Building Interoperability

Gary Kohrt
Vice – President of Solutions and Services
Real-Time Software Solutions

Factory Automation
- GENESIS 64
- Human Machine Interface
  - Supervisory Control & Data Acquisition
  - WebHMI™ Portal Dashboards
  - Advanced Graphics in 2D and 3D
  - Alarm Management
  - Trend Charting
  - GEO SCADA Mapping
  - Asset Management

Historian
- Hyper Historian
- Enterprise Historian
  - High Capacity 100,000 Samples/Sec
  - Mission Critical Redundancy
  - Virtualization
  - SQL Query Interface
  - Advanced Archival
  - Distributable Architecture
  - Real Time Statistical Calculation

Analytics
- AnalytiX
- Analytics and Manufacturing Intelligence
  - Energy Management
  - Asset Fault Detection & Diagnostics
  - Manufacturing Productivity (OEE)
  - Alarm Analysis
  - Reporting
  - Enterprise Data Integration

Mobility
- MobileHMI™ WebHMI
- Remote Visualization and Control
  - Role Based Security
  - Any Place
  - Any Time
  - Any Device

Modular • Interoperable • Secure • Reliable • Scalable • Unified
Interoperability Requirements

- Standard Transports
- Secure Transports
- Application Protocols – Point/Value Interoperable Services
- Application Protocols – Full Object Discovery
- Application Protocols – Independent Certifications
- Application Standards – Information Models
  - Standardized Objects/Classes
  - Standard Properties, Standard Naming, Standard Logic
- Hardware Availability
Standard Secure Transports

SSL
x.509 Certificates
PKI (private/public)
Message Signing
Active Dir/LDAP

TCP/IP
Reverse WWW Connection

Cloud
Internet
Intranet
OPC UA – Security Functions

- **Application Authentication**
  - All application must have a unique Application instance Certificate
  - URI should identify the instance, vendor and product

- **User Authentication**
  - Username / password, WS-Security Token or X.509
  - Fits into existing infrastructures like Active Directory

- **User Authorization**
  - Granular control over user actions: read, write, browse, execute

- **Server Availability**
  - Minimum processing before authentication
    - Restricting message size
    - No security related error codes returned
    - ...

- **System Auditability**
  - Generating audit events for security related operations
## OPC UA Applied Standards

<table>
<thead>
<tr>
<th>Main goal(s)</th>
<th>Algorithm(s)/Standard(s)</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MACs</strong></td>
<td>Authentication, Integrity</td>
<td>HMAC-SHA1, HMAC-SHA256</td>
</tr>
<tr>
<td><strong>Signature</strong></td>
<td>Authentication, Integrity</td>
<td>RSA-SHA1</td>
</tr>
<tr>
<td><strong>Symmetric Encryption</strong></td>
<td>Confidentiality</td>
<td>AES-128-CBC, AES-192-CBC, AES-256-CBC</td>
</tr>
<tr>
<td><strong>Asymmetric Encryption</strong></td>
<td>Confidentiality</td>
<td>RSA-PKCS1, RSA-OAEP</td>
</tr>
<tr>
<td><strong>Key Generation</strong></td>
<td>Confidentiality</td>
<td>P-SHA1</td>
</tr>
<tr>
<td><strong>Certificates</strong></td>
<td>Authentication, Authorization</td>
<td>X.509, X.509v3 (Extensions)</td>
</tr>
</tbody>
</table>
Application Protocols - Real-Time Services

Communications Services
Read Property
Read Property Multiple
Subscribe COV

Confirmed Event Notification
Get Alarm Summary
Get Event Information

Primitive Objects
- Analog Input
  Floor3.Room7.AHU3.Zone_Temp
  74.3 DegF
- Analog Value
- Analog Output
- Binary Input
- Binary Value
- Binary Output
- Multi-State Input
- Multi-State Value
- Multi-State Output
- Schedule
- Calendar
- Trend
Automatic System Generation

Dashboards

Fault Detection and Diagnostics Dashboard

Reports

Roof Top Unit

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Roof Top Unit Functional Profile

Standard Input/Output Set

Standard Naming

Standard Methods Calculations

Standard Commands
Today – Lack of Standardized Classes

Example – On a single campus

<table>
<thead>
<tr>
<th>Space Temperature</th>
<th>Occupied Status</th>
<th>Discharge Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone_Temp</td>
<td>OCC</td>
<td>DA_Temp</td>
</tr>
<tr>
<td>Z_Tmp</td>
<td>Occupied</td>
<td>DA_Temp</td>
</tr>
<tr>
<td>SpaceTemp</td>
<td>OCC_MOD_STS</td>
<td>SA_Temp</td>
</tr>
<tr>
<td>Space_Temp</td>
<td>OCC-Flag</td>
<td>Supply_Temp</td>
</tr>
<tr>
<td>Room_Tmp</td>
<td>OCC_Mode</td>
<td></td>
</tr>
<tr>
<td>Room_Temp</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Roof Top Unit Functional Profile
Applications Protocol – Independent Certification
FOUNDATION OPC Unified Architecture & the Internet of Things!

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OPC Foundation International

- OPC Technology Started in 1995
- OPC Foundation Incorporated January 1996
- OPC Classic 1995 –
- OPC Unified Architecture 2004 -
- OPC Unified Architecture & The Internet, Industrie 4.0 and .... 2014 -

OPC UA is IEC 62541.
OPC Unified Architecture

- OPC UA Publish/Subscriber Communication Model
- Generic Pub-Sub Information Model under development
- Evaluation of existing protocols ongoing

- Client/Server
  - Services
  - Protocols
- Vendor Specific Extensions
  - Companion Information Models
  - Built-in Information Models
- OPC UA Meta Model
- Pub-Sub
  - Model
    - Publisher
    - Topics
    - Routes
  - Protocols
    - UA Secure Multicast
    - AMQP
    - More to evaluate
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

- MDIS – Oil Platforms
- IEC61850 Electric Substations
- IEC61400 Wind Turbines
- FDT Factory Devices
Working Group OPC UA / BACnet

In September 2012 the OPC Foundation and BACnet Interest Group founded a new WG.

The main task was to create a mapping model for OPC UA and BACnet.
BACnet – Building Automation

Release Candidate Specification

BACnet OPC UA Mapping
• BACnet objects to OPC UA objects
• BACnet events to OPC UA alarms
• BACnet logging to OPC UA HA
• BACnet structure to OPC UA structures
• BACnet units to OPC UA units
Interoperability Analysis

- BACnet
- OPC_UA
- Modbus, LON, CC-Link, Dali, Z-Wave, KNX

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## GAPS

<table>
<thead>
<tr>
<th>Requirements</th>
<th>BACnet IP Annex J</th>
<th>OPC-UA</th>
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</thead>
<tbody>
<tr>
<td>Standard Transport</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Secure Transports</td>
<td></td>
<td>✓</td>
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<tr>
<td>Reverse WWW Connection</td>
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<tr>
<td>Application Protocols- Real-Time Services</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Application Protocols- Full Discovery</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Applications Protocol Certification Agencies</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Applications – Standardized Complex Objects</td>
<td></td>
<td>Capable</td>
</tr>
<tr>
<td>Hardware Availability</td>
<td>Commercial BAS</td>
<td>Industrial</td>
</tr>
</tbody>
</table>
Hardware Availability

**Commercial**
- Johnson Controls
- Honeywell
- Reliable
- Delta Controls
- ALERTON
- Schneider Electric
- SIEMENS

**Industrial**
- Rockwell Automation
- Honeywell
- Schneider Electric
- Mitsubishi Electric
- Beckhoff
- SIEMENS

**Metering**
- Eaton (Cutter-Hammer)
- General Electric
- Mitsubishi Electric
- Veris Industries
- Modbus
- Modbus/BACnet
Thank you!