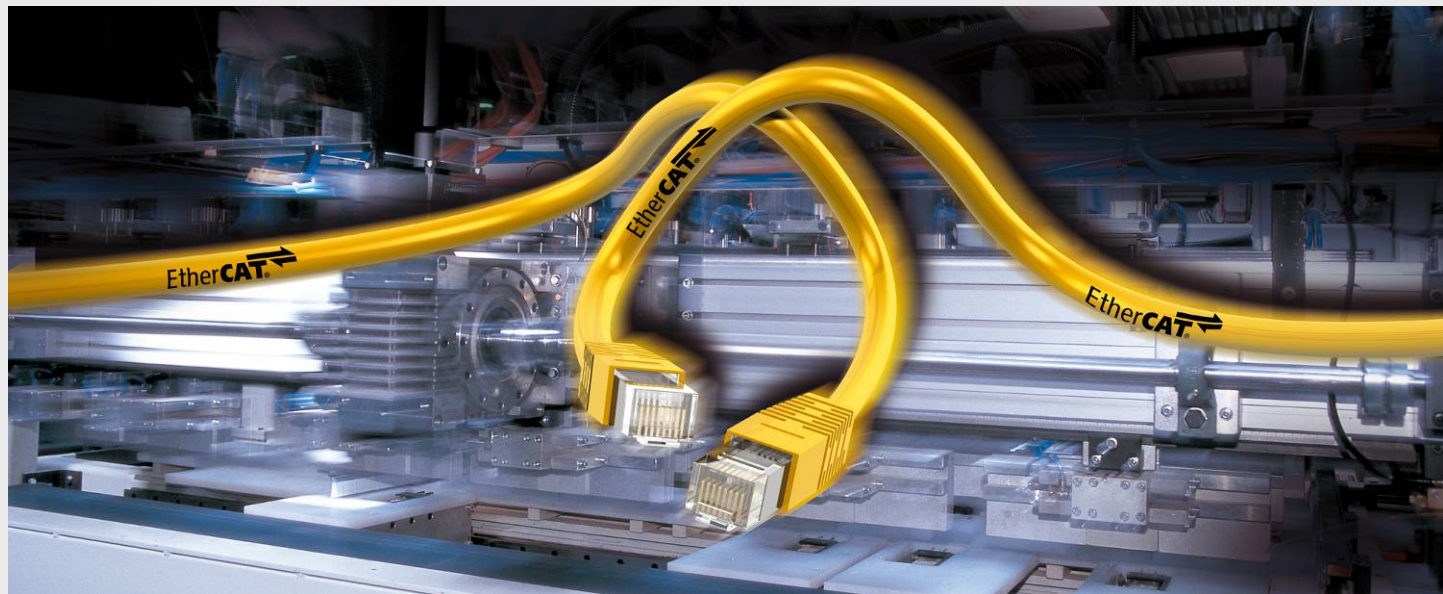


EtherCAT is:

- faster
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

EtherCAT - the Ethernet Fieldbus



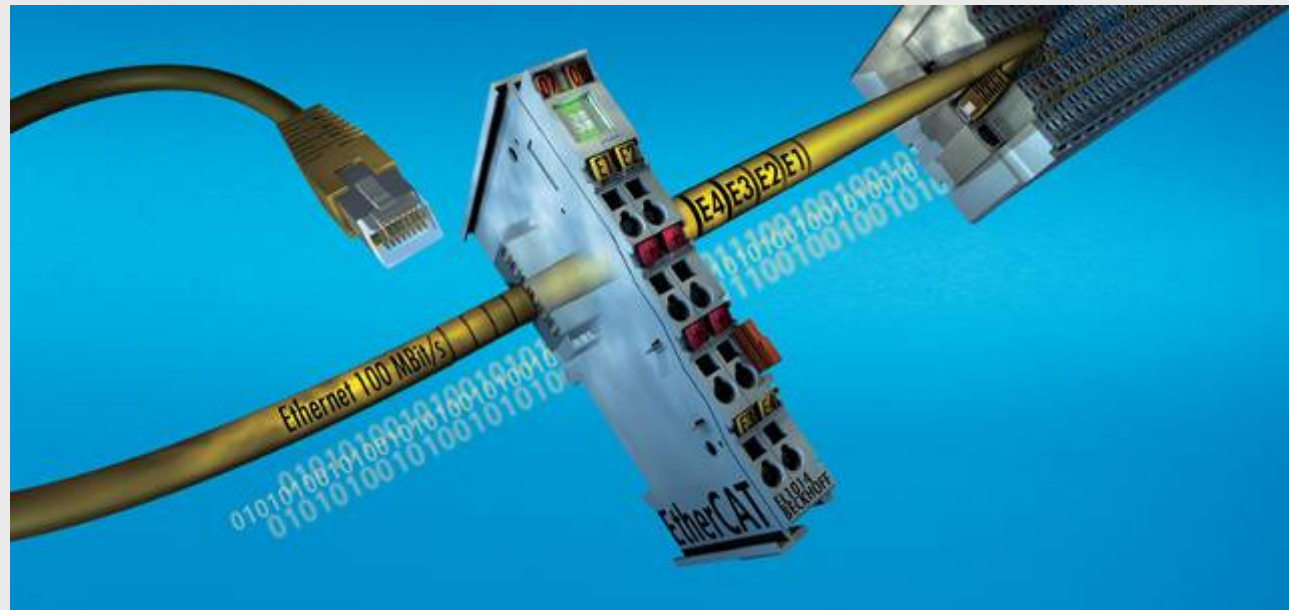


EtherCAT is the Ethernet Fieldbus!

EtherCAT is:

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- redundancy
- versatile

- **EtherCAT is realtime down to the I/O level**
- **no underlying sub-systems any more**
- **no delays in gateways**
- **In- and outputs, sensors, drives, displays: everything on one system!**



EtherCAT is faster!



EtherCAT is:

- faster
- Industrial Ethernet
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- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Transmission Rate: 2 x 100 Mbaud (Voll-Duplex)

Update Times:

- 256 digital I/O in 11 μ s
- **1000 digital I/O** distributed to 100 nodes **in 30 μ s** = 0.03 ms
- 200 analog I/O (16 bit) in 50 μ s, 20 kHz Sampling Rate
- **100 Servo-Axis** (each 8 Byte IN+OUT) **in 100 μ s** = **0.1 ms**
- 12000 digital I/O in 350 μ s

EtherCAT is faster!

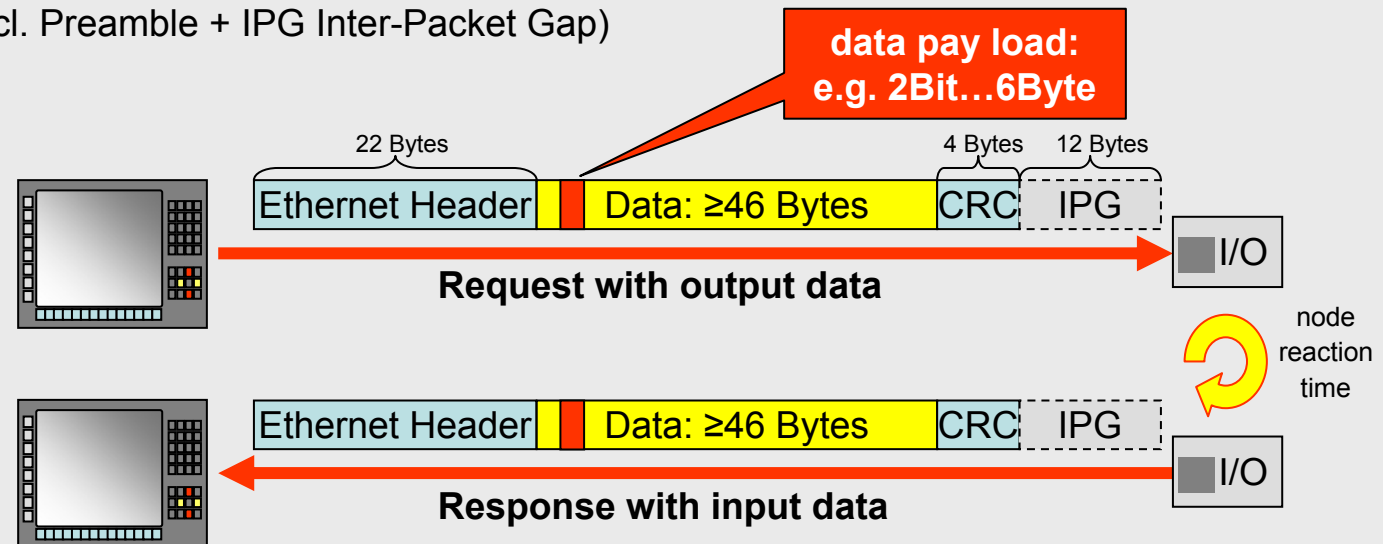
EtherCAT is:

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- safety
- redundancy
- versatile

Bandwidth Usage of Ethernet for I/O and Drives:

Ethernet Frame: ≥ 84 Bytes

(incl. Preamble + IPG Inter-Packet Gap)



with 4 Byte input + 4 Byte output per node:

4,75% application data ratio at 0μs reaction time/node

1,9% application data ratio at 10μs reaction time/node



EtherCAT is faster!

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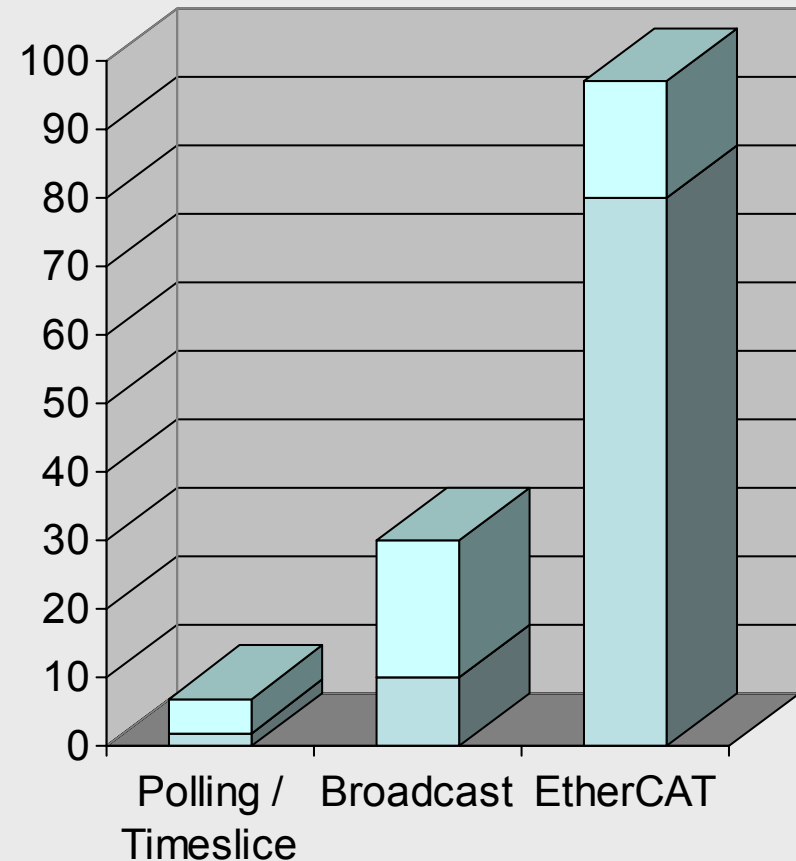
Bandwidth Usage Comparison:

At 4 Byte user data per node:

- Polling / Timeslicing: ca. 2..5%
- Broadcast (Master → Slaves): ca. 20...30%

From 2 Bit user data per node:

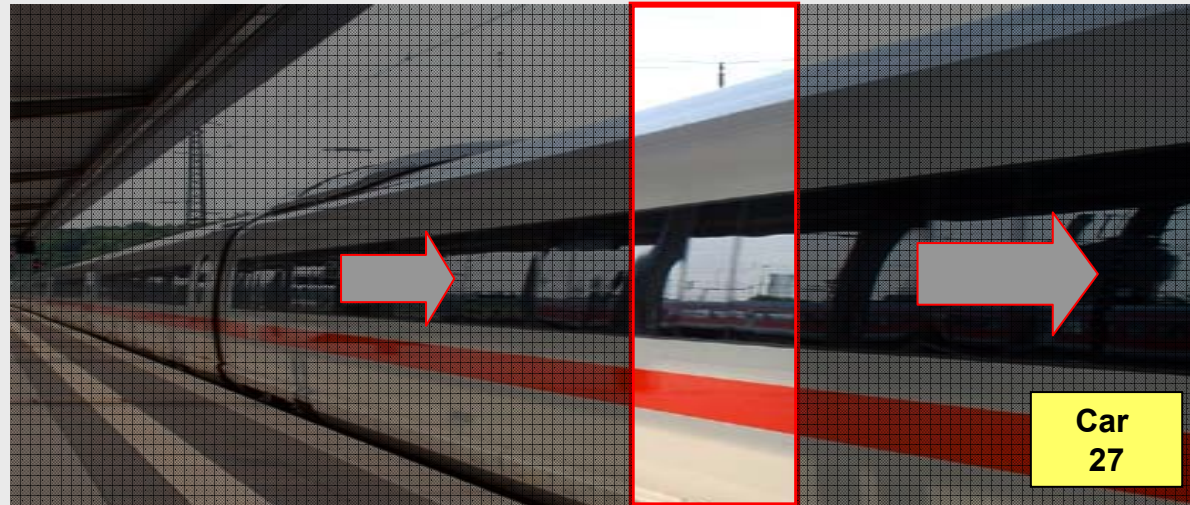
- **EtherCAT: 80...97%**



Functional Principle: Ethernet „on the Fly“

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- versatile



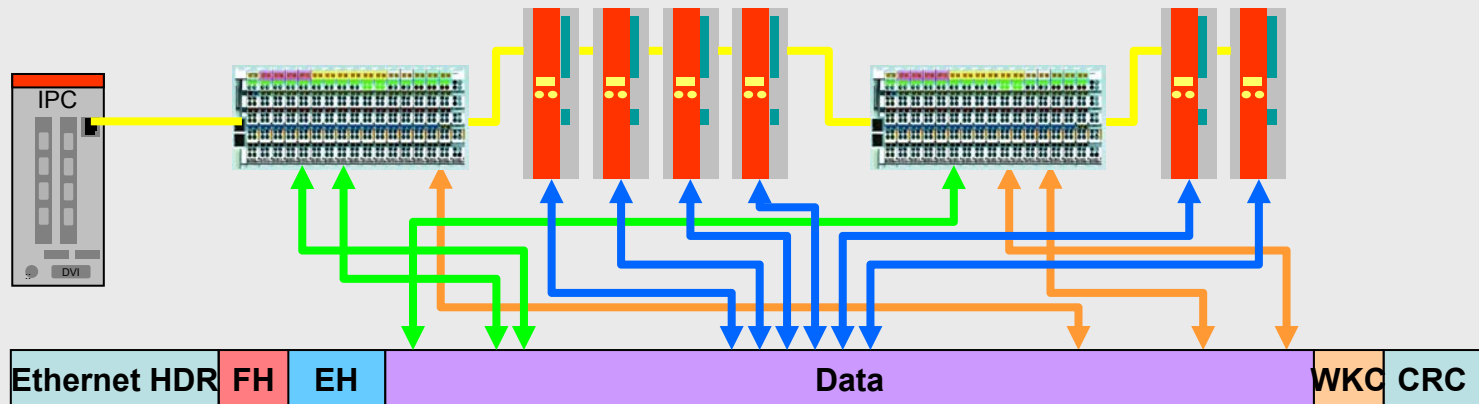
Analogy Fast Train:

- „Train“ (Ethernet Frame) does not stop
- Even when watching „train“ through narrow window one sees the entire train
- „Car“ (Sub-Telegram) has variable length
- One can „extract“ or „insert“ single „persons“ (Bits) or entire „groups“ – even multiple groups per train

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- redundancy
- versatile

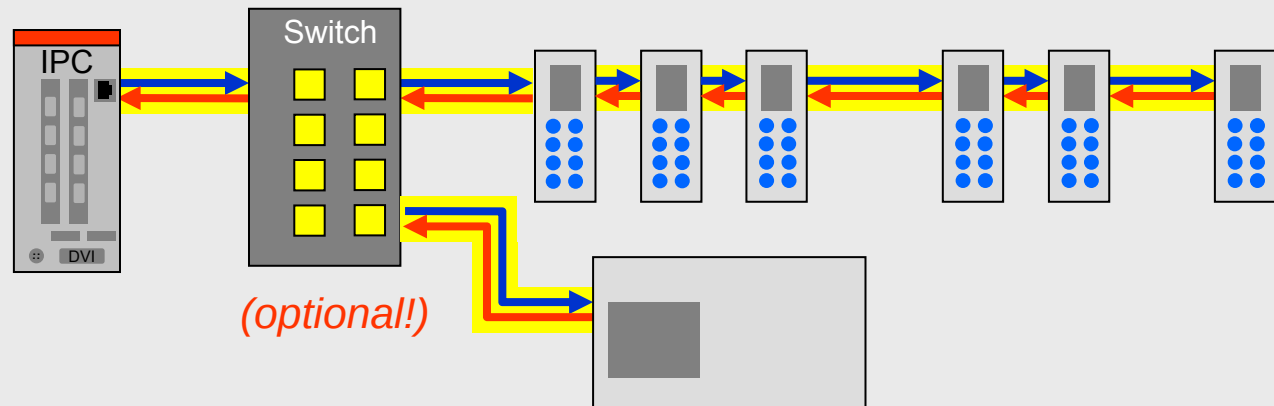
Minimal protocol overhead via implicit addressing



- Optimized telegram structure for decentralised I/O
- Communication completely in hardware: maximum performance
- no switches needed if only EtherCAT devices in the network
- Outstanding diagnostic features
- Ethernet-compatibility maintained

EtherCAT is:

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- easier to implement
- well proven
- open
- safety
- redundancy
- versatile



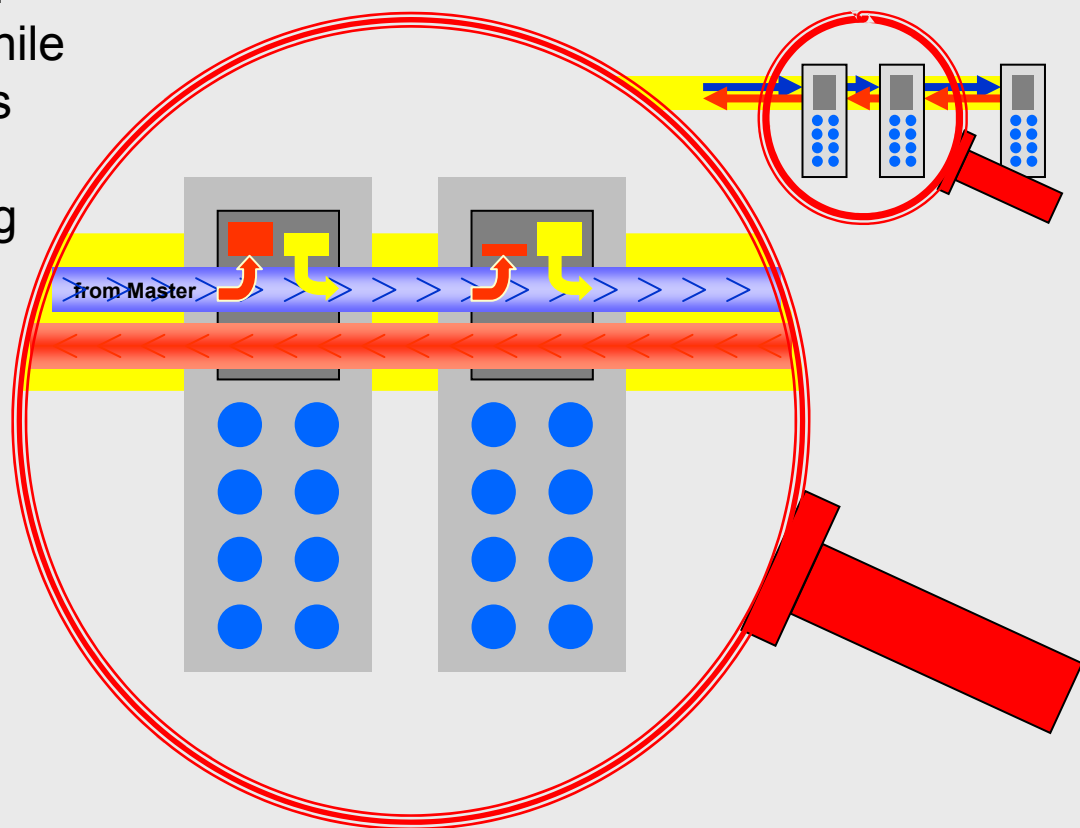
- Standard Switch can be used
- With Switch:
only one MAC Address for up to 65535 nodes

EtherCAT is:

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- easier to implement
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- redundancy
- versatile

Processing on the fly saves time

- Data is modified and/or added while telegram passes through without buffering, storing or disassembly / assembly.
- Minimal Telegram delay per node
- Optimal performance





Performance: Application Example

EtherCAT is:

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- easier to configure
- lower cost
- easier to implement
- well proven
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- redundancy
- versatile

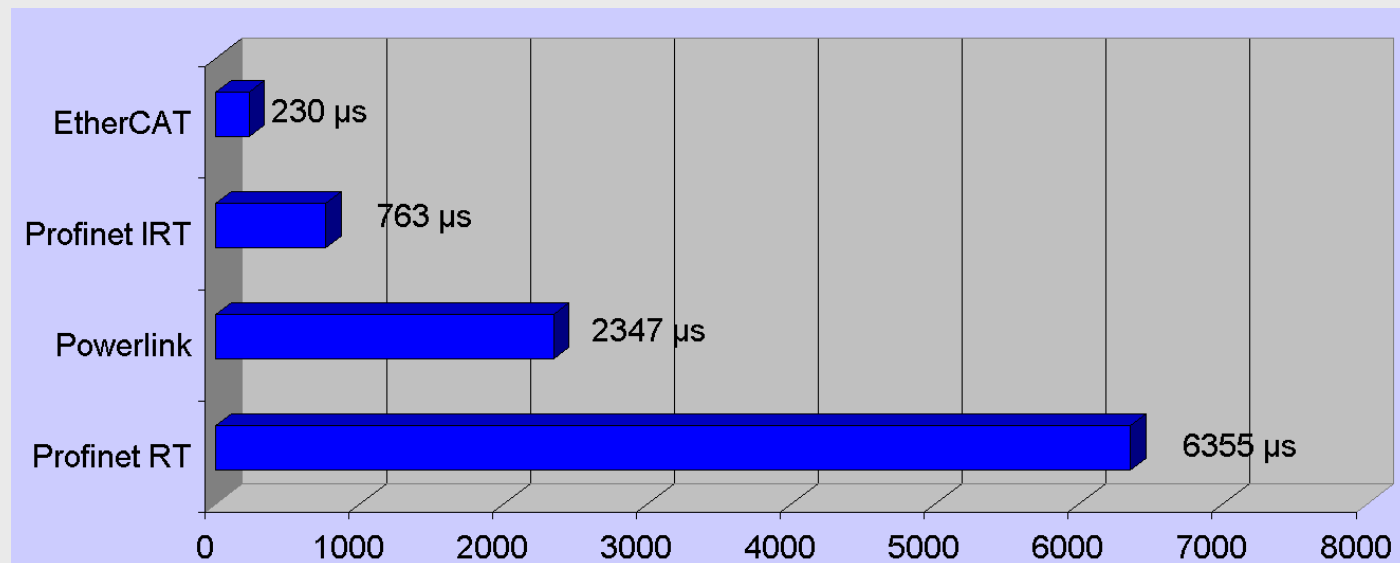
- 40 Axis (each 6 Byte Input- and Output-Data)
- 50 I/O Station with altogether 560 EtherCAT Bus Terminals
- 2000 Digital + 200 Analog I/O, Bus Length 500 m
- Performance EtherCAT: **Cycle Time 230µs** at 33% Bus Load, Telegram Length 77µs
- For comparison:
1 CAN Frame (8 Byte Process Data) @ 500 kBit/s: 250µs

Performance: Application Example

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- redundancy
- versatile

- 40 Axis (each 6 Byte Input- and Output-Data)
- 50 I/O Station with altogether 560 EtherCAT Bus Terminals
- 2000 Digital + 200 Analog I/O, Bus Length 500 m
- Performance EtherCAT: **Cycle Time 230µs** at 33% Bus Load, Telegram Length 77µs
- For comparison:
Profinet IRT **763 µs**, Powerlink V2 **2347µs***, Profinet RT **6355 µs**



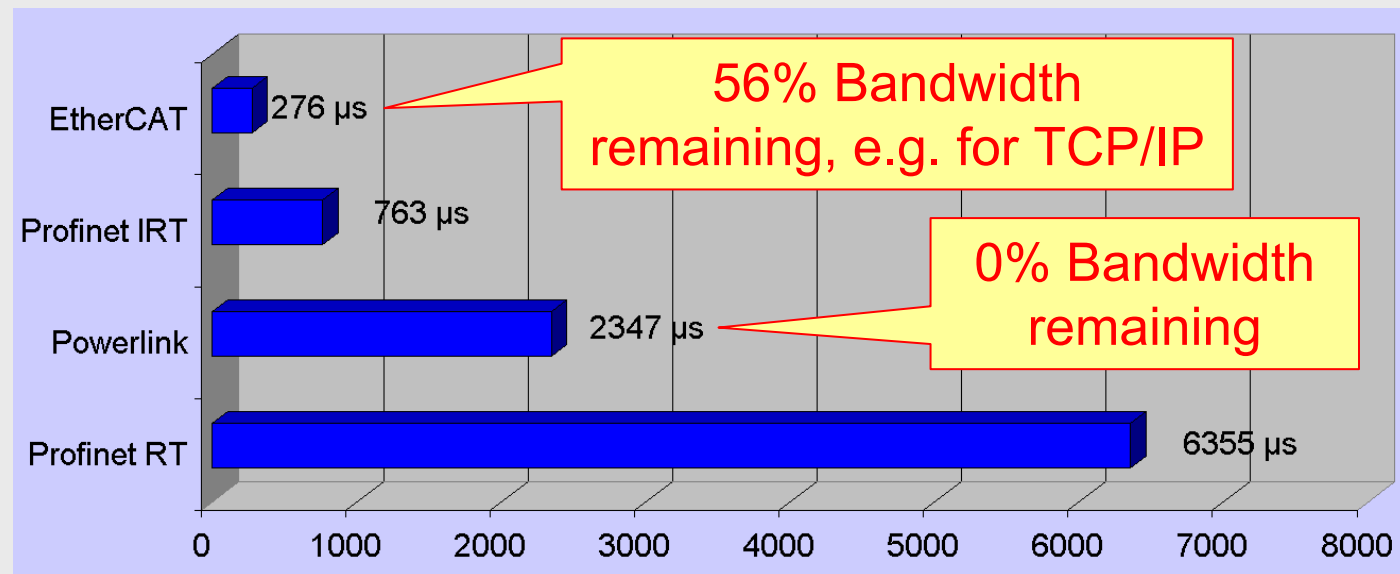
* Source: Ethernet Powerlink Spec V 2.0, App.3

Performance: Application Example

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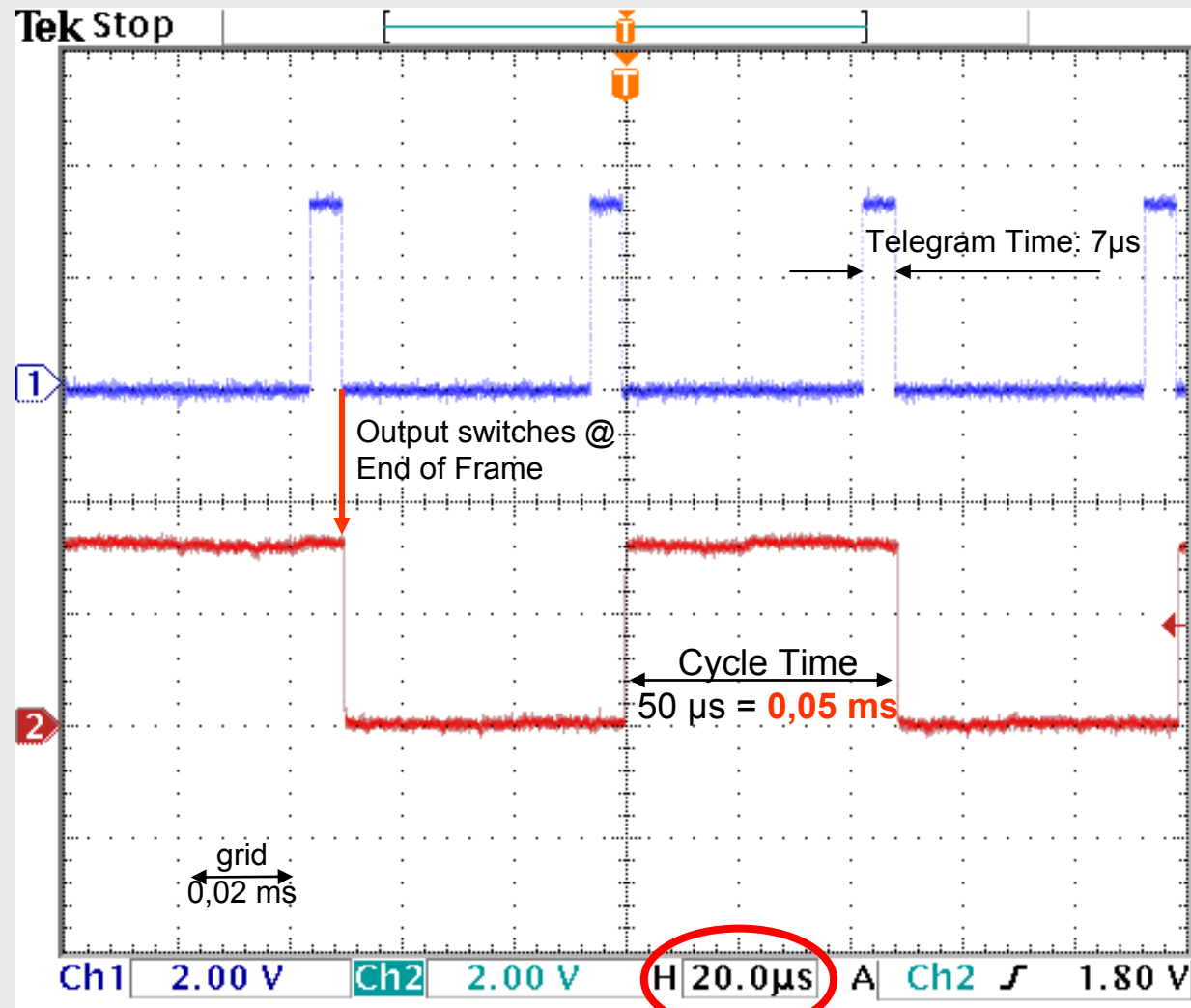
- 40 Axis (each 20 Byte Input- and Output-Data)
- 50 I/O Station with altogether 560 EtherCAT Bus Terminals
- 2000 Digital + 200 Analog I/O, Bus Length 500 m
- Performance EtherCAT: Cycle Time 276µs at 44% Bus Load, Telegram Length 122µs
- for comparison:
Profinet IRT 763 µs, Powerlink V2 2347µs*, Profinet RT 6355 µs



* Source: Ethernet Powerlink Spec V 2.0, App.3

EtherCAT is:

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- redundancy
- versatile

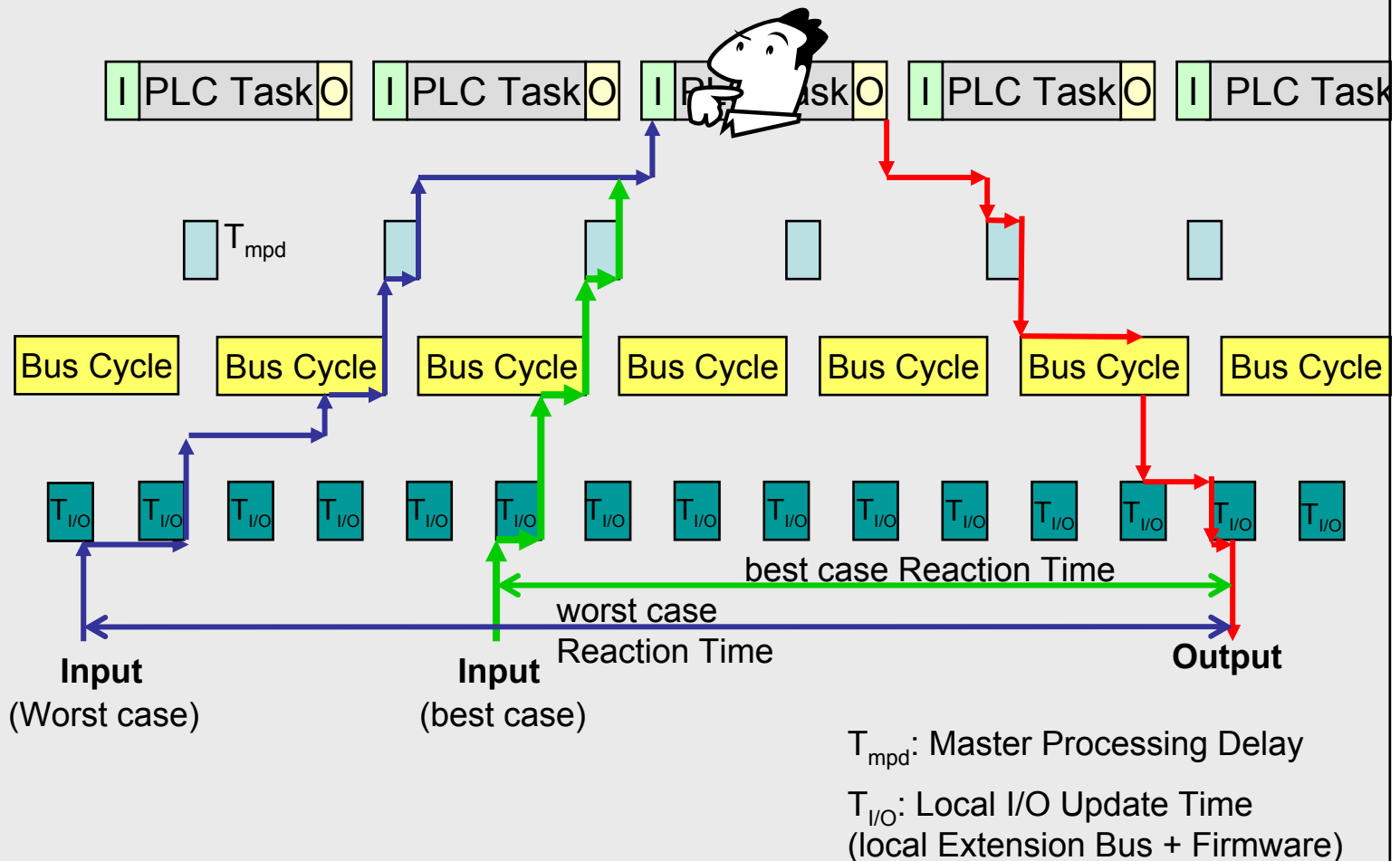


„Slow“ Control Systems benefit, too!

EtherCAT is:

- faster
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Reaction time with legacy fieldbus I/O

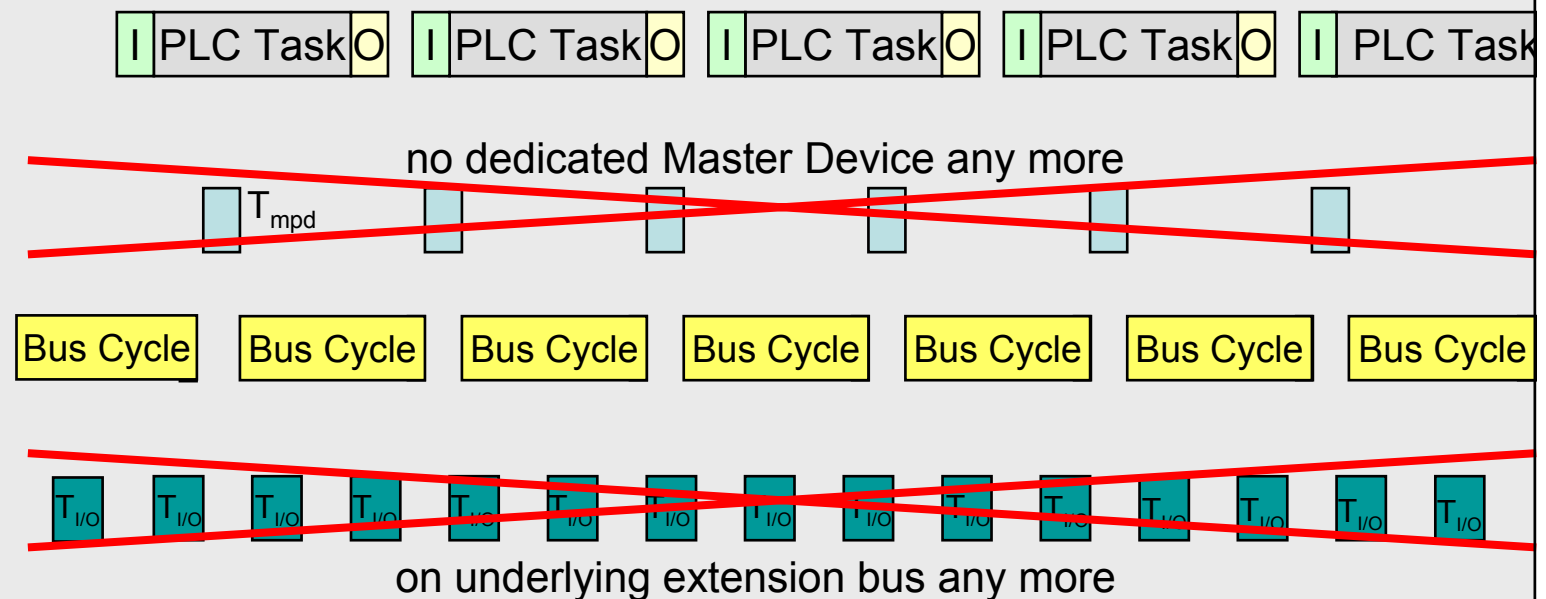


„Slow“ Control Systems benefit, too!

EtherCAT is:

- faster
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- easier to configure
- lower cost
- easier to implement
- well proven
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- safety
- redundancy
- versatile

System Architecture with EtherCAT



„Slow“ Control Systems benefit, too!

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

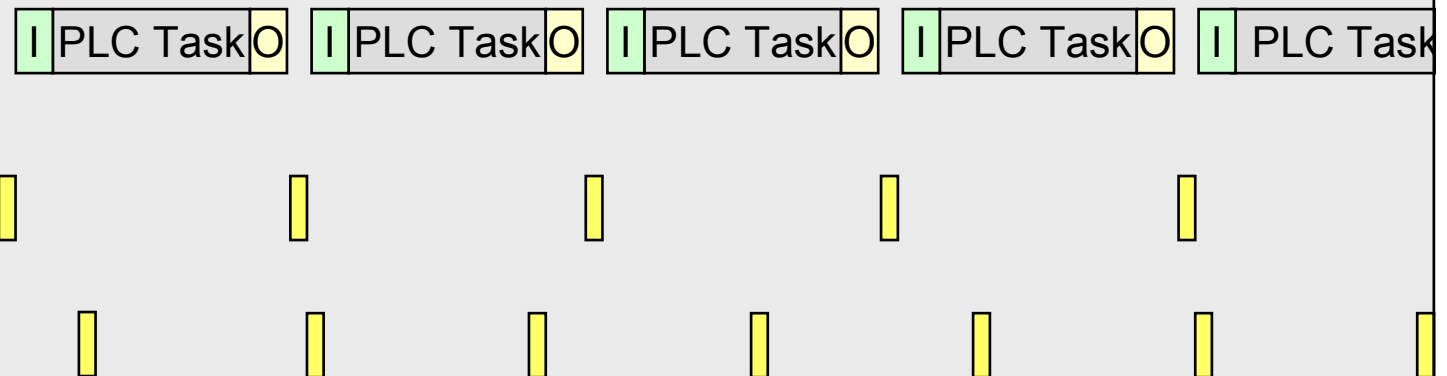
➤ open

➤ safety

➤ redundancy

➤ versatile

System Architecture with EtherCAT

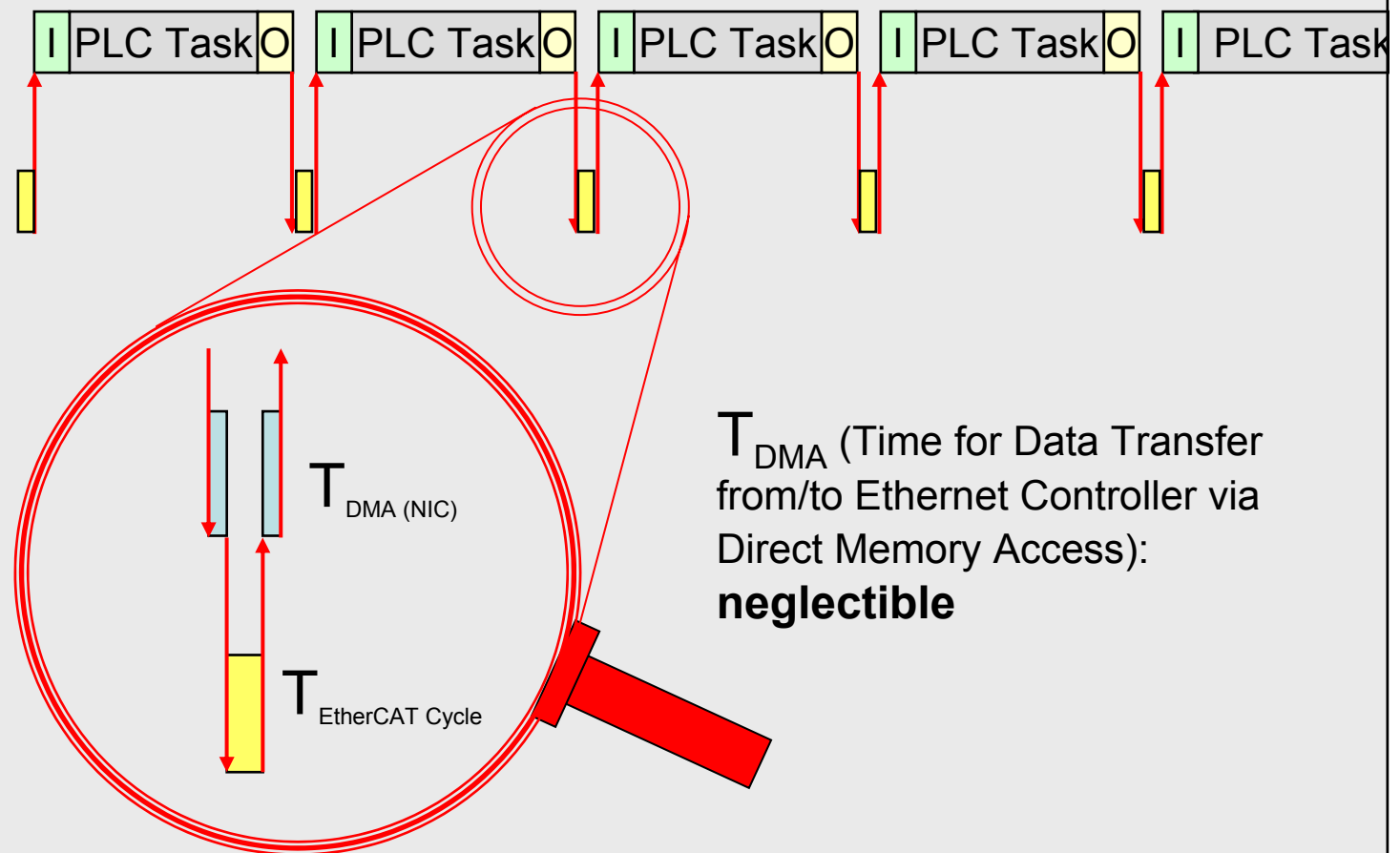


„Slow“ Control Systems benefit, too!

EtherCAT is:

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- versatile

System Architecture with EtherCAT

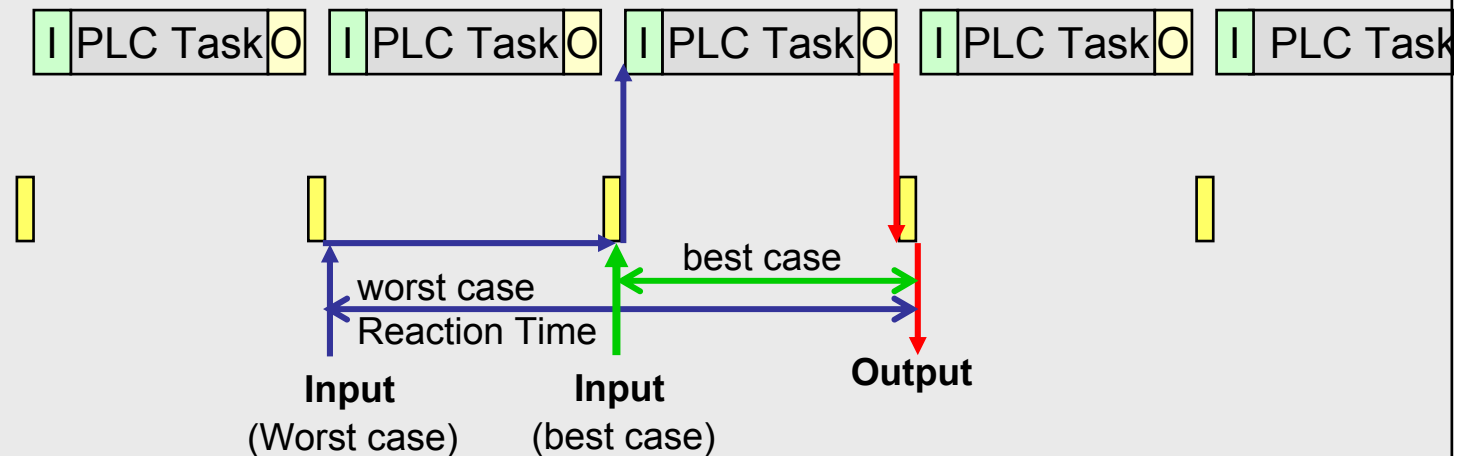


„Slow“ Control Systems benefit, too!

EtherCAT is:

- faster
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- redundancy
- versatile

Reaction Time with EtherCAT



- Reaction Time reduced significantly – with the same Controller Performance
- no underlying local I/O Cycles and extension bus delays any more
- Due to the very simple protocol no dedicated master systems (e.g. plug in cards) required

Fieldbus: requires Mapping in Control System

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

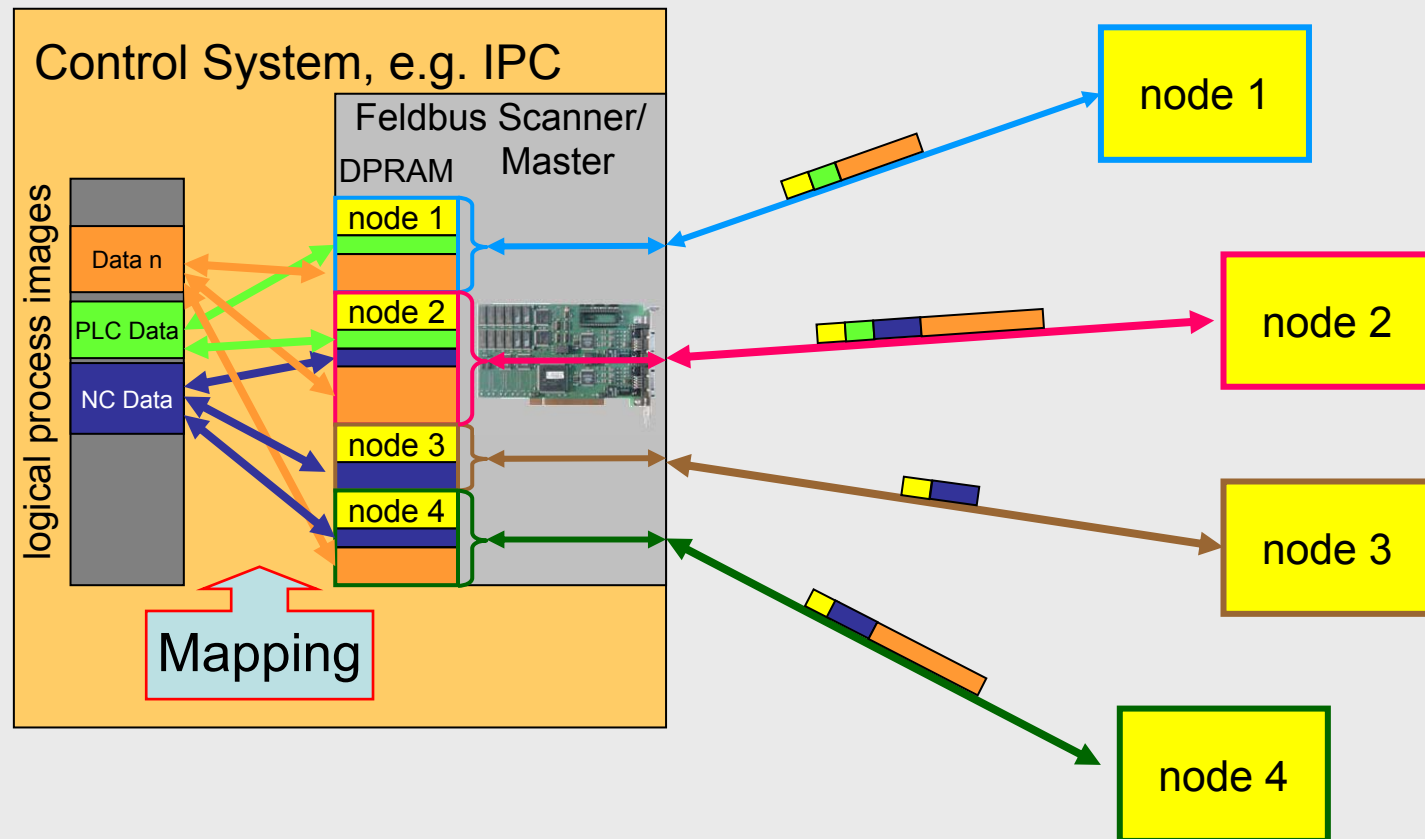
➤ open

➤ safety

➤ redundancy

➤ versatile

- Traditional fieldbus system generate *physical* process image
- This has to be mapped to *logical* process image(s)



Fieldbus: requires Mapping in Control System

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

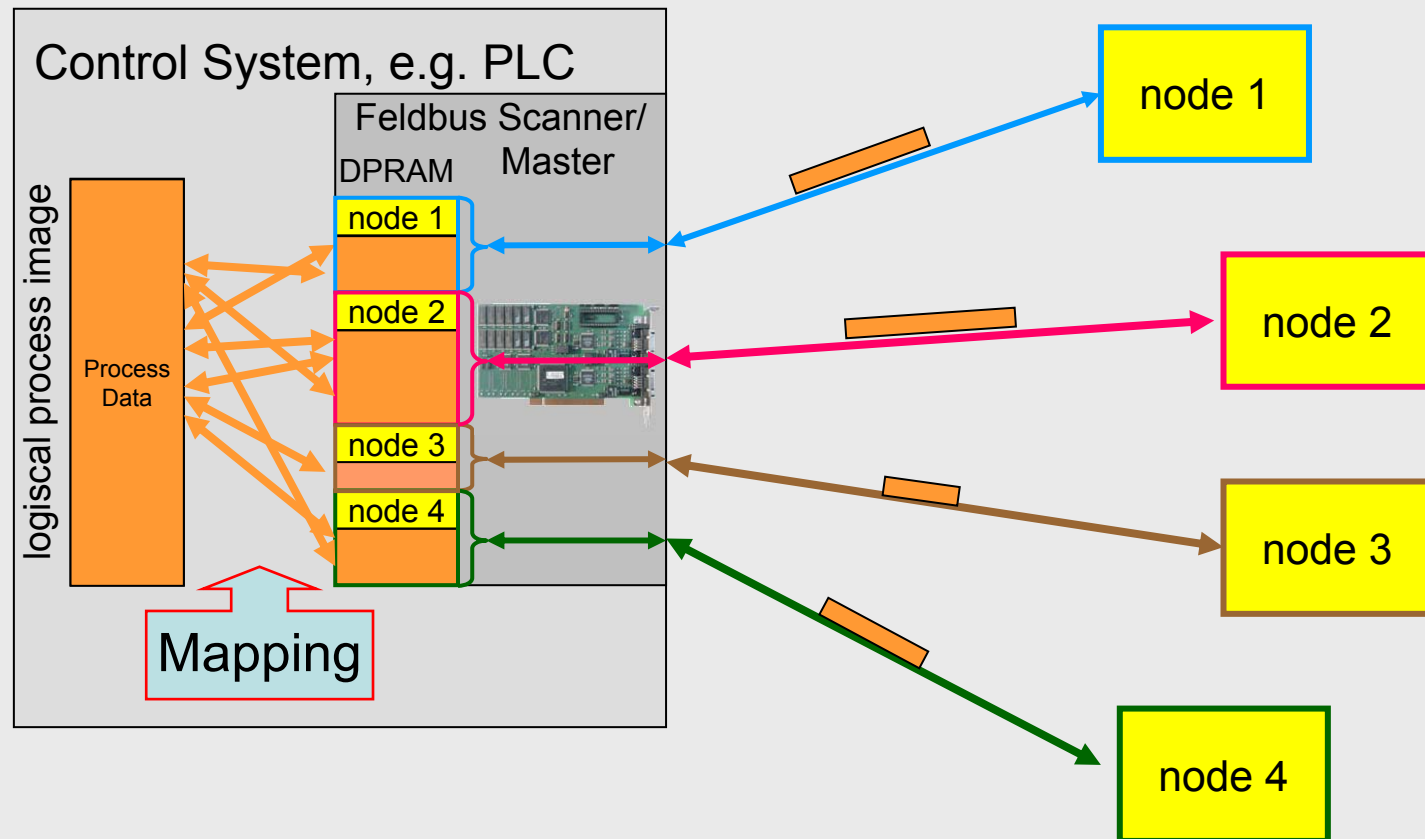
➤ open

➤ safety

➤ redundancy

➤ versatile

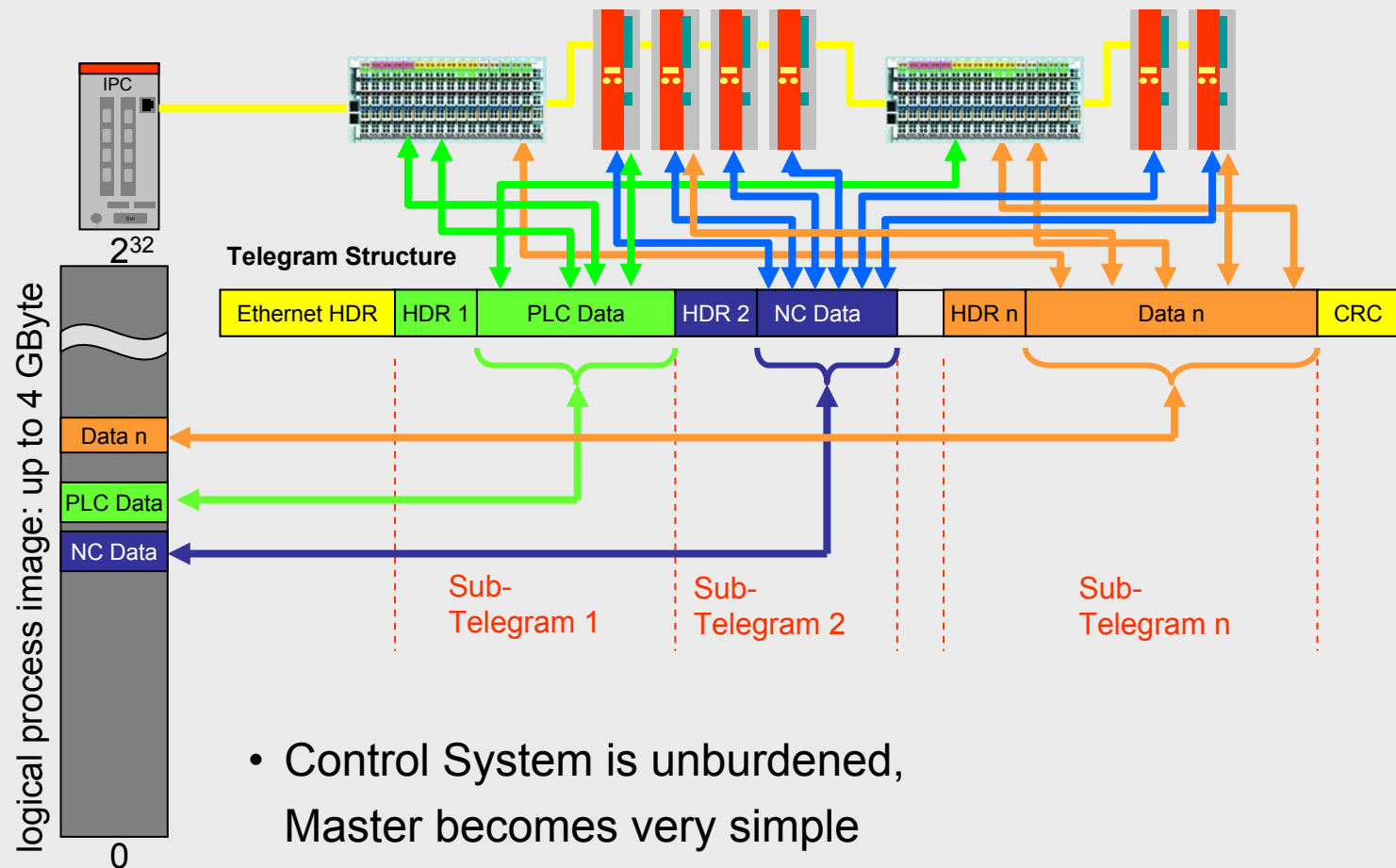
- The same applies to control system with just one process image
- Resorting of process data („Mapping“) is required, too



EtherCAT: Mapping moved into Slave Devices

EtherCAT is:

- faster
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile



- Control System is unburdened, Master becomes very simple
- Data is transmitted according to the application requirements: extremely fast, flexibly and efficiently

Direct Memory Access saves Time

EtherCAT is:

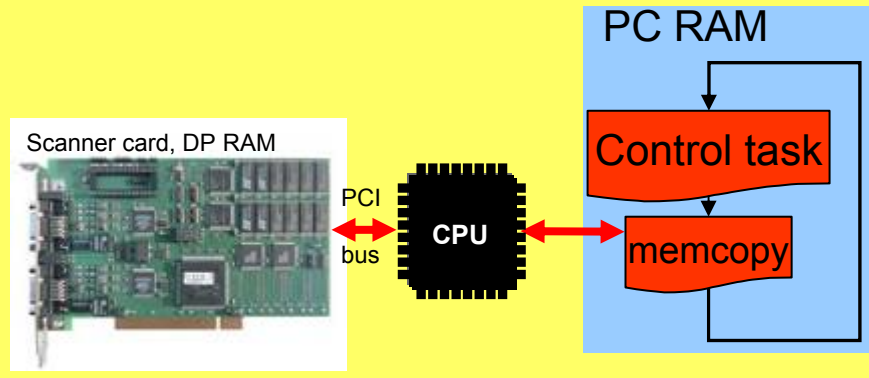
- faster
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Fieldbus Cards: up to 30% of CPU Time for Data Copying

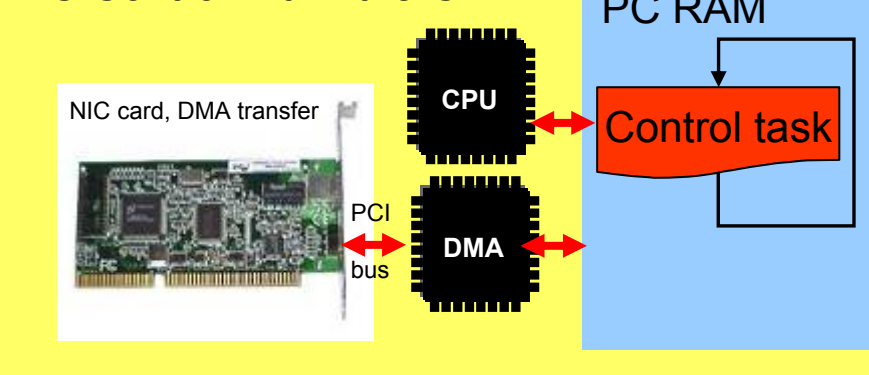
EtherCAT: NIC is PCI Bus Master, Data is provided by DMA, directly to PC RAM :

- CPU relieved
- more Performance

PC Control with Fieldbus Cards



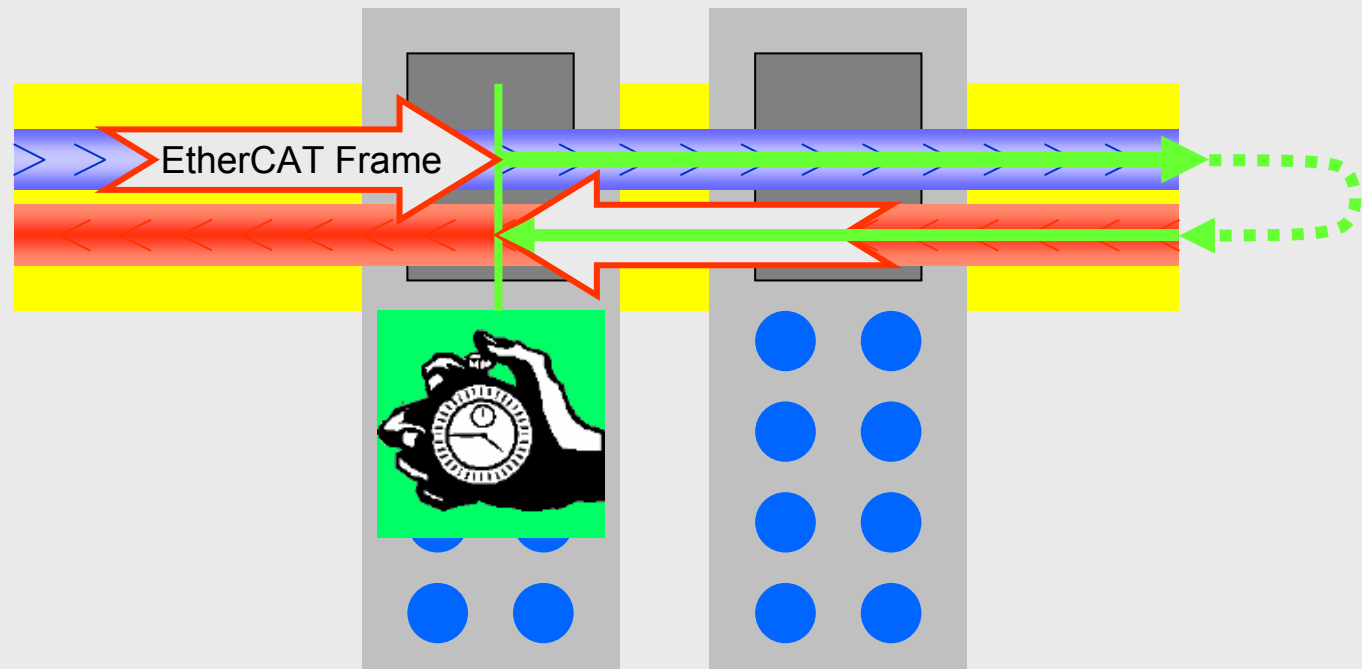
PC Control with EtherCAT



EtherCAT is:

- faster
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

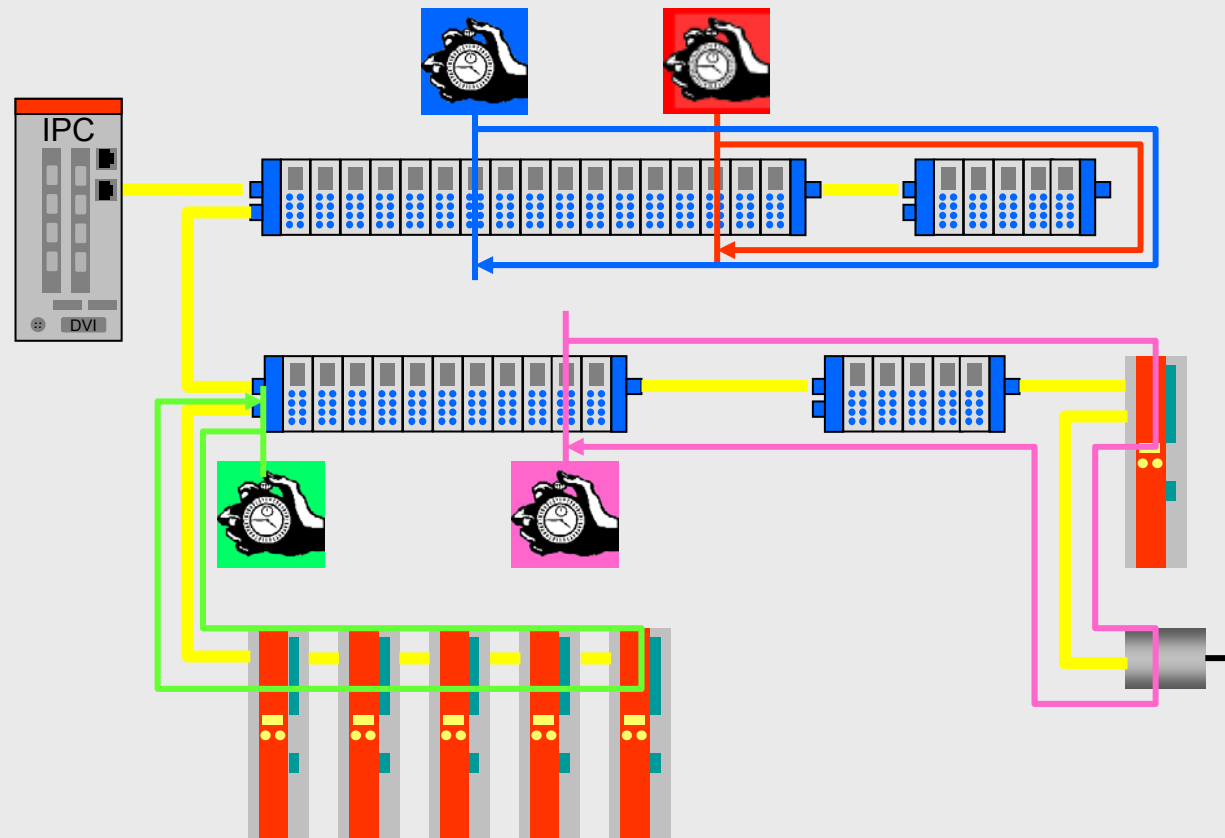
EtherCAT Node measures time difference between leaving and returning frame



EtherCAT is:

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- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

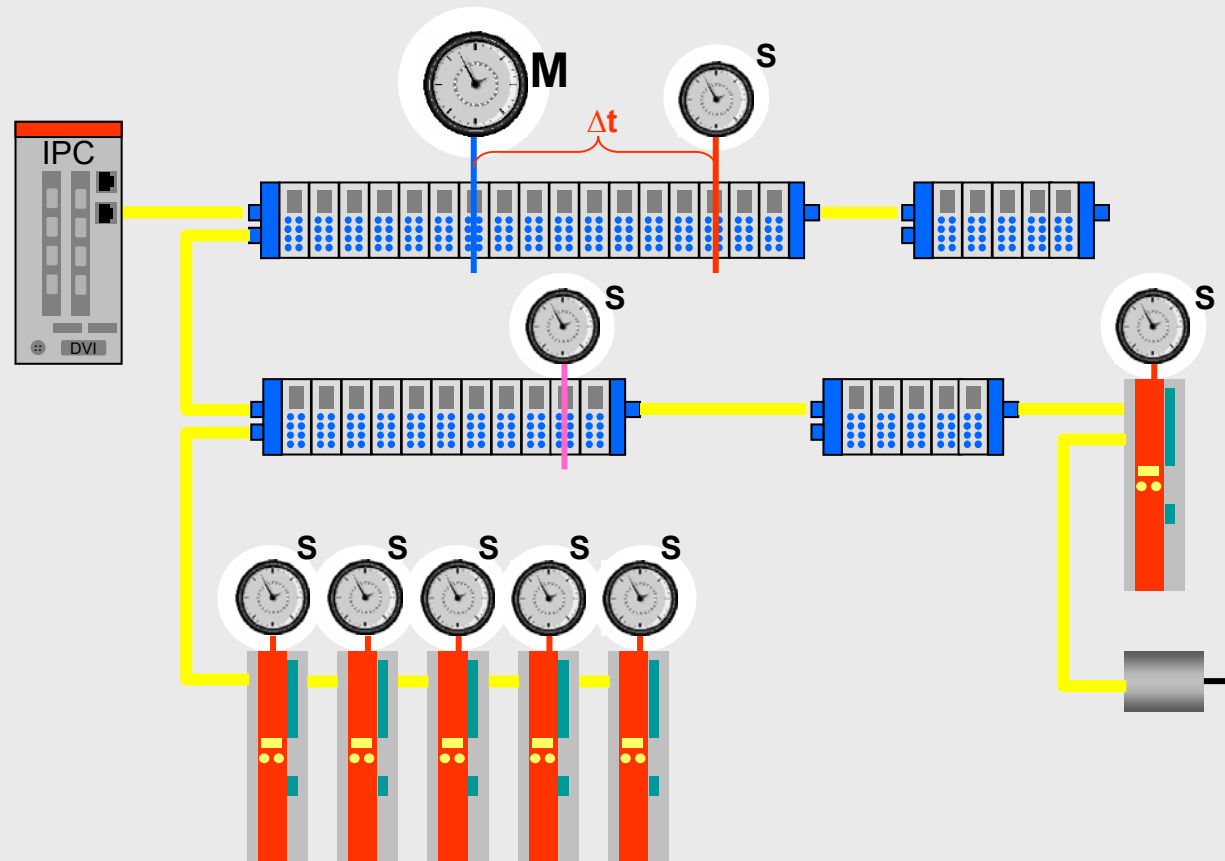
Propagation delays between any nodes can be computed



EtherCAT is:

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- redundancy
- versatile

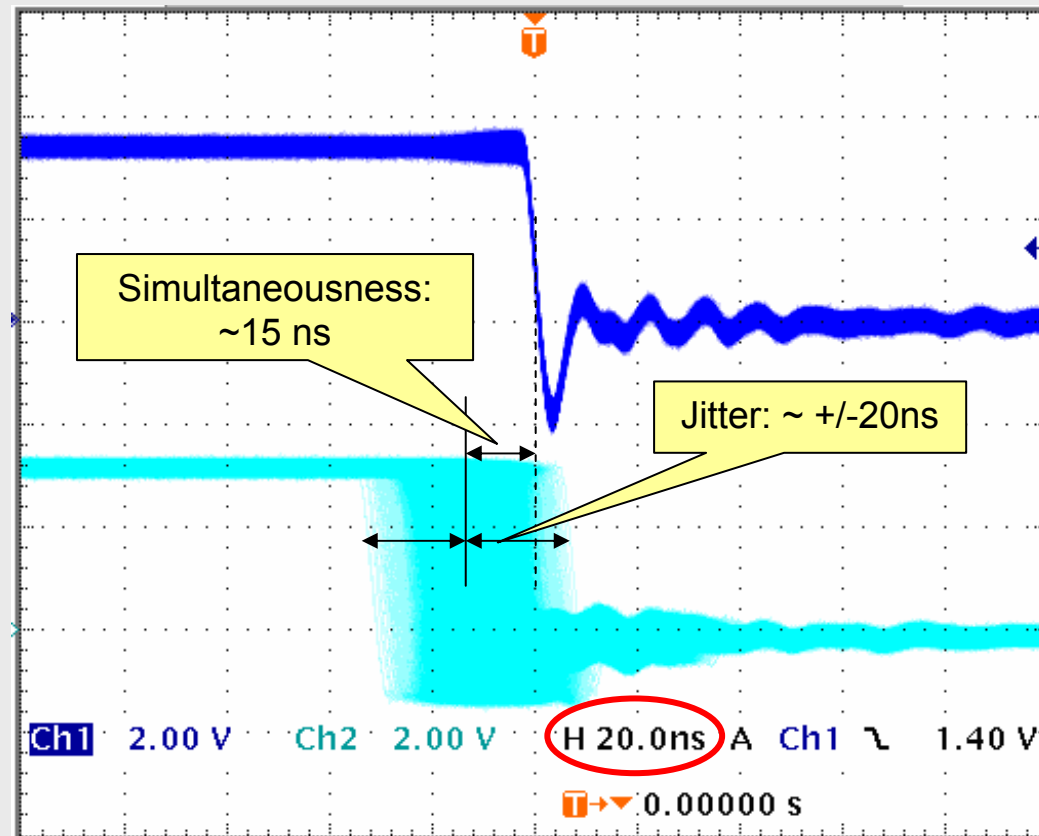
Precise Synchronisation ($\ll 1 \mu\text{s}$!) by exact adjustment of distributed clocks



EtherCAT is:

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- redundancy
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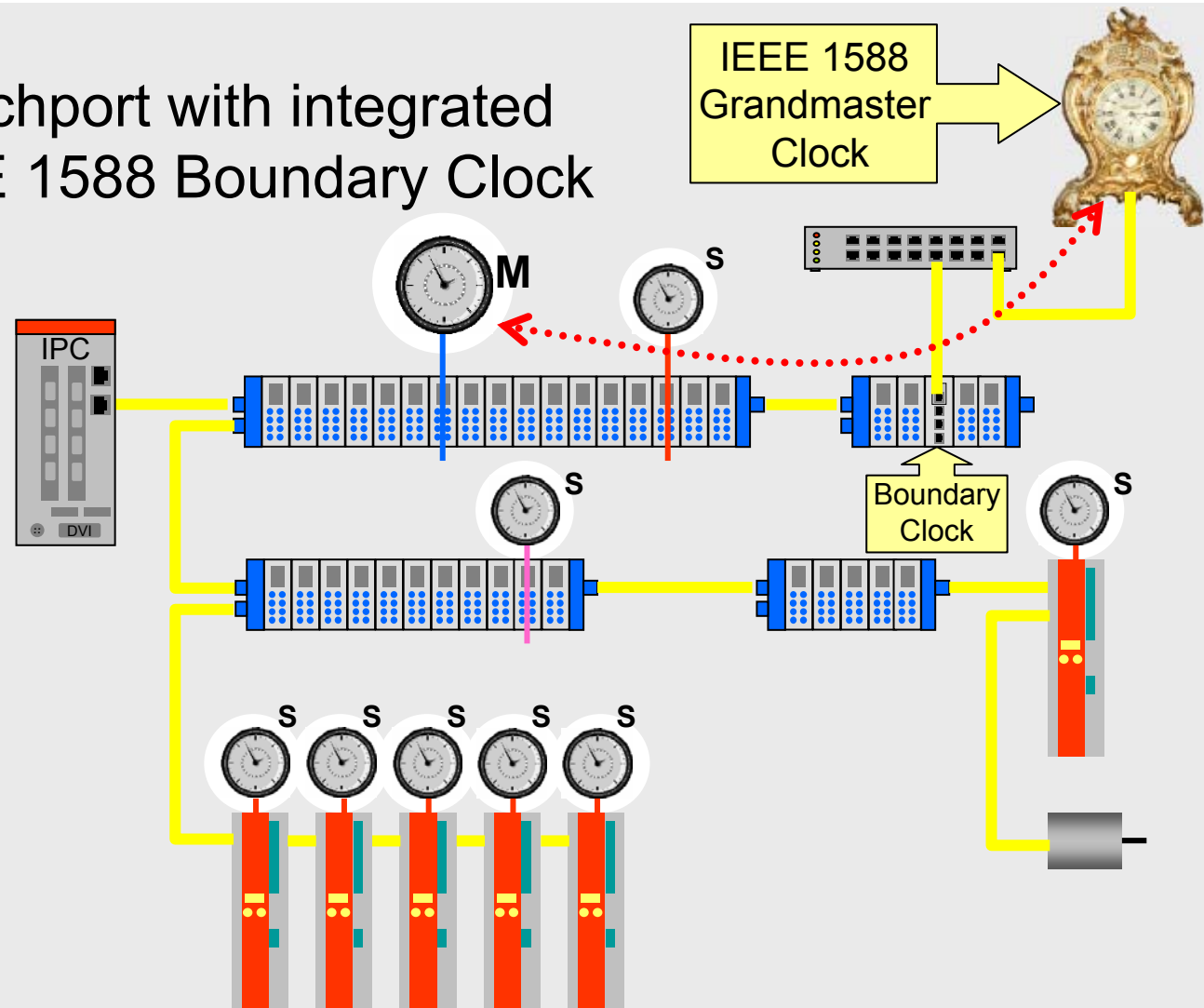
Long Term Scope View of two separated Devices
300 Nodes in between, 120m Cable Length



EtherCAT is:

- faster ✓
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Switchport with integrated IEEE 1588 Boundary Clock



EtherCAT is Industrial Ethernet!

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

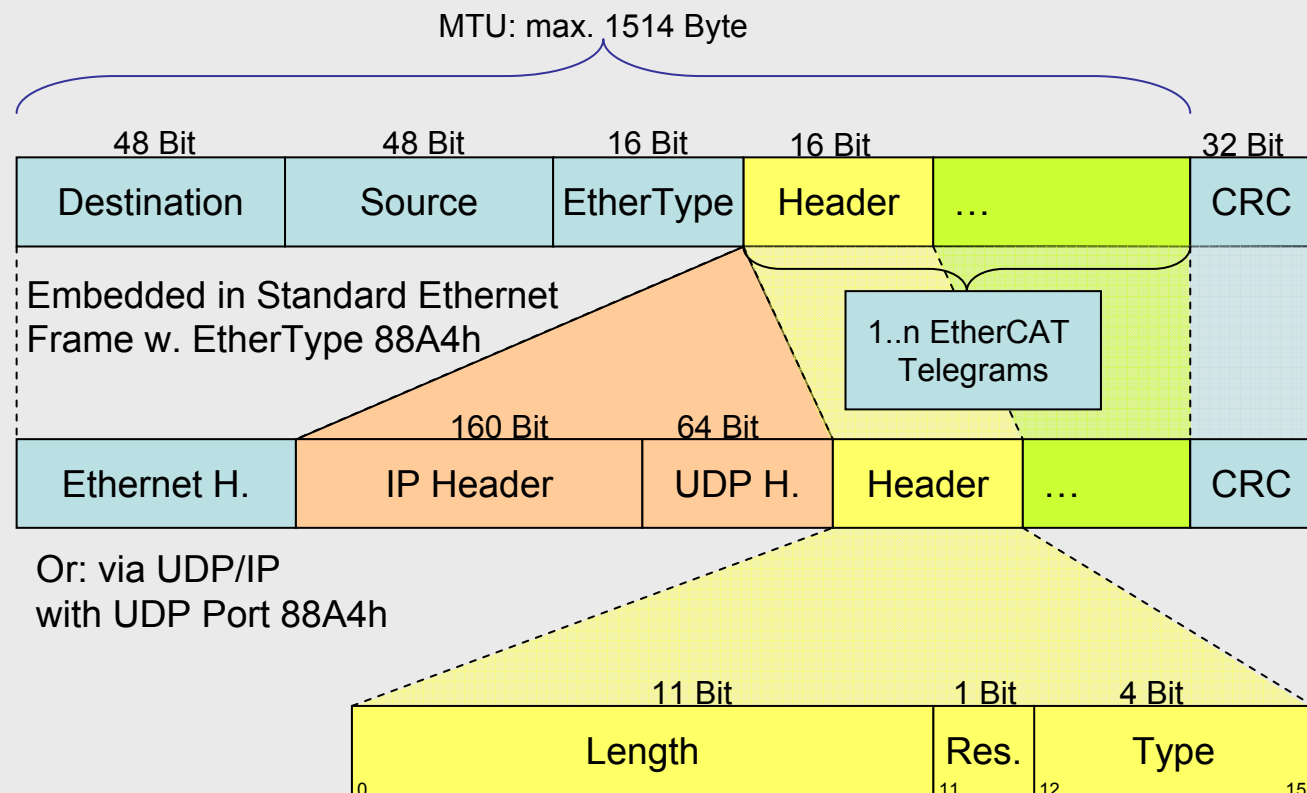
➤ open

➤ safety

➤ redundancy

➤ versatile

- **EtherCAT uses Standard Frames: IEEE 802.3**
- **Alternatively via UDP/IP (if IP Routing is needed)**
- **no shortened Frames**





EtherCAT is Industrial Ethernet!

EtherCAT is:

➤ faster



➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

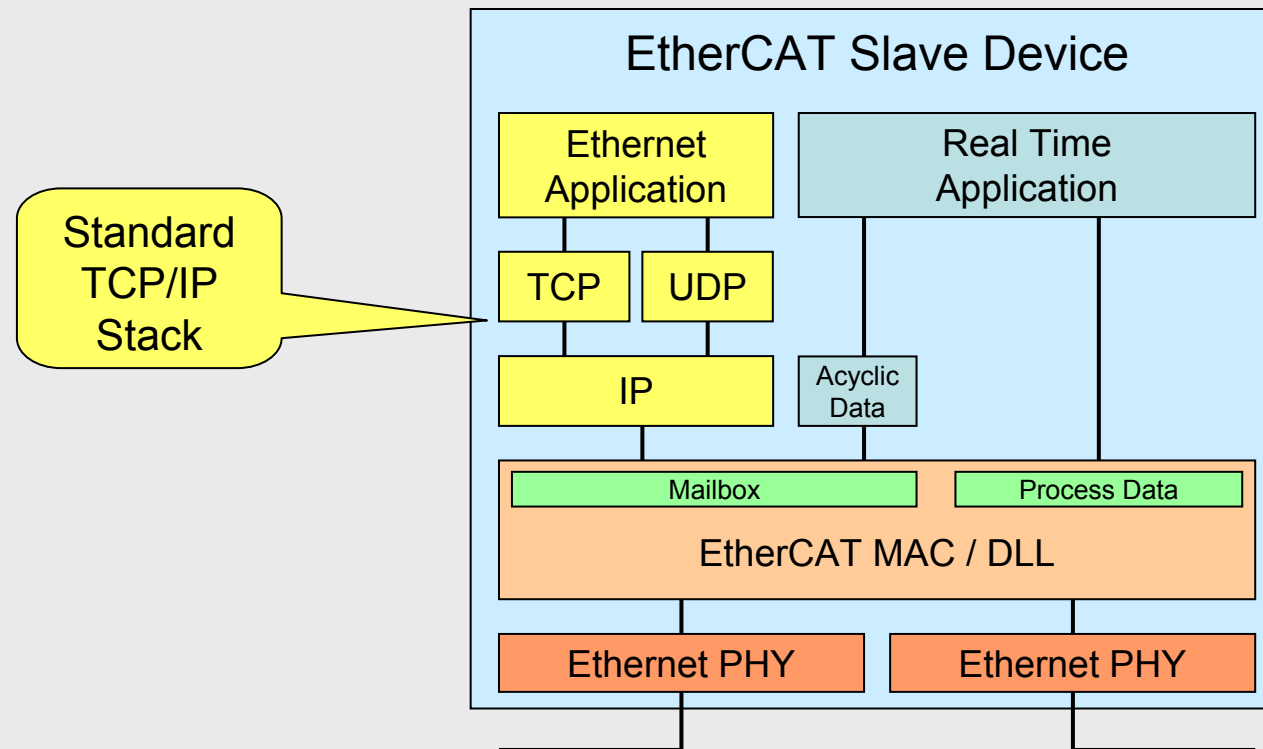
➤ open

➤ safety

➤ redundancy

➤ versatile

- **fully transparent for TCP/IP**
- **all Internet Technologies available: HTTP, FTP, ...**
- **without restricting the Real Time capabilities!**



EtherCAT is Industrial Ethernet!

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

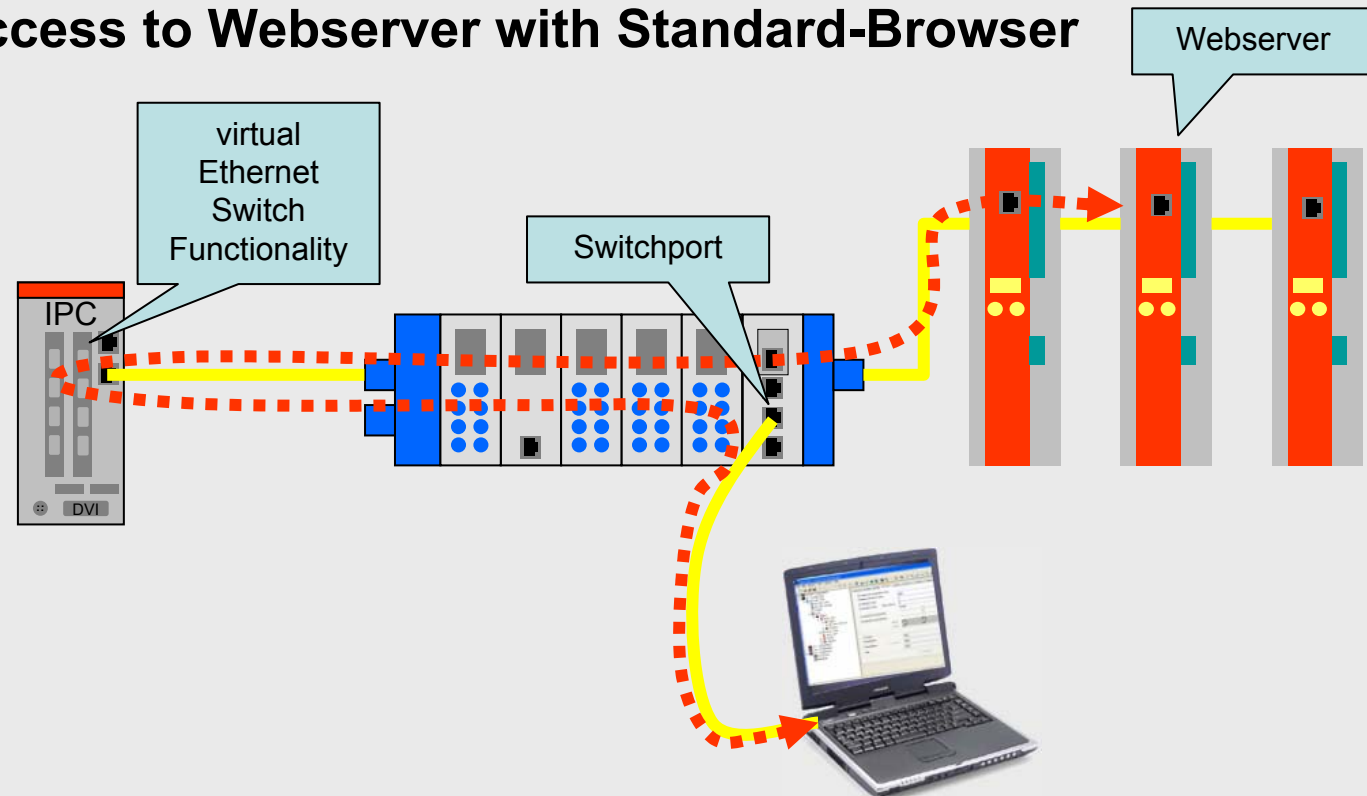
➤ open

➤ safety

➤ redundancy

➤ versatile

- Any Ethernet Device can be connected to Switchport
- Access to Webserver with Standard-Browser



Switchport: Any Ethernet Protocol

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

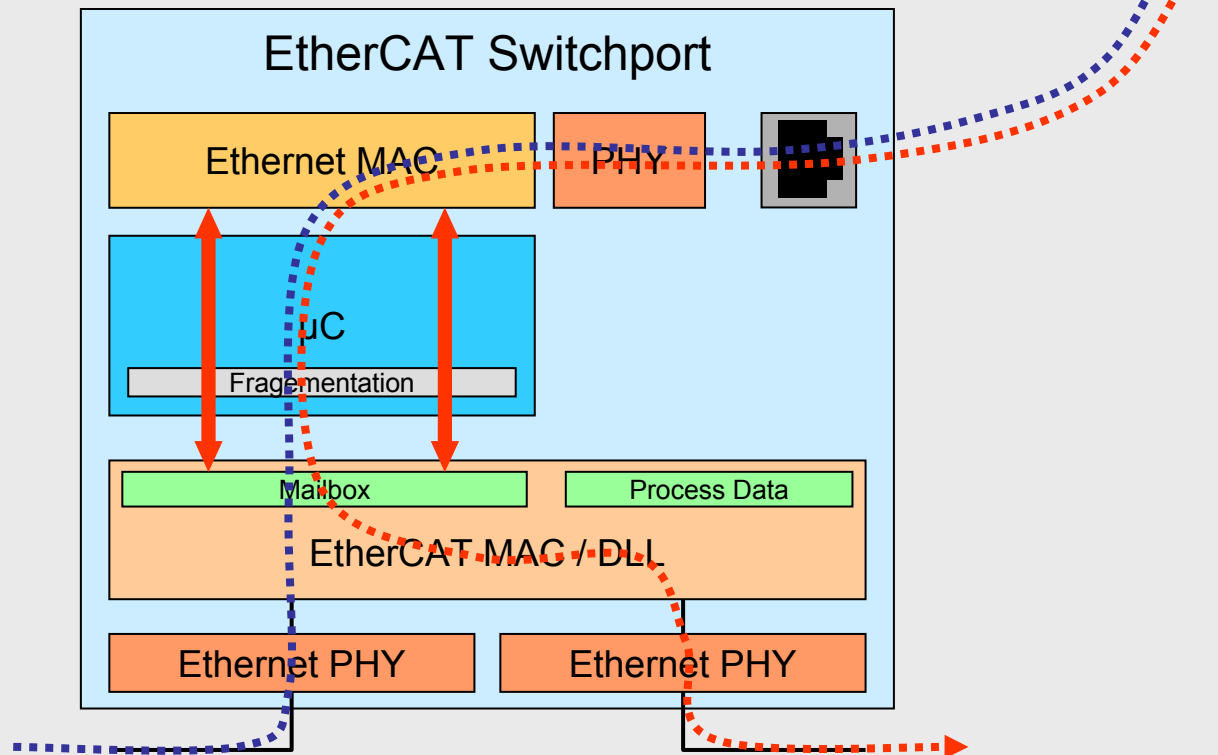
➤ open

➤ safety

➤ redundancy

➤ versatile

- Interface to any Ethernet Device or Network
- Ethernet Frames are inserted in EtherCAT Protocol
- „Ethernet over EtherCAT“



EtherCAT is Industrial Ethernet!

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

➤ well proven

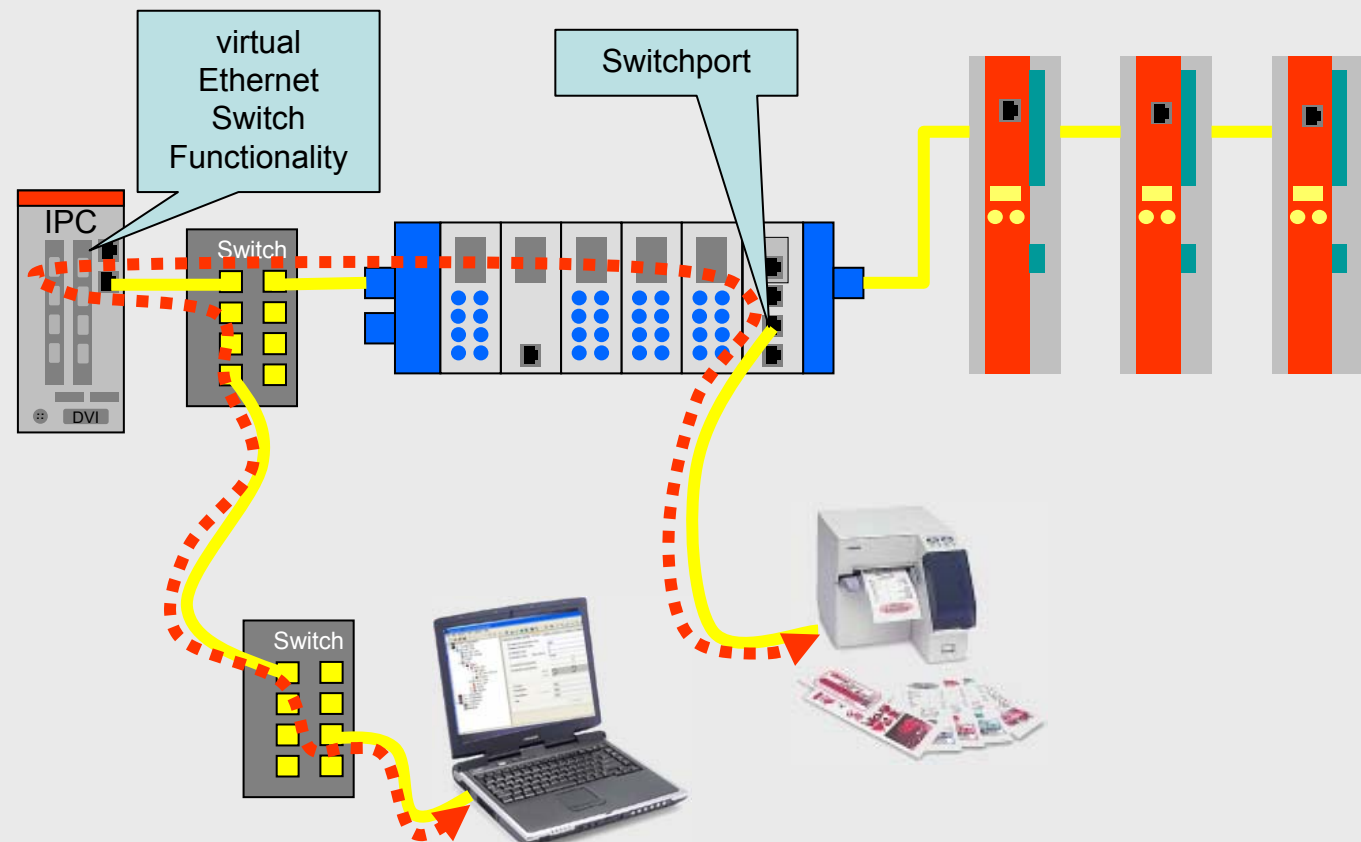
➤ open

➤ safety

➤ redundancy

➤ versatile

- **Virtual Ethernet Switch** routes any Ethernet Frame
- **From inside as well as from outside the segment**



Vertical Integration (I)

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

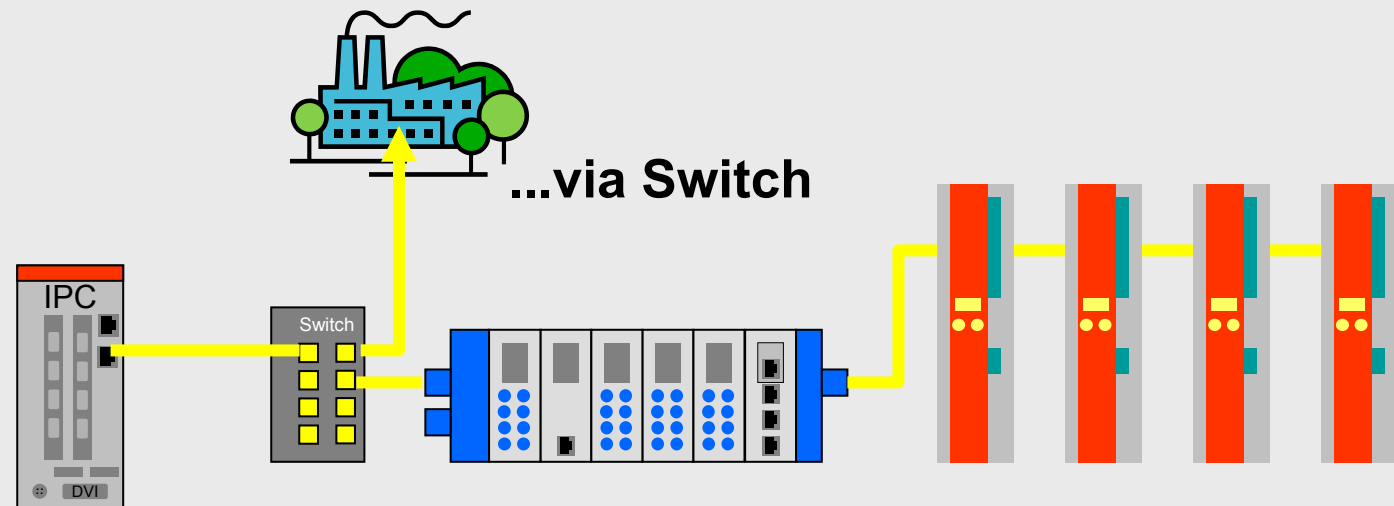
➤ well proven

➤ open

➤ safety

➤ redundancy

➤ versatile



+ any Ethernet Protocol can be used

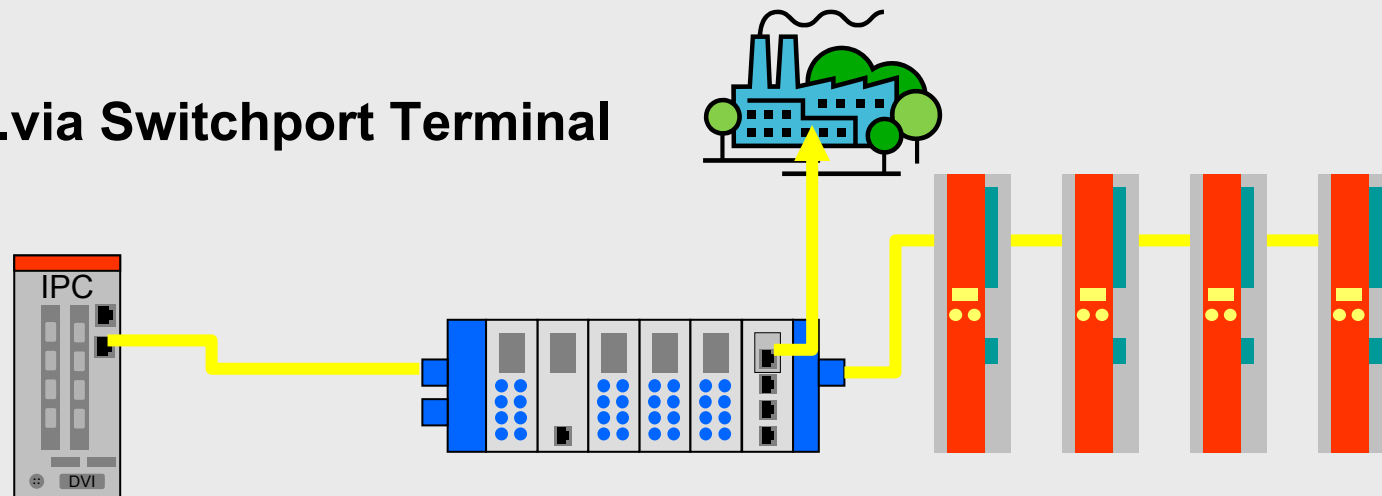
+ requires only one Ethernet Port (at IPC/Controller)

- but: performance reduced by switch delay (and generic Ethernet traffic)

EtherCAT is:

- faster
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

...via Switchport Terminal



- + any Ethernet Protocol can be used
- + requires only one Ethernet Port (at IPC/Controller)
- + EtherCAT performance **is not limited**

Vertical Integration (III)

EtherCAT is:

➤ faster

➤ Industrial Ethernet

➤ more flexible to wire

➤ easier to configure

➤ lower cost

➤ easier to implement

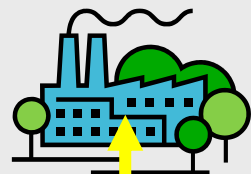
➤ well proven

➤ open

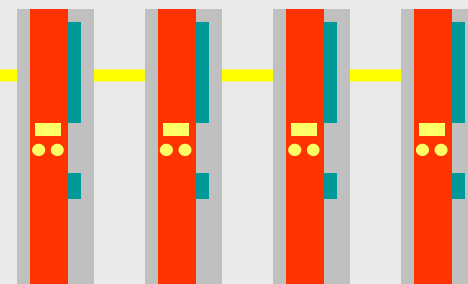
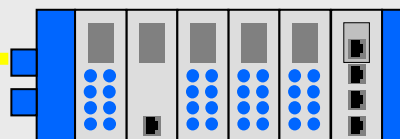
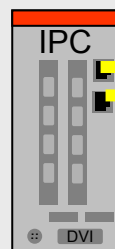
➤ safety

➤ redundancy

➤ versatile



...via 2nd Ethernet Port



+ any Ethernet Protocol can be used

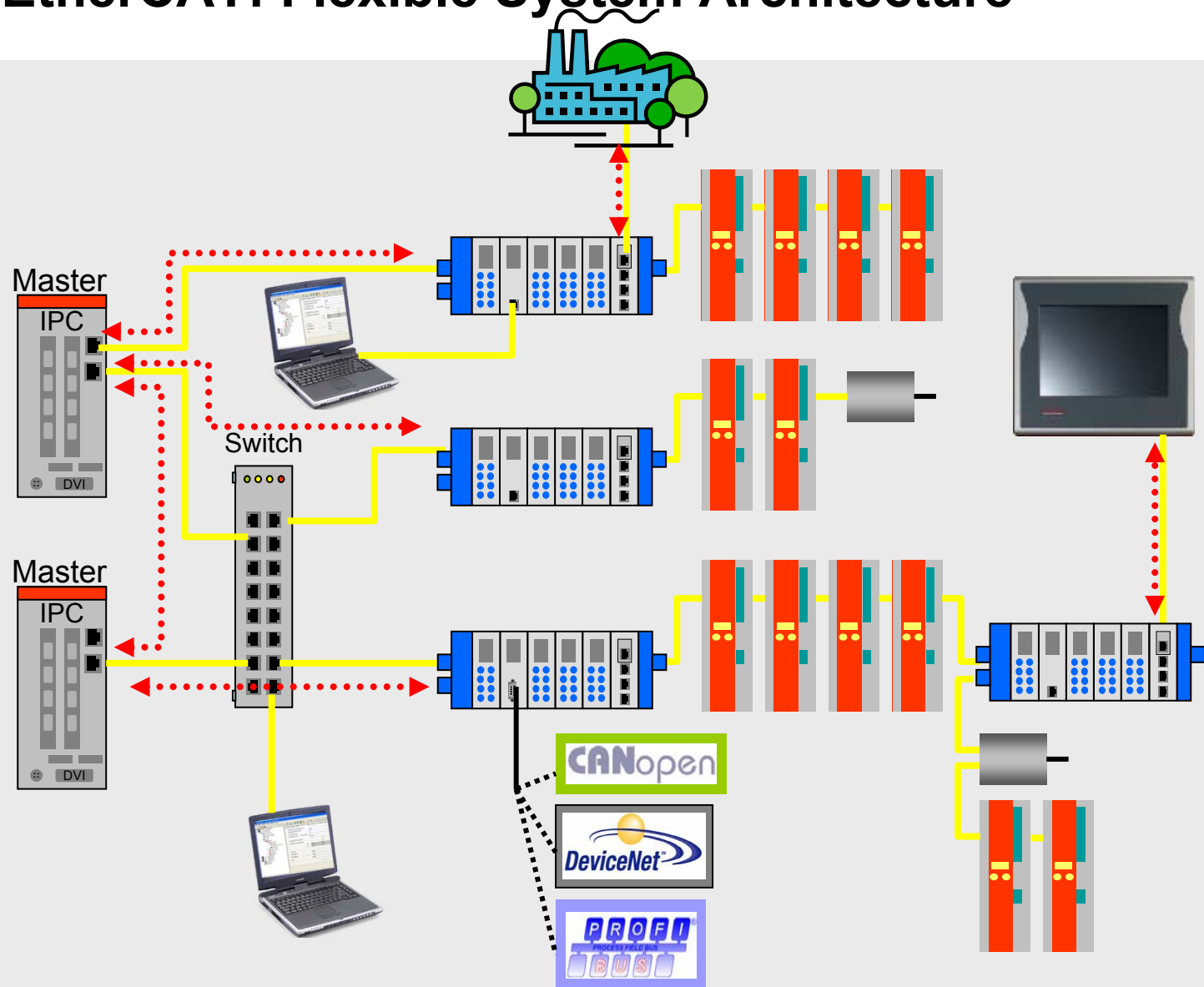
+ EtherCAT performance **is not limited**

- requires second Ethernet Port (at IPC/Controller)

EtherCAT: Flexible System Architecture

EtherCAT is:

- faster ✓
- Industrial Ethernet
- more flexible to wire
- easier to configure
- lower cost
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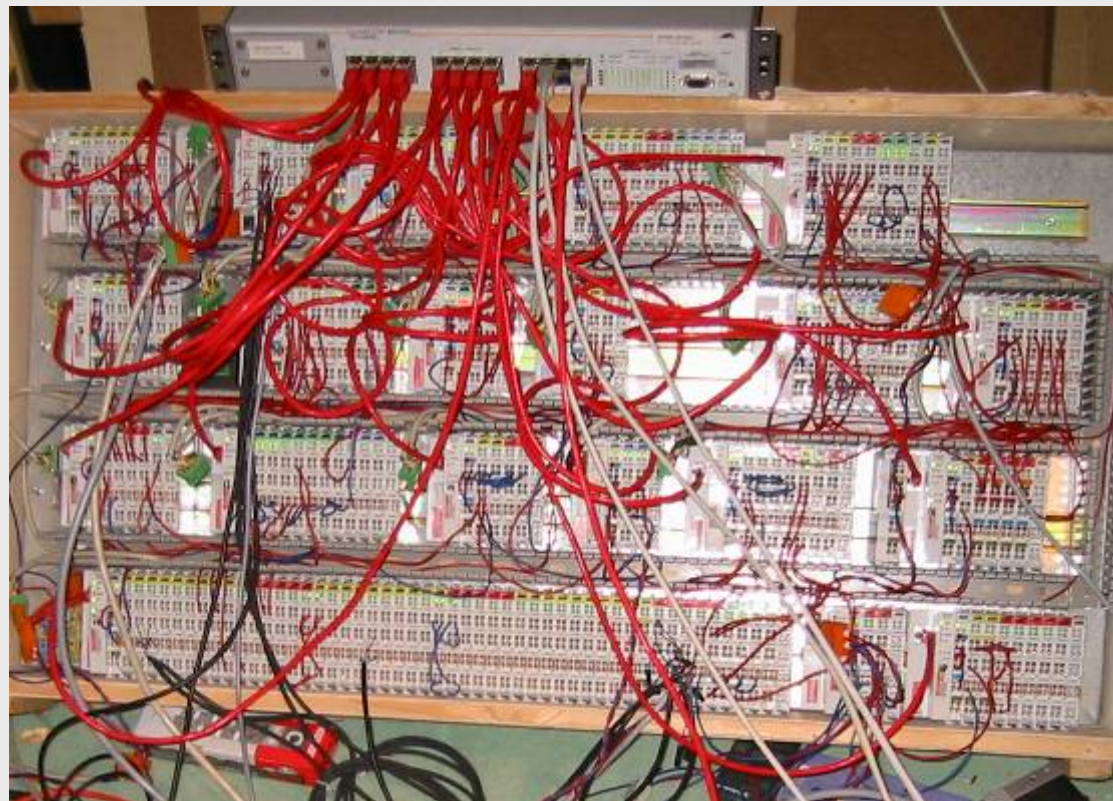
EtherCAT wiring is more flexible

EtherCAT is:

- faster ✓
- Industrial Ethernet ✓
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Standard Ethernet Topology: Star

not ideal – here a test setup for demo purposes ;-)

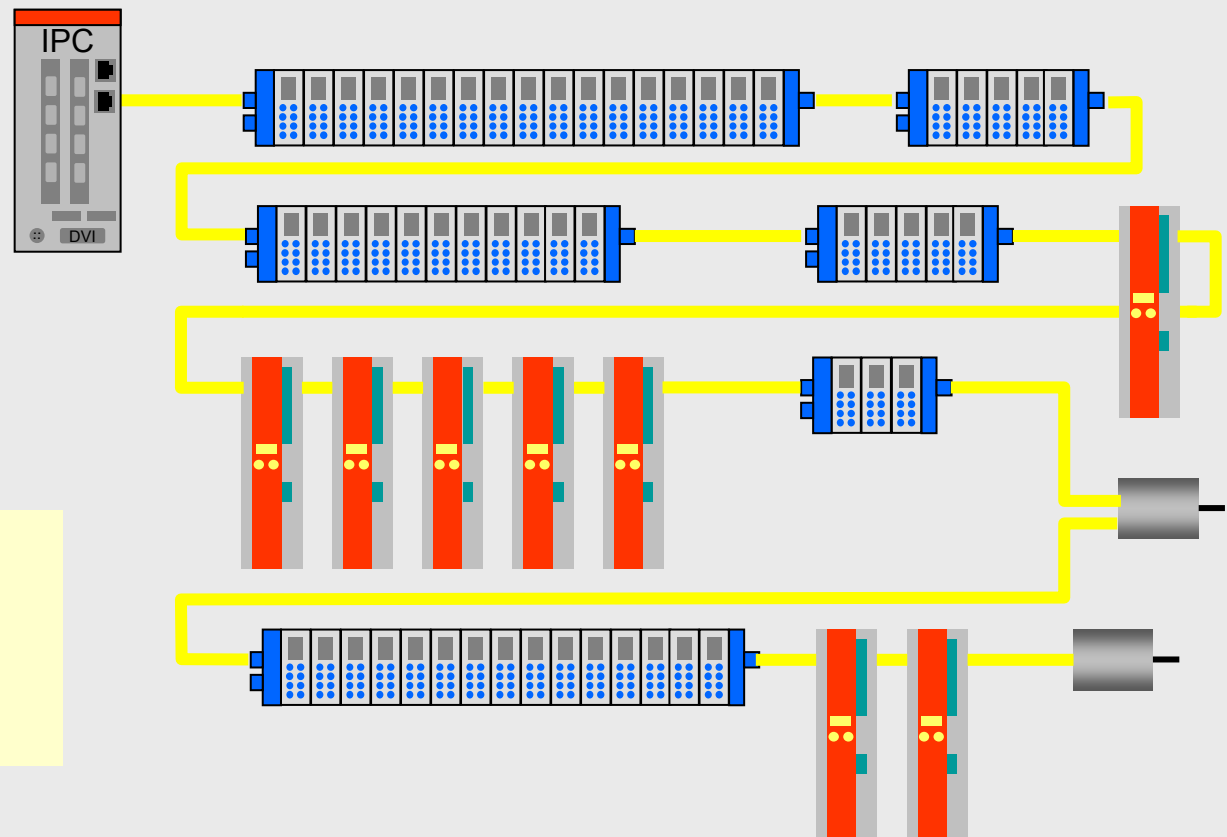


EtherCAT wiring is more flexible

EtherCAT is:

- faster ✓
- Industrial Ethernet ✓
- more flexible to wire
- easier to configure
- lower cost
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- safety
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- versatile

Line-Topology: any number of nodes lined up



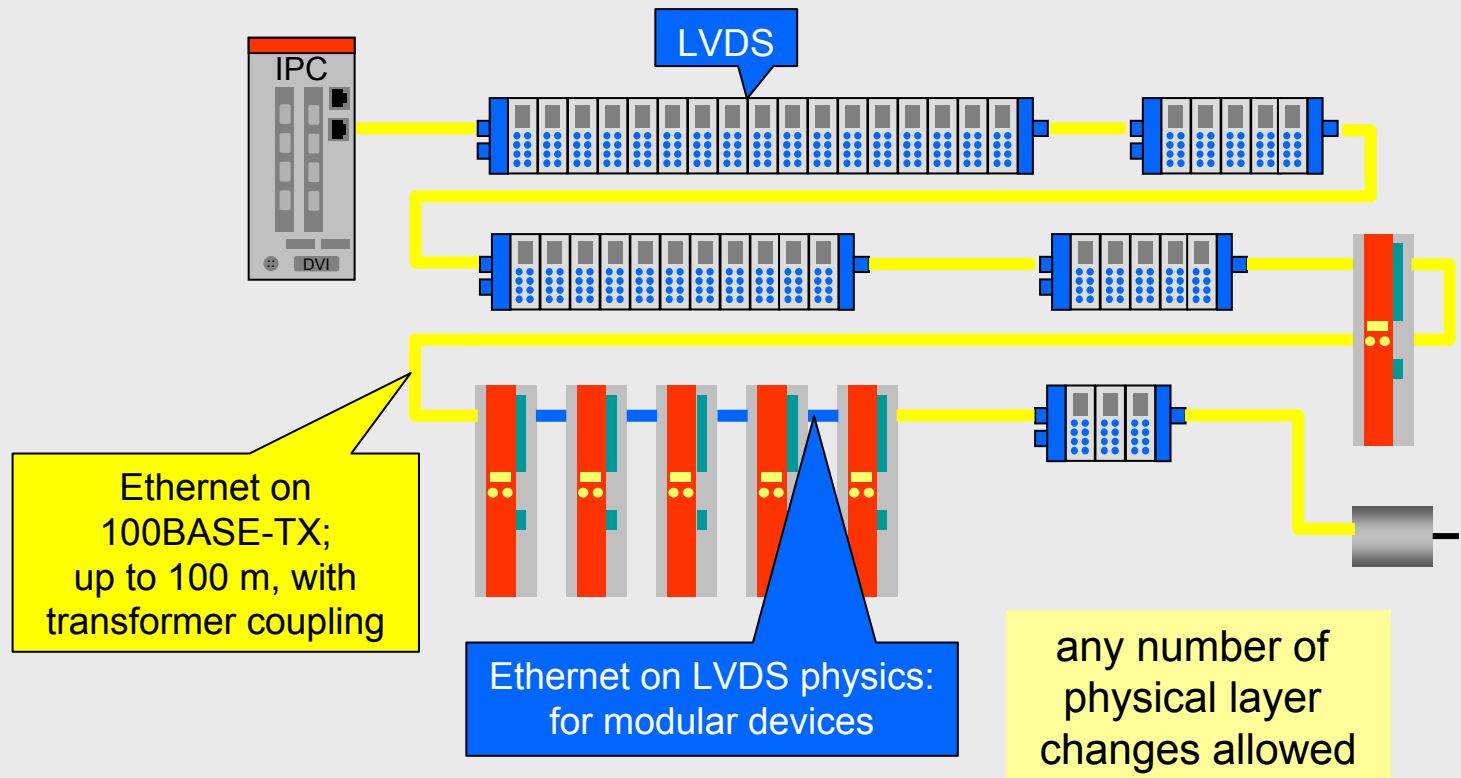
up to
65535
nodes

EtherCAT wiring is more flexible

EtherCAT is:

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- Industrial Ethernet ✓
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- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Electrical Signal Variants: 100BaseTX and LVDS



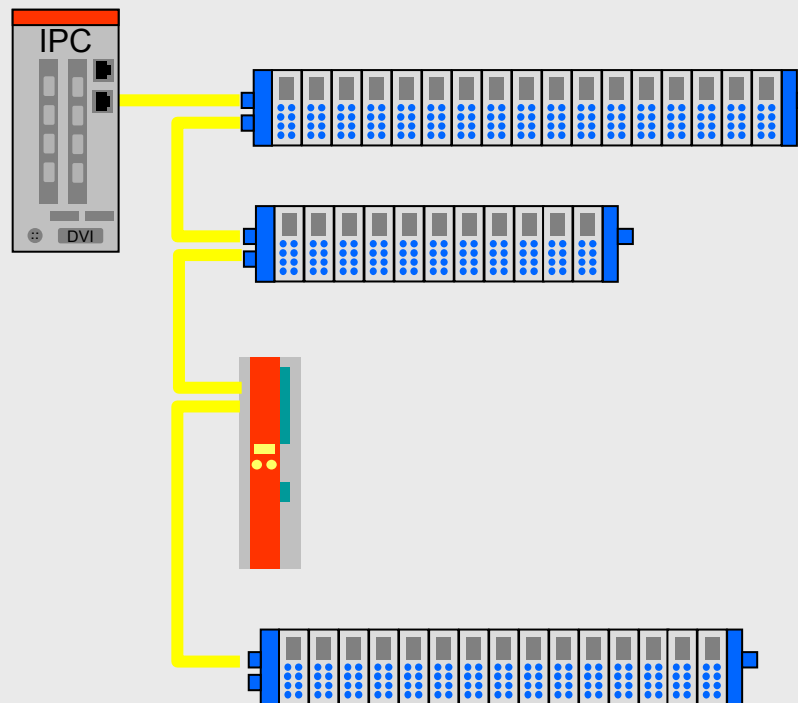
LVDS: Low Voltage Differential Signaling according to ANSI/TIA/EIA-644, also used in IEEE 802.3ae (10Gigabit Ethernet)

EtherCAT wiring is more flexible

EtherCAT is:

- faster ✓
- Industrial Ethernet ✓
- more flexible to wire
- easier to configure
- lower cost
- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Topology-Variant: „Daisy Chain“



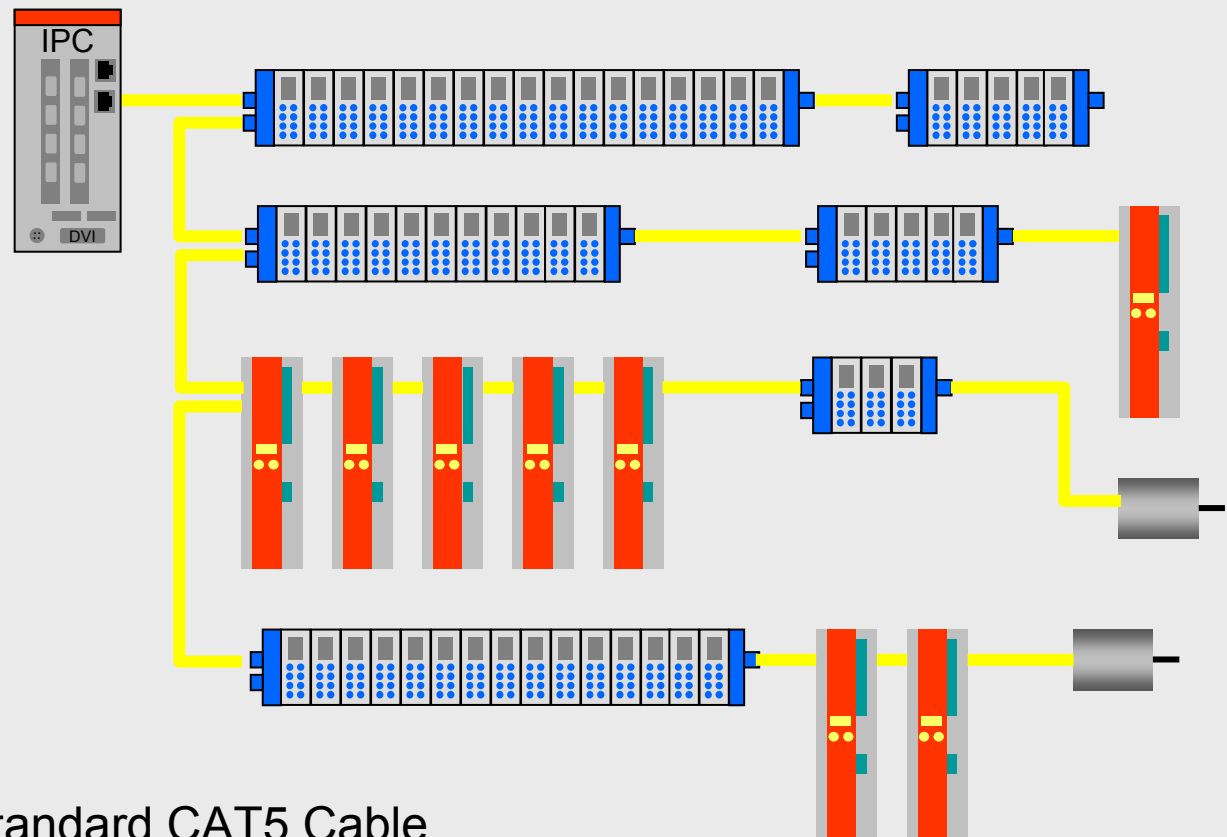
Cable: Standard CAT5 Cable
without „Crossover“

EtherCAT wiring is more flexible

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Topology-Variant: „Daisy Chain“ with Drop Lines



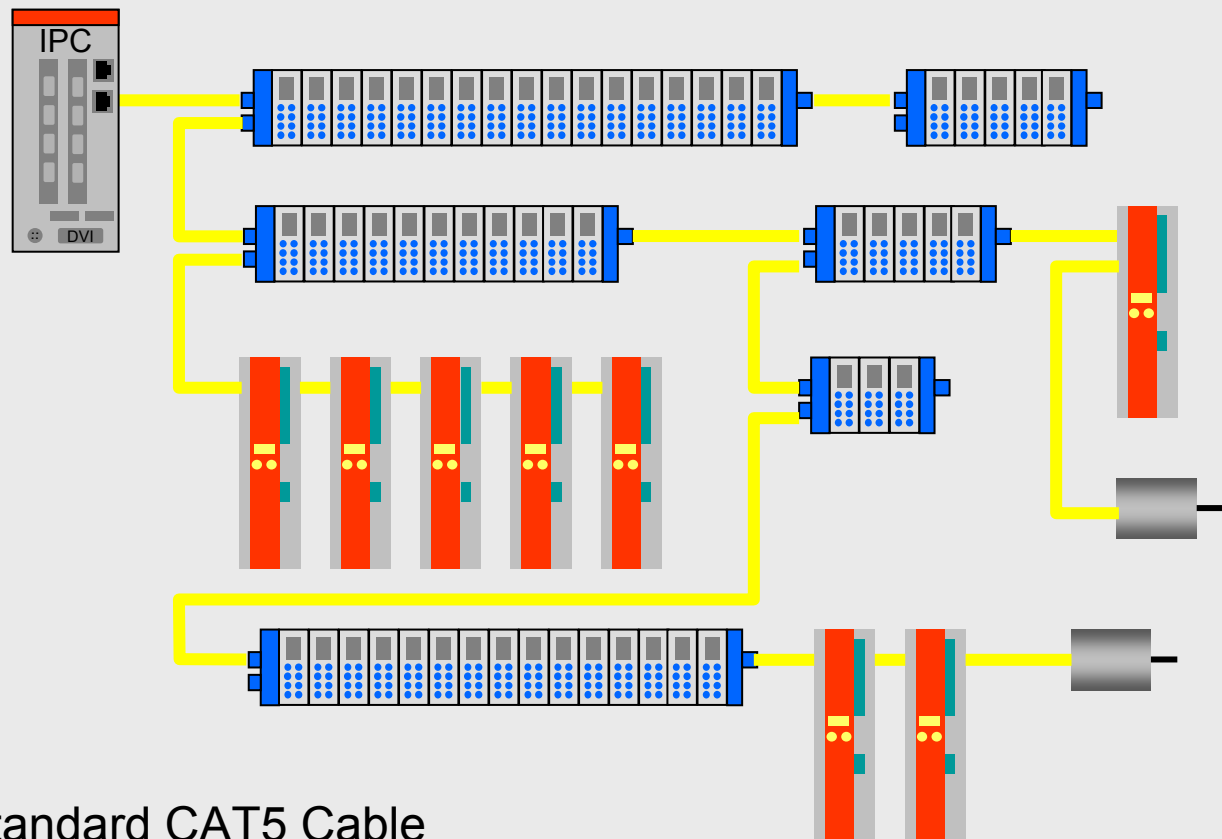
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flexible tree structures – arbitrarily extendable



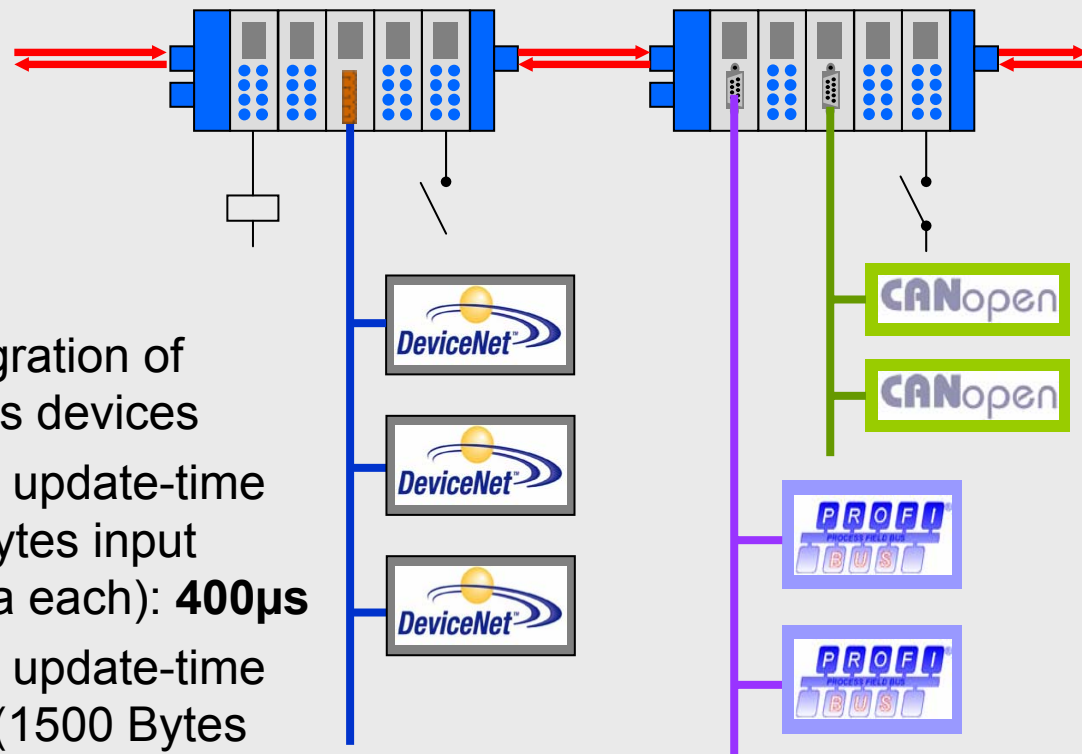
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Protection of your investment:

- Seamless integration of existing fieldbus devices
- Process image update-time via **PCI** (500 Bytes input and output data each): **400µs**
- Process image update-time via **EtherCAT** (1500 Bytes input and output data): **150µs**



EtherCAT instead of PCI

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- redundancy
- versatile

- No Slots in Control System (IPC or SPS) required any more
- Nevertheless maximum expandability





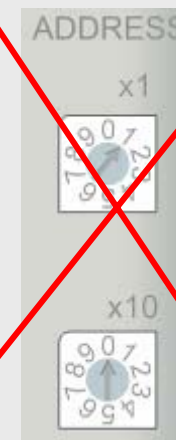
EtherCAT is easier to configure

EtherCAT is:

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- easier to configure
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- safety
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- versatile

Addressing:

- No manual address setting required
- Addresses can be assigned automatically
- Addresses can be kept – no new addressing if nodes are added





EtherCAT is easier to configure

EtherCAT is:

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Topology:

- Automatic topology target/actual comparison

Diagnosis:

- Diagnosis with exact localisation

Network planning:

- Performance independent of:
 - Slave implementation
 - Topology (no Switches/Hubs)

EtherCAT is lower cost



EtherCAT is:

➤ faster



➤ Industrial Ethernet



➤ more flexible to wire



➤ easier to configure



➤ lower cost

➤ easier to implement

➤ well proven

➤ open

➤ safety

➤ redundancy

➤ versatile

Master:

COTS Hardware where it really makes sense:

- Real time with on-board Ethernet controller, no communication coprocessor required
- *no special plug-in card*, on-board Ethernet port is sufficient
- thus: **significant cost advantages at the Master-Side**



EtherCAT is lower cost



EtherCAT is:

➤ faster



➤ Industrial Ethernet



➤ more flexible to wire



➤ easier to configure



➤ lower cost

➤ easier to implement

➤ well proven

➤ open

➤ safety

➤ redundancy

➤ versatile

Slave:

- cost-efficient ASIC or FPGA implements communication functionality
- for simple devices: no μ C needed
- Real time features widely independent of μ C-performance and stack processing times
- thus: **significant cost advantages at the Slave-Side**



EtherCAT is lower cost



EtherCAT is:

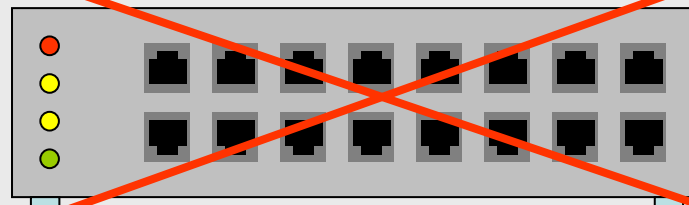
- faster ✓
- Industrial Ethernet ✓
- more flexible to wire ✓
- easier to configure ✓

➤ lower cost

- easier to implement
- well proven
- open
- safety
- redundancy
- versatile

Infrastructure:

- Standard Ethernet Cables + Connectors
- no Switches or Hubs
- thus: significant cost advantages at the Infrastructure-Side



EtherCAT is lower cost



EtherCAT is:

➤ faster



➤ Industrial Ethernet



➤ more flexible to wire



➤ easier to configure



➤ lower cost

➤ easier to implement

➤ well proven

➤ open

➤ safety

➤ redundancy

➤ versatile

Implementation / Tools:

- Standard Network Monitor Tools: Microsoft or Ethereal
- Parser Software: free of charge
- no High Resolution Timing Analyser required
- Evaluation Kit: 430 € - including Slave Sample Code
- Master Sample Code: 1000 €
- thus: **low entry costs, low implementation costs**

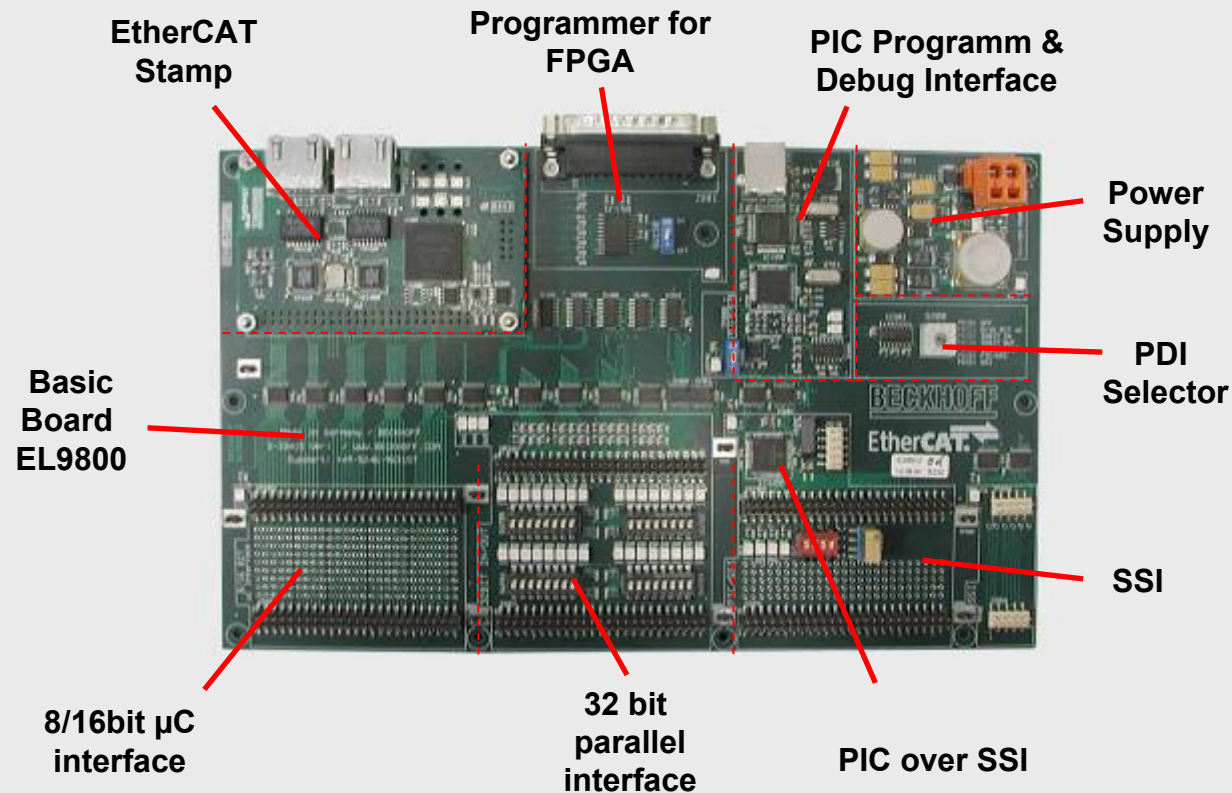
EtherCAT is easier to implement

EtherCAT is:

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- **easier to implement**
- well proven
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- redundancy
- versatile

Slave:

- Evaluation Kit with Sample Code (Source)
- All time critical functions implemented on ASIC or FPGA



EtherCAT is easier to implement

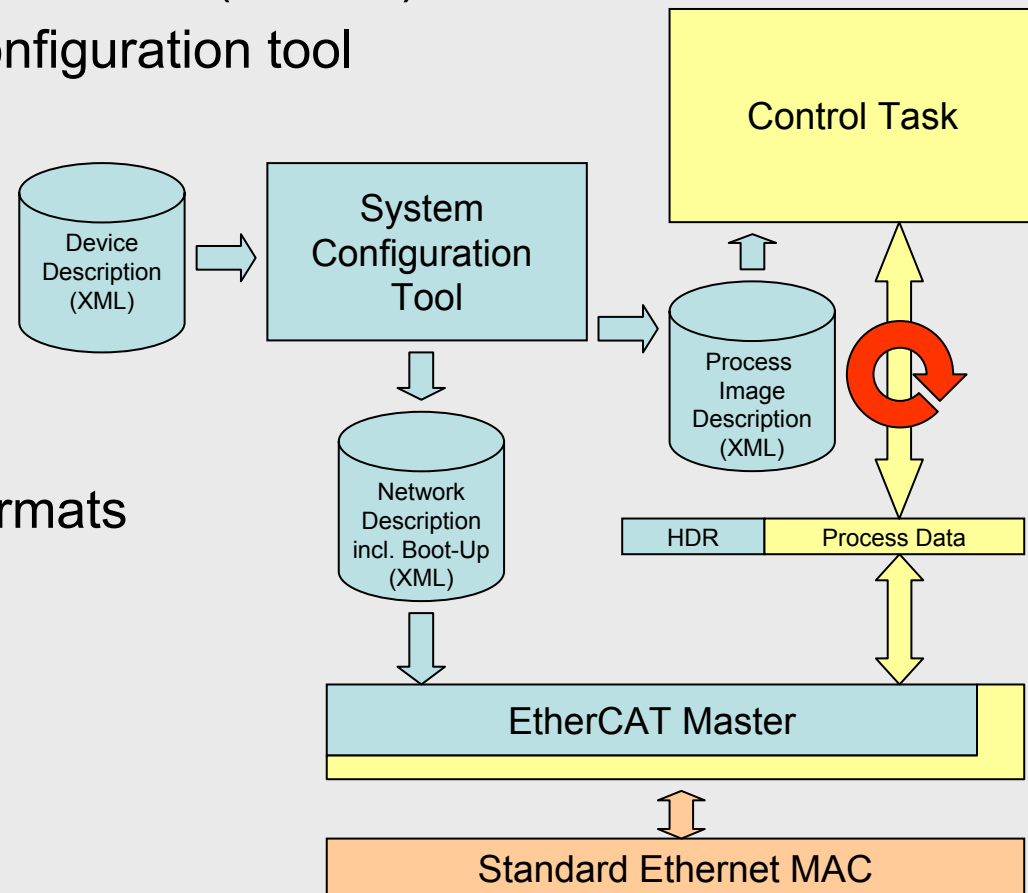
EtherCAT is:

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Master:

- Master Sample Code (Source)
- EtherCAT configuration tool

- XML Data formats



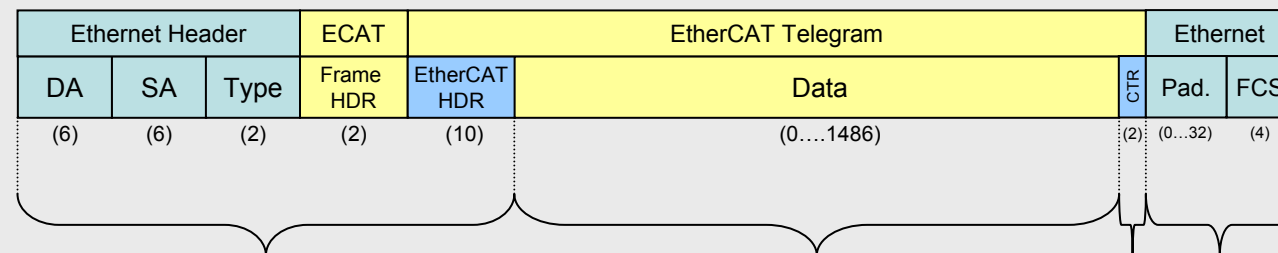
EtherCAT is easier to implement

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Example: Master with just one process image:

- typical e.g. for small controllers with one control task
- up to 1488 Byte Process data size
- **Header for Process Data Communication remains constant**



constant Header

completely sorted (mapped)
process data

Working
Counter:
constant

Padding Bytes and
CRC generated by
Ethernet Controller
(MAC)

- Master can be implemented with minimal effort
- No separate communication processor required (e.g. on plug-in card)
- **Much simpler than legacy fieldbus systems**
- **Very much simpler than competing Industrial Ethernet approaches...**



EtherCAT is well proven

EtherCAT is:

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- lower cost ✓
- easier to implement ✓
- well proven
- open
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- versatile

- today in series production
- more nodes shipped than PROFINET IRT, Powerlink Version 2 and SERCOS III altogether...



EtherCAT is well proven

EtherCAT is:

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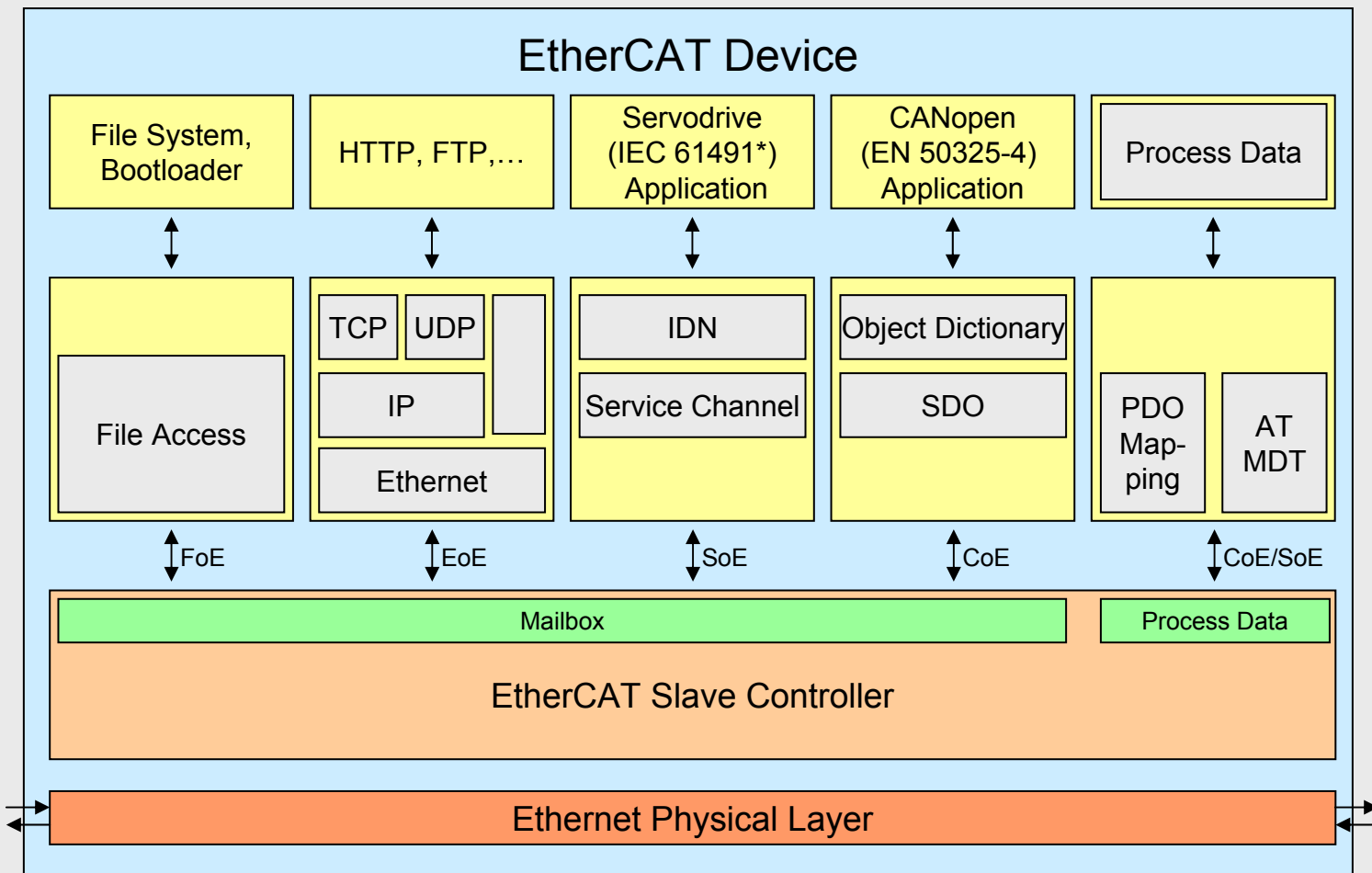
Quote Schuler Company:

„This system enables us to realize fast drive and hydraulic controls for all applications currently used in the Schuler Group. Another crucial factor is that, due to EtherCAT's performance, we still have enough potential for solving complex control tasks in future without speed problems.“



EtherCAT is:

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- more flexible to wire ✓
- easier to configure ✓
- lower cost ✓
- easier to implement ✓
- well proven ✓
- open
- safety
- redundancy
- versatile



*IEC 61491 is the SERCOS Standard. SERCOS interface™ is a trademark by IGS e.V.



EtherCAT is an open technology

EtherCAT is:

- faster ✓
- Industrial Ethernet ✓
- more flexible to wire ✓
- easier to configure ✓
- lower cost ✓
- easier to implement ✓
- well proven ✓
- open
- safety
- redundancy
- versatile



- Foundation: November 2003
- Tasks: Support, Advancement and Promotion of EtherCAT
- Already more than 190* member companies from Europe, North America and Asia/Pacific:
 - Device Manufacturers
 - End Users
 - Technology-Provider
- Membership is open to everybody

* as of June 2005



EtherCAT Technology Group Members (as of June 2005)

EtherCAT is:

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- versatile



24/06/2005

EtherCAT: Ethernet Control Automation Technology

Hannover Fair 2005 ETG Joint Booth Participants



EtherCAT is:

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BAUMÜLLER

servo dynamics

ALSTOM

DANAHER MOTION

Smart Software Solutions

MTS

IAI

ATERA

MOOG

EBV Elektronik
An Avnet Company

BECK.
THE POINT OF SYNERGY

STÖBER ANTRIEBSTECHNIK
GmbH + Co.

Weidmüller



SEW EURODRIVE

TenAsys

IVO

TE ELECTRONIC

BALLUFF
Sensors Worldwide

POSITAL
FRABA

hilscher
COMPETENCE IN COMMUNICATION

Kübler

Digi tronic
Eine Spur schneller.

ST

BECKHOFF

pantec

KW software

Proformatics GmbH

LUST
ANTRIEBSTECHNIK

DLR

EtherCAT is an open technology

EtherCAT is:

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- easier to implement ✓
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- redundancy
- versatile

- Protocol is disclosed completely:
- EtherCAT is IEC Specification (IEC/PAS 62407)



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия



- Currently: voting process for ISO 15745-4
- Integration in IEC 61158, IEC 61784 and IEC 61800 is under way
- Slave Controller available
- Slave Controller provides interoperability
- 2nd Source Slave Controller in the pipeline

EtherCAT is:

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- Management Board of IEC has approved Liaison of EtherCAT Technology Group with IEC SC65C WG 11/12/13 (SC65C: Digital Communication)



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

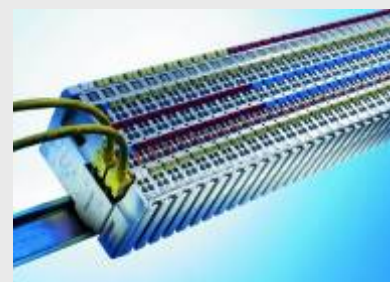
- Thus ETG is official IEC Standardization Partner



EtherCAT Products (Selection)*

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*some available, some announced

EtherCAT is:

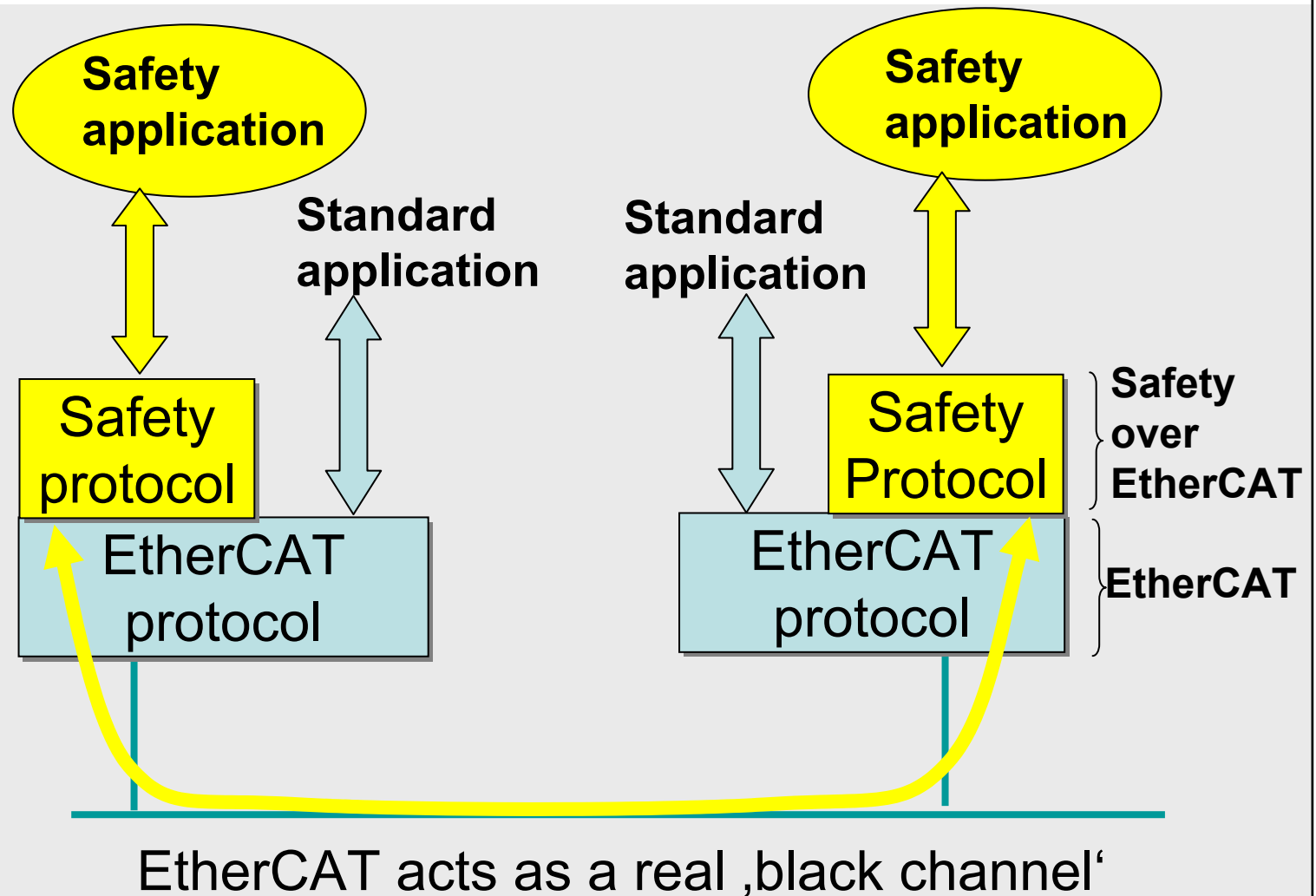
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- versatile

- Fully integrated solution:
safe and standard communication in one channel
- Reduction of fieldbuses and interfaces
- Central configuration, diagnosis and maintenance for safe and ,unsafe‘ I/O in one Tool
- Safety application makes full use of EtherCAT advantages:
 - ✓ Short reaction times
 - ✓ Almost unlimited no. of nodes
 - ✓ Large network extensions
 - ✓ Cable redundancy options
 - ✓ High Flexibility with Hot Connect

Safety over EtherCAT: Technology Approach

EtherCAT is:

- faster ✓
- Industrial Ethernet ✓
- more flexible to wire ✓
- easier to configure ✓
- lower cost ✓
- easier to implement ✓
- well proven ✓
- open ✓
- **safety**
- redundancy
- versatile



EtherCAT is:

➤ faster



➤ Industrial Ethernet



➤ more flexible to wire



➤ easier to configure



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➤ easier to implement



➤ well proven



➤ open



➤ safety

➤ redundancy

➤ versatile

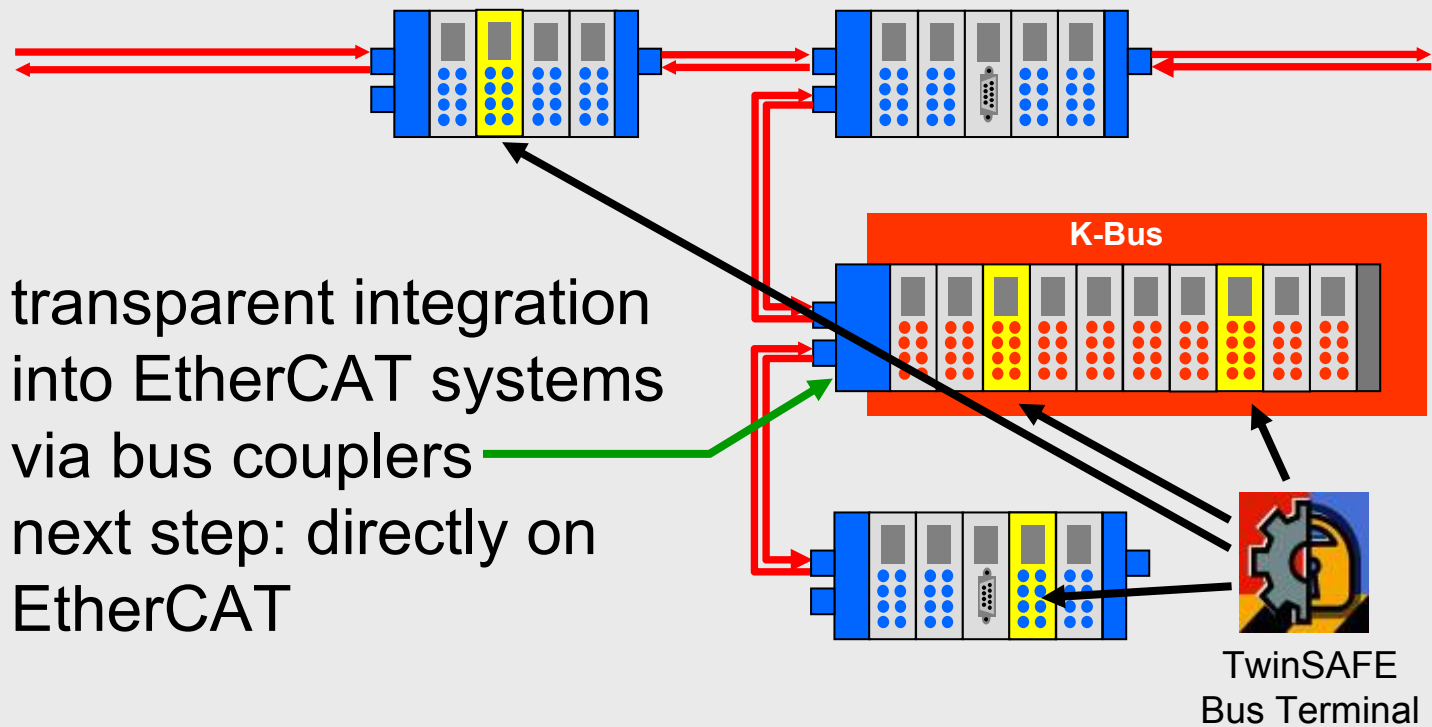
- Safety Protocol developed to IEC 61508
- Protocol meets SIL4 requirements
- routable via non-safe gateways
- routable via fieldbus systems
- Protocol fits for different transfer rates: for 100Mbit Ethernet as well as for 10kbit serial protocol
- Even mix of different bus systems possible
- variable CRC size for minimal overhead
- suitable for safe I/O and drives
- excellent diagnosis

Safety over EtherCAT: Implementations

EtherCAT is:

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- easier to configure ✓
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- open ✓
- **safety**
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- First implementation: Beckhoffs TwinSAFE product line, initially on K-Bus



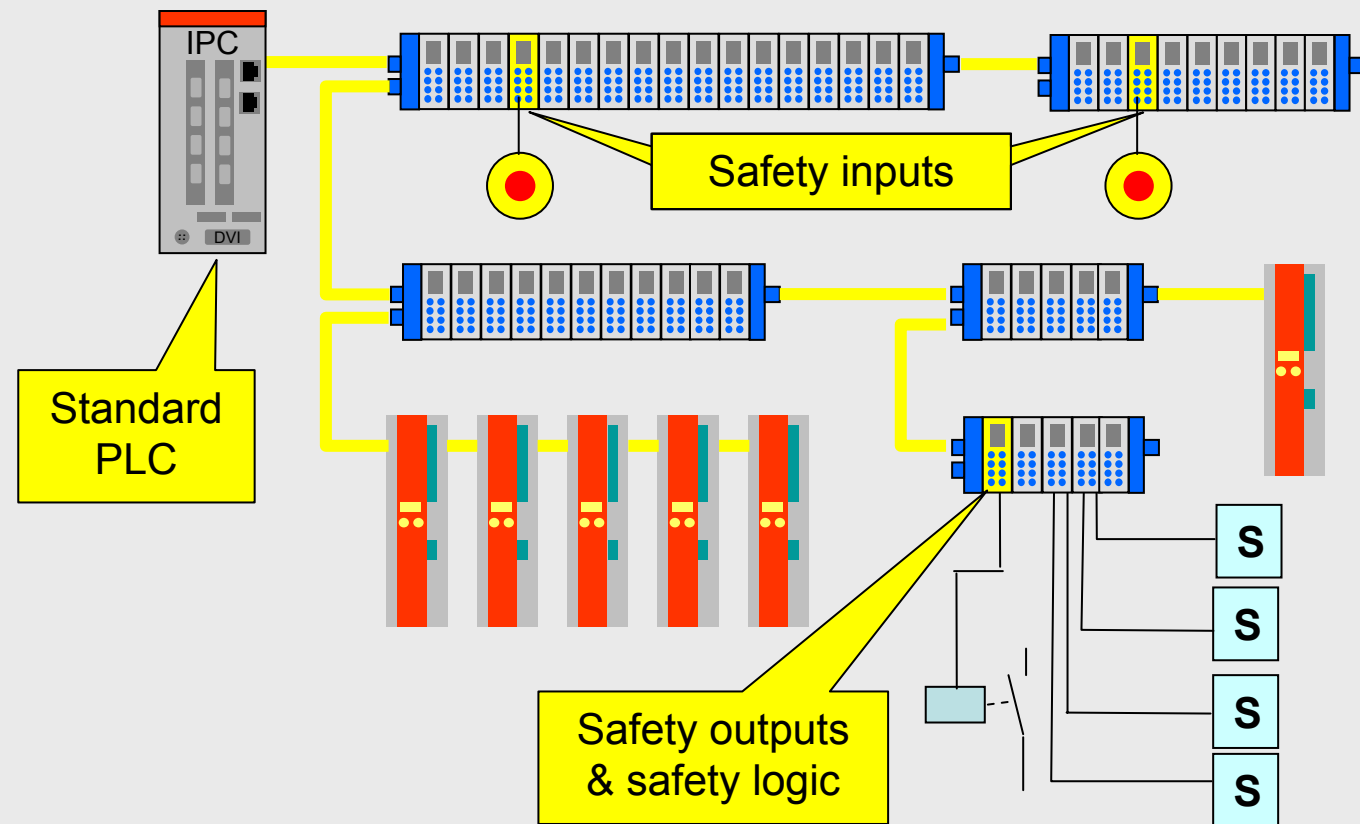
Safety over EtherCAT: Implementations



EtherCAT is:

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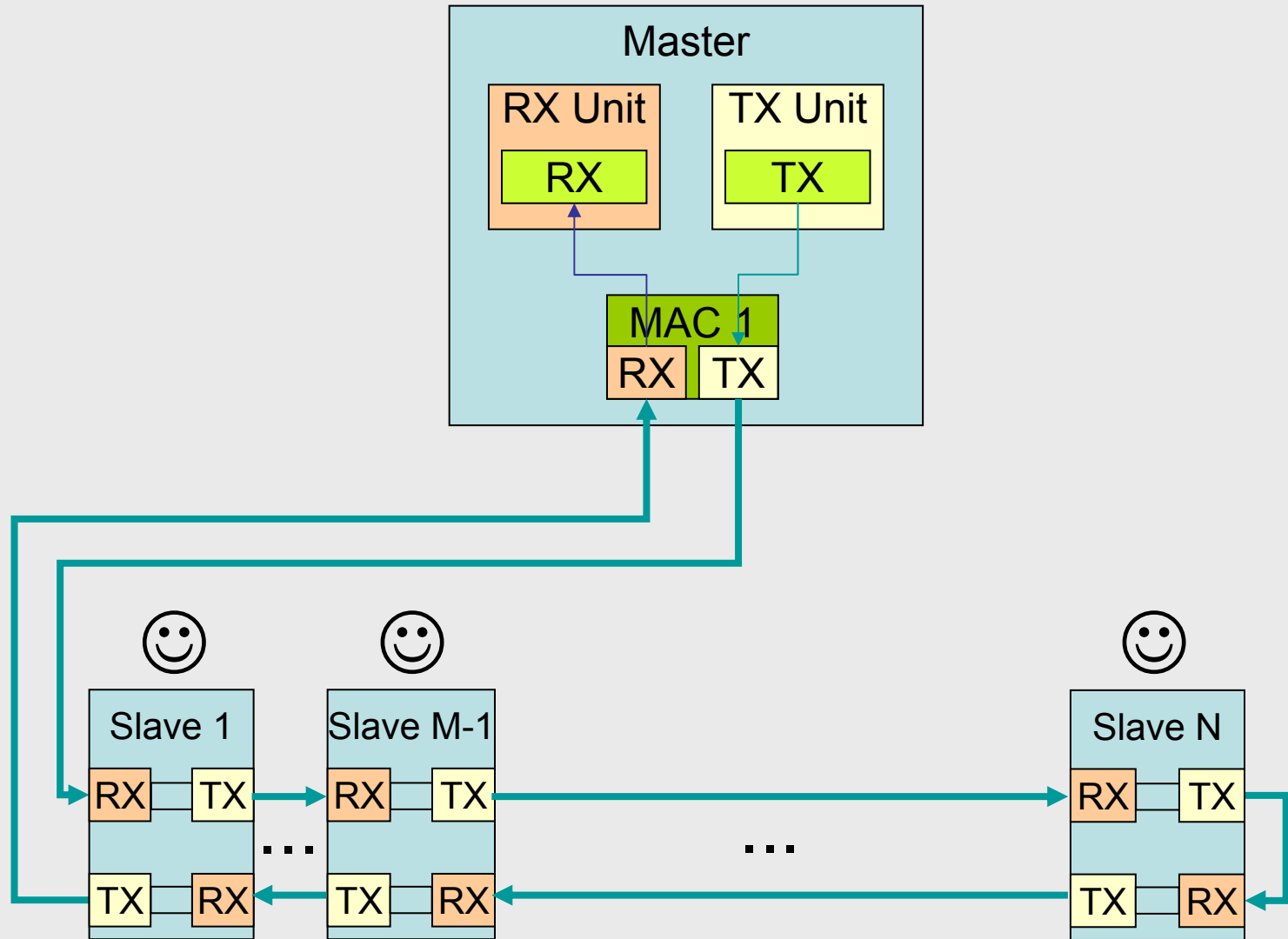
- Decentralized Safety Logic
- Works with Standard PLC
- PLC simply organizes data exchange



Without Redundancy: Normal Operation

EtherCAT is:

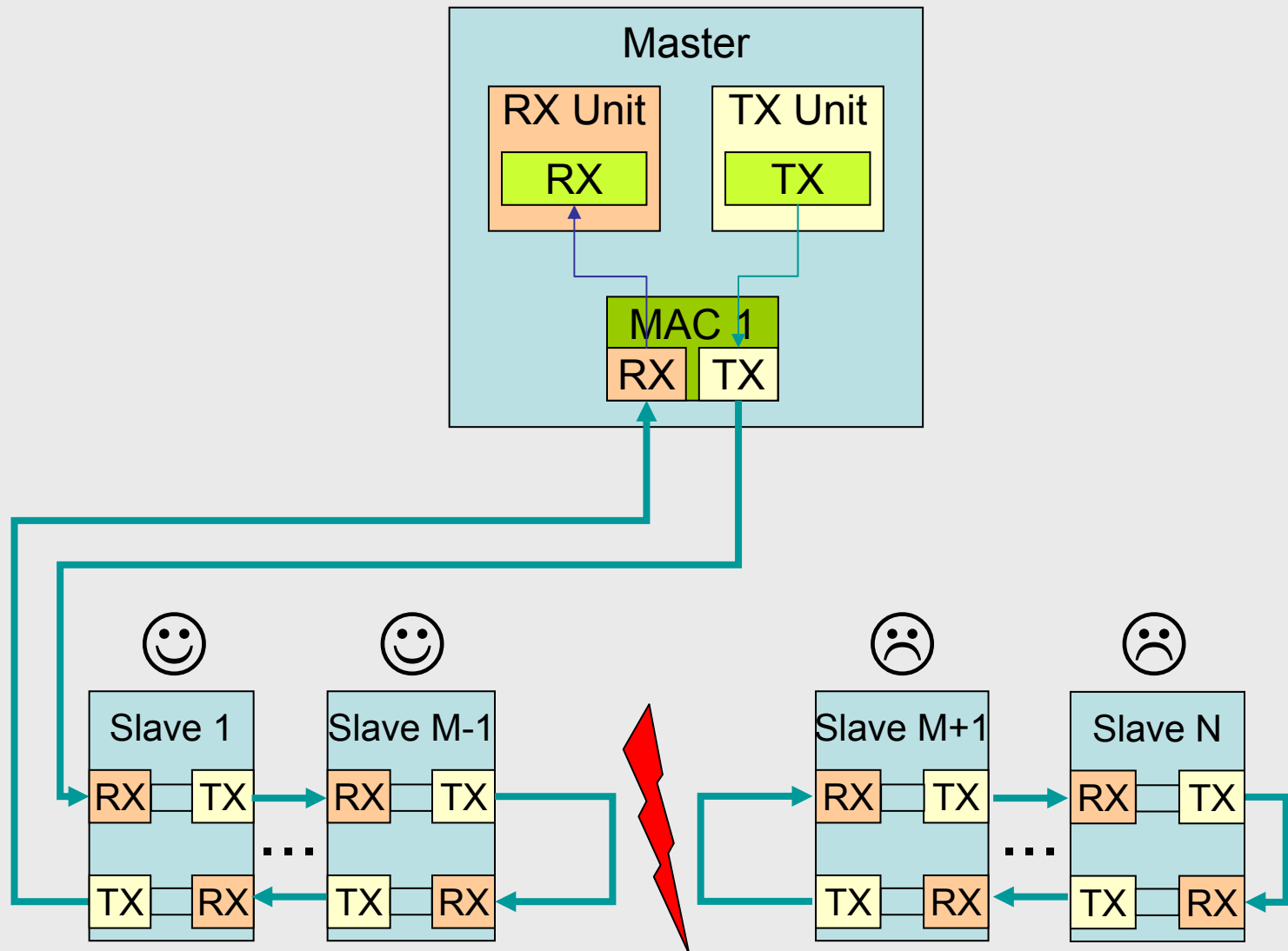
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- open ✓
- safety ✓
- **redundancy**
- versatile



Without Redundancy: Cable Failure

EtherCAT is:

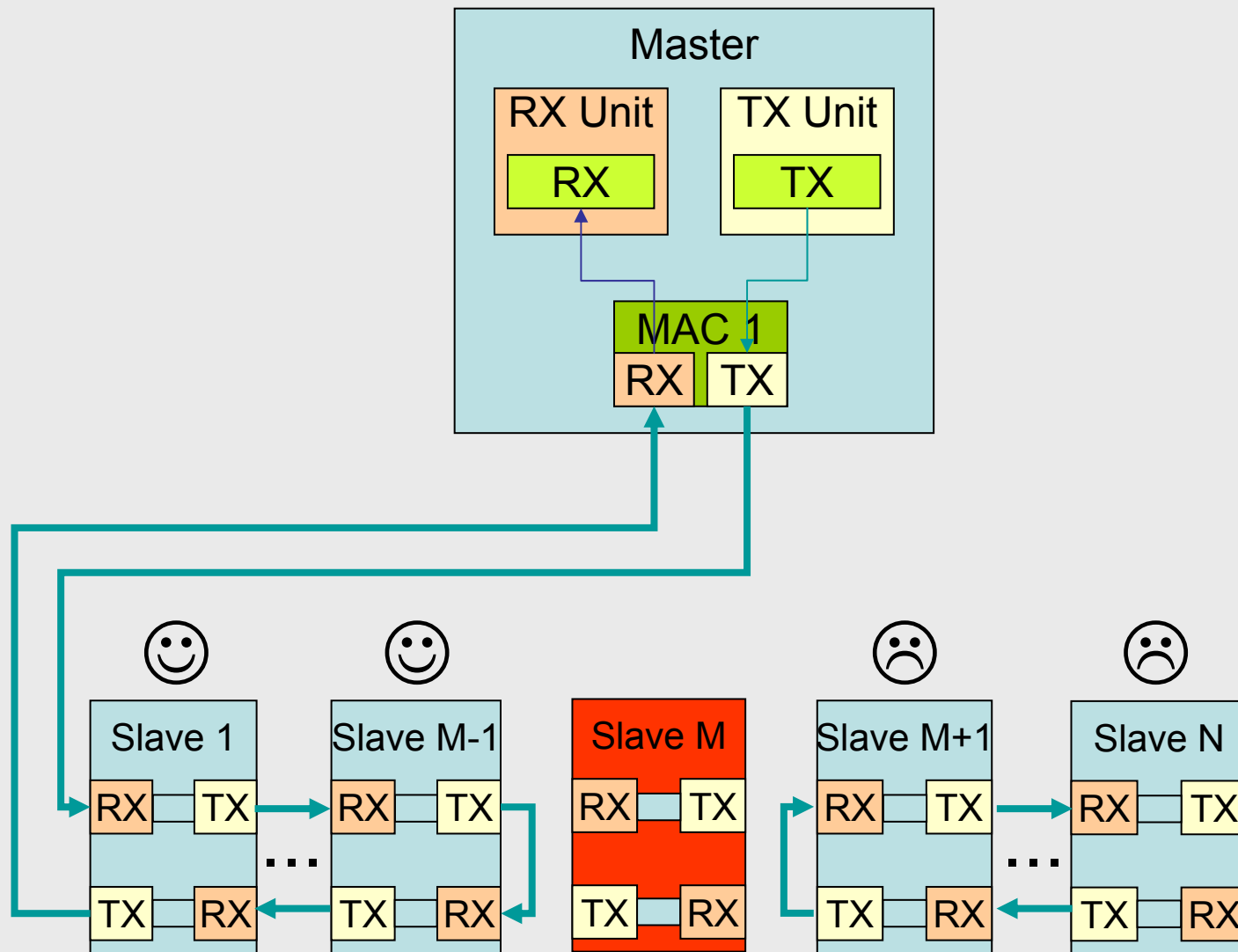
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- **redundancy**
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Without Redundancy: Node Failure

EtherCAT is:

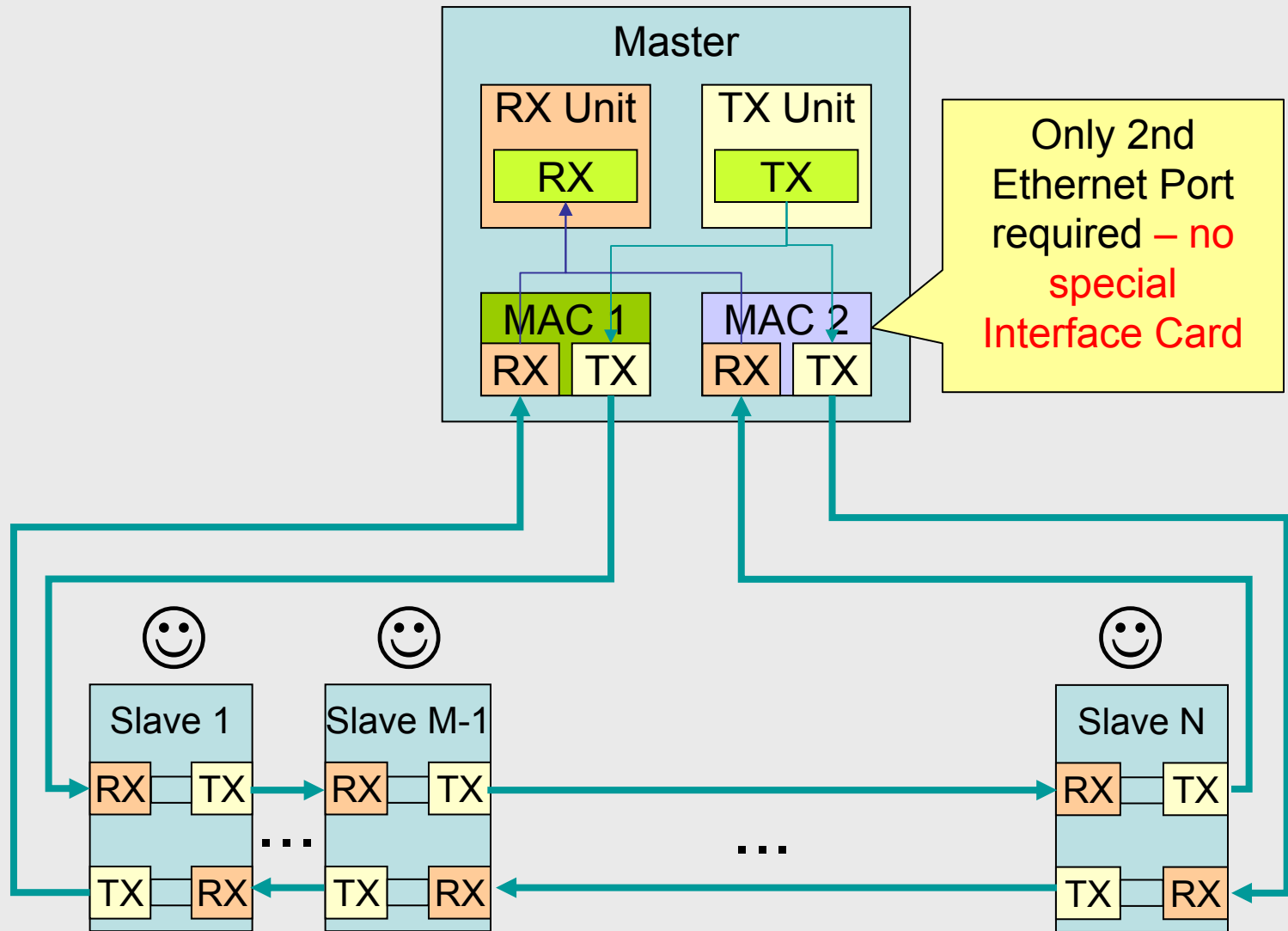
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With Redundancy: Normal Operation

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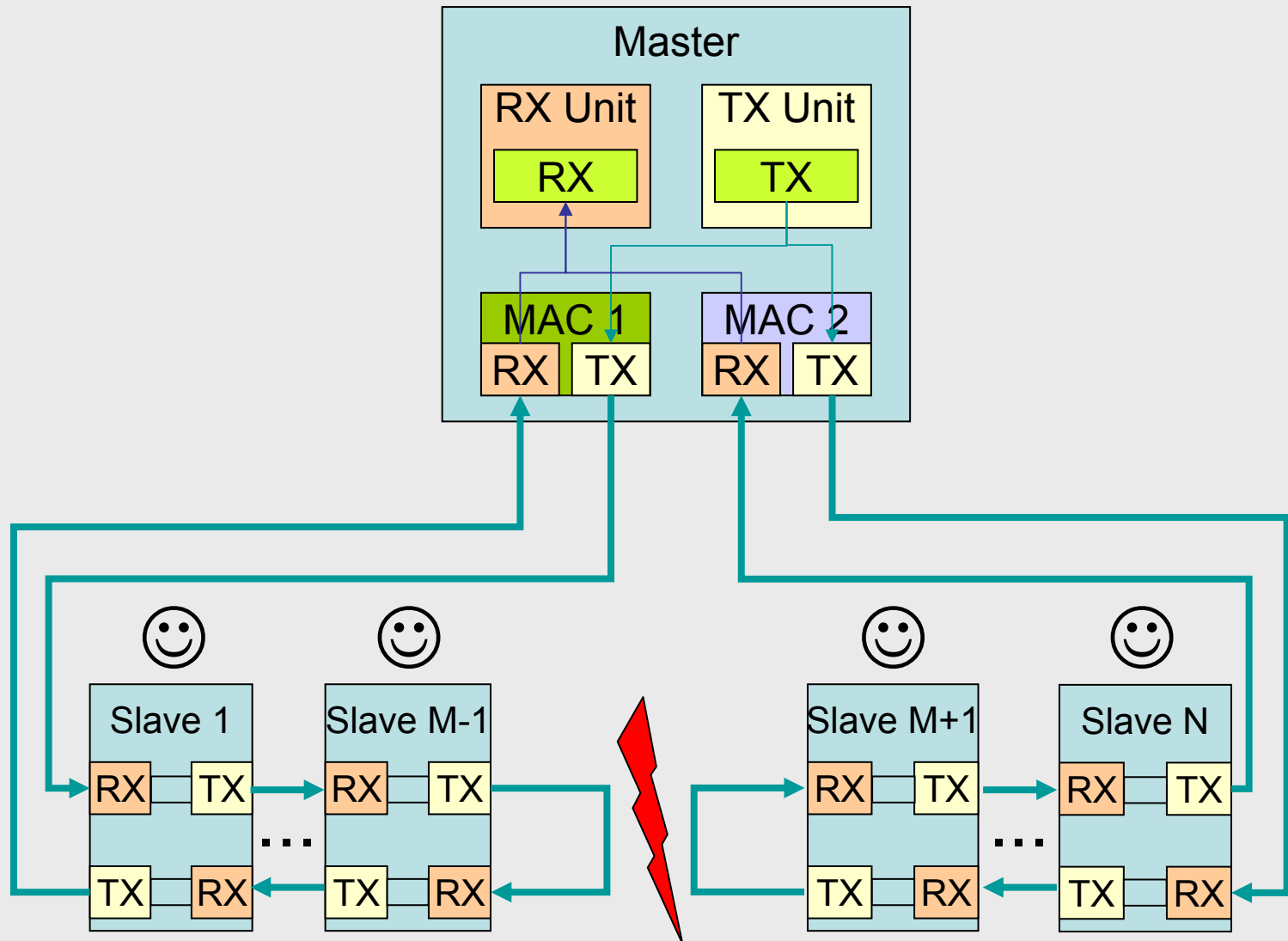
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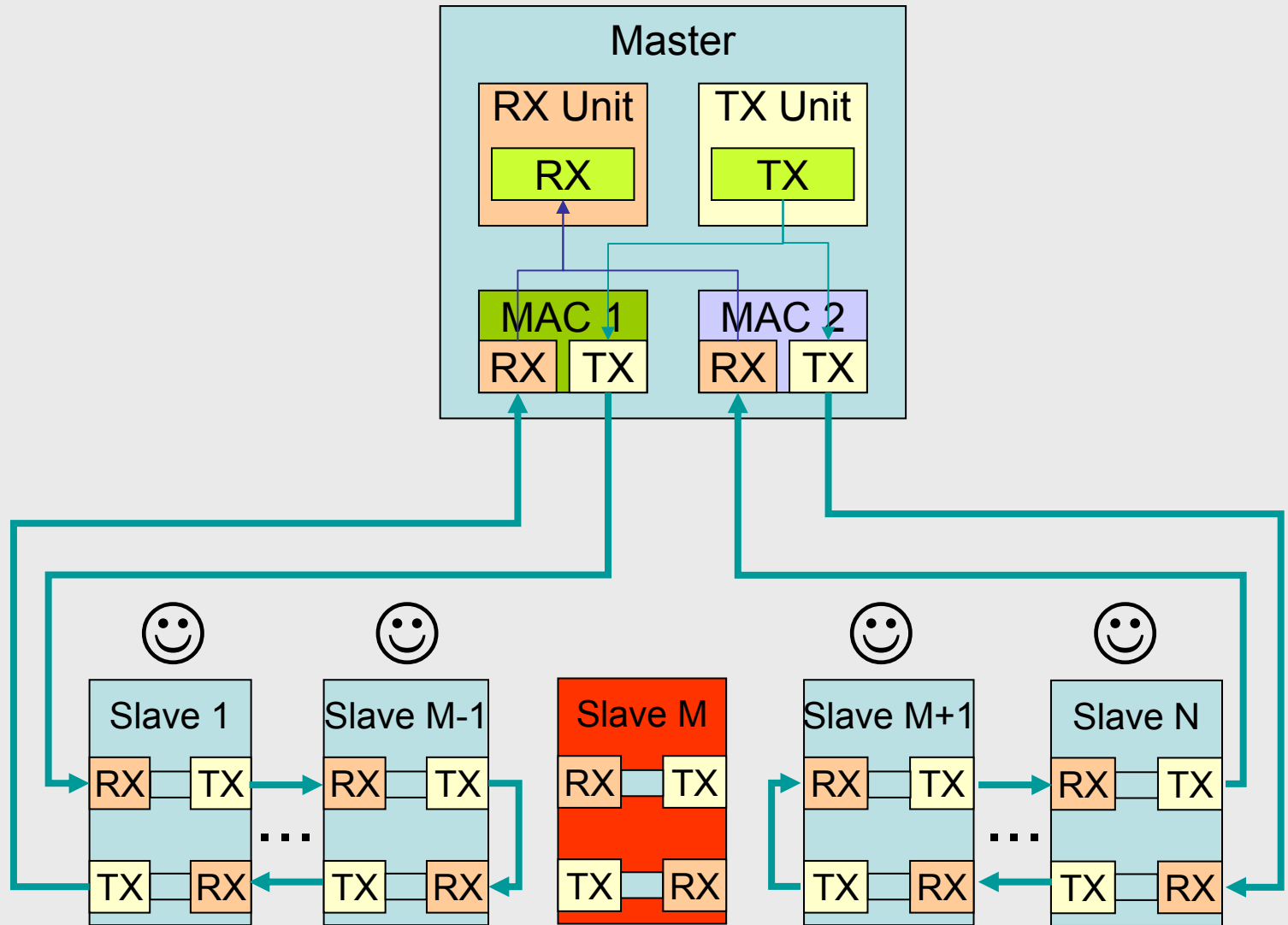
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EtherCAT: High availability

EtherCAT is:

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- lower cost
- easier to implement
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- safety
- redundancy
- versatile



- Master redundancy with Hot-Stand-By
- Cabling redundancy
- Hot Swap of devices
- Hot-Connect of network segments

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- redundancy ✓
- versatile

Fast applications, e.g.:

- packaging machines
- high speed presses
- injection molding machines
- woodworking machines
- machine tooling (CNC)
- robotics
- ...

Widely distributed applications, e.g.:

- materials handling,
- logistics
- data acquisition
- ...



80 μ s Cycle Time



EtherCAT Application Fields

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- easier to configure ✓
- lower cost ✓
- easier to implement ✓
- well proven ✓
- open ✓
- safety ✓
- redundancy ✓
- versatile

Due to low cost master and simple wiring as well:

- Small embedded Controller
- Small PLCs
- Any PC based control application
 - with or without real time requirements

EtherCAT allows one to apply fieldbus technology where cost issues require direct wiring today.

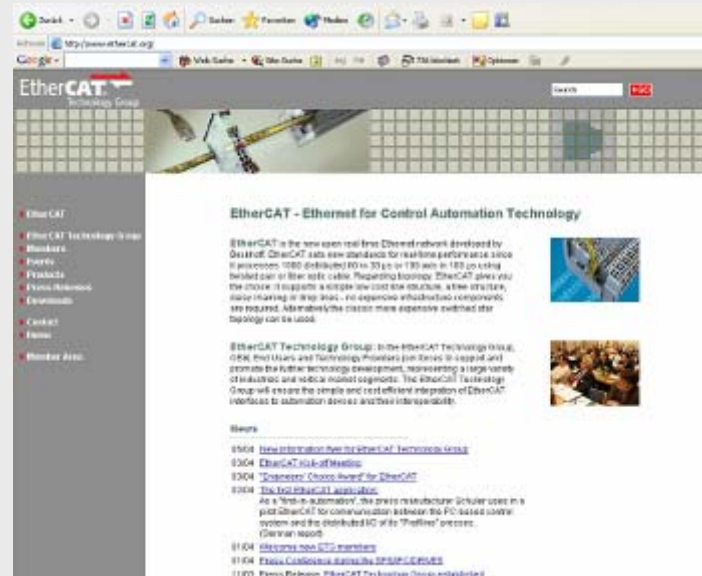


That's EtherCAT!

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www.ethercat.org



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m.rostan@ethercat.org