Presenter

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Introduction to ISA100 Wireless

• Applications
• Network Architecture
• Overview of IEC 62734 standard
Applications
# General Benefits of Wireless Instrumentation

| Cost Savings | • Up to 90% of installed cost of conventional measurement technology can be for cable conduit and related construction.  
  • Typically: 1/5 the time, 1/2 the cost.  
  • New and scaled applications are now economically feasible. |
|--------------|----------------------------------------------------------------------------------------------------------|
| Improved Reliability | • Wired sensors may be prone to failure in difficult environments.  
  • Wireless can add redundancy to a wired solution. |
| Improved Visibility | • Condition monitoring (equipment)  
  • Process monitoring |
| Improved Control | • Add wireless to existing processes for more optimal control. |
| Improved Safety | • Safety related alarms |
Top Use Classes for Wireless Instrumentation

- Automated Safety Instrumented Functions
- Control
  - Open Loop
  - Closed Loop
- Alerts & Alarms
  - Process
  - Safety
- Monitoring & Compliance
  - Condition
  - Process

Timeframe:
- Hours
- Minutes
- Seconds

Timeliness

Courtesy AIW LLC
ISA100 Wireless
Major Application Types

• Asset Health Monitoring & Analytics
• Process Monitoring & Control
• Safety Alarms

• One network, all at the same time
Network Architecture
ISA100 Wireless Network Architecture

Redundant Gateway, System Manager, Security Manager
Redundant Access Point (Backbone Router)
Wide variety of Field Devices

Enterprise Scalability
IPv6 to the Devices

Enterprise Networks
Big Data Aggregation from Multiple Sites

Plant-wide Network
High Reliability and Availability
Duocast for redundancy
Scales to 1000s of devices

Stand Alone Network/Point Solution
Simple and Easy
Able to Grow
Legacy Network Architectures

Scale by Duplication
ISA100 Wireless IoT Network Architecture

Plant-Wide Network
Scale Through IP
ISA100 Wireless Network Architecture

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Wide variety of Field Devices
Internet of Things Enables Next Generation Automation Systems

Systems Today

Systems Tomorrow

XOM diagrams from Lockheed Martin PIRA#OWG20161002
# Main Features of IEC 62734

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE 802.15.4 Radio</td>
<td>Available from multiple high quality sources.</td>
</tr>
<tr>
<td>ETSI Compliant</td>
<td>Compliant to new ETSI 300.328 v1.8.1</td>
</tr>
<tr>
<td></td>
<td>Various modes of compliance, described in the standard</td>
</tr>
<tr>
<td>Robust</td>
<td>Advanced coexistence and resiliency mechanisms at all levels</td>
</tr>
<tr>
<td>Secure</td>
<td>Two layer AES 128 cryptography</td>
</tr>
<tr>
<td>IP based</td>
<td>Future Proof</td>
</tr>
<tr>
<td>Object based</td>
<td>Compact and Extensible</td>
</tr>
<tr>
<td></td>
<td>Supports Tunneling</td>
</tr>
</tbody>
</table>
End-user requirements for Industrial wireless sensing

End-user architectural requirements

1. Security
2. Reliable communication
3. Good power management
4. Open
5. Multi-speed monitoring
6. Multi-functional
7. Scalable
8. Global usability
9. Quality of service
10. Multi-protocol
11. Control ready

ISA100 solutions must meet all requirements simultaneously

Derived from USA Department of Energy and ARC User survey
## Technical requirements for Industrial wireless sensing

| 1. Rate and Latency                                      | • Publication rates 1-2 seconds  
|                                                        | • Capable of 100 ms latency  
|                                                        | • Controlled latency, ~50% publication rate  
|                                                        | • 4 Hz publication in constrained configurations |
| 2. Mesh Networking                                      | • IP Backbone: Engineered and scalable  
|                                                        | • Mesh and non-mesh topology; access points and field devices  
|                                                        | • Peer-to-peer communication  
|                                                        | • Objects = Function blocks at device level  
|                                                        | • Long and deterministic battery life |
| 3. Reliability                                           | • Wireless transmission is deterministic  
|                                                        | • Wireless transmission is received  
|                                                        | • Wireless transmission is accurate  
|                                                        | • Redundant communication paths to process control network |
| 4. Security                                              | • Wireless transmission is secure; prevention & detection |
Two Levels of Security

**TL Security**
- Secure sessions between IP ports
- Protects the data "Layer 5"

**DL Security**
- Hop-by-hop
- Protects the mesh
- Layer "2"

**Data Flow**

ISA100.11a Mesh

UDP/IP

Security

Application
Security Sidebar

• ISA100 Wireless cannot guarantee that a radio message is received, because radios are not 100% reliable. Many levels of redundancy maximize availability.

• The standard does ensure that a received message is valid and confidential. That is the primary purpose of security in the standard.

• Security is always enabled in practice.
## AES-128 Message Processing Authentication and Encryption

<table>
<thead>
<tr>
<th>Header</th>
<th>Payload</th>
</tr>
</thead>
</table>

### Header

**16-byte Key + 13-byte Nonce**

- **Shared secret, sender and receiver**
- **Non-secret nonce must never repeat in life of key. ISA100 Wireless uses time as the nonce.**

<table>
<thead>
<tr>
<th>Header</th>
<th>Payload (encrypted)</th>
<th>MIC</th>
</tr>
</thead>
</table>

- **NIST magic operating in 16-byte blocks. See Wikipedia if curious.**
- **AES-128 calculates Message Integrity Code up to 16 bytes. Normally to 4 byte code is used (MIC-32).**
Robust Communications

Spectrum Analysis
- Identifying Interferers
- Monitoring Saturation

System Management
- Device Configuration
- Element Provisioning
- Performance Monitoring

Policy Enforcement
- Channel Allocation
- Rules Creation
- Blacklisting

2.4 GHz Band Congestion

 ISA100.11a 2.4 GHz Solution

2.4 GHz

Blacklisted Channels
Frequency Hopping

ISA100 – Ensured Coexistence with Many Wireless Networks
## Conclusion

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