



SERCOS goes Ethernet

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Where Does SERCOS Come From?



- 1986 ● VDW/ZVEI “Digital Drive Interface” task force founded.
- 1990 ● Release of the initial SERCOS interface Specification.
 - IGS, the SERCOS interface Organization, founded.
 - 1st testing laboratory at the Univ. of Darmstadt.
- 1993 ● SERCON410 ASIC developed.
- 1994 ● SERCOS North America founded.
- 1995 ● 1st edition of IEC 61491 approved.
- 1998 ● SERCOS Japan founded.
 - European Standard EN 61491 approved.
- 1999 ● SERCON816 ASIC developed.
- 2001 ● 2nd Edition of IEC 61491 approved.
- 2003 ● Ethernet-based SERCOS III announced.
- 2005 ● First SERCOS III product released.

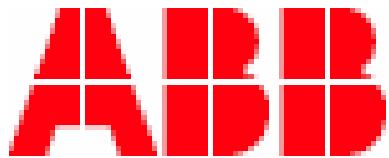




Who Started SERCOS?



The VDW/ZVEI Working Group



Indramat





What Were the Working Group's Goals?



- Open Interface Between Drives & Motion Controls
- Technology Independent
- Multi-Axes Synchronous Operation
- High Speed
- High Resolution
- Economically Practical
- Standardize as Much as Possible!
- Internal Data & Diagnostic Access
- Features & Aids for Troubleshooting



Who is SERCOS Today?





What Does SERCOS Mean?



SErial

Real-time

COmmunication

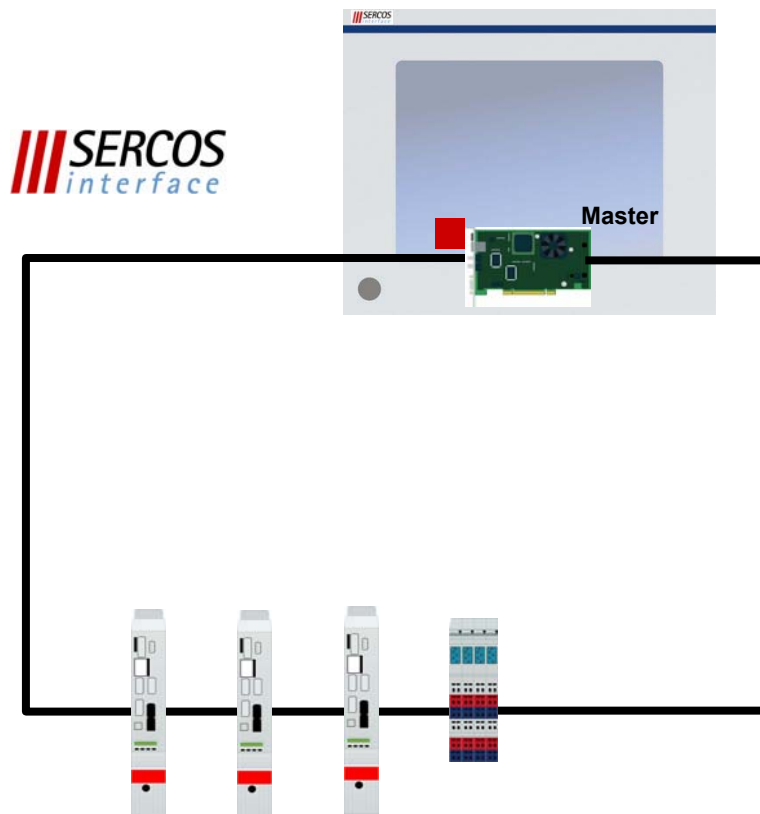
System



SERCOS I/II



- Unidirectional Fiber Optic Ring
- 16 Mbit/s data rate
- Sub-microsecond synchronization
- Over 1.75M installed nodes
- Over 50 Controls Suppliers
- Over 30 Drive Supplies
- 20 year history

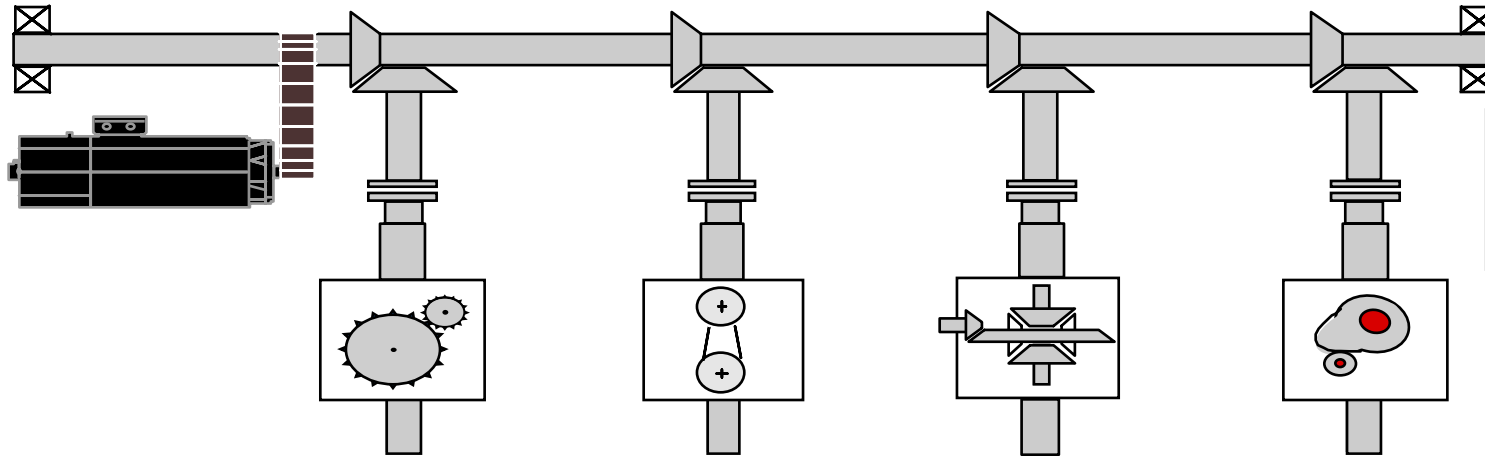




Synchronization with SERCOS



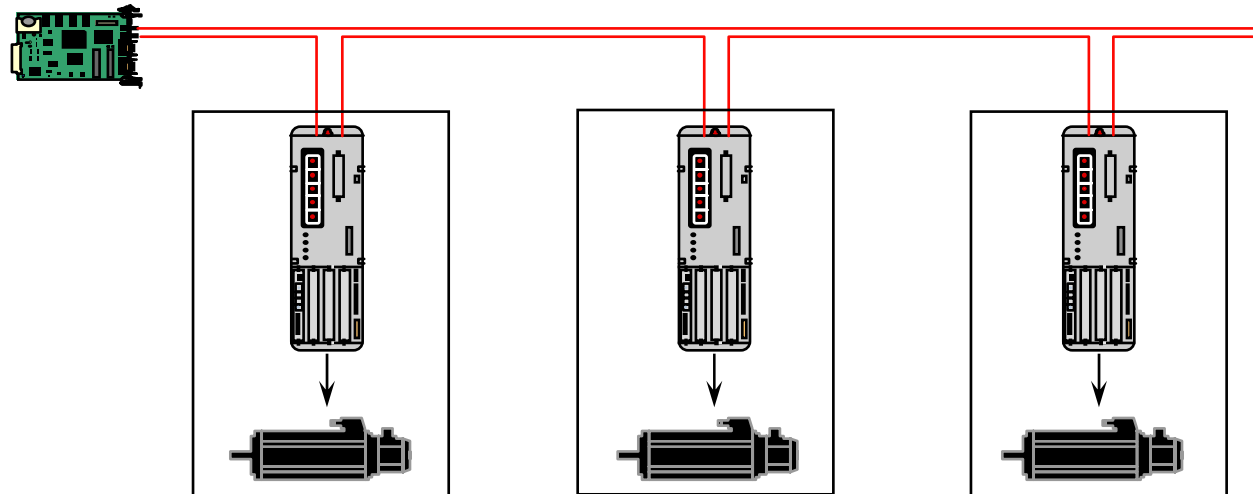
Machines with master drive and mechanical synchronization elements



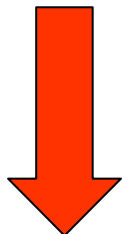
Mechanical line shafts and gears



Machines with decentralized drives synchronized via motion networks



Electronic line shafts and gears





SERCOS Applications Today



Gear Grinding



Camshaft Grinding



High-speed Free-form Milling



Wood working



Packaging Machines



Printing Machines



One Important Key: Standardized
Parameters & Profiles



IDN:	S-0-0036
Name:	Velocity Command Value
Attribute:	4 bytes, signed integer, 1 DP
Unit:	RPM
Minimum:	-2^{31}
Maximum	$+2^{31} - 1$
Operation Data	1000.0

S-0-0038	Positive Velocity Limit Value
S-0-0039	Negative Velocity Limit Value
S-0-0040	Velocity Feedback Value
S-0-0043	Velocity Polarity Parameter
S-0-0092	Bipolar Torque Limit Value
S-0-0124	Standstill Window
S-0-0155	Friction Torque Compensation



The SERCOS Success Story



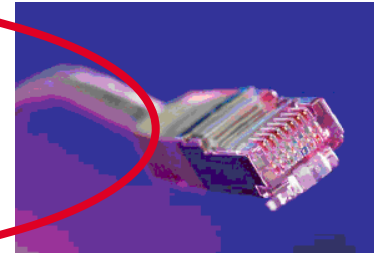
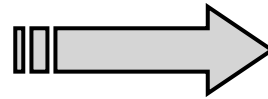
- **Well-defined standard**
 - Profiles and control architectures are defined – not only physical & protocol layers
 - Comprehensive diagnostic features
 - License-free –
Anybody may implement SERCOS
 - IEC 61491 standard since 1995
 - The only international & world-wide accepted digital drive interface standard
 - Thorough Conformance testing and development tools available

- **Widely used**
 - over 50 control manufacturers –
over 30 drive manufacturers
 - Other field bus systems are usually dominated by one or very few control manufacturers
 - More than 1.75 Million nodes installed





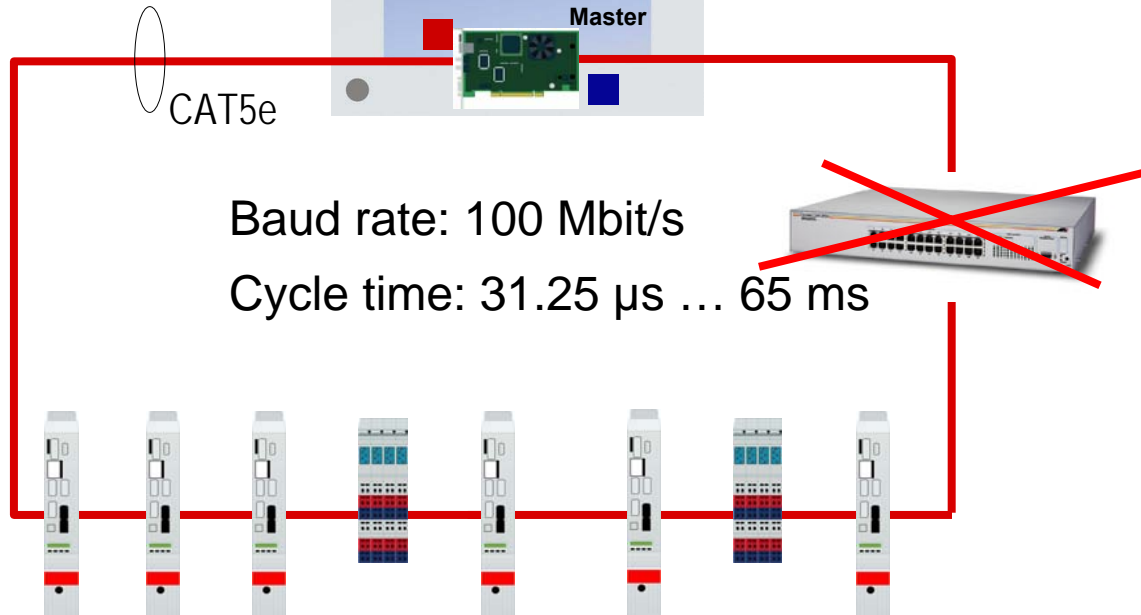
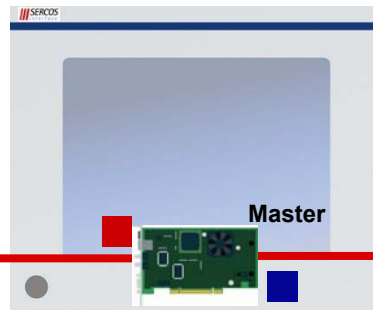
SERCOS III ... The Next Evolutionary Step



- **Tried & true SERCOS real-time communication now on Ethernet.**
- **Application-level compatibility to SERCOS-II.**
- **Direct Drive-to-Drive Cross Communication.**
- **Control-to-Control communication.**
- **Standard IP Communication for startup & diagnostics.**
- **Standard IP communication during real-time operation**
- **SERCOS Safety**
- **Increase data transfer rate for data amount/node count/cycle time.**
- **Hardware redundancy**
- **Hot Plugging**



SERCOS III Basics



Fast Ethernet
(Full-Duplex)

Standard
Ethernet-
Telegrams

Line
Topology

Ring-
Topology

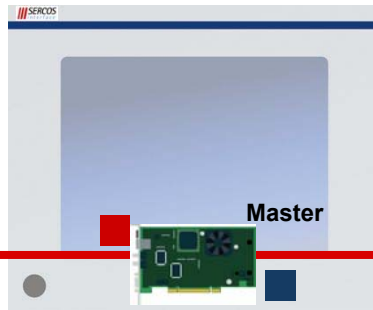
Cyclic Real-Time
Data Transfer

Cost optimized
Topology: no
Switches or Hubs

I/O Device
Support



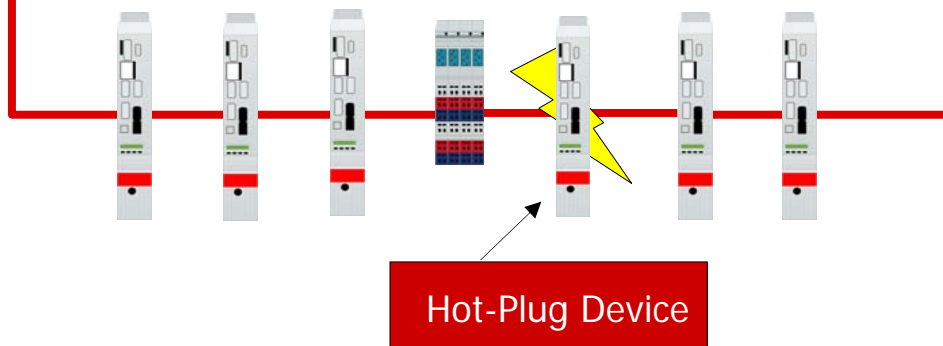
SERCOS III New Features



Hardware
Redundancy

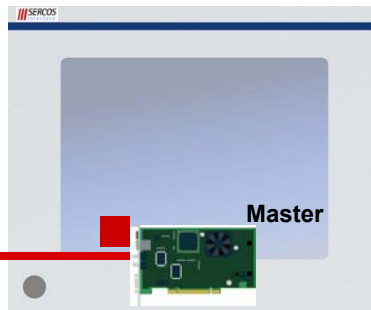
Hot-Plugging
New devices

Baud rate: 100 Mbit/s
Cycle time: 31.25 μ s ... 65 ms



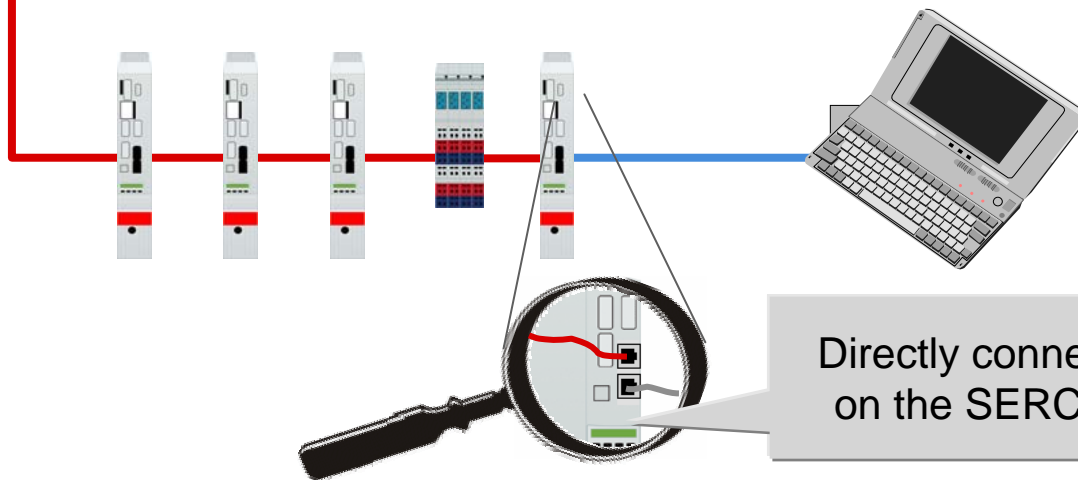


SERCOS III New Features



Connecting
Standard
Ethernet Devices

Baud rate : 100 Mbit/s
Cycle time: 31.25 μ s ... 65 ms



Directly connect IP devices
on the SERCOS-III Slave

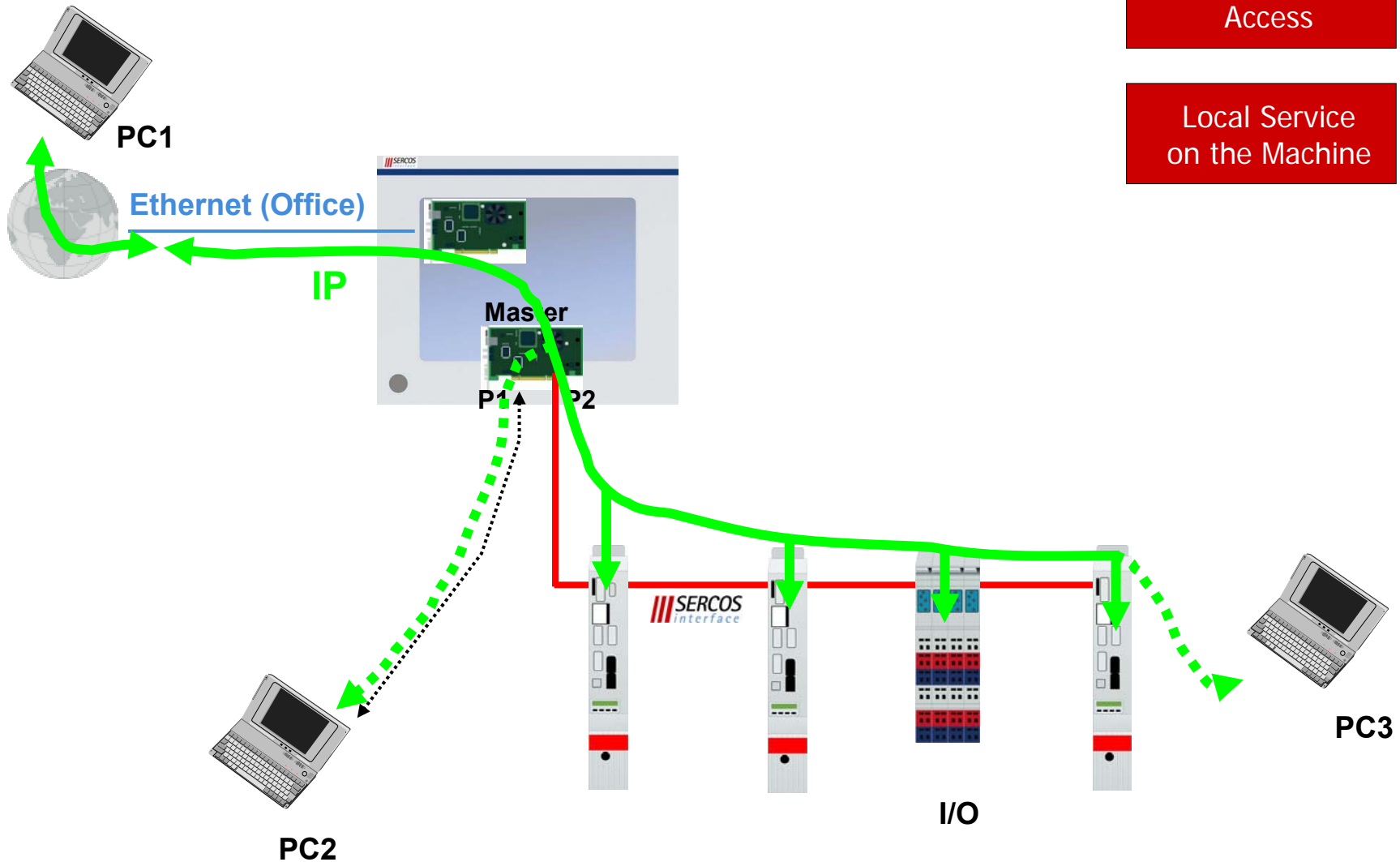


SERCOS III New Features



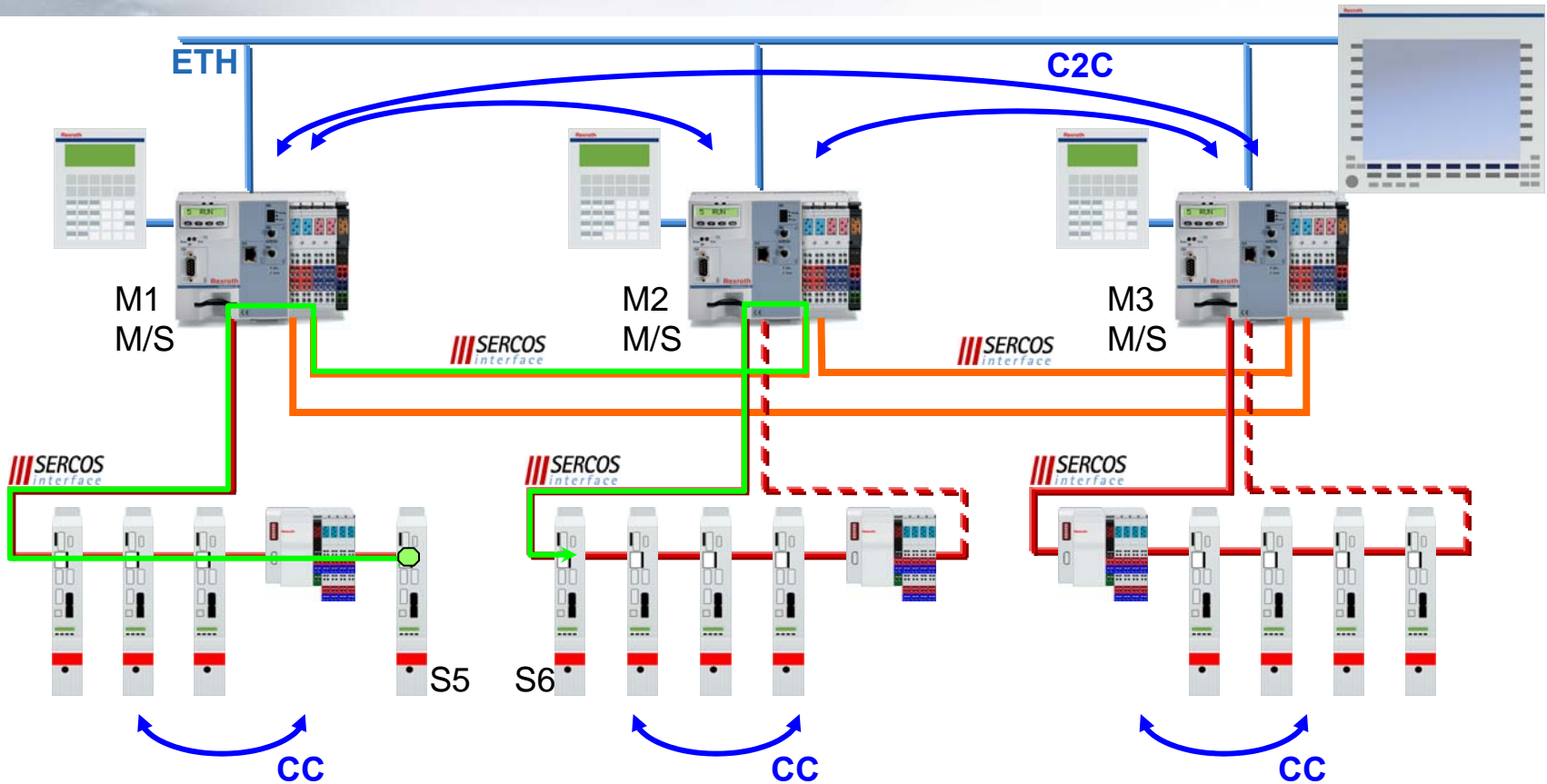
World Wide Access

Local Service on the Machine





SERCOS-III Cross Communications



Direct cross communications between masters (C2C, Controller-to-Controller)

Direct cross communications between Slave-Devices (CC, Cross Communications)

Example: Cross Communication between Slave-Devices S5 and S6 effected via SERCOS Network over masters M1 & M2



SERCOS-III Specification



- Specification adopted November 2004.
- Specification submitted to IEC as a PAS (Publicly Available Specification November 2004.
- Ratified as an IEC tentative standard with 96% acceptance (IEC/PAS 62410)
- Official Standard (IEC 61784/61158) planned for 2007 (together with the remaining Real-time Ethernet Protocols)



Specification

SERCOS III interface

Version 1.20 (December 22, 2004)

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First SERCOS-III products at SPS/Drives 2005



- SERCOS III PCI-Card for Master & Slave (Automata)
- A1 Industrial-PC (Automata)
- SERCOS III Slave implementation w/ netX (Hilscher)
- SERCOS III Communications Module (Hilscher)
- SERCANS III, active PCI-Card (Bosch Rexroth)
- IndraDrive C (Bosch Rexroth)
- IndraControl L (Bosch Rexroth)
- IndraMotion MLD (Bosch Rexroth)
- IndraMotion MLC (Bosch Rexroth)
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Summary



- SERCOS III ...
 - Ties the trusted SERCOS Technology to Ethernet
 - Uses the simple and proven Synchronization Mechanism and Profile of the existing SERCOS
 - Provides a painless transition from SERCOS I/II to III
 - Based on inexpensive and flexible standard hardware
 - Covers all existing and future requirements of a communication system for Motion Control applications (C2C, Safety, I/O)
 - Approved as an IEC (IEC/PAS 62410 Ed.1) tentative standard and is a part of the future IEC 61784/61158 & IEC 61800 standards



SERCOS III – Ethernet-based Real-time Communications for Motion, Safety & I/O



**SERCOS International: Stuttgart Germany: www.SERCOS.de
SERCOS North America (FL): www.SERCOS.com**