

Basics

ISA100 Wireless – User Driven Technology

- The ISA100.11a standard was architected based on end user's requirements and feedback
- ISA100.11a based wireless systems incorporate the required underlying technology, architecture and features that address end user desired capabilities and features







Wireless Adoption Considerations

- OnWorld conducted polls and published results based on interviews with 105 plant managers, process integrators and system engineers
- Results are clearly indicative of end user's concerns
- Data reliability ranked as the primary concern for adoption of wireless sensor networks in industrial applications



Source: "Industrial Wireless Sensor Networks," ON World March 2010





End User's Wireless Adoption Considerations

- For end users to deploy wireless sensor networks in industrial applications the wireless network must be characterized by
 - Highly reliable data communications
 - Ease of deployment and utilization
 - Extensible in the future
 - Vendor interoperability standards based
 - Sound security
 - Prolonged battery life
 - IP addressability
 - Solution needs to operate in a single plant network





ISA100.11a – More Than Monitoring

Safety	0	Emergency action	Always critical	Safety interlock Emergency shutdown Automatic fire control
Control	1	Closed loop Regulatory control	Often critical	Control of primary actuators High frequency cascades
	2	Closed loop Supervisory control	Usually non-critical	Low frequency cascade loops Multivariable controls Optimizers
	3	Open loop control	Human in the loop	Manual flare Remote opening of security gate Manual pump/valve adjustment
Monitoring	4	Alerting	Short-term consequences	Event-based maintenance Battery low indicator Asset tracking
	5	Logging Downloading /uploading	No immediate consequences	History collection Preventative maintenance rounds Sequence of events (SOE) reporting



Classes 1 through 5 and optionally class 0.

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Periodic monitoring and process control where latencies on the order of 100ms can be tolerated with optional behavior for shorter latency



Technical Primer – Logical Roles

Field Network		
I/O Device	Sources or consumes data. Does not route.	
Router	Routes messages for other devices operating in the wireless subnet.	

		Infrastructure	
		Backbone Router	Routes data over the backbone infrastructure.
at at at at		System Manager	Provides policy controlled management for all network devices.
		Security Manager	Enables, controls and supervises the secure operation of all devices.
NÈ(COM		Gateway	Provides an application interface between the wireless and the plant network.

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Note: Devices typically incorporate multiple logical roles.

IPv6 Connectivity

- ISA100 Wireless mandates that all entities support native IPv6 addressability and connectivity
- Internet backbones are transitioning to native IPv6 connectivity
- Backbone can utilize any communication technology/protocol as long as it supports IPv6 connectivity
- ISA100 Wireless Infrastructure devices are IPv6 ready
- Support for standards based IPv4 encapsulation of IPv6 payloads





Technical Primer – Network Topologies

ISA100 standard inherently supports various different network topologies



Infrastructure devices can support a combination of logical roles





"All-in-One" Single Subnet Topology

- Simple network deployment
- Low cost installation and maintenance

Limited scalability

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- Deeper mesh networks result in
 - Increased power consumption results in shorter field instrument battery life
 - Increased communication latency
 - Decreased network throughput
- Limited geographic coverage





Distributed Topology

Increased scalability

- Shallow mesh networks result in
 - Optimized power consumption results in increased field instrument battery life
 - Lower communication latency
 - Increased network throughput
- Extended geographic coverage





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- Network deployment more complex
- Increased cost of installation and maintenance



ISA100 Wireless Network Topology

ISA100 Wireless networks – versatile topologies and scaling due to IPv6 based backbone infrastructure



ISA100 Wireless Architecture - Application

- Architected to concurrently accommodate multiple protocols at the device and host level
- Applications run in an interoperable manner over a common network infrastructure





Current Status Quo

- Recent trend deployments require
 - Increased scalability
 - Support for higher network throughput
- Due to the emergence of novel ISA100
 Wireless compliant instruments such as
 - Stream trap monitoring
 - Safety gas detection
 - Corrosion monitoring
 - Condition monitoring

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Deployment Considerations

- "All-in-One" deployments
 - Gateway is installed outdoors
 - Typically close to the control room
 - Determining optimal location is vital
- Distributed deployments
 - Gateway is installed in the control room
 - BBRs deployed throughout the facility
 - Wi-Fi Mesh backbone simplifies deployments









Connecting to the Plant Network







WISA ISA100 Wireless Module





- Runs an ISA100 Wireless compliant communication stack
- Swift integration within products with minimal learning curve for complex IoT technologies
- Offered also as dual-boot wireless ISA100/WirelessHART module
- Tested for interoperability with Honeywell's WDM, Yokogawa's YFGW710 and Centero's NIO200x Gateways
- Designed for integration in intrinsically safe instruments
- Onboard RF Front-end Module with adjustable output power of up to +14 dBm and selectable RX gain modes
- Market leading sensitivity of -108 dBm and link budget of 122 dB
- Suitable for real estate constrained products



NIO200 HAZLOC ISA100 Wireless Gateway with Wi-Fi Mesh

- Deploy and manage ISA100 Wireless Mesh Networks
- WiFi 802.11 a/b/g/n Mesh/AP/Client meets various deployment models
- HAZLOC C1D2 and ATEX certified
- Oil, petrochemical and mining

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- High throughput and mobility for simultaneous data, audio and video surveillance transmission
- Path-redundant, adaptive and self-healing Mesh
- Level-4 EMC immunity to Surge, ESD/EFT



Industrial Wi-Fi MESH Platform







MANAGE

CONNECT

MONITOR



NIO200 ISA100 Product Line







NIO200IAG ISA100 Wireless All-in-One Gateway

- Deploy and manage ISA100 Wireless Mesh Networks
- ISA100 Wireless compliant System/Security Manager, Gateway and Backbone Router

NIO200IDG ISA100 Wireless Distributed Gateway

- Deploy Distributed ISA100 Wireless Mesh Networks
- ISA100 Wireless compliant System/Security Manager and Gateway

NIO200IDR ISA100 Wireless Backbone Router

- ISA100 Wireless and WiFi Mesh Infrastructure
- ISA100 Wireless compliant Backbone Router



ISA100 Wireless Rapid Development Kit



Problem Statement

- Developing an ISA100 Wireless compliant and certified field instrument is currently a complex undertaking that requires
 - In-depth knowledge of ISA100 application layer concepts and constructs – steep learning curve
 - Significant effort for developing the instrument specific code that resides on the application processor
- Estimated project duration: 8 16 months
- This results in slow market adoption and hinders the growth of ISA100 Wireless compliant/certified ecosystem of field instruments

Current Status Quo – Step 1: Initiation

Research available wireless technologies

Familiarization with ISA100 Wireless technology Formulate product requirements and identify steps involved

Estimate project costs and launch project

Duration: 2 – 4 months





Current Status Quo – Step 2: Development and Certification



Hardware Design and Integration

- Integration of third-party wireless module
- Schematics, layout, enclosure, fab files
- Manufacturing, engineering validation

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Certification

- Wireless compliance: FCC, IC, ARIB, ETSI etc.
- Safety: UL, ATEX, etc.





ISA100 Wireless Field Device Architecture







Goals for Development Kit

- Streamline development process and reduce time-to-market
- User friendly intuitive interfaces and great out-of-box experience
- Reduce learning curve associated with novel ISA100 technology
- KEY: Minimize application processor development effort
- Offer certifiable field instrument implementation that requires minimal tailoring to the customer's specific needs
- Competitively priced with other kits for industrial IoT technologies (WirelessHART, LoRa, Bluetooth Mesh etc)





ISA100 Wireless RDK Highlights

- Develop ISA100 Wireless (IEC 62734) compliant and certifiable field instruments with minimal effort using application layer code provided
- WISA wireless modules included run ISA100
 Wireless communication stack
- Gateway boasts feature rich web-based
 Network Operation and Management System
- User friendly SPiN development board includes OLED display and a large variety of sensors
- Connect external processors, sensors or actuators via Arduino and Freedom form factor connector
- All firmware and software components are remotely upgradeable
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ISA100 Wireless Rapid Development Kit







- Comprehensive end-to-end development platform
- Includes everything needed to
 - Swiftly develop ISA100 Wireless compliant field instruments and devices
 - Evaluate performance of ISA100 Wireless technology
- Includes integrated and pre-configured ISA100 hardware, firmware and software
 - Low-cost NIO200IAG Gateway
 - Two (2) SpIN development boards that include a wide gamut of sensors
 - Two WISA wireless module that run the ISA100 Wireless communication stack
 - Field provisioning and configuration software
- Feature-rich Monitoring and Controls System software
 - Configure and visualize process values received from field instruments
 - Network topology and health diagnostics
 - Device management including RF statistics, remote firmware upgrades etc.
 - MODBUS server configuration
 - All components are remotely upgradable



Rapid Development Kit (RDK) Components







SPiN Field Development Board (Quantity: 2)



Engineering Utility Software (Quantity: 1)



Documentation Package (Quantity: 1)





SPiN Field Development Board

- Great out-of-box experience
- Hosts a wide gamut of sensors allowing out-of-box monitoring and control
- OLED sensor displays locally ISA100 parameters (role, join status, EUI-64, sensor data etc)
- Connects to Utility Software via USB on-board USB bridge
- Expandable hosts Arduino shield connector – user can stack own sensors or controls







ISA100 Wireless Gateway



- Low-cost ISA100 Wireless compliant Network/Security Manager, Gateway and Access Point
- Allows user to swiftly evaluate the performance of ISA100 Wireless field network via rich sensor data set received from SPiN field development boards
- WiFi Backbone connectivity MESH, Access Point of Client
- Hosts intuitive web-based interface for
 - Process data monitoring/control
 - Device management and configuration
 - Network topology and health status
 - Over-the-air upgrades of all components
- MODBUS server and intuitive process value mapping





Engineering Utility Software



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- Feature rich Engineering Utility Software can be installaed on any PC
- Communicates with the SPiN board via USB/serial
- Allows user to provision and configure the ISA100 communication stack
 - Provisioning parameters
 - Country codes and RF profiles
- Full set of ISA100 Wireless commands
- Full configuration of the process values published
- Serial upgrades of the communication stack





Documentation Package – Training Materials

Document or File Title	Description
ISA100 Wireless Nine - Part Training Course	A comprehensive training course provided by the WCI (Wireless Compliance Institute) which covers everything from ISA100 technical basics as well as the process to obtain ISA100 Wireless certification.
The Technology Behind ISA100 Wireless	A presentation that provides the compressed foundation of ISA100 compliant technologies.
White Paper - ISA100 Applications Technology and Systems	White paper that provides a technical foundation as well as industry practices related to ISA100 systems
ISA100 - Spectrum Management and Co- Existence	Presentation that explains ISA100 RF spectrum management features and also provides test results for co-existence with WiFi products.





Documentation Package – Engineering Materials

Document or File Title	Description
RDK User Guide	User guide that describes the functionality of the RDK. It includes initial setup of an ISA100 compliant network as well as the steps needed to create an ISA100 field instrument demo.
Developing ISA100 Compliant Products - Training Course	Training course that provides a step-by-step approach on how to develop ISA100 Wireless compliant field instruments and products.
EASY API Manual	Firmware integration document that details the API and how to tailor the application processor firmware.
Engineering Utility Software - User Guide	Details the functionality and capabilities of the Engineering Utility software.
WISA Radio Module - Hardware Integration Manual	Document contains all the information needed to integrate the WISA wireless module into a product. This includes pinout, pin description, electrical specifications and mechanical drawings.
ISA100 Provisioning and Firmware Upgrade Process	Document describes the process of provisioning and upgrading the WISA ISA100 wireless module via various methods.

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