

Industry 4.0

OPC UA as a Bridge Between IT and Automation

Moore's law as the basis for distributed intelligence

In 1965 Gordon Moore predicted that the number of transistors per unit area on a computer chip would double every 12 months (later corrected to every 24 months). For almost 50 years we have observed a miniaturization and spread of electronics along Moore's law, extending into all areas of life. Mobile phones have become smartphones, buildings and cars are getting smart, and soon smart products created on screen by consumers will produce themselves by finding their own way through the smart factory. The Internet Protocol version 6 (IPv6) as the successor to IPv4 increases the previously available address space from around one to 1029 addresses per capita of the world's population and thus enables the Internet of Things and its industrial equivalent Industry 4.0. In the future, everything will communicate with everything: The milk carton will report the filling capacity, production date, name of the cow and the protein and fat content to the refrigerator and the smartphone. The fridge will communicate with its owner's smartphone, but also directly with the supplier of the milk that is running low: This will be possible thanks to the miniaturization of semiconductor chips predicted by Moore, and the resulting distribution of intelligence.

Intelligent factories enable a lot size of one

The level of automation in the production process has been increasing for many years. In Europe more and more qualified personnel is being replaced by fully automated machines and robots. At the same time the production advantage of Asian countries, which has until now depended on the availability of cheap labor on site, is decreasing as standards of living increase. If a consumer today orders self-designed shoes, the production – transmitted to Asia as a CAD drawing – might be carried

out on the same day. But the consumer will have to wait four to six weeks for the delivery – the transit time of ocean freight to Europe. In the future, production will take place in smaller, intelligent factories near the consumer. What the customer orders is delivered on the next day. Clicking the Order button marks the "digital birth", immediately followed by the selection of the factory capable of producing a lot size of one and located as close as possible to the customer's address. Saving the so far only virtual data – e.g. by storing customer and CAD data, etc. on an RFID chip – marks the "physical birth". From this point in time, the chip will not only control the production process, but also ensure the digital consistency of the engineering along the entire value chain; this is one of the three characteristics of Industry 4.0, in addition to horizontal and vertical integration.

Industry 4.0 – Integration via cyber-physical systems

Sensors, controllers and actuators link physical systems with the virtual world to create cyber-physical systems (CPS). After mechanization (first), electrification (second) and information technology (third), the fourth industrial (r)evolution will now take place through the implementation of the Internet of Things and Services in the factory. Industry 4.0 describes a vision proposed by German scientists ("Industrie 4.0" Working Group of the acatech National Academy of Science and Engineering) and politically supported (in the coalition agreement of the new German government) to strengthen Germany's position worldwide as a manufacturing location and as a leading manufacturing equipment supplier. The final report of the "Industrie 4.0" Working Group published in April 2013 envisages a scenario of newly emerging smart factories in which intelligent products know their own his-

tory, current status and alternative routes to achieving their target state. In this concept, networked machines acting as CPSs autonomously exchange information and control each other. They are connected vertically to business processes and horizontally to distributed networks – from order placement through to out-bound logistics.

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Even without the vision of Industry 4.0, IT technologies would still be driven by Moore's law to progressively move towards the industry and extend into all other areas of life. Industry 4.0 is based on the convergence of IT and industrial automation. In a smart factory, production modules that differ in quantity and quality depending on requirements will be provided using a plug-and-play inspired "Plug and Produce" model. The traditional automation pyramid with central PLC will be replaced by an OPC UA based CPS network. The new Smart Factory demo installation at this year's HMI trade show has been designed along these lines, with each module enabling data exchange through the provision of an OPC UA server or client. As OPC UA is already today an internationally established standard with the implicit capability for expansion, its further development will advance the convergence of IT and automation and thus merge more and more components of Industry 4.0. According to a survey conducted by the "Industrie 4.0 Platform", the members of BITKOM, VDMA and ZVEI regarded standardization as the greatest challenge in the implementation of Industry 4.0. OPC UA is an IEC standard (International Electrotechnical Commission) and has been included in the Industry 4.0 standardization roadmap by the VDE Association for Electrical, Electronic & Information Technologies (Verband der Elekt-

rotechnik Elektronik Informationstechnik e.V.) as the professional association supporting the DKE (German Commission for Electrical, Electronic & Information Technologies of DIN and VDE). OPC UA uses generally accepted security standards and enables data exchange between products from different manufacturers and across operating systems. The OPC UA standard is based on specifications that were developed in close cooperation between manufacturers, users, research institutes and consortia.

The OPC Foundation has been dealing extensively with the requirements of Industry 4.0 and its implementation using OPC UA (see the OPC Foundation brochure on the subject: <https://opcfoundation.org/brochures/>). The widespread acceptance among members of research institutes, industries and professional associations shows that OPC UA is a key technology as a data and information exchange standard for the vision of Industry 4.0.

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