Technical Whitepaper

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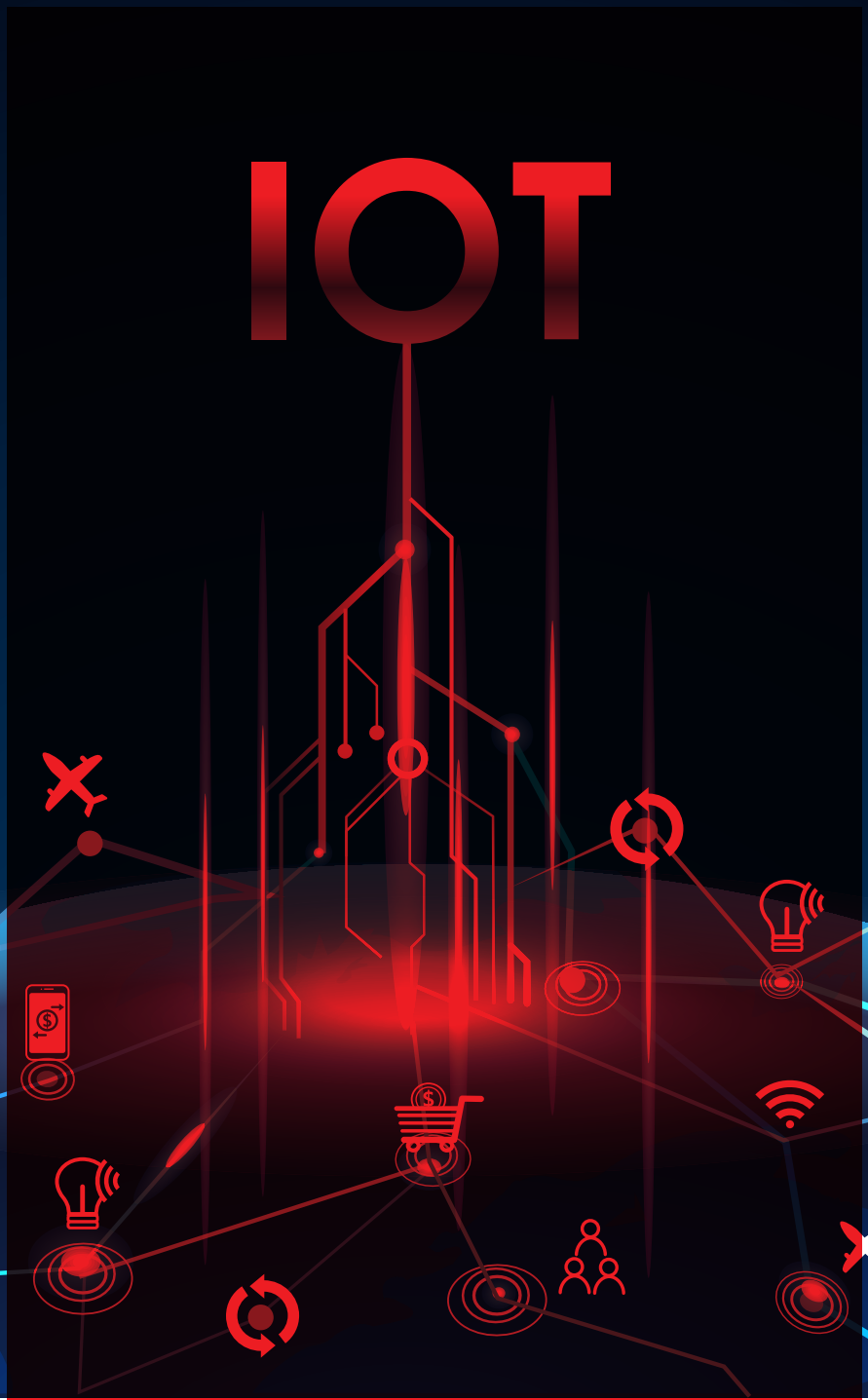
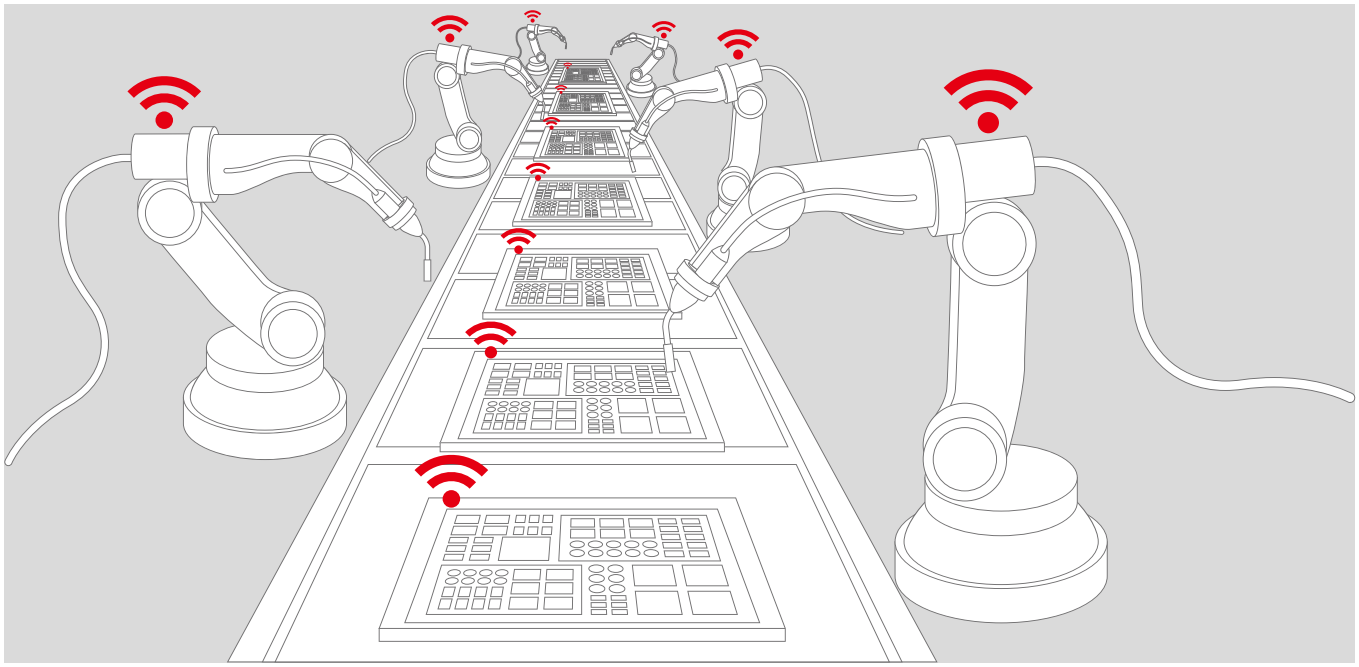
Transforming IIoT Data Interoperability with OPC UA





ABSTRACT

Digital transformation and Industrial Internet of Things (IIoT) share a symbiotic relationship to facilitate business development, reduce operational costs and drive profits. Information and communication technologies (ICT) are increasingly being seen as a driver for Industry 4.0 revolution, overtaking industrial automation.

As industries continue to understand Industry 4.0 – the potential of IIoT is yet to be realised. The need to develop efficient systems comes with its own set of unique challenges. A recent report by Everest Group, states “as many as 78% of enterprises fail to scale their digital transformation initiative”, despite the increasing digital adoption. Apart from work culture transformation and regulatory challenges, enterprises are faced with multi-dimensional challenges; primarily, communication and collaboration across systems. A recent survey by Nexus reported 77% of respondents stating interoperability as their biggest challenge in IoT. How can industries cross this hurdle and adopt Industrial IoT solutions smoothly? Introducing OPC UA –released in 2006. It is a complete solution that covers security, data preservation across layers, data analytics of meta-data and vendor-platform independence. The system looks at a global communication standard that takes care of complex communication channels between central components.

This white paper aims to address interoperability challenges through OPC UA implementation. We explain this by covering the four big reasons which make OPC-UA the answer to your interoperability woes. OPC UA is:

1. Simple - It simplifies Machine to Machine (M2M) communication while being vendor and platform agnostic.

2. Scalable - It allows you to add devices to your closed local network or adopt cloud with minimum hassle.

3. Secure - With message encryption, authentication and access control build into it, OPC UA triumphs over the classical OPC in terms of security.

4. Standardized - The inherent flexibility and ease of adoption has resulted in adoption of OPC UA across industries enabling any organisation to compete at a global stage.

WHAT IS OPC UA?

Networks today follow the ISA 99/95 standard or the Perdue Model that is built on multiple data islands with little to no data exchange. These systems are becoming unreliable due to their complex and inflexible infrastructure. Not to mention the high costs of implementation and maintenance of such networks that tax enterprises.

IIoT Communication Challenges

Since the dawn of the digital transformation era, industries have been redefining their business models to ride the wave. Companies want to make the most of this convergence of IT and OT by enabling machines in their manufacturing operations to communicate with each other. IoT is about seamlessly connecting devices and machines to share data in a simple and transparent way. With the number of 'connected devices' expected to reach 20.4 billion by 2020 (according to a Gartner study), organisations are looking to scale with ease, connecting multiple data points for better insights. However, a report by Nexus points out that a major hurdle in creating cutting-edge IoT solutions is data interoperability. The challenge can arise at device level or even at system level, e.g. when an ERP system is not equipped to understand incoming data from a PLC or when a proprietary system cannot interact with open source software. A translator is needed to bridge this gap and OPC UA is the answer that most industries have accepted already.

To address these challenges, technology experts proposed Open Platform Communication Unified Architecture (OPC UA) – a secure and flexible data integrator that can shift existing Perdue Models to a more IIoT centric model. OPC UA is a "standard that ensures open connectivity, interoperability, security and reliability of industrial automation devices and systems". Pegged as the 'Network of Future', OPC UA approaches digital business transformation as a multi-step process. The system breaks down connectivity issues through a dedicated OPC server, gateway and sensors to extend the capabilities of legacy platforms. OPC UA provides a secure connection oriented client-server information exchange model for bi-directional communication.

For better client-OPC communication across devices, the OPC Foundation defined a standard interface called the OPC Classic. To accommodate technological advancement, OPC UA was released as a new communication technology standard. The new protocol allowed for multiple industrial applications to be interconnected with minimal costs. For its extensive benefits, it is seen as a complete solution serving as a common data connectivity point for local and remote devices.

The architecture was designed to be able to support systems ranging from legacy applications to newer technological platforms. As per OPC Foundation, its functionalities were to:

- **Transport model** – serve as the central data exchange protocol between OPC UA applications.

- **Meta model** – structured hierarchically, the system fosters interoperability between client and server. The model specifies specific protocols for publishing information.

- **Service model** – the front-end of the system serves as the interface between clients and server

OPC UA helps systems in laying data models more flat, in turn increasing data visibility. The major adopter for OPC UA has been its ease of implementation and lowered costs compared to regular networks.

WHY OPC UA MATTERS?

There are four aspects of OPC UA to showcase its significance for any organisation adopting Industrial IoT and facing interoperability challenges. The OPC UA is:

1. Simple
2. Scalable
3. Secure
4. Standardized

1. Simple
It simplifies information exchange for industrial communication enabling devices to interact within/between machines and systems. The unification of IT and OT is made easy with its extensive support of protocols, allowing it to be vendor agnostic and connecting an array of systems to devices.

OPC UA is a stepping stone to Industry 4.0 that advocates availability of data anywhere, any time. This is supported by its capability to work with any platform, be it Windows, Linux, Mac or even Android.

2. Scalable
The standard is built so it can integrate with new technologies and processes while remaining compatible with legacy products. Its rich data model serves as an interface between monitor and control systems based on different vendors' products that use mutually incompatible, often proprietary network communication protocols.

The OPC UA can function in a closed network at a local level or you can use it to communicate over the internet and maximize your cloud capabilities as you grow.

WHY OPC UA MATTERS?

3. Secure

An in-depth security approach is crucial to plugging any gaps in a digital infrastructure. Having being conceptualized by experienced industry leaders, OPC UA overcomes multiple security challenges faced by Classic OPC and other standards.

OPC UA is based on three layers: Transport Layer, Communication Layer and Application Layer[1]. Each layer uniquely supports security to ensure secure communication. The transport layer encrypts any passing message using TCP or HTTPS protocol. The communication layer is capable of performing message signing to ensure confidentiality and integrity. Whereas, the application layer consists of sessions which utilise security certificates to ensure authentication and authorization, ensuring data visibility only to target recipients. The session is bound over a secure channel which is renewed periodically.

4. Standardized

The OPC UA standard is open and the specifications have been published on the OPC Foundation website for anyone to read and use. Its specifications have been developed and improved over time by various industry vendors, end users, and software developers.

OPC UA has a flexible service oriented architecture which has resulted in its adoption across industries, enabling organisations to compete at a global stage.

[1] OPC UA Enables Secure Data Transfer and System Integrations in Private and Public Networks https://www.automaatioseura.fi/site/assets/files/1550/f2068.pdf

IMPLEMENTING OPC UA

The goal of OPC UA has always been to serve as a key data connectivity standard for industrial automation. Enterprises implement the protocol to enable a seamless system wherein interoperability is seen between information, devices and vendors.

In order to decide OPC UA integration into existing products there are 6 decisions:

- **Language** - OPC UA offers four SDKs in three languages: ANSI C, C++ and C#.NET. The decisive criterion for integrating OPC UA functionality to an existing system comes down to the programming language in use.

- **Operating System** – Choosing the target platform isn't crucial as OPC UA is platform independent. All platform dependent functions are abstracted using a platform layer. The structure of SDKs is similar across these platform layers and only this layer is replaced or adapted for the target platform.

- **OPC UA functionality** – Matching OPC UA profiles across required functionalities is the third step in deciding its implementation.

- **Usability** – Designing the architecture for user interface makes it crucial to decide the usability of the system. The toolkit interfaces of UA greatly simplifies the access to data to Read/Write functionality. The speed of implementation increases significantly as source code can be generated quickly for direct use in the SDK.

- **Interface Design** – Flexibility of SDK is required for rapid development. OPC UA offers two interface levels and allows switching between layers for every single functionality.

- **Extensions** – Enterprises can choose the right SDK to expand external libraries and features.

Currently, additional communication methods with Publish-Subscriber (PubSub) model are being introduced into OPC UA, essentially extending the existing client-server architecture. OPC UA PubSub is able to sync with all messaging protocols like, MQTT and AMQP. The new protocol would significantly enhance the usability of the systems in application fields such as Machine to Machine (M2M) communication. Based on PubSub's addition, two methods are available for integration:

- **Messaging over LAN**

OPC UA PubSub targeted for local networks would be used to multicast data over UDP for multiple OPC UA Clients (Subscribers). The system eliminates the need for a broker with an efficient data distribution network.

- **Messaging over WAN/Cloud**

With OPC UA PubSub, applications residing on multiple networks would be connected to each other, wherein data can be published/consumed anywhere, anytime. The system works in situations where multiple publishers and subscribers require communicating.

For its implementation, the OPC Foundation provides three OPC UA communication stacks for interoperability at protocol level. Members have access to source code, test tools and QA; though it is recommended to use a commercial toolkit. OPC UA is an apt solution to binding PLC and sensor data into existing industrial applications such as SCADA and MES systems. It acts as a comprehensive system that looks at a global communication standard and takes care of complex communication channels between central components.

THE OPC UA VALUE

OPC UA implementations can be rewarding for any organisation on its journey towards Industry 4.0. It provides realisable benefits from the production floor to the corporate board room. Some of its benefits include:

- Easy integration with IT applications connecting operations to IT, ensuring visibility of assets at any time from any place resulting in cost and time advantage.
- Advanced security features such as refined access control that allows you to focus on business challenges and not worry about data leaks and breaches.
- Saves additional costs of replacing existing systems and assets to build a smart connected manufacturing site.
- Robust architecture which allows adoption of incoming technological changes; placing any firm in a position to accelerate digitally.
- Reduction in lead time with smooth flow of information which results in a decentralised and dynamic decision making methodology.

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Microland has an illustrious track record of implementing large scale interoperability issues. We have partnered with Kepware to use KEPServerEX platform to allow customers manage their communication via one intuitive user interface, leveraging OPC UA to provide a single source of industrial data. Our team of multi-skilled industrial control engineers leverage company's expertise in the technology domain to deliver a customized and reliable solution. Microland's work with KEPServerEX

2 Image Source: https://www.kepware.com/en-us/products/kepserverex

CONCLUSION

In this digital age, organizations are always looking for innovative and efficient technologies to digitally transform their assets, and data interoperability will be a critical challenge to overcome. OPC UA has been helping companies get a head start on their transformation journey; easing their transition. Continued development of protocols by Microsoft and independent vendors is leading to better cloud productivity solutions. Implementation of OPC UA solutions is complex but with the help of the right integration partner, organisations can reap the immense value and stay ahead of the curve.

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Sr. Director - Industrial IoT Center of Excellence

Manyphay Viengkham has over 17 years of Energy Industry experience designing, building, deploying industrial software. She holds Bachelor Degrees in Computer Science and Biochemistry and Masters in Business Administration. As the Senior Director of Microland's Industrial IoT business, she is responsible for leading the organization's IoT strategy and team in delivering Professional IoT Services.

Before joining Microland, she held various software development and leadership roles within the utility industry (Electric Generation, Electric T&D, Water Filtration, Wastewater Collection & Treatment, Broadband Services) which extended over 9 years. In the following 7 years, she joined General Electric as the Senior Systems Engineer in the GE Smart Grid Solutions team leading system solution architecture, development, and deployment of projects and new product initiatives. In her last role with GE, she served as the Senior Program Manager, leading multiple Predix based solution deployments and worked across the development team delivering asset optimization and efficiency solutions.

Manyphay has also been actively involved with the IEC as the USNC representative to the IEC Strategic Group 3 – Smart Grid and IEC SEG1 – Smart Cities. Currently she leads as the Convenor/Chair of the IEC Systems Resource Group. She's also served on the International Council of Systems Engineers (INCOSE) board for several years. More details about her professional experience on LinkedIn (www.LinkedIn.com/in/Manyphay)

Microland accelerates the digital transformation journey for global enterprises enabling them to deliver high-value business outcomes and superior customer experience. Headquartered in Bangalore, India, Microland has more than 3,800 professionals across its offices in Australia, Europe, India, Middle East and North America. Microland partners with global enterprises to help them become more agile and innovative by integrating emerging technologies and applying automation, analytics and predictive intelligence to business processes.

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