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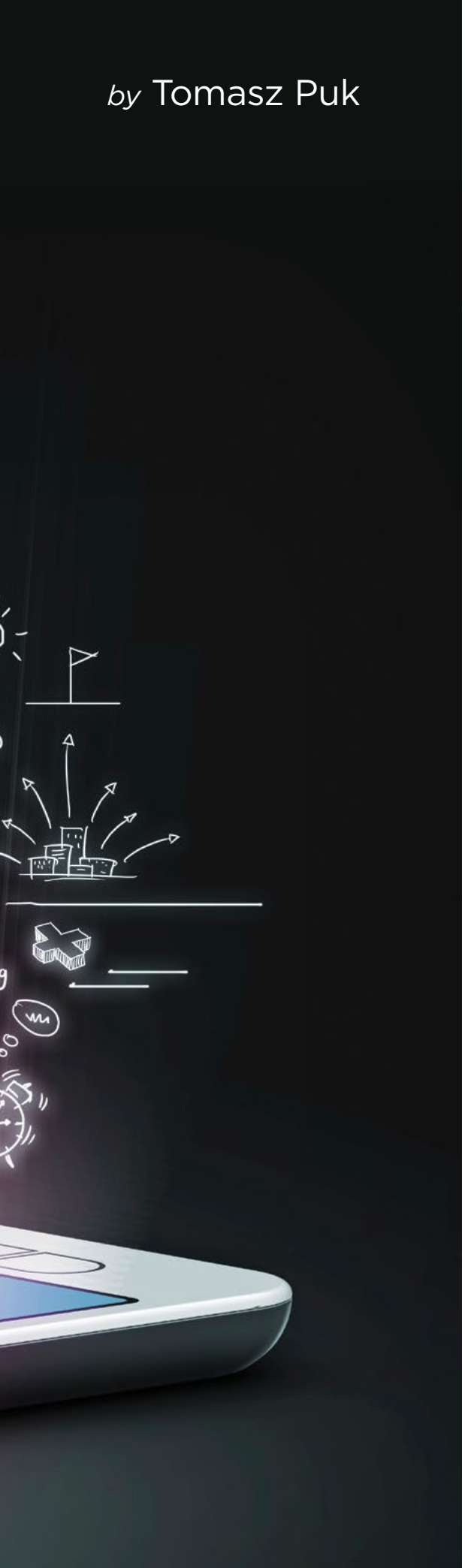
How to Develop an Industrial Internet of Things Solution

by Tomasz Puk



At the CeBIT and CED Tech Venture conferences last year, the Internet of Things (IoT) was surely one of the hottest topics discussed. Wearable gadgets are monitoring our fitness activities, home doors are recognizing our touch to let us in, and consumer shopping patterns are monitored and processed using beacon technologies. These are just a few examples of those dreams we once had coming true today.

Are you ready to develop an industrial IoT for your organization? This article uses a hypothetical organization to demonstrate what's involved in developing an industrial IoT solution and convince you to catch the IoT wave, as it seems to perfectly match the requirements of reliability management functions.

DEFINITION

What is the Internet of Things? Here's a look at two definitions:

"The Internet of Things (IoT) is the network of physical objects or 'things' embedded with electronics, software, sensors, and network connectivity, which enables these objects to collect and exchange data." www.wikipedia.org

"The Internet of Things is the network of physical objects that contain embedded technology to communicate and sense or interact with their internal states or the external environment." www.gartner.com

Those of you responsible for reliability management and condition monitoring will certainly find many similarities in these definitions and your current systems.

The biggest difference is the shift of the intelligence down to "things"/sensors operating in the immediate proximity of the monitored object. IoT sensors do not transmit data anymore; they process it locally, filter it and send only valuable information instead. Another major difference is the connectivity. In the modern world, developing a sensor that can communicate using global broadband service providers, Wi-Fi networks, Bluetooth connections, or any other means of communication is not a challenge any more.

Market Potential

Is this market worth fighting for? Gartner estimates the number of IoT devices to near 26 billion by 2020. IoT products are planned to generate $300 billion incremental revenue mostly in services. Gartner further predicts expansions in such industries as medical devices, factory sensors, agriculture, automotive and infrastructure integrity monitoring.[1]

Another important aspect worth adding to the IoT equation is the shift from a product to a service economy. Manufacturers are not only selling their products, but are starting to offer them together with accompanying services, like an extended operational warranty or replacement, and are even turning their former products into services.

One cost implication in the business-to-customer (B2C) market seems questionable. For example, the price difference between the intelligent lightbulb and the conventional one can peak to 100:1. On the other hand, the price impact of a compute module at around $40 added, for example, to an electric motor, can be negligible, especially for more sophisticated equipment. This is perhaps the major difference between IoT solutions in B2C and business-to-business (B2B) markets, where the latter can offer added value with only a slightly higher end product cost increase.

ACME Organization Case

OK, are you ready for a short journey to IoT product development? Let's take an imaginary ACME organization, an original equipment manufacturer (OEM) of electric motors. A new head of business strategy required the company to broaden its standard product range with new services. Let us accompany ACME in developing its first IoT solution.

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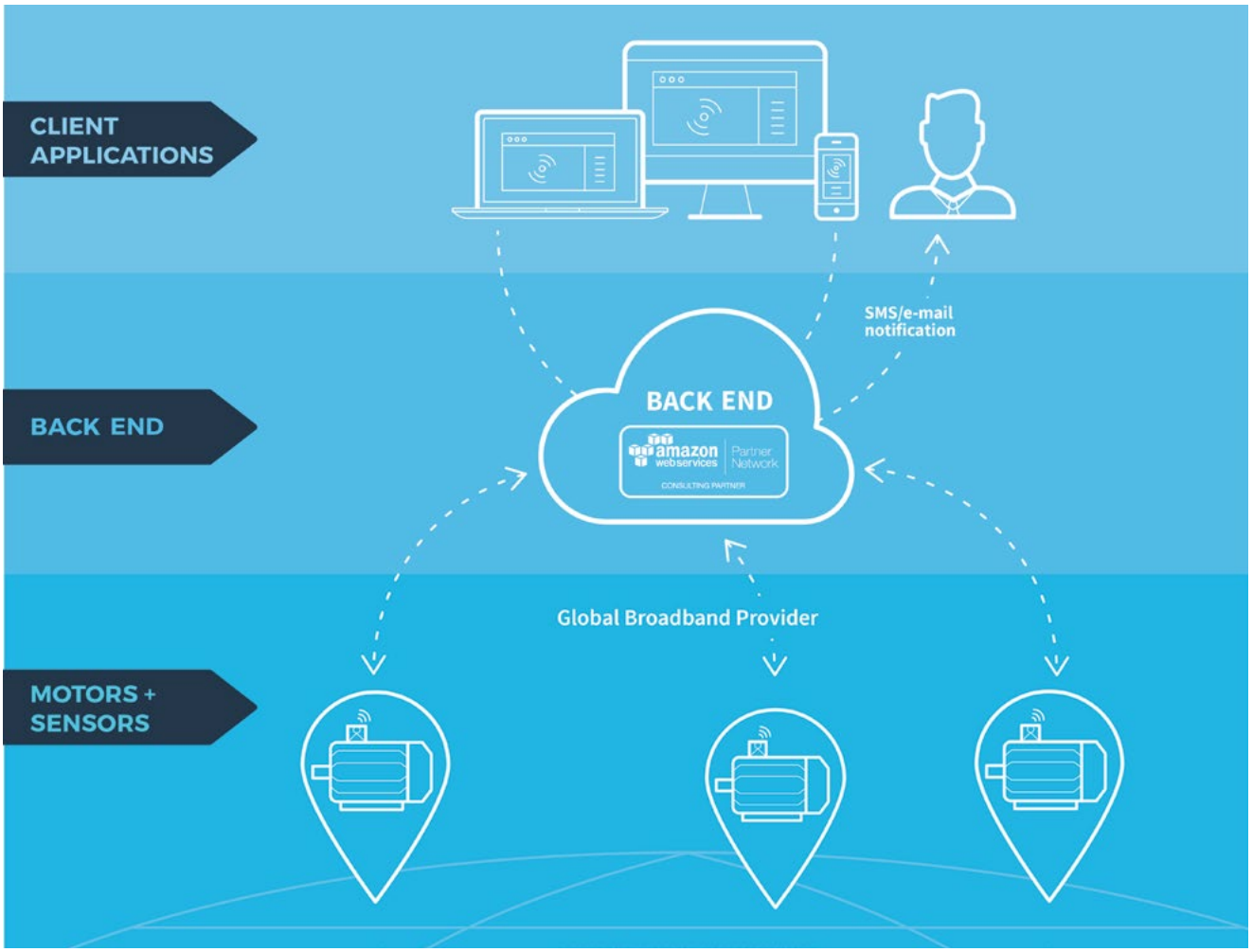
Figure 1: Sample overview of the ACME solution architecture



New Business Model

Definitely, the first thing to start with is a business model design. ACME has to reinvent its existing business model and come up with a new, updated one that will provide justification for the effort and cost behind the new venture. Sounds odd? Well, think about Nespresso®, Uber, or even Microsoft® Office 365. All these examples present situations where old products, like coffee beans, taxi services and software licenses, were turned into new services with different value propositions. Likewise ACME has to modify or redefine its existing value proposition for customers. Is it extended operation time, the accompanying condition monitoring service, or a totally new market niche with the mission's critical equipment?

Within the business model design, in addition to the value proposition, ACME will need to specify markets and paths to reach them, distribution channels and revenue streams. It will have to think about key activities, such as the development of IoT solutions, key resources, cost structure and partners. If you are interested in more details, a good resource is the "Business Model Generation" book by Alexander Osterwalder[2].

Product Concept

As the outcome of its business model redesign, let's assume ACME came up with the idea to enrich its existing product value proposition with an extended warranty and reliability service. Clients would be informed about the condition of their registered equipment, vibration thresholds, or any pending maintenance actions recommended by the manufacturer. The service would be offered as a platform, where local service providing organizations can offer their services, such as shaft alignment or parts replacement, based on the registered machines' conditions.

ACME is planning to collect motor condition information automatically and anonymously using a global broadband service provider. The machines will not be identified without client permission. ACME plans to use information from all the motors for its new product quality improvements. The company also plans to analyze incoming data against new service types.

Where to Start?

ACME is now facing one of the key challenges of a new product development: How and where to develop such a program? Does ACME have such competencies internally or should it look for an external technology partner? Whichever option is chosen, ACME has to assure competencies in the following areas: project/program management, business analysis, electronic design and embedded software development, web application development, user interface/user experience (UI/X) design, quality assurance and cloud infrastructure IT management.

IoT Solution Architecture

Figure 1 presents an overview of the ACME solution architecture. First of all, there is a tier of ACME electric motors equipped with sensors collecting required information. The motors use

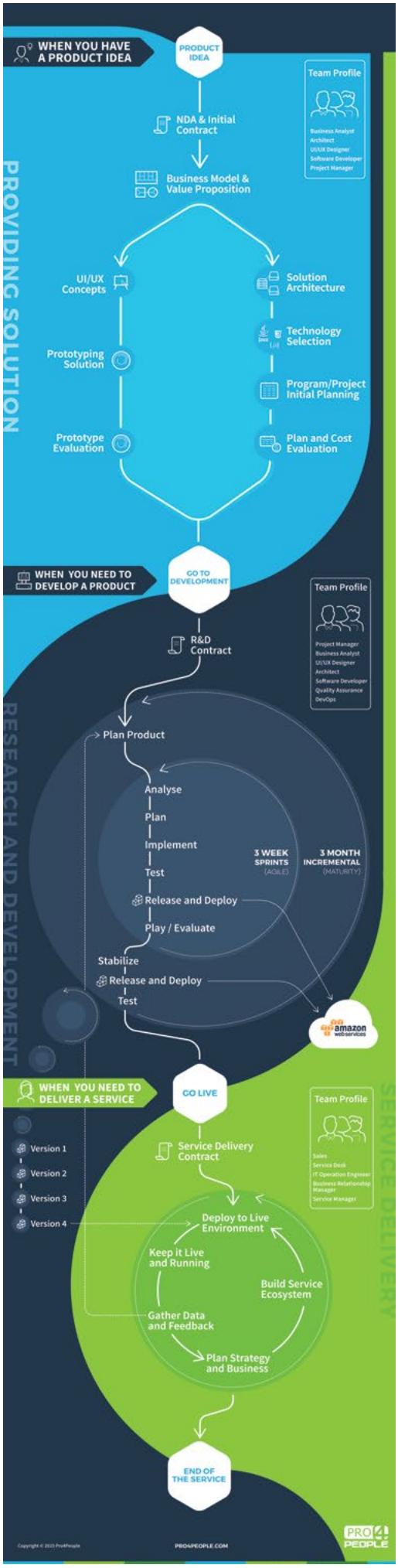


Figure 2: IT Service Lifecycle

global broadband subscriber identity module (SIM) cards to communicate with the back end component of the architecture. Only the processed daily reports are sent to the back end to avoid data overload and to minimize transmission costs.

The back end component is located on Amazon Web Services Cloud[3], enabling the whole IoT solution to operate on the global market from day one, independently to where the ACME motors will be shipped. It is responsible for collecting data from "things," processing and analyzing it, and sending any notifications to people in charge in case any action is required. That part of the architecture is also responsible for data storage on cloud storage services, like Amazon's Simple Storage Service (S3),[4] leaving the door open for future big data processing.

The next tier contains client applications, operating in web browsers on both desktop and mobile devices (responsive web design[5]). The applications are used primarily by clients and then by ACME service delivery teams responsible for providing new services.

Clients purchase ACME motors already equipped with sensors. If a client decides to use a new ACME service, the client has to register its organization and it assets using ACME's web portal. From that moment on, the client can use the new service.

Here are some advantages for the client:

- Communication is built into the ACME motors;
- No up-front investments;
- No additional infrastructure costs;
- No communication configuration required;
- Access to ACME's services in a software as a service[6] model with a monthly fee.

Program

In order to develop this IoT solution, ACME had to actually launch these projects:

- Motor monitoring embedded device, with the goal to develop a measurement device for its motors;
- Cloud project, with the goal to develop back end system logic and client applications;
- IoT service delivery project, with the goal to build functions, processes and an organization structure to deliver new services to ACME clients.

There is also a need to set up a program umbrella above the three projects to assure all projects are synchronized, planned and tested together for the final outcomes. The program itself will go through different phases, such as:

- Solution providing, where the IoT solution concept is created, a prototype built and the program separated into a work breakdown structure;
- Research and development, when all the projects are started and developed together to deliver platform components;
- Service delivery, a phase when an IoT service is up and running after the first initial product release.

The first thing to start with is a business model design

The different lifecycles of the IT service are presented in Figure 2.

Summary

Where is the hypothetical ACME organization now? After 12 months of research and development, it has launched its first version of the solution following the customer development process[7]. The company is collecting data from all newly shipped motors and using it to improve the quality of its products and to learn more about the usage patterns of its equipment. ACME continues to extend its new services portfolio.

Those customers who decide to register their equipment get a reliability report monthly or are informed automatically of a situation requiring direct action. By using its new IoT solution, ACME has managed to improve communication between machines and people responsible for reliability management.

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