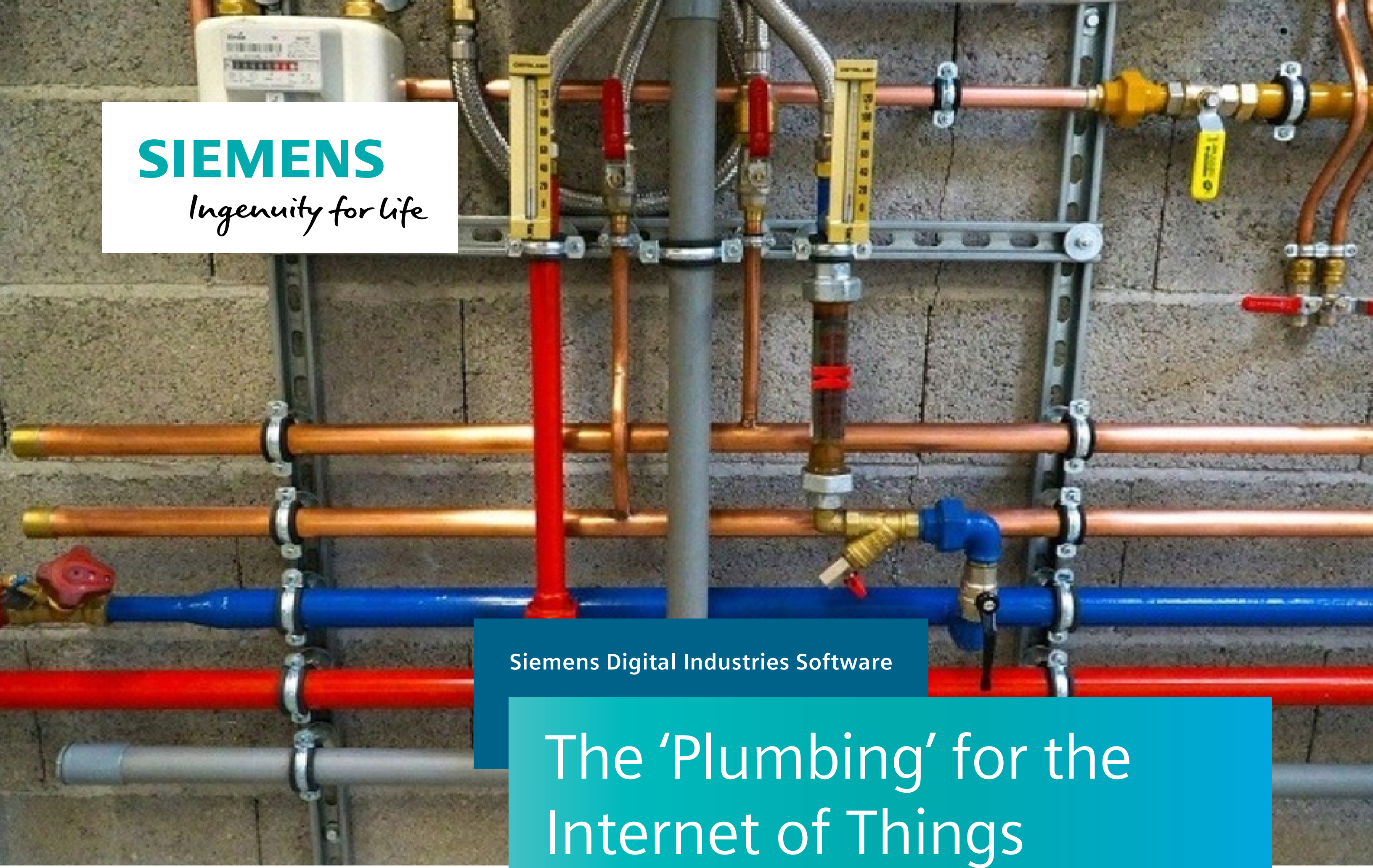

SIEMENS
Ingenuity for life

Siemens Digital Industries Software

The 'Plumbing' for the Internet of Things

Executive summary

Today's device builders are scrambling to create feature-rich connected devices with digital experiences around them with the increasing trend driving the Internet of Things (IoT). Embedded developers are facing short- and long-term challenges that require careful consideration when adopting foundational technology for an IoT implementation, such as maintenance, evolving and supporting the product life cycle. DIY approach to stitch together a modern, secure, scalable and compliant solution in cost effective manner may not be sufficient. This article provides guidance to help the IoT device developer manage the potential risk factors.

Muhammad Shafique
Solution Architect
Embedded Platforms, Siemens Digital Industries Software

Introduction

Internet of Things (IoT) implementations continue to grow at amazing pace in various industry segments as IoT becomes a key factor to differentiate and provide additional value to otherwise standalone devices.

This article covers current trends in IoT technology adoption, the implementation challenges embedded developers face, followed by a recommendation for successful execution to ensure IoT-connected devices are developed to meet time-to-market expectations are also able to meet long term evolution.

IoT Adoption Trends

The key trends driving IoT adoption are as follows:

- The ubiquitous presence of smart phones with applications encompassing every aspect of our lives is driving a similar connected digital experience expectation around other devices. For example, traditional standalone devices like thermostats or air compressors are now increasingly developed as connected devices with a digital user experience around them.
- IoT connectivity allows device builders to continue to manage devices after they are sold and deployed in the field. Device builders can provide remote firmware updates to keep devices secure, or they can offer to remotely maintain and service the devices.
- As the compute and storage resources grow on IoT-enabled devices, they are becoming more capable of providing a local real-time response with growing level of intelligence and autonomy. This intelligence typically relies on data analysis and machine learning done in the cloud and then continually feeding improvements to local intelligence on the device.
- IoT capabilities enable device builders to provide additional value-added services around their devices. This can also lead to business transformation where the device builder focuses on selling the outcome instead of the device (e.g., selling compressed gas as a service instead of selling compressors).

IoT Adoption Curve

Initial IoT adoption focus may be different from organization to organization, but over time, as the learning and experience in IoT continues to grow, new use-cases are identified and implemented. Overall, the IoT enablement can be considered as a journey where humble beginnings multiply over time and eventually lead to business transformation.

A typical IoT adoption journey at an organization may start with some simple proof of concept that is followed up by offering connected device experiences to the user, such as remote on/off or collecting, visualizing and analyzing telemetry data. This can be followed by adding capabilities to remotely manage and service the device. In addition, as more insights are discovered from the collected data, the device builder can provide additional value-added services, including energy management, predictive maintenance etc. Eventually, the device builders can bring in new business models around their devices where they focus on selling outcomes instead of selling the device.

One key observation to make here is that this journey continues to evolve over time and builds on top of initial capabilities. The overall complexity of the solution and the underlying implementation grows as the solution increases in value and its feature set.

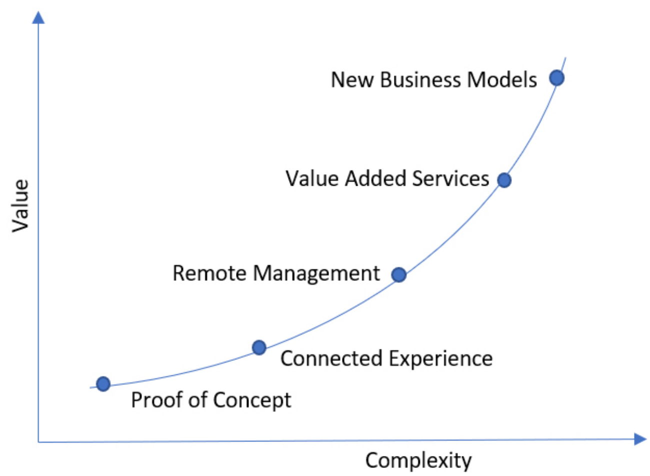

Figure 1: The IoT Adoption Curve

IoT Adoption Challenges

By definition, IoT implementation consists of multiple inter-operating domains. It involves "things" that are typically embedded devices of varying capabilities. They connect to the "internet" that consist of data collection and processing capabilities (IoT Platform), and also provides a user interface for end users, either web or mobile applications.

With this layering definition in mind, here are some of the key challenges inherent to an IoT implementation:

- Security: Keeping each layer secure throughout the life cycle of the IoT implementation is a key challenge. All the inter-operating domains have different needs to keep them secure. For example, the embedded devices need firmware updates with security vulnerability fixes that may have been identified after deployment. The IoT Platform and applications also need package updates and require maintaining access controls at different levels. Cyberattacks causing disruption to operations and critical infrastructure are among the top five increasing global risks [1].

- Keeping Up with Technology: In general, there is a lot of activity at each implementation layer where new technology is introduced quite frequently, and old components become obsolete. As the IoT-enabled devices can be deployed and remain active in the field for long period of time, it is important to provide feature and technical updates to each layer to stay relevant.

- Compliance: New regulatory compliance at government, industry, or at an organizational level continues to emerge that requires tweaks or adjustments to the IoT implementations.

- Cost Management: Keeping the cost of IoT implementation in check is another challenge that device builders face as it can grow substantially over time, as integration between different layers is realized and they are operated as an IoT solution for longer periods of time.

- Scalability: IoT implementations need to scale over time, both horizontally where more devices will be extensively connected, and vertical scalability, where more services and systems will need integration as the IoT solution journey moves up the adoption curve.

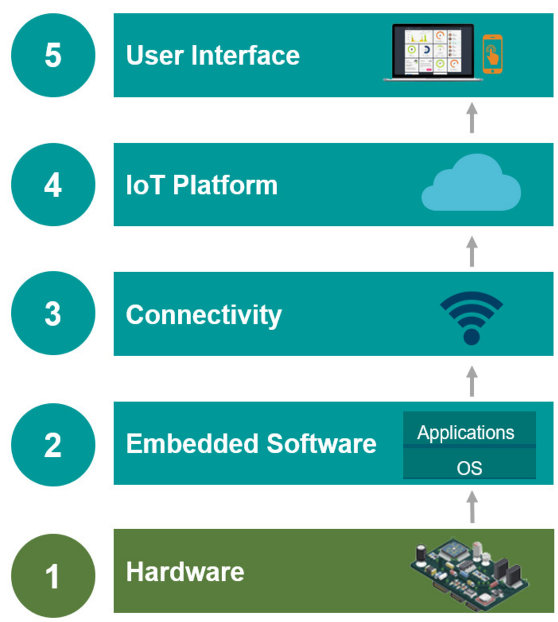

Figure 2: The Enabled IoT Device Stack

IoT Implementation Approach

Starting an IoT journey can be deceptively simple. All one needs to do is take community hardware, install pre-configured open-source software/applications, add an internet connection to one of the free IoT platform accounts, and start visualizing data via one of the freely available dashboarding applications. This simplicity is quite useful on one hand as it helps quickly try out simple IoT use-cases, but on the other hand, it is quite risky as it pushes organizations to homegrown IoT implementations. As described above, this is just a starting point on a long journey, and by using a DIY approach, one is taking on several potential challenges, such as security and threat management, technology updates, compliance, development and integration cost, and future scalability needs.

This approach is particularly problematic in the long run, even if there are early wins, as the cost to operate and maintain the overall solution keeps growing. This results in organizations spending resources on integrating and hardening technology areas that are not their core strength and moves their focus away from the domain-specific applications which provide real value to their customers. For example, a boiler manufacturer or solar system manufacturer needs to focus on building differentiated applications for their customers instead of consuming resources to build and operate the five layers needed as a base for an IoT solution, as discussed above.

Most businesses under-estimate the risks and challenges of the DIY model as "less than 30 percent have taken their IoT programs beyond the pilot phase" [2]. They require increasingly more resources to maintain and keep secure. In 2020, reported security vulnerabilities reached 18,325 (average > 350 per week) [3], so just to navigate and keep up with the newly identified threats each week is a significant effort.

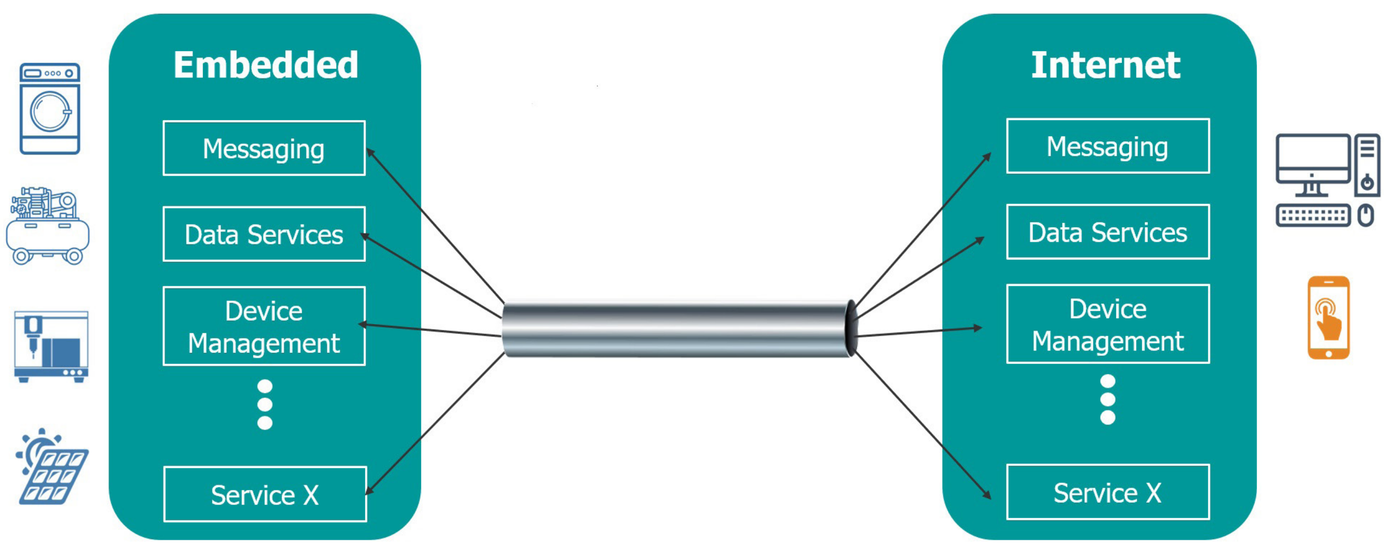

Figure 3: IoT Solutions need plumbing to work seamlessly to provide the desired application functionality

The Plumbing Analogy

A good analogy in this case is to consider the best approach to get plumbing done at one's house. The plumbing system should be realiable, work efficiently and also comply to all applicable building codes and regulations. The obvious choice to get plumbing done is to call the experts and get it done quickly so that one can quickly start using it. It will be far more costly, and time consuming to learn how plumbing works, and then put together an actual working plumbing system. The added advantage of first approach is that expert support is a call away should there be any leaks or other issues in future.

In the same way when starting an IoT journey, the best decision is to get a working system that comes integrated with five layers of technology required for IoT. The in-house team can focus on building domain specific value-added services to acquire competitive edge in the market.

Here, the real discussion should be about efficiency and economics, not about the ability to develop a solution in-house. It just makes sense to get an integrated, cost effective, reliable, and supported base to start the IoT journey instead of spending valuable in-house resources.

The 80/20 Solution

The best approach to embark on an IoT journey is to find a technology stack that provides a strong foundation for various layers of IoT implementations. This can be considered as an 80-20 solution mix where 80% of the solution does not differentiate between a boiler or a compressor, and 20% of the IoT solution is based on domain know-how specific to the boiler or compressor. The ideal solution is end-to-end integrated, hardened, and offers flexibility to support domain-specific customization, and continually evolves as the technology moves forward.

An example of one such solution is offered by Siemens Digital Industries Software, providing an end-to-end technology stack encompassing different layers required for an IoT implementation. The technology stack consists of Siemens' MindSphere, a feature rich, cloud agnostic IoT platform and embedded software from Siemens Embedded with 20 years of experience providing quality embedded software. It comes with implementation of applications (fleet management, remote device management, visualization and dashboarding etc.) This allows device builders to quickly bring IoT implementations to market that are ready to support their growth and business transformation goals.

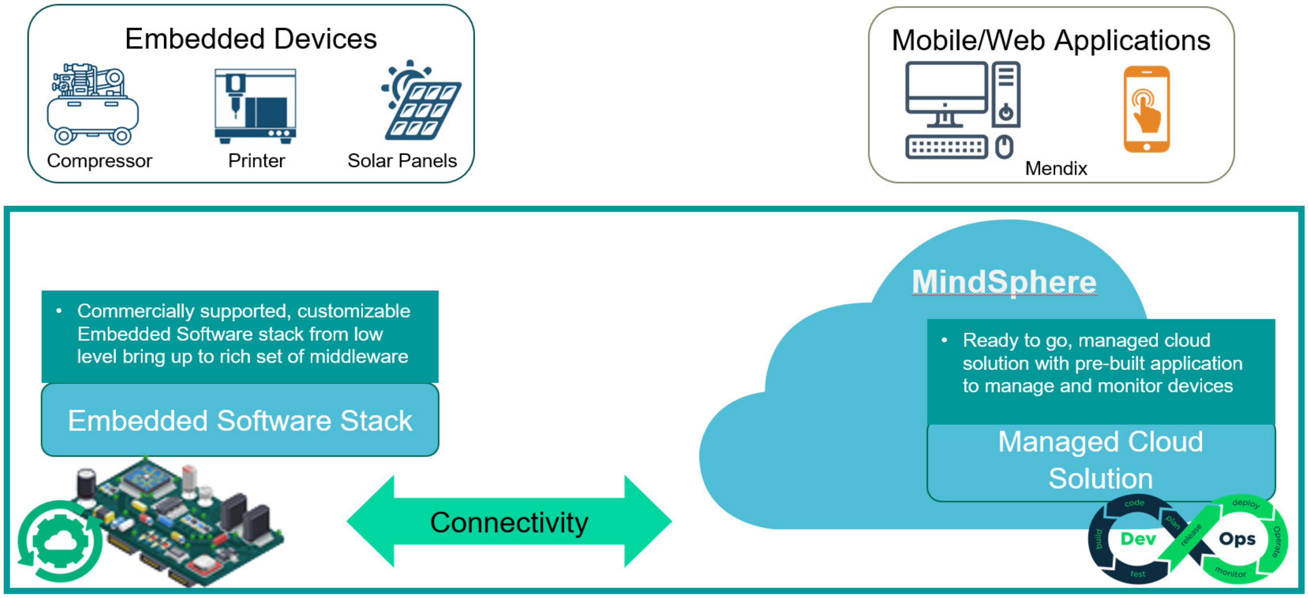

Figure 4: The Siemens Integrated IoT Solution from embedded device to mobile application running on a managed cloud

Conclusion

IoT adoption is on the rise and today's device builders are scrambling to create feature rich connected devices with digital experiences around them. There are short- and long-term challenges that need careful consideration when adopting foundational technology for an IoT implementation as it will need to be maintained, evolved and supported for the life cycle of the product. DIY approach to stitch together a modern, secure, scalable and compliant solution in cost effective manner may not be sufficient as there are too many risk factors to consider. It may be more efficient to seek proven, off the shelf technology stack to build an IoT offering. This approach can helps mitigate the risks and enables device builders to focus on customized applications and rich features which can differentiate their products from competitors.

To explore Siemens IoT solutions for your next project, visit:

https://siemens.com/mindsphere
https://siemens.com/embedded

References

1. 2020 Global Risk Report, World Economic Forum https://www.weforum.org/reports/the-global-risks-report-2020
2. What separates leaders from laggards in the Internet of Things, McKinsey https://www.mckinsey.com/business-functions/mckinsey-digital/ our-insights/ what-separates-leaders-from-laggards-in-the-internet-of-things
3. Vulnerabilities By Year, CVE Details https://www.cvedetails.com/browse-by-date.php

Siemens Digital Industries Software

Headquarters
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 972 987 3000

Americas
Granite Park One
5800 Granite Parkway
Suite 600
Plano, TX 75024
USA
+1 314 264 8499

Europe
Stephenson House
Sir William Siemens Square
Frimley, Camberley
Surrey, GU16 8QD
+44 (0) 1276 413200

Asia-Pacific
Unit 901-902, 9/F
Tower B, Manulife Financial Centre
223-231 Wai Yip Street, Kwun Tong
Kowloon, Hong Kong
+852 2230 3333

Biography

Muhammad Shafique is a solution architect for Embedded Platforms, Siemens Digital Industries Software with over 19 years of experience in the embedded software industry. His experience spans from deeply embedded software (booting strategies, operating systems, and multicore solutions) all the way up to the higher layers of embedded software stack and embedded device management in cloud (Internet of Things stacks/protocols, industrial connectivity protocols). Muhammad holds a bachelor's degree in Electrical Engineering from the University of Engineering & Technology in Lahore, Pakistan.

About Siemens Digital Industries Software

Siemens Digital Industries Software is driving transformation to enable a digital enterprise where engineering, manufacturing and electronics design meet tomorrow. Xcelerator, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, helps companies of all sizes create and leverage a comprehensive digital twin that provides organizations with new insights, opportunities and levels of automation to drive innovation. For more information on Siemens Digital Industries Software products and services, visit siemens.com/software or follow us on LinkedIn, Twitter, Facebook and Instagram. Siemens Digital Industries Software – Where today meets tomorrow.

siemens.com/embedded

WP-SP306 - 01/22 LH