EtherNet/IP + FDI = Value in Process Automation

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Overview

- Motivation
- ODVA's initiative in OPI
- Role of FDI in ODVA's OPI
- Device Integration Standard – EDDL, FDT/DTM, FDI
- Overview of FDI
- EtherNet/IP device in FDI – Technical Details
- FDI Information Model
- EtherNet/IP device in FDI Information Model – Technical Details
- Value Proposition
- Prototype Demo
Motivation

NAMUR Position paper
“An Ethernet communication system for the process industry”
Authored by NAMUR WG 2.6 Fieldbus

“Section 2.2 Network Protocols
Protocols IEC 61784-2 CPF2/2 ‘Ethernet/IP’ and IEC 61784-2 CPF3/5 ‘PROFINET IO CC B’ shall become minimum binding requirements for the process industry. ………”

“Section 5. Field Device Management and Integration
….. The device packages required for field device integration (FDI) shall be available in the devices itself and capable of being transmitted to central device management tools, see NE 105. …..“
3 primary use cases for OPI

- Field Device to ICS Integration
- Field Device to PAM Integration
- Holistic field-to-Enterprise Communication Architecture

Role of FDI in ODVA’s OPI

- Field Device to PAM Integration

Image Source: Optimization of Process Integration - ODVA
EDDL (Electronic Device Description Language)

- IEC international standard (IEC 61804)
- ISA Standard (ISA 104)
- Descriptive Language, Text file
- Platform Independent
- EDDL influences the presentation
- Robust

Supported Industrial Protocols
HART, Wireless HART, PROFINET, Foundation Fieldbus, ISA100 Wireless.

FDI compliant EDDL
Specification covering all supported communication profiles

(EDDL Cooperation Team)
EDDL was created with more graphics and data persistence

IEC standard (IEC61804)
### Content of EDDL

#### 1. Identification:
- MANUFACTURER, DEVICE TYPE, DEVICE_REVISION, and EDD_REVISION

#### 2. DATA DESCRIPTION
- **Variables**
  - LABEL
  - HELP
  - TYPE
  - CLASS
  - DEFAULT_VALUE
  - MIN/MAX_VALUE
  - UNIT
  - ACTIONS (METHODs)
- ARRAY, ITEM_ARRAY
- BLOCK, RECORD
- COLLECTION
- LIST
- FILE
- ....

#### 3. USER INTERFACE DESCRIPTION
- **MENU**
  - WINDOW, DIALOG
  - PAGE, GROUP
- **TABLE, GRID**
- **IMAGE**
  - Horizontal & Vertical Bar
  - Gauge
  - SCOPE, STRIP, SWEEP
- GRAPH YT, XY
- ACTIONS (METHODs)
- ....

#### 4. COMMUNICATION DESCRIPTION
- **COMMAND**
  - Data Ordering
  - Bit masks & positioning
- Transaction
- Error handling and Error messages
- ....

#### 5. METHOD DESCRIPTION
- Set of actions
- Can handle Simple, medium, complex algorithms
- Built-in functions supported
- Supports MenuDisplay
- Error handling
- ....
Content of EDDL - Device Identification

Every Device Description is identified using manufacturer line and it contains:
- Manufacturer name
- Device Type Code
- Device Revision
- DD Revision

Example: MANUFACTURER ABB, DEVICE_TYPE TEMPERATURE_DEVICE, DEVICE_REVISION 1, DD_REVISION 1

Version Management

DEV_REV = 1

DEV_REV = 2

DEV_REV = 1

DEV_REV = 2

DD_REV = 1

DD_REV = 1

DD_REV = 2

DD_REV = 2

0101.sym

0102.sym

0201.sym
Content of EDDL – Data Description

Default value for temperature unit is degF

Condition based Enumeration list. degC is not available when sensor type is LINEAR,

Multi-language help support
Content of EDDL – User Interface Description

MENU Definition

```plaintext
MENU device_setup
{
   LABEL "|en|Device setup";
   STYLE PAGE;
   ITEMS
   {
      process_variables_menu,
      diag_service_menu,
      basic_setup_menu,
      Detailed_setup_menu,
      review_menu
   }
}
```
Content of EDDL – User Interface Description

CHART Definition

```
CHART overview_bargraph_1
{
  LABEL "Level";
  MEMBERS
  {
    LEVEL_SOURCE,  level_bargraph_source;
  }
  TYPE VERTICAL_BAR;
  CYCLE_TIME 2000;
  HEIGHT SMALL;
  WIDTH X_SMALL;
}
```
Content of EDDL – Command Description

Protocol Dependent

Reply mapped to Variable Names

Error handling including user message
Content of EDDL – Method Definition

Methods are represented as Wizards

Programming Language C like method definition

Built-in reusable methods

User Interface is supported
Content of EDDL – Sample method screens
FDT/DTM (Field Device Tool/Device Type Manager)

- IEC international standard (IEC 62453)
- ISA Standard (ISA 103) and China (GB/T 29618) standard
- Software Component, Interface Driven
- Rich Graphical User Interface, Flexible
- DTM controls the presentation

Supported Industrial Protocols

16+ industrial standard communication protocols such as HART, WirelessHART, Foundation Fieldbus, PROFIBUS, PROFINET, Modbus, ISA100, Ethernet IP, CAN Open, IO Link, etc.

Device Integration Standard – FDT/DTM
FDI (Field Device Integration)
- IEC international standard (IEC 62769)
- Combines the concepts from EDDL and FDT
- Reduced dependency on platform
- Scalable solution
- Robust

Supported Industrial Protocols
HART, Wireless HART, PROFIBUS, PROFINET, Foundation Fieldbus, ISA100, Modbus, Generic protocol.

FDI Cooperation, LLC formed by FDT Group, Fieldbus Foundation, HCF, PNO and OPC Foundation

FieldComm Group formed
IEC standard (IEC 62769)

FDI DIM spec in progress*

FDI Standardization project launched

*FDI DIM spec in progress*
All these elements are packaged together in a digitally signed FDI Device Package.
FDI Device Packages are imported into FDI Host System
To support EtherNet/IP Device in FDI, it requires

- FDI Host to support Generic Protocol Extension
- EtherNet/IP FDI Communication Server
- EtherNet/IP FDI Device Package
FDI and Generic Protocol Extension Support

FDI and Generic Protocol Extension Support

Image Source: FieldComm Group
Workflow of EtherNet/IP FDI Comm Server and FDI Host

- Connect to EtherNet/IP FDI Comm Server
- Configure the FDI Communication Server using EtherNet/IP FDI Communication Package
- Scan & Rescan EtherNet/IP Devices
- Connect to EtherNet/IP Device
- Perform Device I/O operation using Transfer API
- Disconnect from EtherNet/IP Device
**Scan and Rescan of EtherNet/IP device**

Mapping of response from EtherNet/IP Identity Object to the TopologyScan Result in FDI Communication Server

<table>
<thead>
<tr>
<th>EtherNet/IP Identity Object Response</th>
<th>Expected Identity Object parameter in TopologyScanResult of GPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Variable Data Type</td>
</tr>
<tr>
<td>Vendor ID</td>
<td>UINT Manufacturer</td>
</tr>
<tr>
<td>Device Type</td>
<td>UINT DeviceModel</td>
</tr>
<tr>
<td>Product Code</td>
<td>UINT -</td>
</tr>
<tr>
<td>Revision</td>
<td>STRUCT DeviceRevision</td>
</tr>
<tr>
<td>Status</td>
<td>WORD -</td>
</tr>
<tr>
<td>Serial Number</td>
<td>UDINT SerialNumber</td>
</tr>
<tr>
<td>Product Name</td>
<td>SHORT_STRING -</td>
</tr>
</tbody>
</table>

Note: DeviceModel in TopologyScanResult shall also include Device Type and Product Code
Use of EtherNet/IP EDS file
- EDS file as an attachment in FDI Device Package
- EDS file to FDI Device Package conversion

Sample EtherNet/IP EDD Variable and Command definition

```plaintext
VARIABLE VendorID
{
   CLASS DYNAMIC & CORRECTION;
   LABEL "Vendor ID";
   TYPE UNSIGNED_INTEGER(2)
   {
      DISPLAY_FORMAT "3d";
      EDIT_FORMAT "3d";
   }
   POST_READ ACTIONS
   {
      BigtoLittle16(VendorID, VendorIDDisplay)
   }
   HANDLING READ;
}

COMMAND ReadIdentityObject
{
   OPERATION READ;
   HEADER "SERVICE_CODE=\"01\" CLASS=\"1\" INSTANCE=\"1\""
   TRANSACTION
   {
      REQUEST
      {
      }
      REPLY
      {
         VendorID, DeviceType, ProductCode, Revision,
         Status, SerialNumber, ProductName
      }
   }
   RESPONSE_CODES
   {
      0, SUCCESS, "No Errors";
      1, MISC_ERROR, "ILLEGAL FUNCTION";
      2, DATA_ENTRY_ERROR, "ILLEGAL DATA ADDRESS";
      3, DATA_ENTRY_ERROR, "ILLEGAL DATA VALUE";
      4, MISC_ERROR, "SERVER DEVICE ERROR";
   }
}
```

Note: Structure of the Header attribute value will be defined in the EtherNet/IP PSD specification.
EtherNet/IP device in FDI – Technical workflow

FDI Server
- Information Model: Device A
- Business Logic Processor
- FDI Comm. Server Integration with GPE support

FDI Client
- User Interface
- Represents the EtherNet/IP Device A

EtherNet/IP Device A

Standard representation of EtherNet/IP device for client access

Imported

OPC UA

OPC UA

EtherNet/IP FDI Communication Server

Renders the User Interface
The FDI Information model (IEC62769-5) is a **companion standard to the OPCUA** for Devices (IEC62541-100)

OPCUA for devices defines the device model and its elements
EtherNet/IP device in FDI Information Model - Technical Details
Value Proposition

- End User
- EtherNet/IP Device Supplier
- System Suppliers
- ODVA and FDI Community
THANK YOU