OPC Unified Architecture
Industrial Interoperability from Sensor to IT Enterprise
OPC Foundation

- Vision
  secure, reliable, multi-vendor, multi-platform, multi domain interoperability from sensor to enterprise

- International
  - Companies from Automation & IT
  - International standard IEC62541
OPC Foundation: Board of Directors

- International board – democratic elections by members every year
  - Companies from Automation & IT
  - All over the world

North America
- Microsoft
- Honeywell
- ICONICS

Europe
- SAP
- SIEMENS
- BECKHOFF
- ascolab

Japan
- YOKOGAWA
Connectivity without Interoperability!

IIoT connectivity is not enough! It does not provide Interoperability!
History: Humans had to learn how machines work

Today: Machines help humans in “their language”! → SoA!

<table>
<thead>
<tr>
<th>DATA TABLE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>WORD0 = 0x5128</td>
</tr>
<tr>
<td>WORD1 = 1111000010101001</td>
</tr>
<tr>
<td>WORD2</td>
</tr>
<tr>
<td>WORD3</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>WORD255</td>
</tr>
</tbody>
</table>

DB5 DW0 = 0x5128
Modern World: SoA to Connect to a Device / Machine / Service...

Service Oriented Architecture (SoA):

- Device / machine provides

  - **Services require Information-Modeling**
    Type and Data consistency

  - **Discovery** of Services

  - **Standardized** Access
    Generic Clients can interact

Support

- **Interoperability**
- **IT-Security**:
  Rolls of access per user
OPC Unified Architecture

OPC UA is an information centric layered architecture

- Secure
- Platform Independent
- Scalable
- Vendor Interoperability
- Object Oriented

Information Models:
- DA = Data Access Live Data
- AC = Alarm & Condition
- HA = Historical Access
- Prog = Statemachines

OPC UA is much more than a protocol

Built-in Information Models
Base, DA, AC, HA, Prog, DI

OPC UA Meta Model
Basic rules for exposing information with OPC UA
OPC Unified Architecture

OPC Foundation collaborations with organizations and domain experts

- OPC UA defines HOW
- Domain experts define WHAT

Companion Information Models
- PLCopen, ADI, FDI, FDT, BACnet, MDIS, ISA95, AutomationML, MTConnect, AutoID, VDW, IEC 61850/61400, ODVA/Sercos and more coming

Built-in Information Models

OPC UA Meta Model
OPC Unified Architecture

OPC UA Client/Server Communication Model
- Client friendly API to access information in the server

Client/Server
- Services
  - Browse
  - Read / Write
  - Method Calls
  - Subscriptions

- Protocols
  - UA Binary TCP
  - HTTPS / UA Binary Webservices

Vendor Specific Extensions
- Companion Information Models
- Built-in Information Models
- OPC UA Meta Model
Unified Architecture

OPC-UA: New Generation OPC

- Definition 2003 – 2006
- Verification and Implementation 2006 – 2008
- Final OPC Foundation Release 2009

- **OPC UA = established OPC features**
  - Platform independence
  - Standard internet and IP based protocols
  - Built in security features
  - Generic object model
  - Extensible type system
  - Scalability through profiles

  + Migration path from Classic OPC
Client/Server & Pub/Sub

OPC UA Publish/Subscriber Communication Model
- Generic Pub-Sub Information Model
- Initial protocols selected, evaluation of other protocols ongoing

OPC UA Meta Model
- Built-in Information Models
- Companion Information Models
- Vendor Specific Extensions

Pub-Sub
- Model
  - PUBSubConfiguration
  - Connections
  - DataSets
- Protocols
  - UA Secure Multicast
  - AMQP
  - More to evaluate
OPC UA PubSub Roadmap

**2014**
- UA WG Use Cases collected

**2015**
- UA WG First Draft
- Main definition phase

**2016**
- UA WG Stable Draft
- UA WG Release Candidate

**2017**
- UA WG PubSub Release UDP AMQP
- UA WG Stable OPC UA TSN Draft

**Prototyping**
- First sample applications available
- First multivendor demo at Hannover Fair
- Enhanced multivendor demo at SPS/IPC/Drives
- Complete PubSub implementations
Specifications IEC62541
Public available

Code
Stacks C# / Java / (AnsiC coming) open source now
License: for Members: RCL / for non Members: GPLv2

Developer tools for members only
Helpfully to speed up implementation and tests

Certification
Face-to-Face
Virtual
North America: Industrial Internet Consortium Listing OPC UA + other protocols / Testbeds

- OPC UA listed
- Today 3 testbeds with integrated OPC UA
  - OPC UA + TSN in Manufacturing
  - OPC UA Sensor in Brownfield environment
  - OPC UA and AutomationML for factory
German Industrie 4.0 recommends OPC UA


- Approach for implementation of a Communication Layer
  - OPC UA: Basis IEC 62541
- Approach for implementation of an Information Layer
  - IEC Common Data Dictionary (IEC 61360 Series/ISO13584-42)
  - Characteristics, classification and tools to eCl@ss
  - Electronic Device Description (EDD)
  - Field Device Tool (FDT)
- Approach for implementation of a Functional and Information Layer
  - Field Device Integration (FDI) as integration technology
- Approach for end-to-end engineering
  - AutomationML
  - ProSTEP iViP
  - eCl@ss (characteristics)
OPC UA: Security analyzed

Who: Federal Office for Information Security (German Government BSI)
Why: Because of relevance of OPC UA for German Industry
   - Analysis of specification / Analysis of Reference Implementation

Result: German version available on BSI web and OPC web
   English version available Mid Feb 2017
Adoption
Gateway: connect existing world

► Direct connection between machines and higher level systems (i.e., ERP, MES, SCADA or SAP), with the integrated OPC UA server

► Variety of supported PLCs: Siemens SIMATIC S7 and S5, Rockwell ControlLogix and CompactLogix controllers with Modbus TCP and RTU (Wago, Beckhoff, Phoenix, Schneider, etc.), Mitsubishi (Melsec-Q), etc.

► Network separation by physically independent ports

► Easy configuration: Symbol import for Siemens and Rockwell PLC, without PLC engineering, online-diagnostic for PLC trouble-shooting
Emerson & OPC UA

- Emerson Process Management
  - Machinery Health™ Protection System (CSI 6500 ATG)
  - native OPC UA Support integrated
Rockwell & OPC UA

- Rockwell Automation Show Nov 2016
  - Compact Logix 5480 with integrated OPC UA Server
SAP & OPC UA
SoA Reshape Automation Pyramid

Demo at Hannover Messe 2016 and extended demo at upcoming 2017
Microsoft support OPC UA

...Hannover Messe 2016 .... always overcrowded...
OPC UA integration into Azure IoT

Download flyer here

Azure IoT Gateway with integrated OPC UA RELEASED ! (OPC Classic on road)
Siemens support OPC UA

11 Siemens products with integrated OPC UA

- SIMATIC S7-1500 PLC Family [https://opcfoundation.org/products/view/434]
- SIMATIC S7-400 with OPC UA CP (CP 443-1 OPC UA) [https://opcfoundation.org/products/view/444]
- RFID Reader SIMATIC RF600 [https://opcfoundation.org/products/view/449]
- SINUMERIK CNC control systems [https://opcfoundation.org/products/view/450]
- SIMOTION IT [https://opcfoundation.org/products/view/199]
- SINEMA Server [https://opcfoundation.org/products/view/446]
- SIMATIC NET OPC Server [https://opcfoundation.org/products/view/202]
- SCADA system SIMATIC WinCC Open Architecture [https://opcfoundation.org/products/view/436]
- SIMATIC B.Data [https://opcfoundation.org/products/view/437]
- SIMATIC HMI Comfort Panels [https://opcfoundation.org/products/view/432]
- SIMOCODE pro Motor Management System [https://opcfoundation.org/products/view/247]
Collaborations

The OPC Foundation closely cooperates with organizations and associations from various branches. Specific information models of other standardization organizations are mapped onto OPC-UA and thus become portable.

https://opcfoundation.org/markets-collaboration/

- Markets
  - Automation
  - Building Automation
  - Energy
  - Engineering
  - Measurement
  - Oil & Gas
  - Transportation
OPC UA & VDMA

- VDMA: Injection molding machine
  - 2014: First telco
  - 2016: Release candidate

- VDMA Machine Vision
  - 2016 started

- VDMA: Robotic: start Feb 13th in Frankfurt
- VDMA: Integrated Assembly Solutions: start Feb 17th in Frankfurt

- VDMA „Leitfaden Industrie4.0 Kommunikation auf Basis von OPC UA“ for Hannover Messe 2017

→ For modelling: Contact your VDMA group…
…or the OPC Foundation
OPC UA Brochures

- Brochure “Interoperability for Industrie 4.0 and the Internet of Things”
- Plan to extend with 4 pages to show more internationality
  - Add China2025
  - Add Korea Innitiative3.0
  - Add OPC UA related testbeds in IIC
- [https://opcfoundation.org/resources/brochures/](https://opcfoundation.org/resources/brochures/)
Thank you!