Wireless Technology in Life Science Manufacturing Facilities

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Not All Wireless is the Same - Topology is Key to Reliability

Home / Office Wireless
- Star topology (Point to Point)
  - Cordless phone
  - Mobile phone
  - R/C toy car
  - Wi-Fi

Industrial Wireless
- Mesh topology
- Security considerations
  - WirelessHART, ISA100.11a
  - Industrial Wi-Fi

Before mesh topology nobody put wireless IN the plant
Two Categories of Wireless Applications

FACT: Point-to-Point solutions do not work in the process environment with long term reliability and lowest cost of ownership.

Wireless Applications Solve Availability, Productivity, HSE, & Energy Challenges

<table>
<thead>
<tr>
<th>Process / Asset Reliability</th>
<th>Personnel Productivity</th>
<th>Efficiency / Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Pump, AHU, Compressor, Centrifuge monitoring</td>
<td>• Manual gauge replacement</td>
<td>• Tank level monitoring</td>
</tr>
<tr>
<td>• Valve monitoring</td>
<td>• Reduced operator rounds</td>
<td>• RFID equipment tracking</td>
</tr>
<tr>
<td>• Filter monitoring</td>
<td>• Mobile workers</td>
<td>• Portable skid process monitoring</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Health/Safety/Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Emissions / discharge monitoring</td>
</tr>
<tr>
<td>• Secondary level measurements</td>
</tr>
<tr>
<td>• Video</td>
</tr>
<tr>
<td>• Personnel Mustering</td>
</tr>
<tr>
<td>• Energy consumption metering: water, air (compressed), gas/fuel, electricity, and steam</td>
</tr>
</tbody>
</table>
**Market Shares of the Leading Wireless Network Protocols in the Process Industries**

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Percent of 2014 Revenues</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proprietary</td>
<td>36.7%</td>
</tr>
<tr>
<td>WirelessHART</td>
<td>31.7%</td>
</tr>
<tr>
<td>ISA 100.11a</td>
<td>7.4%</td>
</tr>
<tr>
<td>Other</td>
<td>24.2%</td>
</tr>
</tbody>
</table>

Percent of 2014 Revenues = $719.1 Million


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**Total Shipments of Wireless Devices in Process Manufacturing**

<table>
<thead>
<tr>
<th>Year</th>
<th>Shipments in Millions of US Dollars</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>719.1</td>
</tr>
<tr>
<td>2015</td>
<td>809.3</td>
</tr>
<tr>
<td>2016</td>
<td>913.3</td>
</tr>
<tr>
<td>2017</td>
<td>1,033.6</td>
</tr>
<tr>
<td>2018</td>
<td>1,173.3</td>
</tr>
<tr>
<td>2019</td>
<td>1,335.9</td>
</tr>
</tbody>
</table>

Figures in Millions of US Dollars

### Total Shipments of Wireless Devices in Process Manufacturing by Device Type

#### History

<table>
<thead>
<tr>
<th>Device Type</th>
<th>2014</th>
<th>2014 %</th>
<th>2019</th>
<th>2019 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure/Flow Transmitter</td>
<td>103.9</td>
<td>17.1%</td>
<td>224.3</td>
<td>19.9%</td>
</tr>
<tr>
<td>Level Transmitter/Switch</td>
<td>47.7</td>
<td>7.9%</td>
<td>102.6</td>
<td>9.1%</td>
</tr>
<tr>
<td>Temperature Transmitter</td>
<td>45.5</td>
<td>7.5%</td>
<td>96.7</td>
<td>8.6%</td>
</tr>
<tr>
<td>pH Transmitter</td>
<td>13.3</td>
<td>2.2%</td>
<td>25.4</td>
<td>2.3%</td>
</tr>
<tr>
<td>Valves/Actuators</td>
<td>10.2</td>
<td>1.7%</td>
<td>16.9</td>
<td>1.5%</td>
</tr>
<tr>
<td>Vibration Transmitters</td>
<td>15.1</td>
<td>2.5%</td>
<td>31.3</td>
<td>2.8%</td>
</tr>
<tr>
<td>Standalone Radios</td>
<td>60.9</td>
<td>10.0%</td>
<td>86.2</td>
<td>7.7%</td>
</tr>
<tr>
<td>Remote I/O</td>
<td>59.6</td>
<td>9.8%</td>
<td>94.6</td>
<td>8.4%</td>
</tr>
<tr>
<td>Gateways</td>
<td>75.2</td>
<td>12.4%</td>
<td>149.1</td>
<td>13.3%</td>
</tr>
<tr>
<td>Bridges/Multiplexers</td>
<td>6.7</td>
<td>1.1%</td>
<td>11.7</td>
<td>1.0%</td>
</tr>
<tr>
<td>Wireless Access Points</td>
<td>100.0</td>
<td>16.5%</td>
<td>165.5</td>
<td>14.7%</td>
</tr>
<tr>
<td>Other Devices</td>
<td>69.0</td>
<td>11.4%</td>
<td>120.3</td>
<td>10.7%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>607.3</td>
<td>100.0%</td>
<td>1,124.6</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

**Figures in Millions of US Dollars**


### Wireless Plant Applications: Backhaul, RFID Tracking, Mobile Worker, Security Cameras

- **Business Drivers**
  - Operator Productivity
    - Remote control client
    - Operator rounds
  - Maintenance Productivity
    - Remote asset management client
    - Maintenance rounds/procedures
  - Emergency Response
    - Automated Head Counting
    - Real time information in the field

![Image of Wireless Plant Applications Diagram]
**Wireless Backhaul System Architecture**

- Control System
- Asset Management
- Control and Asset Applications integrated with Wireless Sensors
- Wireless Network Management
- Wireless Plant Network Infrastructure
- Wireless Field Networks

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**Mobile Operators - Accessing Control Data in the Field**

- Utilize operator control displays on mobile devices
- Access operational data and reports in the manufacturing suite
- View historical trends while anywhere in the plant
Mobile Worker System Architecture

• Problem to be solved
  – Mobility of operator workstations within suite

• Typical scope
  – Wireless Site Survey
  – 2 Wireless LAN Controllers (redundant)
  – Access Points and External Antennas
  – System Implementation

Mobile Operator Rounds – Real-time Data Collection and Work Requests

• Real-time mobile applications replace clipboard for data acquisition
• Electronic workflow to enable best practices
• Issue electronic work orders in the field
**Mobile Equipment Utilization**

- Real time tracking of mobile equipment (RFID tags)
  - On demand searches
  - Historical location and trail
  - View multiple assets distributed through entire site
- Automated alerts
  - Arrival of equipment to production area
  - Equipment leaving the facility to prevent theft and loss
- Scheduled and on-demand reports
  - Inventory and utilization reports
  - Location, next service date and status of required equipment
  - Departure and arrival reports

**Wireless Field Network Applications Help Solve Key Challenges with New Measurements**

Pervasive wireless and analytics turn exponential data into high value, accessible and actionable information.

- **Safety**
  - Comprehensive Safety Monitoring
- **Energy**
  - Complete Energy Management
- **Availability**
  - Total Asset Protection

**Control Loop**

**High Value Process Information**
**Wireless Field Network Applications Help Solve Key Challenges with New Measurements**

Next 10 Years

![Diagram showing the combination of Analog, Digital, and Wireless with Wireless & Analytics]

**Macro Trends in Process Control**

- Data per Measurement Point
- Number of Measurements
- Instrument Department Size

![Graph showing trends in process control]
**Instrumentation and Control Evolution**

- **Pressure signal**
- **4-20 mA Primary Variable**
- **Multiple Variables + Diagnostic Information**
- **Exponential Data Points**

**Pneumatic** 1950

**Analog** 1969

**Digital** 1988

**Wireless** 2007

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**Industrial Wireless: Unique Self-Organizing Full Mesh Topology**

- Redundant data pathways eliminate single points of failure
- Routing at device-level
  - Unique full-mesh, 7 hop path depth
  - No backbone router infrastructure
- Automatic reconfiguration
  - No manual routing configuration

The difference between a home/office network and an industrial network
**Pump Monitoring – Ensure Infrastructure Longevity and Availability**

- WFI Pumps
- RO Water Pumps
- CIP Pumps

- High vibration levels on pumps and motors indicate developing problems that can be fixed early to ensure equipment longevity and availability
- Suction, discharge pressure indicate cavitation, support additional predictive diagnostics

**Centrifuge Monitoring**

- Implement condition monitoring to maximize centrifuge availability
- Change from time-based to condition-based maintenance
- Imbalance and bearing degradation identified as failure modes – use vibration to detect
**Critical Air Handler Monitoring**

- AHU failures result in loss of product and significant costs associated with cleaning the rooms to FDA standards

- Predictive diagnostics via vibration, differential pressure

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**Automated Steam Trap Monitoring - Reduce Energy Costs**

- Wireless monitoring with acoustic transmitter provides real-time visibility to critical and/or high volume steam traps
- Eliminates time-consuming manual inspections

(Modbus, OPC, Ethernet/IP)
Portable Skids

• Problem: Measurements not in Original Scope
  – Temperature and level transmitters not part of original scope
• Solution: Wireless
  – Mobility of vessels within suite with high accuracy process measurements

Internet of Things (IoT)

• Development of the Internet in which everyday objects have network connectivity, allowing them to send and receive data
Internet of Things (IoT)

- Here is a little quiz – Who has the:
  - Pervasive Sensing
  - Industrial Internet
  - Industry 4.0
  - Internet of Your Things
  - Smarter Planet
  - Internet of Everything

Industrial Internet of Things (IIoT)

- It’s here today
- It’s about utilizing the connectivity of industrial sensing technology in new ways
- It’s letting automation in sensors do the work for you
- It’s utilizing process expertise to effectively analyze data and recommend actions
The More You Sense, the More You Solve

The strategic alignment of applications everywhere using the power of advanced sensing to gather data and transform it into actionable information.

Now is the Time

Previously:
- Cost was high
- Info benefit was low
- Data was not measurable
- Data was raw
- Technology complex to install

Now:
- Innovative sensors
- Wireless communications
- Non-intrusive installation
- Mobile and location technology
- Advanced analytic capabilities
- Embedded expertise
- Power technology
IIoT Opportunities in Life Science Manufacturing Facilities

- Gas Leak Monitoring
- Steam Trap Monitoring
- Gas Detection
- Remote Monitoring
- Mobile Maintenance
- Compressor Monitoring
- Heat Exchanger Monitoring
- Cooling Tower Monitoring
- Access Awareness
- Pump Health Monitoring
- Air Handler Monitoring
- Tank Overfill/Spill Detection
- Centrifuge Monitoring
- Mobile Operations