Fieldbus Foundation Technology Update

End User Seminar - Taiwan

at the Grand Hi-Lai Hotel, Kaohsiung

July 6th, 2011

Hisashi Sasajima

V.P. Fieldbus Foundation
Technology Updates

- Wireless and Remote I/O
- Field Device Integration
- Safety Instrumented Functions
- Field Diagnostics
- Host Profile Registration
- Standard Transducer Blocks
- Physical Layer Test Enhancement
- Lab Integration Team
- Making Fieldbus Easier
HSE
Wireless and Remote Input/Output (WIO)
WIO Application Example

Wireless Backhaul

Remote Process

Control Room

WIO Gateway

Conventional I/O

H1

HART I/O

Wireless Sensor Networks

WirelessHART and ISA100.11a
WIO Architecture

Example Technologies
- WiMAX
- WiFi
- Satellite
- Cellular
- Fiber
- Wire

DCS Control Network

Backhaul Network

WIO Gateway

HSE

- HSE Remote I/O
- WirelessHART
- ISA100
WIO Development Teams

HSE Remote I/O (HSE RIO) Team

Fieldbus Foundation - ISA100 Cooperation (FIC) HSE Backhaul Team

WIO Gateway

Wireless Sensor Interface Team

Conventional I/O

H1

HART®

WirelessHART

ISA100.11a
WIO Development Phases

**WIO Phase 1**
HSE Remote I/O

**WIO Phase 2**
HSE Wireless Backhaul and *WirelessHART®* Interface

**WIO Phase 3**
Interface to Other Networks

**WIO Phase 4**
ISA100.11a Interface

- **WIO Phase 1**
  - HSE Remote I/O
  - Wired HSE
  - Gateway
  - I/O
  - FF H1
  - HART I/O

- **WIO Phase 2**
  - HSE Wireless Backhaul
  - *WirelessHART®*
  - Gateway
  - Wireless HSE Backhaul
  - I/O

- **WIO Phase 3**
  - Wired HSE
  - Gateway
  - Wireless HSE Backhaul
  - Other Networks
  - (e.g. MODBUS)
  - Not Active

- **WIO Phase 4**
  - Wired HSE
  - Gateway
  - Wireless HSE Backhaul
  - ISA100.11a
  - Not Active
WIO Phase 1 Timeline
HSE Gateway to Conventional I/O

2007
✓ Specification Team Kickoff Meeting

2008
✓ Draft Preliminary Specifications (DPS)

2009
✓ Validation Team Kickoff Meeting
✓ Laboratory Validation Testing - Conventional I/O

2010
✓ Laboratory Validation Testing - Conventional I/O
✓ Laboratory Validation Testing - Wired HART
✓ Preliminary Specifications – Conventional I/O

2011
✓ Final Specifications – Conventional I/O
WIO Phase 2 Timeline  
HSE Gateway to WirelessHART®

2010
✓ Lab Validation Testing – WirelessHART

2011
✓ Lab Validation Testing – WirelessHART  
■ Lab Validation Testing – WirelessHART Live List  
■ Preliminary Specification - HART and WirelessHART  
■ Final Specification - HART and WirelessHART

Nov
Mar
Jun
Aug
Oct
WIO Phase 2 Timeline
Wireless HSE Backhaul

2009
✓ Backhaul Uses Cases and Requirements Completed Jan
✓ Backhaul Request for Information (RFI) Development Feb - Oct
✓ Review of RFI Responses by ISA100.15 Dec

2010
✓ RFI Gap Analysis Competed Feb
✓ Backhaul Security Modeling using ISA99 Methods Apr
✓ First Wireless HSE Gateway to Conventional I/O Operational Aug
✓ First Wireless HSE Gateway to WirelessHART operational Nov

2011
✓ Backhaul Architectural Model review by ISA100.15 – Interface, Security Mar
✓ Backhaul Architectural Model review by ISA100.15 – Management, QoS May
■ Backhaul Architectural Model approved by ISA100.15 Aug
■ Backhaul Architectural Models approved by ISA100 Oct
WIO Phase 4 Timeline
HSE Gateway to ISA100.11a

**2010**
- Specification Team Kickoff Meeting  
  Oct
- Initial ISA100.11a Integration Architecture  
  Dec

**2011**
- ISA100.11a Integration Architecture Completed  
  Mar
- ISA100.11 Integration Design  
  Apr
- ISA100.11a Integration Design  
  Jun
- ISA100.11 Draft Preliminary Specification  
  TBD
- Lab Validation Testing - ISA100.11a  
  TBD
- Preliminary Specification – ISA100.11a  
  TBD
- Final Specification – ISA100.11a  
  TBD
Field Device Integration (FDI)
ECT/FDI Cooperation History

2003
Phase 1 Project

2004
Phase 2 Project

2005
Maintenance Team

2007
FDI Project

2010
Enhanced Scope
Common Tools
**EDDL Phase 1**

**Phase 1 - Completed**

- Graphing – Use EDDL for graphical display of static Y-t and XY data
- Charting – Use EDDL for graphical display of real-time data from device
- Enhanced User Interface – Use EDDL to describe screen layout
- Enhanced Data Storage - Use EDD to securely store data on the host

**EDDL Phase 1**

- Phase 1 Technical Specification is IEC 61804-3
- Phase 1 Interoperability Guideline is IEC 61804-4
EDDL Phase 2

Enhanced Procedural Support for Complex Devices

Client Applications

OPC UA Protocol

OPC UA Clients

Step 1 – Data Acquisition
Operator HMI
Trend/Historian Asset Management

Step 2 – User Interface
Configuration/Maintenance

Web Services

OPC UA Protocol

OPC UA Servers

HSE, Profinet Protocol

EDD

HSE, Profinet Protocol

Remote I/O

Complex Devices

Access to Multiple Blocks Off-Line Configuration Modular Devices
Original FDI Project Scope

✓ Specify a common set of use cases and requirements
✓ Identify features of EDDL and FDT relative to the use cases and requirements
✓ The degree of overlap shall be defined by the joint technical team based on use case requirements.

- Develop technical specifications for the common Field Device Integration based on descriptive and programmed technologies relative to the use cases
- Develop guidelines for device and system developers
FDI Expanded Scope

- EDDL Harmonization – Reduce non-protocol dependent differences between FF, HCF and PNO profile specifications in the IEC 61804-3 standard (study)
- FDI/FDT2 UIP Harmonization – Reduce UIP differences (study)
- EDD Common Binary Format Specification – Needed for common FDI tool set
- Common Validation Team

Common FDI Tool Set Project to support FDI Implementation

- Common EDD Interpreter
- Common Integrated Development Environment / Tokenizer
- Common Field Device Test Tool
- Common Host System Test Tool
FDI Device Package Standard

Device Package

- **Device Definition** (Mandatory)
- **Business Logic** (Optional)
- **User Interface Description** (Optional)
- **User Interface Plug-in**
  - Optional (Interpreted on Server)
  - Optional (Rendered on Client)
  - Optional (Executes on Client)

**Using**
- IEC 61804-3 EDDL
- IEC 62453 FDT
- IEC 62541 OPC UA

**e.g.**
- Datasheets, Manuals, Certificates
FDI Project Organization

ECT
Steering Committee

Program Manager
Achim Laubenstein, ABB

Specification
Karl-Heinz Deiretsbacher, Siemens

Maintenance & Compliance
Ingo Weber, Siemens

Tools & Components
Daniel Grossmann, ABB

FF: Dave Glanzer
HCF: Open
PNO: Peter Wenzel
FDT: Glen Schulz
OPCF: Tom Burke

FDI specification
Karl-Heinz Deiretsbacher, Siemens

FDI/FDT Interfaces
Jon Westbrook, Emerson

EDDL Harmonization
Michael Braun, Siemens

EDDL Binary Format
Michael Braun, Siemens

FDI FDT Interoperability
Nestor Camino, Invensys

Validation
Jörg Jeske, ABB

FDT Group Specification Team
Suriya Selvaraj, Yokogawa

FDI Architecture
Daniel Grossman, ABB

Common EDD Engine
Reference Host
Daniel Grossman, ABB

Device Package IDE
Martin Augustin, Siemens

Conformance Tools
Matthias Riedl, IFAK

NEW

Change

Working Groups, permanent
Sub-projects, temporary
Sub-projects, completed
External Team
FDI Specification Development

- Develop detailed specifications for tools and components
- Begin work on tools
- License to LLC when contracts in place

<table>
<thead>
<tr>
<th>Software Component</th>
<th>Company/Foundation</th>
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<tbody>
<tr>
<td>Host EDD Engine</td>
<td>Emerson</td>
</tr>
<tr>
<td>Host User Interface Plug-in/Description Tools</td>
<td>ABB</td>
</tr>
<tr>
<td>Device Description IDE</td>
<td>Siemens</td>
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<tr>
<td>Device Tokenizer</td>
<td>Fieldbus Foundation</td>
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<tr>
<td>Reference Host Implementation (for IDE)</td>
<td>HCF</td>
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<tr>
<td></td>
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FDI Specification Development

- FDI Project approved 1Q 2007
- FDI Project technical team kickoff meeting 2Q 2007
- Use case review with NAMUR and WIB 4Q 2007
- Use cases and requirements approved 2Q 2008
- System Architecture 3Q 2008
- Technology criteria 4Q 2008
- Technology selection 1Q 2009
- Functional Specifications 2Q 2009
- Initial Draft Technical Specifications 1Q 2010
- Start Verification and Validation 1Q 2010
- Draft Final specifications 4Q 2010
- Final Specifications 4Q 2011
DD IDE Tool Evolution

- FF IDE Available for License
- FF Tokenizer Development (FDI)
- FDI IDE Development
- FDI IDE Available for License

FDI DD IDE Released
FF DD IDE Discontinued

- FDI Architecture Kick-off
- FDI Agreements Executed
- Milestone Releases
- Maintenance Releases
DD Services Tool Evolution

- FDI EDD Engine Development
- FDI EDD Engine Available for License
- FDI Architecture Kick-off
- FDI Agreements Executed
- Milestone Releases
- Maintenance Releases

FDI Engine Released
DD Services maintained at current feature state
DDS Discontinued

Migration Period
FOUNDATION™ for Safety Instrumented Functions (SIF)
End User Demonstration Sites

- BP – Gelsenkirchen, Germany – Honeywell Logic Solver
- Chevron – Houston, TX – Emerson Logic Solver
- Saudi Aramco – Dhahran – Triconex Logic Solver and Yokogawa Logic Solver
- Shell Global Solutions – Amsterdam – HIMA Logic Solver
Control Valve Stroke Test
(Partial Stroke Test)

![Diagram showing the control valve stroke test process with labels for PST Start, PST Break out Time out, PST Stroke Travel Timeout, PST Complete, PST Break out, PST Rump Rate, PST Pause, PST Stroke Travel, Transient Time.](image)
SIF Development History

Initiated by End Users to gain benefits of H1 in Safety Instrumented Functions

Technical Specification Development Project Approved by BOD in October 2002

TÜV Protocol Type Approval including SIL 3 in December 2005

Marketing Demonstration Approved by BOD in October 2005

Marketing Demonstration Press Day completed May 2008

SIF_AI and Interoperability Test System released in 2008

SIF_DO and Interoperability Test System released in 2010

Pilot projects underway at Shell and Saudi Aramco 2009 - 2011

Registered SIF Products Expected 2012
SIF End User Pilot Projects
Shell Statement

Shell Project & Technology will use SIF on a Nederlandse Aardolie Maatschappij (NAM) project in the Netherlands. This is the first of a number of identical projects expected to utilize the technology.

Shell is in discussions with several leading automation suppliers for commitments on the logic solver. When the instrument scope is complete, Shell is expecting the various device vendors to provide safety-approved products for the initial installations.

The Shell Project & Technology Group Process Automation Control and Optimization (PACO) will monitor the development together with the NAM project organization.

Shell Project & Technology is anxious to see industry progress in the area of FF-SIF implementation.
SIF End User Pilot Projects
Saudi Aramco Statement

Saudi Aramco successfully launched two SIF pilot projects and plans have been initiated to install working SIF systems within operating oil and gas facilities.

A project is planned for the Juaymah gas plant in Saudi Arabia in late 2010. Saudi Aramco expects SIF installation at the Juaymah gas plant to demonstrate lower costs due to reduced hardwired I/O to the safety logic solver, as well as enhanced local testing and diagnostic capabilities.

A second SIF installation is planned with emergency isolation valves with automated functional testing and diagnostics. This configuration will replace existing emergency isolation valves with new valve bodies and pneumatic valve actuators fitted with SIF smart valve controllers.

After these smaller pilot projects are complete, Saudi Aramco plans expanded deployment of SIF technology in order to exploit its benefits on larger, mega scale projects.
SIF Timeline

2008
✓ SIF Demonstration and Press Day  May
✓ SIF Specification v1.2 Released to Developers  Sep
✓ SIF Interoperability Test Kit with SIF_AI Released to Developers  Oct
✓ SIF_AI Lab Validation Completed  Nov

2009
✓ SIF Interoperability Test Kit with SIF_DO Released to Developers  Jun
✓ Begin Testing with SIF_DO Prototype – Supplier A  Jun
✓ Begin Testing with SIF_DO Prototype – Supplier B  Nov
✓ Begin Testing with SIF_DO Prototype – Supplier C  Dec
✓ AG-181 SIF Best Practices and Guidelines Released  Dec

2010
✓ SIF AR Review by SIF Technical Team  Feb
✓ SIF ARs Approved by TSC  Mar
✓ SIF_DO Validation Completed  May
✓ SIF_DO Released by TSC  Jun
✓ SIF Specifications v1.4 Released  Oct
✓ SIF Interoperability Test Kit with SIF_DO Released  Dec
Field Diagnostics
NAMUR Recommendation NE107

NE107: “Self-Monitoring and Diagnosis of Field Devices”

- Diagnosis results must be reliable
- The diagnosis results must always be viewed in the context of the application.
- Internal diagnosis categorized into 4 standard status signals
- Configuration should be free, as reactions to a fault in the device may be very different depending on the user's requirements
- The plant operator to see only these status signals
- Detailed information can be read out by the device specialist
## Specification Development

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<td>Press Release May 06</td>
<td>Foxboro July 06</td>
<td>Frankfurt Oct 06</td>
<td>Houston Feb 07</td>
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<td>Minneapolis July 07</td>
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- **Investigations**
- **Draft Specifications**
- **Validation**

- Early Prototype
- First Validation (ITK) Test Cases
- Final Specification Released
# Tool Development

<table>
<thead>
<tr>
<th>Year</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
<th>Q4</th>
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<tr>
<td>2009</td>
<td>ITK 5.1 Released</td>
<td>ITK 6.0 Profile Requirements Released</td>
<td>Host Test Kit 2.0 Field Diagnostics Test Device</td>
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<tr>
<td>2010</td>
<td>ITK 6.0 Field Diagnostics Mandatory for New Registrations (*)</td>
<td>First Devices Registered Implementing Field Diagnostics</td>
<td>(*) Device vendors can continue to test against ITK 5.2 for 12 months</td>
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Test and Registration Support

✓ Device support with ITK 6
  - Released in September 2010
  - Field Diagnostics is **mandatory** for ITK 6
  - Field Diagnostics is **optional feature** at ITK 5
  - Devices can test under ITK 5 until Sept 2011
  - Feature listed on the registration certificate and web catalog

✓ Host Support with Host Test Kit Module
  - Release in December 2009
  - Sample device implementing full field diagnostic alerts
  - Field Diagnostics support is **mandatory** for 6xb profiles
  - Advanced Field Diagnostics support in 6xc profiles (in development)
Standard Transducer Blocks

Physical Layer Test Enhancement

Lab Integration Team
Standard Transducer Blocks

✓ Pressure Block Completed and in ITK 5.0
✓ Temperature Block Completed and in ITK 5.1
✓ Positioner Block (PST/FST) Completed in in ITK 5.2

Next Block

■ Flow Transducer with High Performance Totalizer
✓ Validation Complete. Publication scheduled Mar 2011
✓ Support scheduled for ITK 6.1

PST – Partial Stroke Test; FST – Full Stroke Test
Physical Layer Test Enhancement

Establish Formal Interoperability Working Group for Physical Layer Test improvements

- Identify enhanced physical layer test requirements and test cases to the 31.25 kbit/s Physical Layer Test Specification
- Create a standardized method for verifying EMC susceptibility for field devices to ensure consistent test setup, test requirements and test cases performed by manufacturers and third party EMC test labs.
- Submit procedures for adoption into IEC 61326
  - EMC Procedures submitted to IEC Aug 2009
  - Test Case Enhancements completed Dec 2010
  - Published April 2011
Establish Formal Interoperability Working Group for System Issues

- Identify key individuals (Test Lab Experts, Trainers, etc.)
- Create formalized process for tracking interoperability and usability issues and performing root cause analysis
- Implement an interoperability issues tracking system
- Schedule and execute quarterly teleconferences
- Schedule and execute bi-annual meetings
- Execute findings of the team

☑ Common Lab Test Requirements published April 2011
Host Profile Registration
Host Profile Registration

2. Host Registration (Host Profile Test)

Define Host Class and supported function

Class 63/64
Bench Host

Class 62
Visitor Host

Class 61
Integrated Host

Operations

Engineering

Fieldbus

Field Device A

Field Device B

Write

Read

1. Interoperability Test & Device Registration

2.

Note: Illustrations are examples only. Supplier defines host.
Host Profile Specification - Key Features

Extension to the existing specifications
- Defined in FF-569 Host Interoperability Support Test Procedures
- Released in next specification package update

Defines four profiles
- Integrated Host
- Bench Host (for use with on-process devices)
- Bench Host (for use with non-commissioned devices)
- Visitor Host

For each profile, features are marked
- (M)andatory - required for system interoperability
- (O)ptional - useful, but not essential
- (P)rohibited - to prevent interoperability issues

Staged Implementation
- Two stage profile (6Xa, 6Xb) provides time for systems to become compliant
Host Test Kit - Key Features and Benefits

Standardized Test Requirements and Test Cases
- All hosts within a profile tested to the same requirements
- EDD requirements implemented in cooperation with Profibus and HART

Standardized DD and CF file(s)
- Assures host can parse files
- Verify EDD and CF interpreter

Standardized Test Device
- All basic IO blocks Function Blocks
- Specialized test transducer blocks
Host Profile 61b additional features

Verify configuration and access to Field Diagnostics
  ➢ Consistent diagnostic presentation

Improved Function Block supported
  ➢ Enhanced block parameters
  ➢ Profiled custom blocks (essentially enhanced blocks)
  ➢ Block Instantiation
  ➢ Control in the Field

Device Level Menus
  ➢ Improved maintenance user interfaces
## Transition to Host Registration

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<thead>
<tr>
<th>Year</th>
<th>2008</th>
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</table>

- **Host Interoperability Support Test (HIST) 1.x**
  - Valid through Dec 2008

- **9 Registered Hosts**

- **Host 6Xa Profile Test/Registration**
  - Valid through June 2010

- **Host 6Xb Profile Test/Registration**
  - **NEW**
  - **Awaiting second 61b host**

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# Registered Host

## 10 Registered Host Systems from 8 Companies

<table>
<thead>
<tr>
<th>Company</th>
<th>System Name</th>
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<tbody>
<tr>
<td>ABB Automation Products GmbH</td>
<td>Industrial IT System 800xA</td>
</tr>
<tr>
<td>GE Energy</td>
<td>GE ControlST</td>
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<tr>
<td>Emerson Process Management</td>
<td>DeltaV &amp; AMS Suite</td>
</tr>
<tr>
<td></td>
<td>Ovation Expert Control System</td>
</tr>
<tr>
<td>Honeywell Process Solutions</td>
<td>Experion PKS</td>
</tr>
<tr>
<td>Invensys Operation Management</td>
<td>Infusion Enterprise Control System</td>
</tr>
<tr>
<td>Siemens AG</td>
<td>SIMATIC PCS 7 Distributed Control System</td>
</tr>
<tr>
<td>Yamatake Corporation</td>
<td>Industrial-DEO / Harmonas</td>
</tr>
<tr>
<td>Yokogawa Electric Corporation</td>
<td>CENTUM VP</td>
</tr>
<tr>
<td></td>
<td>STARDOM</td>
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</tbody>
</table>
Making Fieldbus Easier
Making Fieldbus Easier – Completed Projects

✓ Field Diagnostics
  - Integrates diagnostics into common structures
  - Improve user experience with diagnostics across all devices

✓ Device Replacement Application Note
  - Defines how to build and integrate newer devices into existing configurations
  - Provides guidelines to both device and host manufacturers
  - Improve overall user experience with the maintenance task
Making Fieldbus Easier – Completed Projects

- Simplify the Process for Private Label Devices
  - An OEM supplier must perform a full device test registration
  - A private label of the OEM device is subject to reduced testing rates
  - Reduces the total costs associated with developing basic devices

Manufacturer A
Registered Product

Manufacturer B *
New Product

Benefits
- Save over 50% on test fees
- Expand product portfolio
- Leverage existing development
- Reduced entry costs
- Quicker time to market

* Could be same manufacturer
Making Fieldbus Easier – Completed Projects

✓ Integrated / Visitor Host Interoperability Application Note
  ➢ Best practices for managing connections with multiple hosts
  ➢ Better compatibility between hosts and visitor (handhelds)

✓ PROLIST with Foundation Fieldbus
  ➢ Electronic data sheets for specifying process equipment
  ➢ Improves selection and order process

✓ Block Instantiation/Capability Level Application Note
  ➢ Best practices for device and host manufacturers
  ➢ Improved user experience with modular devices
H1 Segment Check Tool (DesignMate)

- Tool to assist users with building H1 networks with registered products.
- Reduce issues due to incorrect design and installation
- Launched Dec 2010
DesignMate Software

- Complete software tool for planning, validation, and documentation of H1 segments
- Automatically audits segment layouts against physical layer specifications
- Available for free download on the Fieldbus Foundation website [http://www.fieldbus.org](http://www.fieldbus.org)
- Average 300 downloads/month
Making Fieldbus Easier – Ongoing Projects

✓ Physical Layer Testing Services
  - Offer physical layer test services as part of interoperability testing
  - Reduce the incidence of device physical layer issues in the field
  - Launched December 2010

■ Transducer Block Standardization
  - Defines standard block parameters for typical sensors/actuators
  - Consistent configuration for the end user

■ Lab Integration Team
  - Ongoing project to identify interoperability and usability issues
  - Information will drive future improvement projects that will benefit the end user experience