Industrial Automation and Emerging Single-pair Ethernet

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Purpose

- Present an overview of a range of Industrial Automation applications

- Update the prior presentation from 802.24
  - brandt_24_1_1114.pdf

What is Industrial Automation?

- An Industrial Automation Definition:
  - "Application of *technology* to transform *raw materials* into *finished goods*"
    - Moving materials
    - Manipulating materials

- Some technology evolutions
  - Automation degree: Manual (tools) -> Semi-automatic -> Automatic
  - Power source: Human -> animal -> water -> fuel -> electricity
  - Technology: Mechanics -> fluidics -> relays -> electronics

Interconnection of components

- Industrial Automation components
  - Sensors, Actuators, Controllers, Human Interfaces, Information Interfaces
- Generic components are *interconnected* into application systems
  - Power connection
  - Control and information connection
    - Hardwired -> Networks
- Some interconnection goals:
  - Reliable, integrated, simple to apply, economical

Potentially applicable standards

- A wide range of IEEE standards apply to Industrial Automation
  - Power and energy
  - Communication
  - Information

- IEEE Scope for this presentation is 1-Pair Ethernet:
  - IEEE P802.3bp, Multi-Gig CFI
  - 10SPE
    - Long reach
    - Low cost
  - IEEE P802.3bu 1-Pair Power over Data Lines (PoDL)

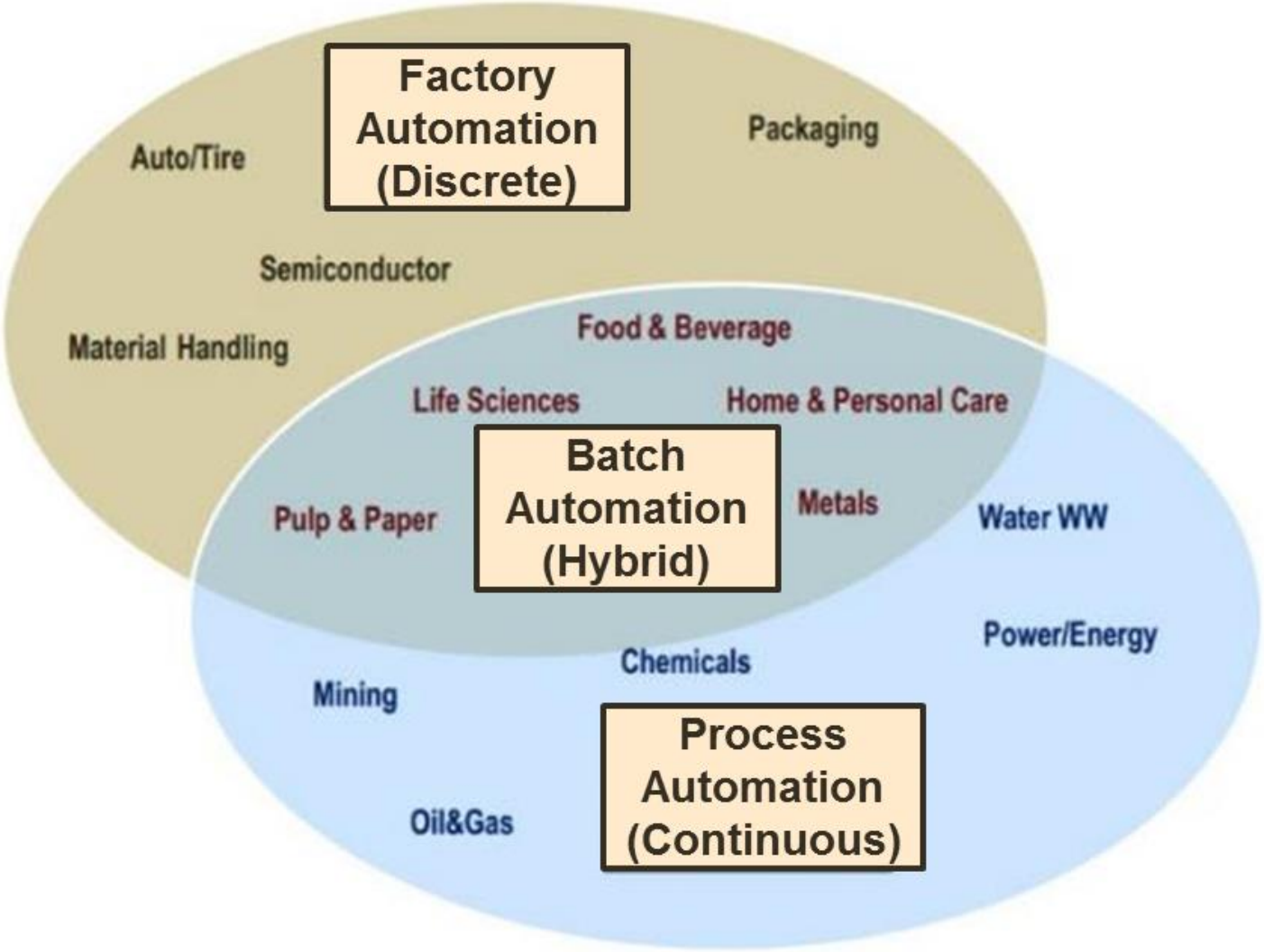
Huge estimates of potential

- In their report “Industrial Internet of Things – 2014”, industry market analysis firm IHS Technology forecasts that there will be (2015):
  - 50B node installed base at 13% connected (sensors, actuators, controllers, interface modules, operator interfaces, IT infrastructure, instrumentation, servers, etc.)
  - 6B new node shipments at 31% connected
  - 1.8B new wired nodes with 11.7% CAGR

There are a very wide range of estimates.

Barrier exist to much of the Ethernet adoption.

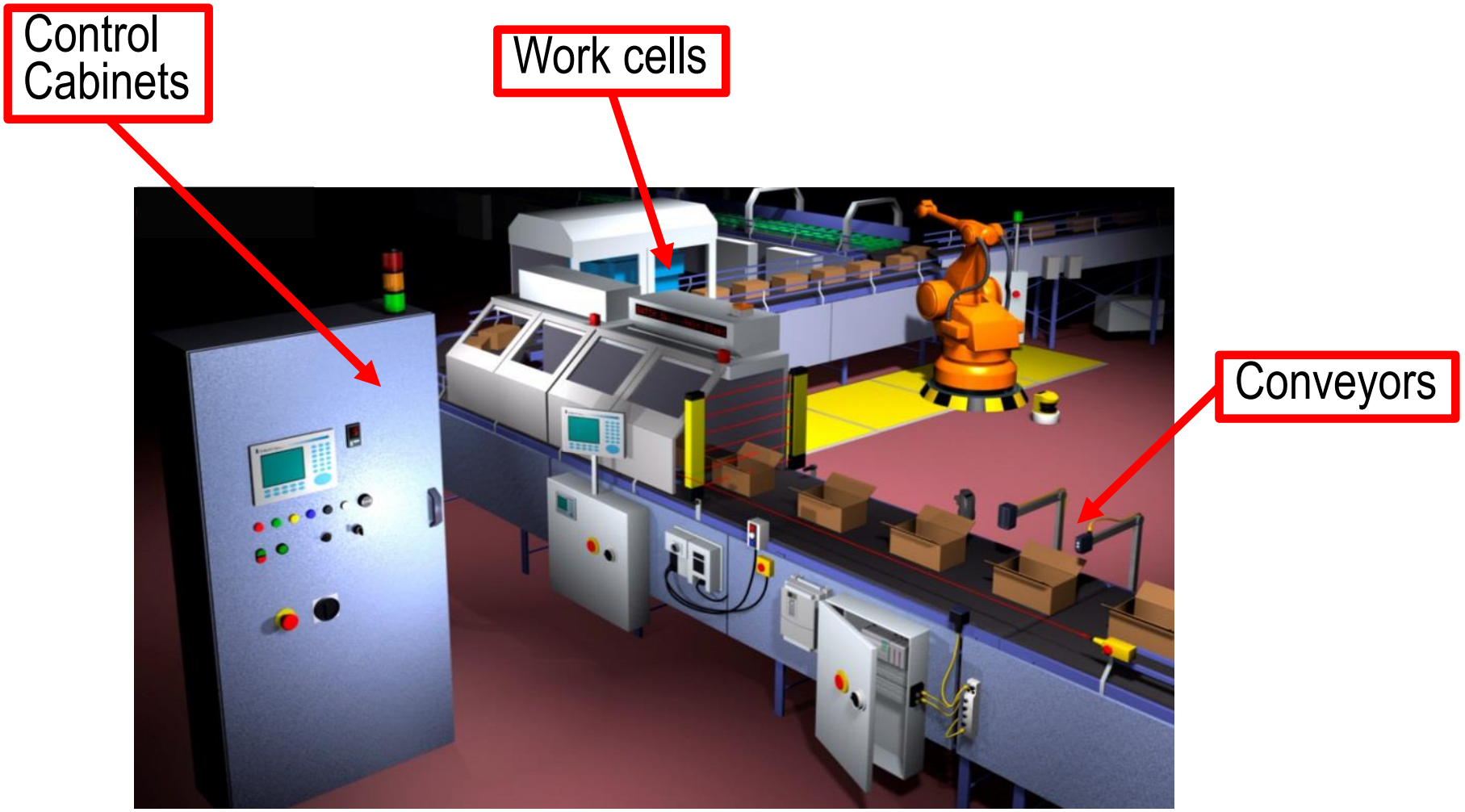
Basic Automation Domains



Networking breakdown

- CFI: Existing Ethernet (~1/3 of networked devices)
  - Relatively short distance (most <40 m)
  - High performance (100 Mb/s -> 1 Gb/s)
- CFI: General-purpose Fieldbuses (~2/3 of networked devices)
  - Long reach (1000 m)
  - Low rates (10 Mb/s)
  - Some Intrinsically Safe
- Other: Component links and discrete wires
  - Very cost sensitive
  - Relatively short distance
  - Low rates (10 Mb/s)

Factory Automation Modules



In-cabinet and On-machine cabling

In-cabinet
IP20
RJ45 Ethernet

On-machine
IP67
M12 Ethernet

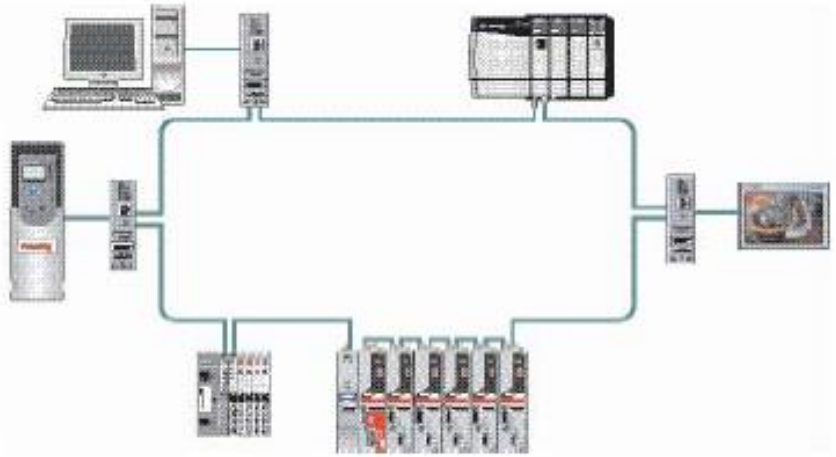
Bulkhead
Adapter

Segment

Segment

In-cabinet

- Dense node packing
- #1: Some high performance, linear configuration of dual-port nodes
  - Cable lengths rarely > 15m

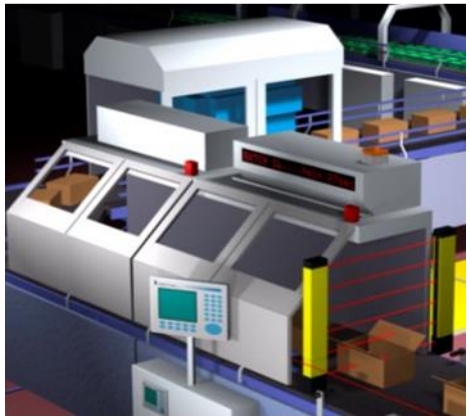


- #2: Many low performance, low cost, <u>bus topology and hardwired</u>
  - Total length < 50m

On-machine

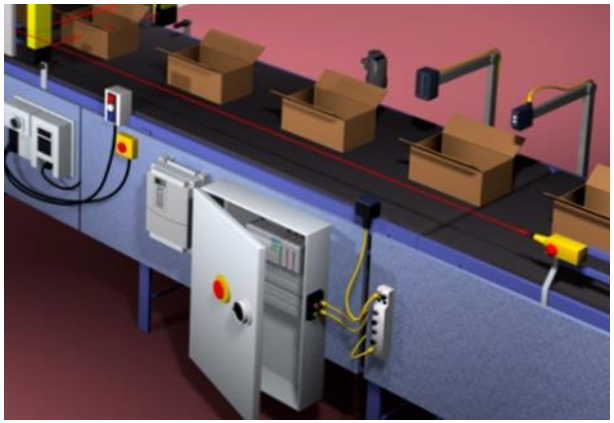
Work Cells

- Nodes spread to best physical position
- Somewhat bigger than the product
  - i.e., an Automobile
- Linear configuration of dual-port nodes
  - Cable lengths rarely > 40m



Conveyors

- Nodes distributed along length
- Often modular
  - i.e., 3m sections
- Linear configuration of dual-port nodes



Plant-wide applications
Factory Automation

- Large products made with large equipment over large areas
  - Airplanes
  - Cement
  - Aluminum
  - Mining
  - Etc.
- Fieldbuses
  - Long reach (1000 m)
  - Low rate (10 Mb/s)

Plant-wide applications
Process Automation

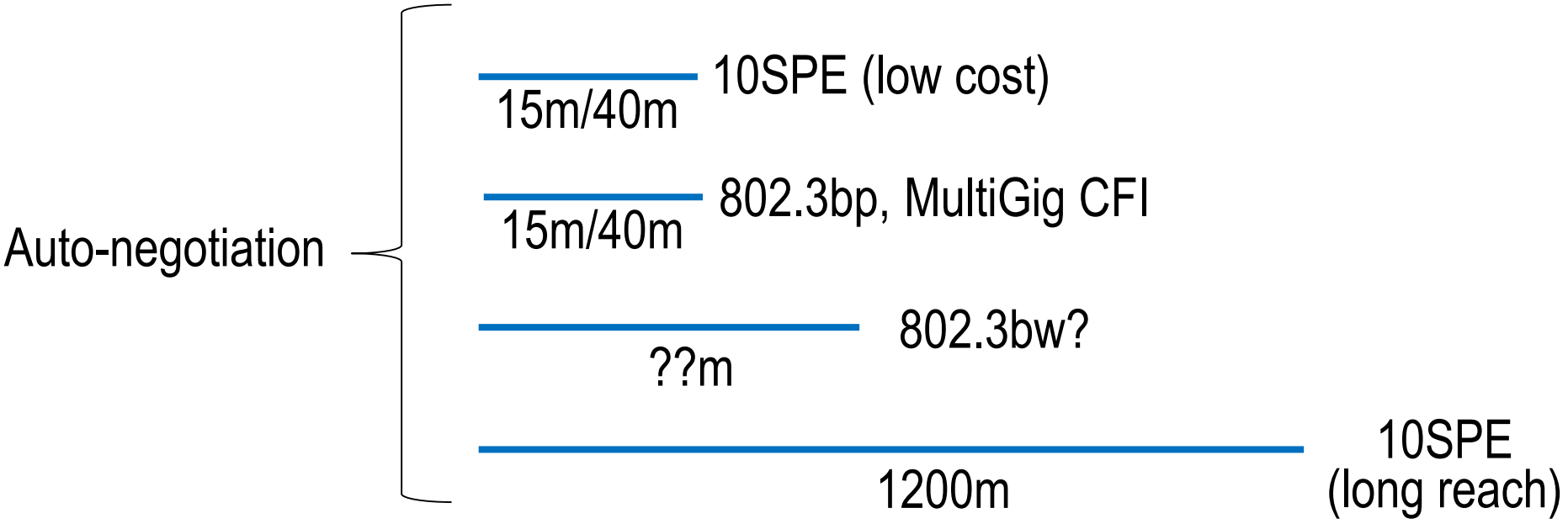
- Nodes spread over large site
- Star topologies
- Legacy cable runs (1000 m)
- Low update rates (10 Mb/s)
- Intrinsic Safety

Process Automation “Skids”

- Skids are reasonably small, but:
  - Same devices as Plant-wide (1000 m, 10 Mb/s, IS)

Single pair application coverage

- Multiple single pair standards are required to cover all applications
- Auto-negotiation is beneficial
  - Increased future rate trends
  - Option to extending distance with reduced rate
  - Flexible switch ports minimize conversions



Power

- Industrial Automation nodes require power
- Various applications will benefit from two strategies
  - 1-pair Ethernet within a “harness” that includes power
    - 24VDC is common
  - 1-pair Ethernet + PoDL

Conclusions

- Major segments within Industrial Automation can benefit from the ongoing 1-pair Ethernet developments
  - Factory Automation
    - In-cabinet, On-machine, Plant-wide
  - Process Automation
    - Skids, Plant-wide
- Various requirements are being addressed:
  - High performance: 802.3bp, Multi-Gig CFI
  - Low cost: 10SPE
  - Long reach: 10SPE
- Auto-negotiation extends the benefits of the individual 1-pair standards