EtherCAT® Master Stack

In cooperation with acontis technologies GmbH IXXAT offers an EtherCAT Master stack to fast and easily implement EtherCAT based controllers.

The EtherCAT Master stack is designed and optimized to run on various embedded (real time) operating systems and it has a very modular structure. The open interfaces of the modules enable the user to exchange or make adaptions depending on the application requirements.

Implementations are already available for Windows CE, VxWorks, On Time RTOS-32, QNX Neutrino RTOS and IntervalZero RTX. For Windows XP and Linux a version is also available (non-real-time capable). Using the source code, the EtherCAT Master stack can be ported easily to other embedded operating systems. On request, IXXAT offers implementation or adaptation services.

Advantages of using the EtherCAT Master stack

- Support of complete EtherCAT Standard according to ETG.1000 with CAN application layer over EtherCAT (CoE), Ethernet over EtherCAT (EoE) and Distributed Clock (DC)
- Extendable with Feature Packs with Hot Connect, File Access over EtherCAT and Master Synchronisation (DCM)
- Modular design, individual customizations are easy to implement
- Reliable, field-tested and robust implementation for various CPU architectures like x86, ARM, XScale, PowerPC and others
- Usage of standard Ethernet controllers, no specific hardware necessary
- Available for a variety of operating systems, easy to port to other embedded operating systems
- High performance with low CPU load and memory footprint, no file system required

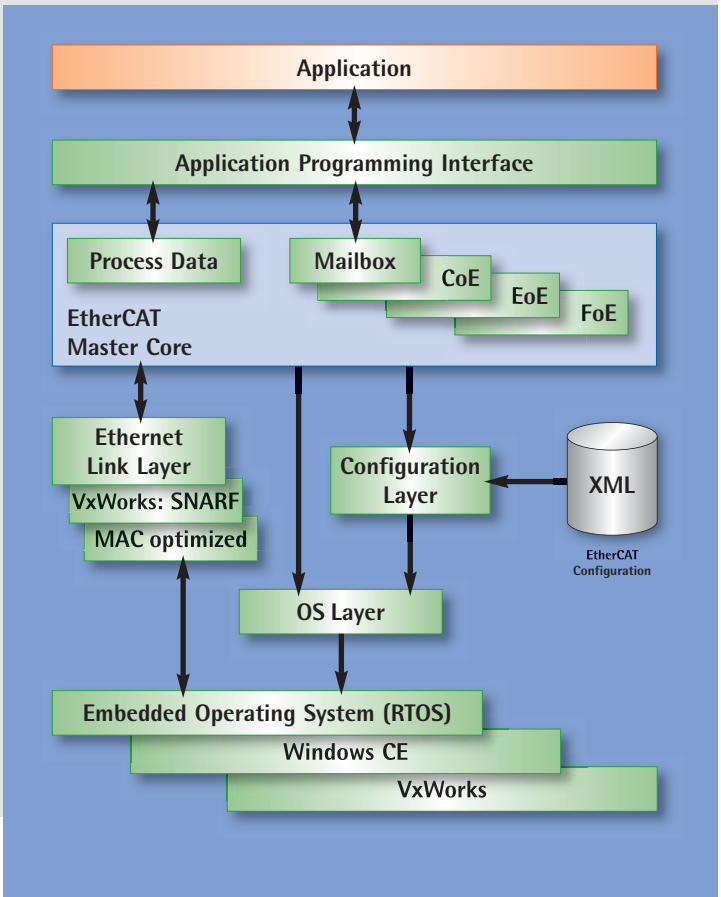
Modular Architecture

The EtherCAT Master stack consists of:

- **Application Programming Interface:** API for the EtherCAT master.
- **EtherCAT Master Core:** The main EtherCAT master functionality is implemented in the core module, including protocol handling, e.g. processing of data transfer and mailbox protocols.
- **Ethernet Link Layer:** Handles the data exchange between master and slaves. Zero-copy and polling techniques are supported to achieve best real-time performance and minimize CPU load.
- **Configuration Layer:** An OS independent XML parser supports the EtherCAT Network Inform. (ENI) Format.
- **OS Layer:** The only OS specific module. All operating system calls are handled here. To achieve the best performance many functions can be implemented using simple "C"-language macros.

Supported EtherCAT Features

- Process data transfer: cyclic data exchange (I/O data)
- Mailbox protocol: acyclic, event driven data and information exchange
- XML based configuration
  - EtherCAT Network Information (ENI) Format
- CAN application layer over EtherCAT (CoE) protocol
  - SDO Upload/Download and SDO Information Services
  - Emergency Request
- Ethernet over EtherCAT (EoE) Protocol
- File Transfer over EtherCAT (FoE) Protocol
- Distributed Clocks
  - SYNC and Latch unit support
- Error detection and diagnosis
  - Bus scan with bus topology and configuration validation of the slaves (slave detection without existing bus configuration, EEPROM information service,



EtherCAT Slave Information (ESI) format)
  - cable break detection
  - wrong or missing slave response
  - Supervising slave states and monitoring of slave operation
  - Support of Ethernet link layer debug messages for run-time error diagnostics
- Optional usage of the alias addressing

Optional functions (Feature Packs)

- Control of multiple, independent EtherCAT networks by one master
- Controller to synchronize master and slaves (DC Master Synchronisation)
- Master Object Dictionary with objects for master state, state of slaves, error history, bus-scan result. Access via SDO services.
- TCP/IP remote interface with identical API for remote and local operation. Useful feature for diagnostic and configuration tools.

EtherCAT Out-of-the-box

Windows CE
The EtherCAT Master stack is available for:

- Windows CE 4.2, 5.0 and 6.0
- Optimized link layer available for Intel PRO/100, Intel PRO/1000 and others

VxWorks
The EtherCAT Master stack for VxWorks is delivered in source code and will be adapted to customers environment (VxWorks version and processor architecture) during system integration. The EtherCAT Master stack is available for:

- VxWorks 5.4 and 5.5: All VxWorks network drivers are supported using the etherLib link layer
- VxWorks 6.1-6.8: All VxWorks network drivers are supported using the SNARF link layer
- VxWorks 6.6-6.8: Additional support of SMP operation
- Optimized link layer available for Intel PRO/100, Intel PRO/1000 and RTL8139

KUKA CeWin
KUKA CeWin is a real-time extension where Windows CE is running in parallel to Windows XP/Vista on the same host while retaining the real-time capabilities of Windows CE. The EtherCAT Master stack is available for:

- CeWin Version 3.5, other versions on request

KUKA VxWin
KUKA VxWin is a real-time extension where VxWorks is running in parallel to Windows XP/Vista on the same host while retaining the real-time capabilities of VxWorks.
The EtherCAT Master stack for KUKA VxWin is delivered in source code and will be adapted to customers KUKA VxWin environment during system integration. The EtherCAT Master stack is available for:

- KUKA VxWin version 3.5, other versions on request

QNX Neutrino RTOS
The EtherCAT Master stack is available for:

- QNX Neutrino RTOS Version 6.x
- Optimized link layer available for Intel PRO/100 and Intel PRO/1000
- Support of further link layer on request

IntervalZero RTX
The EtherCAT Master stack is available for:

- Version 8.x, other versions on request
- Optimized link layer available for Intel PRO/100 and Intel PRO/1000
- Support of further link layer on request

On Time RTOS-32
The EtherCAT Master stack is available for:

- Version 5.0, other versions on request
- Optimized link layer for Intel PRO/100 and PRO/1000
- Support of further link layer on request

Windows XP without Real-Time requirements
All Windows XP network drivers are supported using the WinPCap link layer implementation.

Linux without Real-Time requirements
All Linux network drivers are supported using the Raw Socket link layer implementation.

Other Operating Systems

EtherCAT Master OS Adaptation Layer

The OS adaptation layer enables the customer to port the software onto his own platform. Several customers have already ported the stack successfully within a short time to their specific platforms. Only a few quite simple functions have to be adapted. Performance critical functions will be implemented by macros usually. Main functions are:

- Memory management
- Macros for alignment/endiannes
- String functions
- Timer
- Debug-Message
- Synchronization
- Multi-Core, Symmetric Multiprocessing
- ...

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