Jouni Aro*, **Markus Johansson**

Simulation Platform for Industrie 4.0 Components with OPC UA

Abstract: OPC UA has been defined as the Industrie 4.0 Communication and will be the major requirement for all Industrie 4.0 Components. This paper describes a platform that will enable simulating any industrial system based on the OPC UA information modelling concepts. Simulation will help in building and testing new Industrie 4.0 Components in practice.

Keywords: Industrie 4.0, Smart Manufacturing, OPC UA, Administration Shell, Communication, Information Model, Simulation

***Jouni Aro:** Prosys OPC Ltd, E-mail: jouni.aro@prosysopc.com
Markus Johansson: Prosys OPC Ltd, E-mail: markus.johansson@prosysopc.com

1 Background

Manufacturing is moving towards more flexible production lines that enable more customized products that are produced per order rather than to the storage as is the case with traditional mass production.

To enable this kind of improved flexibility, manufacturers are defining new production lines that are based on modular assembly cells and automatically guided vehicles (AGVs) that move the products from one cell to the next according to the production specification of each product. Some system providers are also defining agent-based manufacturing execution systems (MES) where each component on the production line can take and give production orders from each other.

Industrie 4.0 is a German program which is defining a Reference Architecture Model for Industrie 4.0 (RAMI 4.0) to outline how various standards will be used to enable a common framework for a future factory.

Industrie 4.0 Component is any device or software component that fulfils the RAMI 4.0 requirements. The components are expected to provide an Administration Shell that defines a standard interface for configuring and accessing all information of them. This enables flexible production lines that can be customized for individual production orders and smaller lot sizes.

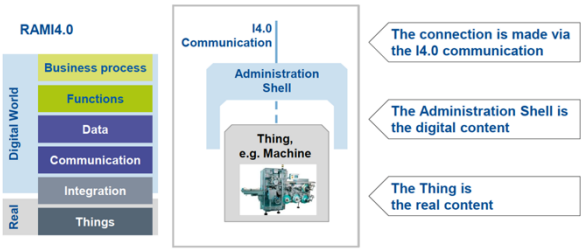

Figure 1. Administration Shell is the digital part of an Industrie 4.0 Component.

OPC Unified Architecture (OPC UA, IEC 62541) is a standard that has been selected to be used for Industrie 4.0 Communication. In addition to standardizing communication, it also defines a standard semantic modelling layer, which can be used to provide a common information modeling layer for RAMI 4.0.

2 Aim

This paper describes a platform that will enable simulating any industrial system based on the OPC UA information modelling concepts. Simulation will help in building and testing new Industrie 4.0 Components in practice.

OPC UA enables modeling of device and machine types and instantiation of these types. For example, as described in Figure 2, MotorType defines a generic model for a motor and Motor1 is a single instance of an actual motor.

OPC UA Information Models are typically specific semantic models, in other words collections of type definitions. OPC Foundation defines a standard model, which is the basis of all other models. Companion Models are domain specific models that are defined by domain organizations, such as PLCopen, ISA-95, PackML, etc. Vendors and users can also define their own models that define types that derive from other models.

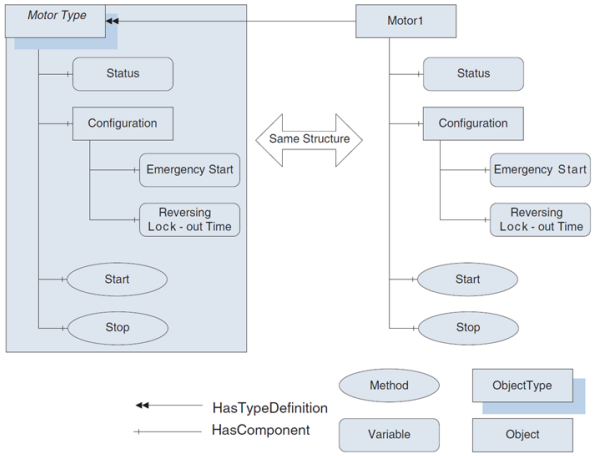

Figure 2. MotorType and Motor1 instance as defined in OPC UA notation.

In order to help designing new OPC UA Information Models and the functionality of actual instances of the respective types, a simulation platform is designed to enable flexible definition of simulated data to be attached to data items of the instances.

In practice, the system will also enable realistic reflection of real devices and can be used for off-line development of other systems and applications that will communicate with these kinds of devices in real world.

3 Methods

The simulation is based on Prosys OPC UA Simulation Server [1], which is extended with a graphical user interface that enables configuration of a complete production line or smaller parts of the component hierarchy. The system will also enable importing structures of actual installations as described in Figure 3. The simulation platform enables configuration of data simulation per component type or individual components [2], so that it can be easily scaled to larger installations and customized according to specific needs.

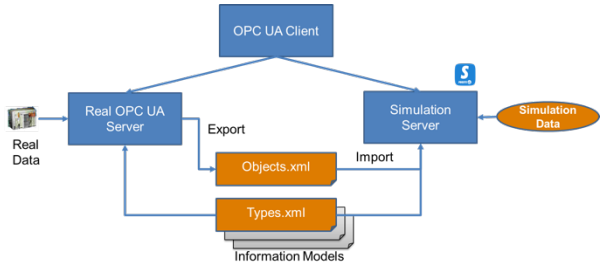

Figure 3. Reflection of a Real OPC UA Server with the Simulation Server. OPC UA Clients can connect to either the real or simulation server to get similar data.

4 Future Development

Once the system enables configuration of various device and production line structures, the system can also be developed towards more complex simulation signals. This will enable more realistic simulation of device and system functionality as well.

References

1] Boström B., JavaFX based OPC UA Simulation Server, M.Sc. thesis, Aalto University, Espoo, 2014
2] Saikko L., Simulating OPC UA Information Models, M.Sc. thesis, Aalto University, Espoo, 2018