IoT Standards Matters

IoT Standards Matters will look at different segments of the IoT market as it relates to implementation and use of standards. Each column will select a particular vertical, and lay out the relevant standards and technologies that affect the evolving IoT hyperspace. The pace of the columns will start broadly with the vision of narrowing the subject of subsequent articles toward more specific applications of standards, whether in the development, application, test, or commissioning of IoT technologies.

Introduction

This is my opening standards column for the *IEEE IoT Magazine*. Hence, I thought of sharing my broader perspective on standardization (developed in last four decades during my journey as a design engineer), contextualizing it with the IoT paradigm and setting the context for what you can expect in this column in the succeeding issues. Through this column, I propose to demystify the popular myth — "Standards block Innovation" amongst other misconceptions about the standardization paradigm. Hope to run an interactive column where questions, comments & critique shall be eagerly looked for and responded earnestly.

Mentor's Musings on IoT 2.0: IoT Coming of Age

by N. Kishor Narang
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Since its advent more than a decade and a half back, the IoT paradigm has crossed through different phases of the famous Gartner Hype Curve, and has truly come of age. It would be apt to see what IoT 2.0 is, or could be all about, today.

"IoT," a concept that originally sounded like something out of sci-fi movie — the "Internet of Things" — is, in fact, a reality, and one that is bound to become even more widespread. From being considered as one of the most disruptive technologies since the World Wide Web, it is now on the verge of becoming one of the most profound technologies by *weaving itself into the fabric of everyday life, until it becomes indistinguishable from it*[1].

The IoT value chain is perhaps the most diverse and complicated value chain of any industry or consortium that exists in the world. In fact, the gold rush to IoT is so pervasive that if you combine much of the value chains of most industry trade associations, standards bodies, the ecosystem partners of trade associations and standards bodies, and then add in the different technology providers feeding those industries, you get close to understanding the scope of the task. In this absolutely heterogeneous scenario, coming up with common harmonized standards is a major hurdle.

New technologies and paradigms like Big Data, Artificial Intelligence, Virtualization, and Cloud Computing, are promising to disrupt the way we design products, systems and solutions. Design engineers need to develop new strategies that can help them navigate seamlessly through a much wider and complex canvas of technologies, ecosystems and stakeholders. It is difficult for innovation to happen across disjointed platforms and technologies. Creating the opportunity for ecosystem partners to work across common open platforms facilitates faster innovation.

Being the skeptic that I am, I am inclined to opine that in spite of so much hype and even genuine potential, the IoT paradigm has not proliferated to its ultimate potential. Every true IoT application or solution needs cross-domain expertise. Bringing the Internet of Things to life requires a comprehensive systems approach, inclusive of intelligent processing and sensing technology, connectivity, software and services, along with a leading ecosystem of partners. We need to see acceleration and a maturing of common standards, more cross-sector collaboration and creative approaches to business models.

Even IEEE, as part of its Strategic Plan for 2020–2025,[2] has put major emphasis on "Enhance public understanding of engineering and technology and pursue standards for their practical application." In my opinion, we need a new paradigm for standards from technology to delivering innovation.

However, proponents of another school of thought feel that standards are important but not the driving factor in IoT deployments. In their opinion, a 20 percent CAGR for IoT (as most analysts like IDC project), which is a faster adoption rate than the growth of any economy, means that things are not broken. They also feel that IoT is so broad a concept that one size fits all approaches using monolithic standards are not likely to succeed. Major organizations such as The Industrial Internet Consortium and OneM2M have stepped back from that and are focusing on specific verticals for standards development.

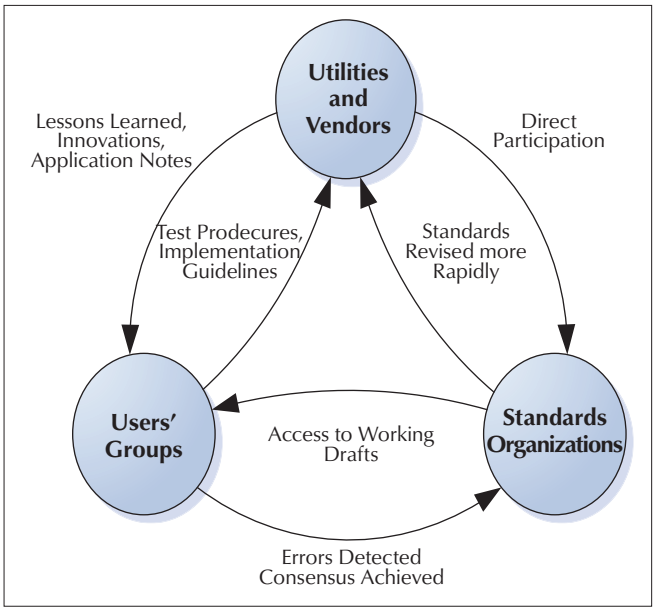
Andrew S. Tanenbaum stated in 1990 that "**The beauty of standards is that there are so many to choose from!**" In an ideal world, we would have exactly one standard for each task or interface. However, in reality, there are often overlapping or rivaling standards, driven by different vendor "camps." So, what can a developer do? Support all standards? Too expensive. Wait for one standard to replace all others? May not happen. Implement a software abstraction layer that permits certain interfaces/standards to be replaced? Good, if possible. Choose one standard and accept incompatibility with all others? Bad, but sometimes the only choice.

"***The irony is that Standards and even SDOs are not at the forefront of Solution designers, developers, providers, deployers or users' minds.***" There are misconceptions on what standards are for, and the case for the use of standards has not been made. Most researchers, design engineers and even startups argue that **standards block innovation**. Liberalization and markets have many great virtues, but they cannot create their own conditions of existence, they **must be designed**! Truly speaking, a consumer focus is also missing in the global standardization movement. It is important to remember that standardization is a **tool** and not an end in itself.

The imperatives of building a sustainable and secure planet have given rise to new paradigms like the green movement, DC power, renewables, microgrids, networking devices, network and cyber security, smart homes, smart buildings, smart grids and smart cities. All these shifting and rising paradigms are ultimately converging into the new and much larger paradigm of 'unified and secure' digital infrastructure.

The extensive work done by various global SDOs has very comprehensively defined the frameworks and roadmap for future Information and Communications Technology (ICT) Infrastructure. However, the new paradigm of Internet of Things has given rise to a new aspect of the way humans, machines and things are going to communicate with each other in the very near future. Internet of Things is all about "heterogeneous" and "aware" devices interacting to simplify people's life in some way or the other. The heterogeneity of the IoT paradigm has made it imperative to have a fresh look at the prevalent architectures and frameworks of the ICT Infrastructure being deployed or being developed.

But true convergence is still eluding the evolved citizens of today's super industrial society, because of a lack of harmonized standards in the respective ecosystems of smart homes, smart buildings, smart grid, and smart cities. The smart nodes of one network cannot talk to smart nodes of the other networks. Multitudes of "proprietary systems/solutions," or "systems/solutions with very limited interoperability" are being deployed in each application area for today's home automation, building automation, industrial automation or even the infrastructure automation needs of the society. This is definitely going to



ensure that we shall not be able to derive the maximum benefits of these technologies, whatsoever.

The multiplicity of technologies and their convergence in many new and emerging markets, however, particularly those involving large-scale infrastructure, demand a top-down approach to standardization starting at the system or system-architecture level rather than at the product level. Therefore, the systemic approach in standardization work can define and strengthen the systems approach throughout the technical community to ensure that highly complex market sectors can be properly addressed and supported. It promotes an increased co-operation with many other standards-developing organizations and relevant non-standards bodies needed on an international level. Further, standardization needs to be inclusive, top down and bottom up; a new hybrid model with a comprehensive approach is needed.

The architectures and frameworks that we design for the different digital infrastructures provide only high-level guidelines to the stakeholders of different layers and components. To achieve comprehensive interoperability, it is imperative to work on the finest granularity of each component and layer for standardization, as well as harmonization, and ensure the interoperability among various similar components addressing different applications at semantic as well as syntactic levels. Further, the standards being adopted for the smart homes or smart buildings deployments must be harmonized with standards in all other relevant ecosystems like smart grids and smart cities and integrated digital infrastructure paradigms. **There is a need to create and suggest frameworks to achieve the Interoperability among all the devices and layers at every interface in the networks**, be it a smart home network, a smart building network, a smart city/community network or the smart grid network that shall enable the stakeholders to prepare a set of detailed standards-based specifications to cater to specific/defined/fixed use cases followed by development of compliance testing frameworks.

One of the most challenging imperatives for standards development organizations today is harmonization of standards in smart homes, smart buildings, smart manufacturing, smart grid, and smart cities for *smart, sustainable and secure communities*.

A reality check of the myths, hypes and the realistic evolution of the IoT paradigm is the need of the hour, and understanding its new Avatar (**IoT 2.0**), leveraging the latest disruptive technologies in a ubiquitous way, bringing more value to the stakeholders with shifting perspectives, is imperative to develop the future strategies in an inclusive, scalable and comprehensive manner.

It is high time we try to bring some semblance of order into this chaotic paradigm by bringing the systems approach to resolve this complex problem. There is substantial scope to harmonize many aspects and bring interoperability among multiple competing and/or conflicting standards be it in the syntactic and semantic aspects, or at different layers' protocols like network layer and application layer protocols, notwithstanding the architectures.

I find *IEEE Internet of Things Magazine*, read by all the global technology and standards experts, researchers and academicians in the IoT domain, as the most appropriate platform to deliberate and brainstorm the current trends, initiatives and challenges being faced by the stakeholders to evolve comprehensive strategies to bring harmonization in standards for this highly heterogeneous and fragmented ecosystem.

In this column, we (me and my fellow Standards Columnist Dr. John Zao) will be discussing the imperatives, challenges and the way forward (with some actionable insights) to leverage standards in our respective IoT journey to make it more inclusive, widespread and comprehensive. In the coming issues, we plan to address a few questions including but not limited to:

- **Who owns the data semantics?** The communications protocols, or the products themselves?
- **A unified (communications technology agnostic) last mile communications protocol stack** — a myth or reality?
- **Unified and secure ICT architecture for IoT in digital infrastructure across domains and verticals** — the imperatives, the advantages, and the approach.

Biographies

N. Kishor Narang (kishor@narnix.com) is a technology consultant, mentor, and design architect in electrical, electronics, and ICT with over 40 years of professional experience in education, research, design, and consulting. He has over 30 years of hardcore research, design, and development experience in fields as diverse as industrial engineering, power and energy engineering, IT, telecommunications, medical devices, and environmental engineering. Professionally, he is an electronics design engineer practicing design and development across a wide spectrum of products, systems, and solutions through his own independent design house, NARNIX, since 1981. For the last 10 years, he has been deeply involved in standardization in the electrical, electronics, communications, and information technology domains with a focus on identifying gaps in standards to bring harmonization through standardized interfaces to ensure end-to-end Interoperability. He has been leading national standardization initiatives at BIS, the Indian national standards development organization (SDO), in smart cities, smart manufacturing, smart energy, and active assisted living as the Chairman of the Smart Infrastructure Sectional Committee LITD 28, along with contributing to multiple other SDOs and initiatives. Globally, he is Vice Chair-Strategy and Project Leader of two international standards in IEC SyC Smart Cities, a Co-Editor in ISO/IEC JTC1/WG 11 Four Standards, and a member of the Steering Committee of OCEANIS, beyond proactive contributions in many committees in global SDOs.

John K. Zhao is an expert on the Internet of Things, edge/fog computing, and Internet security. He received his B.A.Sc. (Hon.) degree in engineering Sscience and M.A.Sc. degree in electrical engineering from the University of Toronto, and later S.M. and Ph.D. degrees in computer science from Harvard University. He is currently the Director of the Intelligent Edge/Fog Computing Research Center and the CTO of the Center of Industry Accelerator and Patent Strategy of National Chiao Tung University in Taiwan. He is also the Founding Chair of the IEEE Standard Working Group on Fog Computing and Networking Architecture Framework and the Founding Vice-Chair of the IEEE Standard Committee on Edge/Fog/Cloud Communication with IoT and Big Data. He is deeply involved in the technology development and promotion of Industrial IoT. As a leader in the Industrial Internet Consortium, he serves as Co-Chair of their Security Working Group, Distributed Computing Task Group, and China Regional Team. Before returning to Asia, he was a Senior Member of Technical Staff and then a Principal Member of Technical Staff in the Information Security Department of BBN Technologies, the pioneer of packet-switching ARPANet. While at BBN, he also served as the principal investigator of four DARPA projects on Mobile IP, Internet Security Policy Management, and Information Assurance Formal Models.

Footnotes

[1] Mark Weiser, The Computer for the 21st Century, *Scientific American*, Sept. 1991.

[2] https://www.ieee.org/about/ieee-strategic-plan.html