The Industrial Internet Consortium's (IIC) second-quarter member meeting, held virtually from June 22nd ~ 26th, was a great success with 213 attendees, 50 working sessions, 14 testbed sessions, nine industry track sessions, three panels, three webinars, two breakout sessions, and one half-day training course on the Security Maturity Model.

STANDARDS

Face-to-face quarterly meetings are generally planned some months out—at least nine, and often twice that. This is necessary because securing enough hotel rooms for large groups is (or should we say "was") difficult to accomplish with less time. We, the IIC, also try to co-locate with our sister program, the Object Management Group®'s (OMG®) standards-development organization around once a year. This is because one of IIC's goals is to formulate standards requirements for the industrial internet that then need to be turned into specifications. As OMG's standards-development is one of the fastest (and a quick route to standardization by the International Standards Organization (ISO)), it's natural that we should talk. So, we planned a joint face-to-face meeting. Of course, that didn't happen, but many joint activities did take place.

One way in which we develop standards requirements is through the testbed program, which generates requirements for future technology standards and drives multi-vendor interoperability. That is a primary reason why we have a testbed program!

The *Track and Trace Testbed* tracks the location of intelligent logistics objects and assets in logistics and supply chains. The business challenges include:

- no transparency across the entire inbound supply chain due to many players,
- externally invisible damage caused by shock or temperature during transport is not detected,
- optimization measures are only possible in segments of the supply chain and there is a
- need for high communication effort between the actors due to lack of transparency.

Using intelligent sensors, gateways and services, load carriers and shipments regularly communicate their location and status to the data center to provide automation and transparency of processes in real time for high-value assets such as containers, load carriers and lattice boxes, especially for time-critical, high-value or sensitive shipments, in closed loops.

Currently, manufacturers of hardware sensors that generate data rely on data sheets to describe the sensor-supplied data. Each manufacturer has defined its own data sheet format. PDF files are downloaded from a manufacturer's website, and then manually read and understood by an end user, who implements software to 'read' the sensor data. Errors and ambiguities can occur in

these situations. There is therefore a demand to standardize the way sensor data is interpreted into a reader, so the testbed team sought proposals for a vendor-independent metamodel for data generated by hardware sensors. The result is a new standard, announced here, Simple Electronic Notation for Sensor Reporting SENSR.

SENSR defines a simple descriptive language that allows sensor manufacturers to publish data sheets in a machine-readable and consumable format. This enables consumers of sensor data to create a single implementation of a SENSR-compatible configuration system and adjust their interpretation of data streams to any sensor in an environment, dynamically. SENSR provides the basis for defining any physical data down to the single-bit level of granularity, as well as complex media types such as MPEG-4.

Time-Sensitive Networking (TSN) is a key technology in multiple industries, especially in manufacturing. Manufacturing operations require tight coordination of sensing and actuation to perform closed-loop control safely and efficiently. Typically, these systems have been deployed using non-standard network infrastructure or air-gapped (unconnected) standard networks. This approach makes it more difficult to access devices and data and creates a technical barrier to consume data anywhere throughout the infrastructure.

To address these needs all the way to the control system, the TSN Task Group of the IEEE organization has been working to update the standards for Ethernet and wireless (IEEE 802) to support deterministic communication. The technology will be used to support real-time control and synchronization of high-performance machines over a single, standard Ethernet network, supporting multi-vendor interoperability and integration. When appropriate, the TSN Testbed will integrate industrial automation protocols that are adopting TSN, such as OPC UA. The testbed includes developing applications and data definitions to be communicated using TSN over OPC UA Pub-Sub, to be implemented by participants.

TSN opens up critical control applications such as robot control, drive control and vision systems to the industrial internet, enables customers, suppliers and vendors to access data from these systems and to apply preventative maintenance and optimization routines to these systems.

The TSN Testbed has contributed to multiple standards, and is presently focusing on recommendations to IEEE 802.1 to characterize traffic types and apply the TSN mechanisms to these, IEEE 802.1AS2020 for timing synchronization, IEEE 802.1 Qbv for scheduled traffic and IEEE 802.1 Qcc for system configuration. (See here for further details.)

The *Connected Care Testbed* focuses on creating an open health care ecosystem for remote monitoring of patients, giving them the option of living at home while managing their chronic conditions. This creates a cost-effective solution for patients and their families, and provides caregivers the opportunity to provide continuous care beyond the walls of their office or facilities. The testbed is hosted at the MD PnP lab, a recognized leader in the development of the concepts and capabilities for integrated clinical environments. The testbed work will be included and released as open source software under the OpenICE framework in collaboration with the ASTM F2761-2009 standard.

Clinical patient monitoring is included in this ecosystem to allow for data aggregation and unification of patient data into a single environment. Caregivers can access a full patient history including clinical and hospital visits with patient vital summaries collected, summarized and analyzed along with the patient's remote monitoring data. Dashboard summaries of patient data provides a single-page view into the patient's health and adherence to prescribed therapies and medications, and alerts can be generated to indicate or prevent adverse health events. All these capabilities provide caregivers better tools for managing chronic conditions of their patients.

The goal of the *DER Integration Testbed* is to prove the viability of a real-time, secure databus to facilitate machine-to-machine, machine-to-control center, and machine-to-data-center communications in microgrid environments. It combines distributed, edge-located processing and control applications with intelligent analytics. Based on real-world power applications, the testbed will deliver improvements and extensions to the UCAIug's OpenFMB project to ensure an open, standardized based on NAESB OpenFMB RMQ.26.

The *LTE for Metro Testbed* incorporates the B-Trunking standards of the International Telecommunication Union, as well as the Urban Rail Train-Ground Integrated Communication System specifications of the China Association of Metros (CAMET). CAMET has more than 500 members including more than 50 metro owners/operators, so it is vital to promote the adoption of LTE-for-metro-related technical specifications to a wider industry community based on real industrial needs.

Currently, no technical standards based on LTE for the urban rail industry have been released by international standards organizations. The testbed team is working to introduce the benefits achieved by the application of LTE technology in urban rail wireless communication for rail operators worldwide. Before LTE for metro, metro operators commonly used Wi-Fi as the major ground-to-train communication standards and technology. LTE for metro intends to enable operators to evolve Wi-Fi network standards to the next generation on an international scale.

The IIC is also working directly with other standards-development organizations and other consortia working to develop standards requirements, for example:

- Plattform Industrie 4.0 includes several subtopics. Farthest ahead is the development and publication of the "Digital Twin and Asset Administration Shell Concepts and Application in the Industrial Internet and Industrial 4.0" joint white paper to be published shortly.
- The Open Services Gateway initiative Alliance (OSGI) is looking at how the IIC's Industrial Internet Reference Architecture can be implemented with OSGi technology, IIC requirements for OSGi, and promoting OSGi in testbeds.

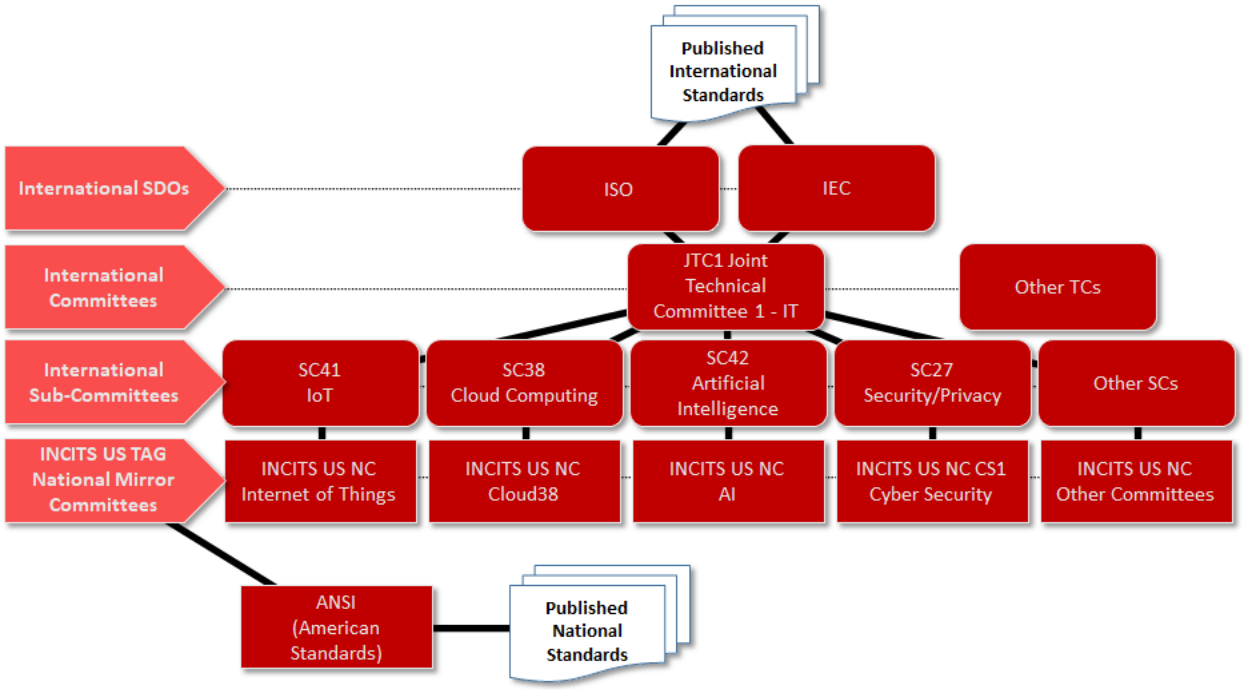

Figure 1: ISO / IEC / JTC1 Relationships

Source: Erin Bournival of Dell Technologies/IIC Standards Task Group Chair

The IIC interacts closely with two standards development organizations that have been chartered with the task of developing IoT standards:

- The ISO/IEC JTC1/SC41 IoT Standards Committee, which is developing and has published a wide range of IoT-pertinent standards, including reference architectures, interoperability standards and application standards. The IIC influences SC41 by reviewing draft standards shared by them and returning IIC member comments and contributions to SC41. These comments are later reviewed by SC41 and incorporated into their standards.
- The IEEE P2413 IoT Standards Committee, which has published an IoT reference architecture, and is currently developing standards for smart cities and intelligent power management. The IIC influences the IEEE P2413 IoT Standards Committee by reviewing draft standards shared by P2413 and returning IIC member comments and contributions for review by P2413 and incorporation into their standards.

Our experience with IoT test beds gives us unique perspectives that standards bodies appreciate.

IIC testbeds also *use* standards. The *Smart Factory Testbed* forms a network of smart factories with flexible adaptation of production capabilities and sharing of resources and assets to improve order fulfillment. Secure Plug & Work techniques based on the standards AutomationML and OPC UA are applied to adapt factories on-the-fly and link them in a supply chain with a minimum

of engineering effort. These standards are applied for information modelling and communication both within the factory and between the factory and the data center. Details can be found here.

End User Engagement

As the world's leading consortium for the industrial internet of things (IIoT), IIC comprises leaders in the development and adoption of IIoT and emerging technologies with extensive knowledge and experience to share. IIC member experts have developed best practices, guidelines and frameworks and have applied these resources across many industries. The Industry Connect Service helps technology users transform their businesses. Users seeking solutions to large complex problems, to scale existing proofs of concept or to identify requirements for industry standards are invited to submit a problem statement. Both the user organization (which need not be an IIC member) and IIC member organizations receive direct value through identification and delivery of possible solutions, opportunities for new technology development and proofs of concepts with testbeds. If interested in submitting a problem statement for consideration by the IIC, please submit one via the link above or contact Howard Kradjel.

Our Industry Leadership Councils (ILCs) are executive roundtables of innovative strategists representing organizations who meet regularly to set the vision for next generation solutions in their respective industries. The Manufacturing ILC was launched in 2018 and meets quarterly. The Council includes experts from major manufacturers in transportation, consumer products, agriculture, aeronautics, medical devices and factory automation solutions. Additional end-user companies are welcome. The general criteria for participation in an ILC are a director level role or higher as well as actively implementing or using an IIoT solution in the corresponding field. The IIC also seeks to add more vertical sectors and seeks founding members. In particular, there is an effort underway, with our Energy Task Group, to form an Energy ILC, focused on utilities and distributed energy management. If you have participant recommendations you may visit the ILC webpage above or have them contact either Howard Kradjel or Cheryl Rocheleau.

Our Special Interest Groups are formed to create customer-validated requirements for the development of holistic solutions for industry, initiate technical validation projects for these requirements, initiate new industry standards to help harmonize the technology landscape and provide an efficient platform for vendors suppliers and industry organizations to jointly shape the future of IIoT solutions. For more information please contact Stephen Mellor.

The IIC launched its Community Forum earlier this year. The Community Forum is an online venue for industry experts to exchange ideas, discuss IIoT problems and network, as well as an IIoT beacon providing helpful, relevant content to technology users, vendors, integrators, technology experts, researchers, government entities and academicians. The Community Forum is a resource for follow-on conversations (on the theme above and many more) and webinars.

Industry Program

IIC testbeds are where the innovation and opportunities of the industrial internet—new technologies, new applications, new products, new services, new processes, new business—can be initiated, thought-through and rigorously tested to ascertain their usefulness and viability before coming to market. Our testbed program has 26 approved testbeds with more to come.

We published a white paper on the *Usage of Standards in the Smart Factory Web Testbed* on 2020-06-29, which describes the usage of the principal pivotal standards (OPC UA, AutomationML and OGC SensorThings API) in the IIC's Smart Factory Web Testbed and convey how key concepts of factory and manufacturing information can be modeled and implemented in the framework of these standards.

GROUP ACTIVITY

IIC groups continue to make progress on their various activities and deliverables. You can find a complete list of IIC publications on the Technical Papers, Publications and White Papers Webpage.

We published a white paper on *Enabling Digital Transformation with IoT Performance and Properties Measurement* along with its *Executive Summary* on 2020-05-07, which investigates the need for measuring various aspects of an industrial digital transformation solution at various stages of its lifecycle and how measurements are essential to manage it, shows how metrics serve different purposes as well as provides an overview of existing efforts in relevant areas from which digital solutions can learn.

We published v1.2 of the *IoT Security Maturity Model (SMM): Description and Intended Use* white paper on 2020-05-05, which provides a path for IoT providers to know where they need to be and how to invest appropriately in sensible security mechanisms that meet their needs and requirements as well as seeks to help organizations identify the appropriate approach for effective enhancement of these practices where needed. We simultaneously published the *IoT Security Maturity Model (SMM): Practitioner's Guide* technical report, which provides a conceptual framework to help organizations select and implement the appropriate security controls from a myriad of options as well as help an organization cyclically determine what their security maturity target state should be and assess their current state.

We published a virtual Journal of Innovation in June which covers various on-demand webinars that offer organizations practical guidance on digital transformation based on concrete examples. Digital transformation can help organizations redefine business processes, models and organizational culture, creating new opportunities and generating new sources of revenue.

We published a joint white paper with the IoT Alliance Australia on *How Digital Transformation and IoT Can Contribute to the UN Sustainable Development Goals* (SDGs) on 2020-06-22, which provides an approximation of how organizations currently operate and how they can leverage digital transformation in their respective organizations to achieve relevant UN SDGs.

WEBINARS

Visit our Webinars Webpage for access to 14 hosted webinars in the past two months and a comprehensive list of past webinars.

INDUSTRIAL INTERNET CONNECTIVITY FRAMEWORK WORKSHOP

The IIC is hosting a ½-day workshop (2 sessions over 2 days) offering attendees the opportunity to learn about the different types of interoperability addressed by the Industrial Internet Connectivity Framework (IICF) and how to select the connectivity framework that best addresses your system needs. See here for details and registration (free, but pre-registration is required).

NEW MEMBERS

Please welcome new members this quarter:

- Advanced Manufacturing International
- Tomsk State University
- University of Bologna

IIC members gain experience they could never have as a non-member. They experience informative and productive global virtual member meetings even during the Corona virus crisis. Here are some key benefits of membership:

- ***Networking***—Make the connections; find the needed expertise.
- ***Information & News***—A fast pass to newsworthy industry developments.
- ***Competitive edge***—Stay ahead of the competition or take advantage of changes and developments that might otherwise have passed you by.
- ***Create a market***—Join a collective voice supporting a single mission; create the disruption in the market and develop the business opportunities.
- ***Establish a vision*** –Members work to define future architectures and innovate technologies for IIoT.
- ***Success***—Members are building businesses and dedicating their professional lives to IIoT. They want to be successful, and they want others to succeed.
- ***Professional development***—Grow your career, meet mentors and mentees, career prospects.
- ***Solve important problems—***and help your partners and customers.
- ***Events*** – Capitalize on opportunities for continuous exposure to industry developments.

The Industrial Internet Consortium is the world's leading membership program transforming business and society by accelerating the Industrial Internet of Things. Our mission is to deliver a trustworthy Industrial Internet of Things in which the world's systems and devices are securely connected and controlled to deliver transformational outcomes. Founded March 2014, the Industrial Internet Consortium catalyzes and coordinates the priorities and enabling technologies of the Industrial Internet. The Industrial Internet Consortium is a program of the Object Management Group® (OMG®).

Visit www.iiconsortium.org.


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