Industrial Ethernet modules

- Kim Berthelsen

Hardware - inside

- netX chip from Hilscher
  - Designed for industrial Ethernet
  - Programmable Ethernet hardware
  - Different protocols in one chip
  - Versatile processor with higher level protocols and general SW
  - Hilscher protocol stacks

Hardware - exterior

Module/net status LED's

Protocol sticker

Power connector

Ethernet connectors labeled IN and OUT

Power LED with int. comm. fail

Link/Activity LED's

I/O connector with RS232

Hardware – I/O

- Standard module (MAC00-Ex4)
  - 1 analog input (to motor),
  - 1 opto isolated digital input and 1 opto-isolated digital output OR a 4 wire multifunction I/O (to motor)
- Extended I/O module (MAC00-Ex41)
  - 2 analog inputs (to motor).
  - AND 4 opto isolated digital inputs, 2 opto-isolated digital outputs,
  - AND a 4 wire multifunction I/O (to motor).

The opto-isolated digital I/O's to the module are all accessible by Ethernet via module registers.

The I/O direct to motor are NOT opto-isolated.

Hardware - compatibility

- Standard MAC400 to MAC3000
- MAC050-MAC141 with special option (MAC140-xx-xxxx-A009)
- SMC85 and MIS340 / 341 /342

! Big performance difference between mini MAC’s and the big MAC’s !

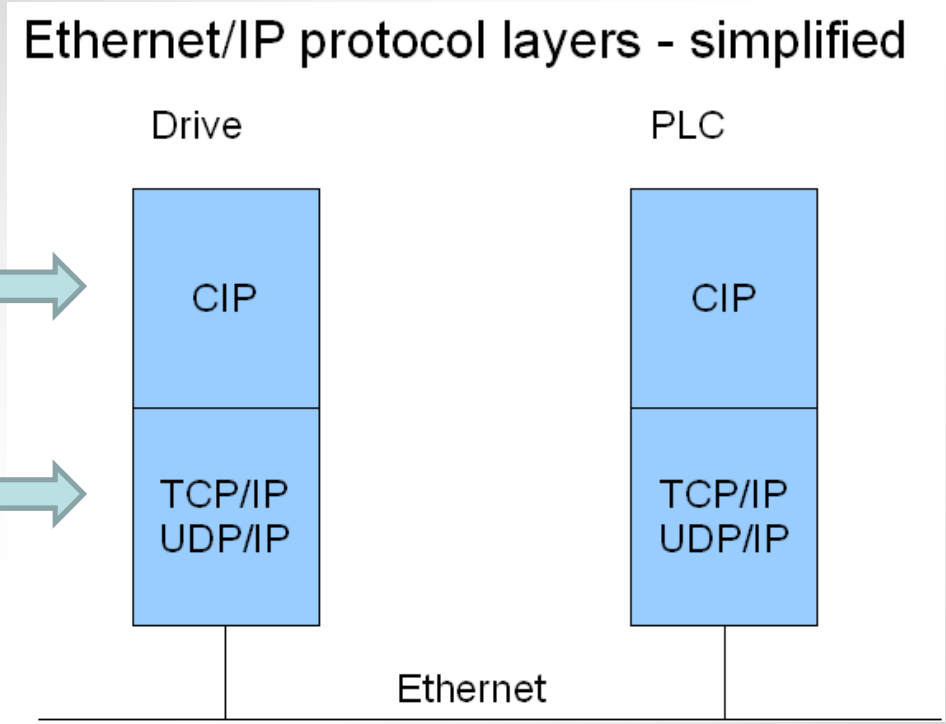
Protocol overview - availability

- Available
  - EtherCAT – MAC00-EC
  - Ethernet/IP – MAC00-EI
  - Ethernet Powerlink – MAC00-EL
  - Profinet RT/IRT – MAC00-EP
  - Modbus TCP – MAC00-EM
- Planned
  - SERCOSIII
  - Others ??

Protocol overview - layers

Application layer

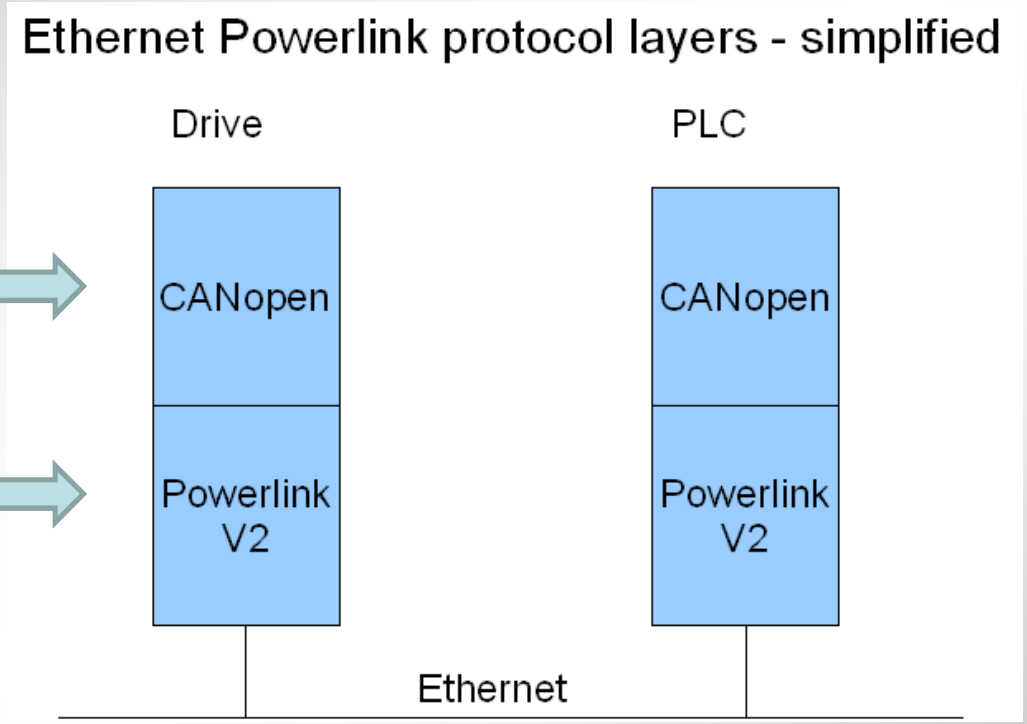
Transport layer



Protocol overview - layers

Application layer

Transport layer



Protocol overview – transport layer

Protocols using standard Ethernet transport layer, enabling co-existence on standard Ethernet.

- Ethernet/IP
- Modbus TCP
- Profinet RT*

Protocols with their own transport layer protocol, requiring gateways to standard Ethernet.

- EtherCAT
- Ethernet Powerlink
- SERCOSIII
- Profinet IRT

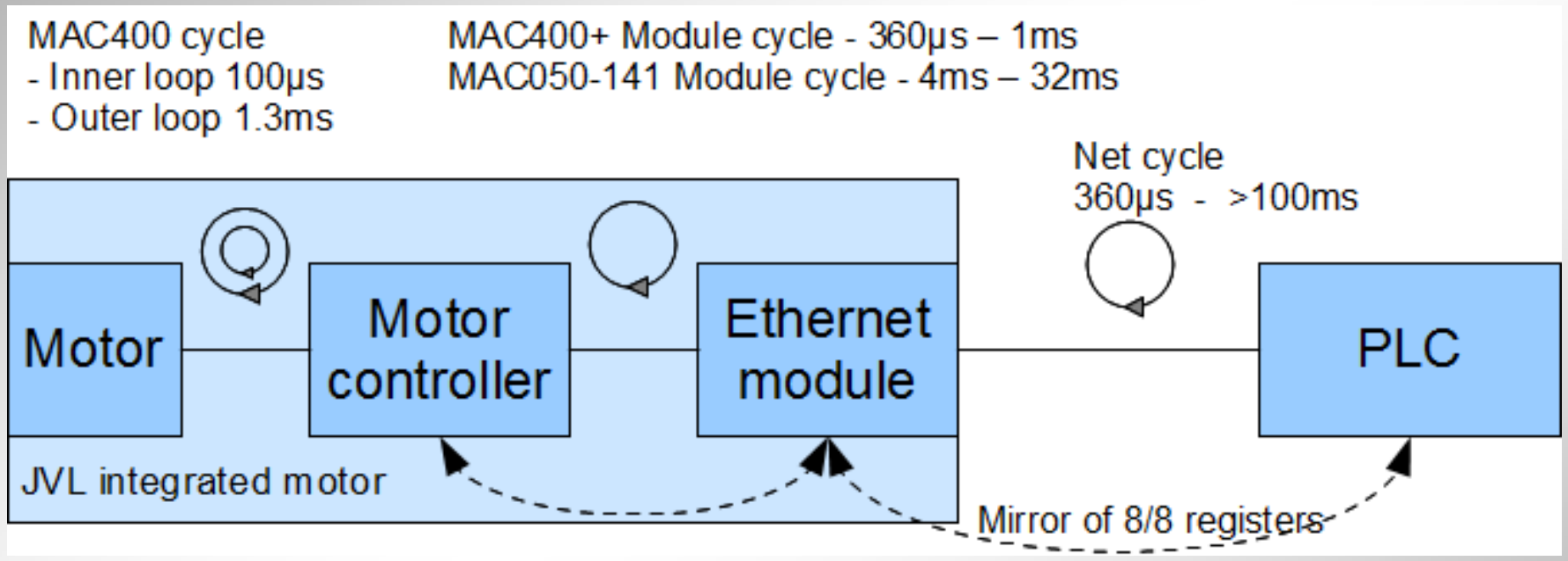
* Switches must be Profinet approved.

Protocol overview – Data transfer

- Two types of data transfer.*
  - Cyclic data
    - Mirrored across the Ethernet, transparently to user when first setup.
    - For fast time critical data, with possibly frequent changes.
  - Non-cyclic data
    - Transferred only on request from the PLC application.
    - For slower and not time critical data, which rarely changes.
- The non-cyclic data is transferred on the Ethernet as low priority frames in between the cyclic frames.

* ModbusTCP only has non-cyclic data transfer.

Protocol overview – Cyclic method



- Up to 8 registers is mirrored in each direction.
- Net cycle time MUST be greater than Module cycle time.
- Module cycle time depends on the motor type and number of registers transferred.

Protocol / MAC00-Exx performance

	EtherCAT	Ethernet/IP	Powerlink	Profinet IRT	Modbus TCP
MAC00-Exx repeater	"EC-switch"	Store-and-forward Switch	Hub	Cut-through Switch	Store-and-forward Switch
Forwarding delay	< 1µs	~10-130µs	< 0.5µs	3.25µs	~10-130µs
Min. cycle time *	360µs	2ms	360µs	1ms	2ms**
Destination slaves per cycle	> 1	1	> 1		1

* Only valid for MAC400-3000 and MIS34x (MAC050-141 min. cycle time = 4ms)

** ModbusTCP has no cyclic data. The value reflects the min. poll time from the master.

Protocol overview – topology

	EtherCAT	Ethernet/IP (with DLR)	Powerlink	Profinet	Modbus TCP
Line	X	X	X	X	X
Star	X	X	X	X	X
Tree	X	X	X	X	X
Ring	X	(X)	-	-	-

Website

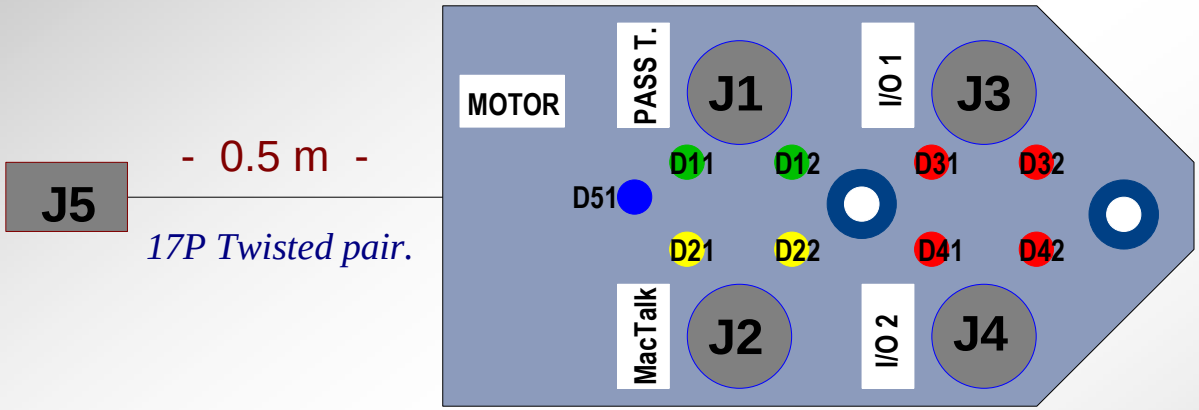
- Protocol overview
- Manual
- Device description files
- PLC demo programs

Mactalk demo

Focus now and in the future

- Synchronization (Distributed Clock, IRT, etc.)
- Drive profiles (CiA DSP402, Profidrive.)
- Mactalk over Ethernet for all protocols
- Firmware upgrade over Ethernet
- SercosIII

Distribution box



- Connect to local I/O
- Connect to Mactalk with JVL std. 8pin cable.
- Applicable for:MIS34xxxxEx and MAC00-Ex41
- LED’s for power, I/O and MacTalk communication.