An ISA-95 companion standard for OPC UA *White paper*

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A future OPC UA companion standard for ISA-95

Last December, OPC Foundation and ISA France have decided to assess the feasibility of the development of an OPC UA companion standard for ISA-95. This long awaited specification will be acclaimed by the industrial control community that already recognizes OPC and ISA-95 as major contributions to the integration of information technology in industrial facilities.

If the necessary conditions are met, the initial release of the companion standard is expected to be delivered by the end this year.

Background

Interoperability between industrial information processing systems is a critical concern for manufacturers who must develop the intelligence and systemic obedience and of their manufacturing sub-system. These capabilities result of efficient and sufficient interactions, internally and externally. They are revealed by a palpable contribution to the strategy of the enterprise, smooth supply chain operation and optimized resource usage.

OPC Foundation and ISA, among other professional organizations, contribute to facilitate interoperability by developing standards upon which software vendors, system integrators and manufacturers can provide, implement and make use of robust, flexible, evolving, and cost effective solutions for seamless interactions.

In 1996, the OPC Foundation released the first OPC specification, offering a simple mean for connecting supervisory and SCADA systems to field controllers, addressing level 1 / Level 2 interface in the Purdue CIM functional hierarchy. This eliminated de facto innumerable protocols for exchanging process control information such as real time data, alarms, events and historical data.

The ISA95 committee excluded from its scope the practical means for exchanging information between systems: arrangement of bits and bytes, network, handshaking and security protocols, physical means for establishing the linking. Instead, the committee focused on developing data models and terminology for addressing more complicated interactions. The 2000's first release addressed the production related information exchanged between level 3 and Level 4 of the Purdue CIM functional hierarchy. This corresponds to the essential communications between ERP (Enterprise Resource Planning) systems and control systems: DCS (Digital Control Systems), SCADA (Supervisory Control And Data Acquisition), or MES (Manufacturing Execution Systems).

Recent evolution

Originally not working on the same subjects – bit and bytes at the CIM level 1-2, vs. data models at CIM level 3-4 – OPC and ISA-95 evolved toward each other:

- OPC mutated into OPC UA, becoming "model aware" and inherently capable of handling complex information. No longer limited to pre-cooked specifications dedicated to real time atomic data, alarms, or historical data, OPC UA encompasses all the communications within and around industrial facilities – including and beyond ISA-95 realm.
- ISA-95 was completed by B2MML, a set of XML schemas offering a practical means to exchange information. B2MML is commonly used today to exchange ISA-95 compliant XML messages between IT systems. ISA-95 itself will be soon released, expanding to all operational activities – such as maintenance, quality, inventory – beyond the initial production focus, as well as to the intra-level 3 interactions.

Interest of implementing ISA-95 in OPC UA

OPC UA is a communication framework for any types of information in the industrial environment, supporting custom complex data structures. It implies the design of application specific models and suggests the development of public add-ons: "OPC-UA companion standards" are expected to be made available for mainstream interoperability standards such as EDDL, ISA-88, ISA-95, or MIMOSA. The ADI for "Analyzer Devices", was the first OPC UA companion standard to be published, still addressing the CIM level 1-2 interface.

ISA-95 does some of the job for interoperability by facilitating the conceptualization of the exchanged information.

B2MML completes ISA-95 by defining XML file formats (XML Schemas) and basic data services/methods as "transactions". The actual way of generating, transmitting and processing XML messages is not specified: additional mechanics is used such as EAI (Enterprise Application Integration) middleware.

An implementation of ISA-95 in OPC UA will offer an alternative to B2MML as an end-to-end solution.

OPC clients will browse ISA-95 structured instances in OPC servers without worrying about low level communication plumbing implemented in separate layer in the infrastructure in different ways from high performance binary coding to verbose, SOA compliant XML/text still always taking into account of the industrial specificities regarding security, real time and auditing (these options can be changed afterward without impacting the definition of interfaces).

Thanks to the sophistication of OPC UA, ISA-95 will be SOA ready. For example an MES application will be able to request a planning optimization from a finite capacity scheduler invoking an "Optimize" method on the submitted real time schedule when ISA-95 only handles data oriented transactions with predefined verbs.

Finally, the multi-layered ontology approach of OPC UA will permit more flexibility for customizing information representation (see below).

Technical challenges

OPC UA is a modern framework, semantic aware for transferring meaning rather than tokens. It offers a layered modelling structure from abstract concepts to actual topics.

ISA-95 defines meta-models and terminology for practical situations identified in its scope. It is a canonical – "dogmatic" – specification that specifies predefined structures for given situations.

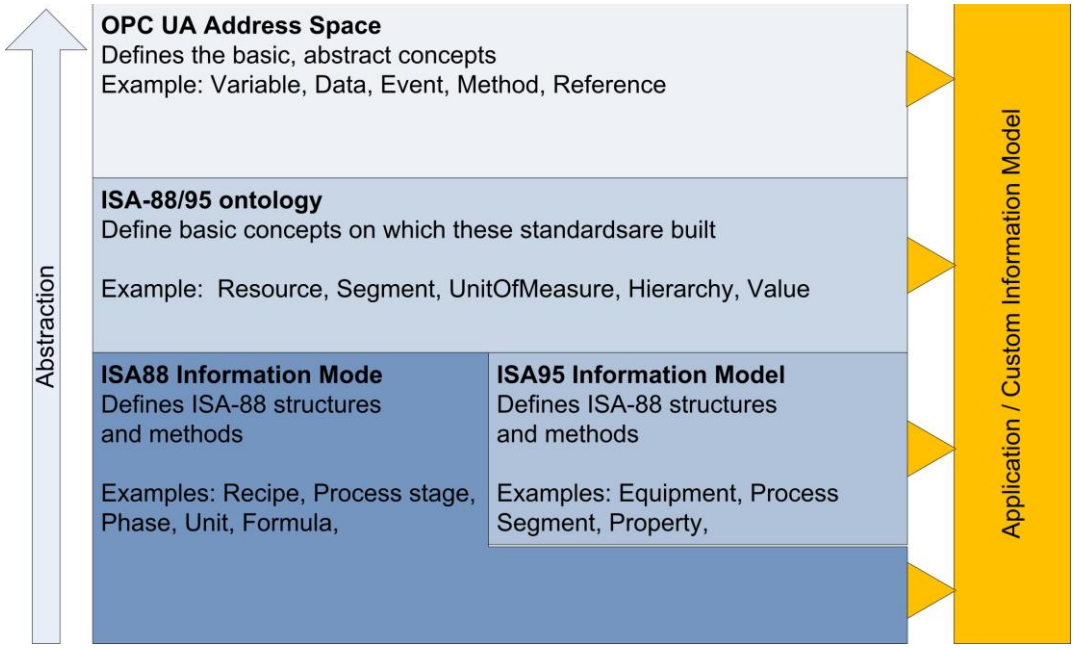
We can compare both in saying that ISA-95 predefines sentences with some variations while OPC UA defines basic words, grammar and syntax rules to create versatile words and sentences – potentially those that ISA-95 recognizes.

Since its origin, OPC UA quoted ISA-95 as a primer candidate to expand OPC adoption beyond its original SCADA-PLC scope. It is rather surprising that this has not happened yet. One of the reasons may be the lack of motivation of the ISA-95 experts who work on B2MML. A more serious reason is the mind shift for ISA-95 spirit to elaborate abstract structures based on the unstated concepts of ISA-95 rather than straight "coding" the models as it was done in B2MML.

The solution is to develop an intermediate level ontology above the ISA-95 models and below the OPC-UA upper level ontology – the OPC UA address Space – on which actual ISA-95 meta models and any custom models can be derived. The resulting specification will allow canonical ISA-95 messages to flow in OPC UA, but also to implement any interactions that fall under this conceptual basis: users will be free to stick on ISA-95 or to use their own terminology and implement their very specific messages that do not currently fit nicely in ISA-95.

This ontology will be extracted from ISA-95 models based on their many similar patterns. This work has already started with the development of an XML schema defining the few abstract – conceptual – data types that can support all the ISA95 data structures.

A side benefit is the possibility to integrate the ISA-88 models that share many of the ISA95 concepts – though apparently totally irrelevant to each other when looking superficially at both standards. Hence, this effort will dramatically clarify the understanding of both standards and simplify their usage by consolidating their significant overlap in a consistent framework.



Practical benefits

Software vendors, system integrators and manufacturers will make use of the specification for designing and managing configurable and evolving infrastructures to support ever changing business needs.

OPC UA and ISA-95

Both standards result of the sharing of a large experience of skilled experts. Yet they are not widely adopted for different reasons: lack of urgent need, learning effort, supposed irrelevance, and real incompleteness. The companion standard will mutually leverage both standards by increasing their applicability

- ISA-95 will get an additional implementation beside B2MML
- OPC UA will get additional substance with the first extension beyond its original level 1-2 scope, materializing the vision of OPC Foundation

Software vendors

will be able to embed OPC UA server sockets will provide easy browsing and mapping of their solution's data to external systems or to design integration hubs to enable interoperability between heterogeneous client systems

System integrators

will more easily address in a timely and cost effective manner their clients' needs for improved interactions.

Manufacturers

This companion standard shall represent a step up to seamless integration between planning and execution domain of industrial enterprises:

- shifting the interface burden and associated to IT slavery to concentrate on leveraging their manufacturing intelligence through the highly sensible interoperability matter;
- trivializing the "Business to Manufacturing" interoperability will save time and money wasted on interfaces to make more profitable use of the new wealth of information made available by the OPC UA / ISA-95 pairing;
- leveraging the investment in mastering and implementing the OPC UA technology;
- using a common interoperability framework for the entire industrial communications.

Information

The prospective study is led by Jean Vieille for ISA France and Michel Condemine for OPC UA.

Experts in ISA-95 and/or OPC UA volunteer to contribute to this development can contact

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