Leveraging OPC UA for Secure, Highly Integrated Machines

This article focuses on leveraging OPC UA to implement Packaging Machine Language (PackML), the standard for modeling industrial machines systems, but the architecture described can be used to control and monitor *any* sort of machine. The issues addressed by the PackML standard are identical to those voiced by end users in in many other industries. (OPC UA is the next generation of OPC technology – a more secure, open, flexible and reliable mechanism for moving information between enterprise systems and the kinds of controls, monitoring devices and sensors that interact with real world data.)

The impetus for Organization for Machine Automation and Control (OMAC) to develop PackML arose from the dissatisfaction of users and systems integrators frustrated by time, expense and laborious details of integrating control machinery into a coherent system. Integrating a capping machine from one vendor with a labeling machine from another vendor with a sterilizing machine from another is more often than not a nightmare. Different philosophies, control logic, communication protocols, controller platforms and operational states means that each machine requires different operational processes, training, standards and diagnostics methods than the next machine. Users don't just have a linear increase in complexity with each new packaging component, the complexity increase can be geometric.

PackML is designed to create a consistent look and feel for machinery components integrated into a system. It provides a foundation for vertical and horizontal integration of these machine components irrespective of the vendor, the control system hardware or the specific application. It provides a layer of consistency between vastly different kinds of machines.

By creating a standard set of machine states and common set of control tags, PackML simplifies the control system development, reduces training and operating costs, and vastly decreases system integration labor and overall expenses.

PackML does not define the specifics of what machine operations occur in any of the machine states it defines. For example, it specifies the transitions that move a machine into Starting State or the Idle State, but it does not specify the functionality of that state. However, having a set of common states and control tags, status tags and administration tags, monitoring of any particular machine component is identical to monitoring other machines, lowering maintenance, support and training costs.

PackML can be compared to the generic object notation of EtherNet/IP, ProfiNet IO or BACnet, although its application-level functionality vastly exceeds what's available in other systems. PackML is a standard for modeling machine behavior that provides a standard mechanism for monitoring and understanding industrial machine operation. PackML decreases the integration effort required to exchange data between machines and between users and machines via operator interfaces.

PackML models machine data through its state machine and the use of standard PackML Tags but does not specify how those tags get from one machine to another or from a machine to an HMI. It does not

specify any transports, security, encodings, interfaces or physical media. That's where OPC UA, TCP/IP and Ethernet come in.

OPC UA provides the secure communications so that communications to other machines and devices are authenticated (proof that the other device is true or genuine) and that users of the Pack Tags are authorized (valid permission to access those Tags). OPC UA provides the common encoding so that the PackML tags can be properly encoded and decoded. Encodings currently include a binary encoding for performance, XML for interfacing legacy systems and JSON for more object oriented systems. OPC UA also provides alternative transport layers like HTTPS, Web Services and other transports to make a very flexible system. Together, with Discovery services for identifying Server capabilities, alarming and event management, historian capabilities and more, OPC UA provides the foundation for vastly simplifying the integration of a PackML machine with other machines, controllers, HMIs, enterprise systems and cloud services.

Vastly simplified integration

This is illustrated in Figure 1. In this packaging system all machines support PackML over OPC UA. Because all machines use standard PackML tags over OPC UA, it is much less complex to configure other downstream machines to properly handle faults, alarms, starts, stops and other process status. And HMIs can be much more easily constructed from the standard state machines and tags used by all machines.

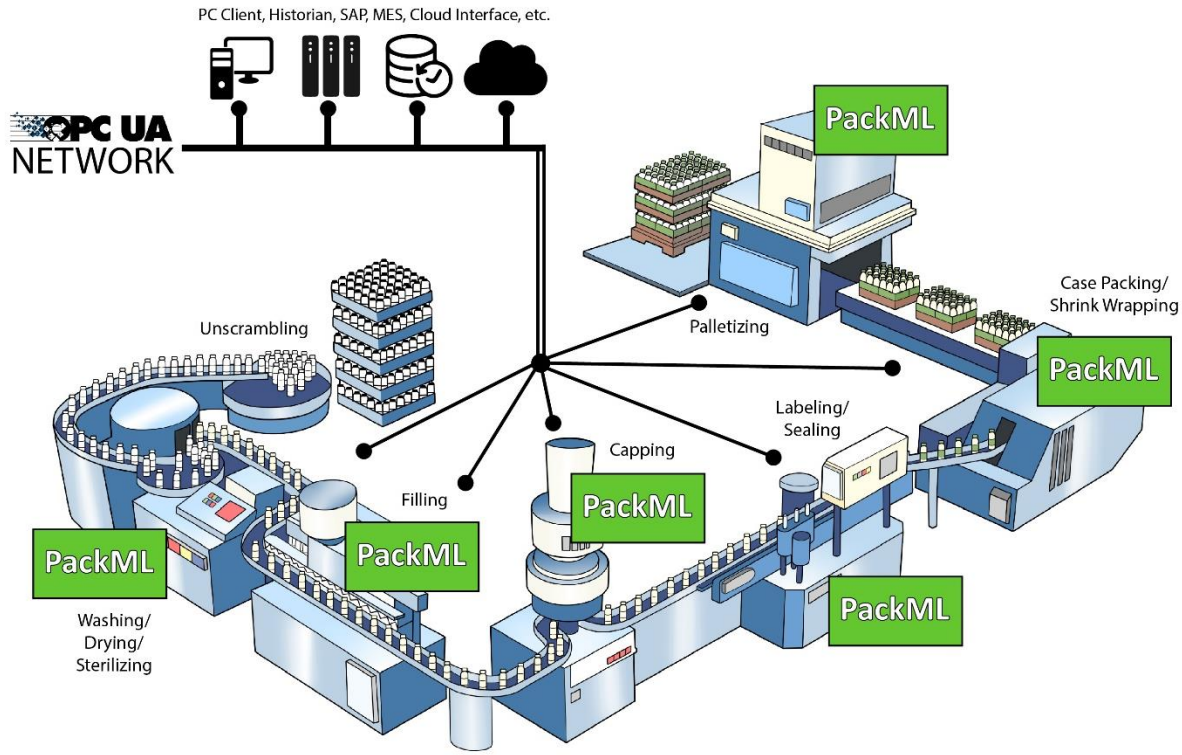

Figure 1 - Packaging System Using Ethernet, OPC UA and PackML

Contrast that with a situation where every machine in this system is built with a proprietary state machine, with a set of proprietary tags encoded in some binary format with its unique security mechanism. Imagine if each machine uses different tag names for state information, different tags for diagnostics, and different tag names for data values. Imagine if some of the machines use XML while others use their own binary data encoding. Imagine if some only use HTTPS for security while others use a certificate-base security scheme. Imagine being responsible for constructing the HMI for that system. Building a system from those components would be a time and expense nightmare.

Unfortunately, in the automation world, we've grown too accepting of the idea that machine integration between vendors of different machines must be complex, laborious and difficult, requiring expensive engineers, and that it has to incur significant expense. With adherence to the kinds of standards described in this paper, system integration for highly connected solutions will not continue to be a complex and expensive. Instead it will just work.

Don't get the impression that this applies only to the packaging industry. These concepts are just as relevant to machinery operations in diaper and tissue converting, food and beverage, automobile production and many other industries. The PackML concepts, tags and state machines can be used in any of these industries and more.

What to do next

If you're new to PackML and want more information, you can find it on the OMAC (Organization for Machine Automation and Control) website. The PackML specification and implementation guide is available at http://www.omac.org.

If you're new to OPC UA it's time to get familiar with this technology. It is going to be a foundational component of manufacturing systems in the future. A good place to begin is the book, *OPC UA – Unified Architecture: The Everyman's Guide to the Most Important Information Technology in Industrial Automation*.

If you're one of those automation engineers who've been ignoring OPC UA and the whole IoT and Cloud business, it's time to get serious about it. Yes, it hasn't been our bread and butter in the past but the times, they are a-changing. Seeing pieces drop out of a mold, packages flying down a conveyor line or bottles and cans being precisely filled is now only part of our job. Getting the data we need to operate more productively and efficiently is the new job – and leveraging OPC UA and application layer architectures like PackML are going to be some of the tools you'll need in the future!

ABOUT THE AUTHOR

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