



Smart Connected Products

How the digital networking of products succeeds

CONTENTS

	THE GROWTH OF DIGITALIZATION AND CONNECTIVITY	3
	THE IPHONE PARADIGM REVOLUTIONIZED OUR PRODUCT PERCEPTION	4
	FROM DISRUPTION TO THE NEW NORMAL	5
	THE DILEMMA OF THE GLOBAL MARKET LEADERS	6
	AN IOT PROVIDER MARKET WITH A GOLD-RUSH MENTALITY IS NOT HELPING	7
	LESSONS FROM IOT PROJECTS FOR LEADING MEDIUM-SIZED COMPANIES	8
	GETTING PRODUCTS CONNECTED QUICKLY, EASILY AND COST-EFFECTIVELY WITH CELLULAR IOT	9
	HARDWARE	10
	CONNECTIVITY	11
	CLOUD	12
	ABOUT US	13



THE GROWTH OF DIGITALIZATION AND CONNECTIVITY

Several years ago, when leading market researchers described how our world would become more connected – the so-called “internet of things” (IoT) – their prediction of billions of connected devices was ridiculed even by experts as being absurd and inconceivable.

But a lot has happened since then. We have all gotten used to the fact that our iPhone gains new features and capabilities with the next “over-the-air software update” or that we can control our room lighting and garden equipment with our smartphone.

It has also long been possible for machines to report when they need servicing, i.e. before they grind to a halt due to a fault, or for motor vehicles to be optimized overnight – including receiving enhancements to key functions, like engine and brake performance. Clearly, a major paradigm shift is underway that is radically changing our perception of products and that will not leave any product untouched. But what has actually happened here?

THE IPHONE PARADIGM REVOLUTIONIZED OUR PRODUCT PERCEPTION

For more than 10 years now, the pioneer in the creation of a new product perception has been the iPhone. With its disruptive product features, it has shown how an established industry can be turned on its head. The iPhone's groundbreaking innovativeness was, however, not only of a technological nature but especially also due to its ease of use, i.e. usability. The existence of the iPhone thus revolutionized all our everyday lives as well as the associated user experience. The iPhone paradigm (hardware becomes software, individuality, continuous improvement) has dramatically changed and shaped users' expectations of modern products – that is to say, their expectations of products in general. For decades, attributes like functionality, quality, and durability were what defined standard products. But nowadays, as per the iPhone paradigm, users have generally come to expect from all modern products (from kitchen appliances, vacuum cleaners,

and robotic lawn mowers to electric vehicles and industrial machinery) that the hardware is becoming a product platform that they can adapt to their individual needs. Products are increasingly electronics based and enhanced with connectivity capabilities and are as a result becoming Smart Connected Products.

Manufacturers that do not offer a broad ecosystem and solutions covering wide-ranging requirements will not succeed in the innovation race in the long run. And, most important of all: life cycle management is being redefined. Buyers today expect to be served new versions of software through “over-the-air software updates” and to receive additional functions free of charge with each new version. As a result, products are becoming much more versatile, possess their own distinctive character, and always feel like they are up to date.



Hardware becomes software

Individualization

Continuous improvement



FROM DISRUPTION TO THE NEW NORMAL

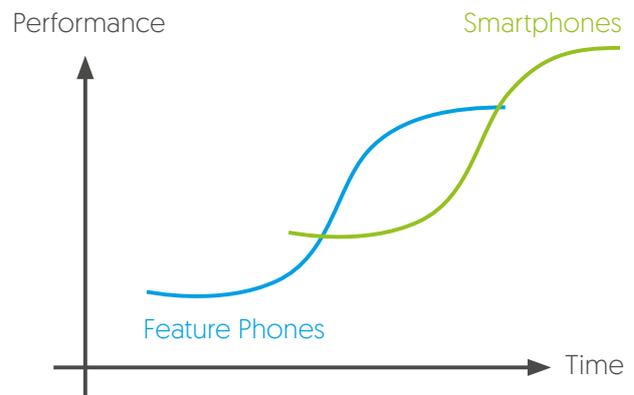
Innovation that adds value from the user's point of view has the power to transform markets radically or, to put it another way, to be "disruptive". The decline of Kodak, the big booksellers, and even the mighty mobile phone manufacturer Nokia is proof that when disruptive change sets in, no amount of financial strength or market share or number of patents owned will provide protection. It is the champions in particular are at risk when the wheels are set in motion. Even in the automotive industry – stable over many years– something similar can now be observed, as the current market shifts show. It is therefore important to be vigilant and to identify trends at an early stage – there is no room for hubris here.

After all, all paradigm shifts undergo the three-stage process that is typical of disruptive transformations:

Stage 1: The new product category is ridiculed. (no benefit, too bad, price/performance, ...).

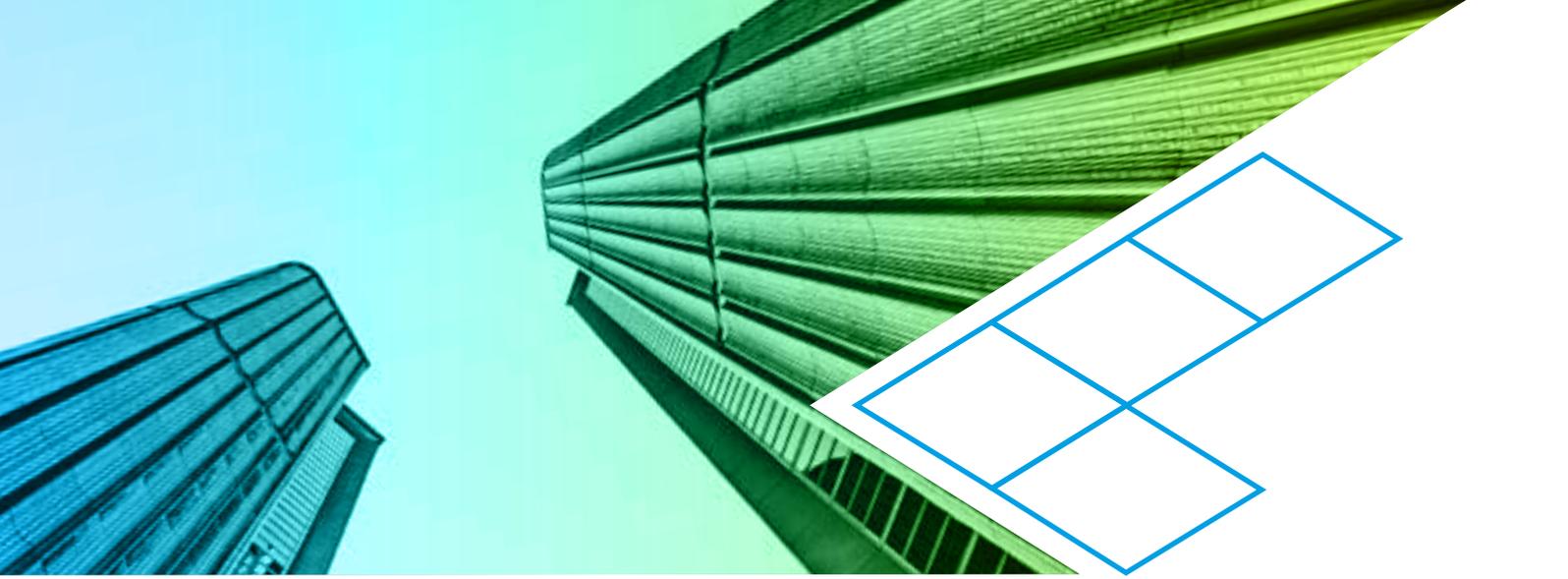
Stage 2: The new product category is fought by the established. (dumping, trade partners are put under pressure, ...).

Stage 3: The new product category becomes the new normal and displaces the established offerings.



To put it in no uncertain terms: What has happened with smartphones and is currently happening in the electric vehicles segment (e.g. Tesla) is a development we are seeing in Germany today in many areas. A general transformation is taking place – a shift from products to smart products, i.e. ones that are increasingly electronics based and connected. Where pioneers set out a few years ago to conquer new markets, we are now seeing digitalization and connectivity on a broad scale. In some segments, like the smart home, smart building, and industry 4.0, this is already normality – not an innovation, but a core product feature that has become indispensable. And this trend is only going to continue.

After all, connected, smart products also help the product vendors. Smart products help them keep on the ball and allocate resources optimally: thanks to the real-time access to devices and usage data, vendors can learn what customers want, i.e. how users use their products. This enables them to optimize and manage product development and servicing with the customer in mind and thus make optimal use of the resources available.



THE DILEMMA OF THE GLOBAL MARKET LEADERS

It is, however, also fact that the transformation to Smart Connected Products is time-consuming and entails high costs. Medium-sized enterprises lack the necessary focus, expertise, and – albeit rarely – the financial means for developing and realizing smart products.

Their core competencies involve activities like sheet-metal forming, manufacturing sections, and fastening screws – skills that for decades have proven extremely successful in terms of generating sales and earnings but that up to now have had few points of contact with the world of IT. As a result, essential competencies are lacking – from electronic engineering, app development, and IT security to round-the-clock fail-safe operation in global

markets. Added to that, skilled personnel are in short supply both within the company and on the labor market.

The dilemma boils down to this: The business of the hidden champions is still booming, and it would seem negligent of them not to make every effort to meet the ongoing strong demand. However, a closer look at the pioneers in their respective market segment or product segment shows that the competition – whether they be established market players or well-funded start-ups – is not sleeping, which means there is a risk of time running out.

AN IOT PROVIDER MARKET WITH A GOLD-RUSH MENTALITY IS NOT HELPING

A world with billions of connected devices promises good business for component and solution providers too.

There is hardly a major supplier – be it a cloud provider, telecommunications company, electronics distributor, or chip manufacturer – that has not yet already addressed the topic on its website or in its strategy or a presentation. Thus, for instance: chip manufacturers are offering the necessary hardware; the major cloud providers (Microsoft Azure, AWS) are promoting their IoT hubs; cellular network operators are offering a growing range of connectivity services and pricing plans; and other service providers are specializing in areas like app development and IT security.

But what is missing is a product package, an integrated end-to-end solution containing all the necessary components. After all, although the individual components are in fact highly capable, they are almost useless on their own. Medium-sized companies are already finding the strong fragmentation of the IoT market overwhelming, particularly when it comes to choosing the right solution modules for their specific application, not to mention then also having to orchestrate the various suppliers. It is not unusual for projects to not be launched at all, simply because they are too complex.

AN OVERALL VIEW OF THE DILEMMA



Full order books in core business:

Lack of time for smart products Innovation pressure: Continuously increasing risk of losing market share



Skilled labor shortage:

Both internally and on the labor market; training of own employees is time consuming and cost intensive



Fragmented IoT market:

Complex, time-consuming, cost-intensive selection process as well as orchestration of digitalization projects



Lack of transparency in outsourcing projects:

On average 9 months' implementation time for high, six-figure sums



Lack of expertise:

Electronics and cloud engineering, mobile app development, IT security, and connectivity required

LESSONS FROM IOT PROJECTS FOR LEADING MEDIUM-SIZED COMPANIES

Many medium-sized companies have difficulties with tackling IoT projects. If the focus is on innovation and not evolution, even the procedure models must be adapted to the new situation. When on familiar terrain, often the most promising approach is good forward planning – known in software development as the “waterfall model”. But in innovation projects, an agile approach is more advisable.

Agile process models like Scrum make it easier to learn along the way. Rapidly iterated, usable increments reveal the opportunities and risks of the product development already during the engineering process. This makes it possible to evaluate preliminary results, ideally through early customer feedback, so further engineering investments can be made in a way that adds considerable value. Ideally, such projects are managed based on a general product vision and by means of regular “quality gates”, thus enabling a target-oriented, systematic engineering approach and ensuring that transparent progress monitoring creates certainty also in the agile process model. But beyond the issue of what is the appropriate

procedure, the main dilemma of medium-sized companies in their development of Smart Connected Products is clear: although they often do not yet have a clear understanding and vision of the “digital business model”, they are expected to make substantial upfront investments in terms of time and money already for the technical integration.

In other words, the goal is still unclear, but the preliminary work and investments required are enormous. What this means in practice is that although an initial demonstrator can be created within a few days during a hackathon, in order to then get the engineering project to a stage where it has a product ready for volume production it will often be necessary for the company to budget large six-figure sums for the connectivity aspect alone and allow for a period of nine months (and longer) for implementation.

This combination prevents many companies from initiating the appropriate engineering activities, even though they recognize the necessity and urgency.

GETTING PRODUCTS CONNECTED QUICKLY, EASILY AND COST-EFFECTIVELY WITH CELLULAR IOT

As a result, there is a need for straightforward, reliable and at the same time cost-effective complete solutions that will help large-volume manufacturers in particular to quickly digitize their products and get them connected. This is only possible with true end-to-end solutions – ones that provide the full spectrum of IT, hardware, and connectivity between the product and the cloud.

One such plug-and-play solution is the Cellular IoT offering from grandcentrix. All that companies need to have is a product in which the Connectivity Board can be installed as well as a suitable power supply via an electrical connection or a high-capacity battery. After a few weeks, companies can evaluate initial product versions and perform functional tests; and after only six to nine months, they can begin volume production. The costs are on average 80% below the current costs for digitalization projects.



HARDWARE

The hardware part of the Cellular IoT offering is a circuit board that will also fit into tight installation spaces. It forms the link between the product and the internet. This circuit board, the motherboard, is connected to the product's controller and uses an integrated modem to establish the connection to the internet. An optional GPS receiver is also available.

The interface provides four digital inputs, four analog inputs (0–10 V), and two digital outputs and thereby already caters to the majority of common industrial applications. Simple analog sensors and digital probes as well as more complex interfaces like TTL-UART can be connected. The power supply connection for the motherboard – with a voltage range of 3.3 V to 17 V – is likewise established via the interface. The motherboard is furthermore equipped with connectors for an external LTE antenna and, if needed, an external GPS antenna.

If other physical interfaces are required for installation in a product or if additional sensors have to be accommodated, it is possible to expand the motherboard with a plug-in daughterboard. This architecture approach allows the integration of special industry standards, such as RS485, RS232 or 24V I/O.

Compared with solutions that promise to support as many standards as possible, fewer parts are used in the Connectivity Board, thus minimizing production costs. Ready-to-use daughterboards are already available for the standards mentioned above, and they can be deployed easily. New add-ons can be developed within a few weeks.



Size comparison Connectivity Board. Image: grandcentrix

CONNECTIVITY

The connection to the internet is enabled using new LTE-based standards, like Narrowband IoT (NB-IoT) and CAT-M1. As one of their names already suggests, they have been developed specifically for use in IoT applications and, unlike 5G, can already be used worldwide today. Both standards are particularly effective when products have to transmit over long distances and frequently from within buildings while at the same time being inexpensive to operate. The use of these licensed mobile communications standards that are available globally with broad coverage ensures a high quality of service, even in remote regions and right down into the basement level of a building.

Since Narrowband IoT can be activated by cellular network operators in existing base stations and has a greater range than conventional LTE, almost 100% of Germany's geographical area is already covered. The focus on narrow bandwidths ("narrowband") and small data volumes, however, also poses technical challenges. First of all, the low data transfer rate (0.2 Mbps down, 0.02 Mbps up) makes large firmware updates of several megabytes difficult.

Moreover, UDP is used as the data transfer protocol, which is considerably more complex to use than the TCP protocol commonly used on the internet. Finally, in the case of large production quantities, all production processes like the procurement and activation of SIM cards must also be arranged and price negotiations conducted with carriers.



Narrowband IoT coverage in Germany. Image: Vodafone

These issues are likewise solved with the Cellular IoT offering and further substantiate the end-to-end approach described above:

- **Over-the-air updates:** The relevant part of the firmware (customer-specific behavior and configuration parameters) is separate from the operating system and can be updated independently via Narrowband IoT. This saves on the amount of data transmitted.
- **Integration in the cloud:** By transforming UDP to TCP, the CT ensures all sent data packets can be processed by cloud platforms. This transformation enables the integration of all popular cloud systems.
- **Carrier integration:** The motherboard comes supplied with a SIM card that is automatically activated as soon as the device is powered up.

CLOUD

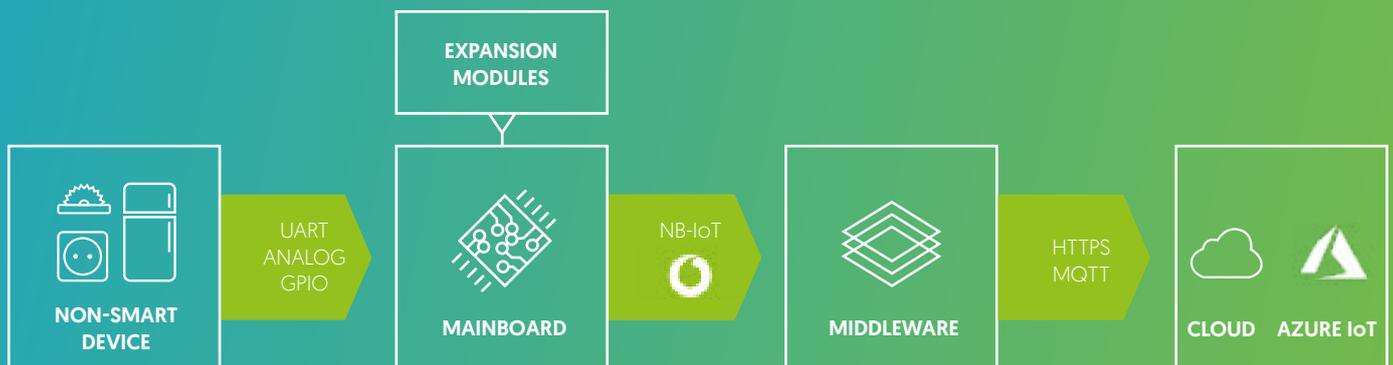
The data collected by the connected products will only begin to add value if it is made available in IoT platforms or analysis systems that allow it to be analyzed in conjunction with data from other business processes. These systems can usually be fed with data via an API or message broker, which is why the Cellular IoT offering is able to communicate with any HTTP(S) endpoints or MQTT servers provided by the customer.

In addition, native support for the most common IoT platform, Microsoft Azure IoT, is built in. If no such system is available, fast visualization of transmitted data is made possible thanks to support for Azure IoT Central.

SECURING MARKET SHARE WITH THE CELLULAR IOT OFFERING

- **End to end** Orchestrated complete solution, including hardware, firmware, and connectivity
- **Plug and play** Easy integration in devices using standard interfaces
- **Quality of service** Use of licensed IoT mobile radio communications standards
- **Global availability** Integration of global carriers, preferably Vodafone
- **Bundle pricing** Straightforward cost control with one price for all components
- **Cost control and provisioning** Via integrated SIM card management

- > **Initial products and tests** after 4 – 6 weeks
- > **Mass production** after 6 – 9 months
- > **Price** < 80% of typical project costs



Cellular IoT Architecture. Image: grandcentrix



ABOUT US

With more than 200 employees, grandcentrix is one of the strongest and most capable providers in the German-speaking market specializing exclusively in the smart home, the internet of things, and large-scale digital projects.

In over ten years since our company was founded, we have implemented many complex connected solutions in the areas of the internet of things, the smart home, retail, insurance, and mobile commerce and have taken on long-term responsibility for running and maintenance.

Our competencies range from the development of specific hardware and connectivity solutions to cloud platforms, front ends, and apps. In all of our projects, we apply agile project management methods and provide solution architecture support and end-to-end cybersecurity consulting.

We are strategic consultants and technical development engineers. We accompany and support our customers throughout all development phases, from the conceptual design stage all the way up to volume production. As of mid December 2019, grandcentrix is part of the Vodafone Group through a 100% shareholding of Vodafone Germany.

From now on, we will also supply you with network-integrated know-how from a single source - worldwide. Would you like to find out personally what we can do for you?

Contact us at [grandcentrix.net](https://www.grandcentrix.net) or get your individual appointment slot [here](#).