Advantages of Digital Communication

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Foundation Fieldbus

• 2 wire Multidrop bus
• Asset Management : CAPEX and OPEX savings
• Multivariable instruments: Less Instruments
• Binary Signals integration – (Wiring savings on on/off valves, limit switches etc)
Conventional technique

4-20mA technique:

- **Factory level**
  - Bus Cycle time < 1000 ms

- **Cell-level**
  - Bus Cycle time < 100 ms

- **Field-level**

- **Work station**
  - Ethernet/TCP/IP
  - Internet/Intranet

- **Management**

- **Operations**

- **Maintenance**

Ex
Fieldbus technique

- **Factory level**
  - Bus Cycle time < 1000 ms

- **Cell-level**
  - Bus Cycle time < 100 ms

- **Field-level**
  - Bus Cycle time < 10 ms

Diagram shows:
- Ethernet TCP/IP
- Internet/Intranet
- Management
- Operations
- Maintenance
- PC/VME
- Work station
- Fieldbus
- Fieldbus EX
Multidrop

- Reduced hardware: wiring, IO cards, cable trays, conduits, and barriers etc.
- Reduced labor: pulling, cutting, stripping, labeling, and connection
FF and traditional 4-20mA

- Integration of 4-20mA protocol
- Increased capabilities (due to full digital)
- Reduction in wiring and terminations
- Reduction in system hardware

![Diagram of FF and traditional 4-20mA system]
Control room – Conventional wiring
Control room – Fieldbus

80 Segments = 800 Instruments
Reduced Space Requirements

- Smaller System Footprint
- Wiring & Rack
- Cable cost
- Junction box
- Cable Conduit
- Processing of cable
- Marshalling
- Barrier

4-20mA/HART System

Fieldbus System

Case of 350 I/O points

Courtesy of Emerson
Advantage Space

Less wiring
- No marshalling
- Barrier in the field
- More instruments per cable

$ $ $ $ $ $ $ $ $ $
Compare connection savings

10 instruments

20 terminations

20 terminations

20 terminations

11 terminations

2 terminations
Compare wiring savings

10 instruments

- 5000 m cable
- 500 m
do not hallucinate.
Asset Management

CAPEX and OPEX savings
User Benefits - Life Cycle Savings

• Cost saving in plant life cycle

Design → Installation → FAT, SAT

Operation → Renewal → Maintenance

CAPEX Savings

• Saving of Cable & Cabinet
• Small # of instruments (control in field)
  • HPT / FISCO / FISCO iC
  • Engineering
  • FAT/SAT
• Smaller System Footprint

OPEX Savings

• Expand operator’s aspect
• Down-Time reduction by diagnosis
• Asset management
• Improvement of maintenance work
  – Remote maintenance work, Automatic maintenance work
  – Application of diagnostics
• Small # of instruments to be checked
• Software change in field instruments download
Fieldbus Project Costs

• Estimated Project Savings
  – Materials/Field Devices: Increased by 15%
  – Installation Labor: Reduced by 50%
  – Commissioning: Reduced by 75%
  – Engineering: Reduced by 50%

• Overall Capital Savings of 25 – 30%
  – Savings will be realized if the project is planned as a fieldbus project and the information is shared with all levels of the organization!
Commissioning Costs Without fieldbus:

- Individually ring out wiring
- Attach device
- Verify communications
- Verify link to control strategy

2 hours / device for 2 technicians
• Commissioning Costs With fieldbus:

25 minutes / device for 1 technician.

• Check segment wiring
• Attach device
• Drag-and-drop commissioning
• Confirmation done via live data
Fieldbus Information Drives Operations and Maintenance
Fieldbus is a critical part of the plant data network.
Areas of failures

- Actuators - 30%
- Sensors - 48%
- I/O - 15%
- Wiring - 5%
- CPU - 2%
63% of time is spent investigating “problems” that do not exist. Fieldbus will tell you this so it will no longer be necessary to check these reports.

Courtesy of Hydrocarbon Engineering April 2004
One set of Statistics*

Timely Data is critical

• 65% of work orders generated for transmitters are bogus – either no problem or problem with other equipment
• 75% of control valves removed from process lines did not require removal
• 50% of instrument tech’s time is spent on paperwork

* Reported to the Industrial Instrumentation and Controls Technology Alliance and presented to the TAMU ISA Symposium, January, 2004
Asset/Resource System Influencers

• Maintenance Cost Reduction Drives End Users
• 40% of Mfg. Cost is Maintenance
• 50% of Maintenance Is Corrective
  – 10 times More Costly Than Preventative Maintenance
• Preventative Maintenance is Done 25% of Time
  – 5 Times More costly Than Predictive Maintenance
• 60% of Preventative Maintenance is Unnecessary

• What has been largely missing up to now is timely, relevant, and accurate information

From ARC Independent Research
Maintenance Savings

• Estimated 10-20% saving in maintenance
  – Assignment of maintenance tasks to operators / right people to do the task
  – Better field diagnostics
  – Better preventative maintenance data
  – Less false alarms
  – Faster troubleshooting
  – Real-time information systems become the test equipment
  – “Re-Ranging” is virtually eliminated!
Maintenance Data Impacts Operations

Goal = Improved operational efficiency

- Predictive/Pro-Active maintenance
  - schedule maintenance based on real-time device and process diagnostics
  - increase plant availability
Asset Management: OPEX Savings

- Use of open standard technology
- Increased information for better operation accuracy of measurement & control
- Enhancement in control function and performance
- Improved throughput
- Online diagnosis enabling best preventative measure
Asset Management: OPEX Savings

• Operation and Production Cost:

• Additional production time:
  – Improved maintenance
    • Fewer process downtime
    • High availability
  – Improved throughput by:
    • High quality and productivity
    • Better alert capabilities and operation
    • Improved accuracy of measurement and control
Asset Management: OPEX Savings

• Maintenance cost:
  – Proactive maintenance
  – Reduction of number of trips to plant
  – Avoid failure than to solve failure
  – Downtime to be kept minimal
  – Fast and easy identification and elimination of possible expected failures.
Multi-Channel Instruments

- Benefits/ Savings
- Two wires for both data and power
- Connects instruments to the control system via serial bus
- Control, regulation and monitoring via twisted pair cable
Foundation Fieldbus

• Multivariable instruments: Less Instruments needed
Multivariable Measurements

Conventional:
- 1 measurement / device
- Penetration / signal

Fieldbus:
- Multiple measurement / device

Fieldbus:
- Multiple measurements
  - Pressure
  - Temperature
  - Mass Flow
  - Volumetric Flow

Conventional:
- 1 measurement
Multivariable Instrument: Valve and Positioner

- Actual position feedback transmission on the same two wires
  - Further reduced wiring
  - No AI card
  - More than just value: status
- Software limit switches
  - Fewer DI cards
  - Less wiring
- Bumpless transfer on local hand operation
  - Smoother operation
- Bumpless firmware download
  - Upgrade while process is running
Advantage More Information

Intelligent field devices

- The more intelligent the more variables
each variable a 2-wire connection (fast) or
HART (slow, additional Hardware)

Fieldbus
Upto 40 Variables

Fieldbus
8 Variables

Fieldbus
3 Variables

Conventional:
3 Variables

Conventional: 1 Variable
Advantage Maintenance

Maintenance:

- The field device sends an alarm and description if it has a failure (currently only current rise)
- The field device sends a warning “Maintenance soon required” (conventional not possible)

→ Predictive maintenance possible
Discrete I/O on Fieldbus

• Discrete I/O:
  – On/Off valves
  – Position feedback
  – Level switch
  – Electric actuators

• Most of these devices come with FF build in
  – Position feedback part of the Output block
  – On/Off valves with FF connection to get the diagnostic
Discrete I/O on Fieldbus

- Some signals are desired but the devices do not have an FF interface
  - E.g. Level alarms, solenoids etc
- Special FF to Discrete solutions are available
  - Valve couplers
  - FF remote IO
  - FF HSE remote I/O
Discrete Signals

- Digital IO couplers
  - Connects up to 4 solenoids plus the position feedback
  - Can also be used just for DI inputs
  - Works with FF- Function blocks like DI, DO, MDI, MDO etc
Discrete I/O on Fieldbus

• FF Remote IO
  – Connects all signals, legacy instruments etc
  – DI And DO also relays etc for highest power.
Foundation Fieldbus Remote I/O

Servicebus

USB / RS455

Workstation

Host

Fieldbus

FF Modular I/O
in Zone 1

FF Modular I/O
in Zone 2, Div. 2

HART
FIELD COMMUNICATION PROTOCOL

FOUNDATION

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FF Modular I/O Architektur
FF Remote I/O Possibilities

- Field devices
- Hazardous area
- FF Remote I/O Gateway

- Analog input 0/4...20mA
- Analog output
- Analog output 0/4...20mA
- Digital input
- Digital output - solenoids
- Digital output - contacts

- AI
- AO
- DI
- DO
- TI
- ComUnit
Advantages

- modular Foundation Fieldbus Remote I/O for NON FF signals
- reduces the number of busses and hosts
- Remote I/O modules can easily be replaced (hot swap)
- simplified commissioning
- reduced marshalling costs
- open for future HSE solutions
- drive power for standard solenoids does not load the bus
- bus independent SIL 2 shut-down for outputs
HSE-Remote I/O

- Develop use cases and requirements for High Speed Ethernet Remote I/O (HSE-RIO) including discrete I/O and gateways to other lower level networks (e.g. HART, Profibus, Modbus, ASI, DeviceNet, etc.) that are interoperable using function blocks and EDDL. Use cases and requirements for related applications may also be developed by the team.
- Develop an project plan for HSE-RIO
- Obtain Technical Steering Committee (TSC) approval and execute the project plan
- Demonstrate interoperability of HSE-RIO devices at end user sites.
HSE Results

• Integrate PID and "non-PID" functions
  – Homogenous system
• Integrate other buses
  – Homogenous system
Conclusion

1. Reduced number of wires and marshaling panels.
2. Reduced number of intrinsic safety barriers.
3. Reduced number of Input/Output Converters.
4. Reduced number of Power Supplies and Cabinets.
5. Reduced size of equipment Rooms.
8. Increased accuracy of measurements.
9. Easier evolution due to standardized function blocks.
10. Increased sophistication and flexibility of instrumentation.
11. Increased uptime due to less equipment, better self diagnostics and remote diagnostics.
12. CAPEX and OPEX savings proven