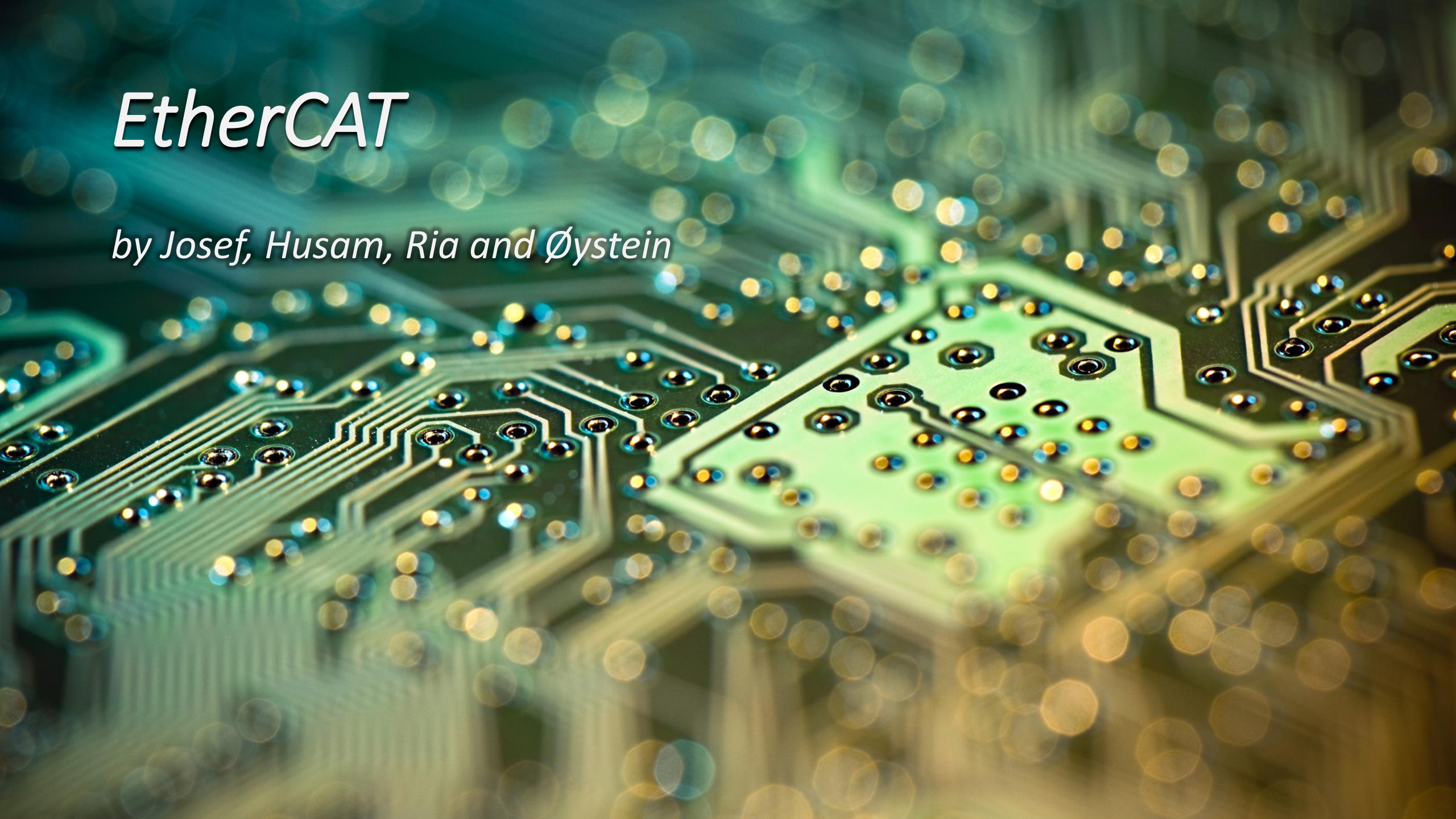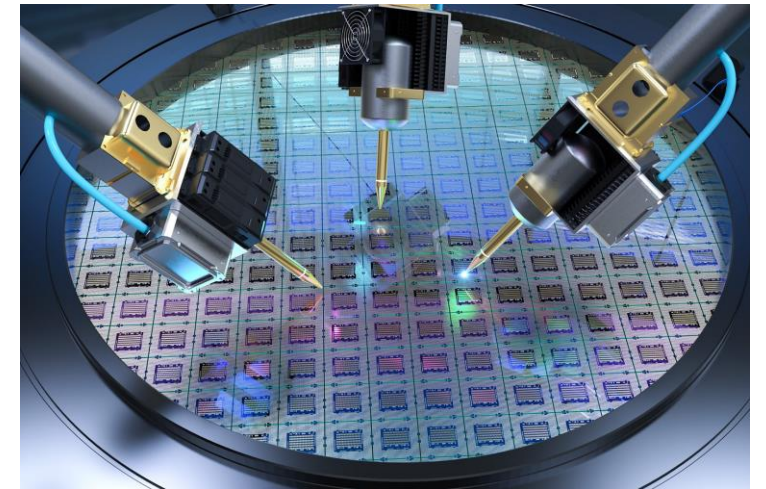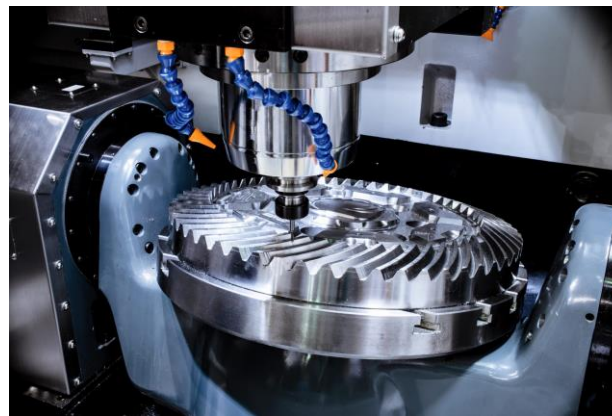# EtherCAT

by Josef, Husam, Ria and Øystein

Target group

- Ethernet for Control Automation Technology

- Motors, actuators, sensors

- Real time data
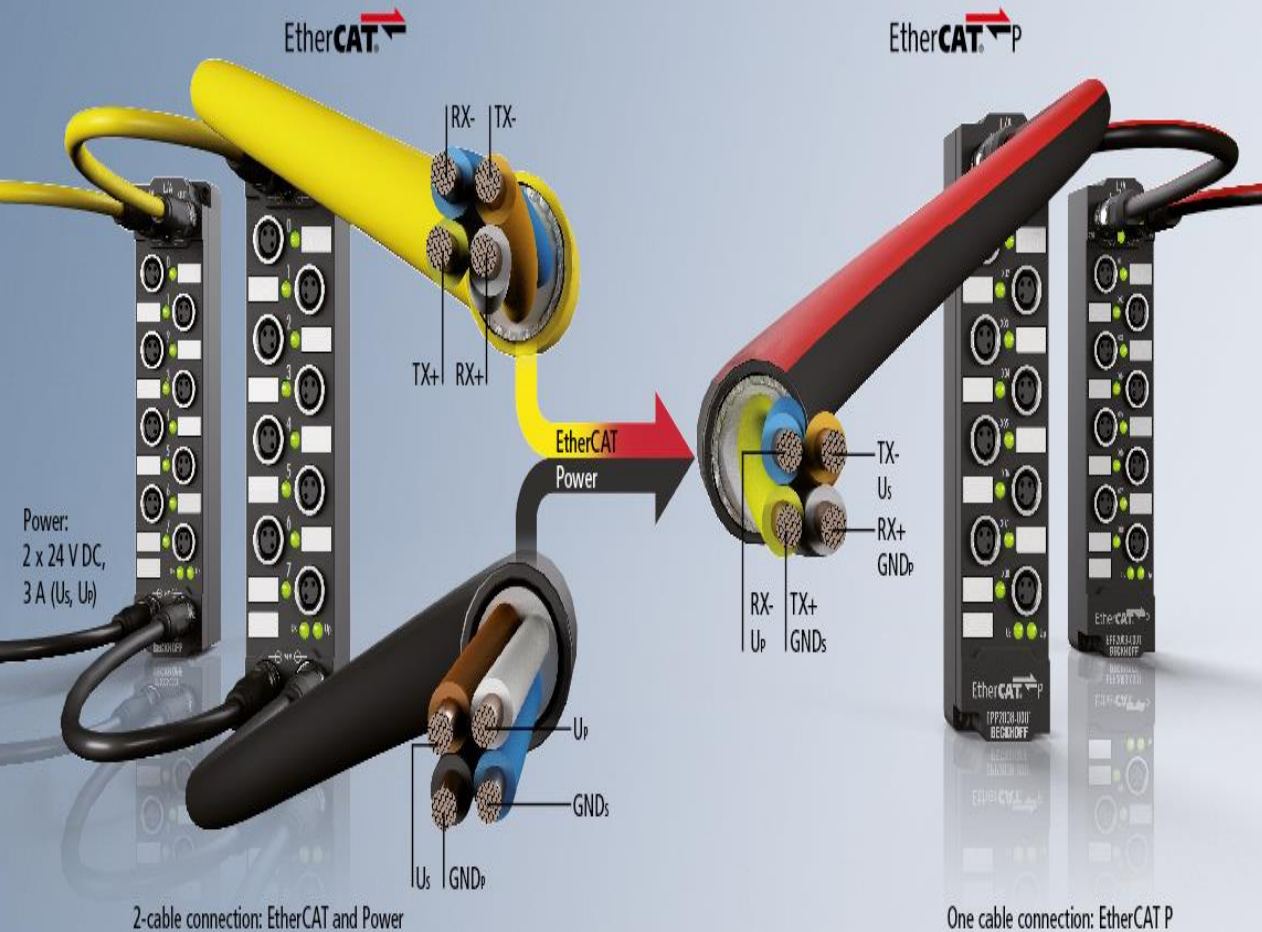
- Hardware compatible

Speed

- EtherCAT is very fast

- Automation, IoT and other applications

EtherCAT®

Medium

EtherCAT

EtherCAT P

RX- TX-

TX+ RX+

EtherCAT
Power

Power:
2 x 24 V DC,
3 A (Us, Up)

Up

GNDs

Us GNDp

2-cable connection: EtherCAT and Power

TX-
Us

RX+
GNDp

RX-
Up

TX+
GNDs

One cable connection: EtherCAT P

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100 Mbit/s EtherCAT

- 100BASE-TX
- Vast choice of components

Min. telegram length (0…46 byte user data)*   =   6.08 µs
Max. telegram length (1,500 byte user data)*   = 122.40 µs

*incl. Preamble and VLAN-Tag

1 Gbit/s EtherCAT G

- 1000BASE-T
- Integration of data-intensive devices
- Very high bandwidth

Min. telegram length (0…46 byte user data)*   =   0.58 µs
Max. telegram length (1,500 byte user data)*   = 12.24 µs

*incl. Preamble and VLAN-Tag

10 Gbit/s EtherCAT G10

- 10GBASE-T
- Integration of EtherCAT G segments
- Ultimate bandwidth

Min. telegram length (0…46 byte user data)*   =   0.06 µs
Max. telegram length (1,500 byte user data)*   =   1.22 µs

*incl. Preamble and VLAN-Tag
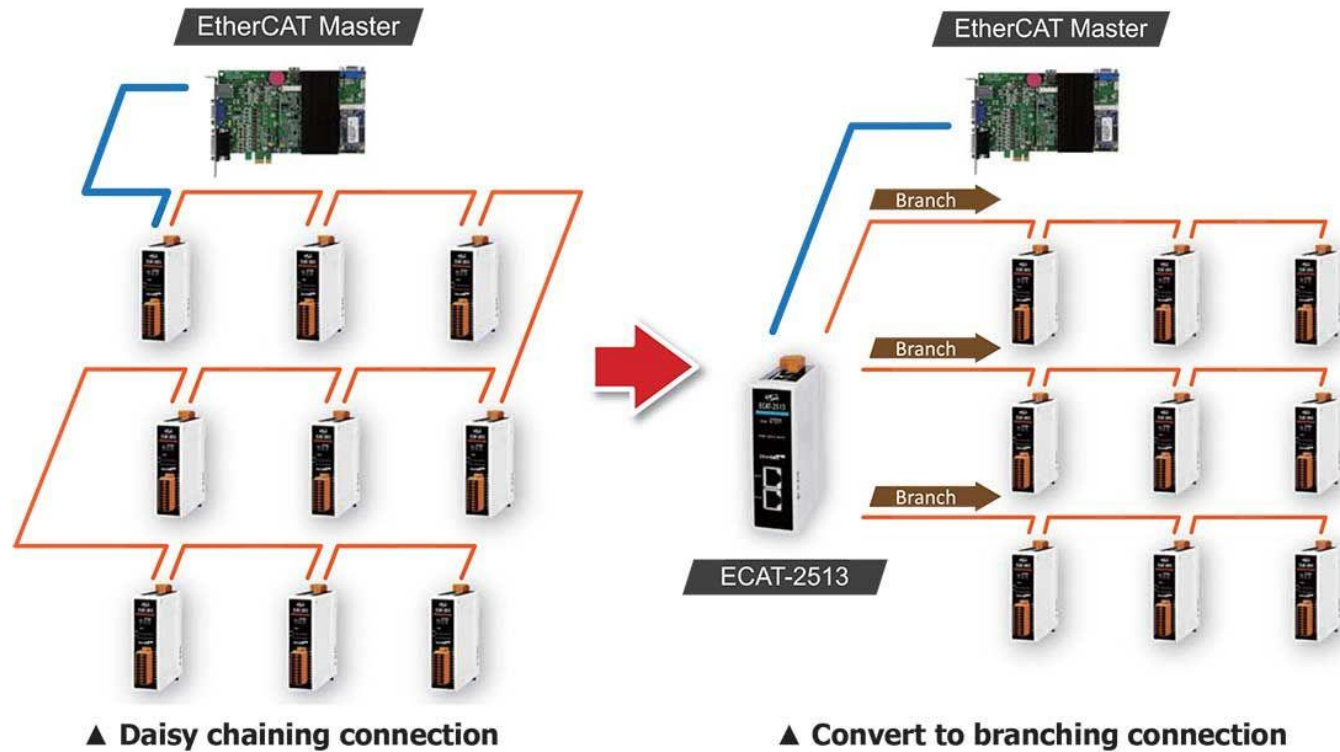
Functionality

- Ethernet protocol

- Slave only responds

- Internal clocking in slaves

- On the fly

Ethernet Header	EtherCAT Data	FCS

EtherCAT Header	EtherCAT Datagrams	Padding Bytes

Datagram 1	Datagram 2	...	Datagram 15

Datagram Header	Data	Working Counter

Topology

EtherCAT Master

▲ Daisy chaining connection

EtherCAT Master

Branch

Branch

Branch

ECAT-2513

▲ Convert to branching connection
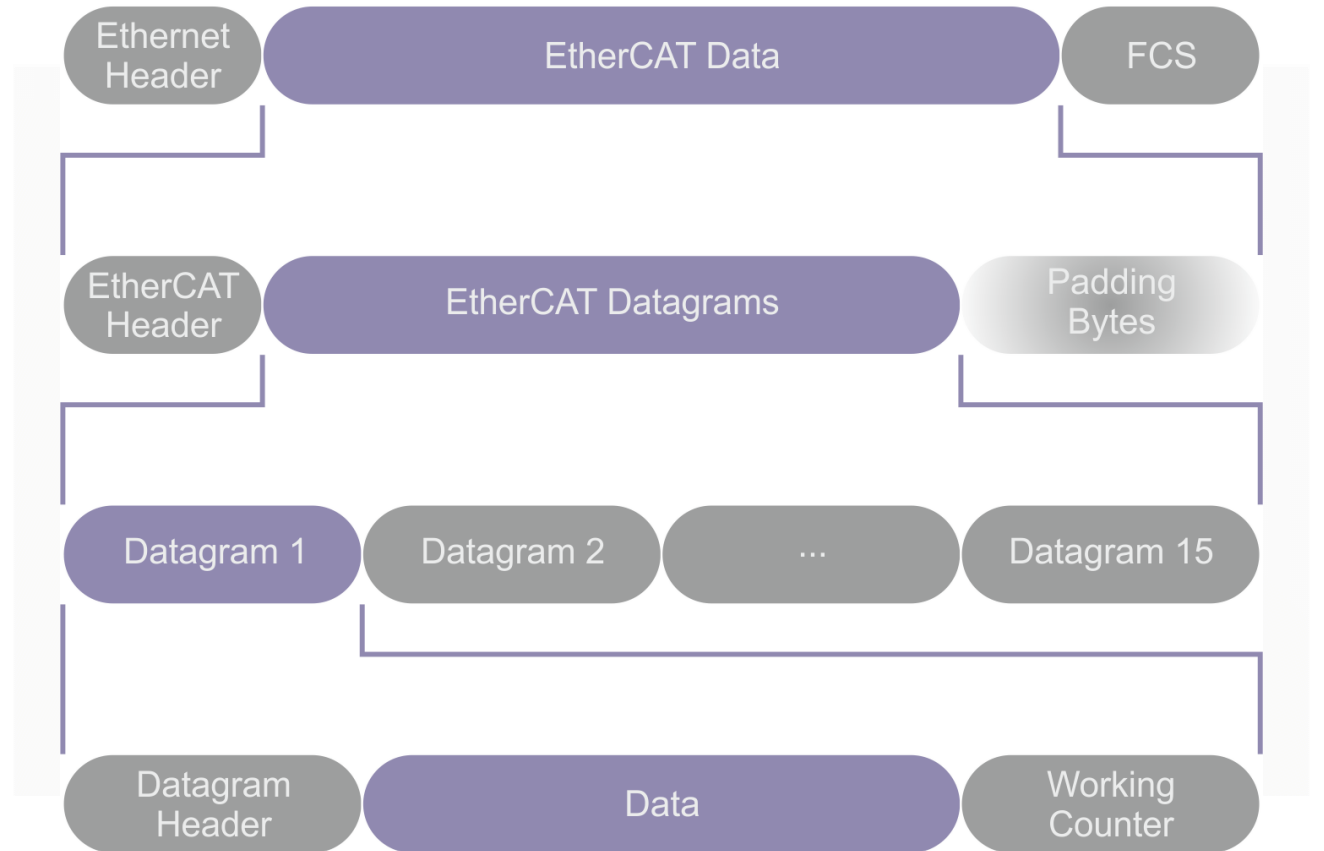
- Flexible

- Full-Duplex

- Automatic link detection

EtherCAT®

7 Layers

- 7 - Application Layer (AL)
- 6 - Presentation Layer
- 5 - Session Layer
- 4 - Transport Layer
- 3 - Network Layer
- 2 - Data Link Layer (DL)
- 1 - Physical Layer (PL)

EtherCAT®

- Standard Data
- Real-time Data
- TCP, UDP
- IP
- EtherCAT® MAC
- EtherCAT® Physical Layer

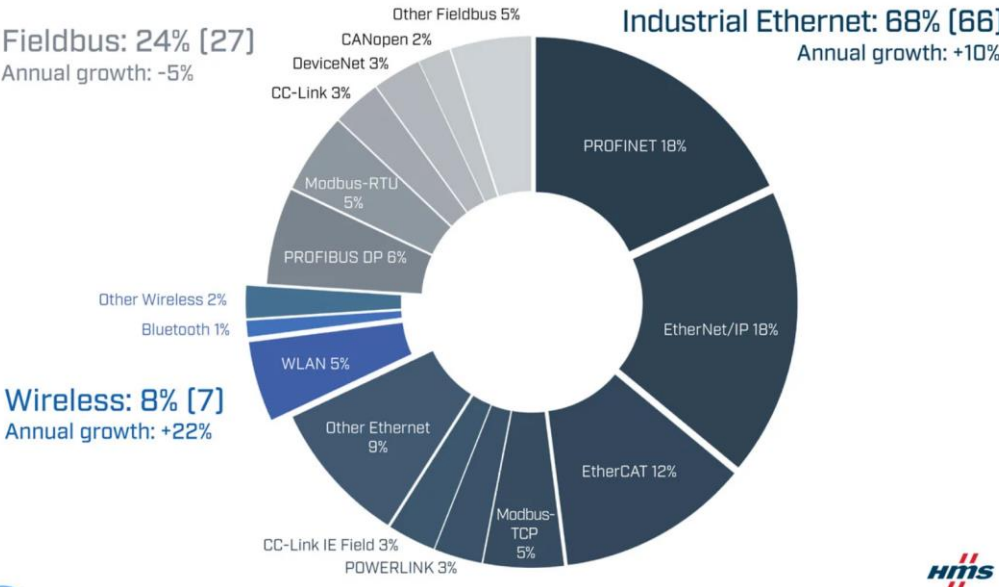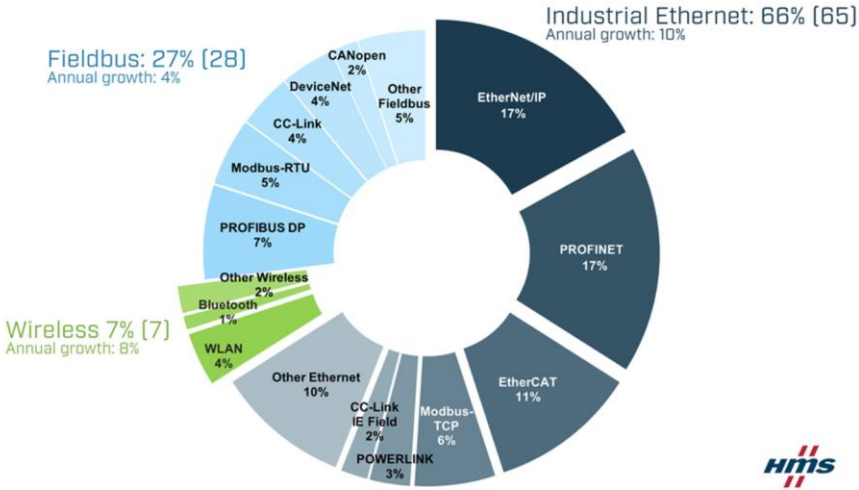| Category	Ether CAT(control automation technology)	Ethernet/IP (Industrial protocol)	PROFINET (Process field network)
Definition: Communication protocol for industrial ethernet network	Master-slave protocol which is high speed and deterministic while processing data	Uses the normal TCP from ethernet but works on level 5,6 and 7 of OCI model to exchange data	Designed to exchange data and uses common ethernet for its communication medium
Features	• Processes on the fly • Cycle time up to 100micro seconds • High bandwidth and low latency and jitter • No collisions of data • Flexible topology and no hubs and switches	• Needs to ingest data and process • Cycle times up to 10ms • Lower bandwidth, higher latency and jitter • Requires hubs and switches • Not adapted to data collision	• Precise cyclic time(31.25 microseconds) due to direct transfer to ethernet frames • Requires switches, sensors • Real time and Isochronous time • Coexists and integrates
Application	Often used in robotics, semiconductor manufacturing, machine control etc	Cannot be used for high-speed applications thus very common to use for data acquisition, diagnostics etc	used for automobile automation, manufacturing etc

Limitations

Can only have one master.

ASIC needed for the slave unit.

Market share and popularity

- Market research
- Surveys and feedbacks
- Sales data
- Collaboration with companies and conferences for insight

2022 Industrial Network Market Shares according to HMS Networks

Sources

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