Introduction to Foundation Field Field Bus

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Acknowledgement Thanks and Reference:

Some information had been taken from Emerson Project Management Slide Show available in the Web.

At least 3 Photographs, some information and 2 Tables have been taken from Emerson Project Management, for Illustration.
Field Bus was designed for Process Industry by the Process Industry

Picture Below: A Complex Project
( Courtesy: Emerson Project Management)
Foundation Field Bus System
Suitable for Remote areas

Courtesy: (Emerson Project Management)

Alaska Oil Well Installation
Process to be monitored in Aggressive Environment
Foundation Field Bus System Suitable for Remote areas

Courtesy: (Emerson Project Management)
Alaska Oil Well Installation
Process to be monitored is in Hazardous Environment
Introduction

• Modern control and automation are essentially based on Foundation Fieldbus.
• The various field instruments and actuators are assigned new capabilities.
• For example, the operators can easily view many more critical process variables and the states of the actuators than in the conventional Distributed Control.
• The most important advantage is that the wiring and installation costs are reduced. All these factors increase the support for the maintenance of the Plants.
Definition of Field-bus:

*It is a two-way, digital multi-drop communication link among intelligent field devices and automation systems.*

- Field bus uses a twisted pair of wires with a shield.
- Both DC power supply and Binary signals are accommodated in a single twisted pair
• Interesting features:

• Some suppliers give polarity insensitive free field bus components so that wiring cross over of the cables does not present any problem.

• The devices, if they are intelligent enough can be made to communicate with each other without disturbing the main computer.

• **Field bus accepts multiple sensors and actuators**
Field Bus (tree) Control of Process

High Speed Field Bus

100 M bits/s

Interface Unit

Low Speed Field Bus

31.25 Kbits/s

Inter Operable

Can be Fast

Ethernet
Installation

The number of devices per segment of the Field bus is 16.

- The simplicity of the Bus transfers the burden from the Hardware side to the Software side.

- The software enables automatic identification of new devices added.

- It also grants an address for the new device. Device information is registered in Computer.
Terminology in Field Bus Systems:

- The following three specifications are based on Speed:
  - **H1**: 31.25 Kbps  #18 AWG  Range 1900* m
  - **H2**: 1.0 Mbps  #22 AWG  Range 750* m
  - **H3**: 2.5 Mbps  #22 AWG  Range 500* m

- The wiring follows IEC 1158-2 Standard

- Total length of cable should be less than 1900 m (shielded, 18 AWG, Type B)
- When connecting up to 12 devices in a powered, bus, the Spur length limit should be:
  - 120 m with one device
  - 90 m with two devices
  - 60 m with three devices  * 30 m with four devices
Communication:

- The data transfer is via bi-directional Frames.
- The Pre-amble, start and end of a Frame are indicated by De-limiters in the Frame.
- The delimiters use binary levels and edges.
- Other data use only binary edges.
- The type of frame and data are also present.
The individual devices take over the bus based upon a priority assigned.

This may be done by using a token passing procedure.
## Analysis of a Typical Message Frame

<table>
<thead>
<tr>
<th>Type of Messg</th>
<th>Message Encoding</th>
<th>User Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 byte</td>
<td>4 to 248 bytes</td>
<td>0 to 244 bytes</td>
</tr>
<tr>
<td>5 bytes</td>
<td>5 to 249 bytes</td>
<td>0 to 244 bytes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Preamble</th>
<th>Start Delimiter</th>
<th>Data Link Layer (DLL)</th>
<th>End Delimiter</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 byte</td>
<td>1 byte</td>
<td>12 to 256 bytes</td>
<td>1 byte</td>
</tr>
</tbody>
</table>

A typical Data Frame
**Field bus Compatible Devices Available:**

<table>
<thead>
<tr>
<th>Absolute Pressure</th>
<th>Differential Pressure</th>
<th>Vortex Flow meter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electromagnetic Flow meter</td>
<td>Coriolis Mass Flowmeter</td>
<td>Ultrasonic Flow meter</td>
</tr>
<tr>
<td>Temperature Transmitter</td>
<td>Temperature Multiplexer</td>
<td>Plain Level</td>
</tr>
<tr>
<td>Magnetostrictive Level</td>
<td>Radar Level</td>
<td>Ultrasonic Level</td>
</tr>
<tr>
<td>Conductivity</td>
<td>pH meter</td>
<td>Oxygen &amp; Combustibles</td>
</tr>
<tr>
<td>Process Gas Chromatograph</td>
<td>Fiber optic temperature</td>
<td>Fiber optic pressure</td>
</tr>
<tr>
<td>Continuous Gas Analyzer</td>
<td>Nuclear Valve Positioners</td>
<td>On/Off Valve</td>
</tr>
<tr>
<td>Fieldbus to Pneumatic</td>
<td>Current to Fieldbus</td>
<td>Fieldbus to Current</td>
</tr>
<tr>
<td><em>Discrete I/O</em></td>
<td>Discrete I/O Multiplexer</td>
<td>Mobile recorder</td>
</tr>
</tbody>
</table>
### Manufacturers of Fieldbus Devices

<table>
<thead>
<tr>
<th></th>
<th>Tyco Valves &amp; Controls</th>
<th>MetsoAutomation</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABB</td>
<td>Foxboro</td>
<td>Endress+ Hauser</td>
</tr>
<tr>
<td></td>
<td>Honeywell</td>
<td>Krohne Messtechnik</td>
</tr>
<tr>
<td></td>
<td>Samson AG</td>
<td>Burkert WrkeGmbH</td>
</tr>
<tr>
<td></td>
<td>Emerson Process Management</td>
<td>Ohmart Vega</td>
</tr>
<tr>
<td></td>
<td>Fieldbus Inc.</td>
<td>Fuji Electric Corp</td>
</tr>
<tr>
<td></td>
<td>Bifi</td>
<td>Yokogawa Electric</td>
</tr>
<tr>
<td></td>
<td>Dresser Valve Division</td>
<td>Ledeen</td>
</tr>
<tr>
<td></td>
<td>EIM Controls Inc</td>
<td>KTEK</td>
</tr>
<tr>
<td></td>
<td>Rotork Controls Ltd</td>
<td>TopWorx</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Beijing HuakongTechnology</td>
</tr>
</tbody>
</table>

*Note: The table lists companies that manufacture fieldbus devices.*
Case History:

(Ref. Emerson Process Management Inc)

- In an oil well installation in Alaska, Cost savings for first 64 wells as quoted by Emerson Inc.

**Cost Savings:**

<table>
<thead>
<tr>
<th>Project component</th>
<th>Cost when Field bus is used</th>
<th>Conventional Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering vs.</td>
<td>$336,000</td>
<td>$480,000</td>
</tr>
<tr>
<td>Commissioning</td>
<td>$14,000</td>
<td>$86,000</td>
</tr>
<tr>
<td>Wiring 206 K$ vs</td>
<td>$206,000</td>
<td>$596,000</td>
</tr>
<tr>
<td>Audited Savings</td>
<td>$556,000</td>
<td>$1162,000</td>
</tr>
</tbody>
</table>
Other Reductions:

- Terminations 84%
- Panel Space 70%
- I/O Cards 93%
- Transmitters 28%
- Wiring 5 mins instead of many hours.

2 wires for a bunch of 16 devices instead of 32 wires in the conventional I/O bus

75 Loops for one cabinet

Commissioning 5 mins instead if many Hours per device

Instrumentation and Maintenance 75% reduction in time
• Conclusions:

• Fieldbus brings dramatic savings in installation and commissioning cost.
• However the real value of the Field bus is seen and appreciated during plant operation...
End