OPC Use Cases, Benefits and Collaborations

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Consumer Electronics -> Industrial Automation
Expectations

- Consumer-electronics are driving the way of future with respect to setting the stage for the engineers of today and tomorrow and expectations in industrial automation.
- Engineers expect that they can purchase and use products from multiple vendors and a work out-of-the-box courtesy of consumer-electronics.
- Suppliers in industrial automation encourage you to buy only products from them and their preferred compatible vendors.
- Suppliers preach guaranteed interoperability only is achievable via their close knit club.
- Standards organizations preach adoption of the specifications from their organization, and how membership in their organization facilitates certification and guaranteed interoperability.
- What is the real answer?

Innovation & Interoperability

[Diagram showing levels of interoperability from Level 0 to Level 6: Conceptual Interoperability, Dynamic Interoperability, Pragmatic Interoperability, Semantic Interoperability, Syntactic Interoperability, Technical Interoperability, No Interoperability]
Business value proposition

- Total Cost Of Ownership
- Multiple Vendors
- Multiple Products
- Expectations Of Multivendor Interoperability
- Information Integration
- Plug-and-play Not Plug And Pray
- Consumer-electronics Driving Expectations
- Systems Thinking

OPC Foundation: Who We Are

**Community:**
- The OPC Foundation is the world’s leading community for interoperability solutions based on OPC specifications that deliver universal connectivity.

**Collaboration:**
- The mission of this community is to advance the development, adoption and certification of OPC based products through global collaborations.

**Compliance:**
- The Foundation is the official source for the OPC Certification Program, ensuring that OPC products plug-and-play in real-world application.
The key markets for OPC technology include:

- Industrial Automation
- Building Automation
- Embedded Devices
- Energy Management (Smart Grid)
- Manufacturing Enterprise Management
- M2M
- Cloud-based Computing

History: The “original problem”

**Before OPC**
- HMI #A
  - Modbus
  - Profibus
  - Profinet
  - DH+
  - EGD
  - Bacnet
  - DNP
  - SNMP
  - TSAA
  - AS511
  - UDC
  - Others...
- HMI #B
  - Modbus
  - Profinet
  - DH+
  - EGD
  - Bacnet
  - DNP
  - SNMP
  - TSAA
  - AS511
  - UDC
  - Others...

**With OPC**
- HMI #A
  - OPC
- HMI #B
  - OPC

OPC Server

PLC

DCS

Controller

OPC and MES Day 2013
Features Provided By OPC

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discover OPC Servers on the network/PC</td>
<td>Clients can be completely agnostic to the underlying PLC, protocol, and addressing scheme</td>
</tr>
<tr>
<td>View the tags available in the server</td>
<td>Easy configuration possible by simply pointing + clicking</td>
</tr>
<tr>
<td>Tags could be grouped into a hierarchy</td>
<td>Reading and writing to tags is much easier than memorizing a PLC address</td>
</tr>
<tr>
<td>Read one or more tags</td>
<td>Optimized traffic on the wire thanks to a highly-efficient subscription model. Adding more clients does not necessarily add more overhead.</td>
</tr>
<tr>
<td>Write to one or more tags</td>
<td></td>
</tr>
<tr>
<td>Subscribe to tags and receive value-change notifications</td>
<td></td>
</tr>
<tr>
<td>Easily identify good/bad data</td>
<td></td>
</tr>
</tbody>
</table>

Benefits From OPC Adoption

- Vendors were no longer required to maintain extensive device protocol libraries
- High-quality and affordable device-drivers (Servers) emerged
- More specialized Clients emerged
- Developer toolkits emerged for rapid development of custom applications that could also integrate with the OPC infrastructure
- End-users could mix-and-match numerous vendor products to achieve the best overall solution
### History: Technology evolved...

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>How to let OPC solve more problems</td>
<td>“OPC” re-branded: <strong>Data Access</strong></td>
</tr>
<tr>
<td>More capabilities needed in Data Access</td>
<td><strong>OPC Data Access</strong> 1.0, 2.05a, 3.0</td>
</tr>
<tr>
<td>Need to store real-time values</td>
<td><strong>OPC Historical Data Access</strong></td>
</tr>
<tr>
<td>Need to standardize Alarm Notifications</td>
<td><strong>OPC Alarms &amp; Conditions</strong></td>
</tr>
<tr>
<td>Need to standardize data acquisition via internet</td>
<td><strong>OPC XML-DA</strong></td>
</tr>
<tr>
<td>Need to allow PLC-to-PLC communications</td>
<td><strong>OPC Data eXchange</strong></td>
</tr>
<tr>
<td>Need to secure access to servers/tags</td>
<td><strong>OPC Security</strong></td>
</tr>
<tr>
<td>Need to standardize batch-process operations</td>
<td><strong>OPC Batch</strong></td>
</tr>
<tr>
<td>Need to standardize a simple PLC program</td>
<td><strong>OPC Program</strong></td>
</tr>
</tbody>
</table>

### OPC Classic – Limited Reach

- **Windows PC**
- **HMI Application (OPC Client)**
- **OPC Server**
- **PLC**
- **Tunnel Alternate OS**
- **No Standard**
- **Proprietary Protocol**
- **OPC Data Access**
- **Internet Firewall**
- **DCOM**
- **Embedded HMI**
- **MES and/or HMI Application (OPC Client)**
Requirements for OPC UA

- Wide adoption of OPC
- OPC used as common system interface
- Security
  - Access control
- Performance
- Internet Firewalls
- Communication between distributed systems
- Robustness
  - Fault tolerant
- Redundancy
  - Fault tolerant
- Platform independent
- Scalability
  - Type system
  - Modeling Data
    - Base for other standard data models
    - Complex data
    - Meta information
    - Method calls
    - Common model for all OPC data
    - Embedded devices
    - MES
    - ERP

OPC UA: Platform Independence & Scalability

- OPC UA
- CE
- Microchip
- Tablet
- Desktop PC
- Smartphone
- Enterprise Servers
- Laptop
- PLC/Controller

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Key Features and Benefits

**Cross Platform**

- Mac
- Java Client
- .NET Client
- Windows 7
- Java Server
- .NET Server
- Windows XP
- Linux
- C/C++ Server
- VxWorks

**Unified Access**

- COM Client
- OPC UA
- Embedded
- AE
- HDA
- UA Client
- UA Server

**Internet and Firewall friendly**

- UA Client
- Internet
- UA Server

**Standard Security Model**

- UA Client
- UA Server

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Key Features and Benefits

**Single Solution from Embedded to Enterprise**

- UA

**Builds on existing investments in OPC COM**

- OPC UA
- OPC COM
- OPC Server
- OPC Client

**Reliability by design**

- UA Client (Active)
- UA Server (Active)
- UA Server (Standby)

**Flexible object-oriented information model**

- Block
- Block Type
- Input
- Output
- Input
- Output
OPC UA Information Modeling

Modeling Data – Providing Information
Transport Data – Platform Independent

OPC UA Scalability & Profiles

Standard internet protocols allow cross-platform communication

Multiple UA APIs
• C/C++
• JAVA
• Microsoft .NET
OPC UA Products Embedded

- PLC & DCS
  - PLC & DCS integrated OPC UA servers available

- IEC 61131-3 vendors
  - Integration into runtime IEC 61131-3 runtime systems

- Embedded HMI
  - Windows CE based HMI vendors implementing OPC UA clients

- OPC Unified Architecture on a chip!
  - Opportunities to expand into other domains, such as security and building automation

- Communication Gateway
  - Wireless sensor gateways with OPC UA server
  - Field bus gateways with OPC UA server

- Building Automation
  - Partnership with BACnet to expose BACnet objects (data and all the meta data!)

OPC UA Products SCADA Level

Device OPC Server
- Existing OPC Server migration to OPC UA
- Many vendors, such as Kepware, Matrikon and Siemens, provide UA interfaces for their PC based OPC device server suites

LINUX / UNIX
- LINUX and UNIX based automation systems are integrating OPC UA
- Replaces external OPC interfaces on Windows based systems

SCADA
- OPC UA server and client
- Numerous SCADA systems have integrated UA
- JAVA based SCADA systems adopt UA

PC
- SCADA / HMI
- OPC UA Client
- UA TCP
- OPC UA Server

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enterprise

SAP supports OPC UA

SAP PCO (Plant Connectivity) provides OPC UA client interface

Different SAP research projects work on UA

MES

Many Historian Systems support OPC UA

JAVA based MES systems adopt UA

Engineering

Industrial networks and devices have OPC UA for configuration, commissioning and operation

PC

Engineering

OPC UA Client

Ethernet

UA TCP

Device

OPC UA Server

OPC UA Products MES and Enterprise

OPC UA: Feature Summary

Incorporates ALL of the OPC Classic specifications into one cohesive standard: DA, HDA, A&E, DX, XMLDA, Batch, Security, Program etc.

Vendors that support one technology, e.g. DA, will be able to very quickly and easily add others, e.g. A&E, HDA, Programs etc.

Provides backwards compatibility with OPC Classic via Proxy/Gateway components.

Achieves other goals for security, platform-independence, performance, and growth.

Vendor products can now quickly and easily be expanded over time to incorporate newer features and capabilities at minimal cost.

Everything you know about OPC Classic is the same in UA!
Certified Products
Vendors with Certified Products

Industrial Automation Collaboration

OPC Unified Architecture Specifications

- Part 5 - Information Model
- Part 8 - Data Access
- Part 9 - Alarms and Conditions

- OPC UA for Devices (DI)
  - OPC UA for Analyzer Devices (ADI)
  - Field Device Integration (FDI)

- Generic FDI Features V 1.01 and IEC
- ISA 95
- MTConnect
- OPC UA for IEC 61131-3 (PLCopen)
- V2 Features
- MES Connectivity
MDIS

MCS-DCS Interface Standardization ("MDIS")

- All Major Oil companies (operators)
- All major DCS Vendors (Yokogawa, ABB, Siemens, Rockwell, Honeywell, Invensys, GE…)
- Sub Sea Vendors

- Standardize Communication
- Standardize Information Model
- Benefits
  - Reduce costs
  - Simplify engineering

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MDIS - Architecture

All Oil Companies agree to require MDIS Information Model once completed in all bid requests.
ISA-95 OPC UA Companion Specification

- Supports all Resources Models
- Includes OPC UA concepts of Subtypes
- Includes DataTypes for better tracking

**Modeling Target**

<table>
<thead>
<tr>
<th>Production Activity</th>
<th>Object Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity Definition</td>
<td>Production Schedule</td>
</tr>
<tr>
<td>Production Definition</td>
<td>Production Performance</td>
</tr>
</tbody>
</table>

**Logical View of Resources**

<table>
<thead>
<tr>
<th>Resources</th>
<th>Role Base Equipment</th>
<th>Physical Asset</th>
<th>Personnel</th>
<th>Material</th>
</tr>
</thead>
</table>

Common Object Model

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DSA-TS Organizations

- Operators (ex. Chevron, Shell, NOC)
- Drilling Contractors (ex. H&P, Transocean)
- Equipment Suppliers (ex. NOV, Canrig, FDS)
- Service Companies (ex. Schlumberger, BHI, Halliburton)

- Key Benefits
  - Maintainability/Setup
  - Security model
  - Compatible with many SCADA systems
  - Information Model
    - Well Information Transfer Standard (WITSML)
    - Used throughout drilling industry

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MTConnect

- Universal factory floor communications protocol
- Intended for the shop floor environment
- Defines a “dictionary” for manufacturing data
  - MTConnect Version 1.2
  - OPC UA Version 1.02

Information Model
- Device
- Component
- Sensors
- Conditions
- Events
- Assets

ODVA – SERCOS – OPC
Technical Approach

Supervisory-to-Manufacturing Execution System
- Leveraging data into actionable information provides business value (e.g., overall equipment efficiency, streamlined supply chain and other KPIs)

Machine-to-Supervisory Systems
- Machine Objects for CIP or OPC (e.g., machine id, meter, production data aggregation)
- Machine Protocol Neutral Machine Attributes (e.g., operating status, run time)

Machine-to-Machine
- Machine Objects and Services for CIP or SERCOS (e.g., command, configure, control)
- Machine Protocol Neutral Attributes (e.g., operating status, energy metrics, safety status)
OPC Collaboration / Evangelism

- **OpenO&M**
  - (ISA S95, Oagis, MIMOSA, MESA (WBF), OPC)
- **PLCopen**
- **FDI Cooperation LLC,**
  - (FF, Hart, PNO, OPC, FDT)
- **MTConnect**
- **FDT**
- **ISA-95**
- **Machinery Initiative (ODVA, Sercos, OPC)**
- **MDIS**
- **Smart Grid**
  - (OpenADR/ESI) SGR, CSWG
- **SLC**
  - (Energistics, OPC, Geospatial, PODS, MIMOSA, PIDX, PoscCeasar)
- **Cloud Based Initiative (TIA)**
- **SPE**
  - (DSATS, WITSML)
- **CIM**
- **Building Automation (BACnet)**
- **ProdML**

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