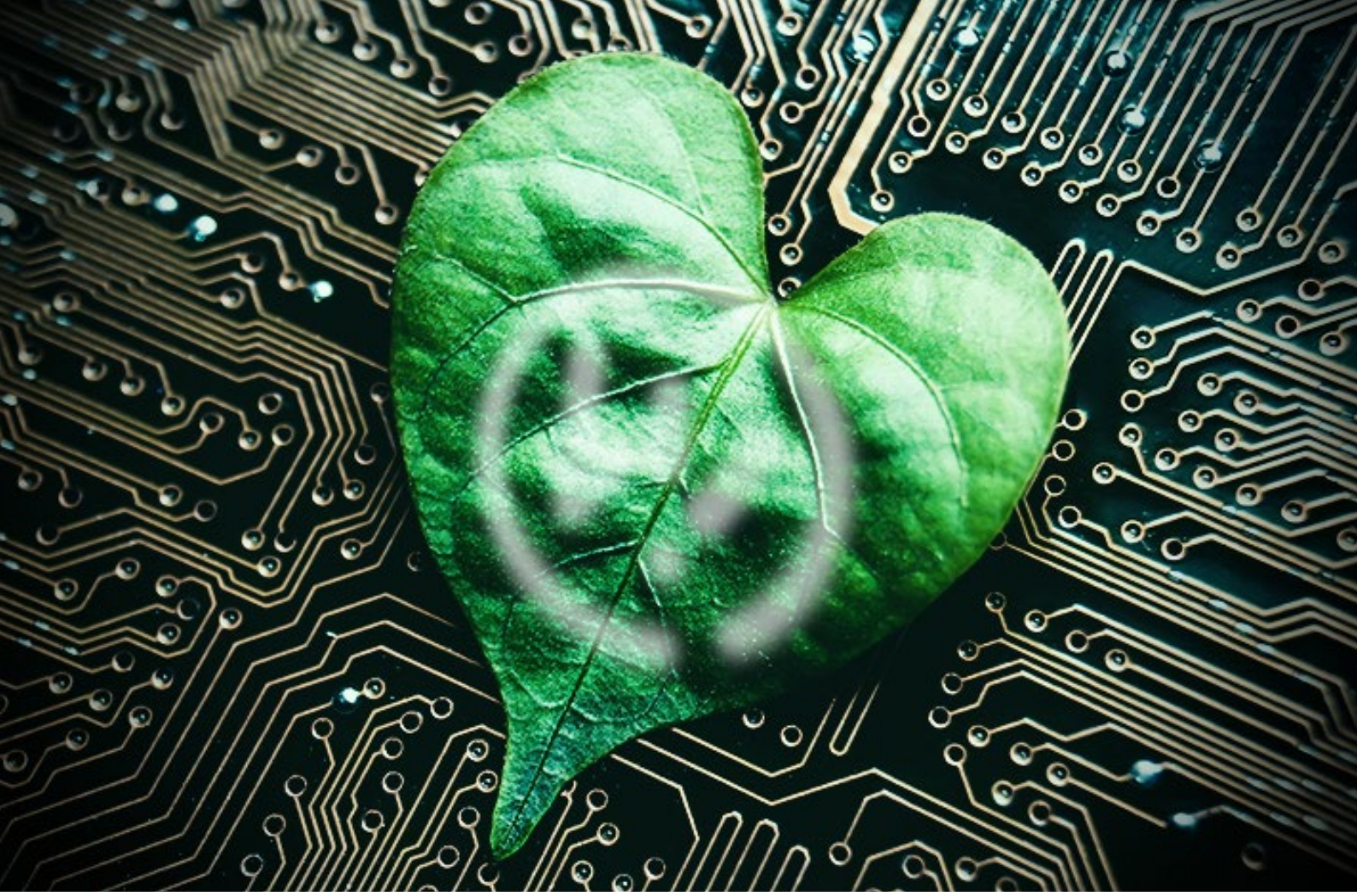




SMART IoT SOLUTIONS FOR SUSTAINABILITY:

A GUIDE TO THE ENVIRONMENTAL BENEFITS OF IoT

w!tIRATM



INTRODUCTION



Håkan Dackefjord was out on his routine run when he spotted a new bicycle leaning against a tree, passing the same bike every day for the next week, wondering if it had been stolen or misplaced. It was this thought that got Håkan thinking, where is my stuff and what is it doing?

Håkan began researching location technology and current solutions in the market and soon realized that the IoT technologies today were competing within two distinct positioning categories – indoor and outdoor. The indoor

market was filled with LPWAN solutions and outdoor consisted mainly of satellite and cellular technologies. Neither of which were suitable to track objects like bikes, tools or machines. Thinking about the bike he understood that a multitude of tracked objects within the IoT space would be moving, and specifically between indoor and outdoor spheres, and in complex environments such as cities or construction sites. A viable asset tracking system would therefore need to work successfully within every type of environment. Unfortunately, no such tracking system existed.

In 2013, Wittra® Sweden AB was founded, Wittra® technology has gained significant traction in the IoT industry and received several awards for its ground-breaking patent protected technology in location intelligence. This technology allows seamless tracking between indoor and outdoor spheres, no matter what the environment.

SMART IoT SYSTEMS CREATE SUSTAINABILITY IN INDUSTRY

Sustainability is important in all kinds of industries, not least in construction and manufacturing where large amount of goods are constantly being processed and moved. Many businesses are trying to find a win-win solution that both increases their sustainability and their overall production, and it seems like a well-crafted IoT solution might just be that.

Two years ago, **World Economic Forum released their guidelines for sustainability** of the Internet of Things. It was evident that IoT had great potential in increasing sustainability, as long as the technology was used responsibly. In their report, they estimated that 84% of IoT projects have potential of addressing parts of UN's sustainability goals.

So, how exactly is IoT aiding businesses in increasing sustainability, and can this be combined with increased profits?

SUSTAINABILITY IN IoT – WHAT'S NEW?

The main potential in IoT, in as far as how it relates to sustainability, lies in the fact that you can start measuring things that previously were difficult to quantify. Smart sensors can measure weight, tilt, temperature, pressure, humidity, gas flow, chemical reactions, vapor, surface, and much more. Everything a smart sensor can measure is used to increase the bottom line for companies in construction, manufacturing, and other industries, but it also aids these companies in meeting their sustainability goals.

In addition to the above, smart sensors are also very robust, which eliminates the need for constant maintenance. The cost has also consistently gone down, and they are very power conservative, which means that they can be used for several years without battery change.

All in all, smart sensors are driving IoT development, and as a tool they are inherently sustainable.

SUSTAINABILITY IMPROVEMENTS

A well-crafted IoT solution can have many positive impacts relating to sustainability.

- **Resource & Energy Efficiency**

By having systems that can communicate and share data in an efficient manner, businesses can anticipate and plan for different scenarios and outcomes by having access to the right amount of resources when they need it. A well-crafted IoT solution increases productivity while also decreases the amount of defective units and lowers energy consumption.

- **Supply Chain & Circularity**

The complexity of the supply chain is a natural part of a market economy. Without the staggering amount of business agreements, it would never be possible to create the products we take for granted, and it would never be possible for us to purchase them to such a low price. The complexity of the supply chain also employs a lot of people, and brings revenue to both businesses and nations. However, the complexity of the supply chain also means that there are very real challenges in terms of sustainability.

As we talked about in a previous paragraph, IoT drives efficiency, and sustainability is all about efficiency. Using less fuel, materials, and spare parts leads to more than just a leaner production, it also leads to less wastage and a reduced environmental footprint in the supply chain.

- **End-of-end-of-life Aspects**

The lifetime of a component is an important part of sustainability. IoT systems can support a more circular economy by making it easier to repair and maintain products. An important part of what is described as the fourth industrial revolution, in which IoT is a huge part, is the rise of predictive maintenance. In short, predictive maintenance means that machinery uses sensor and machine data to predict when they need maintenance. This means that the lifetime of the machine can be increased, leading to the product becoming more sustainable.

There are yet many areas to explore in terms of how IoT solutions can support more sustainable manufacturing and construction and a more sustainable product lifetime.

IoT LEADS TO WAY TO A MORE SUSTAINABLE FUTURE

There are many aspects that can be improved by implementing a sustainable IoT solution. As we have talked about in this post, most of the revenue-increasing activities that relates to IoT also lead to increased sustainability. As experts in the future of technology have stated, there is a fourth industrial revolution happening right now – and it appears to be a greener one. Wittra loves combining efficiency and sustainability – contact us here to learn more about how your company can use IoT to meet your business goals.

WHY DO IoT IMPLEMENTATIONS FAIL?

The IoT market is slated to have more than 41 billion devices by 2025. This makes IoT a vital component of the digital transformation process. Organizations around the world – big and small – know that they cannot afford to be left off the IoT train. We're gonna go through why IoT implementations fail and what's important to keep in mind.

For many companies, the benefits of interconnected flow of information are no longer viewed as a differentiator. It is now a business imperative. Competing companies across industries are racing to integrate IoT and get the first-mover advantage. Leaving the ones who are slow playing catch up.

However, as the technology is new, IoT deployment is not a cut and dried formula, and missteps and misalignments abound. According to Microsoft, 30% of IoT projects fail in the proof-of-concept stage. A number that is much lower than the 2017 Cisco report that pegged the failure rate at 75%. Naturally, with so much money, effort, and long-term profitability riding on its success, boardrooms ring with post mortem discussions of IoT implementation failure. Below are some of the most common reasons that have emerged.

ORGANIZATIONAL CULTURE AND STRUCTURE

As is usual during the uptake of any new technology, the existing company process, culture, and management structures need to go through a period of adjustment to integrate its workings fully. The problem arises when this change doesn't happen. For example when departments have different perspectives on an IoT project. Or if they work in silos that inhibit seamless flow or sharing of information.

Solution

There is always resistance to change, and the only way to overcome it is to introduce the concept of IoT in easy stages. Prepare people for change with discussions, workshops, and senior management commitment. First-time IoT adopters can test and understand the technology with small scale integrations. Several companies offer off-the-shelf solutions for specific departments or processes. These cost less, are faster to implement, and are a great way to introduce the technology gently to everyone in the organization.

LACK OF AN IoT ROADMAP

Doing IoT for the sake of IoT is a recipe for disaster. Managers need to bring context and goal setting to their IoT implementations. They must know what business problem the IoT intervention will solve. What the expected results should be. Also have a clear roadmap of how they plan to continue the integration forward and how to scale and expand it.

Solution

Senior management and department-level buy-ins are critical for success. It is imperative to get everyone on board to devise a long-term strategy after considering the IoT integration from all angles.

LACK OF TECHNOLOGICAL EXPERTISE

IoT devices have become cheaper and business-friendly solutions abound. However, it is a relatively fresh technology. That's why it is a big gap in terms of skills shortages, security concerns, and solution complexity. Microsoft's IoT Signals report in 2019 cites complexity and technical challenges (39%) as the most significant roadblock during the IoT development phase. Similarly, McKinsey's survey reports several capability gaps in IoT projects. 70% of the surveyed companies find integrating IoT solutions into existing workflows the hardest. Cap Gemini identifies constrained analytical capabilities by 60% of organizations as one of the main challenges for IoT adoption.

Solution

Working with a service provider or expert IoT agency can help make implementation smoother. Many also offer managed services that can take care of daily operations. However, in the long run, it is critical to hire and train a team to scale and manage your bigger IoT projects.

LACK OF UNDERSTANDING OF IoT CYBERSECURITY RISKS

One of the biggest concerns around IoT adoption is security. Microsoft reports that 97% of companies are concerned about IoT security. IoT has many and varied devices and gateways, and the safety of these are harder to control. As IoT enters the business, critical applications cybersecurity becomes a bigger worry for everyone. Projects can fail entirely if the security of data, devices, web servers, and communication network cannot be guaranteed. Also, the cost of maintaining an end-to-end security apparatus across a vast number of interconnected devices can become prohibitive.

Solution

Organisations need to include security roadmaps, budgets, and the hiring of cybersecurity specialists into their IoT plan. Companies must consider cutting-edge AI and machine learning-based security solutions that can spot and eliminate anomalies in real-time and on scale.

FINAL THOUGHTS

It's déjà vu! IoT struggles have much in common with the first wave of digital transformation that came with cloud adoption. All the challenges (culture, skills, security, and strategy) remain the same. Hence the approach to solving them can also be similar. We need to revisit the lessons of cloud adoption and keep our eye on the ball. There is little doubt that IoT will play a massive role in the coming decade. And while it is not a silver bullet, ignoring it is not an option at all.

Remember, IoT is a young technology, and it is still evolving. Just as we experienced with cloud adoption, CTO's and CIOs must take the lead to steer their organizations in the right direction. They must use the lessons learned from the IoT experiences of others in the industry and plot their strategies and implementation plans carefully. Partnering with an expert vendor or solution provider is one sensible way ahead for companies dipping their toes into the IoT ocean. Here again, the experience of CIOs can be invaluable while choosing the right IoT vendor. The smart way to incorporate IoT is to start small, learn, and scale slowly.

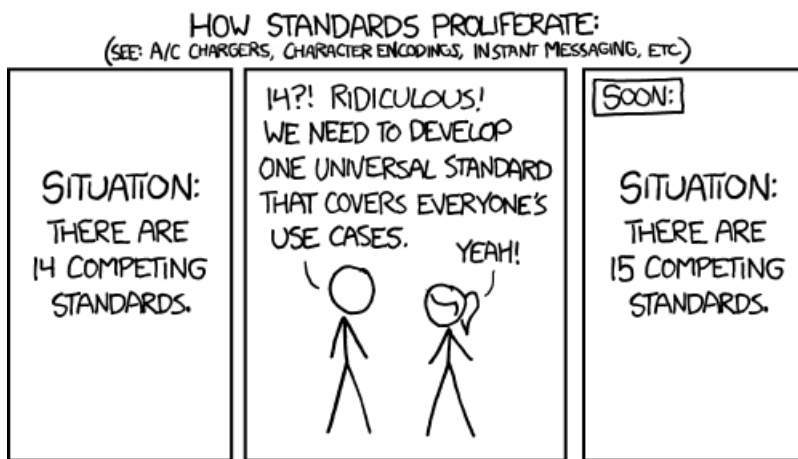
In the end, one thing is clear – the cost of failure is far less than not trying at all!

THE PATH TO FUTURE-PROOF IoT



The idea of the IoT has been laid down for over 20 years. Yet the technology landscape is still very much under construction. New alliances, protocols, and platforms come every year, while others get abandoned. At Wittra we focus on building products that are relevant today yet won't be obsolete when the next innovation comes around. This post describes our approach to building a future-proof IoT.

EVER-CHANGING TECHNOLOGIES



From the early days of the IoT, it became clear that standards were going to be necessary if we were going to achieve massive object connectivity. Proprietary solutions would only get us so far in terms of scale and adoption. As siloed products simply are not able to achieve the network effects of open standard-based ones. This is why connectivity standards emerged rapidly, such as, to name a few:

- ZigBee
- WirelessHart

- Bluetooth Low energy
- ZigBee IP
- Thread
- 6TiSCH
- LoRa
- Wi-Sun
- NB-IoT

We soon ended up with a choice problem. Each standard obviously has its own merits and weaknesses. It's sometimes tailored to specific application domains (such as smart city or building automation) and sometimes totally application-agnostic. The only thing we know for sure is that some of these standards will cease to exist in the future. And that new, superior ones, will appear. Quite inevitably, the IoT will converge to a small subset of the standards. How do we start building now that things have not converged yet, when time-to-market is everything?

OVER-THE-AIR (OTA) UPGRADEABILITY



Over-the-air (OTA) upgrades are essential for almost any IoT product. That is how you deploy new features, fix existing ones, and issue security patches. A great OTA system is what makes it possible for you to reach the market early. This while still having the ability to improve on the product later on.

A particularly challenging aspect of OTA is how to deal with evolution of the protocol stack itself. There exist two main approaches to this challenge, and they can be combined.

THE FIRST APPROACH IS TO ISSUE BACKWARD-COMPATIBLE FIRMWARE

Each new version of the firmware includes support for both the old and the new protocol stack. As the new is rolled out, you can start obsoleting the old, and remove dual-protocol support in next revisions. This is an elegant approach but it is unfortunately costly and not always practical. Implementing and sometimes maintaining backward

compatible software is hard. In certain cases it cannot be afforded at all, for example due to constraints in firmware size.

THE SECOND APPROACH IS TO INCLUDE A FALLBACK MODE FOR UPGRADES

It is wise to add from the very early versions of your product a primitive way to upgrade your firmware. No matter how next protocols turn out to be. This is typically done having the device enter a safe mode via some manual action. Then bringing the device in direct range to a gateway or upgrade station, and issuing the upgrade over a simple communication protocol that is not meant to evolve much or at all over releases. This solution provides a nice anti-bricking insurance.

No matter the approach(es) you select, your OTA system must be incredibly reliable, or else you risk losing devices in the field. Less intuitively, you also want your OTA system to be quick and fully automated. These upgrades are important because it means you can upgrade often and cheaply, and integrate it in your CI/CD workflow. This basically brings the DevOps best practices, and its benefits, to the IoT world. OTA upgrades bring its own set of massive security challenges, which you must have in mind already in the first iterations of your product. One is that you must make sure only you can issue new software to your products. This is done with signed binaries verified at boot-time. Ideally with secure boot and a public-key infrastructure.

Another challenge is to protect your product against supply-chain attacks. The attacker targets your continuous deployment pipeline to deploy malicious code into the products. Treat your supply chain as the critical component that it is. Apply security best practices such as enforcing two-factor authentication, using security tokens to sign the releases etc.

APPLICATION LOGIC OFF THE DEVICE

Let's turn our attention to our system architecture itself, and how to make it future-proof. One key principle, which has led the Internet to its success, is the end-to-end principle. The end-to-end principle basically states that only end hosts need to implement a given application; other participants in the networks are application-agnostic.

On the Internet, this means you have a Web client exchanging with a server. But your access provider and core Internet router, do not need to know anything about what's going on. This brings a key scalability advantage, as intermediate nodes do not need upgrading as the application evolves. What's more, for the Web, the logic basically lies entirely on the server side. The client is nothing but a generic browser, running code supplied by the server.

The IoT can benefit greatly from the same approach, for connectivity between wireless products and either the edge or cloud. If you have a wireless mesh network, keep the forwarding layer application-agnostic. Avoid in-network aggregation and

cross-layering. Keep the gateway as thin as possible, so that it knows a little as possible about the application. If you have an edge architecture, keep the end-to-end principle strict from edge to device. Edge nodes often need to know about the application. And that's manageable, because they are directly connected to the Internet and are in your control.

It's a good idea to have as much of your application logic as possible at the cloud or edge. Not in the IoT device itself. This is simply because the device is by far the hardest and riskiest to upgrade. This also eases CI/CD, as simpler devices are simpler to mock.

AVOID TECHNICAL LOCK-IN FOR YOUR STANDARDS/TECHNOLOGY

In most markets, standard compliance is a must; but it will also benefit your product's future-proofness. Building on standards means you nearly have a guarantee that there will exist long-term maintained open-source implementations of the components and tools you need. This means you can spend less time building infrastructure protocols and focus on your application. When the time comes, you can port your application to a different stack if necessary.

By using standard protocols, you have a whole community to rely on for things like design choice, bug detection, security leaks etc., compared to the capacity within one single company. The more something is used the higher likelihood it will remain and still be maintained in 20 years from now. Think of how nice it is in other areas that things are standardized. Like the fact that you can buy a USB-C cable in many different stores and that it works with a great number of devices.

Generally speaking, avoid technical lock-in. Relying on one single vendor solution and building your solution around it would build a stronger and stronger dependency on that company. This is a risk because what you want today might not be what you want tomorrow.

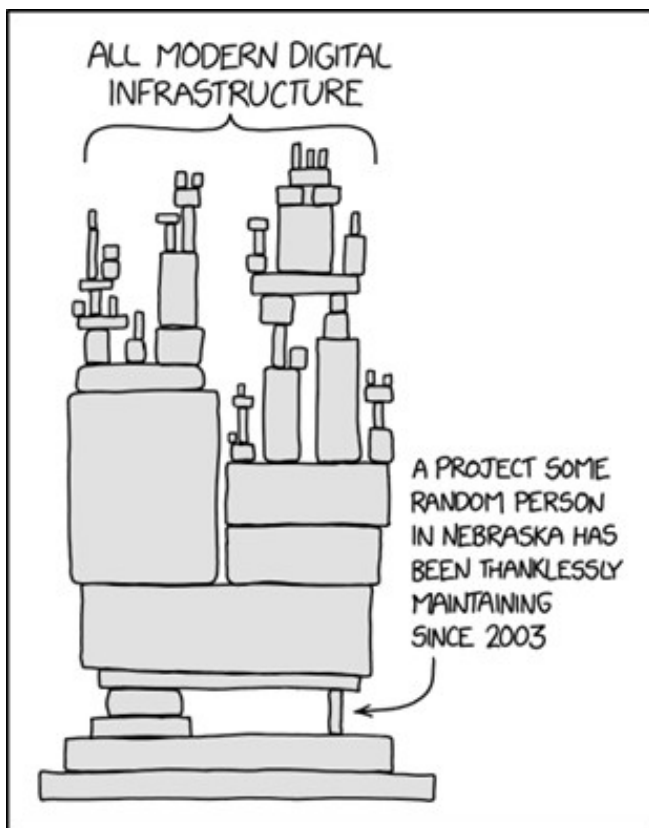
Open source is used more and more within IT companies. Even big players like Microsoft have in the past years embraced the power of open-source software. What you discover fast in the IoT sphere, however, is that it is still a very immature market. Hence hard to find active communities. When using open source, choose wisely.

FUTURE PROOF IoT – DEALING WITH HARDWARE

Hardware is the one component in your system that obviously can't be upgraded remotely. For this reason, in the ever-changing IoT world, it's a good idea to avoid any early-optimization in this area. To the extent where you can afford it (cost and battery-wise for example), having hardware that can do a little too much is better than the opposite. For example, do not hesitate to include a TPM or an accelerometer even if you have no short-term plan to use them. Prefer versatile radio chips over specialized ones. Some chips can even run multiple protocols, sometimes simultaneously. Having

the ability to plug external sensor elements can also make a lot of sense for future-proofness, depending on the market you're in.

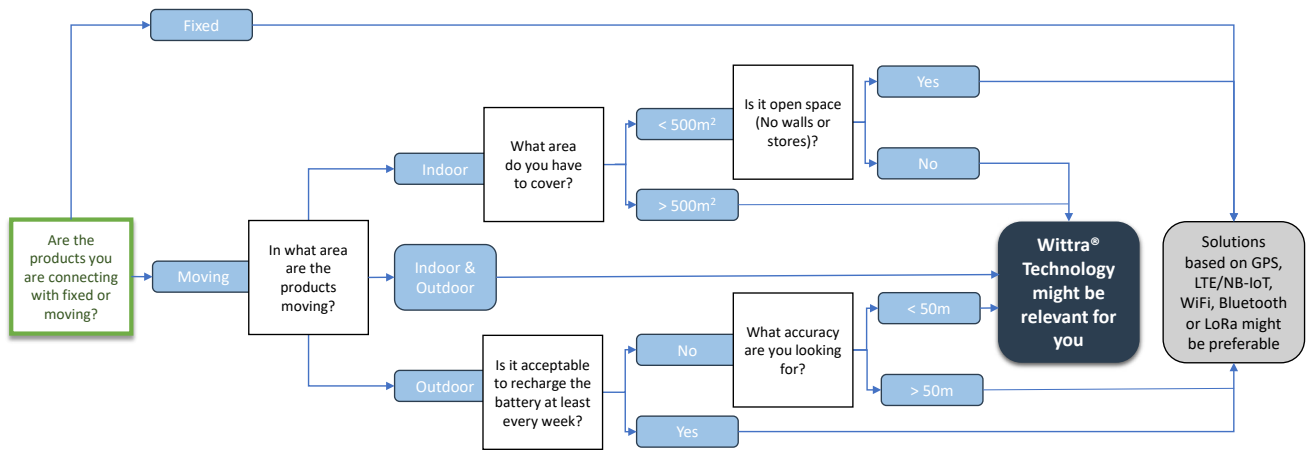
This will postpone the day you have to upgrade your hardware, and lengthen your product lifetime. Once you do have to upgrade the hardware, you'll benefit again from the software guidelines discussed above. No technical lock-in and good open-source communities mean it should be easier to port your software to a new chip or radio.



TAKEAWAY OF THE PATH TO FUTURE-PROOF IoT

The main challenge in IoT is to achieve short time-to-market in a future-proof manner. We believe it can be done. As long as you build your product with upgradeability, modularity, standard compliance in mind from the beginning. The fact that we have to focus so much on best practices and software quality is something that makes IoT such an exciting field! Wittra® technology has gained significant traction in the IoT industry and received several prestigious awards for its ground-breaking technology in location intelligence. See how we future proof IoT. Read more about us [here](#)!

CAN YOU LEVERAGE THE WITTRA TECHNOLOGY?



The Wittra® technology delivers accurate indoor positioning and minimizes the power consumption for positioning outdoors. By utilizing specific ISM frequencies together with patented positioning techniques, Wittra® can track items kilometers from a base station with very low power consumption and outstanding accuracy. The low power radio chips have been developed to support long-range sub-GHz narrow band communication, time of flight distance measurements, context awareness and location accuracy. All optimized in a system for you to deploy by licensing our technology or buying the products.

The core Wittra® technology is protected by 48 granted and pending patents across 11 patent families,



About Wittra

In 2013, Wittra® Sweden AB was founded as a consequence of the team's tireless research, insight, and ongoing development. Since that time, Wittra® technology has gained significant traction in the IoT industry and received several prestigious awards for its ground-breaking technology in location intelligence. This technology is currently protected by 51 patents, making it possible to seamlessly track assets between the indoor and outdoor spheres, no matter what the environment. The next step has been to utilize emerging standards to create products with the right market fit. As a result, Wittra® has launched its first applications into the market, providing a simple, practical solution for keeping track of your things.



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