WHITEPAPER

PA-DIM® bridges the gap between OT and IT in the process industries

Speaking the same language

The Process Automation Device Information Model offers industrial plant owners, automation system vendors and application developers a common language for describing instrumentation device data that’s independent of automation protocols, device type or manufacturer.

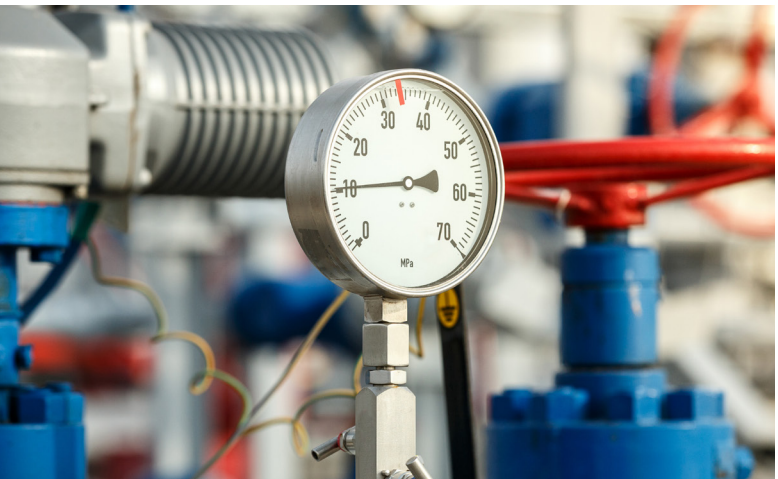
A key enabler for digitalization in the process industries, PA-DIM provides a standardized information architecture for all process automation systems and devices using OPC UA as the base, helping to maximize the business value of instrumentation data as it’s exchanged between OT and higher-level IT systems.

Introduction

The Process Automation Device Information Model (PA-DIM®) is an open specification that defines an OPC UA (Unified Architecture) information model for process automation devices, including semantic identification. This vendor-independent model provides a structured hierarchy that allows standardized access to data produced by field instrumentation devices.

The development of PA-DIM has been driven by the need to give secure, seamless access to device information, simplifying integration of operational technology (OT) with higher-level Information Technology (IT) systems. PA-DIM achieves this by using OPC UA information modelling techniques that offer a common language for describing device data, helping to reduce the risks of high-value data being 'lost in translation' in its exchange between systems of OT, plant IT and enterprise IT.

Providing an open and robust standardized platform for data abstraction and harmonization of different field device types that are widely used in process automation, PA-DIM can be seen as a common bridge between the worlds of OT and IT. The benefits of PA-DIM include greater visibility and control over field device data carried over different protocols by devices from different vendors and of different ages. It also contributes to a reduction in data 'hops' between OT and IT, minimizing the likelihood of compromising the value of OT data, while reducing operational and maintenance costs.



The benefits of PA-DIM include greater visibility and control over field device data carried over different protocols by devices from different vendors and of different ages.

This paper discusses the value of PA-DIM as an enabler for simplified data exchange between devices, systems and IT applications in today's process industries. It highlights how PA-DIM reduces the complexity of transporting high-value data from field devices, via plant automation and control systems, up to enterprise computing resources.

The paper also discusses how PA-DIM is leveraged in ABB's Field Information Manager (FIM) device management tool. FIM's comprehensive field connectivity capabilities enable neatly-structured process data from different device types and protocols to be passed as a 'clean feed' to data-driven IT applications such as condition based monitoring and asset management to enable predictive maintenance strategies. At enterprise level this information can also be leveraged to support fleet management strategies, contributing to a holistic view of asset utilization and performance across an industrial producer's entire estate, including multiple sites.

Addressing the OT/IT convergence challenge

As the front line in industrial processes, field instrumentation gathers data that provides plant operators with valuable insights to control and monitor process performance. This is achieved through accurate measurement of process values such as flow rates, temperature and pressure. These process values, together with field instrumentation diagnostic data, are also used to drive higher-level activities such as process optimization, condition-based maintenance and fleetwide asset management.

Despite its value, it is estimated that less than 20% of data generated by industrial companies is actually used, with an even smaller percentage being subject to analysis. This means that as much as 80% of industrial data is simply wasted. One of the main causes for this loss is because of practical difficulties in accessing, interpreting and acting on it. This in turns frequently stems from the range and diversity of the instruments on a plant, and the way in which data they generate is communicated between the plant and control room.

It is estimated that less than 20% of data generated by industrial companies is actually used.

In a typical industrial plant there may be thousands of devices from numerous vendors – including temperature and pressure transmitters, flowmeters and valve positioners – that are collectively responsible for the control of a large number of processes. Spanning decades and multiple generations of control and automation systems, they've been engineered to operate with a variety of standards-based digital communication protocols including assorted versions of HART, FOUNDATION Fieldbus, PROFIBUS PA and PROFINET, with every protocol representing field device information differently.

What's more, every device has specific functionality and data structures associated with it that are proprietary to different vendors. And as technology has matured over the decades, this has resulted in latest devices having far more sophisticated configuration and diagnostic capabilities than their forebears from 30 years ago or more.

This presents some big challenges in smoothly integrating data from process automation OT with higher-level IT systems and applications at plant and enterprise level. This can be problematic both electronically – where information does not move through these layers – and semantically where information moves but the meaning is misinterpreted.

This complexity places a burden on traditional automation data management strategies that are comparatively inflexible and resource intensive, imposing significant barriers to realizing the full benefits of digitalization.

Speaking the same language
Given these challenges, bridging the gap between OT and IT demands a common information model – a universally recognized language to represent information generated by different protocols. The goal in establishing this common information model is ensuring seamless access to device information, across multiple applications and potentially across multiple sites. Achieving this demands standardization of the form and basic content of the information models for certain device classes, in a way that's independent of any specific communication protocol.

The goal in establishing this common information model is ensuring seamless access to device information, across multiple applications and potentially across multiple sites.

Let's look for a moment at the typical process automation industry architecture. Underpinning connections between instrumentation devices and the systems controlling them is the lowest physical layer. This is represented by legacy 4-20 mA and Fieldbus profiles, as well as the newer and faster Ethernet-APL standard.

Above this physical layer sits the protocol layer, where several standards-based automation protocols including HART, FOUNDATION Fieldbus, PROFIBUS PA and PROFINET represent information that's being generated by field instrumentation devices.

Each of these automation protocols represents field device information differently, with the variety of device functionality between vendors adding further to this complexity. This poses a major challenge in integrating and consolidating large volumes of information generated by process automation OT that's been structured according to different rules, obstructing ready access to this data by higher-level enterprise IT systems.

Uniting interests in the process automation industry

The development of PA-DIM represents a significant collaborative effort, uniting leading players in the process automation space including device manufacturers, standards development and end user organizations.

PA-DIM is the product of a joint working group originally established in 2017 by the OPC Foundation and FieldComm Group, with the goal of standardizing an information architecture for all process automation devices using OPC UA as the basis.

To achieve this, PA-DIM leverages existing standards such as OPC UA Part 100 Devices (DI-Model) and IEC 61987 Common Data Dictionary that provides product ontologies for industrial process automation. The first Version 1.0 of the PA-DIM specification was released in 2020, providing a standardized information model for devices including pressure, temperature, level transmitter, flow meters and valve positioners.

Announced in 2024, PA-DIM Version 1.1 broadens device integration capabilities with the addition of new extensions and features to benefit instrumentation device manufacturers and industrial users, empowering users with harmonized solutions for process instrumentation and process analyzers with field-to-cloud semantic interoperability in context. Expanding device type support to include process analyzers, it's also complemented by an enhanced hierarchy structure, offering greater flexibility in the representation of device information and attributes.

Information description that's protocol independent

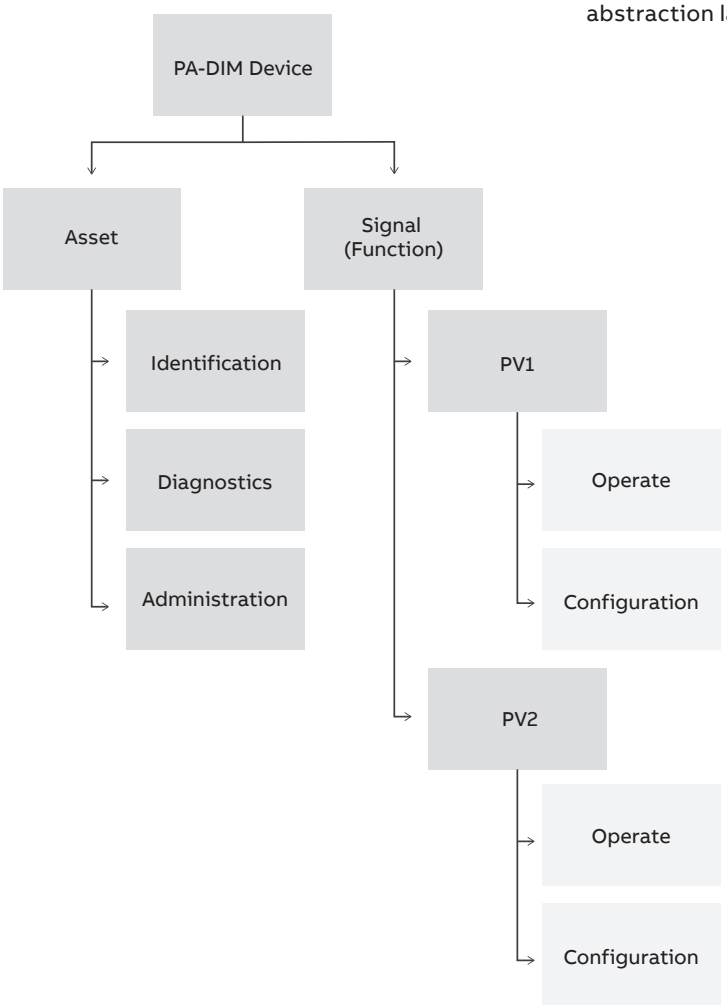
To ensure interoperability and seamless access to device information by higher-level IT systems, it's therefore essential to create a universally understood descriptive language describing the form and basic contents of information models for certain device classes. By maintaining independence from any particular communication protocol, this common language can simplify the frictionless flow of instrumentation information throughout the enterprise, from OT, via a higher-level integration layer, all the way up to top-level IT applications.

The following sections of this paper give practical examples of how the benefits of PA-DIM are leveraged in ABB's Field Information Manager (FIM) device management tool. As a fieldbus device management software platform, FIM automates and simplifies control of large fleets of field devices, spanning latest-generation device technology as well as legacy installations.

FIM automates and simplifies control of large fleets of field devices, spanning latest-generation device technology as well as legacy installations.

It also gives further detail on how PA-DIM uses OPC UA information modelling principles to define the protocol-independent parameters and diagnostic data that are required to describe field devices. Examples of these include temperature, pressure and level transmitters, flow meters and positioners.

Through its implementation of the requirements of the NAMUR Open Architecture (NOA) information model – and also NAMUR Recommendation NE 131 that defines device parameter requirements for common field instrumentation – PA-DIM allows instrumentation vendors to develop their own device drivers. In turn these allow device/parameter names and other contextual information to be automatically mapped by PA-DIM into a neatly-ordered and harmonized abstraction layer.



—
PA-DIM information model provides asset/device related information and several process values including related configuration

PA-DIM at a glance

- Unlocks the full potential of data produced by field devices with a standardized data framework that is machine-readable and universally understood across different devices and protocols.
- Combines OPC UA with the NAMUR Open Architecture (NOA) Information Model that makes production data readily usable for plant and asset monitoring as well as optimization.
- Bridges OT/IT divide by providing structured hierarchy for standardized data representation of process plant instrumentation and other devices, providing unified information model that seamlessly integrates OT data exchange with IT systems and other higher-level applications.
- Simplifies movement of process data from field to enterprise IT systems on-premise and in the cloud to support activities including asset management, process optimization, diagnostics, condition based monitoring and preventative maintenance.
- Offers structured, manufacturer independent hierarchy for standardized access to device data, ensuring consistency across different devices and protocols.
- Allows consistent access to and interpretation of field device information, regardless of fieldbus protocol, device type or vendor.
- Provides an asset- and signal-centric device model with standardized semantics identifiers, where the asset defines the device with its identification, diagnostics and administration, with the signal able to define several process values including related configuration with multi-variable devices.

PA-DIM and ABB Field Information Manager

The benefits of PA-DIM are leveraged in ABB Field Information Manager (FIM), the versatile but easy to use software-based device management tool that gives process plant operators control over large fleets of connected devices at plant level, or across a wider estate of facilities.

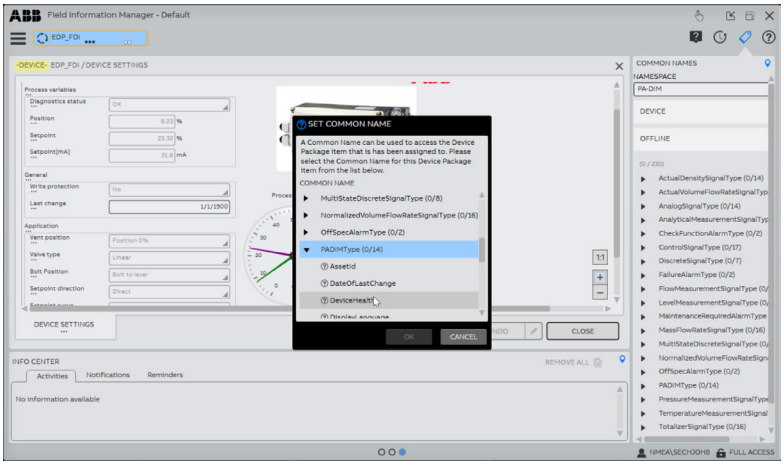
Helping to streamline configuration, commissioning, diagnostics and maintenance of fieldbus instruments, FIM supports plant owners in realizing their goals of greater operational efficiency and measurement accuracy with reduced maintenance costs. In particular its user-centric design and friendly graphical interface are intended to assist field instrumentation technicians and engineers in performing their specific tasks and workflows.

Much of FIM's appeal with plant owners lies in its ability to work seamlessly with legacy instrumentation devices – in many cases still operating decades after their original commissioning – alongside the latest Ethernet-APL PROFINET PA Profile 4.02 devices now entering the market.

FIM in particular provides integrated device management capabilities when deployed in conjunction with ABB's System 800xA and Symphony Plus distributed control systems (DCS). In addition, FIM provides a wide range of connectivity protocol options for HART, HART-IP, PROFIBUS, PROFINET, ASi-5 and HART multiplexers as well as with third-party programmable logic controllers (PLCs) – further broadening its utility in today's broad industrial control and automation ecosystem.

As discussed above, PA-DIM uses OPC UA information modelling principles to define protocol independent parameters that are required to describe field device information. This functionality is implemented in FIM with its Common Names framework, where FIM provides an out-of-the-box PA-DIM Common Names definition. Regardless of the field protocols used by FIM the PA-DIM Common Names provides the standard PA-DIM mapping of device parameters to the FIM OPC UA Server.

Various host systems, web applications and cloud architectures can connect with this OPC UA Server and consume data that's structured according to PA-DIM information model. With this solution no extra hardware or software gateways are required, with FIM providing a 'lean' and cost-effective PA-DIM interface, irrespective of protocol complexity in the fieldbus network.



— Mapping of device package parameters to PA-DIM Common Names definition

ABB's Field Information Manager provides a 'lean' and cost-effective PA-DIM interface, regardless of protocol complexity in the fieldbus network.

Deployed in this way, FIM also provides a separation of concerns according to the NAMUR Open Architecture principles. Here FIM acts as a second channel providing device data to the monitoring and optimization (M+O) domain, functionally separated from the core process control (CPC) domain.

Through FIM, PA-DIM can thus be applied on the OPC UA interface to enhance device connectivity and interoperability. This offers a streamlined interface for transporting real-time data from field devices to other systems such as cloud-based asset management, analytics and condition-based monitoring solutions.

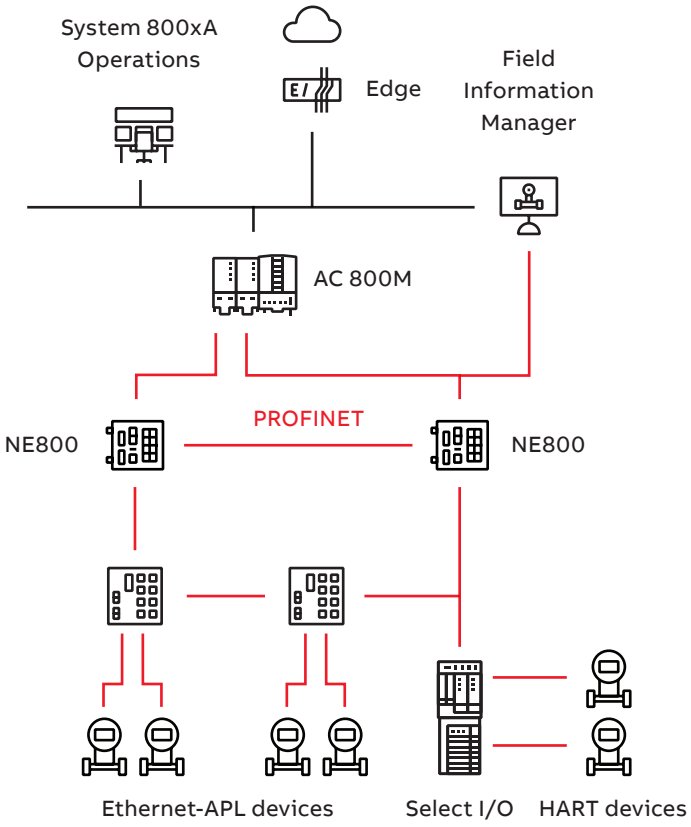
OPC UA: a secure enabler for PA-DIM

Developed and maintained by the OPC Foundation, OPC UA (Open Platform Communications Unified Architecture) is an open source vendor-independent platform enabling data exchange between sensors, systems and enterprise applications.

Strong, scalable security is central to the architecture of OPC UA, with authentication and encryption functions managed via digital signatures. From the cybersecurity perspective of modern plant operations, this intrinsic security of OPC UA serves as a secure foundation for PA-DIM, helping minimize the opportunity for unauthorized intrusion or cyberattack in the interface between OT and IT systems.

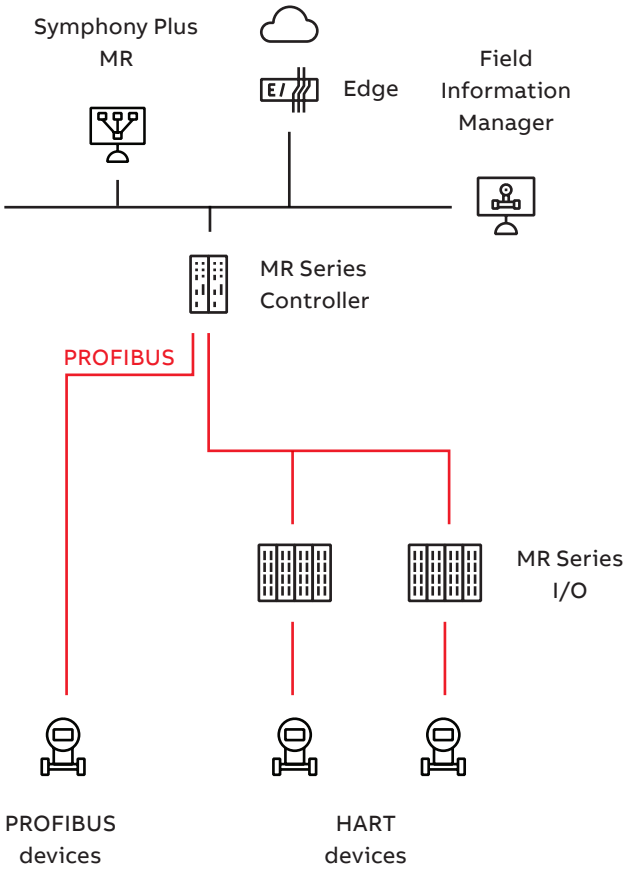
For yesterday, today and tomorrow: PA-DIM use cases

Deploying ABB Field Information Manager (ABB) – with support for OPC UA and PA-DIM – can deliver significant value for enhanced IT/OT efficiency when implemented in brand-new industrial process automation environments. It's also an ideal fit for optimizing asset visibility and control in existing plants featuring decades-old instrumentation and control technologies.



1. New installations with latest-generation devices, protocols and automation systems
ABB FIM with PA-DIM offers industrial users an ideal complement for the latest generation of control and automation technologies. Integrated with ABB Ability™ System 800xA® distributed control system (DCS), for example, FIM provides powerful device management capabilities for a wide range of devices connected to the 800xA system. This includes brand-new PROFINET devices from ABB and other vendors that support the recently ratified Ethernet-APL physical layer, as well as various versions of HART, PROFIBUS PA and PROFINET-compliant devices from a wide range of manufacturers.

Regardless of the vendor, type or version of integrated devices, FIM ensures delivery of a cleanly-structured PA-DIM information model data feed to related IT applications. Acting as a NOA second channel, FIM thus provides a separation of concern between core process control domain and the monitoring/optimization domain.



2. Brownfield sites with legacy fieldbus standards and automation systems
ABB FIM with PA-DIM is equally suited to end user device management in process plants running currently-installed control and automation systems, such as ABB Symphony Plus MR (Melody Rack) Series controllers, communication interfaces and I/O modules that date as far back as the 1990s.

Integrating FIM allows plant operators to leverage the benefits of the latest device management technologies without having to rip-and-replace existing devices, networking and control systems hardware. A PA-DIM compliant FIM server can interface with the DCS's engineering database, retrieving information describing devices that are connected via HART or PROFIBUS protocols into – for example – a still-supported Melody control system. This combination delivers a latest-generation asset management experience on a controller and IO system that was installed over 30 years ago.

ABB as a partner for your digital journey

Unlocking the full potential of real-time operational data is key to driving greater efficiencies at a process, plant and enterprise level. As a world leader in process automation and digitalization solutions for the energy and process industries, ABB is an ideal partner to help organizations gain business advantage by maximizing the value of instrumentation data exchanged between operational technology and higher-level IT systems.

ABB's Field Information Manager (FIM) device management tool leverages the PA-DIM information model, streamlining data exchange between the multiplicity of devices, protocols, systems and IT applications in today's process industries – allowing plant owners to achieve the goals of greater operational efficiency, increased asset visibility and reduced maintenance costs.

new.abb.com/control-systems/fieldbus-solutions
solutions.abb/control-systems
solutions.abb/fieldinfo

7PAA018748 en A