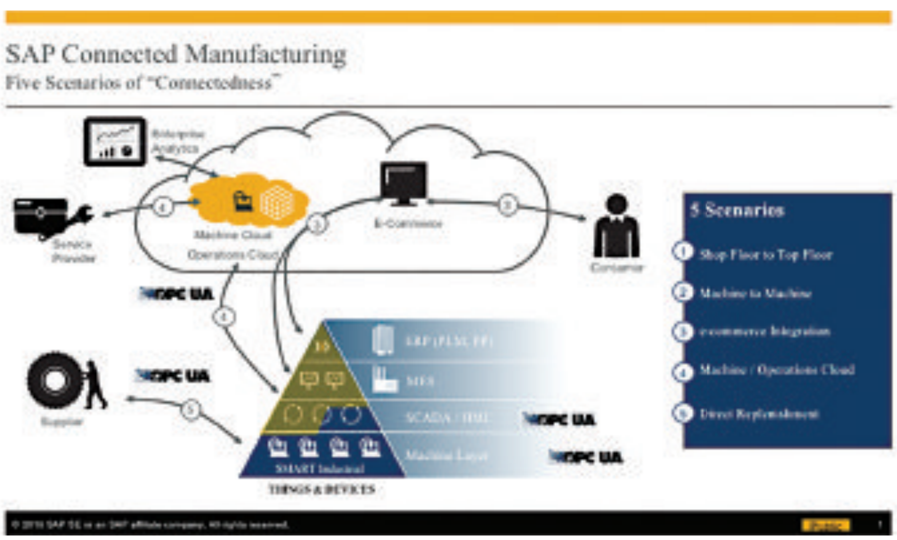
Reshaping the automation pyramid

Stefan Hoppe and *Rüdiger Fritz* discuss a multi-vendor demonstrator that will be on show at Hannover Messe this year to highlight the full potential of OPC UA in production facilitites.



The market increasingly demands individualised products. Product life cycles are getting shorter and average lot sizes are getting smaller. Considering this, cost efficient production in a globalised and resource limited environment requires a highly flexible (IT) infrastructure that also works well in cross-enterprise networks.

An objective must be to bring the worlds of business data and automation data much closer together to reduce the number of media breaks and the number of isolated applications. In addition, the combined data will be the basis for completely new insights.

The classical automation pyramid paradigm is outdated due to its strict and hierarchic separation into Enterprise Resource Planning (ERP), Manufacturing Execution System (MES), SCADA and Machine/Device. The different data models of each layer need to intermesh more seamlessly than in the past and at the same time, the interoperability needs to consider new processes with regard to interaction with customers, suppliers and service providers.

Hence, manufacturing companies have to accept the challenge to transform their IT landscape in such a way that various scenarios of interoperability can be managed while being ready for continuous and easy adaption to new requirements.

The central foundation of a promising strategy for the digital transformation should be given to the standardisation of communication protocols.

A bidirectional connection of machines to other software is often difficult because only vendor-specific, proprietary protocols and interfaces are provided. Although there have been various efforts and approaches to harmonise the variety of M2M protocols and although there is a certain urgency and necessity for more flexibility and openness of IT systems in production environments, still far too often the arguments that gain acceptance are those that prefer the closed system bundle of asset plus SCADA/line-server from a single provider.

The availability of OPC UA could be the perfect basis to bridge the gap between the machine and business layers. OPC UA provides not only the means to transport machine data (e.g. set-points, measured values, parameters) it also has the unique feature of being able to semantically describe the data. Thanks to the OPC UA information model, new processes between a PLC and any higher-level, business-oriented software layer can be established in a very short time.

Set-points and control-variables could be easily maintained and centrally administrated as a natural part of the material master data and even customer order specific information could be directly exchanged with the PLC instead of replicating the data across different software layers. Providing measurement and process details as an enhancement of business documents for comprehensive analytics is also an easy task as soon as the connectivity is standardised.

The proficient implementation of the OPC UA specification offers even further possibilities, shown by a demonstrator, which the co-innovation partners and technology leaders SAP (Enterprise Software), Beckhoff Automation (Automation Technology), Elster-Kromschröder (Measurement Technology), Asentics (Machine Vision for Factory Automation), Stäubli (Robotic Technology) and CAB (Industrial Printing Technology) will be presenting at the Hannover Messe 2016.

Based on a Beckhoff XTS (eXtended Transport System) a machine will assemble personalised products in lot size 1 while configuration and automation related master data will be received directly from the SAP Manfacturing Execution software.

This vertical integration alone would be far from striking, as several progressive companies already make use of such concepts and confirm the value of OPC UA. What is spectacular is that each component of the demonstrator (transport system, robots, cameras, printers, measuring technology) serves as an independent machine unit, which each acts for itself as OPC UA Server and OPC UA client. The autonomous units are orchestrated by SAP Plant Connectivity (PCo) – itself again OPC UA server and client at the same time. In this way, each machine unit can deploy as needed OPC UA methods, events or data points (tags) that publish the respective responsibilities and capabilities of the unit.

Instead of the traditional way to couple the machine units by means of a single 'hardwired' PLC programme, SAP PCo orchestrates the components from the perspective of operational necessity. The layers know the individual routing for a production order and can, for example, instruct the machine to skip an operation X for product Y or to trigger a robot to execute job configuration A for a product B. At the same time, a machine unit could automatically obtain information by calling the provided OPC UA methods of each other building block. Vertical and horizontal integration is evolved into flexible networks.

Leveraging this idea of combined OPC UA Server and Client means, that in future, production facilities can be easily enhanced and adapted. The new mind-set for planning and operating complex automation systems will focus on Service Oriented Architectures.
sap.de/hannovermesse

Stefan Hoppe is vice president of OPC Foundation. Rüdiger Fritz is director, product management SAP Plant Connectivity at SAP SE.

OPC UA: interoperability at its finest!

OPC-UA was developed to provide an open interoperability standard to extend the reach of classic OPC across the firewalls into the MES world and enterprise space. Also published as IEC 62541, it enables exchange of information models of any complexity – both instances and types. It is designed to complement a variety of other international standards and enables interoperability at the semantic level.

OPC-UA is based on a scalable service-oriented architecture that has timeless durability. Security was also designed into the system architecture, based on a detailed analysis of security threats. Because the systems it was designed to support are so diverse, in terms of size, performance, platforms and functional capabilities, the following basic functionalities were specified for OPC-UA:

- **Transport –** for the data exchange mechanisms between OPC-UA applications. Different transport protocols exist for different requirements.
- **Meta model –** Specifies the rules and basic components for publishing an information model via OPC-UA. It also includes various basic nodes and basic types.
- **Services –** These constitute the interface between a server, as information provider, and clients as the users of this information.

Information models follow a layered approach. Each high-order type is based on certain basic rules so clients that only know and implement the basic rules are still able to process complex information models and are able to navigate through the address space and read or write data variables.

The object model enables production data, alarms, events and historic data to be integrated within a single OPC-UA server. This allows a temperature measuring device, for example, to be represented as an object with its temperature value, alarm parameters and corresponding alarm limits.

OPC-UA integrates and standardises the different address spaces and the services so that applications only require a single interface for navigation. Importantly, the OPC-UA model describes how clients access information on the server. It does not, however, specify how this information should be organised on the server.

OPC-UA is also designed to be completely backwards-compatible with all the OPC classic specifications, inclusive of data access, alarming and historical data access. Its availability on chips enables embedded devices to also benefit from OPC-UA functionality.

Ongoing work

Work on the standard is ongoing. The OPC Foundation is currently working with utility companies and a companion specification is being developed for IEC 61850. There are also plans in place to address sustainable energy through the development of an OPC-UA companion specification for IEC 61400. The OPC Foundation also has a close partnership with the PLCOpen organisation and together they have developed a complete set of function blocks and very cohesive mapping between OPC UA and IEC 6111.

MDIS, an international joint industry network group whose aim is to optimise the Master Control System and DCS interface of topside systems in oil and gas production also uses OPC-UA as the protocol standard.

All of the OPC Foundation collaborations are based on the OPC UA information model architecture that provides a seamless way to describe and move data and information between the embedded world and the enterprise. The advantage of this is the fact that it is dynamic and OPC-UA client applications developed today will be able to consume data and information models from OPC-UA servers developed in the future, without the need for modifications or a new release to the OPC-UA client product applications.