FOUNDATION Fieldbus – for project cost reduction

Andreas Agostin, Industrial Network Specialist
Eaton Singapore
FOUNDATION fieldbus started with a few simple ideas:

- Reduce cabling
- Simplify marshalling
- Fast commissioning
- Liberate plants from proprietary protocols
- Ensure multi-vendor interoperability
- Real-time digital closed-loop control
- Allow diagnostics-based maintenance
- Expand device intelligence

→ Benefits for the entire plant life cycle
Project cost reduction by:

- Use of complex devices
- Use of multi-variable devices
- Use of multi-channel devices
- Reduced hardware, not just cable
- No marshalling required
- Fast commissioning
Use of complex devices

- Electric actuators/motor-operated valves
- Gas chromatographs
- Tank gauging systems

These devices used to have proprietary protocols in the past.
Fieldbus enables integration of devices with multiple signals (Multi-variable devices)

- **Hardwired**
  - 1 pair of wires and one I/O channel per signal
  - 3, 6, 12 or more signals per device

- **Fieldbus**
  - A single pair of wires to connect multiple devices
  - Multiple auxiliary signals per device

- **Reduction:**
  - Wiring
  - I/O cards
  - I/O cabinets
  - Footprint
  - Weight
  - Labor

A 5,000 I/O hardwired system becomes a 1,700 fieldbus device system
Example of a multi-variable fieldbus device

**MultiVariable Transmitter**

See ordering information on page 19.

- Combines Differential Pressure, Static Pressure, and Process Temperature measurements along with Mass and Energy Flow in a single device

This single FF transmitter replaces 5 conventional 4-20mA devices

Generic transmitter picture for illustration only
Fieldbus plants can fully utilize device capabilities

- Every device signal can now be employed at full functionality
  - No longer limited to a subset of signals or function
- For example:
  - Continuous feedback for all control valves, on-off valves, and MOV

**Cores I/O Description**

<table>
<thead>
<tr>
<th>Cores</th>
<th>I/O</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3 DO</td>
<td>Open/stop/close control</td>
</tr>
<tr>
<td>2</td>
<td>1 AO</td>
<td>Desired valve position control</td>
</tr>
<tr>
<td>2</td>
<td>1 DO</td>
<td>Emergency shut down</td>
</tr>
<tr>
<td>3</td>
<td>2 DI</td>
<td>Valve position status (limit switches)</td>
</tr>
<tr>
<td>2</td>
<td>1 AI</td>
<td>Percentage open</td>
</tr>
<tr>
<td>1</td>
<td>1 DI</td>
<td>Available for control</td>
</tr>
<tr>
<td>1</td>
<td>1 DI</td>
<td>Local/remote switch</td>
</tr>
<tr>
<td>1</td>
<td>1 DI</td>
<td>Motor running open direction</td>
</tr>
<tr>
<td>1</td>
<td>1 DI</td>
<td>Motor running closed direction</td>
</tr>
<tr>
<td>1</td>
<td>1 DI</td>
<td>Torque switch tripped</td>
</tr>
<tr>
<td>2</td>
<td>1 AI</td>
<td>Percentage torque</td>
</tr>
<tr>
<td>1</td>
<td>1 DI</td>
<td>Motor thermostat tripped</td>
</tr>
<tr>
<td>1</td>
<td>1 DI</td>
<td>Battery condition low</td>
</tr>
<tr>
<td>22</td>
<td>16 ch</td>
<td>TOTAL</td>
</tr>
</tbody>
</table>

**Hardwired system may only afford to use few out of the available signals – only basic functionality**
Multi-channel (multi-point) devices reduce the number of devices in fieldbus plants

- Bus not limited to single real-time value
  - Multi-channel temperature transmitters
    - Eight sensors ideal for temperature profiling applications
  - Multi-point indicators

Eliminate 8 transmitters, 8 pairs of wires, and one 8-channel input card
Reduced Hardware Requirements

Performing functions in software reduces the need for hardware
Plants use fieldbus to eliminate physical signal marshalling

- Signal marshalling handled through software instead of hardware

Each signal is a ‘virtual I/O’ communication on the wires
VirtualMarshalling™ is Software-based I/O Connectivity with Fieldbus

- All signal linking is done block to block in software without hardwiring

All tags are ‚soft’
Simply point and click to incorporate signals from devices

Flexibility
Using additional device signals (e.g. one in, two out) does not require more cable, terminals, barriers, I/O channels, or power etc.
Junction Boxes in Fieldbus Plants Handle More Signals

- A bus with 10 instruments
- Average of three signals per device
- Each trunk can take the place of 30 pairs of wires and I/O channels
Fieldbus plants use networking instead of I/O cards and marshalling

- The smallest hardware footprint of any technology in process automation
- Significantly reducing the overall amount of equipment needed

320 devices is equivalent to 1000 I/O
Component Selection is Simpler in Fieldbus Projects

- Inputs and outputs; analog and discrete, share the same bus:
  - Transmitters, control valves, and two-wire on-off valves etc. together

- No need to select I/O card type

- No need to select barrier type

- All fieldbus devices use the same single type of interface card and barrier

- All devices have the same entity parameters (U, I, P, C, and L)
I/O Design is Simpler in Fieldbus Projects

- Not necessary to know the exact type and quantity of signal for each device

Fieldbus is “Soft” I/O

Hardware standardization through software-based customization

Only devices count

Input, output, discrete or analog are all the same

Standard cabinets
Fieldbus Projects Have Reduced Hardware and Labor Cost

- **Less hardware**
  - Cable, glands, and terminal strips
  - Cable trays and conduit
  - Termination assemblies and I/O cards

- **Less installation labor at every intermediate point**
  - Pulling cable
  - Cutting
  - Stripping
  - Crimping
  - Labeling
  - Connecting

- **The resulting cost is even lower than remote I/O**
Conventional wiring

2nd level 1st level
junction box

Multicore cables
Fieldbus system wiring following 4-20mA

2nd level 1st level
junction box

Fieldbus power supplies

Control system

Multipair (multiple trunks)

480 FF instr.

System cable
Fieldbus system wiring w combined cabinet

2nd level
junction box

1st level
Multipair
(multiple trunks)

DCS with H1 cards
Fieldbus power supplies

576 FF instr.
Fast Commissioning

Test all signals from all devices in one go

• Detection
• Identification
• Binding
• Integration
• Configuration
• Checking
• Documentation
Automatic detection and identification of all devices

- Automatically confirms the correct device type has been installed
- For all kinds of devices:
  - Transmitters
  - Control valve positioners
  - Electric actuators
  - On-off valves
  - Etc.
Automatic Binding, Integration, and Configuration
Download

Automatically assigns address and binds device to I/O in the control strategy

Automatically selects correct DD file for use in Device Management Software

Automatically download complete device configuration – no setting parameter by parameter

<table>
<thead>
<tr>
<th>User Config Name</th>
<th>Manufacture</th>
<th>Device Type</th>
<th>Device</th>
<th>Protocol</th>
</tr>
</thead>
<tbody>
<tr>
<td>3051T Heater Coil Group</td>
<td>Rosemount</td>
<td>3051</td>
<td>3</td>
<td>HART</td>
</tr>
<tr>
<td>3144P Service B</td>
<td>Rosemount</td>
<td>3144P</td>
<td>3</td>
<td>HART</td>
</tr>
<tr>
<td>644 Service A</td>
<td>Rosemount</td>
<td>644</td>
<td>6</td>
<td>HART</td>
</tr>
<tr>
<td>DVC6000 Service A</td>
<td>Fisher Co...</td>
<td>DVC6200/DVC6000</td>
<td>2</td>
<td>HART</td>
</tr>
<tr>
<td>DVC6000 Service B</td>
<td>Fisher Co...</td>
<td>DVC6200/DVC6000</td>
<td>1</td>
<td>HART</td>
</tr>
<tr>
<td>FF 3051.6 Service A</td>
<td>Rosemount</td>
<td>3051 Fieldbus Pressure Transmitter</td>
<td>6</td>
<td>FF</td>
</tr>
<tr>
<td>FF 3051.6 Service B</td>
<td>Rosemount</td>
<td>3051 Fieldbus Pressure Transmitter</td>
<td>6</td>
<td>FF</td>
</tr>
<tr>
<td>FF 3144.3 Service A</td>
<td>Rosemount</td>
<td>3144 Fieldbus Temperature Transmitter</td>
<td>3</td>
<td>FF</td>
</tr>
<tr>
<td>FF 3244.2 Service A</td>
<td>Rosemount</td>
<td>3244MV Fieldbus Temperature Transmitter</td>
<td>2</td>
<td>FF</td>
</tr>
<tr>
<td>FF 3244.2 Service B</td>
<td>Rosemount</td>
<td>3244MV Fieldbus Temperature Transmitter</td>
<td>2</td>
<td>FF</td>
</tr>
</tbody>
</table>
5-Point loop check is not required on fieldbus

- No 4-20 mA ranging
- No 4-20 mA signal distortion
- Traditional five-point loop tests are replaced by a simple plausibility check

- No range mismatch
- Not limited
- No biased
- No non-linearity
- No current calibration mismatch
Automatic Commissioning Loop Check and Documentation

Documentation
Card number, port, device tag, commissioning state, manufacturer, model/type, revision, unique ID, and address etc.
Conclusion
Conclusion

- Reduced hardware requirements
- Smaller system footprint
- Reduced device count
- No marshalling
- Faster commissioning

Make these benefits your own
Where can I learn more?

- www.fieldbus.org