C-Labs solutions for

Lessons Learned from Industrial Ethernets
• 19 Year with Siemens
  • Member of original WinCC Architecture Team
  • Co-Founder of OPC Foundation
  • Microsoft MVP for over 10 years
  • Wrote book on Windows CE in 2000

• 2 Years with Microsoft Windows Embedded
  • PM for Windows XP Embedded 2009
  • Started the System and Services group
  • Developed the “Sensors to Server” marketing campaign

• 5 Years with C-Labs focusing on the IoT: The C-DEngine
  • Delivering a Rapid Application Development Platform for industrial grade solutions for the IoT
  • Engaged in IEEE, OPC Foundation (UA Working group) and PROFINET North America
  • Won the “Entrepreneur of the year 2012 award” from Frost & Sullivan
    • For “plant-to-enterprise integration solutions”
What is Industrial Ethernet used for?

- MES, PLM, DCS, HM and SCADA Applications
- Motion Control
- Controller-2-Controller Communication
- Distributed and Safety I/Os
- Smart and complex Sensors
- High end drives with variable speeds
Why industrial Ethernet did not go with IEEE?

- Real-time could not be achieved with Layer 7 protocols
- 802.1 specification for lower levels not adequate for industrial real-time requirements
- Not enough application outside industrial to drive real-time to 802.1

But...
- Latest efforts of IEEE 802.1 around “Deterministic Ethernet” promise hope
- "IEEE 802.1 Standard for real-time process control, industrial automation and vehicular networks"

Lesson Learned: Standardize early to avoid diversification
Lack of real-time standard lead to diversification

- **Goal was to provide real-time for Ethernet on lower layers**
  - While still providing full support for standard higher layer protocols

- **Several companies working on industrial Ethernet invented competing technologies**
  - PROFINET, EtherNet/IP, EtherCAT, DeviceNET
  - All of them work basically the same but have major differences in package structure, cabling, connectors and setup
  - Don’t plug one network (connector/cable) into another network (connector/cable)!

- **Some are very complicated to setup and even require direct knowledge of MAC addresses**
  - Several vendors bought MAC Address ranges to allow customer to configure network devices

Lesson Learned: Standardize early to avoid diversification
High level protocols on the rise

- While the lower levels work on Real-Time, higher levels are working on interoperability
  - Communicate with other IT and enterprise class devices and services
  - Slowly leading towards the IoT

- Higher level protocols are easier to manage, setup, discover and maintain

- Main player is OPC
  - OPC DA/HA – old standard for Windows only based on COM/DCOM
  - OPC UA (Universal Access) – platform and language neutral based on SOA and WebServices

- Other protocols on the rise
  - Because Ethernet is getting faster (10BaseT to 100 Gigabits)
  - MTConnect achieves almost real-time on Layer 7

Lessons Learned: It was good to allow higher levels in parallel to lower levels – do not block them!
Impact of rising Wireless Technologies

- Wifi becomes de-facto standard for wireless communication
- Bluetooth used in several cases
  - But disrupts Wifi by aggressive hopping
- Wireless requires stronger security to avoid intrusion by unauthorized access
- Many BYODs used on the wireless network only and are only loosely connected
  - Hard to manage for networks used to deal with static IP addresses
- QoS and Reliability solutions are available but not broadly used, yet.

Lesson learned: Plan for wireless networking from the get-go!
Requirement for redundant networks

- Main driver for redundant networks are safety and SIL implementations
- Real-time Network topologies on Layer 4 are very expensive and hard to make redundant
  - Expensive equipment is required and configuration on MAC layer required
- Better approach is to use mesh based protocols with auto-routing features to self-heal
  - But none have made it to standardization level
- Application Layer 7 based mesh protocols might be the solutions and are being tested
  - C-Labs is one of the providers of these solutions
- Ethernet is getting faster
  - Safety solutions can be designed with lower cost networking components

Lesson learned: Look into new ways of creating redundancy
Security issues

- ‘Factory devices will only connect to each other’
  - WRONG! This was true back in the 80s and early 90s!
  - Now most communication between lower layer devices and upper layer services is through ethernet

- The IoT will even bring more connectivity then ever imagined

- Security has to be designed in from the GET-GO!

- Security has to be designed to be easy to deploy and transparent to use!

- Customers just “expect” to have security – and don’t want to invest in extra security devices

Lesson learned: Security has to be included from the get-go and cannot be an afterthought!
The impact of the cloud and IoT

- Many large industrial companies investigate how they can benefit from both

- Cloud brings new opportunities for new business models like services and subscriptions
  - But most companies have no structure or processes for this

- Connectivity to the cloud requires direct internet connection – even if its outbound only
  - IT department policies are often impossible to adhere to by factory devices

- IoT connects devices with each other – that have never known about each other
  - This connectivity brings new value – but adds new challenges
    - Real-time behavior, availability behavior, safety compliance

Lessons learned: Plan network topology layer independent structures to enable cloud and IoT solutions
The latest trend: BYODs and the Factory-Floor

- Enterprises cannot handle the flood of devices coming into the facility
  - Instead of fighting against them, IT has to embrace them!
  - Many different flavors and brands
  - Constantly evolving

- BYODs bring new HMI system requirements …
  - Multi-Touch, Gestures, Stylus and other NUI Input Technologies
  - Biometric logins
  - Stationary HMIs become mobile NMIs
  - Highly distributed data sources – not only cross vendor but also cross networks

Lessons (about to be learned): plan for loosely connected devices – not under your control