Industrial Automation Bus Topology

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Purpose

- The purpose of this presentation is to examine bus topology relevance for Industrial Automation

Reference

Industrial Automation and Emerging Single-pair Ethernet

- http://www.ieee802.org/3/10SPE/public/adhoc/brandt_083116_10SPE_01_adhoc.pdf

- Describes:
  - Substantial market forecasts exist for Industrial Internet of Things
  - **In-cabinet**, On-machine, and Plant-wide applications
  - Components that are very cost sensitive, have low performance and short distance requirements
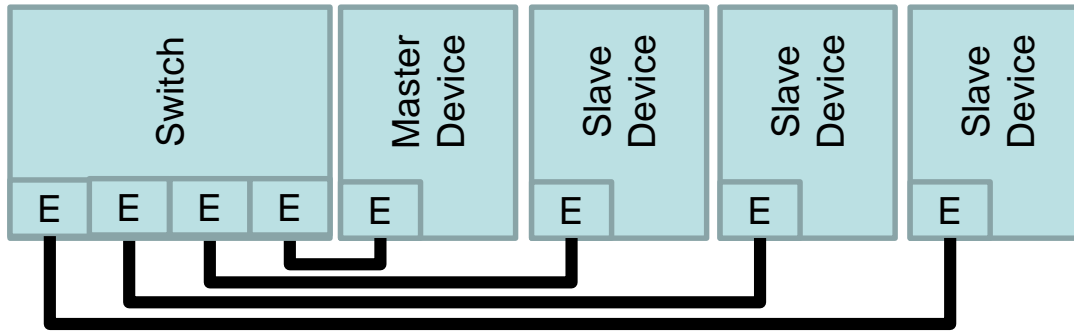
In-cabinet Devices

In-cabinet characteristics

- Many densely packed devices
- Default is hardwired
  - Devices becoming "smart", driving network connection (via **CAN, LIN**, etc.)
- Low performance requirements
- <u>Very</u> cost sensitive devices

- "Device" fieldbus networks are commonly <u>bus topology</u>
  - Total length < 50m
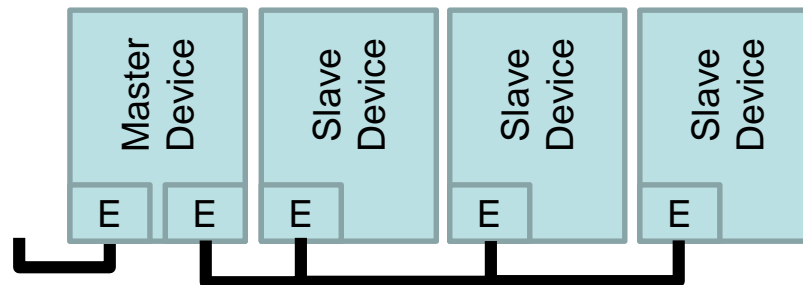
Average interfaces per device

Star
- Many switches
- Bundles of wires
- 2 interfaces per device
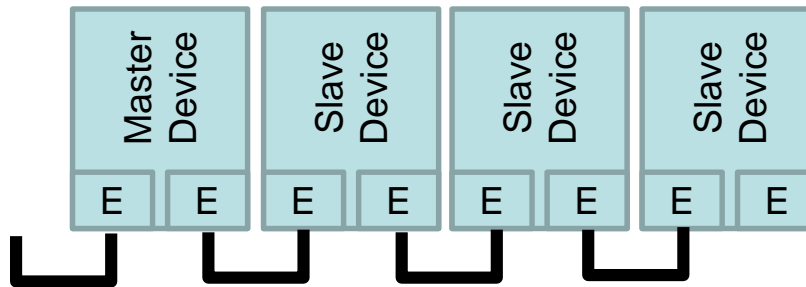
Linear
- Few switches
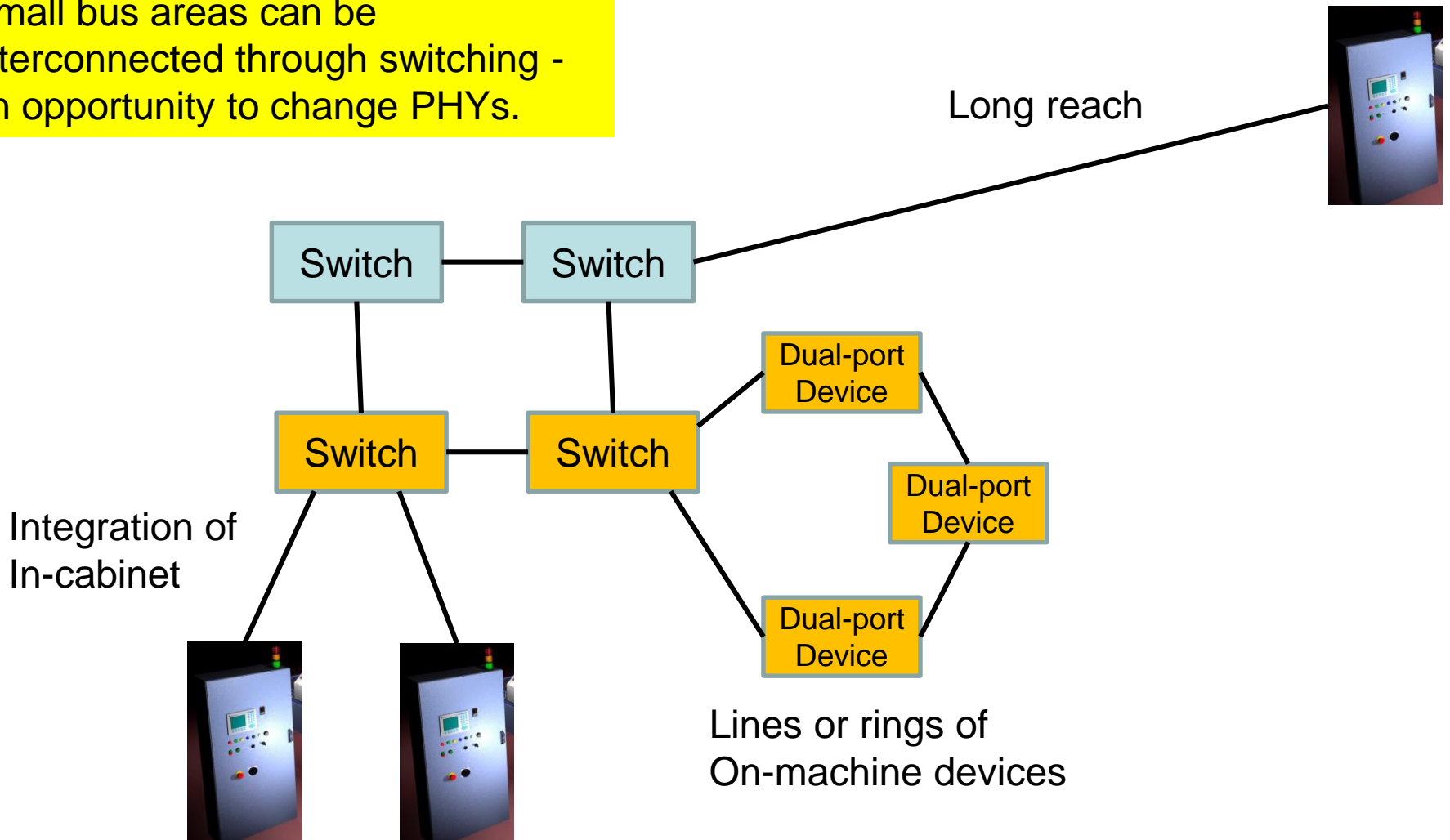- No bundles of wires
- 2 interfaces per device

Bus
- Few switches
- No bundles of wires
- **Average approaches 1 interface per device**

Example topology

Small bus areas can be interconnected through switching - an opportunity to change PHYs.

Long reach

Switch — Switch

Switch — Switch

Dual-port Device

Dual-port Device

Dual-port Device

Integration of In-cabinet

Lines or rings of On-machine devices

Power

- In-cabinet power:
  - 1-pair Ethernet + PoDL
    - Communication and sensors
  - Separate power in the same cable
    - Actuators
    - Saves additional wiring

Determinism

- First thought on bus is CSMA/CD which creates collisions and determinism issues
- But:
  - Applications are Master/Slave
  - Traffic is periodic
  - Timing can be controlled to avoid collisions
  - IEEE 802.1 TSN scheduling techniques could be applied
- Low latency event traffic and client/server efficiency may present technical challenges

Conclusions

- In-cabinet industrial automation could benefit from a bus Ethernet solution

- There may be a good match with transportation requirements in cost sensitivity and reach