Control Over Wireless
Current Applications and Future Opportunities

Automation Week 2012
Presenters

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  – ISA100.11a: Editor, Data Link Layer (mesh networking)
Presentation Overview

- Simple Use Cases
- Wireless Requirements for Control
- Network Design for Control
Control Over Wireless Use Cases
# Wireless Control

## General Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Description</th>
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<tr>
<td>1. Improved reliability</td>
<td>Troublesome wired sensors replaced by wireless counterparts. Wireless may serve as a backup for wired technology.</td>
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<td>2. Improved control</td>
<td>Add wireless devices to existing processes for more optimal control.</td>
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<td>3. Cost savings</td>
<td>Up to 90% of installed cost of conventional measurement technology can be for cable conduit and related construction. New and existing applications are now economically feasible.</td>
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A petroleum refiner uses wireless for fuel/air controller for furnace units

- **Background:** Furnace for cracking units requires uniformity and reliability of temperature control. The wiring from the temperature transmitters is not reliable due to wear and tear caused by the application, resulting in frequent replacement of the wiring, furnace inefficiency, and production scrap.

- **Solution:** Implement ISA100 compliant network & field transmitters to eliminate the wiring. PV input from wireless temperature transmitters feeds into the fuel/air controller which controls the temperature of the furnace.

- **Benefits:** a) Maintain high accuracy temperature control, with higher reliability; b) Improved fuel optimization of the furnace.
A chemical manufacturer deploys wireless for better bitumen level control

- **Background:** Holding tanks need to maintain appropriate level of bitumen at any given point of time for processing usage. Not having insight to the fill levels leads to inefficient inventory management.

- **Solution:** Implement ISA100 compliant network & field transmitters enabling continuous level monitoring and control of the bitumen level.

- **Benefits:** Avoid over fueling of the holding tank & efficient bitumen inventory management.
Wireless Control Example
Full Control Over the Air
Wireless Control Example
Full Control Over the Air
Hybrid Wireless Control
Combine Wired and Wireless
Hybrid Wireless Control
Wireless Secondary Input
## Wireless Control
### General Benefits

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Control Over Wireless
Requirements for Control
ISA100.11a
Baseline Control Scenario

1 second reporting rate
## ISA100 Usage Classes

<table>
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<tr>
<th>Safety</th>
<th>0</th>
<th>Emergency action</th>
<th>Always critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>1</td>
<td>Closed loop Regulatory control</td>
<td>Often critical</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Closed loop Supervisory control</td>
<td>Usually non-critical</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Open loop control</td>
<td>Human in the loop</td>
</tr>
<tr>
<td>Monitoring</td>
<td>4</td>
<td>Alerting</td>
<td>Short-term consequences</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Logging Downloading/uploading</td>
<td>No immediate consequences</td>
</tr>
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# Usage Classes, Examples from the Standard

<table>
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<tr>
<th>Control</th>
<th>1</th>
<th>Closed loop Regulatory control</th>
<th>Often critical</th>
<th>Control of primary actuators High frequency cascades</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>2</td>
<td>Closed loop Supervisory control</td>
<td>Usually non-critical</td>
<td>Low frequency cascade loops Multivariable controls Optimizers</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Open loop control</td>
<td>Human in the loop</td>
<td>Manual flare Remote opening of security gate Manual pump/valve adjustment</td>
</tr>
</tbody>
</table>

Source: ISA100.11a-2011, C.2.2
Reference Wireless Control Performance

- ±1 second latency
- Response time < human attention span
- Scan period ±5% lag in process response
# Five System Requirements For Wireless Control

<p>| | |</p>
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<td>1. Rate and Latency</td>
<td>Publication rates 1-2 seconds. Controlled latency, ~50% publication rate. 4 Hz publication in constrained configurations.</td>
</tr>
<tr>
<td>2. Flexible System Architecture</td>
<td>Engineered and scalable IP backbone.</td>
</tr>
<tr>
<td>3. Mesh Networking</td>
<td>Interoperable peer-to-peer connections. Function blocks at the device level. Battery life is deterministic.</td>
</tr>
<tr>
<td>4. Reliability</td>
<td>Wireless transmission is deterministic. Wireless transmission is received. Wireless transmission is accurate.</td>
</tr>
<tr>
<td>5. Security</td>
<td>Wireless transmission has not been hacked.</td>
</tr>
</tbody>
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Control Over Wireless
ISA100.11a Network Design for Control
Reference Wireless Control Performance

±1 second latency

Response time < human attention span

Scan period ±5% lag in process response
ISA100.11a
Network Architecture

Refer to:
ISA100.11a-2011  5.3
ISA100.11a
Network Architecture

Optimized for Control

Refer to: ISA100.11a-2009 5.3
Wireless Control
Latency Expectations

±1 second  ±0.1 second
Wireless Control
Latency Expectations

±1 second

±0.1 second

Device Mesh for Monitoring
Wireless Control Through the Mesh

Device Mesh Network

City Street

On ramp

Highway

±10 second

±0.1 second
Wireless Control
In the Mesh

±1 second
Three Basic ISA100.11a Networking Options For Control

±1 second

±10 second

ISA100 Wireless Compliance Institute
Thank you!