OPC UA Information Modeling enables industry collaborations.

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Saving Dates.

The 2017 calendar is marked-up with several regulatory deadlines across many industries. As supply chains evolve in complexity and scale, the coordination of all the moving parts of operations management tools and processes becomes increasingly challenging.

In a recent survey by the International Quality & Productivity Center (IQPC, 2017), a pool of pharmaceutical industry operators was asked which area would they be focused in the short term, and the majority of them chose *"overcoming technical interoperability and integration challenges"*.

The example reveals two significant aspects of modern operations:

1. Businesses are mostly data driven
2. Data is easy to collect and store but difficult to retrieve and extract value from

The reality is that all systems are not created equal. A production planning application quantity value looks rather different than a PID controller set point; although the data might be the same (e.g., as part of a batch control recipe).

After a few years, we find ourselves with a healthy number of integration standards so that automation devices can be easily integrated with consistency. For example, the very well-known IEC 61131 standard for PLCs; and for enterprise applications to communicate with control systems, the ISA 88 and 95 standards. And for specific industries, IEC 61850 for electric power systems and Open-SCS for pharmaceutical serialization.

As information workflows cross competence domains in several directions, users and providers start looking for a way to coalesce those standards into a farther-reaching, whole-encompassing interoperability "grammar".

That is one of the main reasons why OPC UA was created.

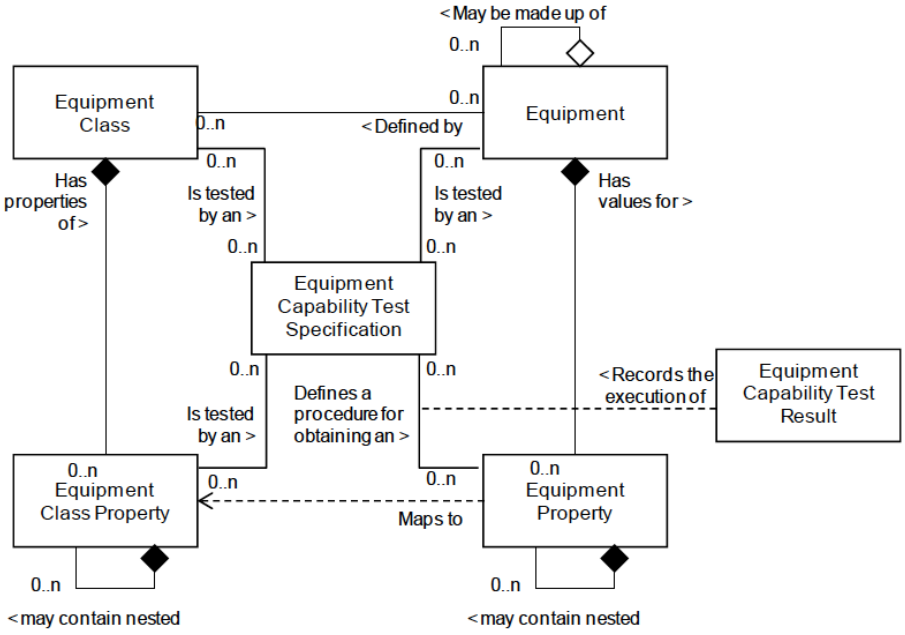
Semantics of Operations: a Case Study of the ISA-95 collaboration

The ISA-95 Enterprise/Control System Integration standard defines some levels of activity in a manufacturing organization. Generally, automation and control support Levels 1 and 2, Manufacturing Operations Management (MOM) systems support Level 3, and business Enterprise Resource Planning (ERP) systems support Level 4 activities. ISA-95 defines four primary categories of information that can be exchanged among MOM systems and between ERP systems and MOM systems:

1. Materials information and their properties
2. Equipment as operational units
3. Physical assets that make up the equipment
4. Personnel and their roles and qualifications

ISA-95 provides a standard manner to uniquely describe this information model for exchange, including the interrelationships between the various types of information.

For example, let's take the Equipment model in the following UML diagram:

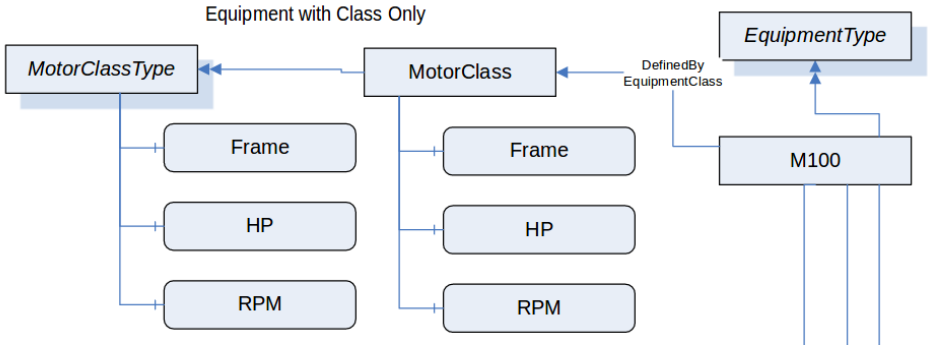


Systems could exchange equipment related information using OPC UA and instantiating objects and structures that implement this particular model.

Data this complex presents the following challenges:

1. This model describes the ability of a system to *discover* its objects without previous knowledge of specific attributes (e.g. unit names, tag names, etc.), but by merely knowing what *type* of equipment it is looking for.
2. Some of the objects can be *recursive* for an undefined number of levels.

In OPC UA, modeling UML structures is seamless. This is an example of an implementation of the ISA-95 Equipment model:



The experienced automation systems developer can immediately see the benefits: 1) the software will have to implement the necessary business rules , 2) OPC UA will take care of putting everything in context and moving it across the wire.

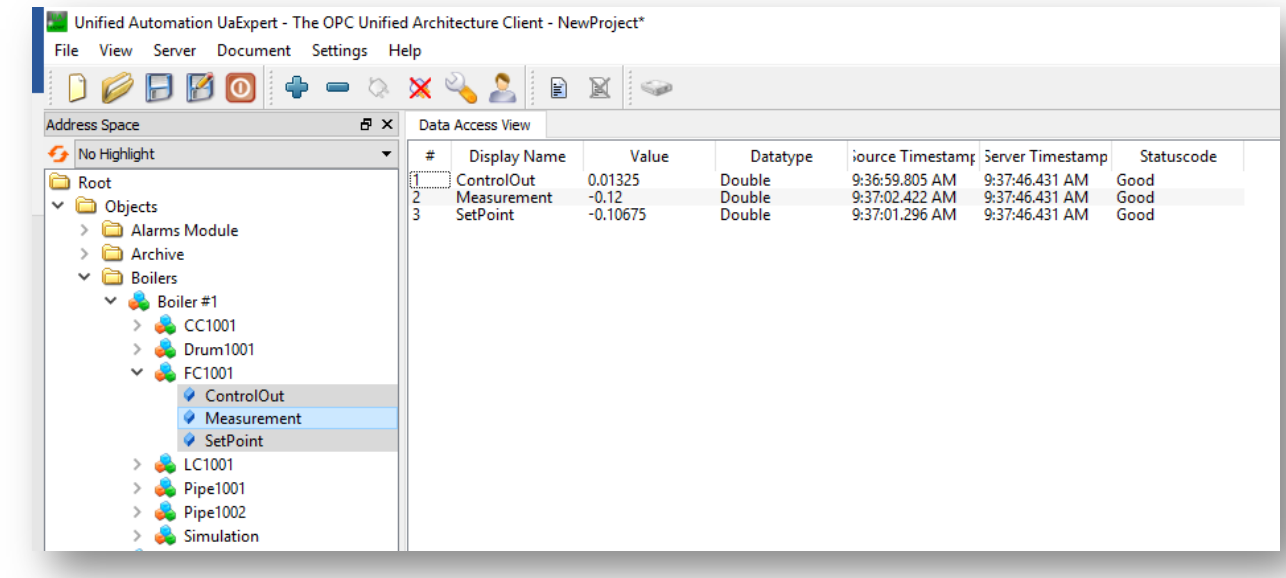
Publicly available API's and tools will allow users to translate such a UML model into an OPC UA *Nodeset*, which is the runtime representation of the Information Model. The *Nodeset* can be imported from a validated XML file that could look like this:

```
55   </UAObject>
56   <UAObject NodeId="ns=1;i=3579" BrowseName="1:Building1" ParentNodeId="ns=1;i=3539">
57     <DisplayName>Building1</DisplayName>
58     <References>
59       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6413</Reference>
60       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6569</Reference>
61       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6491</Reference>
62       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6647</Reference>
63       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6725</Reference>
64       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6803</Reference>
65       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6846</Reference>
66       <Reference ReferenceType="ns=2;i=5116">ns=1;i=6881</Reference>
67       <Reference ReferenceType="Organizes" IsForward="false">ns=3;i=8335</Reference>
68       <Reference ReferenceType="HasTypeDefinition">ns=2;i=5085</Reference>
69       <Reference ReferenceType="ns=2;i=5116" IsForward="false">ns=1;i=3539</Reference>
70     </References>
71   </UAObject>
72   <UAObject NodeId="ns=1;i=6413" BrowseName="1:EJY1000" ParentNodeId="ns=1;i=3579">
73     <DisplayName>EJY1000</DisplayName>
74     <References>
75       <Reference ReferenceType="HasComponent">ns=1;i=7226</Reference>
76       <Reference ReferenceType="HasComponent">ns=1;i=7228</Reference>
77       <Reference ReferenceType="HasComponent">ns=1;i=7230</Reference>
78       <Reference ReferenceType="HasComponent">ns=1;i=7232</Reference>
79       <Reference ReferenceType="HasComponent">ns=1;i=7234</Reference>
80       <Reference ReferenceType="HasComponent">ns=1;i=7236</Reference>
```

This file is automatically generated by a tool and is rarely edited by hand. Information Modeling tools are available on GitHub in the OPC Foundation repositories set (https://github.com/OPCFoundation).

Once the *Nodeset* is loaded by a server, any OPC UA compliant client will be able to discover, browse, read, write, subscribe to that server's address space.

Here is an example of an equipment simulation server connected to the free UAExpert client tool:



Conclusions.

OPC UA is listed as the one and only recommendation for the implementation of the communication layer in the current reference architecture model for Industrie 4.0 (RAMI 4.0), and it has been the framework of choice for many industry collaboration working groups (Resnick, 2016).

New groups are forming every month, involving all the major industry players from both the end user and technology provider communities.

To learn more about the OPC Foundation, OPC UA, and the industries involved in this unprecedented collaboration effort, please visit https://opcfoundation.org/markets-collaboration/ .

If you are interested in adopting OPC UA and join the IIOT revolution, you may contact the author at http://beeond.net/

References

IQPC. (2017). *Traceabilty in Operation Survey 2017.* London: IQPC.

Resnick, C. (2016, May 16). *Is OPC UA Becoming OPC IoT?* (ARC Advisory Group) Retrieved from Industrial IoT/Industrie 4.0 Viewpoints: https://industrial-iot.com/2016/05/opc-ua-becoming-opc-iot/