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
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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

Servo drives
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Topology of sercos III

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

Servo drives
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Topology of sercos III

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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

MDT0

AT0

MDT0

$t_6$

$t_7$

$t_{cyc}$

sercos

Ethertype = 0x88CD

Unified Communication

Ethertype ≠ 0x88CD

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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

- Motion Logic Control / PLC
- EtherNet/IP Originator

Line topology

Example

- Servo drives
- Standard I/O

SERCOS III devices

- Frequency converters
- Standard I/O

Ethernet/IP devices

- Barcode Scanner
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Examples for SWC

Motion Logic Control / PLC
Dual Stack Master

EtherNet/IP Originator

Servo drives

Standard I/O

SERCOS III devices

Frequency converters

Ethernet/IP devices

Ring topology

Example

Barcode Scanner
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Examples for SWC

Motion Logic Control
PLC
Dual Stack Master
EtherNet/IP
Originator

Line topology
Example

SERCOS III devices
Servo drives
Standard I/O
Frequency converters
Laser Scanner

Ethernet/IP devices
M
S
S
M
M

S
S
M
M
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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

- trace
- Port
- sercos III drives
- EtherNet/IP III drives
- EtherNet/IP I/O systems
- sercos III time slots
- EtherNet/IP standard Ethernet
- IP switch
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Extended configuration

sercos III drives

EtherNet/IP I/O systems

EtherNet/IP III drives
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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