



Single Wire Coexistence of sercos and EtherNet/IP

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Technical Track

Single Wire Coexistence of sercos and EtherNet/IP

Outline

- ▶ History
- ▶ New requirements
- ▶ Targets
- ▶ Topology
- ▶ Structure of communication cycle
- ▶ Ethernet advantages
- ▶ Why EtherNet/IP and sercos?
- ▶ Application Scenarios
- ▶ Verification

Single Wire Coexistence of sercos and EtherNet/IP

History

- ▶ All fieldbusses migrate to Ethernet
 - Increases speed & reduces number of cabling systems
- ▶ CIP covers several physical layers and has defined support of bridging and routing
- ▶ sercos
 - Was introduced for usage in digital drives
 - Focused on closed loop control, synchronization, uses TDMA
 - sercos III
 - Uses Industrial Ethernet keeping the TDMA principle
 - Real time Ethernet is kept separate from standard Ethernet
 - Standard Ethernet used for commissioning and diagnosis

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New requirements

- ▶ Safety of machinery
 - Use standard network interface
 - Reduce cost of
 - Implementation (common stack)
 - Test (common tools)
 - Certification (process, tools)
 - Leads to advantages for
 - Vendors
 - OEM
 - End users

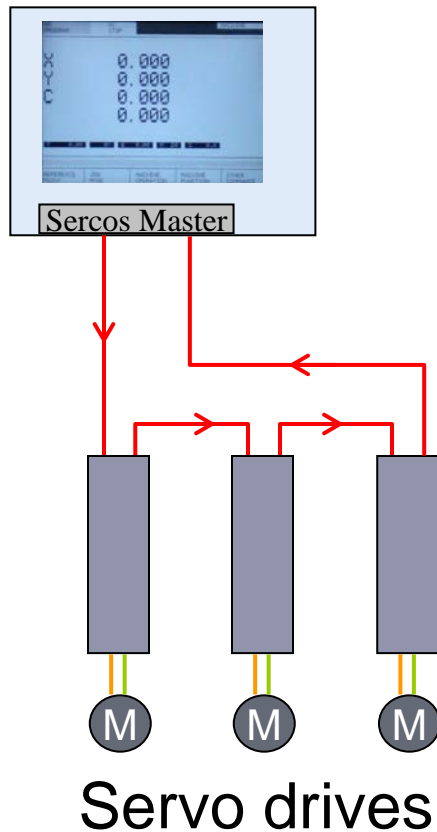
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Targets

- ▶ Industrial Ethernet system use the same physical layer
 - Not all systems can coexist in one network
 - Full/half duplex issues
 - Different time synchronization methods
 - Conflicting priorities
- ▶ Targets for EtherNet/IP and sercos
 - Reduce complexity
 - Reduce costs
 - Extend variety of usable products

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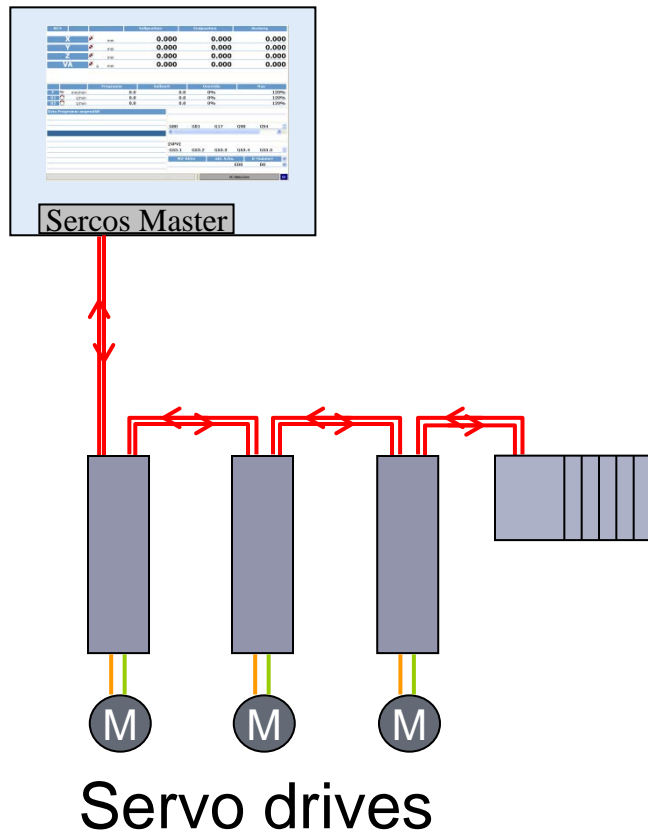
Topology of sercos I & II



- ▶ Target: machine tools
- ▶ Fiber optic ring
- ▶ Single fiber
- ▶ No redundancy
- ▶ High noise immunity

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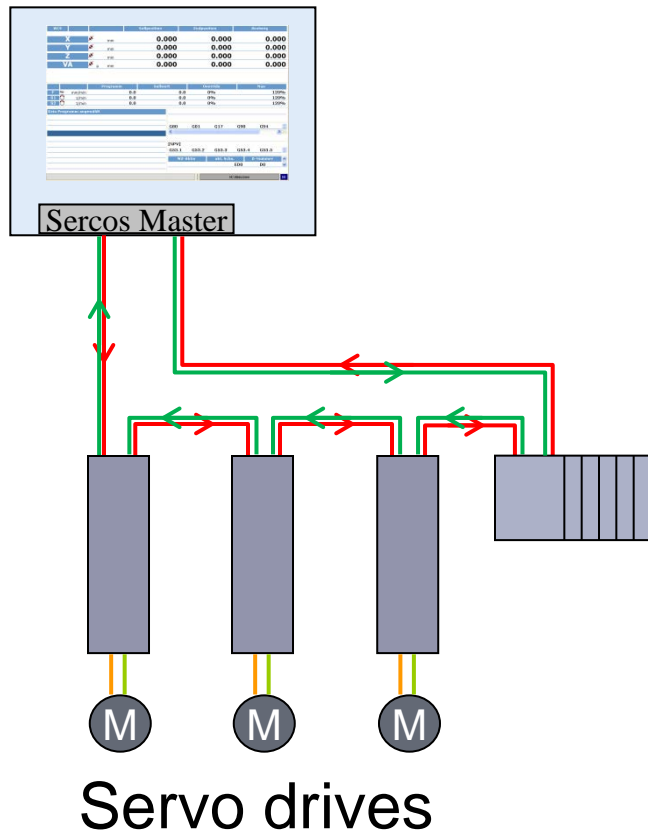
Topology of sercos III



- ▶ Target: all machines
- ▶ Ethernet 100Mbps, full duplex
- ▶ Both directions
- ▶ Hot plug extensible

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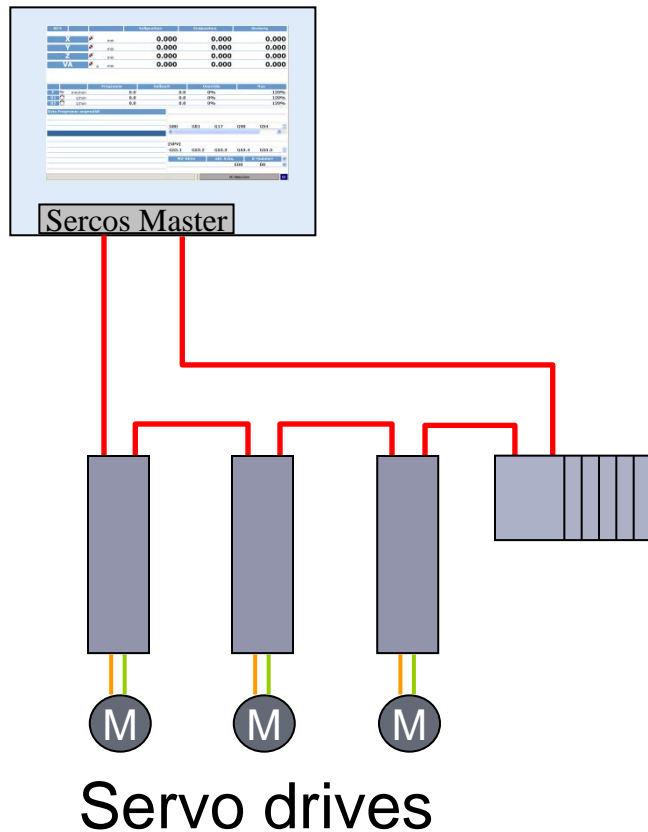
Topology of sercos III



- ▶ Target: all machines
- ▶ Ethernet 100Mbps, full duplex
- ▶ Both directions
- ▶ Hot plug extensible
- ▶ Media Redundancy

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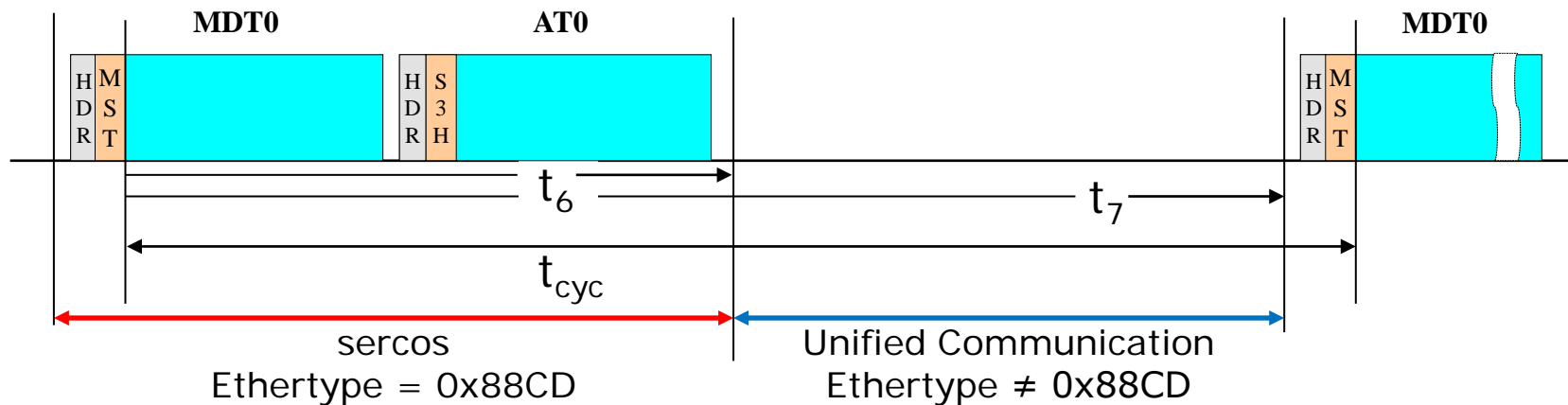
Topology of sercos III



- ▶ Target: all machines
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Structure of communication cycle



MDT: Master Data Telegram

HDR: Header

MST: Master Sync Telegram, timing precision depends on master, compensated for slave order

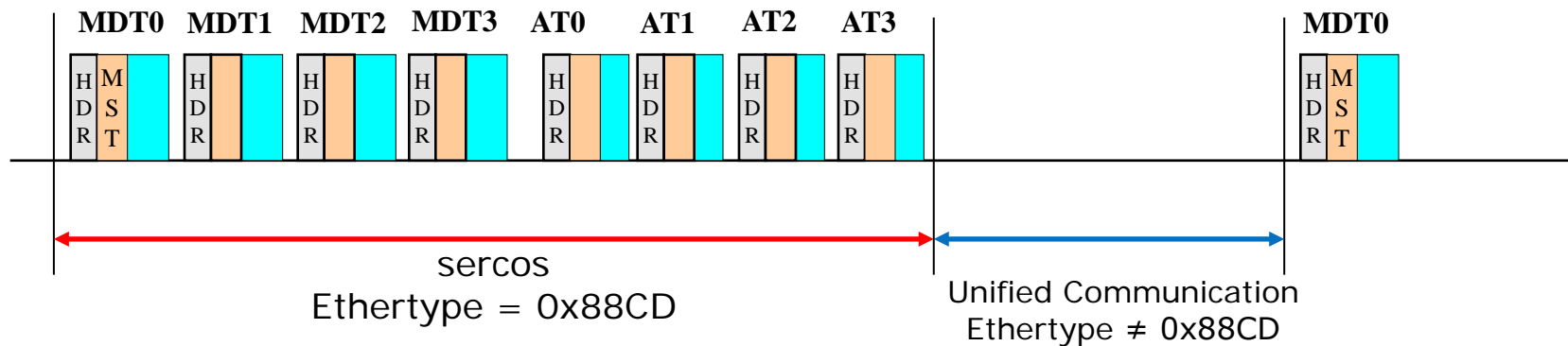
t_{cyc} : cycle time

AT: Answer Telegram

S3H: sercos III header

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Structure of communication cycle



Examples

- ▶ Only MDT0 and AT0: up to 70 sercos III devices using 250µs; cycle time 1ms leaves 750µs for EtherNet/IP (≈ 37 devices)
- ▶ 64 sercos III devices with 2ms cycle time and 400µs sercos time slot
→ leaves 1600µs for EtherNet/IP (≈ 80 devices)

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Ethernet advantages

- ▶ Common cabling
- ▶ Increased data rate
- ▶ Network connectivity using standardized protocols
- ▶ Integrate non-sercos devices
 - e.g. barcode reader
- ▶ Direct commissioning access
- ▶ Remote diagnostics to field device
- ▶ Extended application coverage by integrating new devices

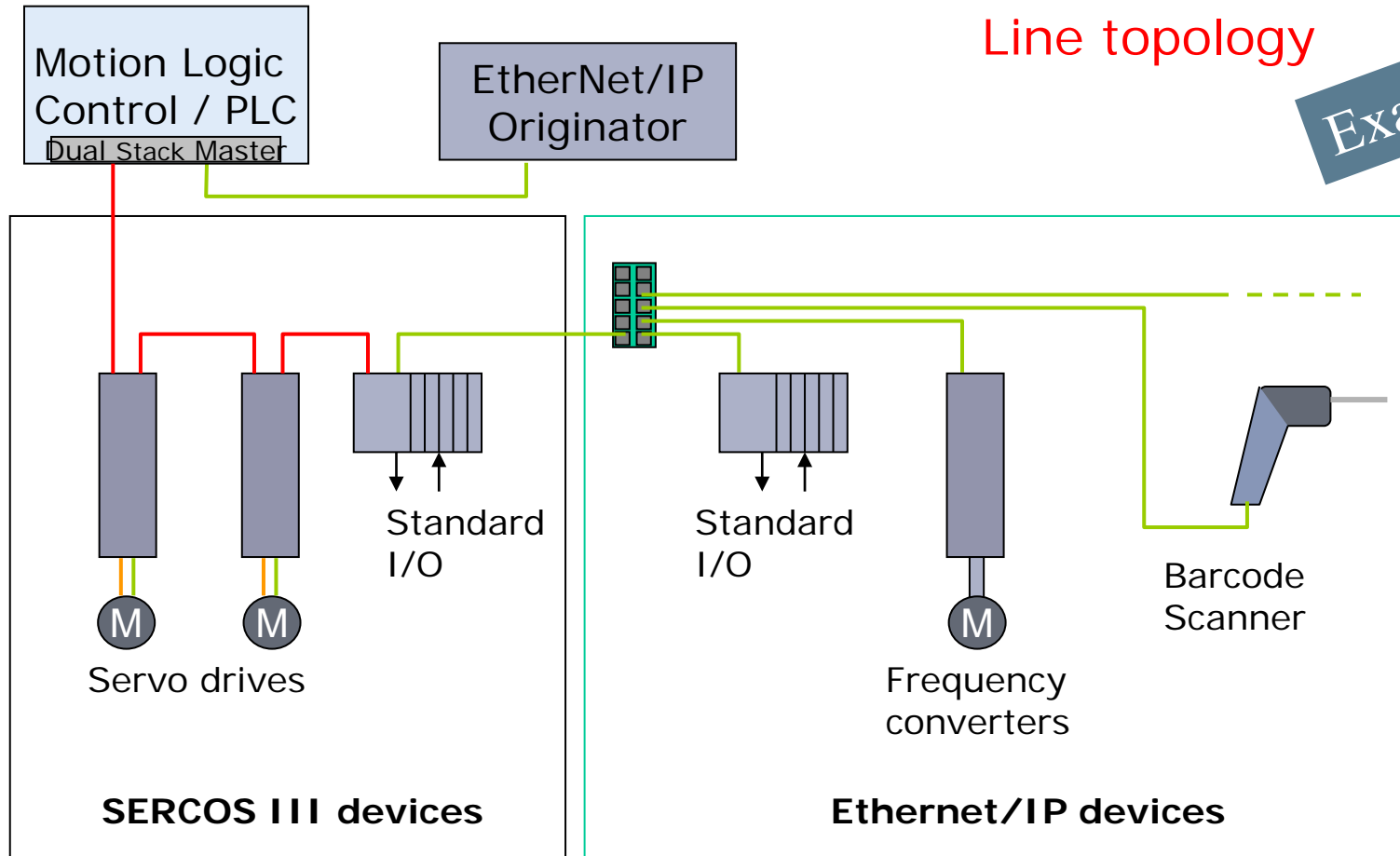
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Why EtherNet/IP and sercos

- ▶ Wide choice of EtherNet/IP products
- ▶ CIP is designed for internetworking
- ▶ CIP is designed in an object oriented way straight from the beginning
- ▶ EtherNet/IP is fairly easy to implement
- ▶ EtherNet/IP stack has a relatively small footprint
- ▶ EtherNet/IP is proven technology
- ▶ sercos and EtherNet/IP share the “CIP Safety” common safety protocol

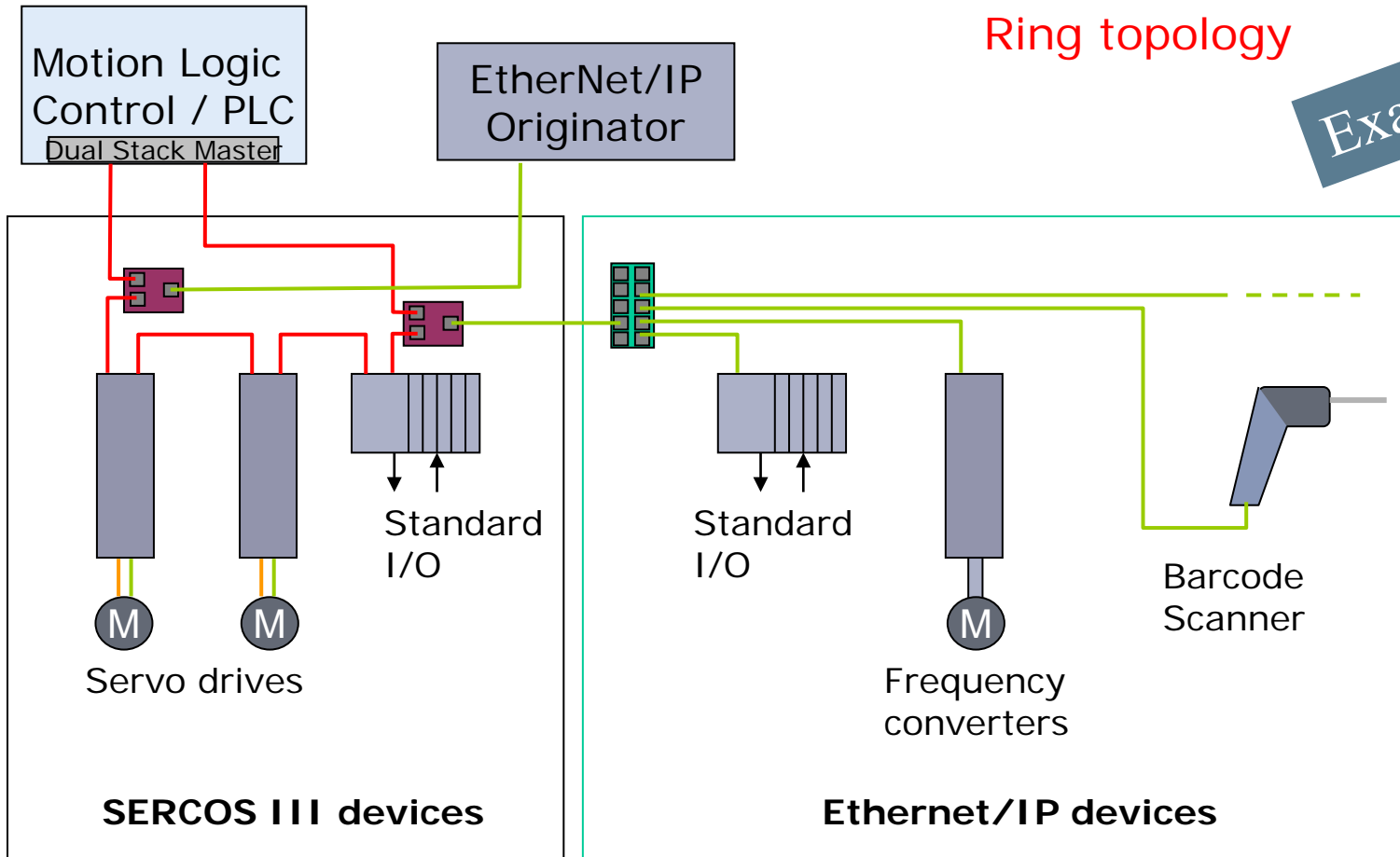
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Examples for SWC



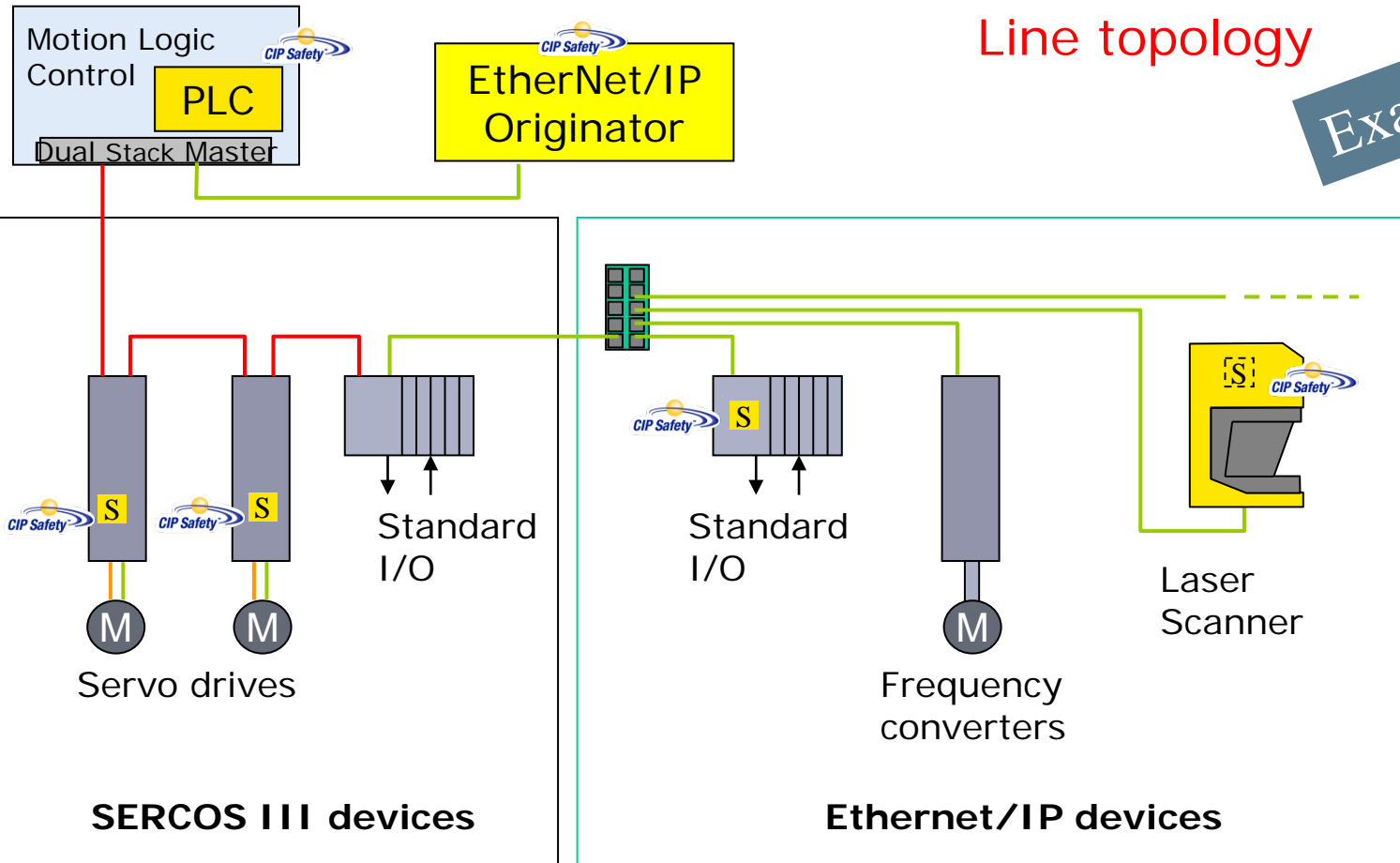
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Examples for SWC



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Examples for SWC



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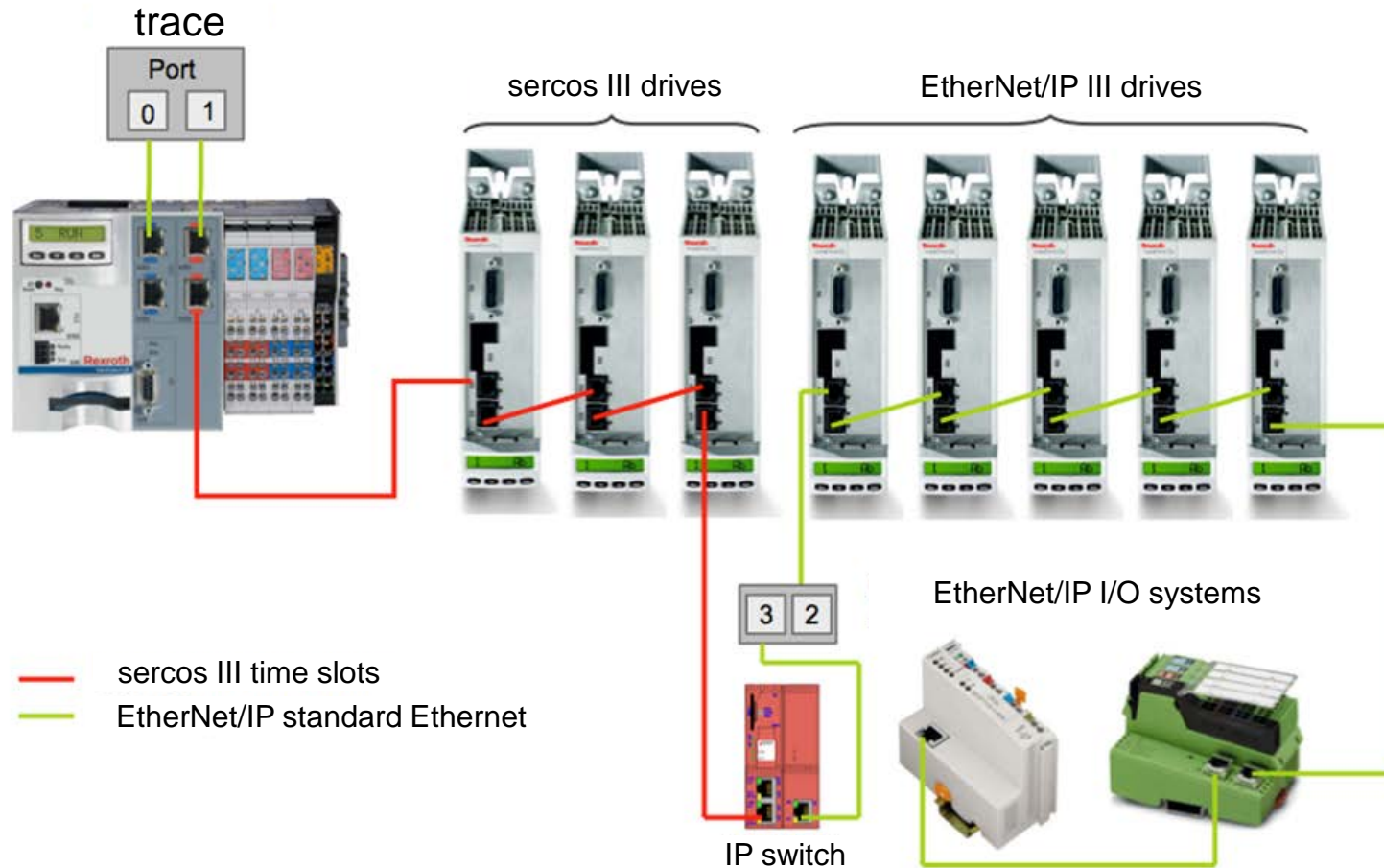
Proof of Concept

- ▶ Criteria
 - No timeout of EtherNet/IP connections
 - No broadcast conflicts
 - Limits only by bandwidth or controller capacity

- ▶ Additional requirements
 - Predetermined number of devices at configuration stage
 - Common physical layer cabling rules

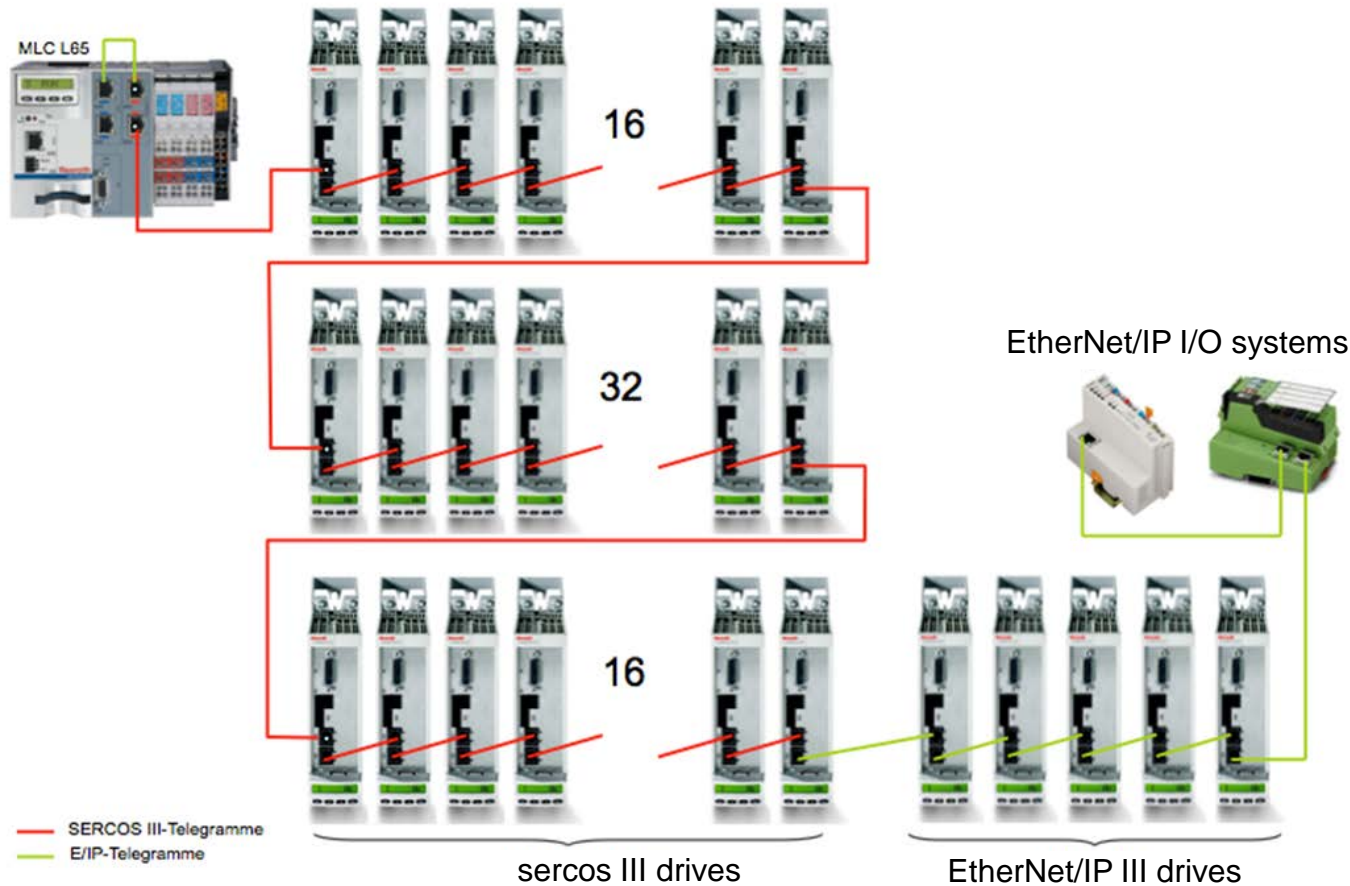
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Basic configuration



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Extended configuration



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Results

▶ Criteria

- No timeout of EtherNet/IP connections
 - Changes in sercos startup
- No broadcast conflicts
 - Changes in end of line behavior
- Limits only by bandwidth or controller capacity

▶ Additional requirements

- Predetermined number of devices at configuration stage
 - Excel sheet
- Common physical layer cabling rules
 - No conflicts

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Summary

- ▶ EtherNet/IP and sercos can coexist in a blended network
- ▶ EtherNet/IP is the best choice for adding devices in the Unified Communication channel
- ▶ Market extension
 - EtherNet/IP devices can be operated by a sercos/EtherNet/IP dual stack master
 - sercos motion applications can access the huge variety of EtherNet/IP devices
- ▶ Limits: CIP sync and CIP motion are currently not supported