Myths and Actual Practice with Industrial Data Communications and Hazardous Areas

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Myths and Best Practice

Practical examination of data communications systems in hazardous areas for Ethernet, Foundation Fieldbus, Profibus or RS-485.

Practical guidelines for best practice in designing your next industrial data communications system in a hazardous area.
Topics

1. Survey of Wireline/Wireless global market
2. Hazardous areas and data comms practical issues and guidelines
   - RS-232 & RS-485
   - Foundation Fieldbus
   - Profibus
   - Ethernet
   - Fibre
   - Wireless
3. Case Study
4. Conclusion
1. Survey of Global Market

- Wireline devices and Wireless in Intrinsic Safety in 2006
- Intrinsically safe devices thought to be mainly European but not according to this survey
- Explosion-proofing and encapsulation – popular in America for hazardous areas protection does not apply to mobile or wireless devices (see survey)
Wireline and Wireless Products for Intrinsic Safety Applications

The Industrial Wireless Book - VDC Survey 2006
Wireline in Intrinsic Safety

- Profibus – majority
- Field instruments – mostly bus oriented
- HART still the leading bus/network
- Highest growth (9%pa) IS safe distributed/remote I/O

Wireless in Intrinsic Safety

- IEEE 802.11 shipment share 68% (eg wireless Ethernet)
- Highest growth (35%pa) intrinsically safe wireless transmitters
- Proprietary networks dominant for safe monitoring and control components
2. Hazardous Areas & Data Comms
## Digital Technologies- Summary

<table>
<thead>
<tr>
<th>Bus</th>
<th>Ease</th>
<th>Field Intelligence</th>
<th>Acceptance</th>
<th>Knowledge Base</th>
<th>Price</th>
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(Slide compliments of Emerson)
Generic Fieldbus Advantages: Let’s Take Off!

- Wiring savings
- Hardware savings - fewer devices (instruments barriers and I/O)
- Documentation savings - Simpler layout and drawings
- Reduced Engineering costs
- footprint savings
- Multi-variable field devices
- Interoperability and freedom of choice
- Reduced Commissioning and startup costs
- Reduced downtime
- Integrity improved
- DCS future capacity savings
“Footprint” Space Savings

Before - 256 I/O

Fieldbus - 4000 I/O

(Slide Compliments of Emerson & Jim Russell)
Foundation Fieldbus

PHYSICAL LAYER WIRE MEDIUM

H1 & HSE APPLICATIONS

**HSE... High Speed Ethernet**
- 100 MBps

**H1... Lower Speed Fieldbus**
- 31.25 Kbps
- Replaces 4 to 20 mA
- 2 - 32 Devices
- Power & Communications
- Intrinsically Safe
- Twisted-pair
- 1900 m length
Playing Lego

FIELDBUS CASCADE CONTROL
Profibus

Factory level
Bus Cycle Time < 1000 ms

Cell level
Bus Cycle Time < 100 ms

Field level
Bus Cycle Time < 10 ms

Ethernet/TCP/IP
TCP/IP/Ethernet

Area Controller

CNC
PC/VME
VME/PC
PLC
DCS

PROFIBUS-FMS
PROFIBUS-DP
PROFIBUS-PA
## Bus and Intrinsic Safety

<table>
<thead>
<tr>
<th>Name of Bus</th>
<th>Intrinsic Safety</th>
<th>Bus powered</th>
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<tbody>
<tr>
<td>FF H1</td>
<td>√</td>
<td>√</td>
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<tr>
<td>FF HSE &amp; Ethernet</td>
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<td>Profibus DP</td>
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<tr>
<td>Profibus PA</td>
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<td>CAN</td>
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<tr>
<td>HART</td>
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</tbody>
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Engineering & Installation in Hazardous Areas

Methods include:
Explosion proof, purging, oil immersion, encapsulation, intrinsically safe and non incendive.

To eliminate one of three parts of the combustion triangle: fuel/oxygen and heat
Different Implementation Methods

- Explosion proof
- Intrinsically safe (ENTITY)
- Intrinsically safe (FISCO)
- Nonincendive (FNICO)
- Hybrid (HPT)
- And others
Key Issues to Weigh Up

• Area classification
• Size and Scalability
• Technology/product selection
• Safety consideration
• Maintenance and downtime
• Engineering considerations
• Control System considerations
• Acceptance and ownership
• Calibration
Ethernet vs Device Level Bus

- Device-level – trunk-and-drop system
- Ethernet – star topology

*Ethernet moves to plant floor*
Functionality Required of Bus and Ethernet

• Standardised profiles for different applications
• Bus powered communications to process instruments in hazardous areas
• Safety communications
• Motion control
• Extensive diagnostics
• Simple cost effective connection to I/O
The IEEE802.3af Standard

- IEEE ratifying 802.3af to supply power to Ethernet based devices.
- Primarily driven by need to power Ethernet telephones (Industrial needs not considered at this time).
- Source device (a hub or switch) will supply a minimum of 300 mA at 48 Volts to the field device. (In same range as FF and DeviceNet).
Fibre

Harsher environmental conditions such as extreme temperature ranges, lightning strikes, electromagnetic interference, ground loops and hazardous locations handled by fibre.
Fibre versus Twisted Pair

Fibre a good choice for hazardous areas but:

Cons

• Costs more
• Bend radiiuses
• Twisted pair can be impervious to certain types of noise

Pros

• Impervious to noise and lightning
• No ground loops
• Security of data better
• Longer distances (2kms)

For both consider cable jacket for weld splatter, moisture and UV.
Wireless
Intrinsic Safety with Wireless

- Explosion proofing and encapsulation, the North American approach is not easy to apply to mobile devices (e.g., steel-encased cell phone!)
- Intrinsic Safety used where incapable of releasing sufficient electrical or thermal energy to cause ignition of a hazardous atmosphere
- Wireless intrinsically safe transmitters can be particularly cost-effective for remote monitoring
<table>
<thead>
<tr>
<th>IEEE Standard Band</th>
<th>Speed</th>
<th>Frequency</th>
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<tbody>
<tr>
<td>802.11</td>
<td>1 and 2 Mbps</td>
<td>2.4GHz</td>
</tr>
<tr>
<td>802.11a</td>
<td>Up to 54 Mbps</td>
<td>5 GHz</td>
</tr>
<tr>
<td>802.11b</td>
<td>5.5-11 Mbps</td>
<td>2.4 GHz</td>
</tr>
<tr>
<td>802.11g</td>
<td>6 to 54 Mbps</td>
<td>2.4GHz</td>
</tr>
</tbody>
</table>
3. Case Study

You have ten minutes in your groups to assess the best approach to a case study of a plant (details supplied) with various Hazardous Areas where you need to apply Ethernet, Fieldbus, Fibre and Wireless effectively.
4. Conclusion

• Foundation Fieldbus H1 and Profibus PA appropriate for instrument level hazardous areas
• Ethernet with fibre appropriate for high level comms in hazardous areas; growing rapidly in importance
• Wireless growing fast but some unpredictability – but the horse to back over the next few years
References

• Implementing Foundation Fieldbus H1 Networks in Hazardous Areas by MooreHawke from www.miinet.com/moorehawke

• Network Infrastructure for EtherNet/IP: Introduction and Considerations by ODVA from www.odva.org

• Intrinsically Safe Foundation Fieldbus H1 Networks by Bruce Bradley November 2006 from www.Controlglobal.com

• Industrial Ethernet solutions under the spotlight by Lars Larsson Siemens AB from www.ferret.com.au/articles

• Economic Fieldbus Solutions for Hazardous Area installations by Jonas Berge in Instrumentation and Control Society, Singapore


• Iceweb resources by Jim Russell and Ian Verhappen from www.iceweb.com.au
THANK YOU

Any questions?
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