NEW TRENDS IN ELECTRIC AUTOMATION SOLUTIONS

Norman Dziedzic
What is Cloud Computing?

NIST Definition of Cloud Computing

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service
CLOUD DEFINITIONS AND ADOPTION

NIST Working Definition Of Cloud Computing
http://www.csrc.nist.gov/groups/SNS/cloud-computing/index.html

Essential Characteristics

Service Models

Deployment Models

Manufacturing Industry Adoption (Global)

Source: IDC's Cloud Survey, 2011

n = 97

MANUFACTURING EXECUTIVE

Cloud Computing & Collaborative Manufacturing
A Cloudy Future
A Cloudy Future

AutoCAD WS Demo of Cloud Functionality
The Inter-Enterprise Nightmare

- The Problem
  - Many different vendors
  - Custom made solutions
  - Proprietary technologies
  - Point-to-point Integration
  - Limited “real-time” information
  - Maintenance nightmare
  - Multiple dependencies

- Solution
  - OPC Unified Architecture

Thomas J. Burke
SOA (Service Oriented Architecture)

Single set of Services
- Query, Read, Write, Subscribe…

Named/Types relationships between nodes

The UA Server embodies the functionality of existing OPC Servers using a single set of services
OPC As Control “Cloud”

OPC Demo

- PLCs: Connect to any PLC through OPC
- Database: Connect to any number of databases
- Central Server: Ignition Gateway with all modules
- Web-launched Clients: Access projects anywhere with an unlimited number of clients
- Web-launched Designers: Design projects concurrently with multiple designers
- Mobile Devices: Access via wireless smartphones and tablets
Smart Sensors

- RFID
- IO-Link

- Color
- Contrast
- Capacitance
- Background Suppression

Characteristic curve

Analog output

Easy setpoint adjustment
Do Everything HMIs…

- Data Logging / Database Connection
- Recipes
- Security / Audit Trail

- Language Change
- Passthru Data
- PLC Functionality
- Remote Access
- Multiple PLC Configurations
Smart Everything

- Smart Connectivity
  - Reduce Mistakes
  - Greatly Reduced Installation Time
  - Added Diagnostics
  - Automatic Addressing
  - Integrated Power
  - Integrates with existing industrial buses
Smart Everything

- Smart Drives /
  Motors /
  Valves
Smart Everything

- Vision
- Measurement
- Tagging
Super Smart Machine Vision?

- The light field sensor captures the **color**, **intensity** and vector **direction** of the rays of light.
- Image can be focused later via software
- Possibility to Use one camera to inspect multi level part
- [Sample Image](#)
Is Smaller Smarter?

One and done: Single-atom transistor is end of Moore's Law; may be beginning of quantum computing

February 19, 2012

A controllable transistor engineered from a single phosphorus atom has been developed by researchers at the University of New South Wales, Purdue University and the University of Melbourne. The atom, shown here in the center of an image from a computer model, sits in a channel in a silicon crystal. The atomic-sized transistor and wires might allow researchers to control gated qubits of information in future quantum computers. (Purdue University image)

Download Image (http://news.uns.purdue.edu/images/2012/klimeck-atom.jpg)
Smart Everything
Tablets Everywhere

- Why Tablets?
  - Portability
  - Instant ON time
  - Connectivity
  - Office Integration
  - Cool Factor

iPad Demo

Image courtesy of Apple Inc.
Smart Everything

- Smart Programming: IEC 61131-3
  - A Language for every need?

  Ladder Logic (LD)

  Instruction List (IL)

  Function Block (FB)

  Structured Text (ST)

  Sequential Function Chart (SFC)
Smart Everything

- Smart Programming: IEC 61131-3
  - Object Oriented Programming
  - User Created Function Blocks
Smart Everything

- Smarty Pants

- Is Smarter Always Better?
- What Does it Take to be Smart?
- What is Smart Management?
THERE IS AN ENERGY REVOLUTION TAKING PLACE

Less Power to the People 😊
Thin is In!

Weight is being rung out of almost everything resulting in great material and shipping savings.

Now the challenge is handling these more fragile products

It’s Hip to be Square

To increase packaging density, more square and rectangular designs are in vogue

New gripper and fixture designs are required as parts move away from round shapes. Changeover can be more complex as well with square shapes.
Conservation of the Basics

- Compressed Air
  - Minimize Pressure eliminate leaks

- Electricity
  - New AC Motor Standards EISA End of 2010
  - Regenerative Drives Re-Capture Deceleration Energy

- Water
  - In 1930
    - Producing 1 Ton of Steel Required
    - 200 Tons of Water
  - In 2005
    - Producing 1 Ton of Steel Required
    - 5 Tons of Water
The Energy Ripple Effect of a Thinner/Lighter Part Design

- Less Raw Material
- Less Energy to Process the Material
- Lower Energy Required to Produce Part
- Less Energy to Ship Material to Plant
- Less Energy to Ship Part to Customer
- Less Energy to Recycle at End of Life
- Lower Energy Required to Produce Part
- Less Energy to Ship Material to Plant
- Less Energy to Process the Material
- Less Raw Material
- Now the challenge is to handle these lighter, thinner parts through manufacturing and shipping.
The Energy Ripple Effect of Efficient Panel Design

- Less Raw Material for Enclosures
- Less Energy to Fab Enclosures & Make Wire
- Less Energy to Cool Enclosures
- Less Energy to Recycle at End of Life
- Less Energy to Ship Enclosures & Wire to Plant
- Smaller Machine Footprint
- Less Energy to Ship Machine to Customer
- Less Energy to Ship Machine to Customer
Safety Up Front
And
Functional Safety

Do you know your MTTFd? 😊
Safety Up Front

- Traditional Machine Building

- Mechanical Build
- Field Wiring
- Commission Test
- Debug
- Measure by Hand
- Hard Guard
- Light Curtains or Scanners
Safety Up Front

- New Machine Design & Building

- Risk Assessment Early in Process
- Consider Safety During Setups, Changeovers, Maintenance
- Select Safety Components Based on Required Performance Level
- Safety is not an “Add On” or Rushed at End of Project
Safety Up Front

Safe Motion Functions

• Safe Standstill / Safe Operational Stop
• Safely Reduced Velocity / Increment
• Safe Direction of Movement
• Safely Limited Absolute Position
• Safe Brake Management
Safety Up Front

Safety Controllers
- Consolidate Wiring
- Multiple Safety Devices
- One or Multiple Outputs
- Multiple Functions

Curtains
Mats
Scanners
Rope Pull
2 - Hand
Safety Standards Musical Chairs

Out with the old

• EN954-1 Gone Dec 31, 2011

In with the New

• EN ISO 13849-1
Safety Standards Musical Chairs

New (EN ISO 13849-1)
Performance Levels

Old (EN 945-1)
Categories

Risk Graph from Annex A of EN ISO 13849-1

Risk Graph from Annex B of EN 945-1
Safety Standards Musical Chairs

New Buzz Words

• **SRP/CS**: Safety-Related Parts of Control Systems
• **PFH_d**: Probability of a dangerous Failure per Hour
• **PL_r**: Performance Level Required
• **MTTF_d**: Mean Time to Dangerous Failure
• **DC**: Diagnostic Coverage
• **CCF**: Common Cause of Failure

New Tools

• **SISTEMA**: Software Tool to determine Performance Levels
• **Manufacturer Databases**: Data on MTTFd to use in SISTEMA
Functional Safety

16508-1

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ETHERNET EVERYWHERE
Ethernet Everywhere

- What is “Ethernet?”
  - Cables?
  - Connectors?
  - Computers?
  - Networks
  - World Wide Web?
Industrial Ethernet generally means a specific protocol

- Sercos III
- Ethernet/IP
- Modbus/TCP
- EtherCAT
- Profinet
- Powerlink
- …
Proliferation of cheap laptops and netbooks means Ethernet hardware is easy to access and use.

- Many devices now include a Web Interface for configuration
- Only a web browser is required for setup

The Good:
Ethernet can provide a connection to anywhere in the world

The Bad:
Ethernet can provide a connection to anywhere in the world
Knowledge of Ethernet basics is now absolutely **essential** for the controls engineer!

- Can you change the IP address of your computer?
- Do you know what a sub-mask is?
- Do you know how to ping an address?
- Are we running out of addresses?
Ethernet Everywhere
What is this IPv6 Stuff About?

• IPv4
  • allows approximately 4.3 Billion Addresses in the format: \(192.168.1.55\)
  • Every PUBLIC device needs a unique address
  • While not really used up, all addresses are allocated!

• IPv6
  • allows approximately \(3.4 \times 10^{38}\) addresses in the format \(fe80:0:0:0:202:b3ff:fe1e:8329\)
Average Users:
No Noticeable change as translation will occur for them automatically on outbound and inbound traffic

Controls Engineers:
Will need to understand IPv6 to connect control systems between plants and from suppliers to end users.
Pulling the Old *Switcheroo*...

- How about the difference between *managed* and *unmanaged* Ethernet switches?
- What about routers?
- Can you secure your network?
IT’S A WIRELESS WORLD

Wires, we don’t need no stinking Wires! 😊
A multitude of Options

- 802.11a/b/g/n (Wi-Fi)
- 900 MHz
- Bluetooth
- GSM Modems
- HART (highway addressable remote transducer)
- ISA 100.11a
- ZigBee
- Light Flashes?
Wireless World

- Why Wireless?
  - Ease of Installation
  - No Need to run Wires
  - Remote Locations
  - Rotating Equipment
There is general acceptance of Wireless for Monitoring Functions

But Less willingness to use wireless for Control. Users want “Determinism” (generally 10msec response – guaranteed)

Site Survey is the key to installation success

Security is also an issue
Wireless World

Range
How far will it go?

Circles of Success

- **Performance Zone**
  - Path Engineering Required
  - Wireless Conduits up to 20 miles

- **Common Sense Zone**
  - Success with Experience
  - Wireless Conduits up to 1/2 mile

- **No Worry Zone**
  - This is “Electricians’ Territory”
  - Wireless Conduits up to 1/4 mile

Distance

Received Signal Strength

Receiver Threshold
Wireless World

Intentional Interference

Eavesdropping | Data Injection | Data Manipulation

Public Standards
- Radio “language” is known.
- Equipment is readily available.
- Encryption is the only protection.

Proprietary Systems
- Non public air interface.
- Equipment available to “insiders”.
- Un-known technology is a significant barrier.
- Encryption helps.
NEW TRENDS IN AUTOMATION

Smart Everything

- Wires, What Wires?
- Energy Revolution
- Ethernet Everywhere
- Safety up Front

Wires? Everywhere? What?