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Edgecross Consortium to Address Edge Integration in IIoT-enabled Architectures

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Executive Overview

Customers and suppliers of automated equipment across all industries are waking up to the numerous incremental value propositions associated with industrial internet-based strategies. Initiatives such as the Industrial Internet of Things (IIoT), Industrie 4.0 (I4.0), information technology (IT)/operational technology (OT) convergence, smart manufacturing, Smart Society, and others are viewed as a means of accelerating core business drivers, including increased revenues, reduced costs, asset optimization, and ability to extend the base of potential customers. This recognition extends to the C-Level, where executives increasingly recognize the potential business impact of these initiatives.

Successful execution of industrial internet-enabled business improvement strategies requires increased IT/OT convergence, edge-to cloud integration and open architectures. Industrial edge platforms are emerging as a primary means of addressing these core functional requirements.

Pursuit of industrial internet-enabled strategies necessitates a departure from the traditional siloed "IT vs OT/factory automation (FA)" perspective that has historically pervaded manufacturing firms. Success with internet-enabled business improvement requires true convergence of IT, OT, and engineering technology (ET) to implement the access, transparency, security, and execution capabilities needed to deliver on its significant promise.

These prospects herald the dawning of a new age at the industrial network edge, one that must be addressed as customers prepare for and implement internet-based business strategies. This preparation extends to ensuring that what enterprise applications view as "the network edge" meets the requirements for successfully executing connectivity-enabled business strategies. This has numerous implications throughout the architecture.

The newly formed Edgecross Consortium looks to meet the need for the core functionality required in the emerging era of edge computing, including an edge platform that provides seamless coordination throughout the architecture. IT systems will now be able to not only reach into the OT/FA realm in search of operational improvements, but also into cloud-resident supply chain and engineering activities. The Edgecross Consortium mission extends beyond a simple IIoT integration framework to creation of an edge platform environment capable of meeting today's business and technology integration challenges.

The IIoT Business Value Proposition

Initiatives such as the Industrial Internet of Things (IIoT), Industrie 4.0 (I4.0), China 2025, and the Smart Society are increasingly seen as the means to reduce downtime, increase flexibility, and achieve an open, connected and secure infrastructure. In today's environment, target outcomes for internet-enabled strategies can range from reduced operations or maintenance costs to reduced machine downtime, increased production flexibility, or migration to a service-oriented product offering. These benefits extend throughout the value chain to suppliers, OEMs, system integrators, and end customers.

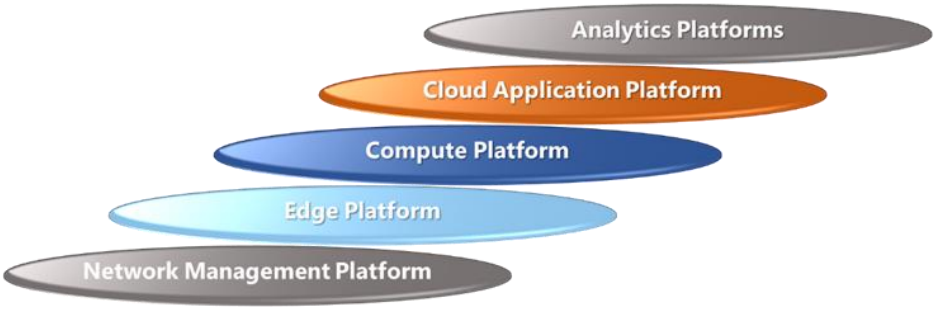
Target outcomes for industrial internet-enabled strategies include lower operations and maintenance costs, reduced downtime, increased production flexibility, and/or migration to a service-oriented offering.

To achieve these objectives, customers must be able to dynamically access, monitor, manage, control, and optimize the associated assets, machines, processes, and/or connected end products. The industrial network edge and the devices associated with it have emerged as primary vehicles for delivering incremental business value via internet-enabled strategies.

The Rise of the IIoT Network Edge

Connectivity, transparency, and remote access are primary enablers of many of today's internet strategies. Cloud integration, IT/OT/ET convergence, and the overall need to feed data from the field to higher-level applications are central to achieving these objectives, as is seamless horizontal and vertical integration throughout the architecture. Each of these concepts relies heavily on the industrial network edge as its information conduit.

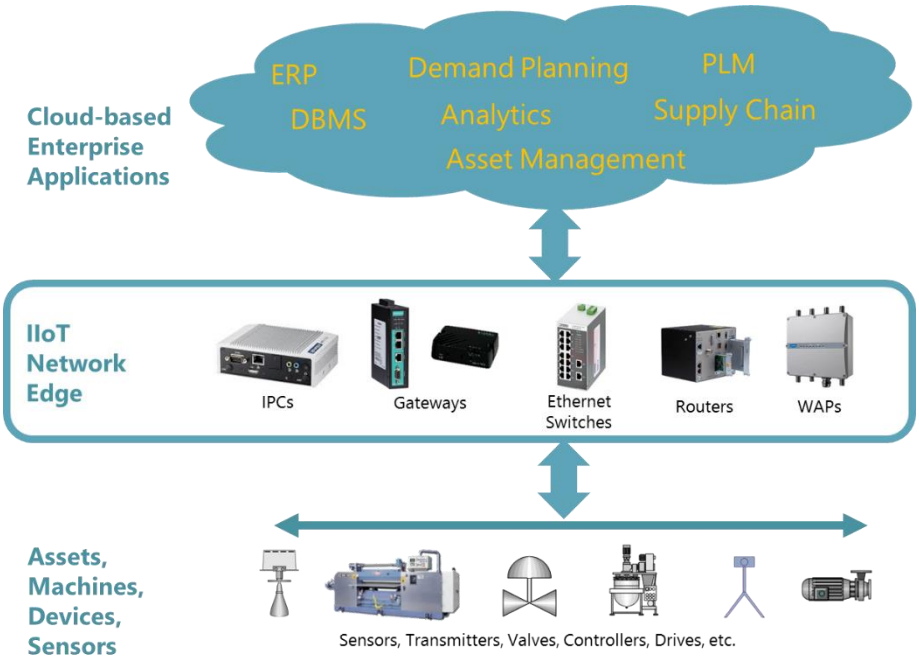
The IIoT requires extensive integration of field and asset data with enterprise-level business improvement applications, many of which are resident in the cloud. Numerous different types of cloud-based platforms are emerging concurrent with the rise of the IIoT, including vendor-specific operating systems platforms and those that rely on public clouds, such as Amazon Web Services or Microsoft Azure.



Numerous different types of IIoT platforms are emerging

Cloud-based enterprise-level business improvement strategies in the Industrial Internet age need data from edge machines, processes, and other assets and components to feed data-driven activities such as analytics. These cloud-based architectures rely on the network edge to provide data communications, application integration, and security, among other key roles.

Formerly isolated, OT-centric installations must now respond to the need to integrate data with IT and ET. This emphasis on communication with higher-level applications is behind the term "network edge," since a top-down perspective from the enterprise level results in field-level equipment appearing at the outer edge of the architecture.



The Network Edge performs an important role in IIoT Strategies

This trend is evident as companies are already escalating connectivity requirements in their request for proposals (RFPs), using these new capabilities to achieve initial benefits in areas such as remote monitoring, diagnostics, and energy management that typically require remote access and incremental data gathering. New project requisitions around the world and across industries provide concrete evidence of the need for multifold increases in edge connectivity.

Edge-to-Cloud Integration Challenges

Industrial internet strategies are typically viewed as a means of delivering the edge data necessary to fuel performance improvement strategies executed in higher level applications. In the industrial market, this is particularly true for the large amount of data required by cloud-based analytics and similar applications tasked with delivering reduced machine downtime and other strategic industrial internet value propositions. It is also a necessary enabler behind the push toward Product-as-a-Service as a means of both delivering services and monitoring usage.

Edge-to-cloud integration presents challenges in areas such as the need to pre-process large volumes of data, unacceptable latency times, and potential security concerns.

Cloud integration at the edge currently serves many additional purposes, including device configuration and management, remote access and monitoring, data storage, and/or application execution. Enterprise applications are emerging as primary consumers of data generated at the industrial edge, but the sheer volume of data generated by these devices makes cloud-based execution unrealistic in many cases. Edge applications themselves may not be able to tolerate the latency inherent in delivering data back and forth to the Cloud for analysis and feedback, plus some customers are not willing to serve their data up into a Cloud due to security concerns.

Migration toward Edge Computing

Migration of cloud-based applications down to the network edge infrastructure and intelligent end device tiers is one of the main pressures driving change at the industrial edge. Further evolution of the edge-to-

cloud integration phenomenon includes emergence of edge or fog computing strategies. With this approach, some of the functionality traditionally associated with the enterprise level is migrating into edge devices themselves. Edge computing is distinct from traditional automation and control in that it emphasizes execution of applications typically resident in the cloud rather than local control programs.

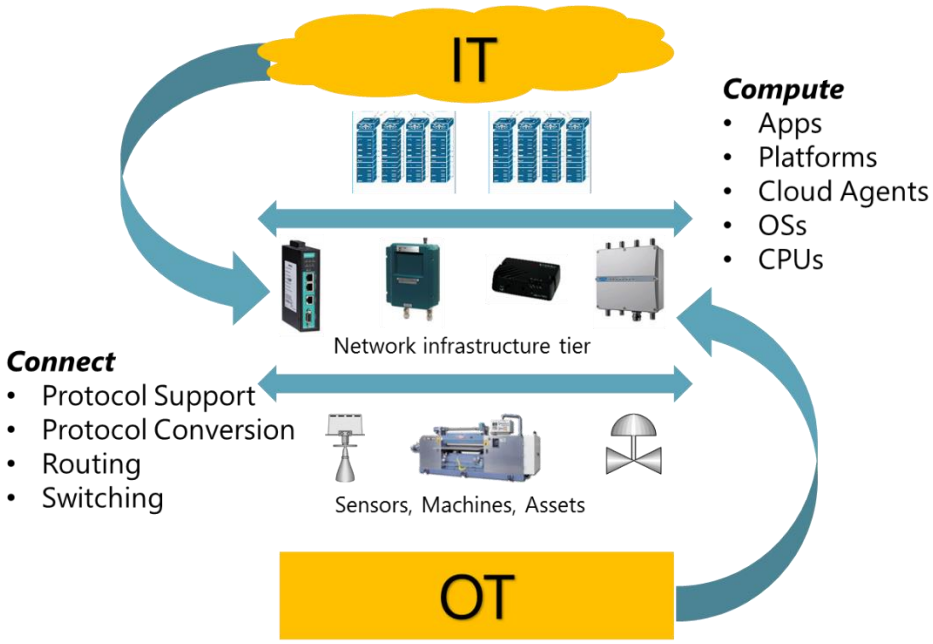
Edge computing helps avoid overburdening enterprise applications and communication links by processing data at the edge and driving further distribution of the architecture. Edge devices themselves continue to deliver ongoing price/performance improvements in both connectivity and compute capability, which in turn facilitates continued migration toward edge computing.

Edge computing insulates IT systems from the deluge of machine data, plus it provides the speed and security necessary for OT/FA applications.

Two primary drivers are contributing to this reality: the need to process data locally to prevent a data deluge from the field to the enterprise, plus the speed, security, and other advantages inherent in executing applications close to their data source and target execution environment. Availability of analytical feedback near or on the target assets delivers speedy, ultimately real-time feedback, as well as improved operational security.

Edge computing capabilities will help offload enterprise applications from the potential tsunami of data emanating from edge devices. Edge computing can assist by identifying and flagging data anomalies that may be associated with problems in the device and/or process, plus assist with filtering, offloading, and storing data not immediately required by the enterprise application.

These events are extending the definition of IT and OT/FA convergence to the merging of computational power and connectivity, or compute/connect. Network infrastructure devices whose primary traditional role has been to enable data connectivity between and within different layers of the architecture are now adding compute power to meet the emerging demands of edge computing. At the same time, the need to process and deliver preprocessed OT data to cloud-based enterprise applications is driving compute capability down in the architecture and closer to the edge.



IT/OT Convergence includes Compute/Connect convergence at the Edge

The Need for Open Architecture IIoT Edge Platforms

Increasing functional and performance burdens on the IIoT edge are leading to the need for a dedicated edge platform environment that can meet the rising number of requirements. This component of the architecture is emerging to address needs such as reduced time, effort, cost, and specialized skills required to achieve IT connectivity to hybrid OT environments, as well as availability of standard tools for device management and developing and deploying applications.

IIoT edge platforms reduce the time, effort, cost, and specialized skills necessary to achieve edge-to-cloud integration.

Edge platforms are emerging as a necessary architectural requirement that insulates both IT and OT from the intricacies of their specific environments. Edge platforms can deliver pre-processed OT data to IT-based applications in the appropriate format and via support of IT protocols, while also easing integration requirements for OT devices and processes. Edge platforms can also provide context for connected data and may offer modeling, visualization, and certain analytics tools.

Edgecross Consortium Tackles Edge Computing Challenges?

Six leading industrial companies, including Advantech, IBM Japan, Mitsubishi Electric, NEC, Omron, and Oracle Japan, have formed the Edgecross Consortium to address the need for edge computing standardization on a global scale and across industries. As the list of sponsoring firms suggests, the consortium intends to bring IT and OT/FA together to enable the extensive incremental value enabled by the emergence of the IIoT and edge computing. This mission extends beyond a simple IIoT integration framework to creation of an edge platform environment capable of meeting today's business and technology integration challenges.

The Edgecross platform provides core functionality to bring IT and OT/FA together and enable IIoT-driven performance improvement.

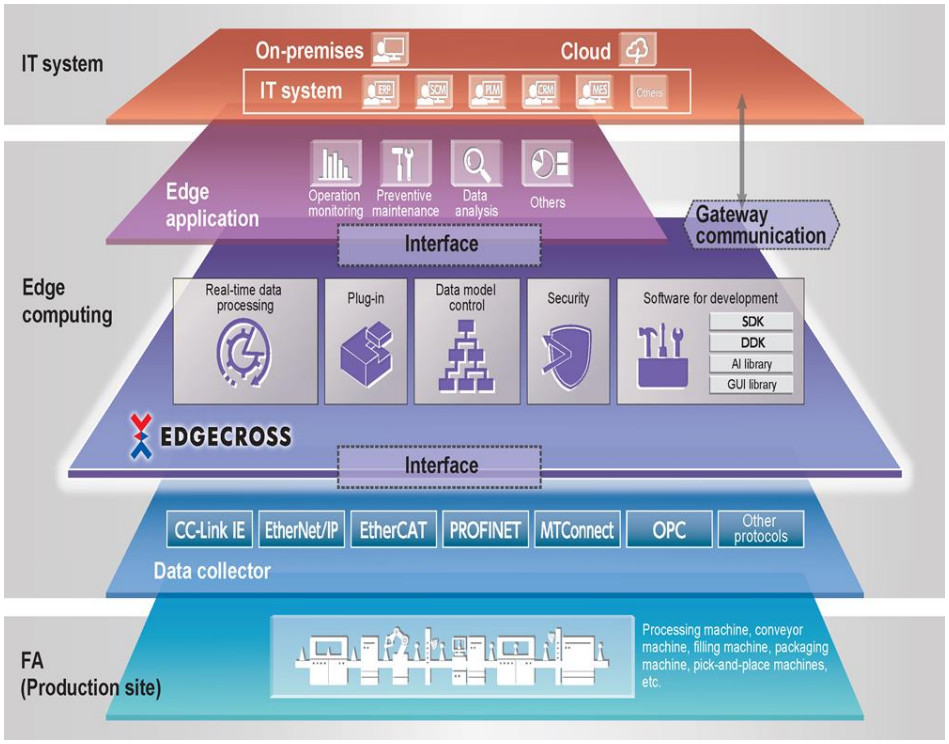
The Edgecross platform vision addresses core functionality required in the emerging realm of edge computing. The IPC gateway-based architecture enables data collection from throughout the OT/FA environment, regardless of the vendor or network types deployed. Real-time diagnosis and feedback occurs at the production site, enabling real-time local feedback and response. Local edge data processing capabilities enable OT/FA personnel as well as edge applications to abstract data for use in optimizing operations both locally and across global locations. Edgecross further enables IT-driven applications to execute in the OT/FA environment and supports a vast library of edge computing applications.

The Edgecross platform enables these possibilities through a platform that provides seamless coordination throughout the architecture. IT systems are now able to not only reach into the OT/FA realm to address operational improvements, but also into cloud-resident supply chain and engineering activities.

Edgecross Platform Components

Development and support of a widely disseminated interface between IT systems and the OT/FA environment will be one of the Edgecross Consortium's initial deliverables. This interface will support existing installations, allowing incorporation of legacy equipment into the architecture. IPC-

based gateway communication will also be supported to allow seamless data coordination with OT/FA equipment and cloud-based IT systems. The combination of an IPC-based gateway and edge platform software delivers a powerful edge processing environment capable of real-time data processing and data model control. This architecture is consistent with the current emphasis on gateways to achieve edge-to-cloud integration.



Edgecross platform overview

The Consortium's initial activities target development of two critical core functional components that enable the Edgecross platform to run on IPCs: real time data processing and data modeling control. Real-time data processing capabilities will allow the platform to be used to determine when and from which devices data will be collected. This capability will enable the platform to meet the needs of specific edge applications in terms of both appropriate data formatting and implementing desired timing cycles for data collection. This extends to managing feedback to edge devices, enabling faster and easier development of edge applications with real-time diagnostic feedback.

The data modeling control function will be used to generate structural models of edge devices into a familiar tree structure. This model will include both a Bill of Materials (BOM)-type feature containing the order of

device's structural elements as well as important control functions such as current, temperature, or torque.

Accurate data modeling is a challenge in edge processing applications due to the differing kinds, functions, suppliers, and/or shipping destinations of the machines and equipment installed in the shop floors inherent in its diverse landscape. This diversity can lead to difficulty in effectively identifying the cause or location of a specific issue flagged by analytics applications if a proper data model that reflects the actual structure of edge devices is not in place.

Edgecross takes a two-pronged approach to the important issue of accurate data modeling at the edge. This approach is based on standard device profiles accessed via a standard edge platform supporting standard OT and IT interfaces. Core platform functionality will include automatic generation of model data based on these standard device profiles. The profiles, which will include details on both the device attributes as well as their usage with specific automation networks, will be provided by the edge device providers.

The consortium also aims to promote standardization of these data models in further pursuit of a more accurate and simplified approach to edge processing. The success of this standardization effort, which falls under the consortium's Technical Working Group, will rely on device suppliers and equipment builders participating in the standards effort and developing conforming device profiles.

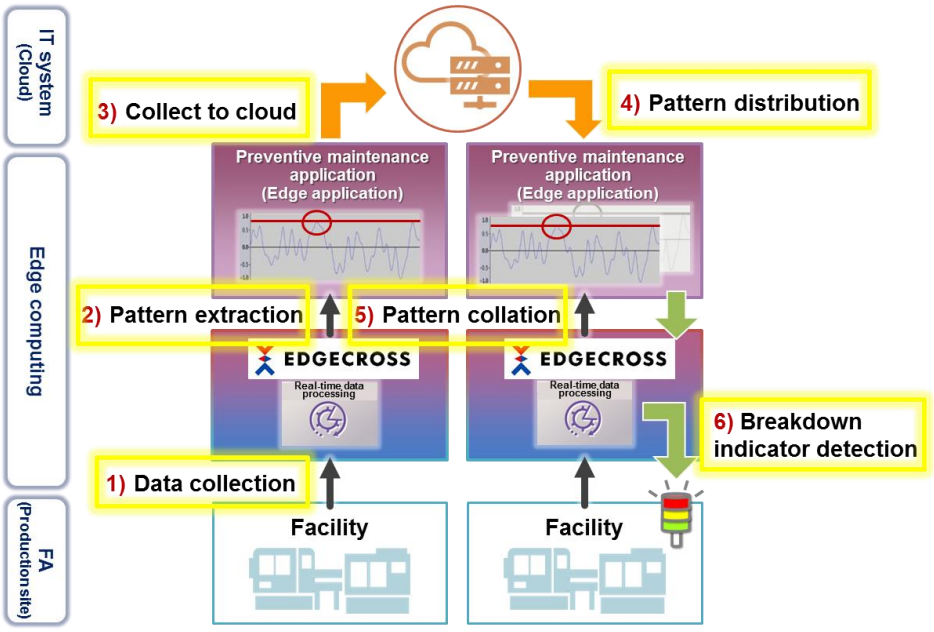
The combination of an IPC-based gateway and edge platform software delivers a powerful edge processing environment capable of real-time data processing and data model control. Inclusion of an offering of "data collector" function in the Edgecross vision eliminates the need for developers to spend time on non-value-add custom integration tasks and allows data to be easily incorporated from a variety of field inputs. The Consortium plans to further ease development through availability of open development kits and technical support resources.

The Consortium has already started to distribute beta development kits for IT system companies and edge application developers to its membership. The Consortium will open its Market Place and start to offer edge applications at the time of the official launch of the basic Edgecross software platform, which is planned for spring 2018.

Application Example: Enabling Preventative Maintenance

Preventative maintenance capabilities are essential to achieving IIoT-driven objectives such as reduced machine downtime and/or eliminating extended facility shutdowns. Edgecross fulfills the edge integration and execution requirements necessary to perform preventative maintenance by easily collecting, converting and analyzing data to and from the OT/FA and IT environments.

In this example, the platform collects and converts data from a variety of equipment and network types to make it suitable for use by the preventative maintenance application. The maintenance software analyzes the data and generates a diagnosis within its own execution environment, then sends any necessary notifications to production devices via Edgecross. Edgecross could then light a signal lamp that notifies personnel of an impending equipment breakdown and alerting them to the need for corrective action. Edgecross enables this capability by fostering easy integration, analysis, and dissemination of field equipment data to IT systems, and then conveying the resulting response seamlessly through the architecture.



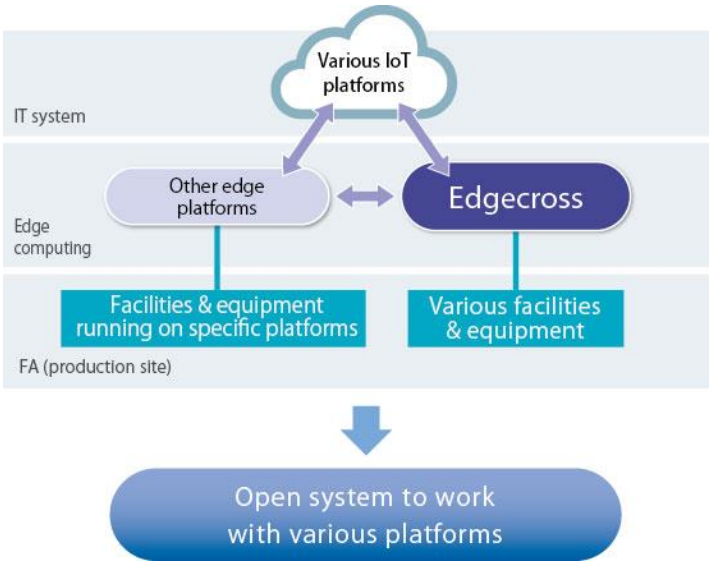
Edgecross enables performance improvements across facilities

Edgecross further allows this application to extend to facilities throughout a global enterprise. Data collected from local facilities across different sites

can be consolidated and analyzed to extract breakdown indication detection patterns. These patterns can then be collected into the cloud through the Edgecross gateway, then distributed to the preventative maintenance application running on Edgecross platform installed at the overseas remote sites. The patterns can be compared to machines and equipment behavioral data collected from overseas facilities in the Edgecross environment. Edgecross then enables notification of potential upcoming equipment breakdowns to operators in overseas facilities.

Membership and Activities Schedule

At the first announcement on November 6, 2017, the Consortium announced a long list of supporting companies, including: AWS, Beckhoff, Bynas, Canon IT Solutions, CDS, CIMX, Citizen Machinery, Contec, Dassault Systemes, Disec, DMG Mori, Elmic, ePlan, Fujitsu, Fujisoft, HP, ILC, Intel, Interface, ISID, JTE, KSK Analytics, Lattice Technology, Mazak, McAfee, Mcor, Microsoft, Net One Systems, NSD, NSW, Panasonic Industrial Devices SUNX, PFU, Portwell, Saison Information Systems, Renesas, Schneider Electric, Siemens, Soft Service, Tibco, Toshiba Electronic Engineering, Trend Micro, Tsuzuki, VMware, Wind River, and WingArc1st.



Edgecross to pursue partnership with various other platforms in the marketplace

Two new members, CTC and Kuka, were added on the day of the consortium's founding during the opening day of System Control Fair (SCF) 2017 in Tokyo on November 29, bringing the total member-ship to 53 companies.

Initial Consortium activities

will focus on developing specifications for the Edgecross open software platform and promoting its dissemination. This work will include providing avenues for supporting companies to cooperate and collaborate through member's participation in Technical and Marketing WGs, as well as conformance tests for certification of compatible products. Cooperative marketing such as opening of Market Place on the internet for application sales will be followed. Further activities will include expanding applications across industries and geographies and cooperation with leading academic institutions.

The Consortium plans to recruit additional members via its presence at exhibitions and other future marketing efforts. It also plans to pursue partnerships with other edge-computing platforms and cloud-based IoT platforms in the marketplace.

Comments from Founding Members

Taka Furusawa, Director, Industrial-IoT Group, iFactory Sector, Advantech Japan Co., Ltd.

From our extensive experience in the manufacturing and sales business of edge computing products to the world, we see many of our customers share worries of whether to start from where in the IIoT field. The biggest contribution of the Consortium will it enables to present clear directions and methods to such customers not by offering solution supported by a single supplier but by gathering expertise and experience of multiple member companies.

Challenges include how to establish conformed technological format by adopting different and diversified opinions of the member companies through the Technical WG activities. How many and how faster the Consortium can accumulate best practices and use cases of the Edgecross applications as customer references is another challenge. For the management of Market Place of the applications will be another issue. Advantech, who operates WISE-PaaS as its own platform and launches their own Market Place, is willing to share its expertise and experiences with the Consortium.

Tatsuya Matsunaga, VP, Value Creation, Business Development, IBM Japan, Ltd.

I strongly support the purpose of establishing this consortium to coordinate FA and IT from Japan. We will leverage the global knowledge and skills that IBM has and its various in the Watson IoT area while respecting the purpose of Edgecross and contributing to the development of this Consortium.

Tetsuya Kawai, Deputy GM, 1st Manufacturing Industries Solution Div., NEC Corporation

Edge computing platform is to give an effective meaning for IT business vendors such as NEC to acquire data from manufacturing field. The notion that edge connecting both competitive fields of IT and OT can be cooperative is quite persuasive for us. Certification program for the products conformity and integrity will make sure customers confidence to adopt this platform.

Challenges of the Consortium will include credibility of the platform openness, development of sophisticated software and platform, and achievement of full-functional and -operable data corrector functionality. As a founding member, NEC will contribute to persuade industry about its openness, supporting advanced technologies such as cybersecurity, networking, AI to develop advanced platform by joining the Technical WG activities, and contributing evaluation of data corrector functionality through testbed trials and a like.

Yutaka Miyanaga, Executive Vice President, Omron Corporation, Company President, Industrial Automation Company

We support the purpose of the establishment of the consortium. We will leverage our broad lineup of FA equipment and control technology that work with applications. We will also promote the introduction of IoT for machines, devices, and equipment at the manufacturing site, and lead Edgecross together with each of the supporting companies to contribute to the development of Japan's manufacturing industry.

Shinji Taketsume, Operating Officer, Cloud Solution Sales, Oracle Corporation Japan

Oracle Japan is very much honored to become a founding member of this Consortium. Oracle offers its wide-range and integrated Oracle Cloud throughout the globe and has many achievements in the area of IoT as well. We will contribute in spreading Edgecross by offering Oracle Cloud.

Haruyuki Otani, GM, Solution Systems Dept., Solution Business Strategy Div., FA Systems Group, Mitsubishi Electric Corporation

Mitsubishi Electric is aiming to expand the scope of e-F@ctory solutions business by utilizing Edgecross promotion. The basic structure of e-F@ctory composes three-layer including FA manufacturing field layer, upper IT layer, and edge layer between the two. To enforce the solution business in edge area further, we found that we need to establish open edge software platform that will enable to connect equipment data from the FA operation field in multi-vendor environment to upper IT applications, which are running another multi-vendor environment.

Accumulating variety of use case is critical to success of the Consortium initiatives. Technically, it will be a challenge to increase number of general-purpose applications available on the edge platform. To promote wider utilization of the Edgecross platform, we believe it is necessary to produce products and services by using general-purpose applications with standard data format, previously many of them were produced by customizations. The Technical WG will in charge of it by obtaining the cooperation of the various members including IT companies.

Author profiles

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Areas of Expertise

Chantal's primary activities include working with the ARC teams covering the Industrial Internet of Things (IoT), industrial networks and other topics.

Chantal's focus areas include the Industrial Internet of Things (IoT), industrial Ethernet switches and devices, wireless networks, and device networks. She also administers the ARC Industrial Internet of Things and Industrial Network Edge groups on LinkedIn. Chantal has been with ARC since 1990 and has conducted numerous industry-leading research activities in areas including:

- Total Available Market for Industrial Network Infrastructure
- Connected Device Management Platforms for Industrial IoT
- Industrial Ethernet Devices
- Industrial Ethernet Switches and Infrastructure
- Industrial Wireless (process and discrete industries)
- Industrial Device Networks
- Intelligent Train Control Systems
- And many more

Prior to ARC, she was with Venture Development Corporation where she focused on sensors and device-level topics, and International Data Group where she provided market research support. Prior to her career as an industry analyst, Chantal was with the injection molded plastic fastener business of Dennison Manufacturing and then L.E. Mason, a local aluminum, zinc, and magnesium die cast manufacturer.

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Editor: Paul Miller

Acronym Reference: **For a complete list of industry acronyms, please refer** **Acronym Reference:** For a complete list of industry acronyms, please refer to www.arcweb.com/research/pages/industry-terms-and-abbreviations.aspx

BOM	Bill of Materials	**IT**	Information Technology
CPU	Central Processing Unit	**I4.0**	Industrie 4.0
DBMS	Database Management System	**OT**	Operational Technology
DDK	Driver Development Kit	**PaaS**	Product as a Services
ET	Engineering Technology	**PLC**	Programmable Logic Controller
EAM	Enterprise Asset Management	**PLM**	Product Lifecycle Management
ERP	Enterprise Resource Planning	**RFP**	Request for Proposal
FA	Factory Automation	**ROA**	Return on Assets
IIoT	Industrial Internet of Things	**SDK**	Software Development Kit
IPC	Industrial Personal Computer	**WAP**	Wireless Application Protocol

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