Hot Technologies

The Industry IoT Consortium's (IIC) third-quarter member meeting, held virtually (sigh) from September 27th ~ 29th, was another success with 87 attendees, multiple working sessions, plenary keynotes and other organization-wide discussions.

The meeting profiled two published papers. First, the *Industrial Internet of Things Networking Framework*. The framework guides IIoT stakeholders on designing and developing the appropriate networking solutions to enable industrial IoT (IIoT) applications and stimulate digital transformation. It details the requirements, technologies, standards, and solutions for networking that support diverse applications and deployments across a broad range of sectors.

The *Trustworthiness Framework Foundations* describes trustworthiness as the degree of confidence one has that the system performs as expected. Characteristics include safety, security, privacy, reliability and resilience in the face of environmental disturbances, human errors, system faults and attacks. It then discusses in detail how these characteristics can be reconciled to make a system trustworthy. (We profiled this work in our prior quarterly report.)

At the meeting, the IIC also unveiled its new name and logo. The rebranded Industry IoT Consortium will be focused on driving technology innovation that fosters business development. We help organizations identify best practices, build brands, and transform their businesses.

HOT TECHNOLOGIES

In an effort to deliver transformative business value to organizations, industry and society by accelerating adoption of a trustworthy IoT, we regularly identify new technologies that may be critical to our mission. We completed a group brainstorming that identified a list of over 100 raw ideas and selected the ten most promising ones to assist in defining future work areas.

Edge-based AI inference and learning: Artificial intelligence and machine learning (AI/ML) are already key IoT implementation technologies. If a series of technical, political and social challenges can be overcome, they could do amazing things for society.

Today, the vast majority of learning and inference functions are implemented in cloud data centers. But data-center-only implementation is not suitable for many critical AI/ML workloads, because of concerns about latency, network bandwidth, data gravity and trustworthiness. Consequently, portions of the AI/ML functions are being distributed to the edge, starting with the inference phase of AI/ML, operating using ML models that were pre-computed in cloud data centers, and then the model-creation phase will move toward the edge too.

Zero-trust security: We have all heard horror stories about IoT systems that let us down on security, privacy, safety, reliability or resilience. These are the dimensions of trustworthiness: one of the largest concerns as IoT systems become more prevalent and critical.

Today, critical IoT assets is are made trustworthy by "air-gap" or "walled garden" approaches where critical resources are physically isolated from the internet, or through collections of ad hoc security packages. In zero-trust security, data, applications, devices, people, and networks are not trusted until they are rigorously authenticated by trusted algorithms. This improves the trustworthiness of networks for mission- and life-critical IoT applications.

Secure access service edge: The network footprint is increasing, from the workplace, to the smart home, to billions of remote IoT devices. As networks expand, so do the security threats they face.

Secure access service edge (SASE) is a combination of the zero-trust security techniques with software-defined wide-area networks (SD-WAN) It integrates SD-WAN, firewall as a service, secure web gateways, cloud-security brokers and zero-trust network access that secures entire networks, spanning IoT devices, through layers of edge computers up to cloud data centers.

Advanced optical networking: As users and applications are added, and more high-bandwidth sessions run concurrently, network technology must evolve to keep pace with demand.

Limitations in the bandwidth, spectrum, trustworthiness, efficiency and cost of today's wireless and copper interconnect for IoT devices will drive networks toward fiber and free-space optics. Today's networks typically provide 10Gb/s of interconnect bandwidth or less. Advanced fiber optical networks will increase this to 100Gb/s, 400Gb/s and within a year, to over a terabit per second on a single fiber. In addition, free-space optical technologies such as Li-Fi (light fidelity) and visible light communication (VLC) will provide high-bandwidth optical communication directly through space without the need for fibers, supplementing congested radio spectrum.

Virtual worlds, social XR platforms, remote experts: People want immersive experiences as they interact with the huge pools of data stored on the internet, and the huge numbers of IoT devices deployed. Augmented reality and virtual reality (AR/VR) put one right in the center of that data.

Advances in AR/VR have greatly expanded their value in IoT networks. Social extended reality (XR) has evolved experimental- and entertainment-focused AR/VR systems into a network-based, multi-user experience for serious IoT applications. Remote expert systems using AR/VR/XR will transform field service, medical, emergency, sales and many other verticals and applications.

COVID technologies: We all want life to get back to normal, to meet in person and visit people we care about. We also want to feel safe. IoT technologies can help.

Society's response to COVID-19 and other health emergencies requires significant technological advances and IoT capabilities. Systems that monitor people entering a building for elevated temperature or surveying them for symptoms are already in use. Future technologies will use IoT sensors, actuators and connected devices to perform automated contact tracing, enforce social

distancing, implement and verify vaccine passports and perform robot disinfection. These measures should help control the spread of infectious diseases.

Licensed wireless: These demand drivers for advanced optical networking also apply to the radio-based interconnect used by mobile, portable and difficult-to-connect IoT devices. Critical IoT applications choose to use licensed radio spectrum (where the government strictly controls who can transmit) over unlicensed bands (where any device can transmit at any time—creating unpredictable network performance).

Wireless networks that use licensed spectrum are of particular interest for high performance, predictable, mission critical IoT interconnect. Several different radio-access technologies use licensed wireless spectrum, including: 3, 4, 5 and 6G cellular networks, private networks, microwave, and low-earth orbit satellites or CubeSats. Advanced radio technologies, including fancy modulation techniques, massive numbers of array antennas, beamforming, and low-power radio systems will contribute to the advances in licensed wireless networks. These technologies may be applicable to the high performance, high scale interconnect of critical IoT networks.

Heterogeneous computing: The massive device counts and data-set sizes in IoT networks, along with the sophistication of the algorithms needed to analyze all of that data have uncovered serious performance problems with the standard complex instruction set computing/reduced instruction set computing (CISC/RISC) processors typically used in cloud data-center servers. This reduces system response times and capacity, and leads to excessive energy use, large physical size and weight, and unacceptably high costs as computation use soars.

Heterogeneous computing can help. Standard RISC/CISC processors are supplemented with different types of processors whose architectures are better suited to specialized, massively parallel computation tasks. Examples include: graphics processing units (GPUs, where thousands of simple CPU cores work in parallel on the problem), tensor processing units (TPUs, which are special processor architectures highly optimized for AI/ML applications), field programmable gate arrays (FPGAs, arrays of simple hardware gates that can be configured into custom data paths), digital signal processors (DSPs, specialized processors optimized for signal processing tasks) and application-specific integrated circuits (ASICs, custom chips designed for a specific purpose or algorithm). Careful application of these techniques can improve the capacity, performance, power usage, and cost of processing IoT data by orders of magnitude.

Maintenance, operational aid and VR customer support: Machine operators, maintenance workers, medical technicians, etc. all need efficient access to digital data to work effectively in their complex tasks. AR/VR techniques can improve their accuracy and efficiency, and help them on their journey toward digital transformation.

Maintenance workers use AR/VR to call up plans, procedures, status, history and other parameters of the equipment on which they working. Some of this data comes from sensors capturing the exact state of the machine at the moment, some comes from historical archives

detailing past operations of the system and any recent operational anomalies, and some can come from a digital-twin simulation of the behavior of the complex system. This data is overlaid on a view of the system, enabling the technician to zero in on the specific problem, and call up recommended procedures to correct it quickly and safely.

Quantum computing offers rapid, power-efficient solution of complex problems–some of which may take decades of CPU time on traditional computers. It also creates threats to some aspects of IoT networks, especially cryptography.

We are monitoring the potential impact of quantum computing on IoT systems. Some areas of interest include: new quantum-optimized algorithms greatly increase the operational efficiency of IoT systems, post-quantum cryptography that is resistant to security threats posed by quantum decryption techniques, and quantum entanglement, which can provide absolutely secure data transfers. Much of this work is in the early research phase now, but it is expected to become mainstream in IoT networks in the latter half of this decade.

Industry Working Group

The Industry Working Group has three major initiatives:

The *Business Pain Point Collection* initiative seeks to identify and understand business and industry pain points so our ecosystem may expedite business and industry guidance and solutions. We encourage everyone—members, liaison partners, non-member end users—to contribute to this collection. IIC will endeavor to identify digital transformation enablers that address the pain points so they may be deployed. Quickly.

The *Specific Application Identification Initiative* identifies technology-user-driven use cases and digital transformation technology enablers that support development of guidelines, best practices, frameworks, test drives, testbeds and business pain points. The initiative focuses on specific application areas of interest to specific verticals and technology that can be applied to enable use cases in multple verticals.

The *Business Solution Accelerator Initiative* is focussed on engaging technology users to describe their business problem and co-create a solution with the IIC ecosystem. It addresses the pain points that technology users face in their businesses, and identifies the key technologies and digital transformation enablers that resolve them. They are collecting pain points for a repository organized by business operational technologies and technology-user solutions and how to use the various resources available that will lead to a practical guide on how to support the go-to-market strategies and reach customers.

Our vertical Industry Task Groups exist to understand business and technology needs within an industry. They connect industry needs to requirements, testbeds, and guidance that enable technology deployment and digital transformation. We have vertical groups for automotive, energy, healthcare, mining, and smart factory.

The Automotive and Industrial Over-The-Air Group promotes OTA updates and related technologies to technology users in the automotive, intelligent transport systems (ITS) and other industries. It identifies and develops best practices, test drives, testbeds and use cases that guide application of OTA and related communication and digital transformation enabling technologies.

The Go Kart!--An Automotive and OTA Testbed demonstrates how software can be managed (deployed, updated, and replaced) on a fleet of vehicles remotely. It covers standard topics such as vehicle control and data handling: collection, filtering, and analysis. The solution also addresses the specific automotive safety risks in a cybersecurity realm and introduces Li Fi as a complementary wireless communication option for such updates as well as general V2X communication. While the focus is on Automotive, OTA is applicable to other domains such as Healthcare, Manufacturing and any IoT devices that need updating

The Healthcare Task Group is identifying and documenting vertical use cases supporting infrastructure patterns and guidance to meet user needs. They are working on identifying technologies and digital transformation enablers and defining terminology, outcomes and patterns. They completed the Remote Patient Monitoring architecture pattern, and split it into two patterns, a generic pattern and a specialization of the generic pattern to the remote patient monitoring. Two healthcare-related efforts were approved:

The Gait Analysis Test Bed offers an effective means to provide valuable information about health condition for the elderly before symptoms present (Mibyo “未病” Pre-Symptomatic state) by observing the walking posture of the subject.

The Value Asset Tracking for Healthcare Networks test drive addresses supply-chain challenges in healthcare.

The Test Drives Webpage is live which contains four approved test drives: the Intelligent Video Test Drive, the IoT Sensor Implementation Test Drive, the Supply Network Dynamic Simulation Test Drive and the Smart Mold, Injection Process Optimization and AI Test Drive. New emphasis is being placed on understanding the application, evolution and results of standards in testbeds.

The Industry Working Group also spearheads Industry Leadership Councils (executive roundtables of innovative strategists representing organizations who meet regularly to set the vision for next-generation solutions in their respective industries) and Special Interest Groups.

The Industry Working Group is collaborating with the Digital Transformation Working Group to define and identify digital transformation enablers.

PATTERNS

We are gathering, creating and publishing architectural and design patterns for use in industry to support the selection of patterns by providing guidance and expert knowledge in various forms.

End products will be posted on the Patterns Webpage. You can submit a pattern using the Pattern Template.

Three Algorithmic/Microservice Design patterns, three Computing Model Design patterns, and five Architectural patterns have been collected to date.

WEBINARS AND PUBLICATIONS

Visit our Webinars Webpage for access to one IIC-hosted and three liaison syndicated webinars this past quarter as well as a comprehensive list of past and future webinars. A complete list of IIC publications can be found here.

NEW MEMBERS

Please welcome new members this quarter:

- ComTeic Digital Consulting, Ltd.
- DataSAM
- Edgedynamix
- Henderson and Associates Pty Ltd.
- Kingfish Solutions
- Level Company
- Qubitro, Inc.
- Smart Talk Beacon Ltd.
- University of Duisburg-Essen

IIC members gain experience they could never have as a non-member. 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 Industry IoT Consortium® (IIC®) delivers transformative business value to industry, organizations, and society by accelerating adoption of a trustworthy internet of things. The IIC is a program of the Object Management Group® (OMG®). Visit www.iiconsortium.org.