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Test Applications for OPC UA PubSub Communication

Abstract: OPC Unified Architecture (OPC UA, IEC 62541) has become a leading communication framework in industrial automation. OPC UA defines a secure client/server communication model, including information modelling language that enable standardized connectivity between applications in process monitoring, production control, manufacturing execution, etc. OPC UA PubSub defines an alternative publisher/subscriber model that enables real-time data delivery for process control, secure connectivity to cloud applications over unreliable networks, and massively connected industrial applications.

Prosys OPC UA Browser and Simulation Server are applications that enable testing and verifying OPC UA connections in industrial applications. They have now been extended with PubSub capabilities to help researchers, developers and end-users take benefit of the new OPC UA PubSub technology easier and faster.

Keywords: OPC UA, UDP, MQTT, UADP, JSON, publisher, subscriber, security, information modeling

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1 Background

OPC Unified Architecture (OPC UA) [1] enables standard communication of industrial applications in different use cases. In addition to standardizing secure transport level communication [2,3], OPC UA also defines information modelling capabilities [4] that enables interoperation on the semantic level.

Traditionally OPC UA is based on a client/server communication model, which is very suitable to process monitoring and production control. OPC UA PubSub communication model [5] defines and alternative publisher/subscriber model, which makes OPC UA also suitable for real-time process control and big data collection in cloud systems as well as highly scalable communication networks [6] by enabling applications to exchange data without a continuous point-to-point connection with each other.

Prosys OPC UA Browser and Prosys OPC UA Simulation Server are applications that can be used for testing and verifying OPC UA functionality within other OPC UA applications [7]. They include OPC UA Client and Server functionality, respectively, including all OPC UA security features.

Prosys OPC UA Simulation can also be used to test and verify OPC UA Information Models and act as a mock up server when the real OPC UA Servers are not available [8,9].

2 Aim

In order to develop reliable OPC UA applications, the companies manufacturing OPC UA capable devices and machines, as well as end-users using integrating them in actual production processes, need tools that help them to verify the communication and diagnose communication issues.

The paper describes how OPC UA PubSub functionality has been added to Prosys OPC UA Browser and Prosys OPC UA Simulation Server. This makes them useful tools for developers and integrators that utilize the opportunity provided by the publisher/subscriber communication model.

3 Methods

OPC UA PubSub aims to solve problems related to deterministic data transfer, unreliable networks and scalability. The PubSub model is actually implemented using two different transport protocols: 1) UDP, which is used in local networks, enabling even real-time communication when run on networks with deterministic TSN capability and 2) MQTT Broker-based communication, which enables data delivery to cloud applications without strict timing requirements and also the large-scale message bus based communication within production networks.

In addition to the PubSub transport protocols, OPC UA also defines standard message formats: 1) binary UADP messages for optimized performance and 2) JSON messages for optimized interoperability with non-OPC

UA capable subscribers.

Compared to plain MQTT and other MQTT based protocols, the standard message formats defined by OPC UA enable higher level integration between systems from different vendors than is possible with custom message formats that are normally used.

Prosys OPC UA Simulation Server has been extended with OPC UA Publisher functionality, including both UDP and MQTT communication as well as UADP and JSON message formats. It includes an easy to use user interface that enables both communication and dataset configuration. This enables testing and verification of OPC UA Subscriber applications without any actual OPC UA capable devices.

Prosys OPC UA Browser, on the other hand, has been extended with OPC UA Subscriber functionality. It can display data published by any OPC UA Publisher. In addition, it can log contents of all MQTT messages, even when they are not following the OPC UA message format. This can help in testing and verifying all publisher communication in any UDP network or MQTT broker.

The functionality included in both applications was implemented with Prosys OPC UA SDK for Java. The SDK can be used to add similar OPC UA PubSub functionality to any Java application.

The SDK implements the OPC UA configuration model, which consists of Connection configuration and Dataset configuration.

The PubSub Connection defines the target of the messages that the Publisher is sending. The target can be UDP broadcast or an MQTT broker. The messages can be binary UADP messages or alternatively JSON messages with MQTT.

The Dataset configuration defines a standard mapping of OPC UA Variables and Events to message payload.

The functionality of the applications can be easily demonstrated with each other [10] and likewise, they are useful tools with all other OPC UA applications.

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