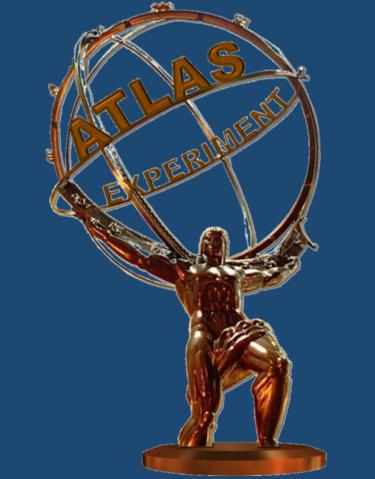
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Abstract

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OPC UA WITHIN THE CONTROL SYSTEM OF THE ATLAS EXPERIMENT



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The Detector Control System (DCS) of the ATLAS experiment at the LHC has been using the OPC DA standard as an interface for controlling various standard and custom hardware components and their integration into the SCADA layer. Due to its platform restrictions and expiring long-term support, OPC DA will be replaced by the succeeding OPC Unified Architecture (UA) standard. OPC UA offers powerful object-oriented information modelling capabilities, platform independence, secure communication and allows server embedding into custom electronics. We present an OPC UA server implementation for CANopen devices which is used in the ATLAS DCS to control dedicated IO boards distributed within and outside the detector. Architecture and server configuration aspects are detailed and the server performance is evaluated and compared with the previous OPC DA server. Furthermore, based on the experience with the first server implementation, OPC UA is evaluated as standard middleware solution for future use in the ATLAS DCS and beyond.

OPC DA in initial implementation of the DCS

OPC DA was used successfully through number of years, but:

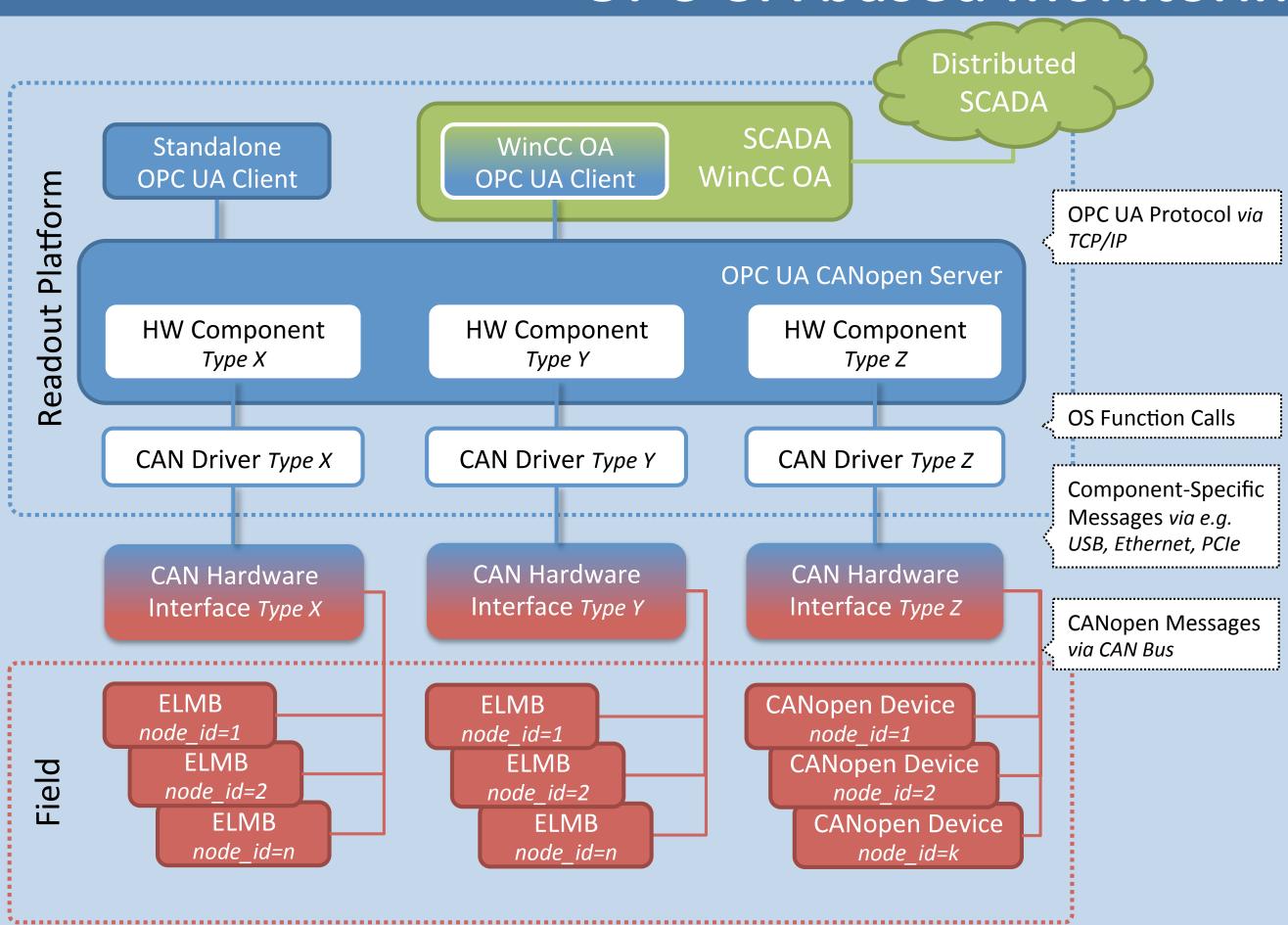
- it is bound to MS Windows
- it is approaching obsolescence
- its performance doesn't scale satisfactorily

Therefore it is one of the biggest obstacles in modernisation of the DCS.

OPC UA Highlights

- independence from operating system and communication technology
- robust object-oriented data modelling capabilities
- OPC UA connectivity possible in custom, specialised hardware
- PKI (Public Key Infrastructure) support
- Natural update from OPC DA

OPC UA based monitoring and control in the ATLAS DCS



Major part of monitoring and control is made using >5000 ELMBs, which communicate using CANopen protocol by CAN interface. The OPC UA CANopen server is a link between CANopen devices (mostly ELMBs, but not only) and the SCADA layer (using OPC UA interface).

Regular readout of ELMBs is being performed. The OPC UA CANopen server processes the data and consequently data points of the SCADA layer are updated by OPC UA client. At the same time communication from the SCADA layer to ELMBs is maintained and it passes commands and settings which actuate hardware of the detector.

The OPC UA CANopen server

The server features:

- OPC UA Interface to the SCADA layer or stand-alone OPC UA clients
- CANopen communication via CAN interface to hardware
- Independence of CAN interfacing hardware
- Full compliance with the CANopen standard
- Extensible configuration system
- Modular design
- No non-portable code
- Error recovery and diagnostics support

Configuration CANopen **OPC UA** OPC OPC Interface Address Address Space N A Space Interface Client CAN notifications read/write data items Interface Node **OPC UA** Dispatcher Manager Component

Performance

350 300 250 250 300 1 WinCC OA Client SubscriptionClient 3 WinCC OA Clients (CPU Load combined) Updates / second

Summary:

- The server scales beyond single CPU easily.
- The OPC UA interfacing itself is a minor part (less than 10%) of readout processing in the SCADA layer.
- Performance capabilities order of magnitude higher than the performance requirements.

Ongoing development

- OPC UA is being evaluated as the common middleware communication protocol in the DCS, as an alternative to currently dominating DIM protocol.
- Implementation of OPC UA servers in custom FPGA-based modules is being carried on.

Conclusions

Significant part of the ATLAS DCS already runs using the OPC UA standard. No major design flaws were observed. It is easy to see far improved performance even without performing any formal measurements.