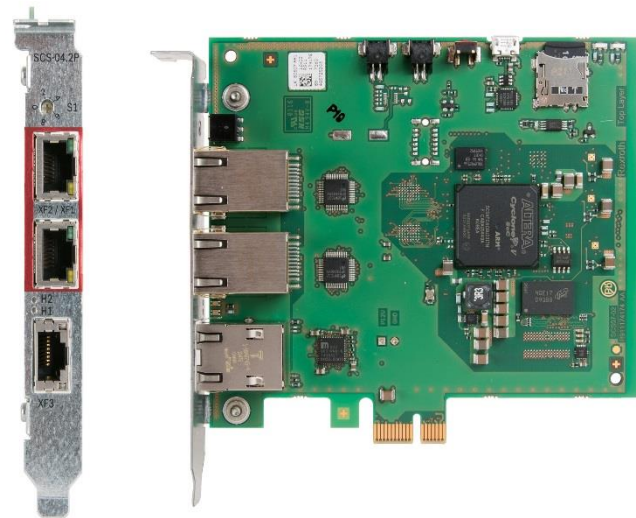# Sercans product family
Easy. Complete. Independent. *Lean.*

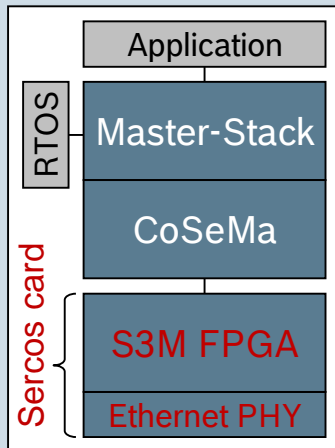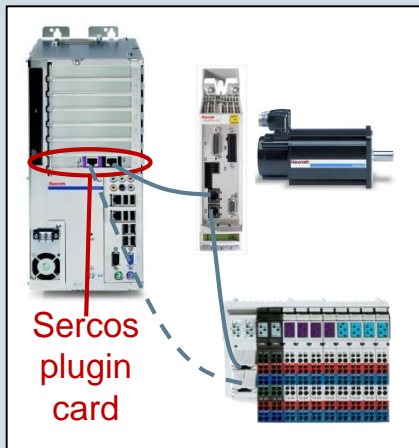**Sercans XS* (Soft & Lean) and Sercans S/M/L (Fast & Easy)**

Sercans product family | Status: 2016-07-28

*   In definition phase, partially available as evaluation version under customer agreement
** Drive&Control business of Bosch Group − Bosch Rexroth = The Drive&Control Company

Rexroth
Bosch Group

Advantages Sercos SoftMaster

Hard Master Sercans S, M, L

Sercos plugin card

Application
RTOS
Master-Stack
CoSeMa
S3M FPGA
Ethernet PHY

Sercos card

+ Higher synchronicity
+ All Sercos features possible
+ Lower SW real-time requirements

SoftMaster Sercans XS

Std. Ethernet

Application
Master-Stack
CoSeMa
Soft Master
RTOS Abstr.	NIC/TTS
Std. Eth. HW

RTOS

+ Lower HW cost
+ Reduction of mechanical controller size (no Sercos plugin card)

Advantage:
Competitive master price
Reduction of size*
Keep main Sercos Pros

Result:
1) New application fields
2) New customer groups
3) More Customer satisfaction

RTOS: Real-Time Operating System   **NIC:** Network interface card   **TTS:** Time Triggered Send   * Prototype

REXROTH
Bosch Group

Sercans XS vs. SoftMaster Core
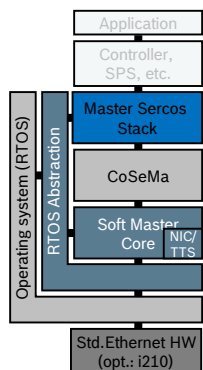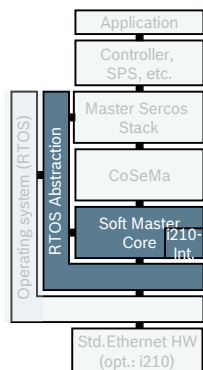
Sercos Soft Master Core (Series status)
- Soft-Master FPGA emulation only
- Support via SourceForge mailing list
- **Customer value:**
  - Best price solution possible!

Sercans XS (Well approved prototype)
- Incl. Soft-Master-Core, RTOS-Abstr., Sercos III Stack
- **Economy**: Easy-to-use stack, sample program, Standard Ethernet, down to 500µs cycle time (prototype, well approved)
- **Basic**: Added: NIC triggered timing (TTS), down to 125µs cycle time, Ring redundancy, UCC via master (prototype, in approval)
- **Advanced**: Compatibilty to Sercans HW solutions, minimum application programming efforts **(still in definition phase!)**
- Evaluated hardware package available (var. HMI controls)
- Support (multi-level tech support)
- **Customer value:**
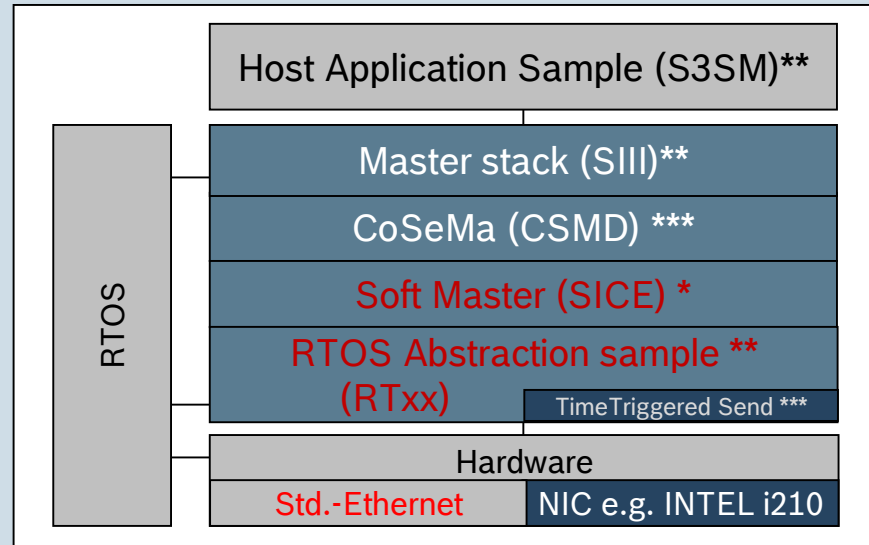 - Shortest time to market!
  - Best Performance!

Advantage: Differentiation of the offer
Result: Let the customer decide
There are arguments for each solution

IndraControl VPB

INTEL I210T1

Sercans XS

RTOS: Real-**t**ime **O**perating **S**ystem**; UCC: U**nified **C**ommunication **C**hannel (Standard Ethernet transmission)
CoSeMa: Common **Se**rcos **Ma**ster is a free available middle-ware library for Sercos on sourceforge

Rexroth
Bosch Group

Sercos Soft-Master as Sercans XS*

Sercos SoftMaster comfort package (Status 2016-07)

Std. Ethernet

Host Application Sample (S3SM)**	
RTOS	Master stack (SIII)**
	CoSeMa (CSMD) ***
	Soft Master (SICE) *
	RTOS Abstraction sample ** (RTxx)
	TimeTriggered Send ***
	Hardware
	Std.-Ethernet / NIC e.g. INTEL i210
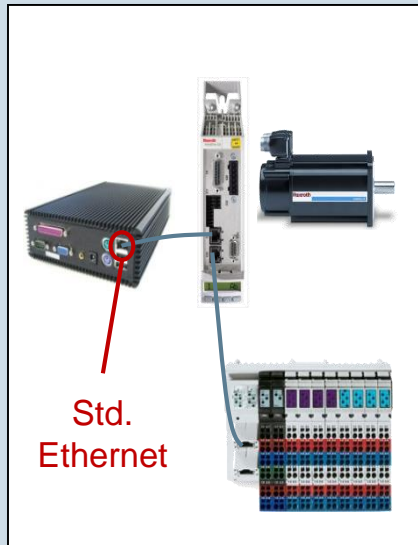
RTOS: Real-Time Operating System   NIC: Network interface card timing   *** AV Series status

* PT Prototype   ** EW Prototype   *** **1st real Application of AVB/TSN Technology**

Rexroth
Bosch Group

Scalable performance for all applications
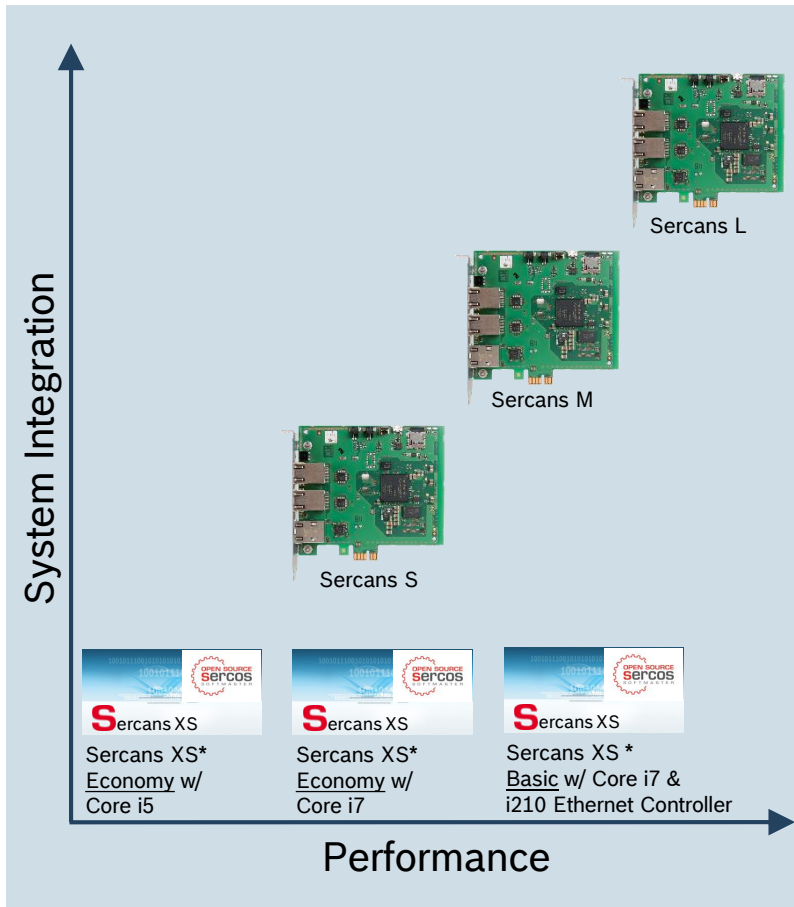
Sercans XS* − Standard Ethernet Controller
- Cost-efficient solution
- Connectable devices system dependant

Sercans S − PCIe card
- Ideal for small, simple series machines
- Up to 16 devices connectable

Sercans M − PCI / PCIe-card
- Standard type for most applications
- Up to 99 devices connectable

Sercans L − PCI Express-card
- Ideal for big, complex, high-end-systems
- Extended data throughput to application (factor 10 compared to Sercans M)
- Easy integration in operating system / application
- Up to 511 devices connectable

* Sercans XS still in **prototype** phase; well approved, re-prioritization upon request

Rexroth
Bosch Group

Sercos software contributions

* Sercos Config Tool is still in project preparation phase!

- **Bosch Rexroth decided to leave Sercos technology distribution to technology providers (with Sercans as exception):**
  - Cannon Automata
  - Hilscher
  - HMS
  - Other Processor/logic manufacturers

- **Established ways to distribute Bosch Rexroth's contribution**
  - Contribution to **consortium development** (CIP-Safety, Sercos Monitor, Sercos Config Tool*) w or w/o **license fees in favor of Sercos International**
  - Provision of Master/Slave **IP Core** to Sercos Technology provider(s) with **license fees in favor of Sercos International**
  - **Open source projects** at **SourceForge** (CoSeMA, S/IP Client, SoftMaster Core, UCC Virtual Ethernet Driver)

Sercos SoftMaster Open Source Project (1)

Press Release

Sercos III Soft-Master-Core Open Source announced

Sercos International (SI) has announced that in cooperation with Bosch Rexroth a Sercos III Soft-Master core will be provided as an open source software.

By using a Sercos III Soft-Master, a Sercos III master device can be implemented without a specific Sercos III hardware controller in the form of FPGAs or ASICs. Instead, a standard Ethernet controller is used and the Sercos III hardware functions are emulated in a host-based driver software. With this implementation approach a sufficient real-time performance can be ensured for a large number of applications. If an Ethernet controller is used that operates with multiple queues and a telegram scheduler (as e.g. the INTEL i210™), a synchronicity similar to that of a hardware-based master can be achieved.

April 13, 2015

Page 1 of 2

Sercos SoftMaster Core Open Source Project (2)

sercos international | **Soft Master**

- Application
- Master stack
- CoSeMa
- SoftMaster
- RTOS Abstr.
- Std. Eth. HW

RTOS

OPEN SOURCE **sercos** SOFTMASTER

+ Lower HW cost
+ Reduction of mechanical controller size (no Sercos plugin card)
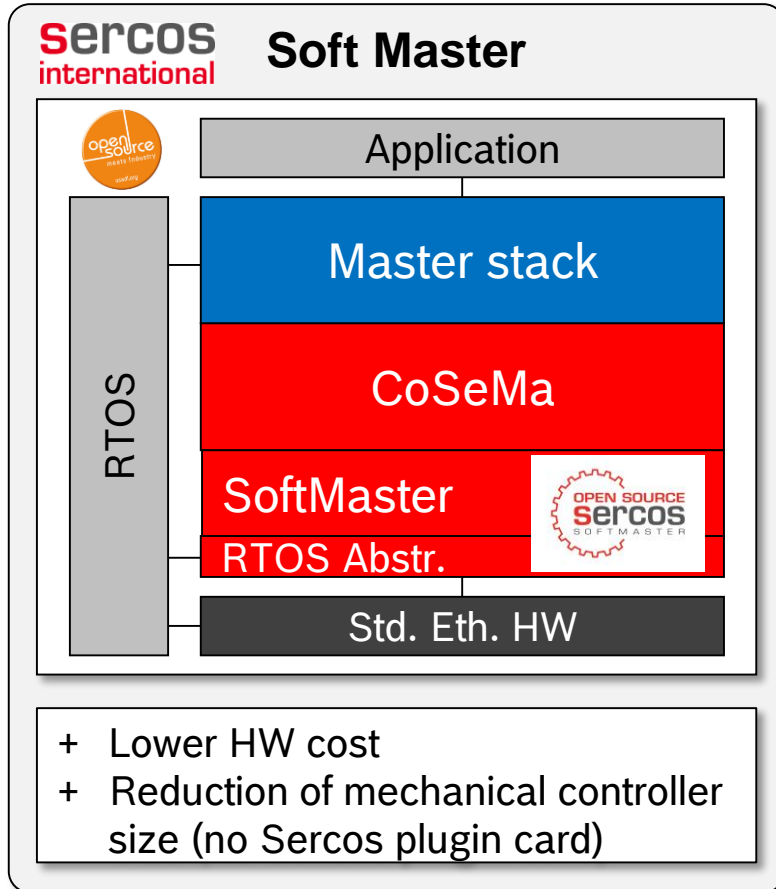
- Open Source Project started in cooperation with Bosch Rexroth and OSADL (planned cooperation with Schneider Electric)

- SoftMaster Core supporting Standard Ethernet controller & Intel i210

- OS independent due to RTOS abstraction

- Compatible to CoSeMa 5V3 and 6V1

- With Std. network controller:
  - Packet jitter achievable ~20..60µs*
  - Slave-Synchronicity achievable ~1µs*

- With NIC Timing and TTS (e.g. INTEL i210): almost HardMaster performance (<< 1µs)

*) depending on platform (hardware & OS)

Rexroth
Bosch Group

Sercos SoftMaster Core – Basis of Sercans XS

- **Sercos SoftMaster** provides an interface to the **Common Sercos Master API** (CoSeMa) which is available as **open source** software on **Sourceforge**: cosema.sourceforge.net

- **CoSeMa**

  - This master function library contains API routines for **initializing**, **phase sequencing**, **timing calculation** and functions for **cyclical and acyclic communication**

  - **Programming language: C**

  - Independent of operating system

- **Sercos SoftMaster Core**

  - Added 12/2015 as extra project to SourceForge

REXROTH
Bosch Group

Open source licensing – Basis of Sercans XS

License handling of the Open Source Sercos Softmaster

- Subject to open source license: Sercos Soft Master Core

- Technically: Sercos IP Core Emulation (S.IC.E)

- License model: Changed from LGPL to MIT

- Effective: 2015-12-15

- Programming language: C

- Independent of operating system

- Further software components are prepared to follow

Rexroth
Bosch Group

Broad RTOS support − Basis of Sercans XS*

- Extension to IPC IndraControl VPB/VPP
- Minimum cycle time: 500µs … 1 ms
- Support of topology depends on realtime capabilities of the Ethernet controller (Standard or INTEL i210)
- Tested on IndraControl VPx with RTOS:
  - INtime for Windows from tenAsys
  - Windows 7 ext. RTX from IntervalZero
  - Linux with PREEMPT_RT patch
  - QNX Neutrino
  - Windows Embedded Compact 7
  - VxWorks
- Improved Performance by NIC-based precision timing, supporting TTS (e.g I210 from Intel or similar)

* Well approved Prototype!

RTOS: Real-Time Operating System   **NIC**: Network interface card/controller   **TTS**: Time Triggered Send

Broad HW approval − Basis for Sercans XS*

Sercans XS

- **Industrial PC x86**
  - 32/64 Bit
  - IndraControl VBP / VPP
  - IndraControl VEP
  - Siemens IPC
  - Desktop Office PC
- **ARM**
  - A8 and A9
  - Beaglebone Black **
  - IndraControl VR21 **

*   Well approved Prototype!

** Under evaluation

Rexroth
Bosch Group

Sercos Config Tool (in preparation)
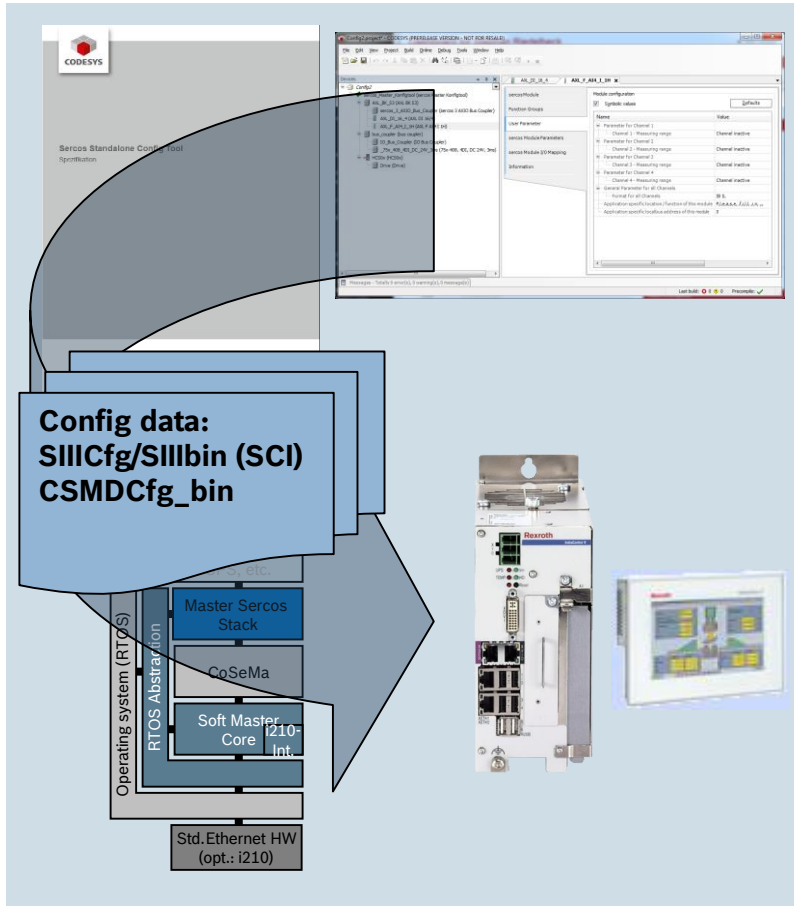
- **Flexible Config of OEM controls**

- **Consortium (Sercos International, 3S)**
  - Rovema
  - Phoenix Contact
  - Bosch Rexroth

- **Implementation**
  - 3S
  - Shared costs (estimated 60 k€)
  - Consortium members appreciated

- **Functions**
  - Offline configuration (CoDeSys S3)
  - Online (Scan, Parameter r/w, Diagnostics)
  - IO-Link gateway

Rexroth
Bosch Group

Sercans inside DC's **open solution portfolio**

OEM software part

OEM solution plus
HMI & control **hardware**, **Sercans** and Sercos devices

BASIC

Built-in
(IEC 6-1131, LUA, Java, DIN 66025)
(ML*, MTX)

STANDARD

Built-in
(IEC, LUA, Java, DIN 66025) **plus OCI**
(ML*, MTX)

EXTRA

Discover freedom and efficiency and a full range of solutions!

DC software part
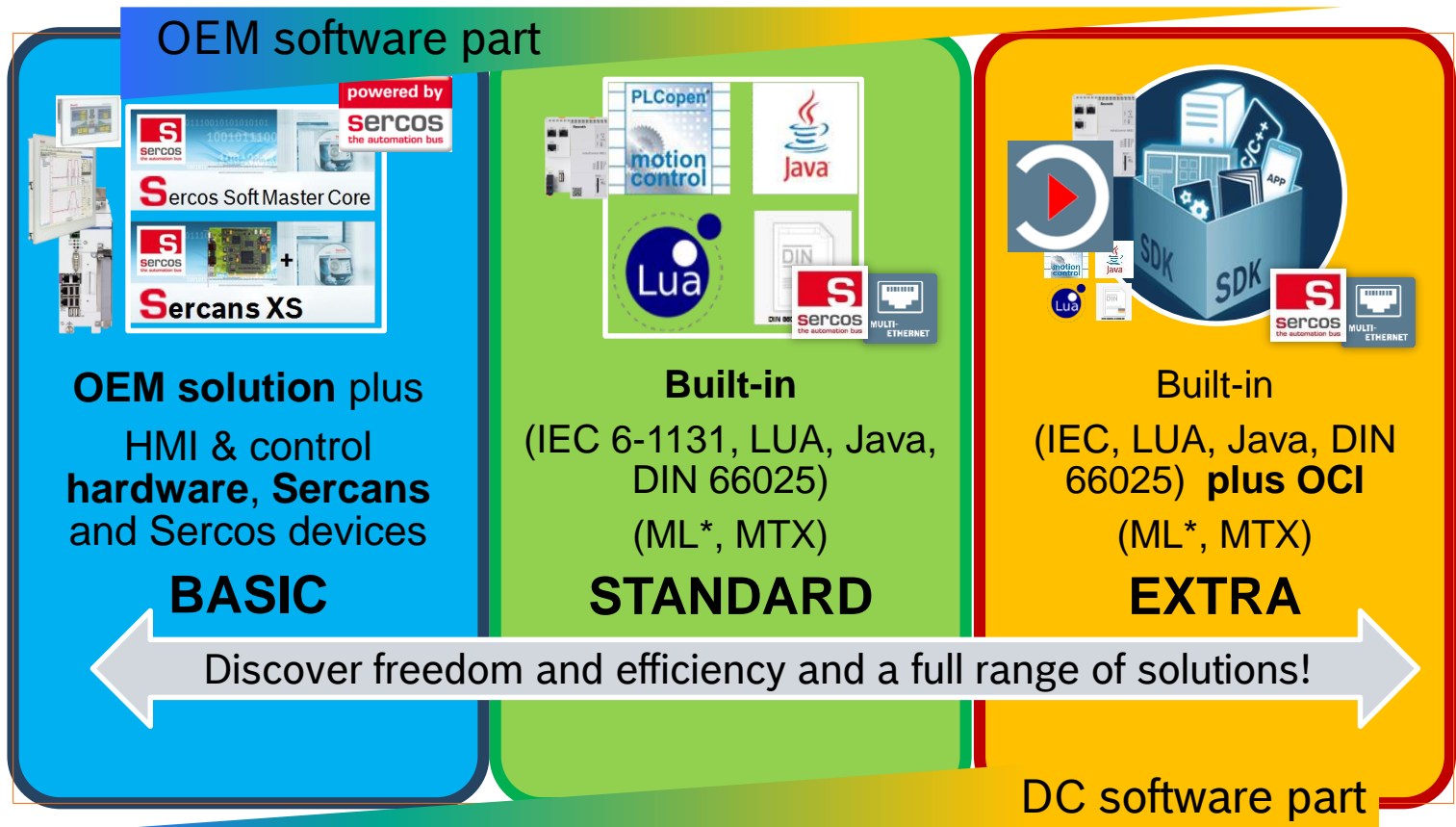
<u>Bosch Connect:</u> Sercos SoftMaster opens door to challenging high volume applications

Rexroth
Bosch Group

Advanced solution VPB 40.3 *

Starting at 4.270,-€

Approved

1. 24 V DC power supply
2. Status-LED
3. DVI
4. CDI Interface for operator display
5. 2 x GBit LAN
6. 6 x USB 2.0
7. Slot
   - 1xPCI
8. Mass storage
   - Hard disk
   - Hard disk RAID 1 (Option)
   - Solid-State-Disk (Option)
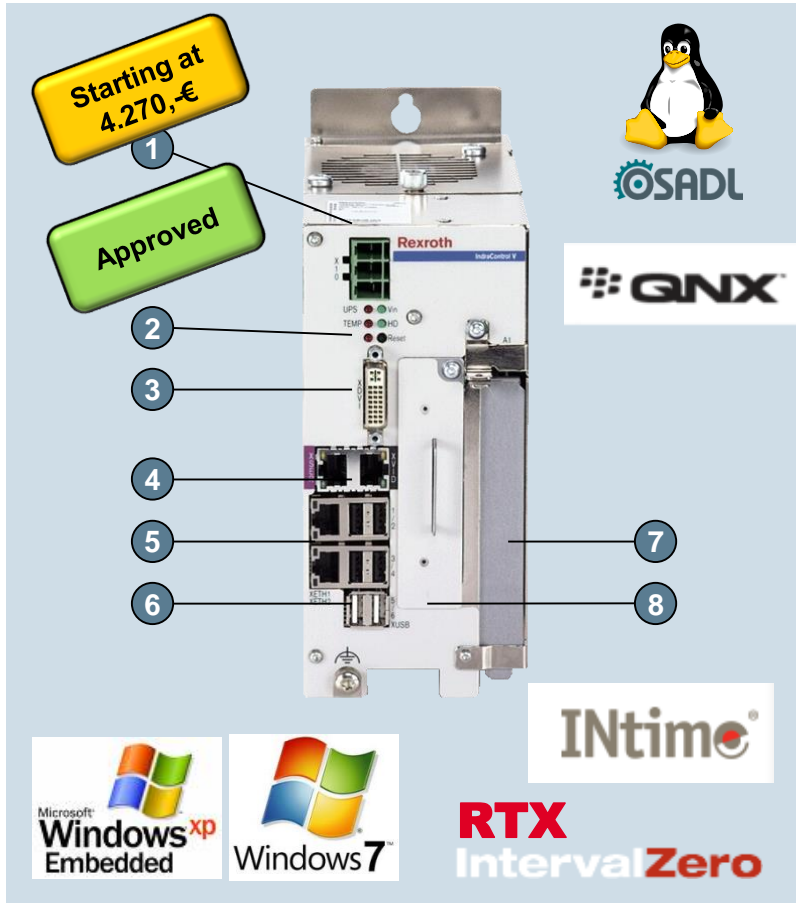
Advantage:
All-inside (HMI, Sercans XS and Sercans S/M/L)
Competitive Price

Result:
Customer can concentrate on his solution!

Follow up: VPB 40.4 / PRxx (definition phase)

* Prototype

Advanced solution VR21 **

Starting at 1.280,-€

In prototype approval ! High volume only!

Resistive single touch functionality

4,3"-widescreen-display
resolution: 480×272
colors: 16 bit

7"- widescreen-display
resolution: 800×480
colors: 16 bit

9"-widescreen-display
resolution: 800x480
colors: 24 bit

Advantage:
All-inside (HMI and Sercans XSj,
HW-platform option &
Demo option
Competitive Price
Result:
Customer can concentrate
on his solution!

Technical data

Housing: galvanised steel

CPU **ARM Cortex-A8** 800 MHz.

512 MB RAM, 256 MB Flash

1x Ethernet 10/100 Mbit

2x USB 2.0 Host

power supply 24V DC

** Example, HW-Base in definition phase, not scheduled

REXROTH
Bosch Group

Overview and comparison

	Sercans XS Economy (SoftMaster)	Sercans XS Basic (SoftMaster)	Sercos-FPGA / Sercans S, M, L (HardMaster)
Architecture	**RTOS** — Host Application / Master stack / CoSeMa / SoftMaster / RTOS-Abstr. / Std.-Eth.-HW	**RTOS** — Host Application / Master stack / CoSeMa / SoftMaster / RTOS-Abstr. / 2 * NIC (TTS)	RTOS1 Host / RTOS2 Core — **HW** — Host Application / DP-RAM / Integrated Master stack / CoSeMa / S3M-FPGA / Ethernet-PHYs
HW	1 Std.-Ethernet-Controller	2 * INTEL i210-Ethernet-Controller (or TTS* capable HW)	Sercos-FPGA; 2 * Ethernet-PHY
Pros	• Std.-HW, div. types • Typ. Cost benefit	• Quasi-Std.-HW • Typ. Cost benefit • High synchronicity (Jitter <150ns or even 40ns) • UCC@Master supported • Ring redundancy	- Benchmark reference -
Cons	• Lower synchronicity • Curr. only line topology • UCC@Master not solved yet • Min. Cycle ~ 500µs • CPU-load SoftMaster <5% • CoSeMa 5V3 and 6V1	• Min. cycle ~125µs • CPU load SoftMaster <5% • CoSeMa 5V3 and 6V1	- Benchmark reference -

NIC: Network interface card/controller (precise Timing)   **TTS**: Time Triggered Send

Rexroth
Bosch Group

Technical Comparison

Architecture	Sercans XS Economy (SoftMaster)	Sercans XS Basic (SoftMaster)	Sercos-FPGA / Sercans S, M, L (HardMaster)
Architecture	RTOS: Host Application / Master stack / CoSeMa / SoftMaster / RTOS-Abstr. / Std.-Eth.-HW	RTOS: Host Application / Master stack / CoSeMa / SoftMaster / RTOS-Abstr. / 2 * NIC (TTS)	RTOS1 Host, RTOS2 Core, HW; Host Application / DP-RAM / Master stack / CoSeMa / HW: S3M-FPGA / Ethernet-PHYs
HW	1 Std.-Ethernet-Controller	2 * INTEL i210-Ethernet-Controller (or TTS* capable HW) — INTEL I210 T1	Sercos-FPGA / Sercans PC-board; 2 * Ethernet-PHY — Sercans S, M, L
Cycle time	500µs	125µs	31,25µs FPGA / 62,5µs; 125µs; 2ms (Sercans L, M, S)
No. devices	Only limited by Host	Only limited by Host	- / 255, 128, 16 (Sercans L, M, S)
Synchronicity	20...50µs (~1µs by device PLL)	20...40ns	20...40ns
Topology	Line	Ring (Redundancy), Line, Dual Line	Ring (Redundancy), Line, Dual Line
UCC	Within Line	Routing@Master, Within Ring/Line	Routing@Master, Within Ring/Line
CPU Load	<5% Load on Host	<5% Load on Host	Minimum load on Host

NIC: Network interface card/controller (precise Timing)   **TTS**: Time Triggered Send

Rexroth
Bosch Group

Benefits for Multiplier & OEM

OPEN SOURCE
sercos
S O F T M A S T E R

Sercans XS

* Definition phase   ** Evaluation in progress

- **Customer value**
  - Open Source, freely available Sercos SoftMaster
  - Fitting into suite of other Open Source Software (CoSeMa, S/IP Services, UCC-ETH Driver)
  - RTOS and platform independent C Code
  - 6 supported RTOS
  - 2 supported HW platforms
  - Full line solution concept Sercans XS to L *
  - Hardware package option VPx/VR(high volume) *
  - Maximum component support (Drive, IO, Process)

- **Performance**
  - HardMaster synchronicity (NIC based TTS, e.g. i210)
  - Extendibility to Sercans S/M/L *

- **Ease of use, flexibility**
  - UCC always available (Engineering with full Ethernet capabilities)
  - Software compatible Sercans XS to L *
  - Software tested on Hardware package option **

Rexroth
Bosch Group

Use cases of migration − where to go?

Solution	Sercans S, M & L	Sercans XS Advanced Compatibility option	Sercans XS Basic HighSynchro option	Sercans XS Economy Low Cost option

Sercans II or III
- Cycle times <125µs, Non-realtime Host computer
- Minimum application effort, Cycle times <500µs
- Minimum cost, minimum space, Cycle times >=500µs

Sercos III FPGA
- Cycle times <125µs, Non-realtime Host computer
- Minimum application effort, Cycle times <500µs
- Minimum cost, minimum space, Cycle times >=500µs

Sercos II ASIC
- Cycle times <125µs, Non-realtime Host computer
- Cycle times <500µs
- Minimum cost,, minimum space, Cycle times >=500µs

Non-Sercos fieldbus or analog
- Cycle times <125µs, Non-realtime Host computer
- Cycle times <500µs
- Minimum cost,, minimum space, Cycle times >=500µs

Currently Available AV, PT or EW   Currently not available, up to application   N/A as DC product

Rexroth
Bosch Group

Sercos SoftMaster on Tour (Hanover fair 2016)

Hannes Richter (ISG, 2nd right) explains INtime-based SoftMaster demo of ISG's NC-Kernel, Virtuos, Phoenix Contacts eCLR and Bosch Rexroths IndraDrive and SafeLogic Compact to **Gary Liang (Phoenix Contact China, 2nd left)** accompanied by **Kim Hartman (left)** and **Andreas Knape (TenAsys, right)**

Rexroth
Bosch Group

Demo scheme

2. Bildschirm 24", Virtuos auf VPB

DVI

CDI XVID

sercos
the automation bus

*

B*

B*

B*

B*

B*

B*

*

B*

B*

B*

B*

sercos
the automation bus

DC

DC

Haupt EIN *

*

Sick C4000 Lichtvorhang *

EFI-Link

*

230V AC Netz

*

Endschalter 1&2

Sercos-Monitor

24V DC Netzteil	230V AC
Absicherung	
Netzfilter	

Haupt-schütz	Trenn-trafo

B = Buchsenseite
* = Auf Exponatplatte

REXROTH
Bosch Group

Sercans XS in-a-box goes on tour to Asia

Components:
- VPB40.3 i7-8core, PCIe
- INTEL i210 T1 network card
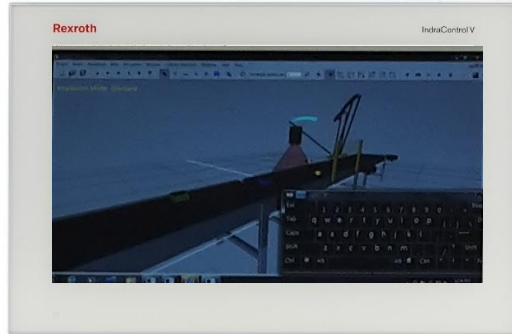- OCE demo suit case
- VDP15

Tour Plan:
- ION (Japan)
    - **07/27/2016 Tokyo**
    - **08/24/2016 Nagoya**
- Automation (India)
    - **08/22-25/2016 Mumbai**
- IAS (China)
    - **11/01-05/2016 Shanghai**

Demo Software:
- ISG NC-Kernel
- Phoenix Contact Software ProConOS eCLR PLC runtime
- ISG Virtuos simulation & commissioning
- TenAsys INtime RTOS

Open Core Engineering with Open Standards

Multi-Touch Display
VDP15.3

Servo Drive
IndraDrive Cs

Supported by:

Industrial PC
VPB40.3
I7 8core

Servo Motor
IndraDyn S
MSK030

Linear module
MKK40

Space* for your application

Select from thousands of components**

* Sercans XS needs << 5% of resources on an IPC   ** from the whole Sercos Eco-system including Bosch Rexroth

REXROTH
Bosch Group

Sercos goes Soft − a <u>lean</u> & <u>scalable</u> IE solution *

Sercans_XS
Advanced
<u>Compatibility</u> option * **

Sercans_XS
Basic
<u>HighSynchro</u> option *

Sercans_XS
Economy
<u>Low cost</u> *

based on

OPEN SOURCE sercos SOFTMASTER

Sercans XS * SoftMaster
The <u>least cost</u> Sercos Master solution

The <u>easiest</u> way to use **sercos** the automation bus <u>benefits</u>

 * Evaluation prototype
** Definition Phase
_ Customer value & benefits
IE Industrial Ethernet

Rexroth
Bosch Group

... makes your solution as light that you can fly!

Graphics Source: http://openclipart.org/detail/28921/plane
- Unlimited Commercial Use
- All Clipart are Released into the Public Domain

Sercans Master distribution concept

Option: Reduce risk by approved Rexroth IndraControl V platform

More Sercos platforms.
More functions, freedom,
service and added value!

Sercos 100% performance, less costs

MLC/MTX S3 Driver	CoDeSys IO-Driver	ProConOs Communication Stack	TwinCAT Automation device driver	S5/S7 Device driver

IndraWorks DS · Sercans & Sercos SoftMaster Library · Sercos Config Tool

Sercans XS (soft)
Rexroth: System 2017

Sercans S (passive/active, standard)
Rexroth: passive used

AV
Sercans M (active, advanced)

PT
Sercans L (active, high performing)

All system components available

A free software model for Sercans XS

Stimulate by

- Low evaluation investment
- Obstacle-free start

Honest deal of

- Training, Support & Service charge
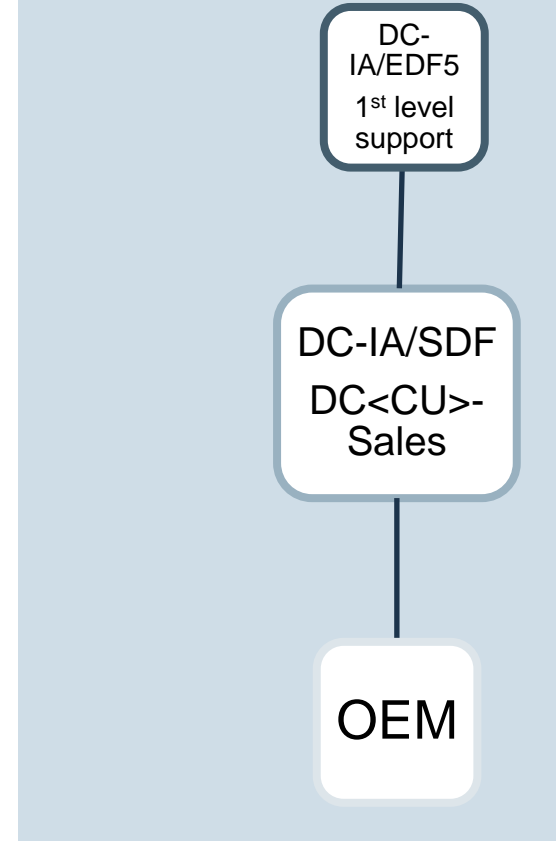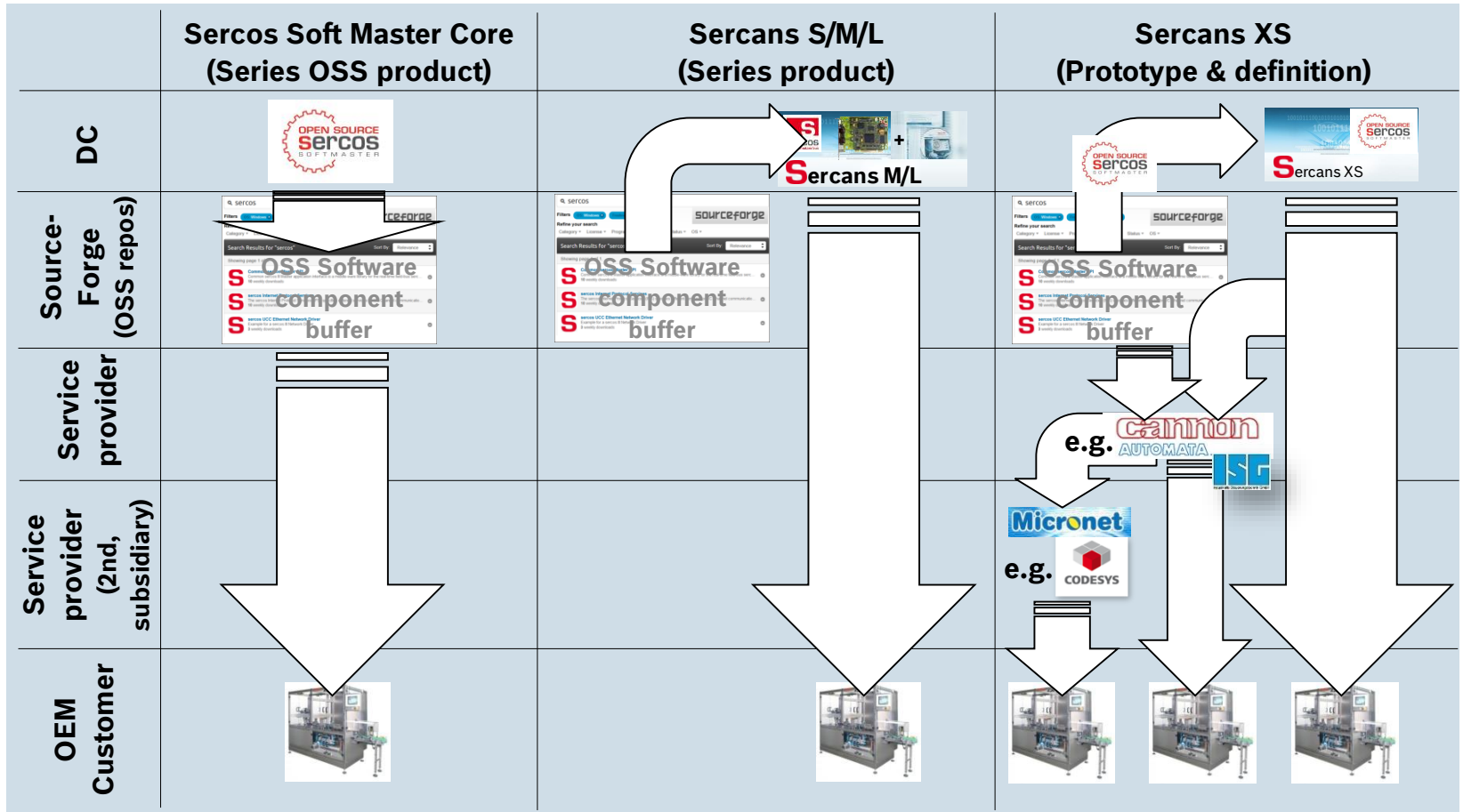- Mutual benefit out of continuous improvement

OPEN SOURCE Sercos SOFTMASTER

Sercans XS

Rexroth
Bosch Group

Multiplier and (OEM) Direct sales model

Preferred:

DC-IA/EDF5 2nd level support

Multiplier 1st level support (MC, RC, CNC, PLC)

OEM

OEM

OEM

On Demand:

DC-IA/EDF5 1st level support

DC-IA/SDF DC<CU>-Sales

OEM

Rexroth
Bosch Group
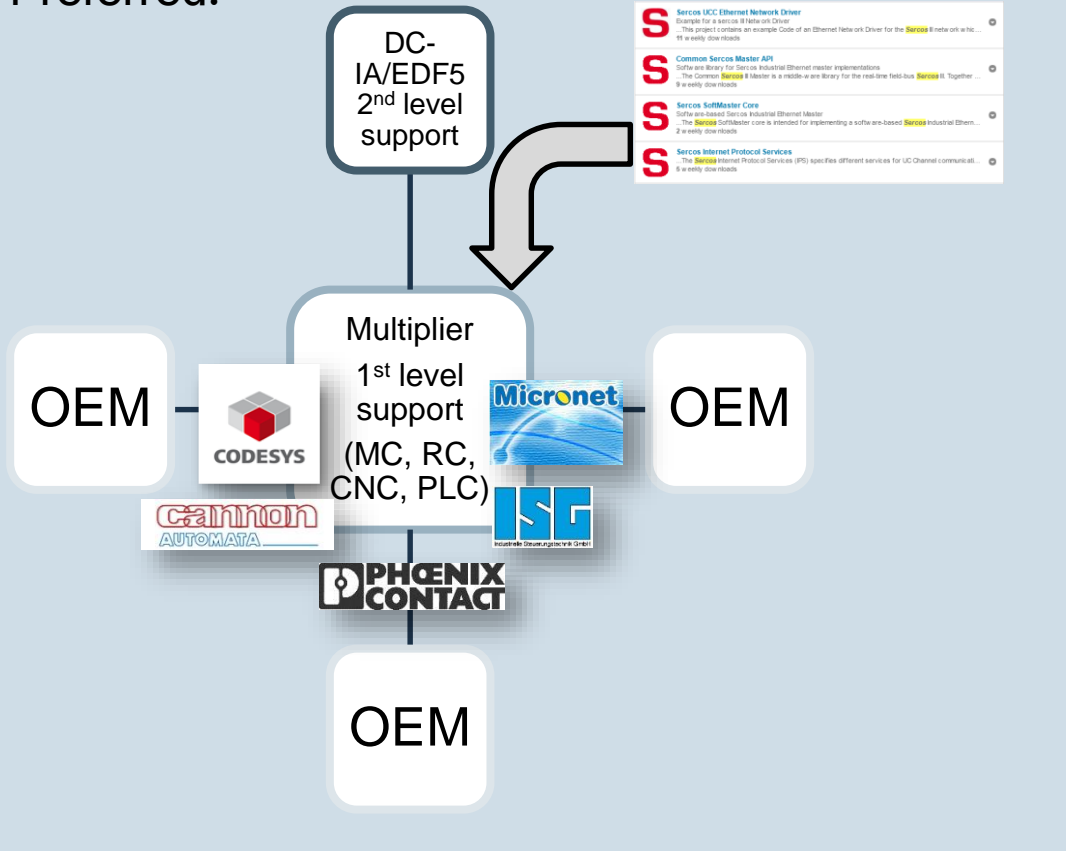
Sales and support chains

Rexroth
Bosch Group

Training, support and service projects

Order position	Content	Quotation
Initial workshop (Kick-off on-site)	• Task analysis • Conceptual design • Additional code module definition • Effort estimation • Schedule definition Result: Quotation for final project	Please contact your local Bosch Rexroth distributor or country unit! *
Integration support (Phone, Webex, Skype and E-Mail)	• Platform integration preparation • Application integration • Problem analysis and solution (consulting) • Bugfixing	Please contact your local Bosch Rexroth distributor or country unit! *
Integration on-site support (including travel expenses)	• Code integration • Testing & Debugging • Acceptance testing	Please contact your local Bosch Rexroth distributor or country unit! *
Alternatively DIEN-Engineering-Service R911297673	• Specific definition of tasks, efforts and conditions	Flatrate (to be defined per project)

* Contact via Bosch Rexroth Web or send your inquiry to mailto://Friedrich.Scheurer@boschrexroth.de at DC-IA/SPC2

Rexroth
Bosch Group

Friedrich Scheurer

Product Management Sercos Technology DC-IA/SPC2

Bosch Rexroth AG
The Drive & Control Company
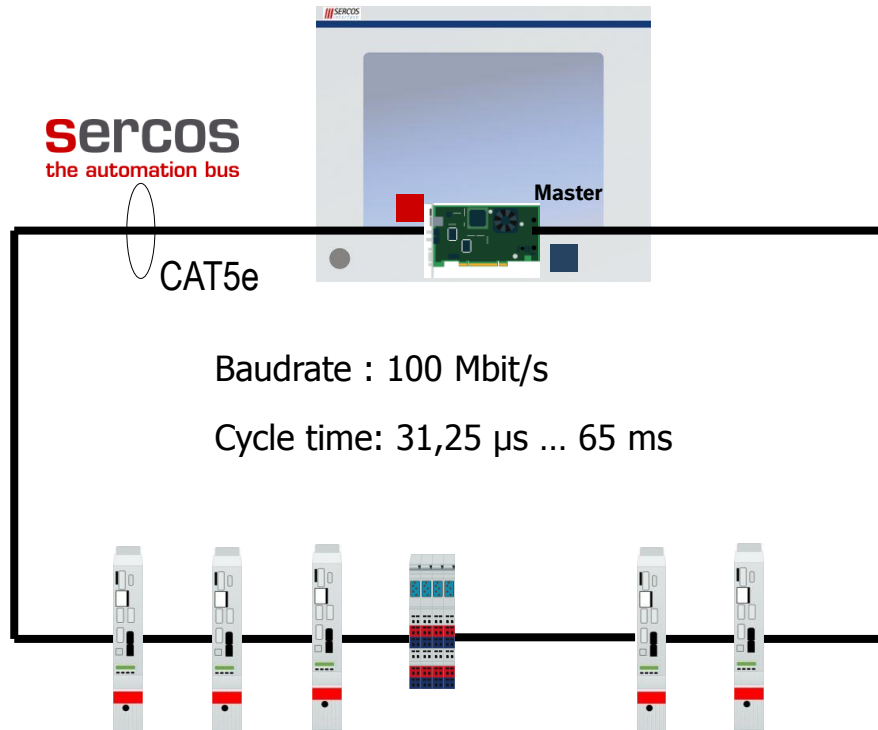Tel. +49(9352)18-5669
Mob. +49 172 37 24 635
Mail: Friedrich.Scheurer@boschrexroth.de

Rexroth
Bosch Group

Sercos Basics

Rexroth
Bosch Group

Topology Overview

sercos
the automation bus

CAT5e

Master

Baudrate : 100 Mbit/s

Cycle time: 31,25 µs … 65 ms

Fast Ethernet (Full-Duplex)

Standard Ethernet Frames

Line Topology

Ring Topology

Cyclic real-time communication

Rexroth
Bosch Group

Topology - Line and Ring
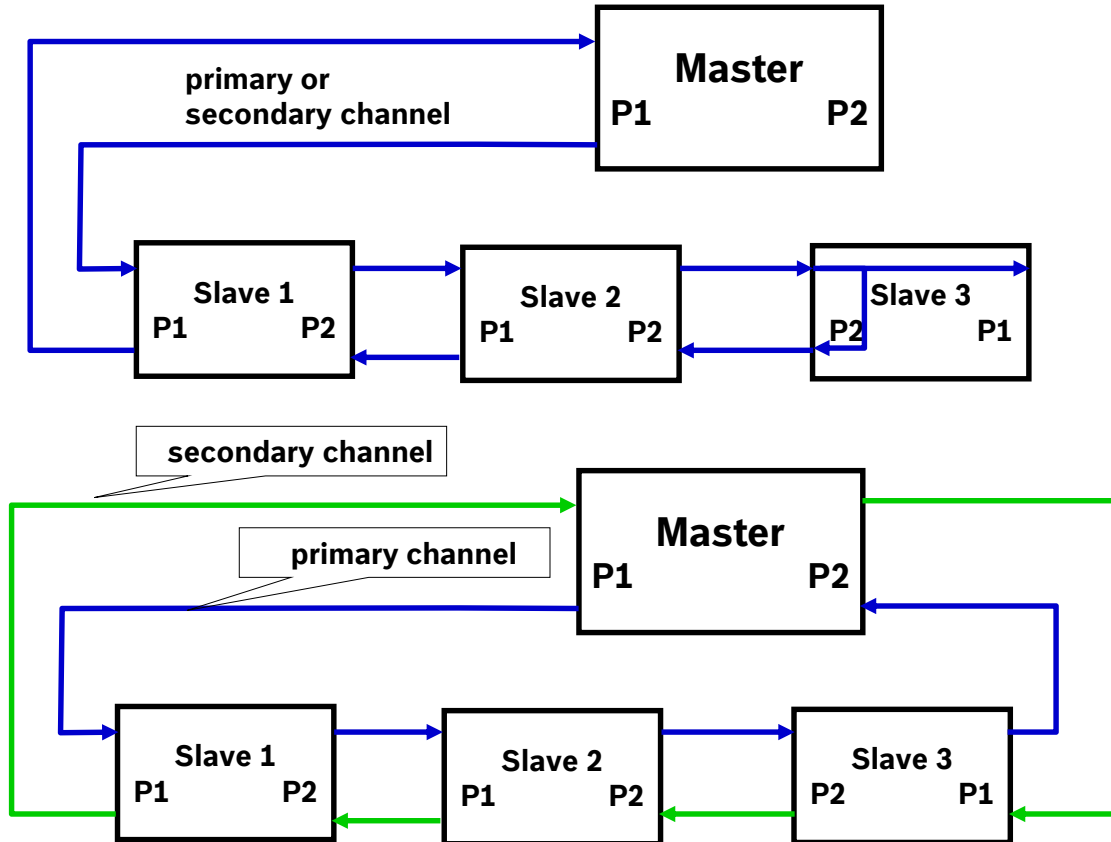
Line

The master may process the data from the slaves on port P1 or P2

Ring

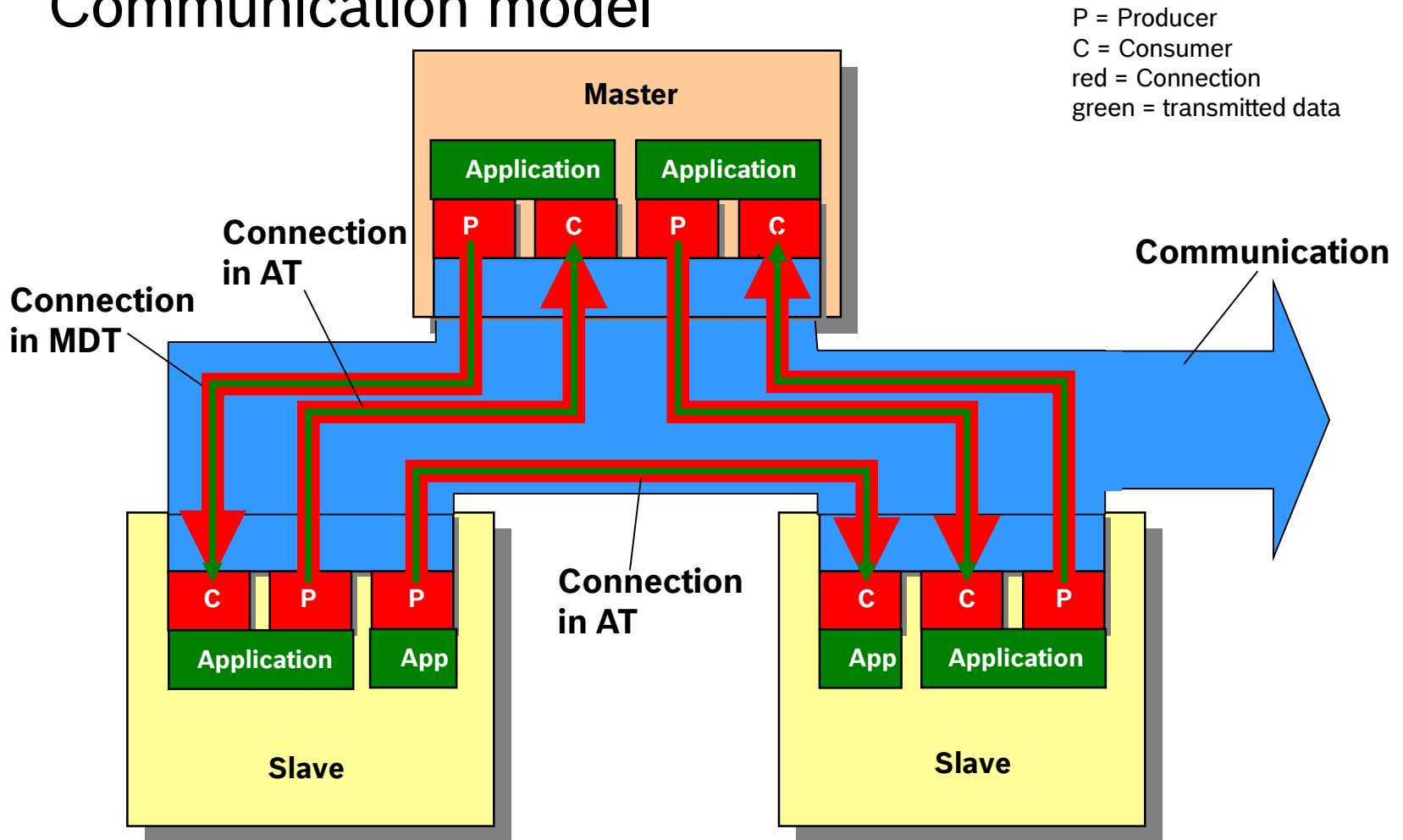**Cyclic redundant transmission of real-time data in primary and secondary channel**

Rexroth
Bosch Group

Redundancy Overview

Redundancy,
e.g. Cable break

sercos
the automation bus

Master

Baudrate : 100 Mbit/s

Cycle time: 31,25 µs … 65 ms

Rexroth
Bosch Group
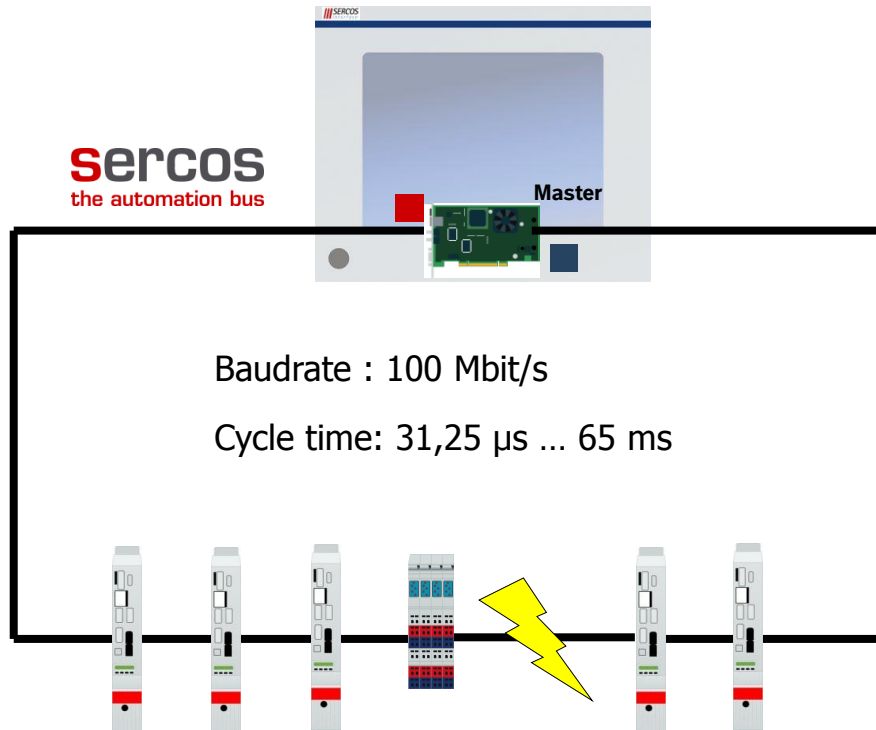
Communication Timing in CP3 and CP4

Communication model

P = Producer
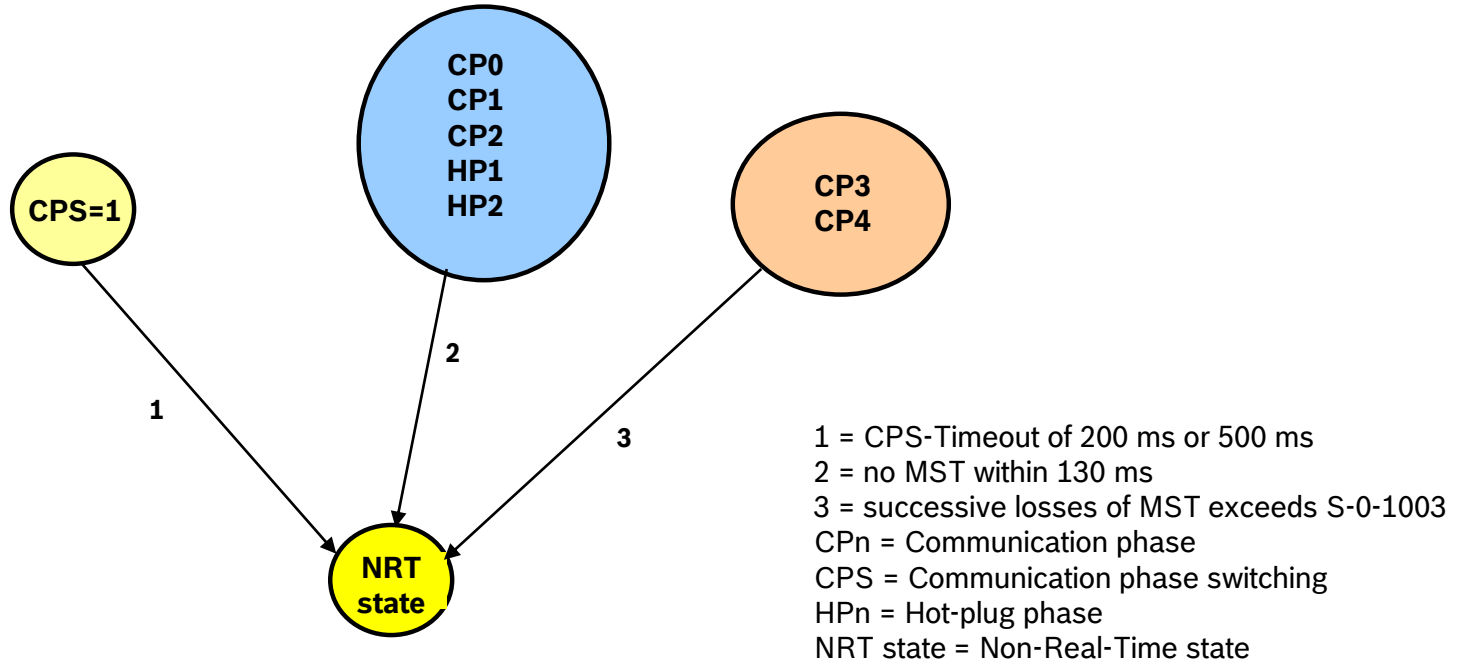C = Consumer
red = Connection
green = transmitted data

Rexroth
Bosch Group
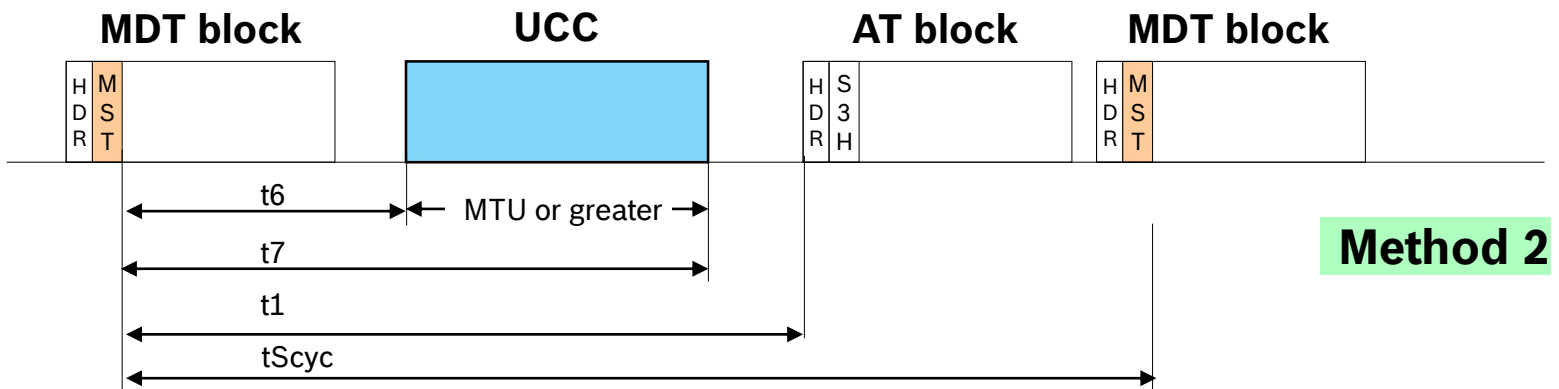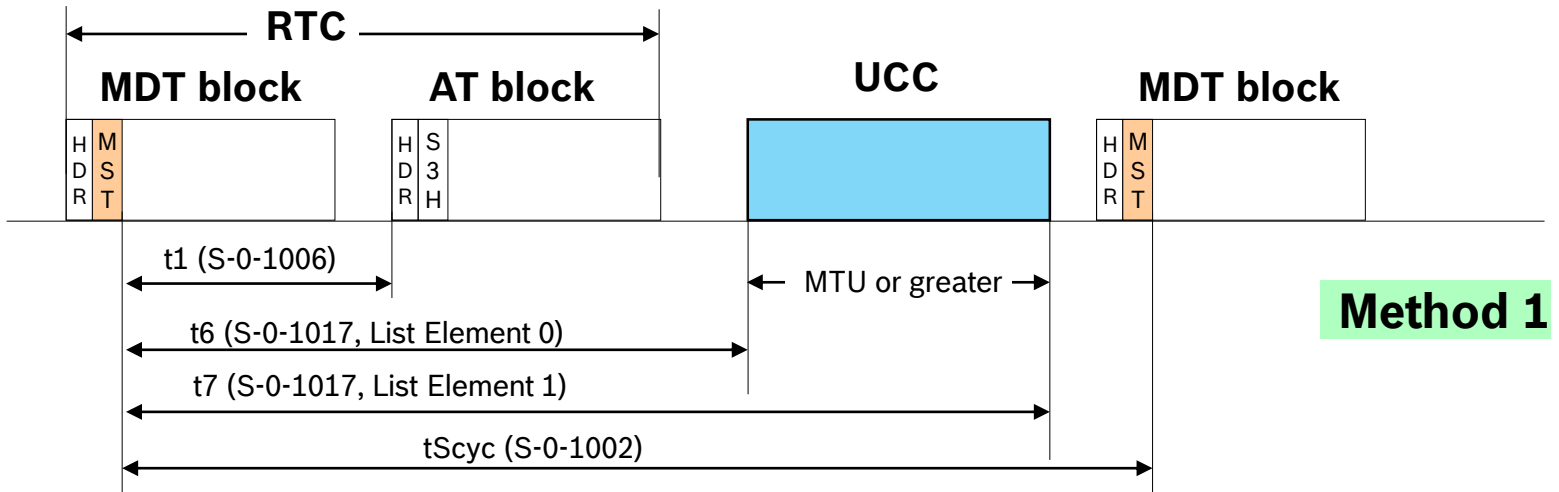
Sercos Cross Communication Concept

**Real-time data exchanged in both directions within
the same communication cycle**

Master　　　　Slave 1　　　　Slave 2　　　　Slave (n)

Direct cross communication in forward path

CAT5e

Direct cross communication in reverse path
(same transmission time from slave 1 to slave 2 and vice versa)
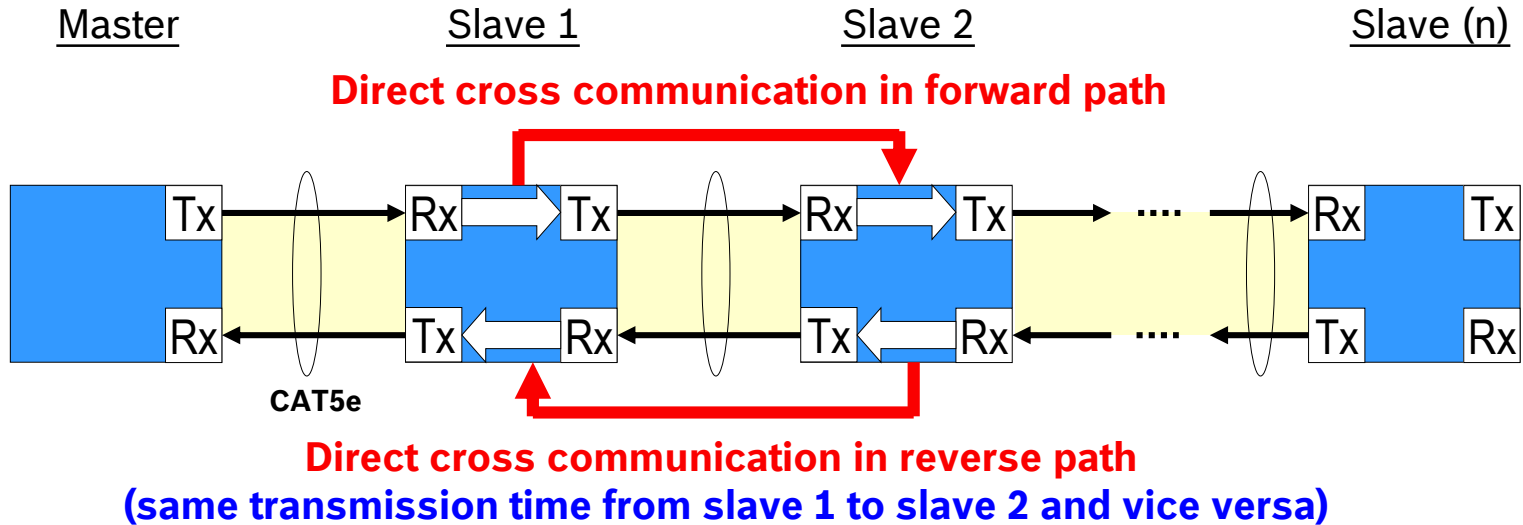
⟹ Real-time processing during passing through a node
⟶ Signal transmission without interpretation
Tx: Ethernet transmitter, Physical Interface
Rx: Ethernet receiver, Physical Interface

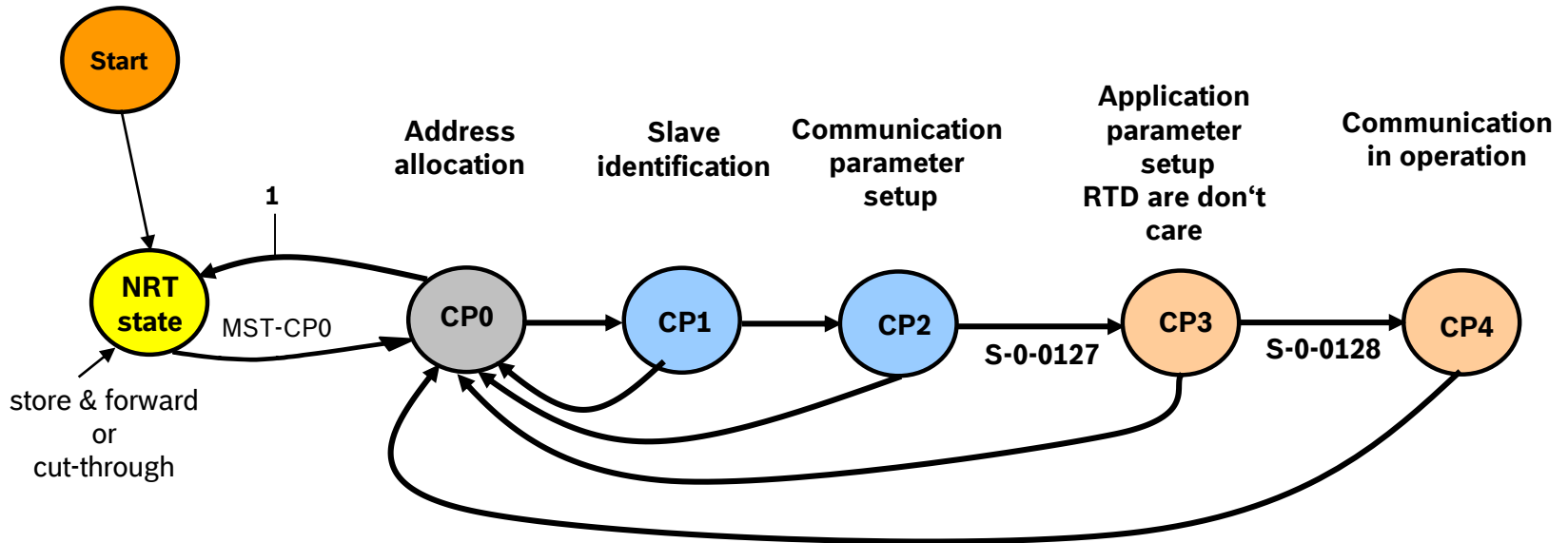**Rexroth**
Bosch Group

Communication error handling
in CP0 to CP4, CPS, HP0 to HP2

1 = CPS-Timeout of 200 ms or 500 ms
2 = no MST within 130 ms
3 = successive losses of MST exceeds S-0-1003
CPn = Communication phase
CPS = Communication phase switching
HPn = Hot-plug phase
NRT state = Non-Real-Time state

Sercos III telegram loss (CP3/4) = if no valid telegram are received on P1 and P2 within one communication cycle

Rexroth
Bosch Group

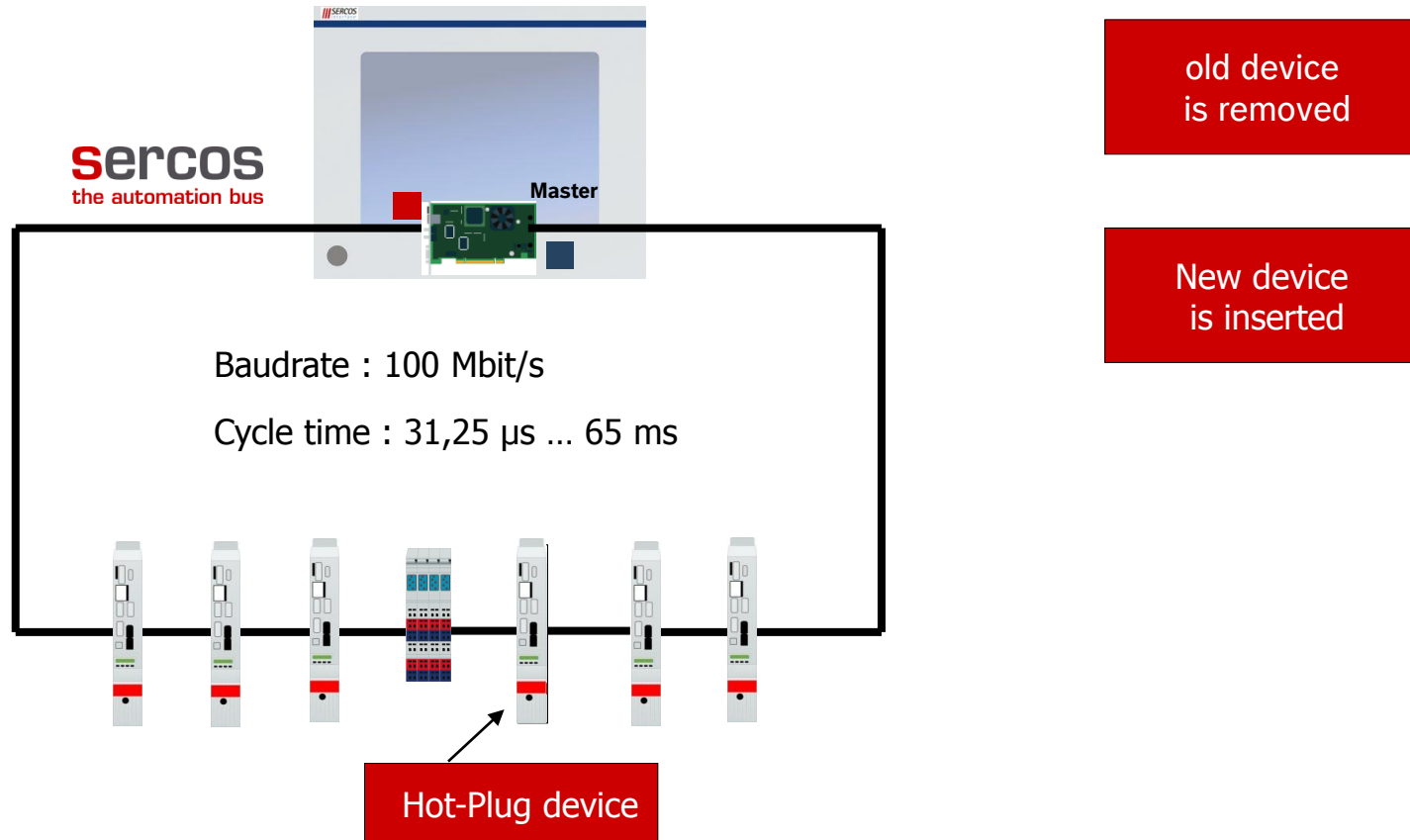# Initialization
Communication phases (CP0 to CP4)

1 = no MST-CP0 within 130 ms
CP = Communication phase
NRT state = Non-Real-Time state

Rexroth
Bosch Group

Hot-plugging Overview

Master

sercos
the automation bus

Baudrate : 100 Mbit/s

Cycle time : 31,25 µs … 65 ms

old device
is removed

New device
is inserted

Hot-Plug device

Rexroth
Bosch Group

Hot-plugging Hot-plug phases (HP0 to HP2)

- Hot-plugging is possible with line only

- with ring, a ring break has to initiated first

- Hot-plug function active on one channel only (P or S)

- Master shall be prepared for the HP slave

- Hot-plugging consists of 3 phases (HP0 to HP2)

1 = no MST-CP4 within 130 ms or HP not supported

2 = HP Slave activates Loopback
    Master commands FF to last slave

3 = Master switches from HP field to SVC

4= Master activates timing of CP3/4 (S-0-0127)

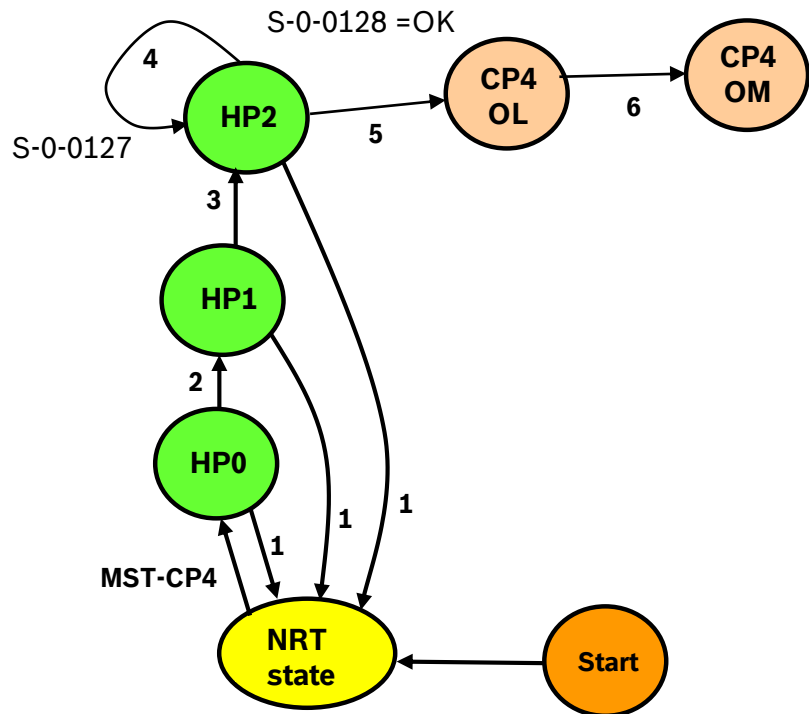5 = Master activates OL (S-0-0128)

6 = Master activates operation mode
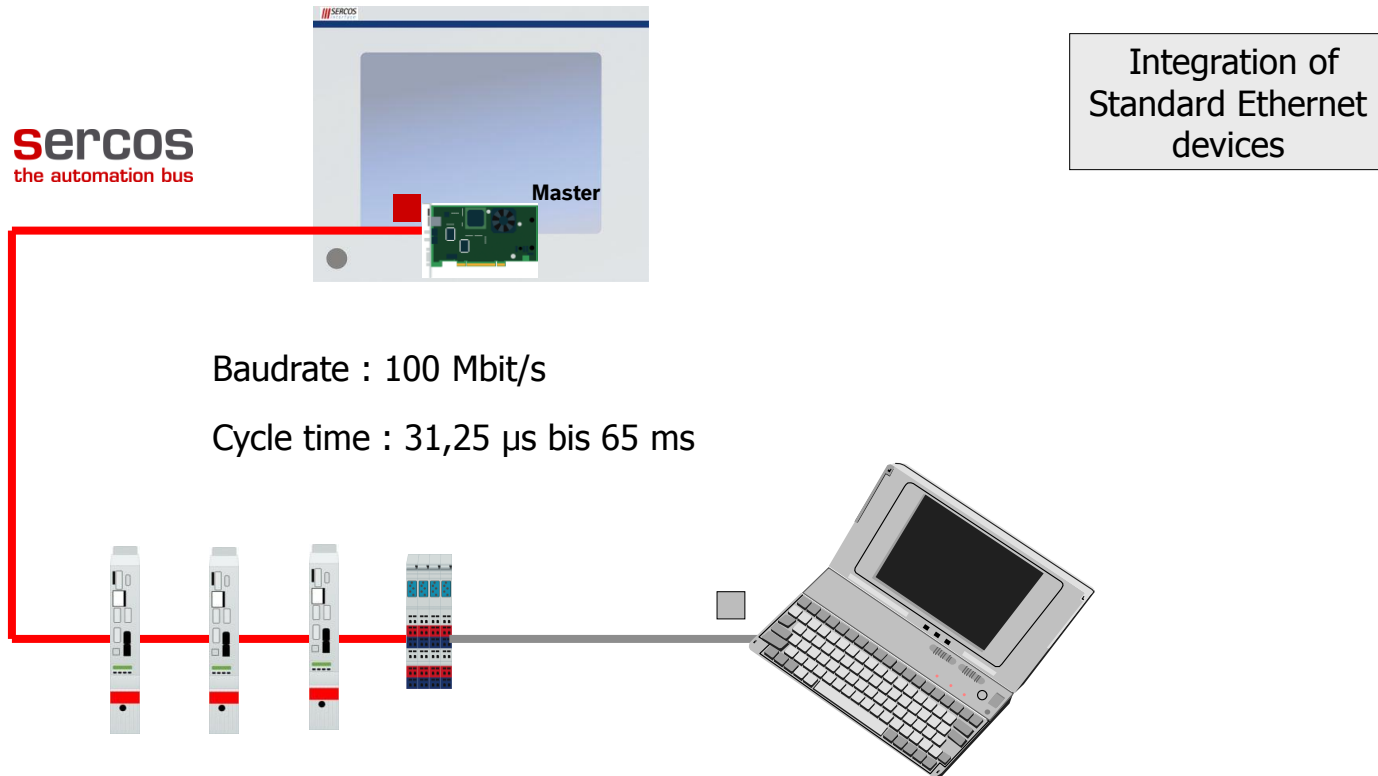
NRT state = Non-Real-Time state

HP = Hot-plugging

OL = Operating level

OM = Operation mode

Rexroth
Bosch Group

IP Communication - Overview

Integration of Standard Ethernet devices

Master

Baudrate : 100 Mbit/s

Cycle time : 31,25 µs bis 65 ms

Rexroth
Bosch Group

IP Communication

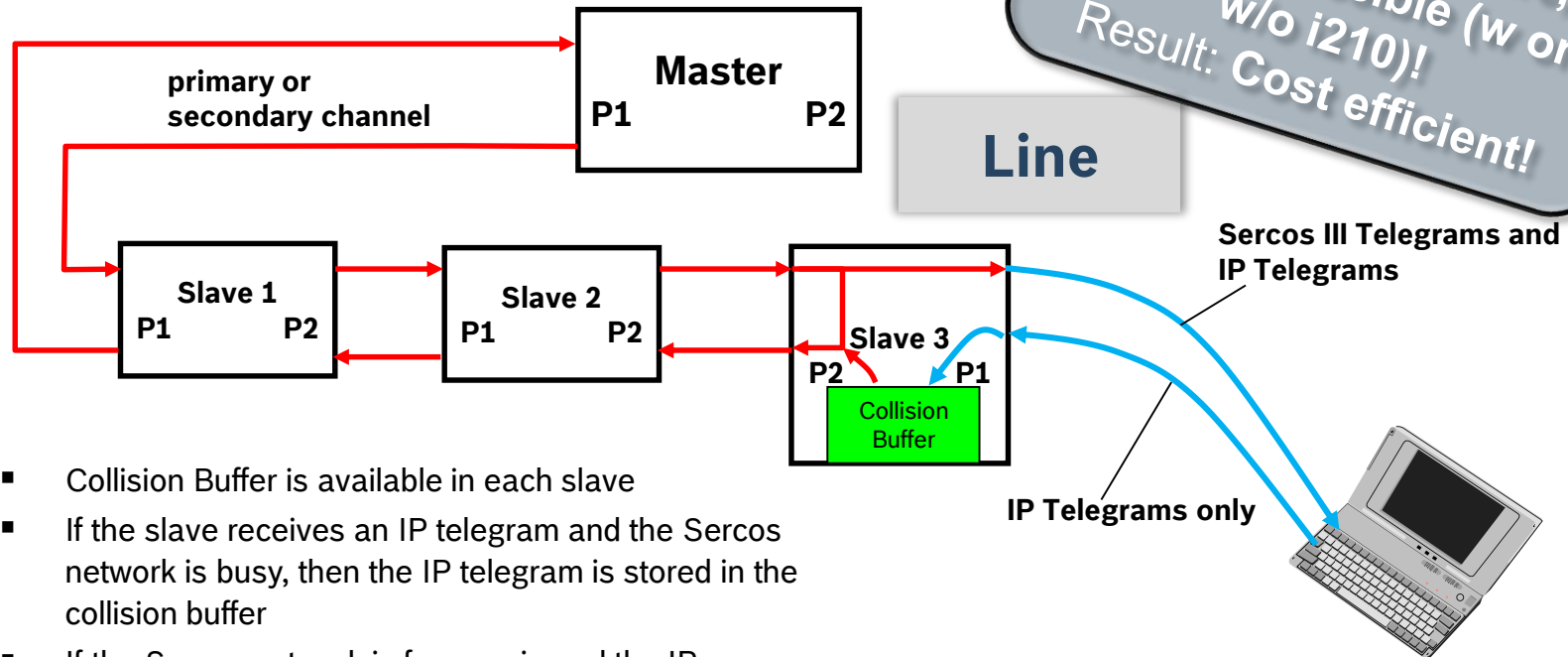## Service defines exchange of Sercos III data

- TFTP (trivial file transfer protocol)
  - Standard protocol based on UDP
  - TCP / IP Stack isn't necessary
  - used for firmware download

- **Sercos Internet Protocol S/IP**
  - Standard protocol between nodes
  - Defined on TCP/IP and UTP/IP
  - This protocol leads on mechanism of OPC-UA.
  - Protocol is under verification
  - used to modify and setup parameters in the slave

IP Communication - General

Advantage:
Minimum Hardware,
always possible (w or
w/o i210)!
Result: Cost efficient!

Master

P1   P2

primary or
secondary channel

Line

Slave 1
P1   P2

Slave 2
P1   P2

Slave 3
P2   P1

Collision Buffer

Sercos III Telegrams and IP Telegrams

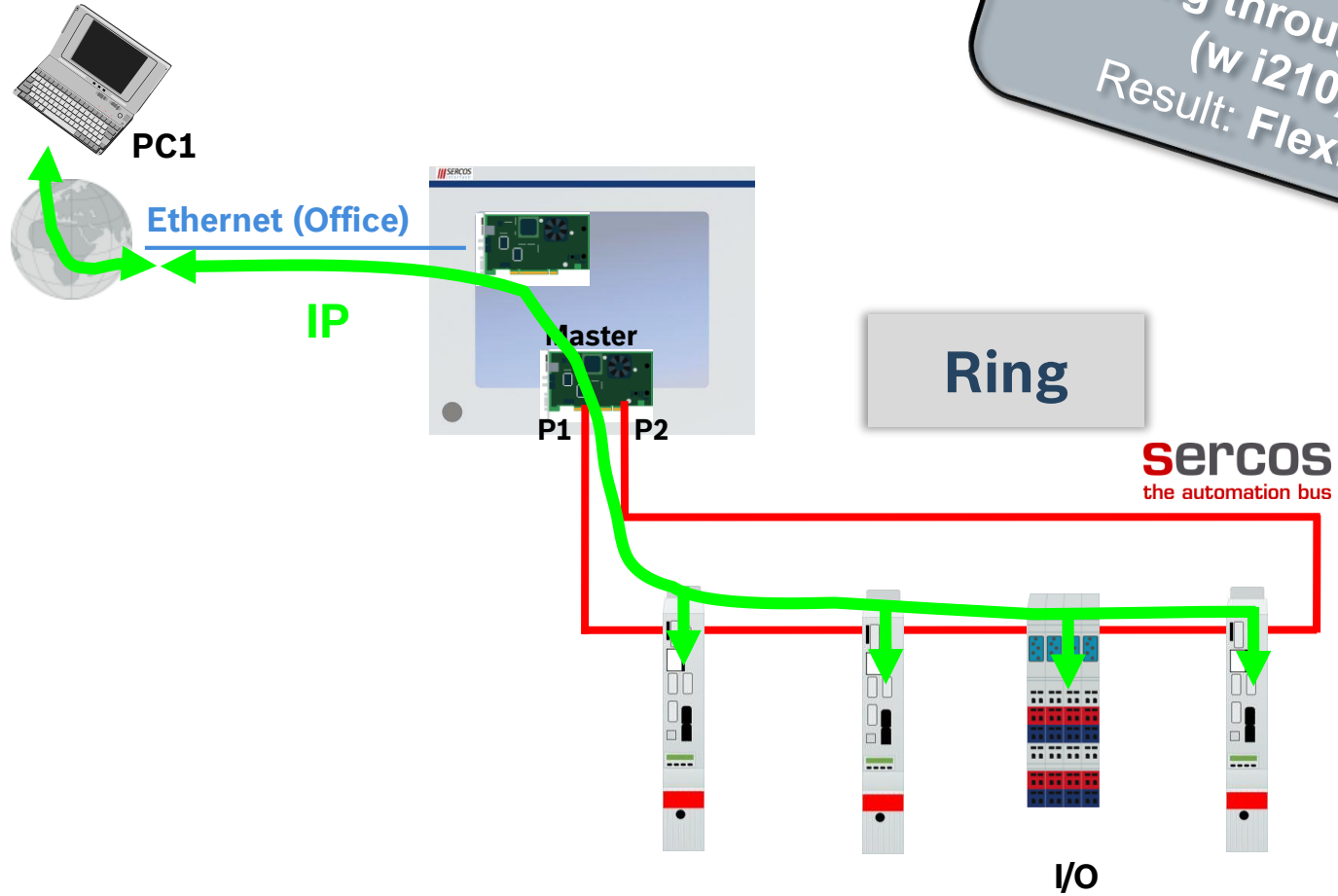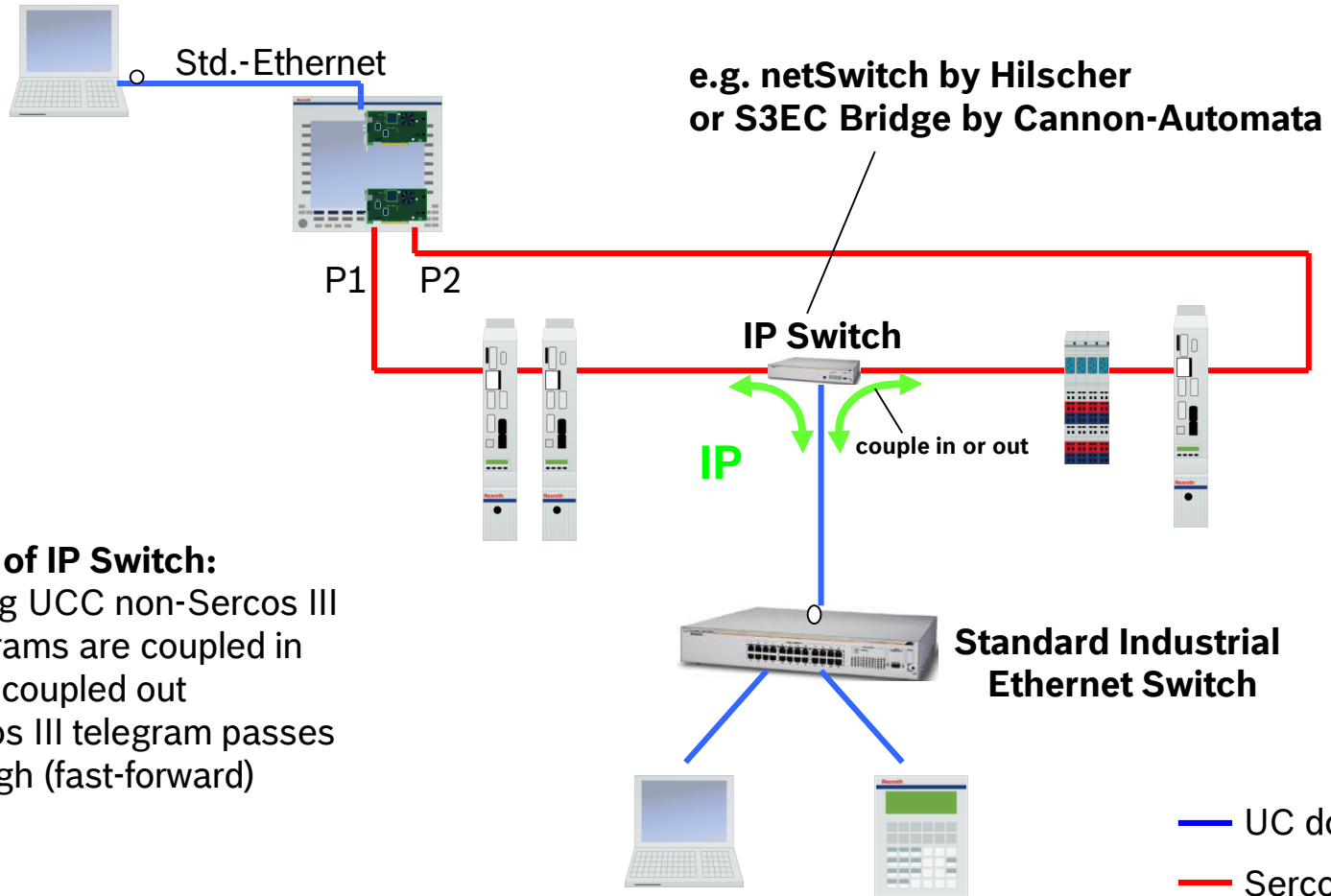**IP Telegrams only**

- Collision Buffer is available in each slave
- If the slave receives an IP telegram and the Sercos network is busy, then the IP telegram is stored in the collision buffer
- If the Sercos network is free again and the IP telegram is not consumed by the slave itself, then the IP telegram is automatically forwarded.
- PC receives Sercos III telegrams and IP telegrams
- PC transmits IP telegrams only

Rexroth
Bosch Group

IP Communication - Ring topology

Advantage:
Redundancy, UCC
Routing through Master
(w i210)!
Result: **Flexible!**

PC1

Ethernet (Office)

IP

Master

P1   **P2**

Ring

sercos
the automation bus

I/O

Rexroth
Bosch Group

IP Communication – IP switch with ring topology

Std.-Ethernet

**e.g. netSwitch by Hilscher
or S3EC Bridge by Cannon-Automata**

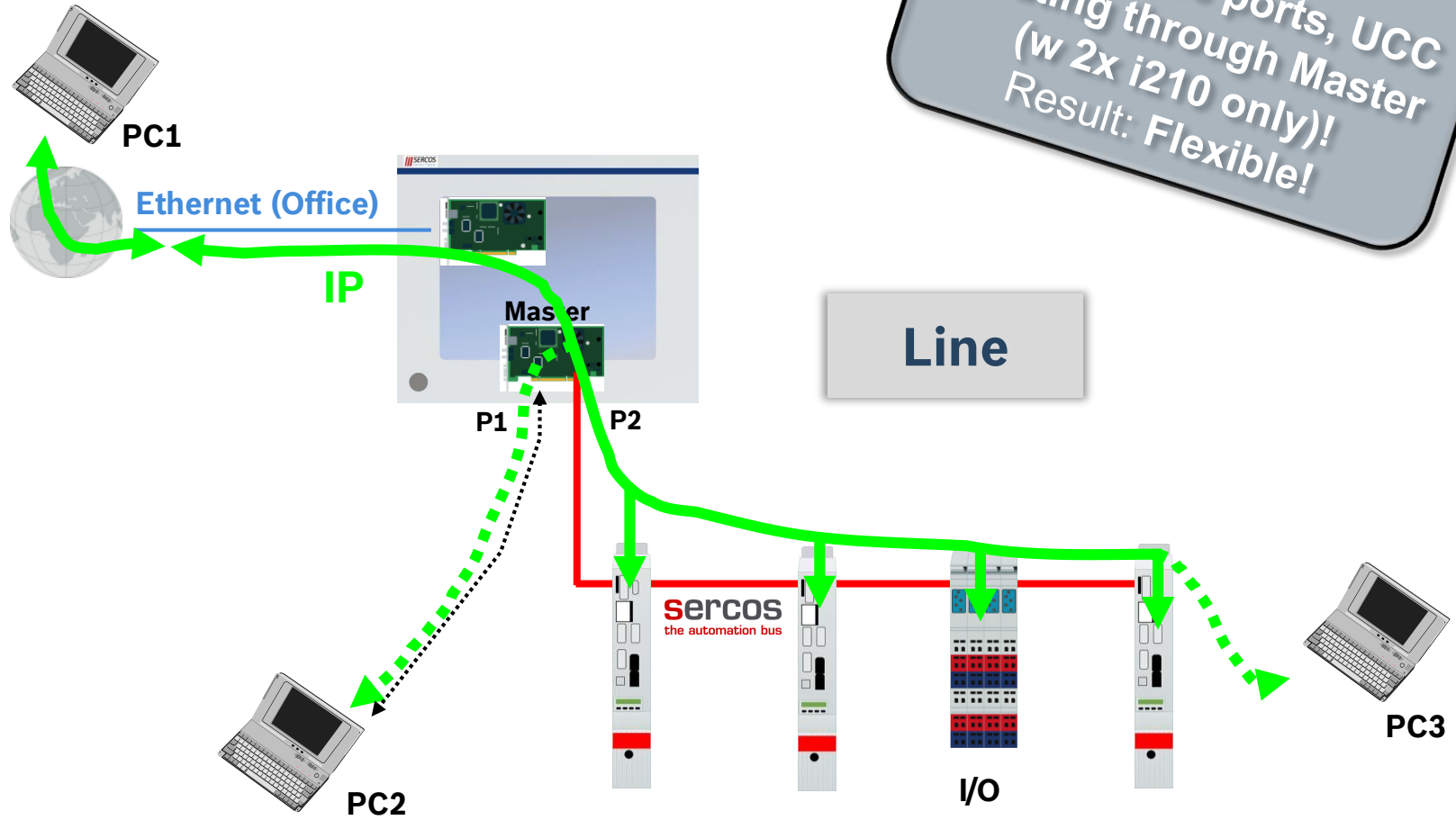P1   P2

IP Switch

IP   **couple in or out**

Function of IP Switch:
- During UCC non-Sercos III telegrams are coupled in resp. coupled out
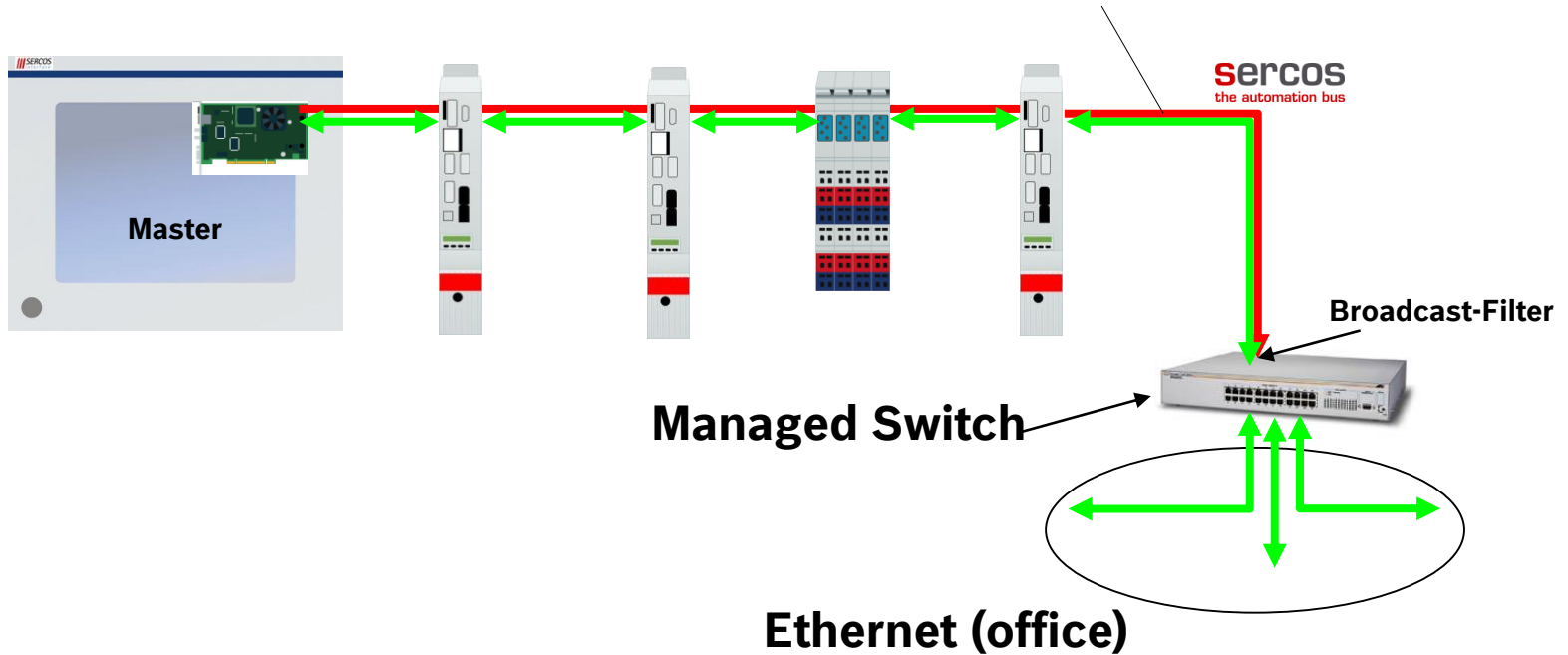- Sercos III telegram passes through (fast-forward)

**Standard Industrial
Ethernet Switch**

—— UC domain

—— Sercos III

Rexroth
Bosch Group

IP Communication - Line with Managed Switch

S III telegrams using Broadcast address

Master

sercos
the automation bus

Broadcast-Filter

Managed Switch

Ethernet (office)

Rexroth
Bosch Group

IP Communication
Commissioning without Sercos III communication
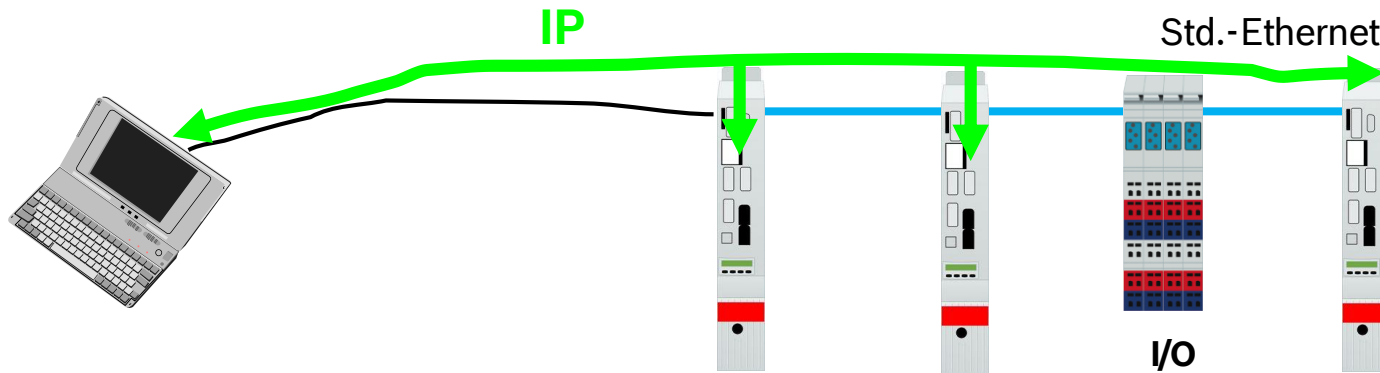
- Download/Upload of parameters via S/IP possible
- Firmware download via TFTP possible
- PC is connected to a unused Sercos III port
- Address assignment with „zero-conf-service" (part of DHCP)
- IP addresses are listed in the PC
- LED flashes, if slave is addressed

S/IP = defined services, e.g. how to read and write parameters

Rexroth
Bosch Group

Communication performance

Cycle time [µs]	Cyclic data [Byte]	Number of Slaves			Number of MDT / AT
		UCC not used	UCC 1500 Byte 125 µs	UCC 250 Byte 20 µs	
31,25	8	7	--	2	1/1
62,5	12	14	--	8	1/1
125	16	26	--	21	1/1
250	12	61 (10)	30	57	1/1
250	32	33	17	31	1/1
500	12	122 (20)	94	120	2/2
1000	12	251	220	245	4/4
1000	32	137	120	134	4/4
1000	50	97	85	95	4/4

Rexroth
Bosch Group

Communication and device profiles

Rexroth
Bosch Group
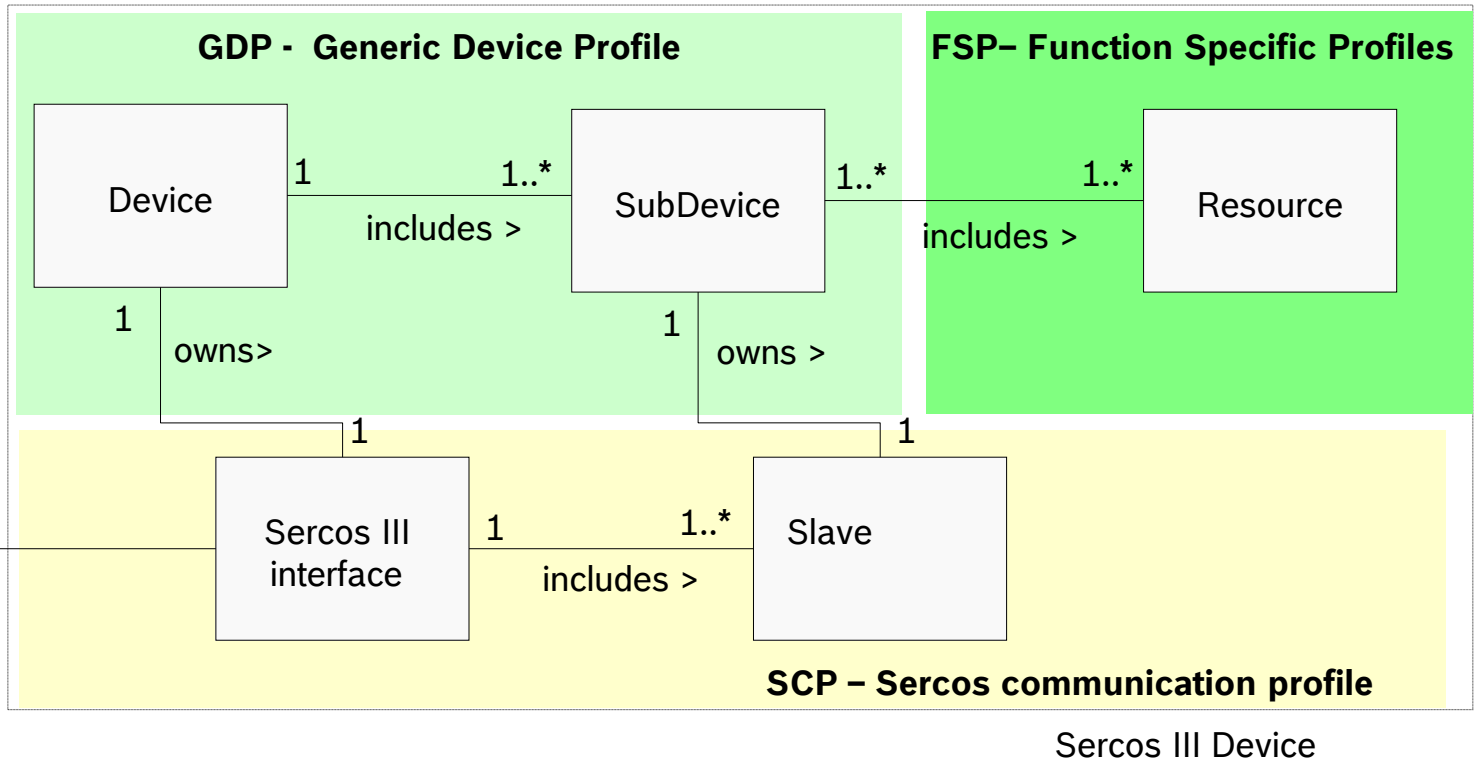
Addressing scheme / logical comm. channels
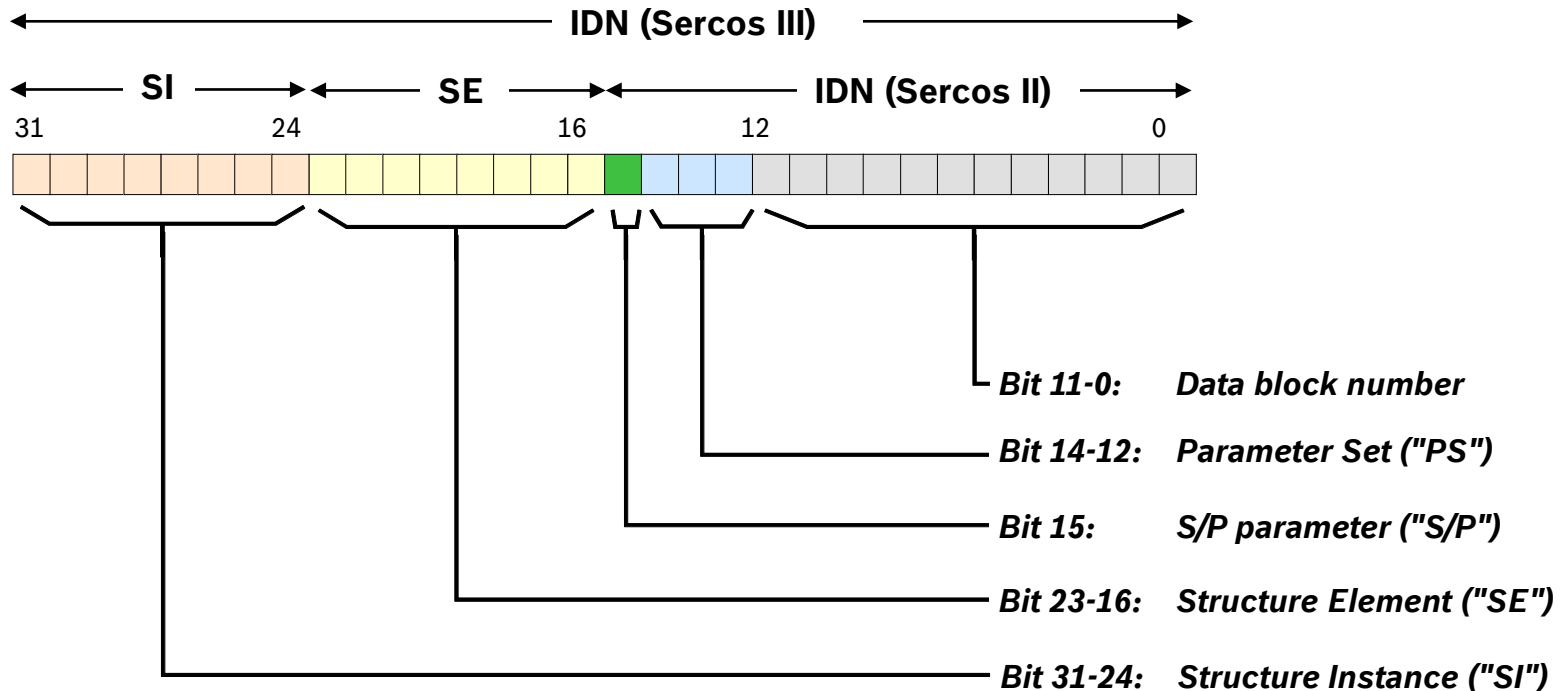
Rexroth
Bosch Group
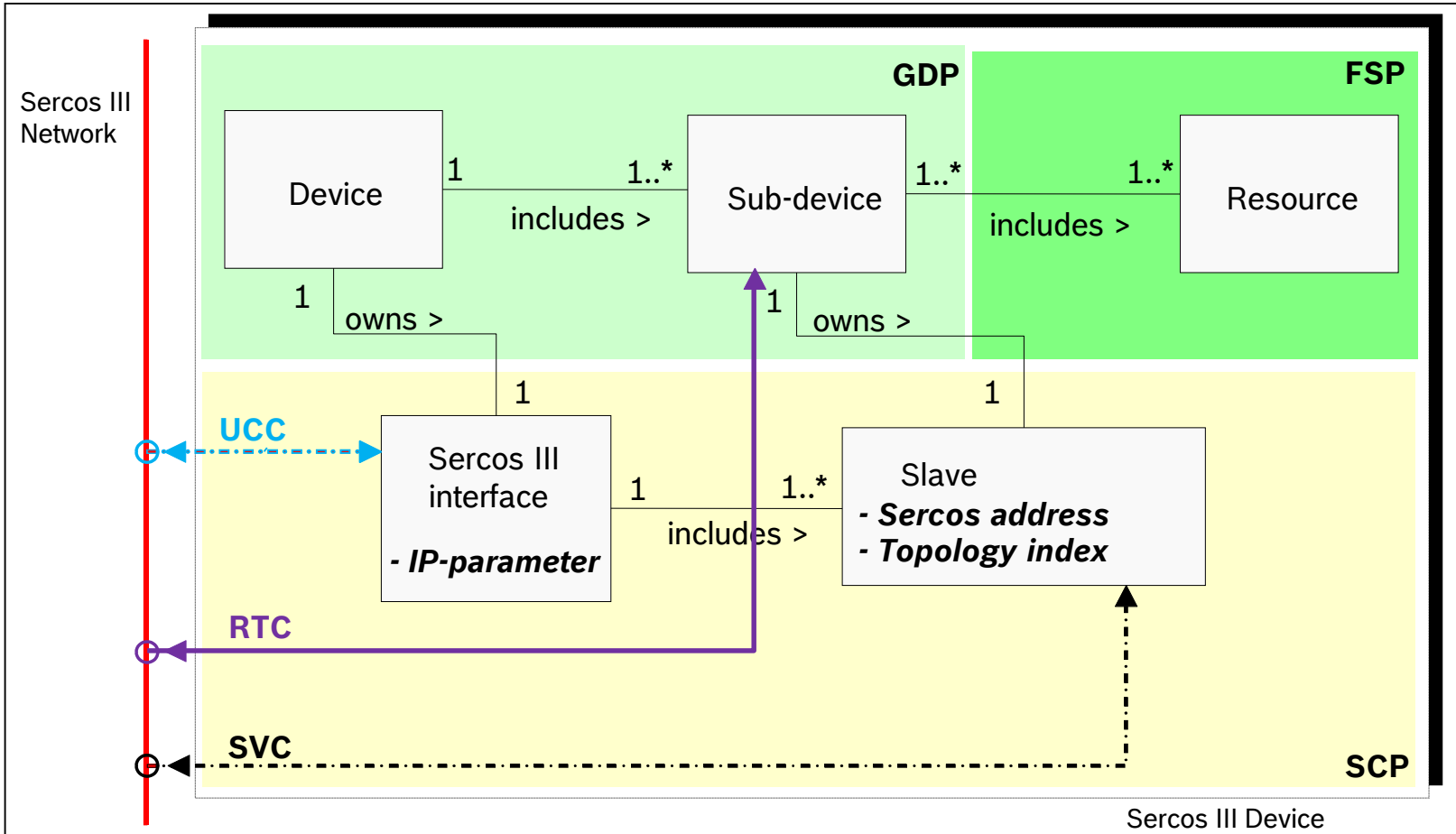
Parameter Stucture (Identification Numbers IDN)

- Every parameter can consist of up to 7 elements.
- 3 elements are mandatory

| Element No.	Description	Requirement
1	IDN	mandatory
2	Name	optional
3	Attribute	mandatory
4	Unit	optional
5	Min. Value	optional
6	Max. Value	optional
7	Data	mandatory

Rexroth
Bosch Group

Identification Number – IDN (Element 1: write access)

IDN (Sercos III)

SI SE IDN (Sercos II)

31 24 16 12 0

- Bit 11-0: *Data block number*
- Bit 14-12: *Parameter Set ("PS")*
- Bit 15: *S/P parameter ("S/P")*
- Bit 23-16: *Structure Element ("SE")*
- Bit 31-24: *Structure Instance ("SI")*

- **< IDN>.<SI>.<SE> e.g. S-0-1530.2.5**
- **SE: 0-127, are used for Standard parameters**
- **SE: 128-255, are usable for product specific parameters**
- **SI: 0-255, addressing the structure of the same type (instance)**

Rexroth
Bosch Group

Addressing area with SI, SE and Parameter set

S-1-1530.1.1

S-0-1530.1.3

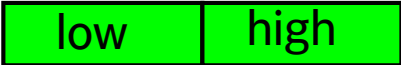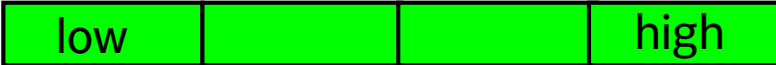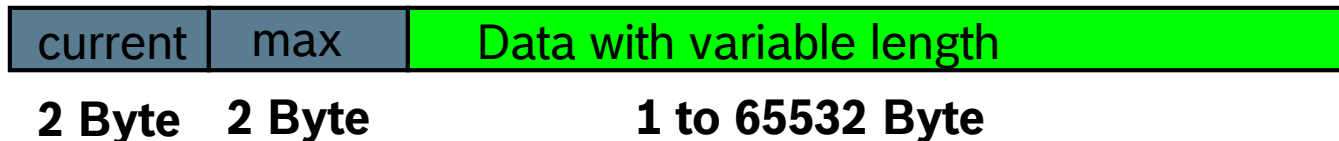S-0-1530.0.7
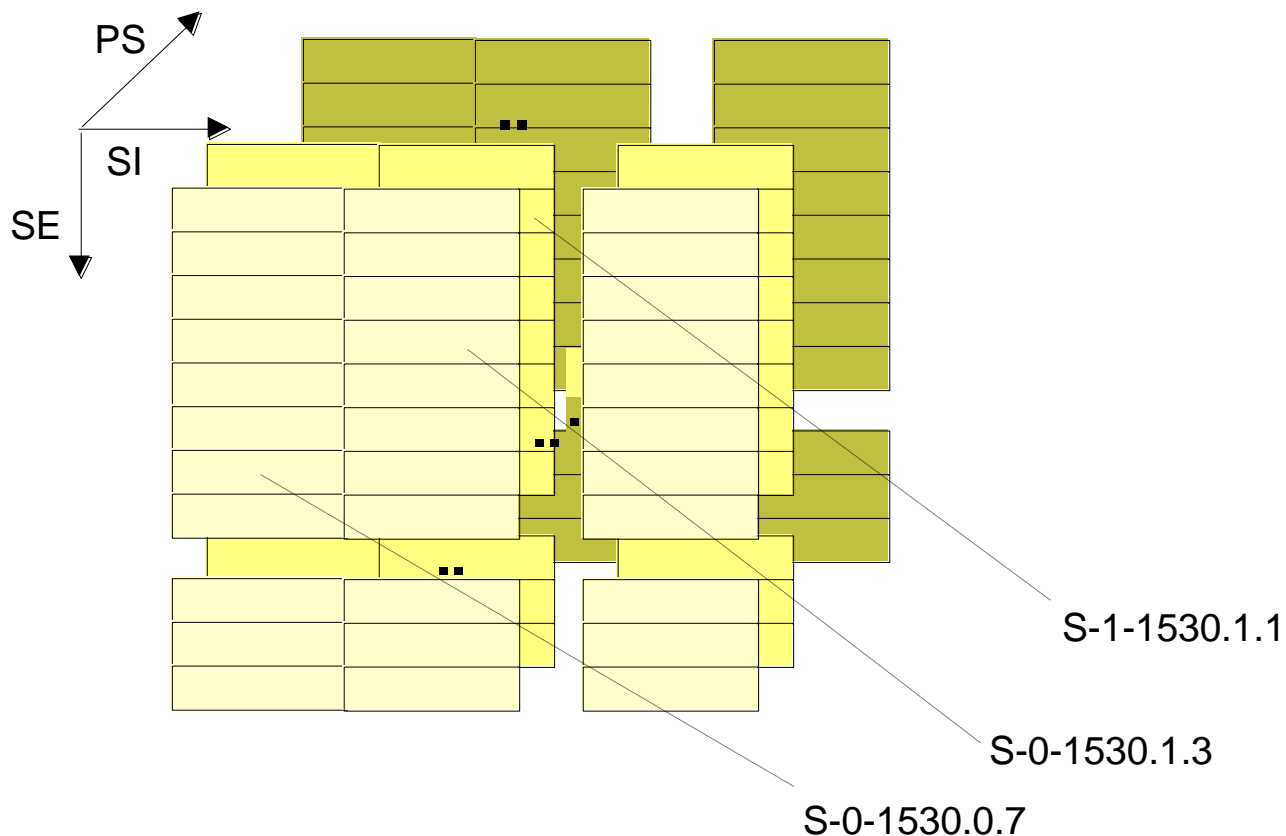
Attribute (Element 3)

- **Display format**
    - **binary**
    - **unsigned decimal**
    - **signed decimal**
    - **hexadecimal**
    - **floating point**
    - **text (UTF8)**
    - **IDN**
    - **Time**

- **Data length**
    - **fixed with 2, 4, 8 byte**
    - **variable with list elements of 1, 2, 4, 8 byte**
- **Write protection**
- **Conversion factor**
- **Decimal point**

Data length	Display format						
	binary	unsigned dec	signed dec	hex	text	IDN	float
2 byte	x	x	x	x			
4 byte	x	x	x	x		x	x
8 byte	x	x	x	x			x
1 byte list	x	x		x	x		
2 byte list	x	x	x	x			
4 byte list	x	x	x	x		x	x
8 byte list	x	x	x	x			x

Rexroth
Bosch Group

Operation Data (Element 7)

- 2 Byte

- 4 Byte

low	high

- 8 Byte

low			high

- variable Length

current	max	Data with variable length

  2 Byte **2 Byte**   **1 to 65532 Byte**

Rexroth
Bosch Group

Data Scaling of Operation data

- Scaling for all Position data

- Scaling for all Velocity data

- Scaling for all Torque/Force data

- Scaling for all Acceleration/Jerk data

Rexroth
Bosch Group

# Data Scaling - Scaling Parameter

- Scaling Type

- Scaling Factor

- Scaling Exponent

- Rotational Position Resolution (for position data only)

Rexroth
Bosch Group

Data Scaling - Scaling selections

- Scaling types
  - No scaling
  - Linear
  - Rotational

- Preferred Scaling
- Parameter Scaling
- Data reference
  - Motor shaft
  - Load
- Processing format
  - absolute
  - modulo

Rexroth
Bosch Group

Position Scaling Diagram
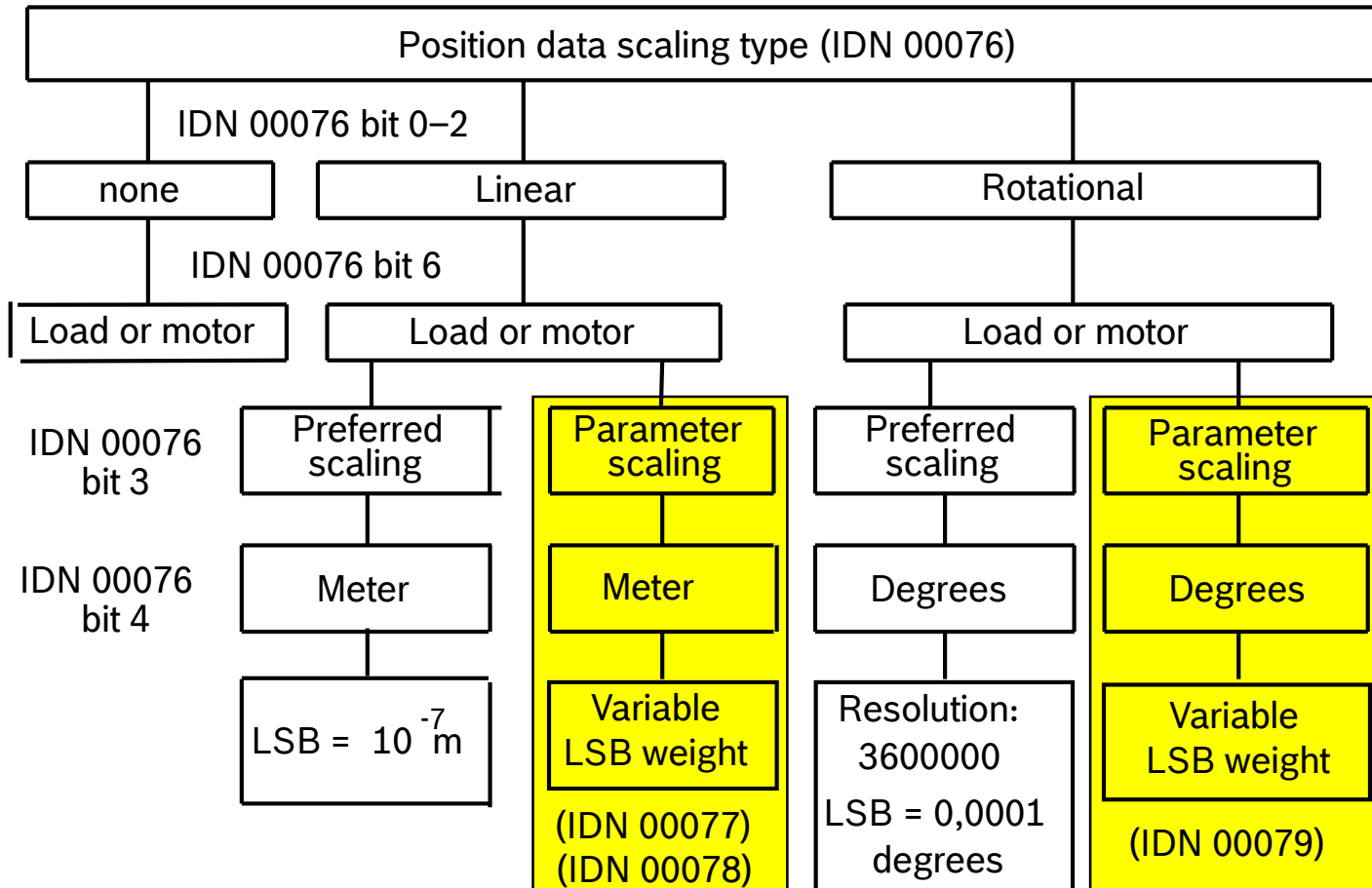
More information

- Sercos eLearning
- Sercos technology overview web
- Sercos brochures
- Sercos webinars
- Sercos specifications in Wiki (Register here!)

Rexroth
Bosch Group

Thank you for Considering Sercans solutions!

Rexroth
Bosch Group