Current Developments in xDS Device Descriptions

Matthew Frazer (ODVA)
Todd Andrew Snide (Schneider Electric)
Introduction

The xDS SIG is developing the next generation digital device description. This presentation highlights the current design considerations:

• Use of AutomationML as a basis for modeling device information.
• Security considerations
• Use of Open Packaging Conventions as a means of packaging the information.
• Proposed xDS tooling
What is xDS?

- The goal: A simple, scalable, secure, reusable digital device description.
- Includes all necessary information to configure, monitor, control, diagnose, and test CIP devices.
- Supporting workflows:
  - Network and Security Configuration
  - Device Configuration
  - Network Diagnostics
  - Device Diagnostics
  - Device Conformance
AutomationML

- AML was developed for automation data exchange interconnecting engineering tools.
- Established Organization with support.
- AML tools exist: editor, engine, libraries.
- Library, tutorial and usage documentation available.
- Other consortia have adopted AML:
  - Asset Administration Shell for Industrie 4.0
  - Others
  - Potentially allows sharing descriptors across other systems
Modeling CIP Devices using AML

- In depth details on AML are out of scope in the presentation
- Basic AML concepts needed for xDS Device Description:
  - RoleClass: Abstract semantic information about an object
  - SystemUnitClass: Reusable format representing a specific object type
    - Contains at least one RoleClass
  - InterfaceClass: Models an interface between components
- All can be collected into class libraries
  - Custom libraries can be created
- An ODVA xDS Primitives Library will be created
# xDS Hierarchy

<table>
<thead>
<tr>
<th>CAEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>AutomationML</td>
</tr>
<tr>
<td>AML Base Libraries</td>
</tr>
<tr>
<td><strong>xDS Primitives Libraries</strong></td>
</tr>
<tr>
<td>• Role Class Lib</td>
</tr>
<tr>
<td>• Interface Class Lib</td>
</tr>
<tr>
<td>• Attribute Type Lib</td>
</tr>
<tr>
<td><strong>CIP Device Description Model</strong></td>
</tr>
<tr>
<td>• Predefined form for modeling a CIP Device in a System Unit Class Lib</td>
</tr>
<tr>
<td><strong>Specific xDS Device Model</strong></td>
</tr>
</tbody>
</table>

Created and supplied by ODVA. Based on the xDS specification.

The xDS specification will define the format.

Generated by the vendor.
Use of ODVA xDS Primitives

- The ODVA-provided xDS Primitives Library can be used by tools that create or interpret an xDS artifact.
CIP Device modeled according to AML communications model
- The physical device describes identification information
- The logical device provides constructs to describe logical interfaces
  - Parameters
  - Assemblies
  - I/O Connections
  - Features
xDS Primitives – RoleClass Library

**Device** – A physical CIP device.
- **EtherNet/IPDevice** – EtherNet/IP implementation
- **DeviceNetDevice** – DeviceNet implementation

**CIPDeviceDescription** – CIP logical device model.
- **ConnectionList** – Container for I/O connections
- **ParameterGroup** – Container for parameters
- **AssemblyList** – Container for CIP assemblies
- **FeatureList** – Container for specific feature definitions
- **CIPObjectModel** – Object model container
xDS Primitives – InterfaceClasses

• Parameter – Model of a single configuration parameter
  – Could represent a CIP Parameter but is not required to do so
• Connection – Model of a single supported I/O connection
• Assembly – Model of a CIP Assembly, to include the assembly layout

```
ODVAXDSInterfaceClassLib
  IC Parameter{Class: VariableInterface }
  IC Connection{Class: LogicalEndPoint }
  IC Assembly{Class: DatagrammObject }
```
A CIP Device Model Example

Vendor ID | 24 – ODVA
Device Type | 7 – General Purpose Discrete IO Device
Product Code | 20
Revision | 1.001
Product Name | Virtual Discrete IO Device

Reference Device Identity

<table>
<thead>
<tr>
<th>Object</th>
<th>Instances</th>
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<tbody>
<tr>
<td>Identity</td>
<td>1</td>
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<tr>
<td>Message Router</td>
<td>1</td>
</tr>
<tr>
<td>Ethernet Link</td>
<td>1</td>
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<tr>
<td>TCP/IP Interface</td>
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<tr>
<td>Connection Manager</td>
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<tr>
<td>Assembly</td>
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<tr>
<td>Discrete Input Point</td>
<td>1, 2, 3, 4</td>
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<tr>
<td>Discrete Output Point</td>
<td>1, 2, 3, 4</td>
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</table>
xDS Representation of a CIP Device

- Library container of devices
- Physical device description
- Logical device description
- Parameter Groups
- Assembly Groups
- I/O Connection Definitions
- CIP Object Model Description (not yet defined)
CIP Device Attributes

Identity Attributes
- IdentificationData
- VendorName
- VendorID
- VendorURI
- ProductType
- ProductTypeStr
- ProductCode
- Revision
- SerialNumber
- ProductName

Assembly Attributes
- Name
- Path
- Size
- Members
  - D1Value
  - D2Value
  - D3Value
  - D4Value

Connection Attributes
- ConnectionType
- TriggerAndTransport
  - TransportClass
  - TriggerMode
- ConnectionPath
- ConnectionParameters
  - ConnectionParameters
  - ConnectionParameters
- ConnectionProperties
  - ConnectionProperties
  - ConfigurationProperties
    - ConfigurationProperties
    - Format

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Security Considerations - Threat Model

Primary Areas of Concern

• Invalid xDS device descriptions
  – Accidental or malicious modifications.

• Nonconformant device
  – Misrepresenting a device as conformant.

Threat Model Primary Use Cases

• Vendor Device Deployment
  – Vendor will digitally sign xDS artifact.

• ODVA Conformance
  – Upon successful testing ODVA will:
    • Insert a DoC.
    • Digitally sign the DoC & parts of xDS

• End User Tools
  – End User tools will validate an xDS artifact upon uploading
xDS Packaging - Open Packaging Conventions

• ISO 29500-2 & ECMA-376.
• Structured storage in a “zip” file.
• Expression of relationships between parts through a directed graph of associations.
• Multiple, independent digital signatures based on portions of the content.
# xDS Packaging – Proposed Sections

<table>
<thead>
<tr>
<th>Section</th>
<th>Part of Vendor Signature</th>
<th>Part of ODVA Signature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version Information</td>
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</tr>
<tr>
<td>AML Device Descriptions</td>
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<td>Required</td>
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<tr>
<td>Graphics</td>
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<td></td>
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<tr>
<td>Icons</td>
<td>Optional</td>
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<td>Localization String Tables</td>
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<td>Legacy EDS Files</td>
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<td>Vendor Documentation</td>
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<tr>
<td>Vendor Specific Files</td>
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<tr>
<td>ODVA Conformance</td>
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<td>Required</td>
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<tr>
<td>Signatures</td>
<td></td>
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</tbody>
</table>
xDS Tools

• "EZ-xDS"

• xDS Reference Implementation
  – Opensource reference to demonstrate how to read and interpret xDS information