Hybrid Mesh Ensures the Reliability of ISA100 Connectivity

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Oct., 3rd, 2017
NEXCOM’s Value Proposition
Industrial Wireless in Ex Industries

- Keep people, plants and the environment safe
- Improve plant and asset reliability
- Optimize through efficient employees, equipment and processes

ISA100.11a (IEC 62734) user cases

- Improved control of plant steam supply by detecting "cool spots" in cross plant steam lines
- Reducing risk of overfilling tanks by adding redundant level measurements (in oil and petroleum refineries)
- Monitor and control safety valves
- Monitor and control pressure and temperature of process fluids and gases
# Usage Classes for ISA100a (Class2~Class5)

<table>
<thead>
<tr>
<th>Safety</th>
<th>Class 0: Emergency action</th>
<th>(always critical)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Class 1: Closed loop regulatory control</td>
<td>(often critical)</td>
</tr>
<tr>
<td></td>
<td>Class 2: Closed loop supervisory control</td>
<td>(usually non-critical)</td>
</tr>
<tr>
<td></td>
<td>Class 3: Open loop control</td>
<td>(human in the loop)</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Class 4: Alerting</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Short-term operational consequence (e.g., event-based maintenance)</em></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Class 5: Logging &amp; downloading/uploading</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>No immediate operational consequence</em> (e.g., history collection, SOE, preventive maintenance)*</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Batch levels* 3 & 4 could be class 2, class 1 or even class 0, depending on function

*Batch levels as defined by ISA S88; where L3 = "unit" and L4 = "process cell"
Market

ISA100 Wireless Global Installation Map
Many Billions of Operation Hours
Examples of Ex Industries Covered

- Automotive, Train Refuel Stations or Petrol Station
- Oil & Gas Extraction, Drilling Ships
- Oil Refineries, Rigs, & Processing Plant
- Gas Pipelines and Distribution Centers
- Petrochemical & Chemical Processing Plants
- Printing Industries, Paper and Textiles
- Marine, Aircraft Refuel and Hangar
- Hospital Operating Room
- Surface Coating Industries
- Underground Coal Mining
- Sewerage Treatment Plant
- Sugar Refineries, Storage, Packaging and Distribution
- Metal Surface Grinding, Especially Al dusts and Particles
- Woodworking Areas, Furniture Manufacturer
- Grain Handling and Storages and Processing
- Transportation
- Pharmaceuticals
- Food Processing
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
Wireless Built for Reliable performance

Rugged NIO 200 Forms A Robust Industrial Wireless Network

- Hybrid mesh for reliable connection from ISA10.11a field instruments to backbone network
- Web-based nCare to simplify network configuration, provisioning, and management
- Compliance with UL C1D2, ATEX C1Z2, IEC 60950-1, and IEC 61000 Level 4 for use in HazLoc

Level Measurement
**ISA100a Connectivity Architecture**

- Network Manager
- Asset Health Management
- Wi-Fi / ISA100a / WiHART / TCP/IP

**Components:**

- **DSC controller**
- **Cloud SCADA**
- **nCare**
- **nCare 2Go**
- **APP (PAD/Phone)**

**Network Nodes:**

- **IWF503**: 802.11ac P2P AP
- **IWF310**: 5GHz Mesh Backbone
- **IWF501**: 802.11ac P2P AP
- **NIO200**: ISA100 GW
- **NIO20**: ISA100 Adaptor

**Network Protocols:**

- **WiFi / ISA100a / WiHART / TCP/IP**

**Application Areas:**

- **Shop Floor Management**
- **AGV / Mobility**
- **Process Automation**
- **Video Monitoring**
IoT Studio – CloudSCADA

Application Layer

IoT Studio + Azure App Service + IoT Hub + Document DB

Communication Layer

Device Layer

Devices/PLC
Sensors

Injection Machine LV250
IoT Studio – CloudSCADA (Sanmin Factory – 7F-SMT)
ISA100a Supports Multiple Topology

- **Standalone Gateway:**
  - Wi-Fi Mesh AP/Mesh Gateway
  - System and Security Manager
  - Gateway Process

- **IWSN Backbone Router**

- **Distributed Network Topology**

- **All-in-one Gateway**

IWSN:
ISA100.11a & WirelessHART

FD: Field Device, & IWSN Adapter

Connectivity Layer

Field Devices Layer
Hybrid network of Wi-Fi & ISA100

One gateway, Multi network:
- Wi-Fi Mesh
- Wi-Fi Access
- ISA100a Mesh
- Ethernet

Multi-link, more reliable
- Redundancy
- Flexible to expand
- Less maintenance cost
- High throughput

- nCare
- Cloud SCADA
- DCS
IP-Based ISA100 Connectivity - Fiber Backbone

Subnet

Subnet

Sounds good in deployment

Subnet

Subnet

Fiber optics
But, when sensor network expands, then.....

Cabling cost
Lack of flexibility
Maintenance cost

You’re losing Money

$$$

Fiber optics
IP-Based ISA100 Connectivity - Hybrid Mesh Backbone

When sensor network expands, then.....

- No fiber optics
- Good Flexibility
- Less Maintenance cost

Your Money is secured!

Wi-Fi Mesh Network
GSAP for Field Device Tunneling via ISA100

A single wireless device (single catalog number) can operate across multiple systems.

A specific protocol translator is required in the gateway for each system.

ISA100.11a provides an efficient application model that native devices can use for this purpose.
Open Standard I/F with OPC UA & DCS

- NIO200IDG: ISA100 Distributed Gateway
- NIO200IDR: ISA100 Backbone Router
- NIO200IAG: ISA100 All-in-One Gateway

Different Fieldbuses:
- EtherNet/IP
- DeviceNet
- PROFIBUS

Cloud SCADA
- nCare
- FDI*

GSAP Tunneling
- OPC-Client
- Access
- Excel

ISA100 Architecture
- NIO20I: ISA100 Adaptor
- NIO200: ISA100 Devices

Modbus
- Modbus

Azure

*FDI: Functional Safety Device Interface
### About EMC Immunity

<table>
<thead>
<tr>
<th>Level</th>
<th>ESD</th>
<th>Surge</th>
<th>EFT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level-1</td>
<td>Contact: +/- 2KV</td>
<td>+/- 0.5KV</td>
<td>+/- 0.5KV</td>
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<tr>
<td></td>
<td>Air: +/- 2KV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level-2</td>
<td>Contact: +/- 4KV</td>
<td>+/- 1KV</td>
<td>+/- 1KV</td>
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<tr>
<td></td>
<td>Air: +/- 4KV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level-3</td>
<td>Contact: +/- 6KV</td>
<td>+/- 2KV</td>
<td>+/- 2KV</td>
</tr>
<tr>
<td></td>
<td>Air: +/- 8KV</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level-4</td>
<td>Contact: +/- 8KV</td>
<td>+/- 4KV</td>
<td>+/- 4KV</td>
</tr>
<tr>
<td></td>
<td>Air: +/- 15KV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- EMC level-4 protection prevents devices from damage and possible malfunctioning due to ESD, Surge and EFT.
- Normally, EMC protection level is only up to level-2.
- Level-4 provides almost the strongest protection to devices in the field.
EMC Level-4 Test Result of NIO200

**Air Discharge**

<table>
<thead>
<tr>
<th>Test Points</th>
<th>± 2 KV</th>
<th>± 4 KV</th>
<th>± 8 KV</th>
<th>± 12 KV</th>
<th>± 15 KV</th>
<th>Pass</th>
<th>Fail</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>Reset port</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
</tbody>
</table>

**Contact Discharge**

<table>
<thead>
<tr>
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<th>± 2 KV</th>
<th>± 4 KV</th>
<th>± 8 KV</th>
<th>± 12 KV</th>
<th>± 15 KV</th>
<th>Pass</th>
<th>Fail</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ant port</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
<tr>
<td>Screw</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td></td>
</tr>
</tbody>
</table>

**Surge Immunity Test Record**

- **AC power ports**
  - Tested on: L, N, PE, L+N, L+N+PE
  - Test voltage level: ±2.0KV
  - Pulse rate: 5KHZ
  - Performance Criteria: A
  - Result: PASS

- **I/O signal, data and control line ports**
  - Tested on: RJ-45
  - Test voltage level: ±4.0KV
  - Pulse rate: 5KHZ
  - Performance Criteria: A
  - Result: PASS

**Surge**

- **ESD**
  - Contact: +/- 8KV
  - Air: +/- 15KV

- **EFT**
  - DC: +/- 2KV
  - Ethernet: +/- 4KV

- **Surge**
  - +/- 4KV

**Remark:** Criteria B: 测试中 LAN 連線中斷 會自動恢復連線

Test result: Pass
Drilling a hole in NIO200 and evacuating for dust test (3 hours).

With measuring particle density inside to evaluate solid particle protection.

Result: PASS
Packet Loss Validation Result

Excellent performance of Wi-Fi Mesh backbone transmission

Packet lost rate < 30 counts per million packets
Latency about 1 ms
Wi-Fi Mesh Reliability Illustration

Mesh packet loss rate (30 PPM) → Airline safety rate

- IRS-Tax advice
- Prescription Writing
- Restaurant bills
- Payroll processing
- Baggage Handling

High reliability of EZ Mesh connectivity
nCare in 4.0 factory

- **Central Management**
  - Visual Topology: in-time status monitoring / Traffic Management
  - Device management: Remote Provisioning for fast deployment
  - MAC Filter Security: Unauthorized AP / Device Access Control
  - Auto Notice: Notification for any user-defined abnormal events
  - nCARE-to-go: React & Resolve anywhere

- **Device (Asset) Health Monitoring**
  - Threshold based Device healthy monitoring for Predictive maintenance
  - Multiple Device type supported: Wired, Wireless, Industrial devices

- **Maintainace assistance**
  - Event Playback: Easier Troubleshooting
  - Remote Desktop Access
  - Remote Configuration & Upgrade
  - Setting Backup & Restore

**How can Devices be managed??**
nCare for all Connectivity

- SCADA
- MQTT/AMQP
- Network Manager
- Device Manager
- nCARE to Go

IWF
- Backbone
- Mesh
- Mesh Point

WMI (NB)
- Modbus
- ISA100
- IWSN
- Mesh
- DTM

TCP/IP
- Access Point
- Switch
- L3

DTM
- Wireless Instruments

Modbus Device
- AGV
- Machine
- IP CAM
- Meter

nCARE to Go
Visual Topology

Shortcut to “network device” setting
Bundle Google & Customer Site Map

Modify Device

General Setting

IP Address: 10.211.10.53
Device Name: IWF300

Latitude: 0
Longitude: 0

Read Community: public
Write Community: private

If you change community, device will reboot.
Device Configure

General Setting

- IP Address: 10.211.10.54
- Device Name: IWF300
- Latitude: 25.007861
- Longitude: 121.483502
- Read Community: public
- Write Community: private

If you change community, device will reboot.

Modify Device

WifiRadio: wlan0
ESSID / Mesh ID: NEX_2G
Mode: Access Point

Operating Frequency
- Mode: 11n
- Channel: 11 (2.462 GHz)
- Width: 40 MHz/AP or Client mod
- TxPower: 7 dBm (5mW)

Wireless Security
- Encryption: WPA2-PSK
- Cipher: auto
- Key: **********

It will take few seconds to modify.
<table>
<thead>
<tr>
<th>Clear</th>
<th>ID</th>
<th>IP Address</th>
<th>Device Name</th>
<th>Severity</th>
<th>Event</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>10.211.10.53</td>
<td>IWF300</td>
<td>Normal</td>
<td>Polling Success</td>
<td>2016-08-09 09:41:57</td>
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<tr>
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<td>2</td>
<td>10.211.10.53</td>
<td>IWF300</td>
<td>Critical</td>
<td>Polling Failed</td>
<td>2016-08-09 09:40:45</td>
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<td>3</td>
<td>10.211.10.53</td>
<td>IWF300</td>
<td>Normal</td>
<td>Polling Success</td>
<td>2016-08-09 09:38:39</td>
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<td>10.211.10.53</td>
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<td>Critical</td>
<td>Polling Failed</td>
<td>2016-08-09 09:37:27</td>
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<td>5</td>
<td>10.211.10.52</td>
<td>IWF300</td>
<td>Normal</td>
<td>Polling Success</td>
<td>2016-08-09 09:26:16</td>
</tr>
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<td></td>
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<td>IWF300</td>
<td>Normal</td>
<td>Polling Success</td>
<td>2016-08-09 09:26:16</td>
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<tr>
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<td>2016-08-09 09:22:28</td>
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<td>IWF300</td>
<td>Critical</td>
<td>Polling Failed</td>
<td>2016-08-09 09:17:16</td>
</tr>
</tbody>
</table>
Email Notification

nCare automatically sends notification to receiver by mail.

Notification information:

- **Source:** 10.211.10.45
- **Event:** Polling Failed
- **Date:** 2016-04-18 09:26:50
- **Severity:** Critical
Easy Management - Mobile APP

Android version: Available
IOS version: In process with Apple Store
Go Industrial Wireless for IIOT

- Industrial Wireless ISA100a
- Industrial Wi-Fi Mesh Backbone
- Industrial Network & Asset Management nCare
- Industrial IoT Cloud SCADA

Connected Industrial Plants
Standards Compliant Solutions
Stay Safe All the time
Thank You!