ODVA™

OPTIMIZATION OF PROCESS INTEGRATION

ODVA'S VISION OF A UNIFIED COMMUNICATION
SOLUTION FOR THE PROCESS INDUSTRIES

- CONVERGENT
- COMPATIBLE
- SCALABLE
- OPEN

Executive Summary

Today's process industries share many challenges with hybrid and discrete industries, such as increasing global competition and ever-present cost and environmental pressures. While users have looked to the latest automation technologies as key elements to help address these challenges, plants in process industries typically operate continuously for many years making it more difficult for them to adopt and benefit from these advances, such as industrial Ethernet and IP technologies. However, with an aging installed base of process automation systems and the need for additional capacity to meet consumer demand in emerging economies, this situation is

about to change. It is projected that the process industries will invest over US$100 billion globally in new control systems for process automation, split equally between modernization and new installations.[1] As a result, many users in process industries will be looking to develop new strategies for maintaining cost-effective, sustainable production capacity. To achieve all of the business results needed, these strategies must take into account the efficient integration of the plant's network infrastructure into the existing business applications.
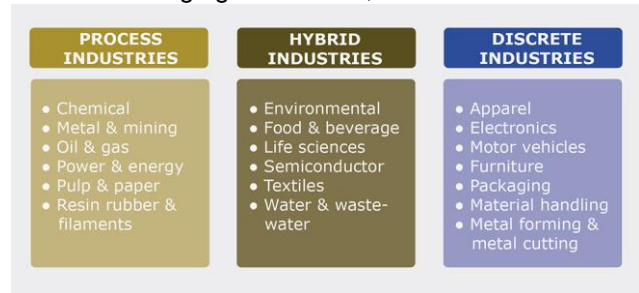
PROCESS INDUSTRIES	HYBRID INDUSTRIES	DISCRETE INDUSTRIES
• Chemical • Metal & mining • Oil & gas • Power & energy • Pulp & paper • Resin rubber & filaments	• Environmental • Food & beverage • Life sciences • Semiconductor • Textiles • Water & waste-water	• Apparel • Electronics • Motor vehicles • Furniture • Packaging • Material handling • Metal forming & metal cutting

Figure 1
Industry Classification

Moreover, these strategies call for a network architecture that provides the best integration, not only within the process plant but also with external systems. Unfortunately, the diverse and often complex nature of field devices in process plants has made integration complicated because users have needed to deploy a range of specialty process fieldbuses in the network architecture. This fact, combined with the often extreme nature of applications in process industries – extreme plant size, hazardous areas, climate, environmental hazards, or remoteness – have made it difficult for users to realize all the benefits possible from process integration. However, standard Ethernet and IP technologies – already proven in hybrid and discrete industries – stand to change this situation for the process industries.

ODVA envisions an approach to the optimization of process integration that will be convergent, compatible, scalable and open for users and their suppliers. The approach will simplify exchange of configuration, diagnostic and production data between field devices and higher-level systems such as supervisory control and data acquisition systems (SCADA). In addition, plant asset management (PAM) and secure remote access of field installations will be enabled and plant-to-enterprise communication simplified. This, together with the proven benefits and cost advantages of commercially available, off-the-shelf Ethernet and Internet technologies will help businesses improve productivity and competitiveness.

In this white paper, ODVA describes the opportunity for the optimization of process integration (OPI™) and an overview of its vision for a comprehensive approach to OPI including:
- OPI in the industrial ecosystem;
- ODVA's vision of OPI in the production domain;
- Industrial use cases for OPI;
- ODVA's technical approach to OPI; and
- OPI in practice.

The audience for this paper includes business and technical leaders in process industries who are seeking to define their future network architecture and product managers at automation product vendors who are seeking to map out the product roadmaps to support applications in the process industries.

OPI in the Industrial Ecosystem

ODVA has a broad overall approach to OPI based on the three principle domains of the industrial ecosystem – production, enterprise and power grid – as shown in Figure 1. The focal point of OPI is the production domain and the process plant. This approach is characterized by the need for the integration of field and functional safety devices with the control systems, along with the business value of providing process information from the field to enterprise systems. The foundation of OPI is an interoperability framework achieved through a unified communication system using standard Ethernet and Internet technologies. This framework also covers other requirements particularly relevant to applications in the process industries such as intrinsic safety and configuration of field devices with a large number of parameters.

ODVA's plan for OPI leverages its core competency in information and communication technologies. These are grounded in ODVA's media-independent Common Industrial Protocol (CIP™) and in EtherNet/IP™, its network technology which is based on standard, unmodified Ethernet and Internet technologies. For OPI between field devices and industrial control systems or ICS, often referred to as DCS or PAC, ODVA seeks to include objects, services and device profiles that are optimized for applications in the process industries and permit the transparent and seamless exchange of production, logistics, configuration and diagnostic information. In the long term, ODVA envisions physical layer implementations that allow for the integration of devices on Ethernet that are intrinsically safe and network-powered.
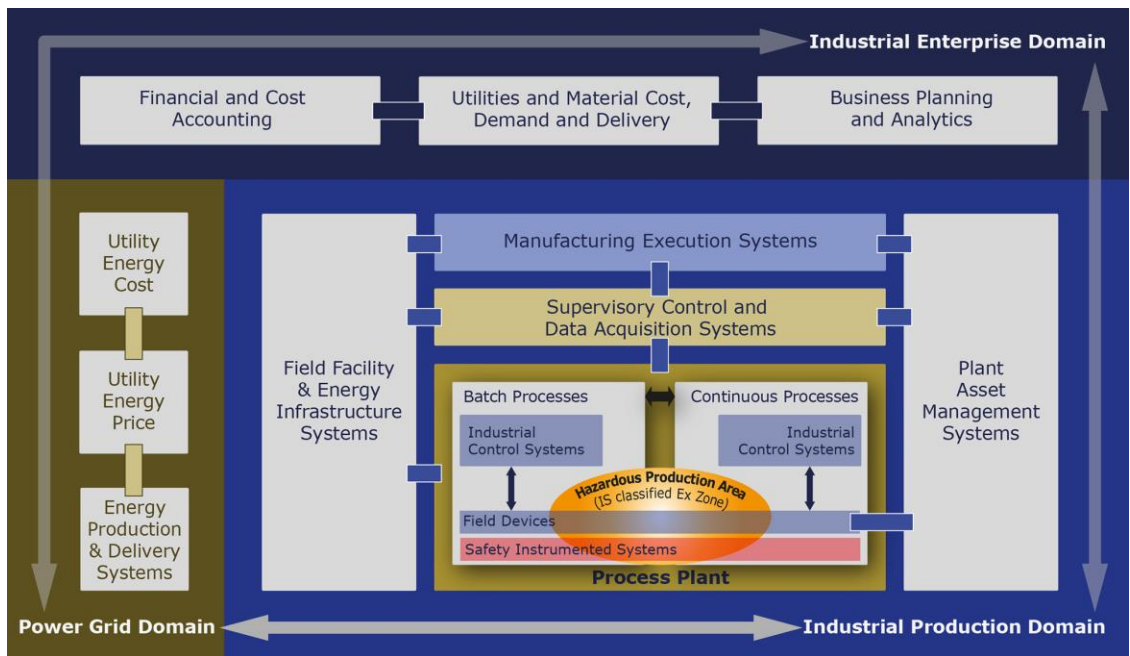

Figure 2
OPI in the Industrial Ecosystem

Vision of OPI in the Production Domain

The production domain in process plants – where the tight integration of field devices with industrial control systems is required – is the focal point of OPI. Although integration of field devices is essential, plant engineers have not been provided with standard ways to facilitate this integration. Originally, process plants relied on 4-20 mA analog signals for transmitting process values to and from field devices. More recently, these analog signals have been often replaced with digital communication technologies in the form of specialized process automation fieldbuses. However, these fieldbuses traditionally require specialist training, knowledge and tools to integrate with higher-level networks and, in many cases, have not been designed for the transmission of large amounts of data available from today's instrumentation. Remote access is also complicated, requiring additional hardware in the form of gateways to allow remote access connections to the plant and its field devices, industrial control systems, and interrelated systems using IP-based technologies.

ODVA, with its expertise in standard information and communication technologies for industrial automation, combined with its large community of device vendors, who make and sell EtherNet/IP-compliant products for industrial automation, can provide the process industries with an evolved approach to OPI that is:

- **Convergent** in its long term approach to support the deployment of standard Ethernet and Internet technologies in the process industries across all domains of the industrial ecosystem;
- **Compatible** by enabling users to integrate new devices and systems with their installed base while evolving their automation architecture to complement the architecture for supervisory and enterprise systems;
- **Scalable** from simple field devices to complex systems of automation equipment in the enterprise environment; and
- **Open** by virtue of its use of multi-vendor, interoperable standards managed by an independent, vendor-neutral organization

Overall market trends for standard Ethernet and IP technologies, including but not limited to, EtherNet/IP indicate that such an evolution will occur in the process industries and accelerate over time, mirroring the evolution in the hybrid and discrete industries. EtherNet/IP incorporates the same commercial off-the-shelf (COTS) network interface components (NICs) used in standard Ethernet and IP technologies. The overall connection cost for devices using these COTS-based NICs continues to fall and, in a growing number of cases, is less today than traditional non-Ethernet fieldbuses. Plus, the power and space requirements for these NICs are also decreasing. Furthermore, the new generation of engineers and plant personnel is familiar with standard Ethernet and Internet technologies and will make it the preferred technology for both new and retrofit installations, leveraging existing know-how for reduced training and increased productivity. With some people forecasting the "Internet of Things" (IoT) to grow at a rate of 36% between now and 2021[2], more and more devices will be IP-enabled by default. The overall impact of IoT can already be seen today in the process industries where the number of Ethernet-enabled devices has been forecast to double by 2016 with a compound annual growth rate of over 15%.[3] This trend is also consistent with thought leadership on key standards and technologies for future process automation systems in which the basis of plant level communication is expected to be industrial Ethernet.[4]

OPI seeks to ensure that users in the process industries can take advantage of these trends and that process data is accessible at every layer in the production domain. This approach forms the foundation for future optimization of process integration in terms of all of the interrelated assets, systems and processes within the production domain.

Use Cases for OPI

Despite wider acceptance and use of Ethernet and IP technologies in process automation, there are still gaps between the field, control and enterprise levels. Plus, different control systems favor different fieldbuses. OPI will ease this situation by providing users with a unified communication solution that includes the information and communication standards for the objects, services and profiles needed.

Realization of OPI requires a three-pronged approach to common use cases in automation for process industries: (1) field device to ICS integration; (2) field device to PAM communication integration; and (3) a seamless, holistic field-to-enterprise communication architecture. ODVA's approach for OPI is based on natural solution groupings for these use cases and originates from a four-part working hypothesis:

1. Use of industrial Ethernet in process plants is growing and will accelerate, first with its use as the backbone for control systems and then expanding to new field devices. Ultimately it will converge multiple diverse networks and simplify the automation architecture.
2. At the field level, industrial Ethernet will first be applied to devices with larger data exchange requirements such as flow meters which contain instrumentation data (e.g., mass flow, viscosity) or control valves which contain process data (e.g., travel distance, stiction). In the longer term, devices with smaller data exchange requirements, such as simple sensors and actuators, will follow as has been seen in hybrid industries.
3. The scale of process automation control systems, in terms of number of devices and control loops, as well as geographic distribution of the overall system, tends to be larger than in hybrid and discrete production plants. This distribution calls for a network with a scalable architecture that can support a large number of devices and a peer-to-peer or distributed control architecture.
4. The useful life of plant and equipment in automation applications in process industries will continue to be much longer than in hybrid and discrete industries. Thus, users in the process industries will need a retrofit approach to the optimization of plant integration that accommodates an automation architecture that blends the old with the new.

Use Case Type 1: Field Device-to-ICS Integration
Field device-to-ICS integration is the foundation of OPI. Integration of field devices into ICS incorporates the communication requirements for existing field devices on specialty fieldbuses along with the communication improvements for new field devices on industrial Ethernet such as enhanced diagnostics and instrumentation data. It also includes physical layer options such as Power-over-Ethernet and will conform to emerging standards for intrinsically safe Ethernet.

Use Case Type 2: Field Device-to-PAM Integration
Field device-to-PAM integration is the accelerant for OPI. It seeks to ensure that the field device provides optimal performance at all stages in its life cycle from commissioning and operation to calibration and maintenance. PAM is particularly important in process applications where installations are expected to operate for long periods of time without shutdown.

Use Case Type 3: Holistic Field-to-Enterprise Communication Architecture
A holistic field-to-enterprise communication architecture is the integrator for OPI. It supports optimization of process integration by enabling the paradigm shift from the classical, restrictive automation pyramid towards a flatter and more inclusive distributed network architecture. With a single, converged and transparent enterprise-wide communication architecture, it can provide full access between the automation and enterprise resource planning systems. The result is a unified communication solution that allows virtually unlimited access to data – anywhere, any time. OPI will allow users to update and improve the performance and serviceability of field installations as well the integration of process applications with the overall enterprise in a safe and secure manner.

Technical Approach

Users will benefit from a multi-vendor, interoperable portfolio of products and solutions from ODVA's community of vendor members through the evolution of ODVA's open standards for OPI. To achieve this result, ODVA's technical approach will leverage the inherent **strengths of EtherNet/IP** which include:

- **Most services** to manage network access and control throughout the architecture;
- **Peer-to-peer** communication to support distributed control and data exchange;
- **Reduced overall system cost** to simplify integration from the device to the IT level;
- **VLAN transport of real-time messages** to eliminate the need for physical subnets; and
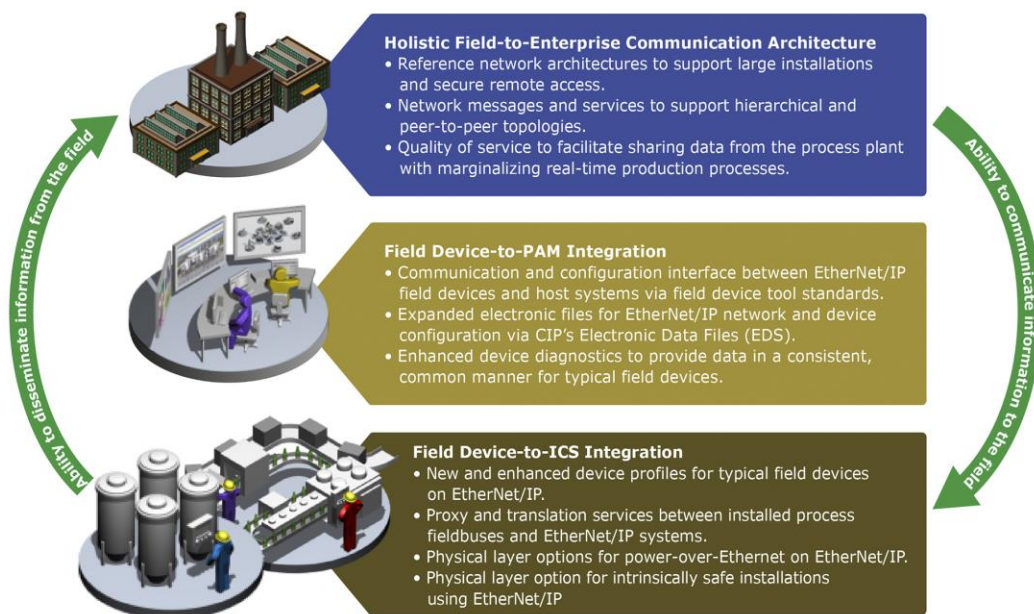- **High availability** network with the best overall switchover mechanisms

Figure 3
The Technical Approach to OPI's Unified Communication Solution

At the heart of OPI's technical approach is a unified communication solution based on EtherNet/IP and CIP, ODVA's proven protocol used by EtherNet/IP. To ensure that this approach addresses the application requirements of the three primary use cases being addressed by OPI, ODVA has identified specific actions for each use case which will drive the focus of its technical work in support of OPI as shown in Figure 3 above. Moreover, because CIP is media independent, messages generated by EtherNet/IP-compliant devices can be transported throughout the process plant and up to the enterprise over any TCP/IP-based network. This ensures that users will have increased availability of process information and thus be able to access, retrieve, use and virtualize it – anywhere, any time. Further, to help ensure maximum standardization and economies of scale, ODVA will leverage other relevant industry standards and technical innovations where practicable – such as industry recommendations for diagnostics and condition monitoring field devices and innovations and/or standards for power-over-Ethernet and intrinsic safety.

OPI in Practice

OPI enables a unified communication solution that can be ultimately comprised of standard unmodified Ethernet and Internet technologies using EtherNet/IP in combination with an IP-oriented network architecture. In practice, skid builders and end users are able to integrate both simple and complex field devices and instrumentation more easily and support multiple control loops in real time with higher performance. Process data can be collected, visualized and accessed at multiple levels in the production domain and aggregated for use throughout the industrial ecosystem.

The comprehensive approach to OPI allows current applications to be optimized for overall equipment effectiveness while still providing a technical foundation for future evolution toward a fully unified communication solution that can leverage the benefits, and migrate to, standard Ethernet and Internet technologies using EtherNet/IP. EtherNet/IP is a proven technology built to be future-proof and holistic in its approach to industrial automation. It was first released in 2001 and today products can be purchased from hundreds of vendors. A growing number of these products can be found in the process industries adding to the significant installed base of EtherNet/IP products that are already found in hybrid and discrete industries.

Application Example: OPI-enabled Chemical Dispenser

Dye injection systems, used by textile manufacturers, dispense a significant amount of chemicals. Reduced chemical usage, combined with demand-driven production runs can combine to together to offer significant return on investment. To achieve this, OPI allows the user to integrate complex field devices, such as pumps and mass flow controllers, with industrial control systems in a single converged communication solution. As a result, multiple, simultaneous, real-time control loops are possible and uptime is maximized through diagnostic and condition monitoring by plant asset management systems. In one case, a manufacturer was able to reduce chemical usage by 10% while formulating and dispensing dye liquors on the fly to produce unique product formulations in response to market demand.
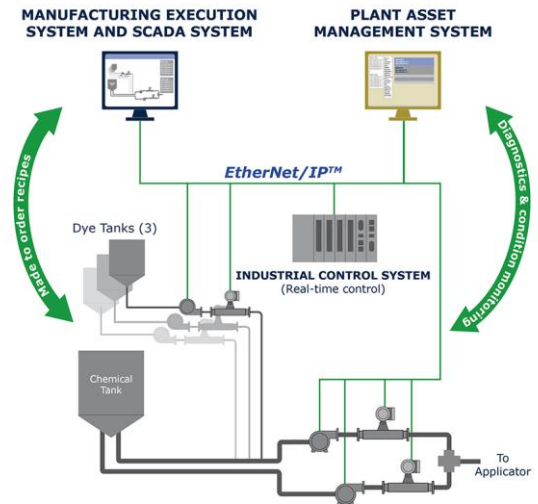
Holistic Field-to-Enterprise Communication Architecture

Commitment to OPI

OPI is central to ODVA's long-term commitment to help industry achieve its goals for sustainability that seek to balance profits with our planet and its people. The definition and roadmap for OPI is the result of an in-depth investigation within ODVA and its key stakeholders into the needs of the process industries. ODVA intends for OPI to start providing users with a return on investment as soon possible, starting with enhanced profiles for typical field devices found in hybrid applications in 2015 and with accelerating benefits each year thereafter as shown in Figure 4.
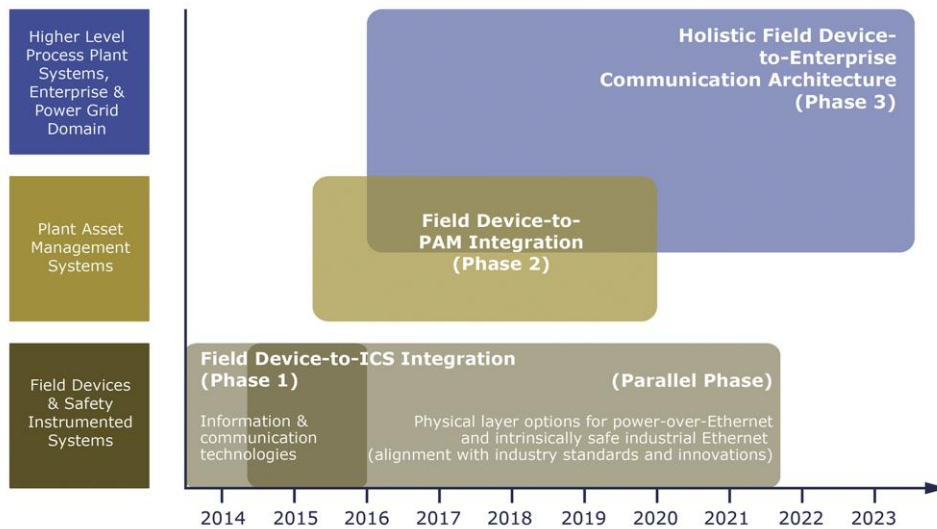
Figure 4
Projected timeline for implementing OPI functionality in ODVA specifications and requirements

With its core values of vendor-neutrality, open participation and open technologies, ODVA provides the ideal forum for building consensus among market leaders in process automation. As a result, EtherNet/IP is the ideal convergent and unified communication solution for realizing the next generation of productivity enhancements which are possible with a unified communication solution that leverages and makes the Optimization of Process Integration reality.

About ODVA

Founded in 1995, ODVA is a global association whose members comprise the world's leading automation companies. ODVA's mission is to advance open, interoperable information and communication technologies in industrial automation. ODVA recognizes its media independent network protocol, the Common Industrial Protocol or "CIP" – and the network adaptations of CIP – EtherNet/IP, DeviceNet, CompoNet and ControlNet – as its core technology and the primary common interest of its membership. ODVA's vision is to contribute to the sustainability and prosperity of the global community by transforming the model for information and communication technology in the industrial ecosystem. For future interoperability of production systems and the integration of the production systems with other systems, ODVA embraces the adoption of commercial-off-the-shelf (COTS) and standard, unmodified Internet and Ethernet technologies as a guiding principle wherever possible. This principle is exemplified by EtherNet/IP – the world's number one industrial Ethernet network. For more information about ODVA, visit odva.org.

CIP, EtherNet/IP, OPI and OPI-enabled are trademarks of ODVA. Other trademarks are property of their respective owners.

Footnotes
[1] L. O'Brien and W. Chin (2008, 3 January) "ARC Insights: North American Industrial Infrastructure Needs More Than Just a Facelift"
[2] Analysis Mason, 2012: M2M device connections by market type, worldwide, 2011–2021
[3] T Moore (2013. 15 February) "Industrial Ethernet and Fieldbus Technologies – World – 2013"
[4] D, Woll, L. O'Brien, D. Hill, and P. Miller (2011, March) "ARC Strategies: Evolving Collaborative Process Automation Systems Create New Opportunities"