



# EPICS Device Support

INTERFACING INDUSTRIAL CONTROLLERS

Ralph Lange, ITER

Dirk Zimoch, PSI

# The OPC UA Standard

## *Interfacing SCADA to Controllers (PLCs)*

Industrial standard (2008) to interface controllers

- ▶ Covers data, alarms, events, historical data, remote methods
- ▶ Symbolic addressing
- ▶ Browsible

Based on OPC Classic (Microsoft, 1996), adding

- ▶ Portability (does not require DCOM/Windows)
- ▶ WAN Support (TCP instead of DCOM)
- ▶ Safety/security (certificate-based authentication and encrypted connection)
- ▶ Information modeling (user-defined structures)



# EPICS Device Support Module

## *Two Low-Level OPC UA Client Choices*

- ▶ Commercial C++ Client SDK by Unified Automation
  - ▶ 4k€ for source code and 1 year support (extend support: 20% per year)  
*one developer/many products or many developers/one product*
  - ▶ Binaries can be deployed/distributed royalty-free
  - ▶ Platforms: Windows and Linux; evaluation bundles available
  - ▶ Newest versions (1.7.9 and 1.8) have issues
- ▶ New (2024): Free open62541 SDK C client libraries
  - Work by Dirk Zimoch (PSI) and Carsten Winkler (HZB/BESSY)*
  - ▶ Not trivial to set up
  - ▶ More complexity on the Device Support side
  - ▶ Platforms: Windows and Linux
  - ▶ Less documentation than the Unified Automation SDK

# EPICS Device Support Module

## Status

- ▶ Requirements Specification v1.1: <https://bit.ly/opcua-srs-1.1>
- ▶ Design done (no formal doc)
- ▶ Implementation nearly complete
  - ▶ All basic data types and arrays thereof (*read/write/subscribe*)
  - ▶ Supporting all applicable EPICS record types (bidirectional outputs)
  - ▶ User-defined structures (*read/write/subscribe*), timestamps from data
  - ▶ Server-side queues, configurable connection behavior
  - ▶ Configurable server-side deadband filters
  - ▶ OPC UA Security (encrypt, sign, authenticate)  
*Lots of testing help by Roland Fleischhauer (HZB/BESSY)*
  - ▶ Integrated end-to-end test against a software server  
*Work by Ross Elliot and Karl Vestin (ESS)*

# EPICS Device Support Module

*New in version 0.11*

5

- ▶ Better Enum support
  - ▶ Automatic choice strings from server for string and mbbi/mbbo records
- ▶ Support for Unions and OptStructs
- ▶ More OPC UA string types
  - ▶ LocalizedText and QualifiedName (as string or structure)
  - ▶ XmlElement (as string)
  - ▶ ByteString (as hex string or UCHAR array)
- ▶ Limited support for server-side deadband filters

# EPICS Device Support Module

## Roadmap

6

- ▶ Started:
  - ▶ Wiki pages: List of servers that have been integrated  
Useful tricks and hints (*zero feedback so far*)
- ▶ Currently:
  - ▶ Performance improvements for large data structures (*Ralph*)
  - ▶ User Manual (*Ralph*)
  - ▶ Support for array/matrix slicing and arrays of structures (*Dirk*)
- ▶ Soon:
  - ▶ Support for OPC UA methods (remote execution of PLC code) (*Ralph*)
  - ▶ Support for servers that change structures on-the-fly (*Karl*)

# Users (as known)

Facility	OPC UA Server	Status
ASIPP	LabVIEW	production
	PLC Siemens S7-1500	production
Australian Synchrotron BESSY II @HZB	PLC Siemens S7-1500F	near production
	PLC Siemens S7-1500	production
	Phoenix Contact Softing uaGate	production
CHIMERA @CCFE	PLC Siemens S7-1500	development
	LabVIEW	development
ESS	PLC Siemens S7-1500F	production
	ABB Power SCADA	near production
	Siemens DESIGO	development
Fermilab	Kepware KEPServerEX	testing
	PLC Siemens S7-400	development
IPR	PLC Siemens S7-1500	testing
ITER	PLC Siemens S7-1500 / S7-1200	production
	Siemens WinCC OA	production
	PCVue	production
	LabVIEW (compactRIO)	prototyping
KATRIN @KIT	LabVIEW	prototyping
IBPT @KIT	PLC Siemens S7-1500	production
PSI	PLC Siemens S7-1500	production
	PLC WAGO 750-8212	production
	PLC Beckhoff	production
	open62541 server on Red Pitaya	near production
Varian ProBeam	PLC Siemens S7	production
	PLC Beckhoff	production

# EPICS Device Support Module

8

## *Download*

- ▶ Device Support under EPICS license
- ▶ Upstream repository, Wiki pages, binaries, (future manual):  
<https://github.com/epics-modules/opcua>
- !! The GitHub download area has statically linked shared libraries containing the Unified Automation SDK client (i.e., plug-in libraries to link your IOCs against)
  - ▶ Easy to use, fully functional, free forever
  - ▶ Needs to match exactly your Linux distro and EPICS Base