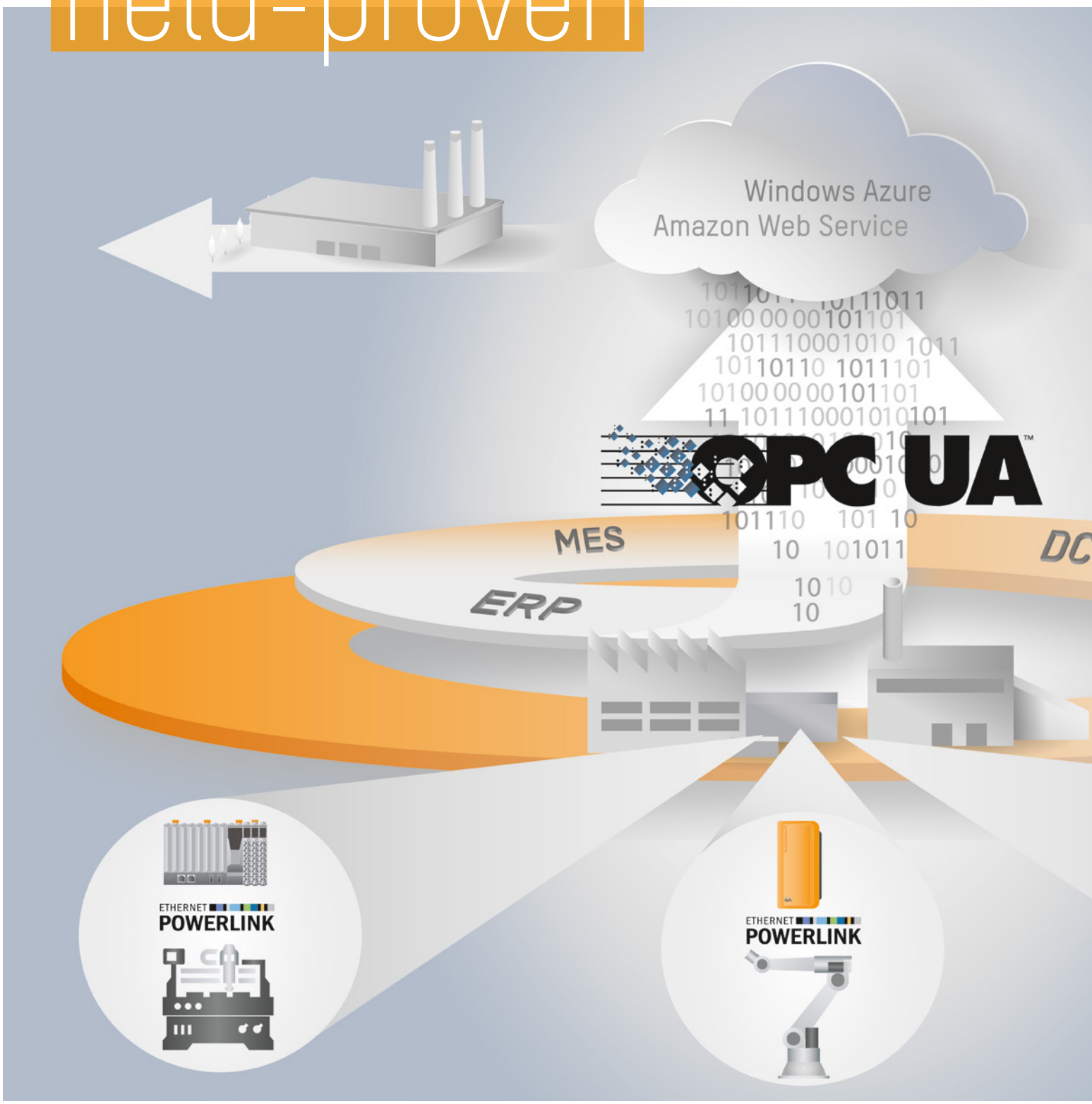
Field-tested, field-proven



OEMs and system integrators have high hopes for OPC UA TSN. So far, those hopes have been based on theoretical concepts and technologies still under development – but not any longer. Together with its partner companies, B&R has proven the ability of OPC UA TSN to meet communication requirements from the line level up to the ERP level under real-world conditions.

Over the past few months, B&R has performed intensive field testing together with TSN network specialist TTTech. "The results are impressive," reports Sebastian Sachse, technical manager of B&R's Open Automation business unit. "In some aspects, OPC UA TSN has even outperformed our expectations."

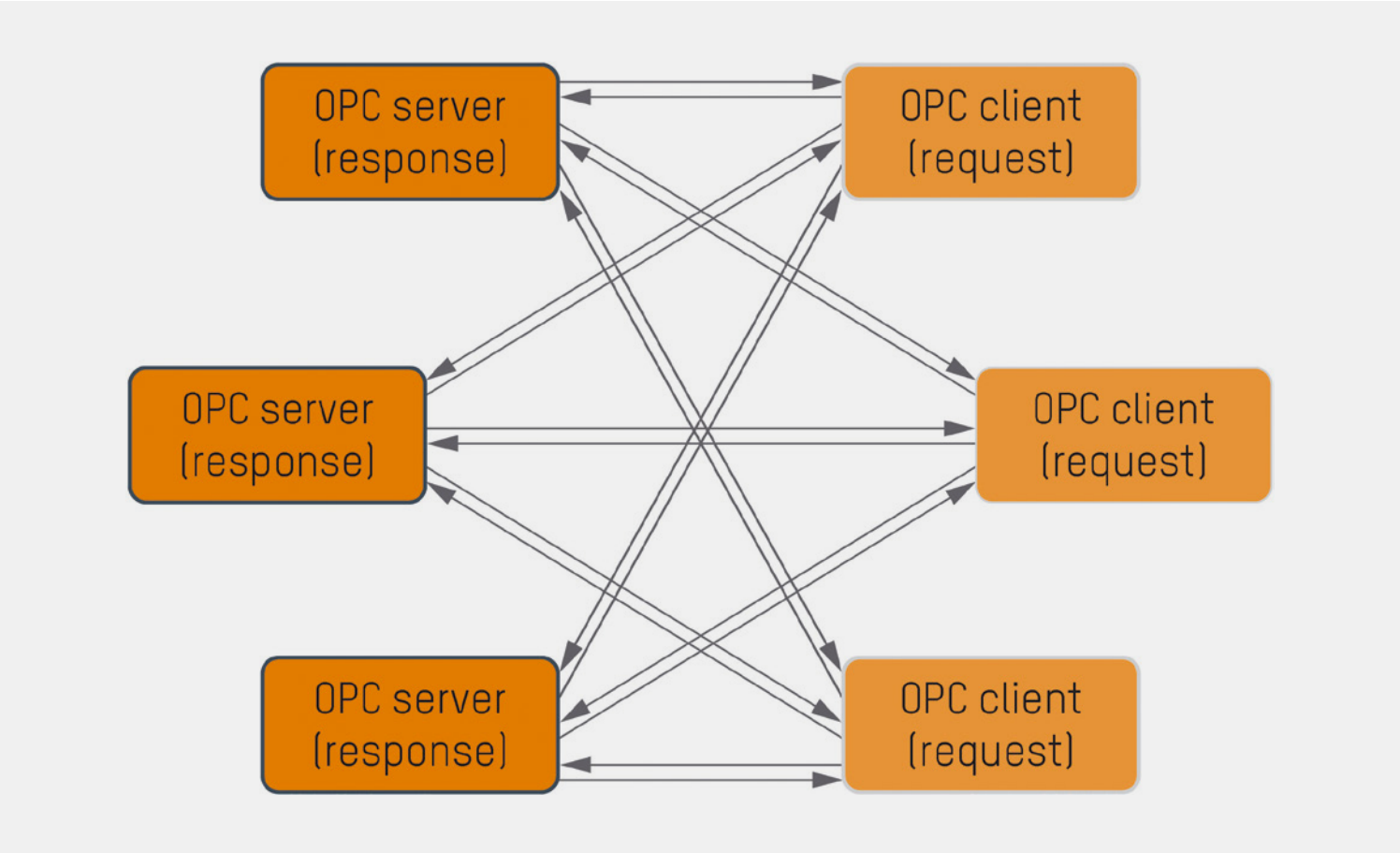
Time-critical applications at the line level, such as synchronization of conveyor belts with various other equipment, require cycle times as low as two milliseconds. "We've gone even lower than that on our test installations," says Sachse. With jitter measurements as low as 100 nanoseconds, the results were on par with the best fieldbus systems on the market today.

Networks without borders

"The other impressive thing about our test installations is their stability," emphasizes Sachse. "After all, we're working with technology so new that its IEEE specification hasn't even been completed yet." B&R's test installations will soon join those of other participants in the IIC's TSN Testbed to examine the interoperability of components on a multi-vendor OPC UA network with TSN. Other TSN Testbed participants included: National Instruments, Cisco, Schneider, Bosch, GE, Intel and TTTech.

Low resource intensity

Pivotal criteria for practical OPC UA applications will be its code size and resource requirements. "If OPC UA were only able to run on powerful industrial PCs and controllers, use in machinery and equipment would be out of the question," explains Sachse. By im-



With a client-server mechanism, a client requests information and receives a response from a server.

plementing OPC UA on a bus controller from its X20 system, B&R has clearly demonstrated the feasibility of I/O-level applications for OPC UA servers and clients. "It proves that OPC UA is perfectly scalable to any conceivable task at the line-level and beyond."

Reduced network traffic

With its bus controller implementation, B&R has also tested an important new feature of the OPC UA specification. The publisher-subscriber (pub/sub) model plays a key role in allowing OPC UA TSN to achieve the necessary performance.

Until now, OPC UA has used a client/server mechanism, where a client requests information and receives a response from a server. On networks with large numbers of nodes, traffic increases disproportionately and impairs the performance of the system.

The publisher-subscriber model, in contrast, enables one-to-many and many-to-many communication. A server sends its data to the network (publish) and every client can receive this data (subscribe). This eliminates the need for a permanent connection between client and server, which is particularly resource intensive.

B&R is actively participating in the OPC Foundation working group developing the specification for OPC UA's publisher-subscriber model. "I expect the specification to be completed by the end of the year – and rapidly implemented by many manufacturers soon thereafter," says Sachse.

OPC UA as a standard

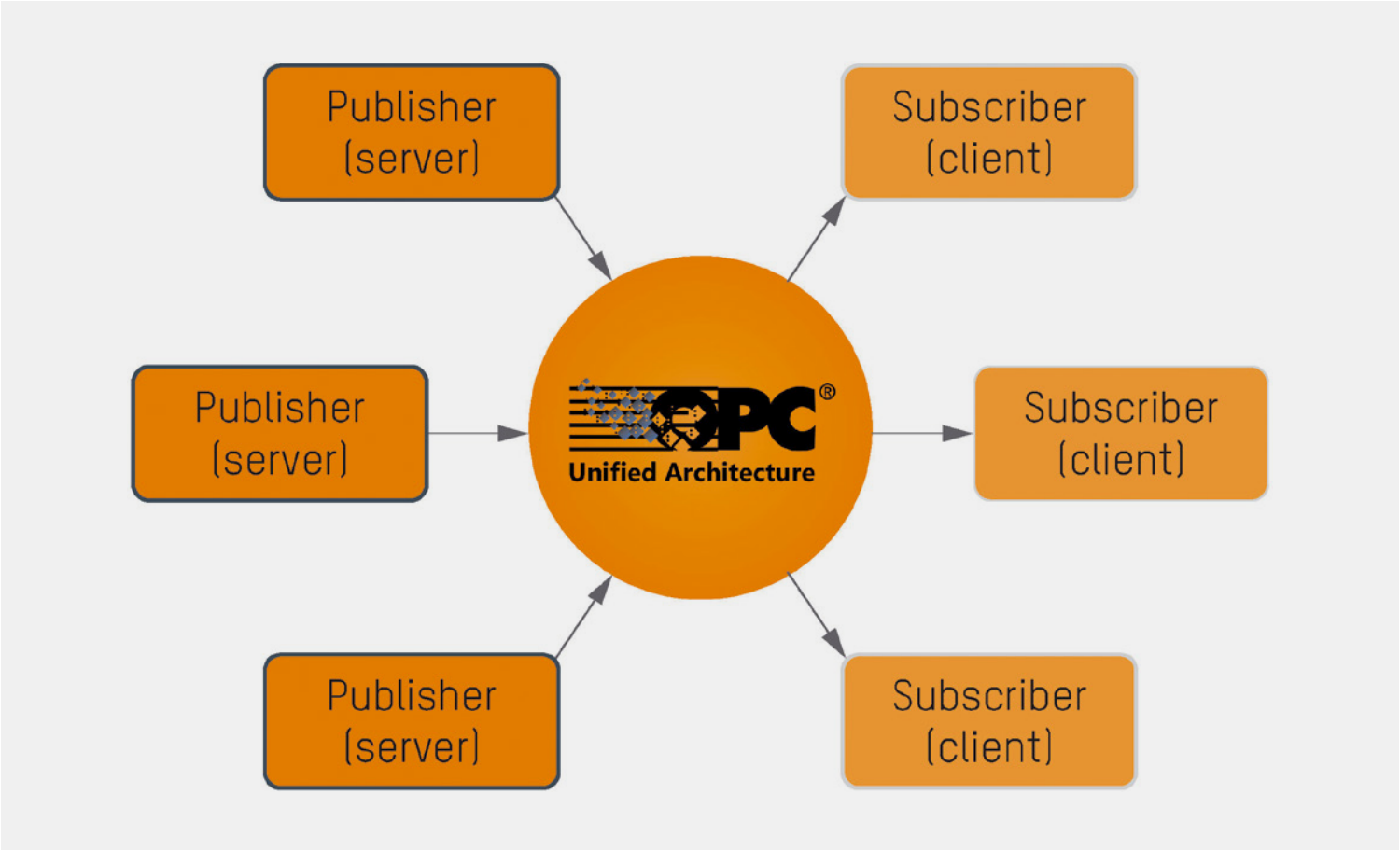
The momentum behind the OPC UA movement is evident in the number of standards organizations basing their work on the vendor-independent protocol. EUROMAP, the leading developer of global standards for the plastics industry, recently defined OPC UA as the basis for two new EUROMAP interfaces, and more are on the way.

The umbrella organization for the packaging industry, OMAC, will also be integrating OPC UA into its PackML standard and is already working on specific implementations. "It really is astonishing how quickly such well-established industry standards are now turning to OPC UA," says Sachse. "The performance demonstrated by our field testing with OPC UA TSN confirms that they're moving in the right direction."

The IIC and its TSN Testbed

The Industrial Internet Consortium (IIC) aims to enable the intelligent networking of machinery, equipment and facilities. One of the primary goals of founders GE, IBM, Intel and Schneider is to accelerate adoption of the Internet of Things (IoT).

To identify which technologies are best suited to IoT applications, the IIC organizes testbed groups, where these technologies are evaluated on multi-vendor test installations. B&R has been an IIC member since 2006 and is participating in the TSN Testbed, where the combination of TSN and OPC UA is being evaluated for the first time in an industrial environment.



With a publish-subscribe model, a server sends its data to the network (publish) and every client can receive this data (subscribe).

OPC UA TSN

From a technical standpoint, it would certainly be feasible to add real-time capability to OPC UA itself, but doing so would involve considerable effort and would still have disadvantages. That's why a large group of automation and robotics manufacturers have joined forces to move in a different direction. OPC UA will take advantage of Time Sensitive Networking (TSN).

TSN is a set of extensions currently in development that will later be included in the IEEE 802.1 standard. The goal is to provide real-time data transmission over Ethernet. A significant advantage of the TSN standard is that the automotive industry is behind it. That means that the required semiconductor components will be available very quickly and relatively inexpensively.

The amount of data being transmitted in automobiles has skyrocketed in the past several years. Conventional bus systems don't have nearly the bandwidth to handle it. The first step for the automotive industry was adoption of the 802.1 AVB (Audio Video Bridging) standard, which enables synchronized, prioritized streaming of audio and video files. This allows images from rear view cameras mounted on the back bumper to be transferred via Ethernet.

To pursue the goal of reaching new industries and broadening the spectrum of applications, the AVB working group became the TSN initiative. The automotive industry would also like to handle all control tasks and applications that require functional safety over Ethernet. For this to be possible, they will need cycle times in the real-time range and deterministic network behavior. These are the exact same requirements faced in the automation of production lines.

OPC UA TSN bridges the gap between the IP-based world of IT and the field of factory automation. OPC UA TSN is the perfect solution for all applications in factory automation. With sub-millisecond synchronization, it offers sufficient precision for tasks such as line synchronization, SCADA system integration, basic control tasks or even conveyor belt operation and I/O integration.

With OPC UA extending its reach to the level of line automation in the coming years, there will be some dramatic changes to the architecture of machinery and equipment. It will likely mean the end of factory-level fieldbus systems as we know them today. ←

Sebastian Sachse
Technology Manager, Open Automation

"OPC UA TSN has outperformed our expectations."