NI11

IT and Plant Floor - Breaking Down the Barriers
Related Sessions

- NI02 - Telecommunications Bonding and Grounding – Industrial
- NI03 - Testing the Physical Layer for Ethernet/IP
- NI04 - When is a good time to have MICE on your plant floor? Structured Cabling Best Practices (Industrial Ethernet)
- NI10 - EtherNet I/P Best Practices & Topologies
- NI13 – The Connected Enterprise
- NI18 – Remote Access
Industrial Networks Trends

• Open networks are in demand
  – Broad availability of products, applications and vendor support for Industrial Automation and Control System (IACS)
  – Network standards for coexistence and interoperability of industrial automation devices

• Convergence of network technologies
  – Reduce the number of disparate networks in an operation and create seamless information sharing throughout the plant-wide / site-wide architecture
  – Use of common network design, deployment and troubleshooting tools across the plant-wide / site-wide architecture; avoid special tools for each application

• Better asset utilization to support lean initiatives
  – Common network infrastructure assets, while accounting for environmental requirements
  – Reduce training, support, and inventory for different networking technologies

• Future-ready – maximizing investments and minimizing risks
  – Support new technologies and features without a network forklift upgrade
Manufacturing Network Convergence

Traditional – 3 Tier Manufacturing Network Model
- Corporate Network
  - Back-Office Mainframes and Servers (ERP, MES, etc.)
  - Human Machine Interface (HMI)
- Sensors and other Input/Output Devices
- Motors, Drives, Actuators
- Supervisory Control
- Controller
- Office Applications, Internetworking, Data Servers, Storage

Converged Ethernet Manufacturing Network Model
- Corporate Network
  - Back-Office Mainframes and Servers (ERP, MES, etc.)
  - Office Applications, Internetworking, Data Servers, Storage
- Human Machine Interface (HMI)
- Sensors and other Input/Output Devices
- Motors, Drives, Actuators
- Supervisory Control
- Controller
- Robotics

Convergence of Control and Information
Manufacturing and Enterprise Network Convergence

- **Enterprise Network Requirements**
  - Internet Protocols
  - Enterprise class gear
  - High availability – redundant star topologies
  - Access Nodes
  - Determinism, latency, jitter, etc.
  - Voice, video, data applications
  - IP Addressing - dynamic
  - Security - pervasive

- **Manufacturing Network Requirements**
  - Industrial and internet protocols
  - Industrial gear
  - Resiliency – redundant star/ring topologies and industrial environments
  - Infrastructure Nodes
  - Determinism, latency, jitter, etc.
  - Motion, control and safety
  - IP Addressing – static
  - Security - emerging

So, what are the similarities and differences?
# Cultural and Organizational Convergence

## Security Policies

<table>
<thead>
<tr>
<th>Focus</th>
<th>IT Network</th>
<th>Controls Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Protecting Intellectual Property and Company Assets</td>
<td>24/7 Operations, High OEE</td>
</tr>
</tbody>
</table>

## Priorities

<table>
<thead>
<tr>
<th>Types of Data Traffic</th>
<th>IT Network</th>
<th>Controls Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Converged Network of Data, Voice and Video</td>
<td>Converged Network of Data, Control, Information, Safety and Motion</td>
</tr>
</tbody>
</table>

## Access Control

<table>
<thead>
<tr>
<th>Access Control</th>
<th>IT Network</th>
<th>Controls Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strict Network Authentication and Access Policies</td>
<td>Strict Physical Access</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Simple Network Device Access</td>
</tr>
</tbody>
</table>

## Implications of a Device Failure

<table>
<thead>
<tr>
<th>Implications of a Device Failure</th>
<th>IT Network</th>
<th>Controls Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Continues to Operate</td>
<td>Could Stop Operation</td>
</tr>
</tbody>
</table>

## Threat Protection

<table>
<thead>
<tr>
<th>Threat Protection</th>
<th>IT Network</th>
<th>Controls Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shut Down Access to Detected Threat</td>
<td>Potentially Keep Operating with a Detected Threat</td>
</tr>
</tbody>
</table>

## Upgrades

<table>
<thead>
<tr>
<th>Upgrades</th>
<th>IT Network</th>
<th>Controls Network</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASAP</td>
<td>Scheduled</td>
</tr>
<tr>
<td></td>
<td>During Uptime</td>
<td>During Downtime</td>
</tr>
</tbody>
</table>
EtherNet/IP is the global leader: 7.5M+ nodes sold, 375+ vendors, 1000s product lines

**System Integrator**
- Enable seamless plant-wide / site-wide information sharing
- Converge industrial and non-industrial traffic

**IT Network Engineer**
- Use standard Ethernet and TCP/IP
- Utilize common network infrastructure assets & tools

**Control System Engineer**
- Enable future-ready, high performance
- Use an established, widely accepted network technology supported by leading industry vendors

**Equipment Builder**
- Enable convergence-ready solutions
- Use a single multi-discipline control and information platform

**Field Devices**

**Plantwide Technologies**

**Discrete, Process, Safety, Motion**

**For...**

**EtherNet/IP - One Standard Industrial Network Technology**
Network Technology Convergence
Single Industrial Network Technology

Convergence of Industrial Automation Technology (IAT) with Information Technology (IT)

Multi-discipline Industrial Network Convergence
Collaboration of Partners
Network Technology Convergence

Rockwell Automation
Leader in Industrial Network Infrastructure

EtherNet/IP
The Established #1 Industrial Ethernet

Panduit
Physical Layer Network Infrastructure

Level 4 – Data Center
Level 3 - Site Operations

Wireless, Security, Switching/Routing

People
Technology
Processes & Innovation

Processing
Filling
Material Handling

www.industrial-ip.org

POWERED BY WERNER ELECTRIC
Best Practices for Network, Technology and Cultural Convergence

• Emergence of Manufacturing IT
• IT and Manufacturing collaboration on
  – System architecture design
  – Service and support models
  – Manufacturing Security Policy
• Communicate to IT what protocols and services are being used
  – TCP/UDP, Managed/Unmanaged switches, Multicast, IP addressing, VLANs, QoS?
• Communicate IT requirements to Manufacturing
• Standardization of design and technology
• Consult reference architectures, reference models and standards
  – Network Segmentation
  – Domains of Trust

An open, two-way dialog is critical!
• Understand application and functional requirements
  – Devices to be connected – industrial and non-industrial
  – Data requirements for availability, integrity and confidentiality
  – Communication patterns, topology and resiliency requirements
  – Types of traffic – information, control, safety, time synchronization, drive control, voice, video

• Develop a logical framework (roadmap)
  – Migrate from flat networks to structured and hardened networks
  – Define zones and segmentation, place applications and devices in the logical framework based on requirements

• Develop a physical framework to align with and support the logical framework

• Deploy a Defense-in-Depth Security Model

• Reduce risk, simplify design, and speed deployment:
  – Use information technology (IT) standards
  – Follow industrial automation technology (IAT) standards
  – Utilize reference models and reference architectures

Because Network Infrastructure Matters!!
Networking Design Considerations

- Help reduce Latency and Jitter, to help increase data Availability, Integrity and Confidentiality, and to help design and deploy a Scalable, Robust, Secure and Future-Ready EtherNet/IP network infrastructure
  - Single Industrial Network Technology
  - Robust Physical Layer
  - Segmentation
  - Resiliency Protocols and Redundant Topologies
  - Time Synchronization
  - Prioritization - Quality of Service (QoS)
  - Multicast Management
  - Convergence-Ready Solutions
  - Security - Defense-in-Depth
  - Scalable Secure Remote Access
These industry leaders are collaborating to provide recommendations, design guidance, best practices and solutions to help customers successfully design and deploy scalable, robust, and future-ready EtherNet/IP networks utilizing common network infrastructure assets.

- **Enabling Convergence**
  - Plant-wide / Site-wide industrial networks
  - Industrial Automation Technology (IAT) and Information Technology (IT)

- **Providing Collateral**
  - Design Guides
  - Application Guides
  - Whitepapers
  - Webcasts
  - Seminars

Because Network Infrastructure Matters!!

**Power**

**WERNER ELECTRIC**
Unified Physical Infrastructure
Collaboration of Partners - Common Network Infrastructure

Align Converge Optimize

Solve industrial challenges with the future in mind

Plant-wide: Industrial Automation Solution

Building: Enterprise Solution

Office: Data Center Solution
Wireless, Security, Switching/Routing
Collaboration of Partners - Common Network Infrastructure Assets

- Campus wired and wireless network framework for structure and hierarchy best practices
- Unified communications for mobility and collaboration
  - Voice, video & data
- Unified computing systems for server, switch and firewall virtualization
- Integration with Cisco and IT network management applications
- Resiliency and availability features
  - REP, Flex Links, HSRP, StackWise
- Integrated catalyst network security
EtherNet/IP: “IP” - Industrial Protocol
Single Industrial Network Technology

- **ODVA**
  - Supported by global industry leaders such as Cisco Systems®, Omron®, Schneider Electric®, Bosch Rexroth AG®, Endress+Hauser and Rockwell Automation
  - Conformance & Performance Testing

- **Standard**
  - IEEE 802.3 - standard Ethernet, Precision Time Protocol (IEEE-1588)
  - IETF - Internet Engineering Task Force, standard Internet Protocol (IP)
  - ODVA - Common Industrial Protocol (CIP)
  - IEC - International Electrotechnical Commission – IEC 61158

- **IT Friendly and Future-Ready (Sustainable)**
- **Multi-discipline control and information platform**
- **Established - products, applications and vendors**

What’s the difference?
- Ethernet IP
- EtherNet/IP
EtherNet/IP – Established (partial list)
Single Industrial Network Technology

375+ EtherNet/IP Vendors Registered
Maximize uptime
Failure prediction
Real-time data
Lower costs
Human error reduction

“A significant portion of network downtime, approx. 80%, is attributed to Physical Layer Connections.”

Sage Research

“76% of companies are seeing convergence between IT and controls systems.”

Rockwell Automation
Industrial IP Advantage

• New ‘go-to’ resource for educational, technical and thought leadership information about industrial communications

• Standard Internet Protocol (IP) for Industrial Applications

• Coalition of like-minded companies

www.industrial-IP.org
Who is driving this activity?

A coalition of like minded companies joining together to educate the market on the benefits of Ethernet, Internet Protocol and EtherNet/IP

- Rockwell Automation
  - Plantwide Optimization and Machine Builder Performance
- Panduit Corp
  - Unified Physical Infrastructure
- Cisco Systems
  - Internet of Everything
Website Walkthrough

Welcome

Using the power of standard, unmodified Internet Protocol (IP) improves connectivity between people, partners and processes, devices, departments and systems in industrial applications, and opens up new opportunities for productivity, efficiency and flexibility. Industrial IP Advantage is here to help you make the most of networking technologies existing and emerging — that make integration and the flow of information effortless. This community will keep you up to date with the latest trends, developments, implementation advice and opinions on the use of IP in industrial applications.
Physical Layer Design Considerations

• Standard Physical Media

  – Connectors
  – Patch panels
  – Cable management
  – Grounding, Bonding and Shielding (noise mitigation)
  – Wired vs. Wireless
  – Copper vs. Fiber
  – UTP vs. STP
  – Singlemode vs. Multimode

.....More than just “cable” these days!
Assessment!

**Downtime Cost**
How Critical is the Network?
Drives Resiliency, Hardening and Recovery

**Number of Connections**
Today
Next 10 years

**Bandwidth Consumers**
Data
Video
Control

**Walk Through**
Cable Distances
Environment
Obstructions

**Security**
Control Physical and Electronic Access

POWERED BY WERNER ELECTRIC
Networking Design Considerations

- Help reduce Latency and Jitter, to help increase data Availability, Integrity and Confidentiality, and to help design and deploy a Scalable, Robust, Secure and Future-Ready EtherNet/IP network infrastructure
  - Single Industrial Network Technology
  - Robust Physical Layer
  - Segmentation
  - Resiliency Protocols and Redundant Topologies
  - Time Synchronization
  - Prioritization - Quality of Service (QoS)
  - Multicast Management
  - Convergence-Ready Solutions
  - Security - Defense-in-Depth
  - Scalable Secure Remote Access
## Select Best Media for Your Needs

<table>
<thead>
<tr>
<th>UTP vs. STP</th>
<th>UTP (unshielded twisted pair)</th>
<th>STP (shielded twisted pair)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs less</td>
<td>Excellent immunity from EMI and RFI noise</td>
<td></td>
</tr>
<tr>
<td>Installs faster</td>
<td>Can locate cable close to source of noise</td>
<td></td>
</tr>
<tr>
<td>Smaller diameter, more flexible</td>
<td>Well suited for more rigorous environments</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAT5e vs. CAT6</th>
<th>CAT5e</th>
<th>CAT6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Costs less</td>
<td>Higher signal to noise ratio; performance margins</td>
<td></td>
</tr>
<tr>
<td>Suitable for speeds of less than a gigabit</td>
<td>Designed to deliver gigabit performance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Copper vs. Fiber</th>
<th>Copper</th>
<th>Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Termination and installation is faster</td>
<td>Cost of fiber transceivers is higher</td>
<td></td>
</tr>
<tr>
<td>Less fragile</td>
<td>Use when excessive EMI noise is present</td>
<td></td>
</tr>
<tr>
<td>Distances of less than 100m</td>
<td>Use when distance is a factor (over 100m)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Singlemode vs. Multimode Fiber</th>
<th>Multimode Fiber</th>
<th>Singlemode Fiber</th>
</tr>
</thead>
<tbody>
<tr>
<td>For distances of up to 550M @ 1G &amp; 2km @ 100M</td>
<td>Longer distance (up to 50km)</td>
<td></td>
</tr>
<tr>
<td>Lower cost transceivers, connectors and installation</td>
<td>Higher bandwidth capabilities</td>
<td></td>
</tr>
<tr>
<td>Higher fiber cost, but lower total system cost</td>
<td>Lower fiber cost, but higher total system cost</td>
<td></td>
</tr>
</tbody>
</table>
• M.I.C.E. provides a method of categorizing the environmental classes for each plant Cell/Area zone

• This provides for determination of the level of “hardening” required for the network media, connectors, pathways, devices and enclosures

• The MICE environmental classification is a measure of product robustness:
  – Specified in ISO/IEC 24702
  – Part of TIA-1005 and ANSI/TIA-568-C.0 standards

• Examples of rating:
  – 1585 Media : M₃I₃C₃E₃
  – M12: M₃I₃C₃E₃
  – RJ-45: M₁I₁C₂E₂
M.I.C.E diagramming allows the design to balance component costs with mitigation costs in order to build a robust yet cost-effective system.
Structured Cabling
- Solid horizontal cable terminated with jacks
- Typically installed and left in place; measured and warrantied performance
- Connected to equipment with flexible patch cords

Point to Point Cabling
- Stranded cable field terminated with plugs;
- Measurements infrequently done
- No standard exists to define the measurement method
- If the green light goes on, then it works
Centralized Cabling
• Home runs from each node back to the network room

Zone Cabling
• Provides for Reduced home-run wiring, easy moves / adds / changes and reduced size of network room
• Single cable terminated to plugs
• Most often stranded conductors for flexibility
  – Solid cable prone to break
  – De-rated length
• Testing can be inaccurate
• Plugs can be hard to terminate reliably for the long term especially for higher bandwidth cable
• Can not plan for the future
  – Extra cables are not secure
Structured Cabling

- Consists of patch cords, jack (patch panel), and horizontal cabling – (also known as perm link)
- Accurately test horizontal cable
- Panduit patch cords 100% tested
- Easier to reliably terminate to a jack compared to a plug
- Can have spare or redundant links
  - Aids in troubleshoot
  - Easier to add connections “on the fly”
  - Can plan for the future
Zone System
Integrated with Rockwell Automation Equipment

- Fully assembled solution
  - Stratix Switch and Power Supplies
  - Multiple configurations
- Zone network topology
  - Reduces cabling installation
  - Localizes network traffic to improve network resiliency
  - Improves capability for network redundancy
  - Reduces cost of future expansion
- System is pre-engineered, pre-tested and pre-validated
  - UL approved panel (UL 508A)
  - Thermally validated
  - Tested for resistance to shock and vibration during shipment
  - Optimized for structured networking
  - Significantly reduces the amount of time when integrating the plant floor and enterprise networks by up to 75%
Dielectric Conduit-ted Fiber Distribution Cable

DIN mount enclosure to break out and protect buffered fibers

Fiber Panel to create testable permanent links on distribution cable

LC to LC Jumpers to Ethernet Switch uplink

Copper patch panel and horizontal cable distribution

Integrated Network Zone
• Industrial Ethernet Physical Infrastructure Reference Architecture Design Guide

• Control Panel White Papers from Panduit and Hoffman
  http://www.panduit-hoffman.com

• Converged Plantwide Ethernet (CPwE) –

• Media Planning and Installation Manual
  http://www.odva.org

• Design Tools:
  – Rockwell Automation Proposal Works
  – Rockwell Automation
    Integrated Architecture Builder (IAB)
    www.rockwellautomation.com/go/tools

• Industrial IP Advantage
  website: www.industrial-ip.org
Where can I learn more?

• Sessions
  • NI02 - Telecommunications Bonding and Grounding – Industrial
  • NI03 - Testing the Physical Layer for Ethernet/IP
  • NI04 - When is a good time to have MICE on your plant floor? Structured Cabling Best Practices (Industrial Ethernet)
  • NI10 - EtherNet I/P Best Practices & Topologies
  • NI13 – The Connected Enterprise
  • NI18 – Remote Access

• Tradeshow
  • Solution Area 3 – Process & Connected Enterprise
  • Werner DataComm Booths