# Distributed Computing in the Edge

The Industrial Internet Consortium's (IIC) fourth-quarter member meeting held virtually from December 7th through 10th, 2020, was a great success with 187 attendees, 26 working sessions, 14 industry track sessions, nine plenary sessions, five testbed sessions, two keynotes, a virtual technology center tour, a virtual networking reception and a half-day security training course.

## DISTRIBUTED COMPUTING IN THE EDGE

Computing at the edge has grown steadily over the past decade, driven by the need to extend the technologies used in data centers to support cloud computing closer to things in the physical world. This is a key factor in accelerating the development of the industrial internet of things (IIoT). One year after publishing *The Edge Computing Advantage*, targeted to executives and focused on business, capabilities and reducing confusion around vocabulary, on October 18th the IIC has published *The Industrial Internet of Things Distributed Computing in the Edge* technical report. It is targeted to IoT system architects and implementers and provides a structural framework for distributing computing in the edge, defines key architectural concepts employed therein, specifies an edge system's elements' essential capabilities, gives special attention to security and management functions and describes interfaces among these elements.

The key technical advance is that capabilities once carried out solely in a data center, and commonly referred to as "cloud computing", can now be carried out in the edge. The implications are that the data center is the physical entity that can carry out logical "cloud capabilities" and, obversely, that cloud computing is the logical entity that executes those capabilities including those can be carried out in the edge.

Here, we digress for a short discussion on vocabulary. The IIC Vocabulary defines *edge* to be the "boundary between the pertinent digital and physical entities, delineated by IoT devices" and *edge computing* as "distributed computing that is performed near the edge, where nearness is determined by the system requirements". That is, "edge" is used in the former as a boundary and in the latter as a region. The technical report uses "*at* the edge" to mean at the boundary (though that boundary is fuzzy), and "*in* the edge" to mean in the region. Similarly, "*to* the edge" connotes distribution away from data centers. Hope that clears things up.

The technical report covers multiple topics, beginning with a technical rendition of the business benefits. Specifically, the report reprises the business benefits in the white paper in a technical manner and then outlines the technical properties that need to be achieved if those benefits are to accrue. Then it provides a high-level technical architectural framework in architectural and implementation-oriented language. This builds on *The Edge Computing Advantage* whitepaper and explains all the technical details of the high-level architectural diagram used there and reproduced below.
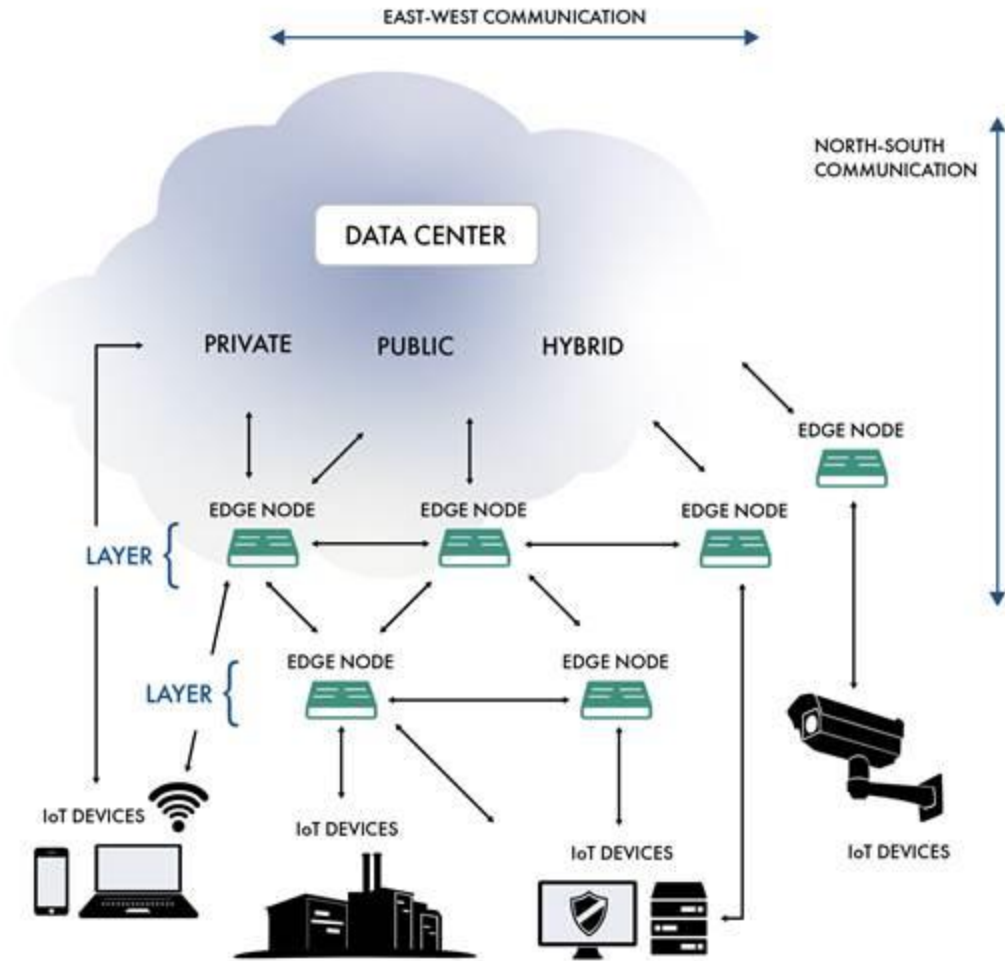
The report then gets down and dirty. It describes the functional composition of an edge node, focusing especially on how each is booted securely. It describes each of the components in gory detail so that architects and implementers can see what needs to be built as shown below.
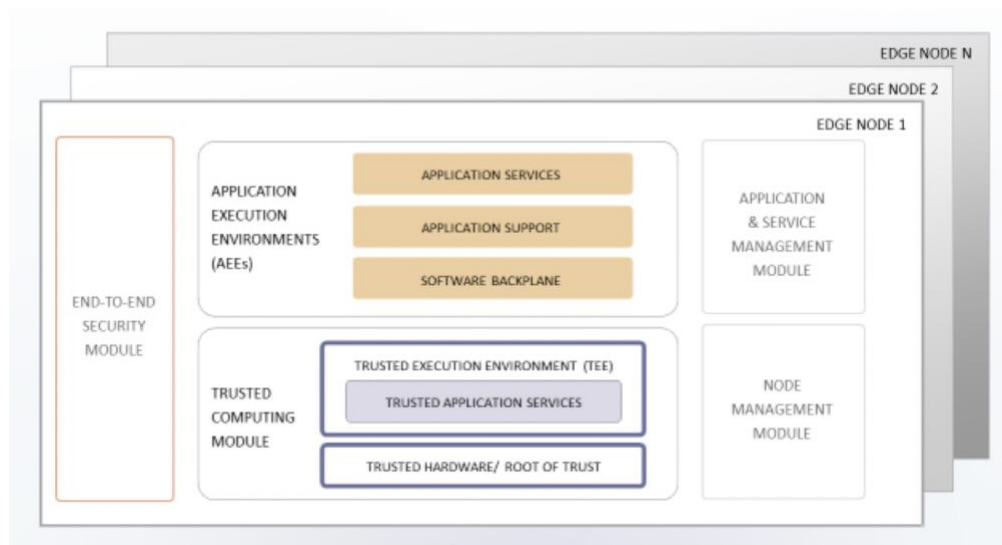
For now, just note the "cards" stacked up one behind another. The *structure* of each edge node is duplicated from edge node *1* to edge node *n*, making up the whole system. Then we build up, in a stepwise-refinement manner, to discuss how to manage the system as a whole.

To manage the system as a whole, there are two main topics: system security and management and provisioning. A chapter is devoted to each. The report concludes with a discussion of the lifecycle of edge nodes and systems, and some viewpoints on the future of edge technologies.

You can see how the whole system fits together in the figure below.
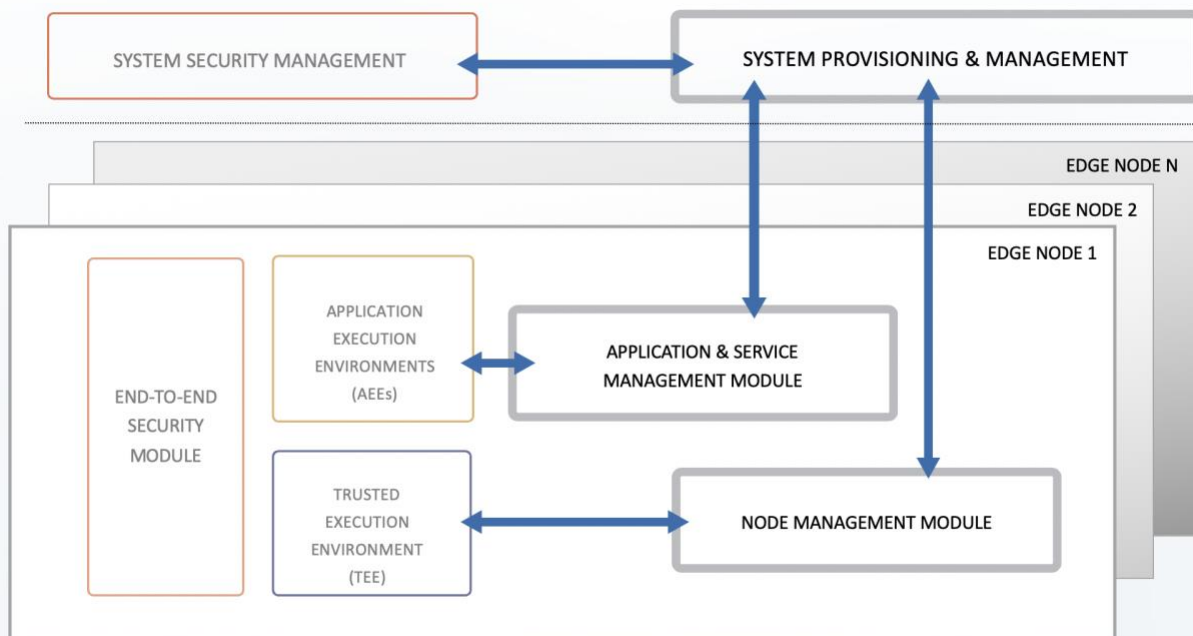


## END USER ENGAGEMENT

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 produced the first in a series of technical briefs aimed at help manufacturing leaders keep pace with rapid emergence of new technology. The ILC meets quarterly and includes representatives from major companies; 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 form an Energy ILC, focused on utilities and distributed energy management. If you have participant recommendations you may visit the ILC webpage above or contact either Howard Kradjel or Cheryl Rocheleau.

Our Vertical 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]().

Our [Special Interest Groups]() 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 shape the future of IIoT solutions jointly. For more information, please contact [Stephen Mellor]().

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 and [webinars]().

## INDUSTRY PROGRAM

IIC [Testbeds]() are where the innovation and opportunities lie for 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 IIC testbeds]() with more to come.

IIC [Test Drives]() are solutions that may be deployed as pilots to trial a technology. Test drives enable technology end users to learn about a technology in their facilities. Three test drives are approved: The Smart Mold, Injection Process Optimization and AI test drive was approved in Q2.

[IoT Challenges]() aim at solving real problems and validating solutions that address specific end-user identified pain points. In these challenges, architects and solution providers compete to design industrial internet solutions that address high-profile real-world problems. The [Smart Logistics Challenge]() is seeking principal partners.

The [product catalog]() encourages members to add products to the catalog, so that the public can shop for members' products. The User Name is *IICCatalog* and the password is *IICCatalog*.

## GROUP ACTIVITY

IIC groups made significant progress on their deliverables this quarter, including *[The Industrial Internet of Things Distributed Computing in the Edge]()* described above. This web page has the complete list of publications: [Technical Papers, Publications and White Papers]().

The *Journal of Innovation* published its latest edition on *IoT Enabling Rapid Response to COVID and Future Pandemics* on November 17th. This edition addresses such pandemic-related topics as physical distancing and crowd density monitoring via computer vision, workspace redesign, global process validation systems for vaccine production rollout and advances in connected worker technology.

## WEBINARS

Visit our Webinars Webpage for access to nine hosted webinars this past quarter as well as a comprehensive list of past and future webinars.

## NEW MEMBERS

Please welcome new members this quarter:

- Aina Design Corp.
- Dataparency, LLC
- i4Score.com
- MESS – Turkish Employers Associate of Metal Industry
- Scurid AI Tech Private Ltd.
- The Industry Four
- Zotera, LLC

This was a relatively short "quarter" (only nine weeks), so let's end it there. Even though we cannot yet be face-to-face, we can still achieve a lot. And so we shall.

*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.*

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*— To help your partners and customers.
- *Events* – Capitalize on opportunities for continuous exposure to industry developments.