Award Winning Case Study

OMV Petrom OT Pilot Project Utilizing ISA100 Wireless for Real-Time Oil Field Monitoring

OMV Petrom Exploration & Production

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The energy for a better life.

About the Speaker

Sorin Dobrescu

OMV PETROM, AUTOMATION ENGINEER

Sorin Dobrescu holds the position of Automation Engineer with OMV Petrom, in the Automation and OT department. He has 40 years of experience in designing and implementing medium and large-scale SCADA/DCS systems in various industries such as metallurgy, smart grid, nuclear power plants and oil & gas. Since 2015, when he started with OMV Petrom, Sorin has been involved in many projects concerning the implementation of new OT solutions tailored for matured onshore oilfields. Sorin holds a master's degree in Automation and Computer Science from Polytechnic University in Bucharest, and a master's degree in Mechanical Engineering from Petroleum & Gas University in Ploiesti. He has published 2 articles regarding distributed architectures and reusable algorithms for distributed control in onshore oilfields.

About the Speaker

Robert Assimiti

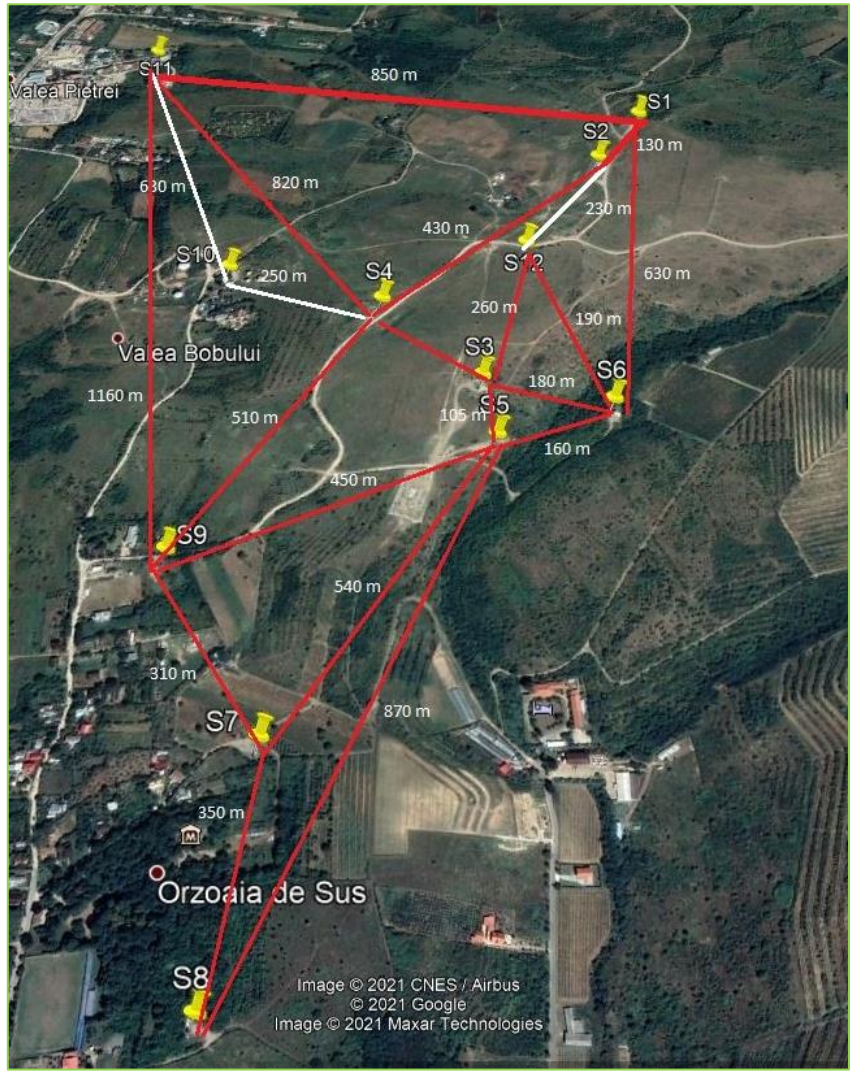
WCI Governing Board Member
Member of the WCI Technical Steering and Committee

Co-Founder and CEO
Centero

Robert Assimiti has over 20 years of technical leadership in the wireless arena. He has architected and developed several highly-scalable, mesh based wireless product lines for both commercial and industrial wireless applications. He manages a team of technologists focused on the creation of new technologies, standardization and generation of novel intellectual property. He has also authored and co-authored several patents. Robert defines Centero's current and future technical strategic market position. He also oversees strategic partnerships, the integration of new business models, the incubation of new technologies and the cultivation of world-class talent. Robert is also an active member of the WCI Governing Board and the Technical Steering committee. He holds a Bachelor Degree in Computer Engineering from the Georgia Institute of Technology.

Background

- The oil field is comprised of 7 operational oil wells & one gathering facility (“production cells”)
- All oil wells are outfitted with Beam Pumping Unit (BPU) along with additional equipment like chemical injection units, etc.;
- The actual data acquisition infrastructure is based on star topology, using 3G - 4G routers - no real-time process network
- Each production cell has its own local PLC that is engaged in supervisory control (ISA95 – Level 1)
- The extraction points are spread over an area of 1.5 x 1.0 kilometers
- Terrain is rather plain with small hills and some wooded areas



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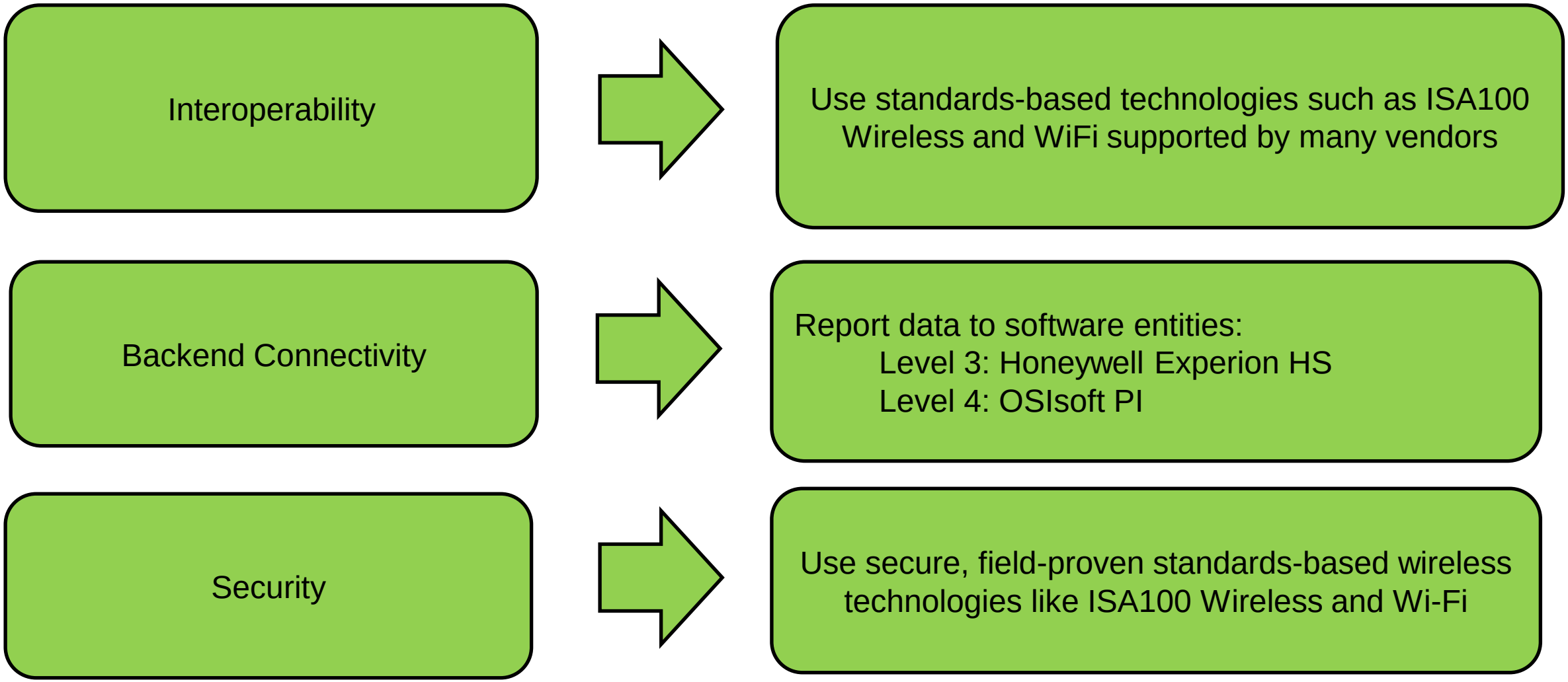
The Challenge

- To build a real-time process network with minimal capital expenditure
- Real time monitoring and supervisory control for whole production system (Level 2 &2,5 at productions system):
  - ✓ Ensure that the extraction process is in good health
  - ✓ Pro-actively detect potential issues
  - ✓ Increase data connections performance: bandwidth and availability;
- Monitor additional parameters in the production cell
  - ✓ Temperature and pressure monitoring
- Monitor existing PLCs engaged in supervisory control
- Reduce capital expenditure incurred by having to install hardwired field instruments and monitoring equipment spread over an area of 1.5 x 1.0 kilometers

Requirements

Reduce CAPEX	Eliminate costly cabling needed using wireless connectivity for both the backbone infrastructure and field equipment
Real-time monitoring covering the entire oil field	Use wireless connectivity for both: Field Ares Network: instruments, PLCs, RTUs WAN: backbone infrastructure
High data reliability and latency guarantees	Mesh wireless technology such as ISA100 Wireless architected specifically for wireless process automation (monitoring and control)

Requirements



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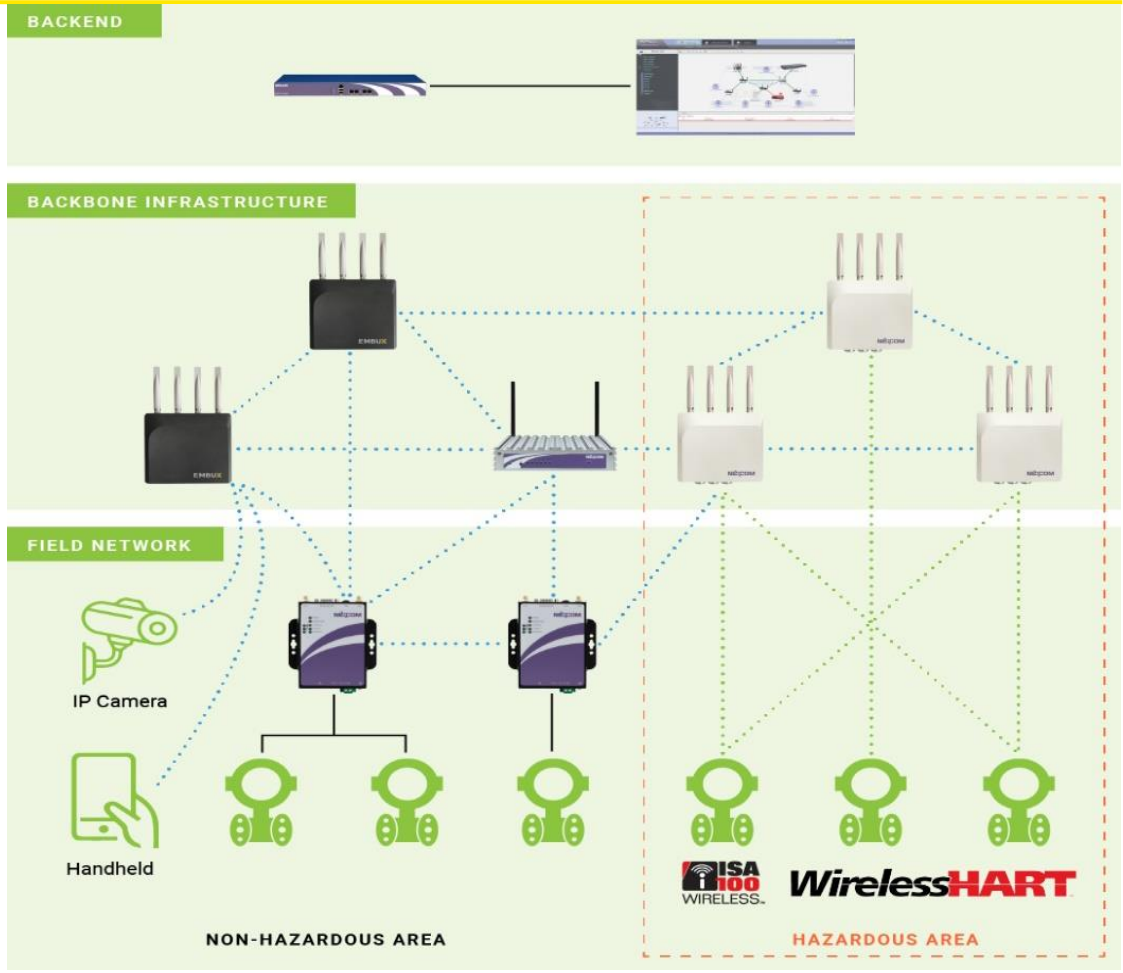
Requirements

- The field instruments installed at the 8 production cells together with the wireless backbone infrastructure will form the plant-wide wireless network
- Parameters of interest will be available in real-time throughout the plant-wide network
  - ✓ISA100 Wireless field instruments
  - ✓PLCs
  - ✓RTUs
- Field instruments installed will be engaged in monitoring and will also report data locally to PLCs for supervisory control through wired actuators
- Field instruments will monitor and control various parameters such as pressure and temperature
  - ✓Typical data reporting rates range from 1 – 30 seconds (data burst/publish rate)
- Field instruments will be installed in HAZLOC areas
- Backbone infrastructure devices (Gateways, routers) will be installed in non-HAZLOC areas

The Solution - The Backbone Infrastructure (WAN)

Centero's Offering - Industrial IoT for Wireless Process Automation

- Connect ISA100 Wireless compliant field instruments
- Deploy highly reliable plant wide Wi-Fi Mesh wireless backbone canopy
- Connect MODBUS RTU/TCP and Ethernet/serial field instruments using WiFi adapters
- Products suitable for deployment in hazardous and non-hazardous areas
- Support for high-throughput, low-latency communications and mobility for simultaneous field data, audio and video surveillance transmission
- Connect IP cameras and handheld maintenance tools



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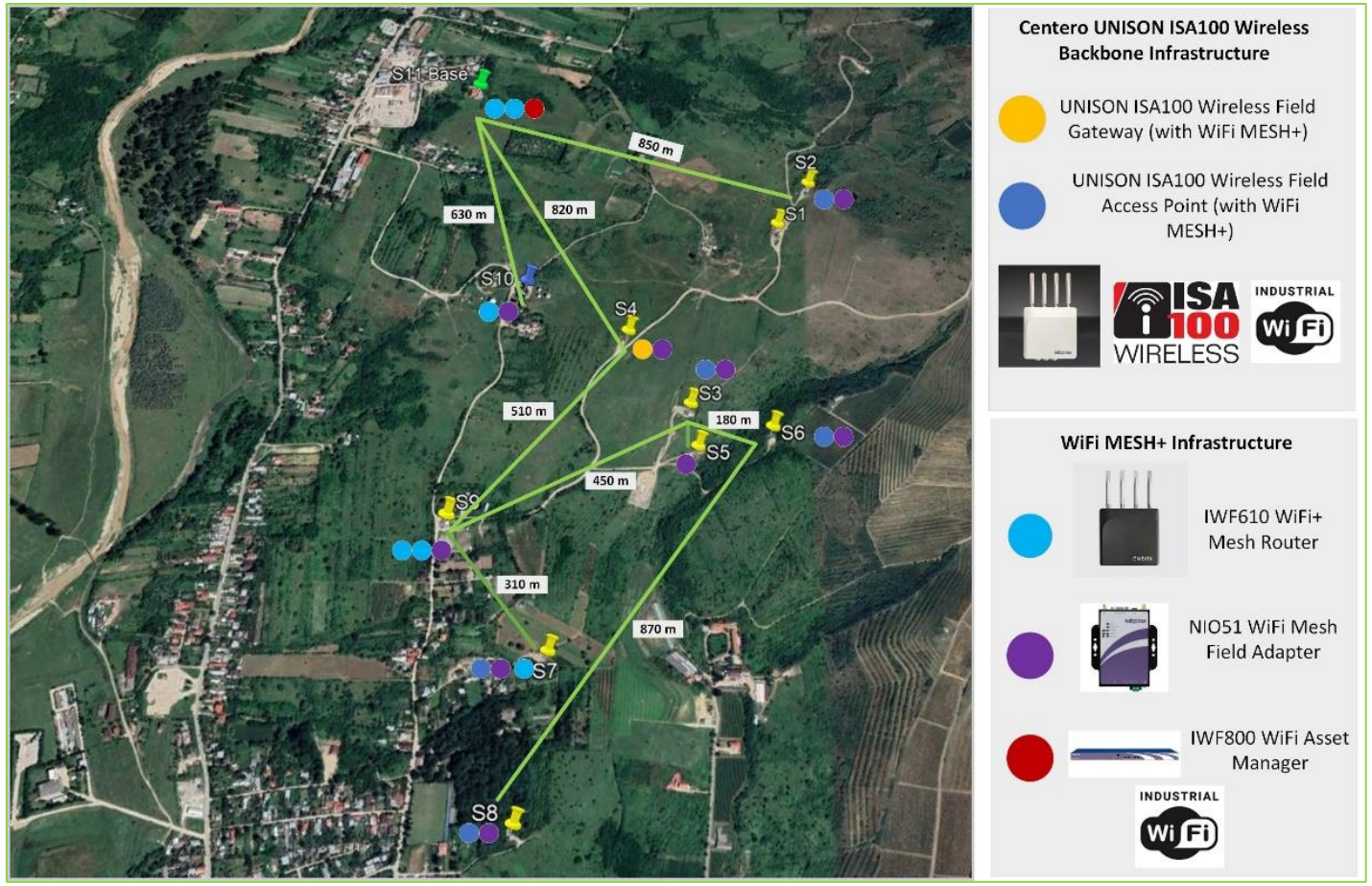
The Solution - The Backbone Infrastructure (WAN)

The wireless backbone infrastructure allows bridging of the OT/IT domains for a comprehensive digital transformation



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Benefits of ISA100 Wireless

Cost Savings	▪ Up to 90% of installed cost of conventional measurement technology can be for cable conduit and related construction ▪ Typically: 1/2 the costs, 1/5 of the time ▪ New and scaled applications are now economically feasible
Improved Reliability	▪ Wired sensors may be prone to failure in difficult environment ▪ Wireless can add redundancy to a wired solution
Improved Visibility	▪ Condition monitoring of secondary and remote equipment ▪ Process monitoring, fast additional data for trouble shooting
Improved Control	▪ Add wireless to existing processes for more optimal control
Improved Safety	▪ Safety related alarms - end to end SIL2 certifiable

Product Line Highlights

- ISA100 Wireless and WiFI Mesh+ high throughput backbone connectivity
- Supports highly scalable deployments in multiple topologies
- Monitoring and advanced control features
- Over-the-air provisioning with advanced security features
- Advanced diagnostics – NAMUR, wireless health and battery life
- Native support for DD/CF files
- Long-range ISA100 Wireless connectivity - 1.2 miles (2 km) LoS
- Multiple plant connectivity interfaces
- Multiple models for deployments in hazardous as well as non-hazardous areas
- Can be privately labeled by interested parties

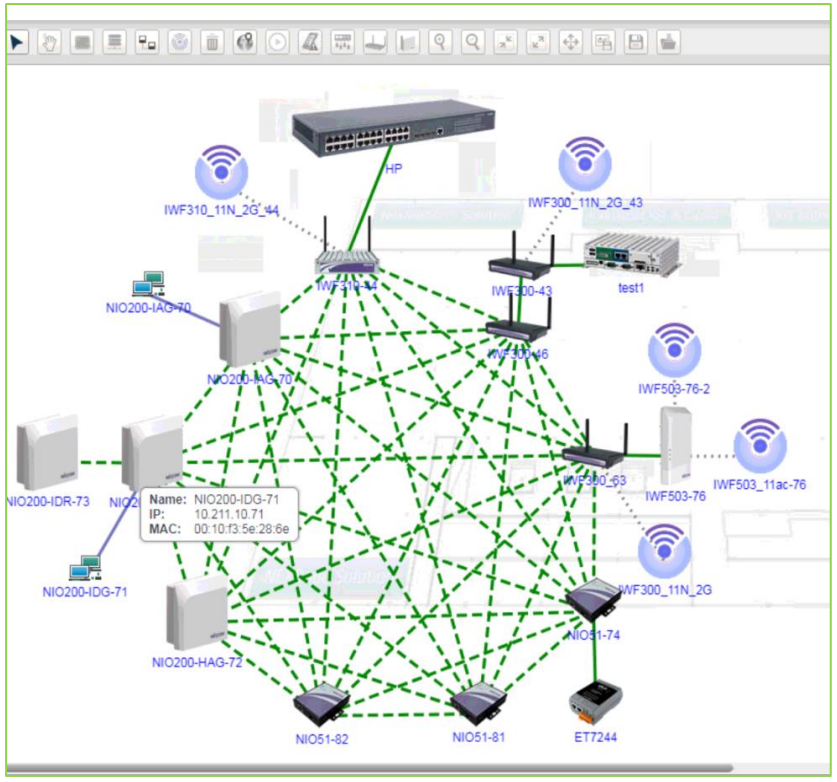
UNISON Field Wireless Gateway

- ISA100 Wireless compliant System/Security Manager, Gateway and Backbone Router
- Scalability: **200** ISA100 Wireless field instruments in up to **20** wireless mesh subnets
- Publication data reporting rates: 0.5, 1, 2, 5, 10, 30 seconds, 1, 5, 15, 30 and 60 minutes
- Over-the-Air provisioning with enhanced security mechanisms
- DD/CF file parsing including all ISA100 Wireless native objects and WCI extensions
- Suitable for deployments in hazardous locations - C1D2 or ATEX
  - UL: Class I, Division 2, Groups A, B, C, D and T4
  - ATEX: Class I, Zone 2; EX nA II, T2
- Plant network interfaces: MODBUS, GCCI, OPC UA (ISA100 Data Model) and PROFINET/PROFIsafe
- All software and firmware is remotely upgradable via secure AES-256 encrypted and authenticated process
- Power redundancy (DC and PoE)

UNISON Field Wireless Access Point

- ISA100 Wireless Backbone Router with WiFi Mesh+ backbone connectivity
- Works in conjunction with the UNISON Field Wireless Gateway
- Used in high-scalable distributed topology deployments
- Support for Over-the-Air provisioning
- Scalability - ISA100 Wireless subnet of up to 50 field instruments
- High throughput WiFi Mesh backbone infrastructure connectivity
- Suitable for deployments in hazardous locations - C1D2 or ATEX
  - UL: Class I, Division 2, Groups A, B, C, D and T4
  - ATEX: Zone 2; EX nA II, T2
- All software and firmware is remotely upgradable via secure AES-256 encrypted and authenticated process
- Power redundancy (DC and PoE)

Comprehensive Industrial Wi-Fi MESH Platform



MANAGE

CONNECT

MONITOR

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IWF610 IP67 Industrial WiFi Mesh Router

CONNECT

INDUSTRIAL

Wi Fi

- Dual band IP67 certified 802.11 a/b/g/n mesh router
- Multiple operation modes Mesh/AP/Client meets various deployment models
- Extended range achieved due to two (2) 27 dBm high RF output power modules with 2X2 MIMO Path redundant, adaptive and self healing Mesh network functionality
- High throughput for simultaneous field data, audio and video surveillance
- Multiple Virtual Access Points (VAPs) in each Wi Fi radio: Mesh and AP can exist in the same radio (up to 8 x VAP for each radio)
- Wireless security: WEP, WAP/WPA2, WPA2 personal, WPA2 Enterprise, Hidden ESSID, MAC address filtering
- Extended 40 to +75 C operation temperature range
- Heavy industrial grade with Level 4 EMC immunity to Surge, ESD/EFT
- Easy web based configuration and security management through EMWatch software and nCare
- Power redundancy (DC and PoE)
- Covered by 2-year warranty

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NIO51 Industrial WiFI Mesh Adapter, Router

INDUSTRIAL

Wi Fi

MONITOR and CONTROL

- Deploy and manage industrial WiFI Mesh connected field instruments and infrastructure
- Cost-effective industrial WiFI/Mesh connectivity for Modbus RTU/TCP and serial/Ethernet devices
- Multiple WiFI operation Mesh/Router/Client modes meet various deployment models
- Path-redundant, adaptive and self-healing WiFi Mesh network connectivity
- MODBUS RTU/TCP to WiFi adapter
- Supports serial RS232/422/485/Ethernet to WiFi and Ethernet bridging
- WiFI Mesh/802.11 a/b/g/n and 2.4/5 GHz selectable with 2x2 MIMO
- Extended -40 to +70 °C operating temperature range
- Easy web-based configuration and security management through nCare

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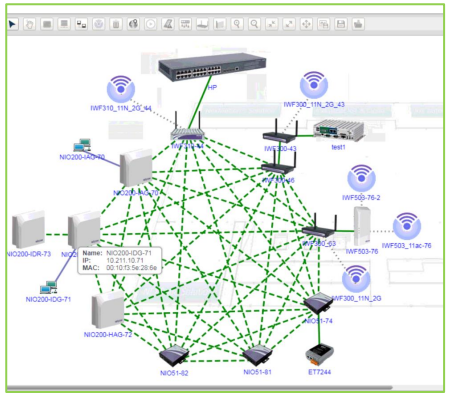
IWF800 nCare I4.0 Asset Manager



MANAGE

- Manage Industrial IoT Field/Infrastructure Devices and Networks
- Comprehensive device and network management solution for NIO200, NIO51, IWF product families and third-party devices
- Full process transparency by bridging the Information Technology and Operational Technology domains
- Asset auto-discovery and configuration via LLDP, CAPWAP, SNMP and MODBUS protocols
- Supports remote provisioning, configuration, firmware upgrades and reboots
- MODBUS field device asset management via MODBUS TCP
- Intuitive and user-friendly user interface shows network topology and device health status
- High scalability – manage up to 6000 devices
- Configure alerts and notifications based on pre-defined thresholds
- User administration through three privilege levels

OPC UA Interface

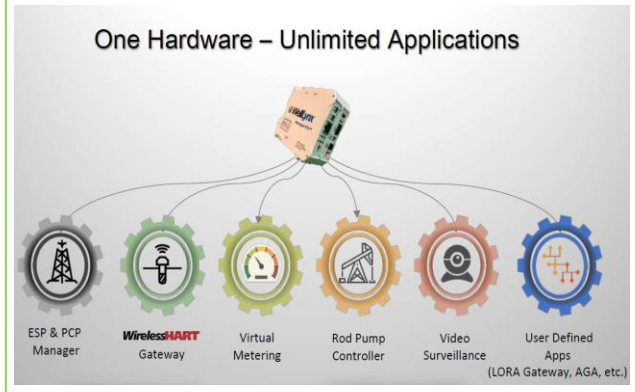
- Used for Level 4 integration with OSIsoft PI historian
- Based on WCI standard document that defines an OPC UA Information Model to represent and access ISA100 Wireless devices
- Standardization was a cooperative effort between the WCI and the OPC Foundation
- Includes the following OPC US models
  - ISA100 Field Devices – extension of PA-DIM model (OPC 30081)
  - ISA100 Access Point
  - ISA100 Network information model
- UNISON Gateway includes translator that supports dynamic mapping of parameters exposed in DD/CF file via OPC UA interface
- Number of OPC UA clients supported – 5 concurrent connections

The Solution - The Field Area Network (FAN)

Pumpjack Monitoring and Surveillance

- Data is being transmitted over the WiFi Mesh backbone infrastructure
- Pumpjack donkey arm is monitored by using a
  - Kenech WLP Wireless Load accelerometer
  - WellLynx RTU

- WellLynx RTU
  - Suitable for deployments in hazardous locations - CLASS 1 DIV 2 certified
  - Plant network interfaces: RS485, Ethernet (RJ45), WiFi, Modbus RTU, Modbus TCP, DNP3, OPC-UA, MQTT



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The Solution - The Field Area Network (FAN)

Oil Well Production Cell Monitoring

- ISA100 Wireless certified instruments communicate with the ISA100 Wireless Field Gateway and Field Access Point
- Data is being transmitted over the WiFi Mesh backbone infrastructure
- Field instruments will monitor and control various parameters such as pressure and temperature
  - Typical data reporting rates range from 1 – 30 seconds (data burst/publish rate)
- Field instruments are installed in HAZLOC areas
  - Honeywell Temperature Transmitter STIW400
  - Honeywell Pressure Transmitter STGW74L

Challenges Encountered

- Onshore Oil field real-time monitoring is a novel use case
- Large distances between the oil wells (production cells) required installation of directional antennas
- Antennas had to be installed via extension cables on top of electric poles at various heights
- Terrain and vegetation also presented a challenge for some of the wireless links
- Directional antennas needed to be aligned and fine tuned for optimal wireless performance for the long wireless range connectivity
- Weatherproofing and insulating wireless connectors (antenna connectors, surge arrestors, cables etc) was challenging as condensation degrades wireless communications

Current Status

- ISA100 Wireless and WiFi Mesh+ wireless backbone infrastructure is functional:
  - ISA100 Wireless communication reliability > 99.9%
  - WiFi Mesh+ wireless backbone infrastructure communication reliability > 99.7%
- ISA100 Wireless field instruments installed and integrated with WellLynx RTUs
- Process value are available to DCS (Honeywell Experion) and OSI PI from:
  - ISA100 Wireless field instruments through:
    - MODBUS -> to DCS
    - OPC UA ISA100 Wireless data model -> directly to OSI PI (under implementation)
  - Existing instruments (legacy) collected through WellLynx RTUs -> to DCS and OSI PI using OPC UA
- Batteries are being installed to deal with power line undervoltage fluctuations and short power outages
- Next steps:
  - Upgrade the actual system to a fail-safe version of infrastructure and start testing real-time optimization (AspenTech APC for whole production system);
  - Rollout this OT infrastructure to a larger production system to take advantage of existing real-time optimization tools and decisions support systems (OSI Soft PI and SeeQ)

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