Advanced Mechatronics System for higher-level Performance & Flexibility

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Advanced Mechatronics: Independent Movers System

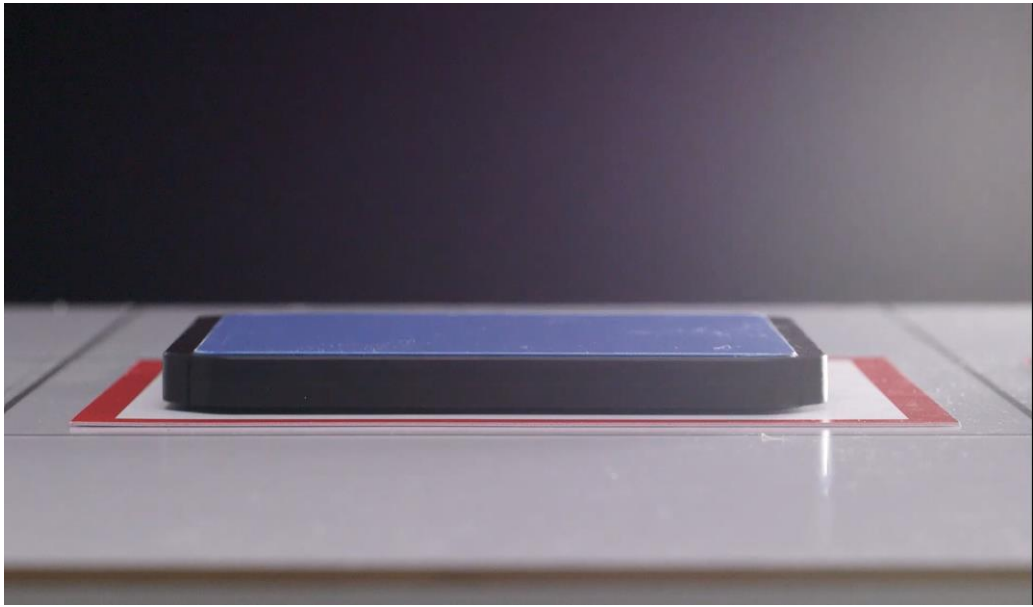
- Passive movers move along an active travel path consisting of motor modules.
- Movers are freely movable on the path and can be controlled independently of one another
  - Brake / Accelerate
  - Gearing
  - Electronic Cams
  - exert a constant force at a standstill and in motion.
- Modular System: Geometry and length of the travel path as well as the number of movers can be adapted to suit the application (> 100m , 200 movers)

Advanced Mechatronics: Planar System

- A passive mover containing permanent magnets levitates above XPlanar tiles that generate a magnetic field to control and to generate the movement

- The movers are independent of each other

- Six degree of freedom:
  - Positioning in X/Y up to 2m/s
  - Lifting, Lowering, weighing variable in height by up to 5mm
  - Tilting by 5°



Control System Architecture

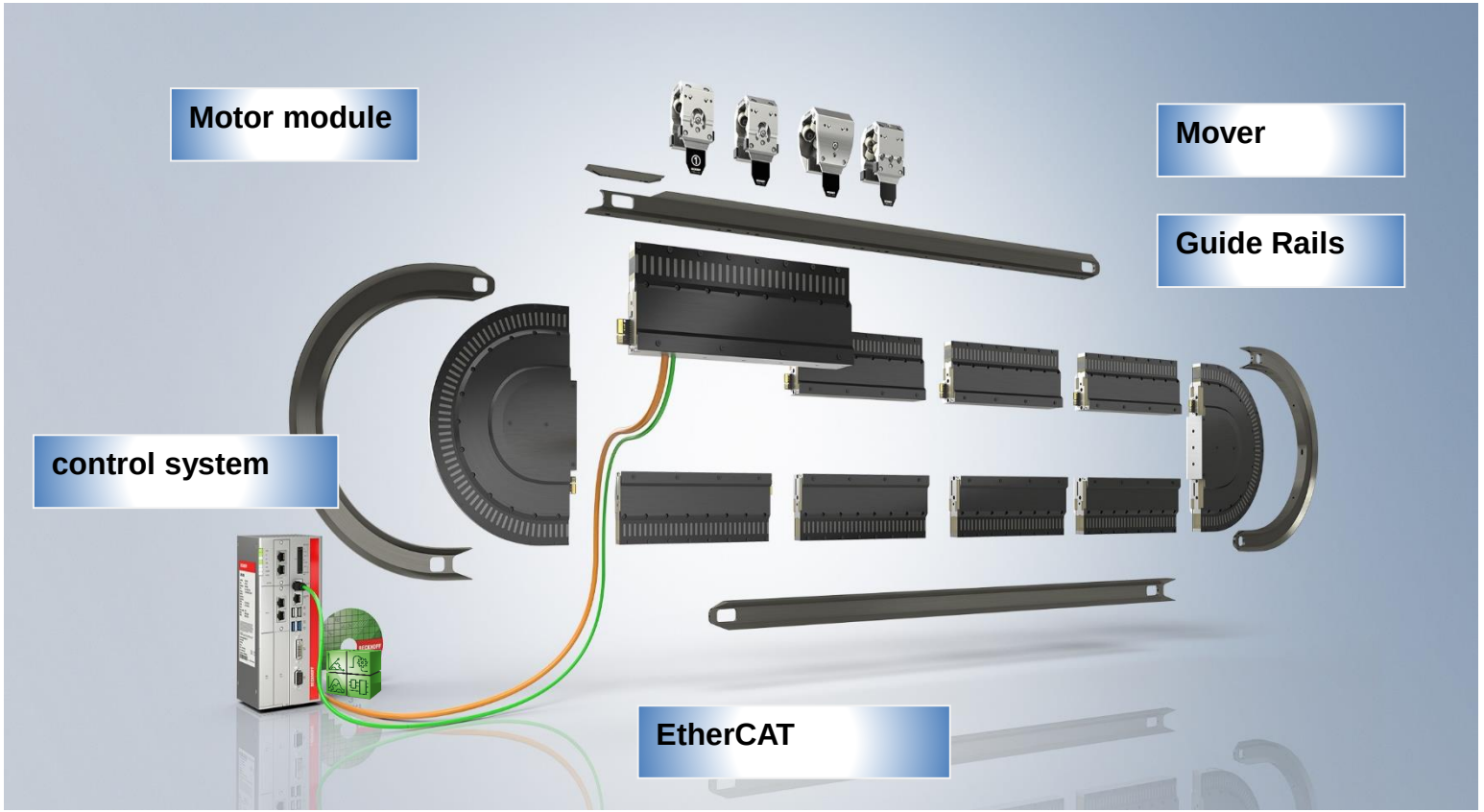
The system must satisfy the following fundamental characteristics:

- Modularity
- Independence and controllability of movers at any point in the path/space
- Fast engineering: short time-to market
- Flexible operation through software & simple configuration

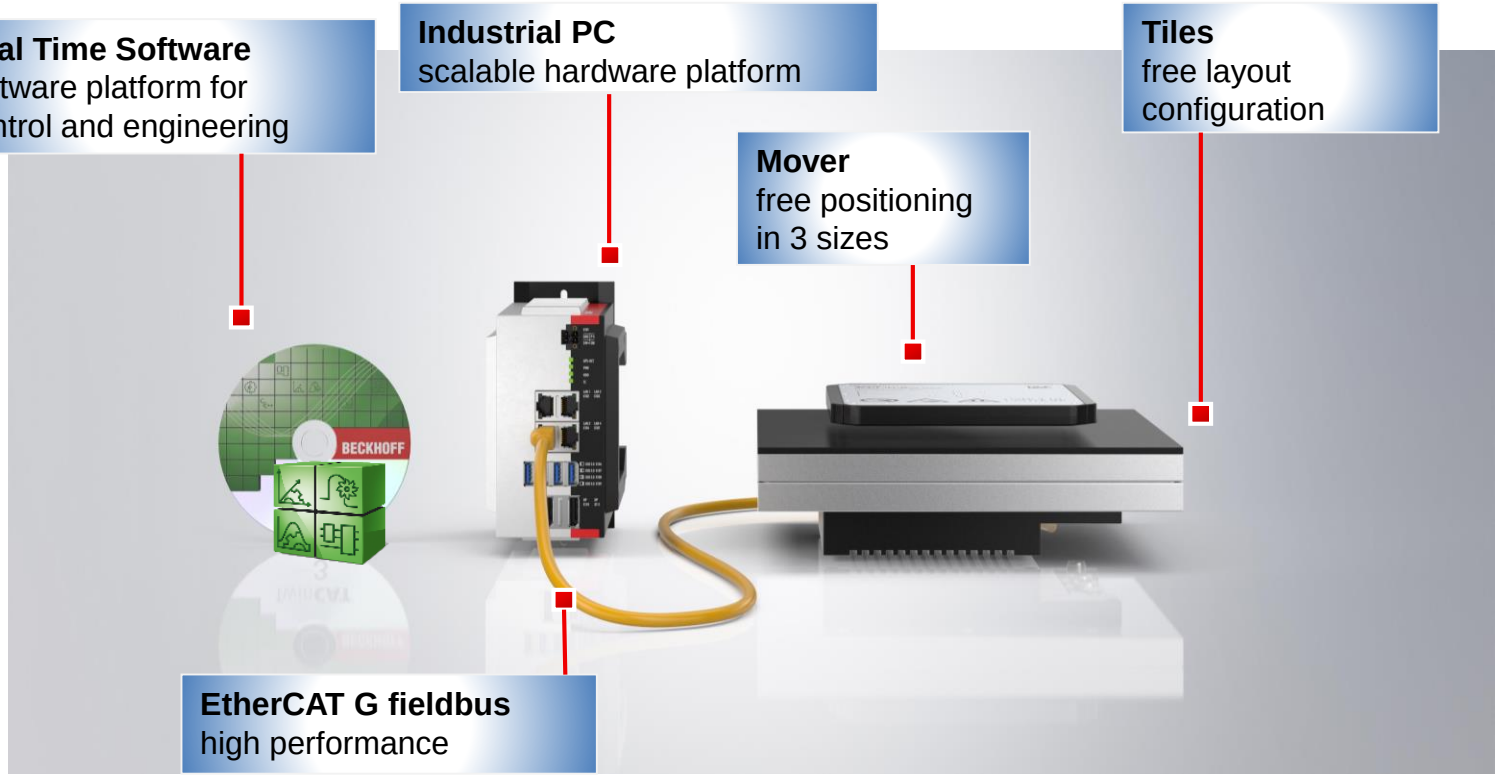
The optimal solution is centralized control where all the control algorithms and feedback ones reside in the controller itself

No drive is present in the control cabinet ➔ Compact system for smaller machines

Control System Architecture

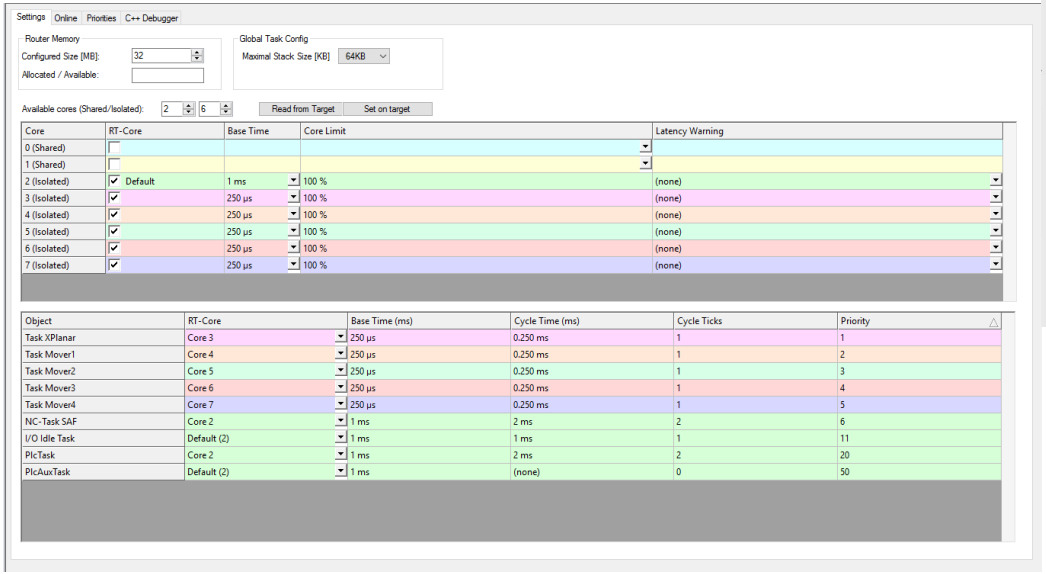


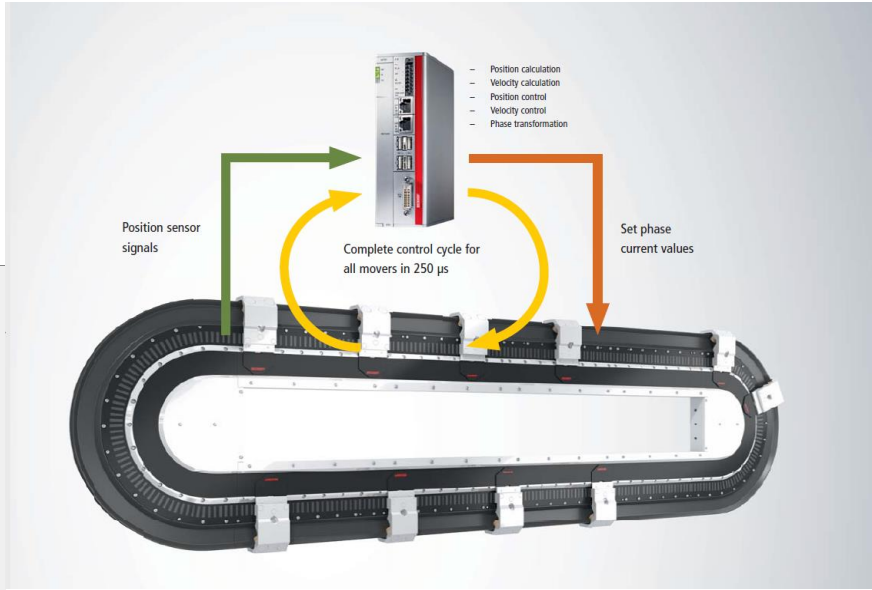
Control System Architecture



Control System

- All typical servo-drive control loops moved within IPC ➔ Tcyc < 250us



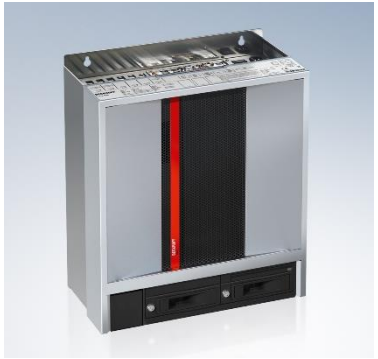


Realtime extension of the OS can manage in parallel multiple cores ➔ Using multicore CPUs to increase number of movers and system length/area

Industrial PC

CONTROL CABINET INDUSTRIAL PC

- Intel® Core™ i7-9700E, 9th generation, 2.6 GHz, **8 cores**



EMBEDDED PC

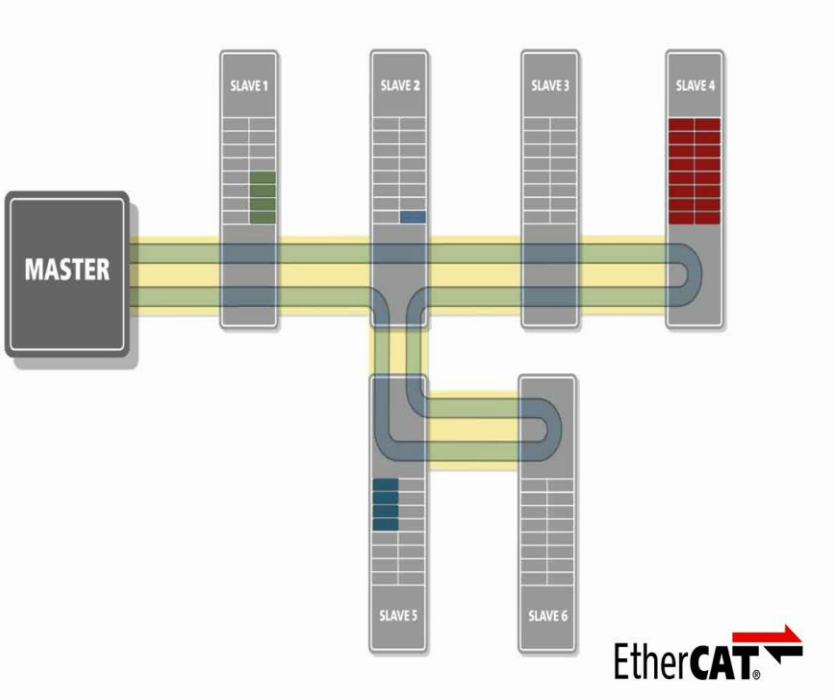
- Intel® Xeon® D-1548, **8 cores**, 2.0 GHz
- Intel® Xeon® D-1567, **12 cores**, 2.1 GHz

CONTROL CABINET INDUSTRIAL SERVER

- **Two** Intel® Xeon® Scalable processors with **8, 12, 16 or 20 cores each** on one motherboard
- 64 GB DDR4 RAM EEC, expandable to 1024 GB
- graphic card, 1 DVI-I and 1 DVI-D connector

FieldBus: EtherCAT

EtherCAT (*Ethernet for Control Automation Technology*) is an Ethernet-based 100Mb/s fieldbus system
High performance through on the fly data elaboration



Performance:

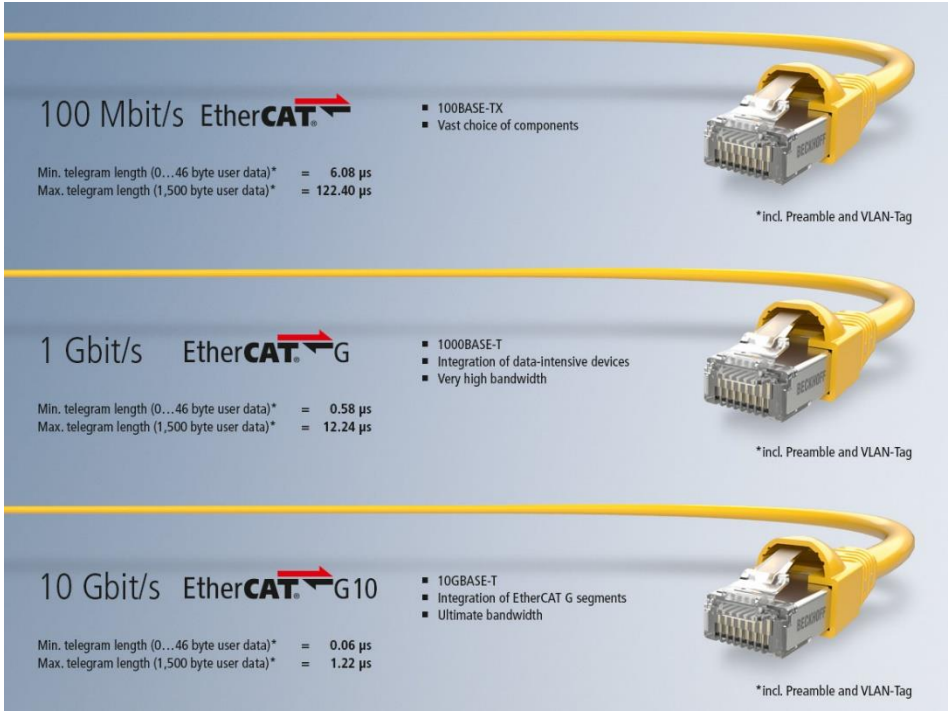
- 1000 digital distributed I/O in 30µs
- 100 servo-axes in 100µs
- EtherCAT integrated in I/O Slice, no Sub-Bus
- No extra Hardware is necessary: Optimal use of standard Ethernet port
- Accurate Synchronization (<< 1 µs) thanks to Distributed Clocks Technology

EtherCAT G

- Based on EtherCAT protocol
- Ethernet based on 1Gbit/s & 10Gbit/s

Speed

- 2,000 digital inputs/outputs every 15 µs
- 100 servo axes every 30 µs



Conclusions

- Advanced Mechatronics System through PC-Based Control & EtherCAT
- EtherCAT: high-performance fieldbus
- Real Time Tasks on Multicore Systems
- PC-Based Automation: possibility to implement a lot of functionalities in the controller

- ❑ Planar Transport System
- ❑ Linear Transport System
- ❑ Robotics
- ❑ Vision System
- ❑ MATLAB/Simulink
- ❑ Analytics
- ❑ Machine Learning
- ❑ …

Thank you for your attention

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