OPC UA Enables Smart Manufacturing

Jouni Aro
CTO, Prosys OPC
Chairman, OPC Committee
Member, Technical Advisory Council, OPC Foundation
The Internet of Things and Services

Smart Home
Smart Building

Smart Meter

Smart Factory

Industrie 4.0

Smart Devices

Healthcare

Smartphone

Smart Mobility

Smart Grid

(Graphics Bosch Rexroth AG)
Global Trends of Manufacturing Requirements

Past

longer product life cycles

longer delivery time

increased salaries

cost-driven

Today

shorter product life cycles

longer development time

product individualization

customer-driven

faster • better • cheaper

(SmartFactory®K System Architecture for Industrie 4.0 Production Plants - Whitepaper SF-1.2: 04/2018)
Target Criteria for a Smart Factory

<table>
<thead>
<tr>
<th>TARGET CRITERIA</th>
<th>REQUIREMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>High production variability</td>
<td>1. Flexible functionalities</td>
</tr>
<tr>
<td>Fast conversion</td>
<td>1. Fast retooling (setup) and operation</td>
</tr>
<tr>
<td>Transparent Production</td>
<td>1. Integrated data transfer</td>
</tr>
</tbody>
</table>

TRENDS
- More customization of products
- Shorter product life cycles
- Digitalization

(SmartFactory KL System Architecture for Industrie 4.0 Production Plants - Whitepaper SF-1.2: 04/2018)
The Old World: Industry 3.0

- Hardware-based structure
- Functions are bound to hardware
- Hierarchy-based communication
- Product is isolated

(Martin Hankel, Plattform Industrie 4.0 / Graphics © Anna Salari, designed by freepik)
The New World: Industry 4.0

- Flexible systems and machines
- Functions are distributed throughout the network
- Participants interact across hierarchy levels
  - Communication among all participants
- Product is part of the network

(Martin Hankel, Plattform Industrie 4.0 / Graphics © Anna Salari, designed by freepik)
Modular Assembly

- Individually customized products
- Flexible production "line"

(https://blog.audi.de/modulare-montage-bei-audi/)
Matrix Production

- Configurable Production Cells
- Automated Guided Vehicles
- Dynamic Process
- Active Communication

Matrix Production

- Logistics Separated from Production

Matrix Production

- Reconfigurable Assembly Path
- Flexible Production Capacity

RAMI 4.0 ensures that all participants involved in Industrie 4.0 discussions understand each other.
Every Thing needs an Administration Shell, to be able to integrate into Industrie 4.0 network

(Martin Hankel, 2016)
The Industrie 4.0 Topics

I4.0 Component  
I4.0 Communication  
Administration Shell  
Asset e.g. Machine *  
Digital World  
Business  
Functional  
Information  
Communication  
Integration  
Assets  
Real World

RAMI4.0

Technology topics I4.0

- Standard functions
  Basic features that are device independent and equal

- I4.0 Semantics
  One common language (vocabulary and syntax)
  Virtual description
  I4.0 Services

- I4.0 Communication
  which can use the new I4.0 services

- Identification
  Uniquely identification of physical things and data

- Security

Worldwide standards for the main technology topics are needed

* Refers to individual components such as Sensors, actuators, controllers, software, ...

(Martin Hankel, 2016)
# The Industrial Interoperability Standard

**OPC UA**: The industrial framework enabling secured, standardized data and interfaces

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<tr>
<th>Interoperability</th>
<th>Data Modelling</th>
<th>Security</th>
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<tr>
<td>Independent: Vendor, Platform, Market and OS</td>
<td>Rich data modeling preserves source context</td>
<td>Secure Design from group-up</td>
</tr>
<tr>
<td>Open Source on GitHub</td>
<td>Vendors can extend the data model of each product (Companion Specification)</td>
<td>Based on open security standards</td>
</tr>
<tr>
<td>Discoverable Services Oriented Architecture (SOA) independent of the transport method</td>
<td>Maps domain specific protocols, e.g. BACNet</td>
<td>Authentication</td>
</tr>
<tr>
<td>Owned by a Non-Profit (OPC Foundation)</td>
<td>Maps domain specific information e.g. Robotics, Machine Vision, Energy, ...</td>
<td>Evolves as security technologies evolve</td>
</tr>
<tr>
<td>50M installed base and exponential growth</td>
<td>Today 50 initiatives!</td>
<td>Vendors/Users can choose level of security</td>
</tr>
<tr>
<td>Scalability: From Sensor to Cloud</td>
<td></td>
<td>Easily acceptable by IT departments</td>
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- **Security**
  - Secure Design from group-up
  - Based on open security standards
  - Authentication | Encryption
  - Evolves as security technologies evolve
  - Vendors/Users can choose level of security
  - Easily acceptable by IT departments
OPC Foundation

- **Vision**
  - Secure, reliable, multi-vendor, multi-platform, multi domain interoperability from sensor to enterprise
  - [https://opcfoundation.org](https://opcfoundation.org)

- **International**
  - Non profit organization (founded 1995)
  - Companies from Automation & IT
  - Standard: OPC UA is IEC62541

- **Deliverables**
  - Specification: open available
  - Code open source / Stacks in AnsiC/C++, C# .NET Standard, Java
  - Tools: Helpfully to speed up implementations and tests
  - Certification: open labs for OPC members and non-members

- **Ecosystem with toolkits and education**

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**OPC Member**

- 612 Members (August, 2018)

**OPC Board**

- Microsoft, SAP, Siemens, Beckhoff, Honeywell, Yokogawa, ICONICS, Ascolab
OPC Foundation Announces New President

10/31/2018

Stefan Hoppe is elected President and Executive Director of the OPC Foundation after Thomas J. Burke nominates Mr. Hoppe as his successor.
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.
OPC UA in RAMI (Industrie 4.0)

(Andreas Faath, VDMA Forum Industrie 4.0)
Industrie 4.0 Component

The connection is made via the I4.0 communication

The Administration Shell is the digital content

The Thing is the real content
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: OPC UA is Secure


Guidelines for secure configuration
Clear, concise, easy to read
Best practices

Download documents here
www.opcfoundation.org/security
Service-oriented Architecture (SoA) Reshapes the Automation Pyramid

Demo at Hannover Messe 2016 and 2017 and 2018
Intelligent Assets

- Assets provide services (exposed as OPC UA Server)
- Assets can initiate actions (as OPC UA Client)
  - “DoJob(OrderNr)”
  - Confirm “JobDone(OrderNr)”

SAP Plant Connectivity

- OPC UA Client / Server Communication done ONLY via OPC UA method calls
- (NO HANDSHAKE MECHANISM)
Case: Smart Robot

1. Robot takes a Job Order:
   - DoPickandPlace(OrderNr, PreTeachedNr)

2. Robot calls the Camera
   - MakePictureAndAnalyze(OrderNr)

3. Robot confirms the Job
   - JobDone(OrderNr)

Vertical & horizontal communication
- SAP is not aware of the camera
- The robot appears as a “Smart Robot”
**OPC Technology: History and Future**

- **OPC Classic:**
  - OLE for Process Control
  - Data Access
  - Alarms & Events
  - Historical Access

- **OPC UA:**
  - Unified Architecture
  - Technology and OS independent

- **Edge/Cloud Pub/Sub Controller to Controller**

- **Industrial mobile apps Field devices**

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**Clouds**

**SCADA, MES, ERP,**

**IT Network HMIs**

**Machine Control**

**Field Level**

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**Time**

OPC Day Finland 2018, Jouni Aro
Future: Deterministic real-time for OPC UA Pub/Sub “OPC UA over TSN” and “OPC UA over 5G”

**Vertical:** OPC UA based Controller-to-Cloud communication can be done
- directly
- via Gateway
- via MQTT or AMQP

**Horizontal:** OPC UA based Controller-to-Controller communication can be done
- without TSN or 5G
- with TSN
- with 5G
Information: Brochures Updated (V8)

- “Interoperability for Industrie 4.0 and the Internet of Things”

- Edition 2018: Extended with
  - Made in China 2025
  - North America IIC related OPC UA testbeds
  - Korea Manufacturing Initiative 3.0
  - Japan Industrial Value Chain Initiative

- PubSub communication
- OPC UA over TSN

- https://opcfoundation.org/resources/brochures/

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OPC UA Videos

- Landing page
  https://opcfoundation.org/resources/multimedia/

- YouTube Channel: TheOPCFoundation
  https://www.youtube.com/user/TheOPCFoundation

  - OPC UA Technical Introduction, Uwe Steinkrauss
  - OPC UA Security, Darek Kominek
  - All About Certification, Alexander Allmendinger
  - Getting Started with OPC UA, Jouni Aro
    - Part 1: End User Products
    - Part 2: Developer Kits
  - Azure Industrial IoT – Overview, Erich Barnstedt

- Plus more about Companion Specifications, etc.
Information: Subscribe to OPC Newsletter

Subscribe to “monthly Newsletter” of OPC Foundation
- Announcements about new working groups / status update on working groups
- Technology highlights

https://opcfoundation.org/
Thank you!