Technology Description

created by

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Contents

List of Figures

1 Introduction

IgH uses the **EtherLab®** technology mainly for control and automation of test rigs. EtherLab® is a well proven, client/server concept, that separates the tasks of visualization, data logging and control (fig. 1).

EtherLab® is a technology developed by IgH, that combines hard- and software. EtherLab® is no product, but a technique that uses well-proven and new components to build a solution for problems of proving grounds and automation. EtherLab® is an open source toolkit for generation of real time code under Linux® with MATLAB/Simulink/RTW® and EtherCAT® technologies.

EtherLab® is very flexible, both on software and on the hardware aspect. You do not have to buy more channels, than you really need, and you do not have to create more software than you really need. EtherLab® does the rest: The source file is compiled by the control PC and is loaded as a kernel module. That's it.

2 Control Concept

The basic component of EtherLab® is the connections of a real time kernel module under Linux® with peripheral devices via Ethernet technology. On hardware side, components of the EtherCAT® technology are supported. The creation of the software is either done via MATLAB/Simulink/RTW® or directly in C.

EtherLab® uses Linux® as operating system for the control PC, because it serves well for real time purposes (when slightly modified) without losing the necessary characteristics of stability, speed, graphical user interfaces and network functionality.

For the operator's PC, Windows® is used as operating system, because most users know the look-and-feel and there are good tools for developing user interfaces.

As operating system for the optional data logging, Linux® is used. The logging PC acts as a client to the control PC, but offers the data as a server. The data can be visualized with a Windows® application via network.

The whole system consists of

- the control PC with real time operating system (Linux®/RTAI) and EtherCAT® components,
- one or more operator PCs,
- (optional) a PC for data logging purposes.

All essential functions are executed by the control PC and therefore are independent of the availability of the network connection between client and server. The outsourcing of operating and visualization to client PCs has the following advantages:

- Using the visualization is location-independent.
- There can be multiple clients connected to a server at the same time.
- Usually there has to be no software installed on the operator PCs, because it is provided by the server.
- Modifications of the visualization can be applied without interfering the control process.
- Modifications of the data logging and the respective visualization can be applied without interfering the control process. The visualization of the logged data is not dependent of the operation of the control software.

Through the network connection, administrative tasks can be handled remotely. Also, an easy backup of results to special backup servers is possible, and results can easily be viewed via LAN. Usually, the control PC does not provide a (physical) user interface, but is controlled via network for diagnostic purposes.

EtherLab® stands out for its high flexibility and for being an open solution regarding software and formats. The source code for all components is publicly available. Open source software stands for high protection of investment, because all components can be freely used and even modified and enhanced.

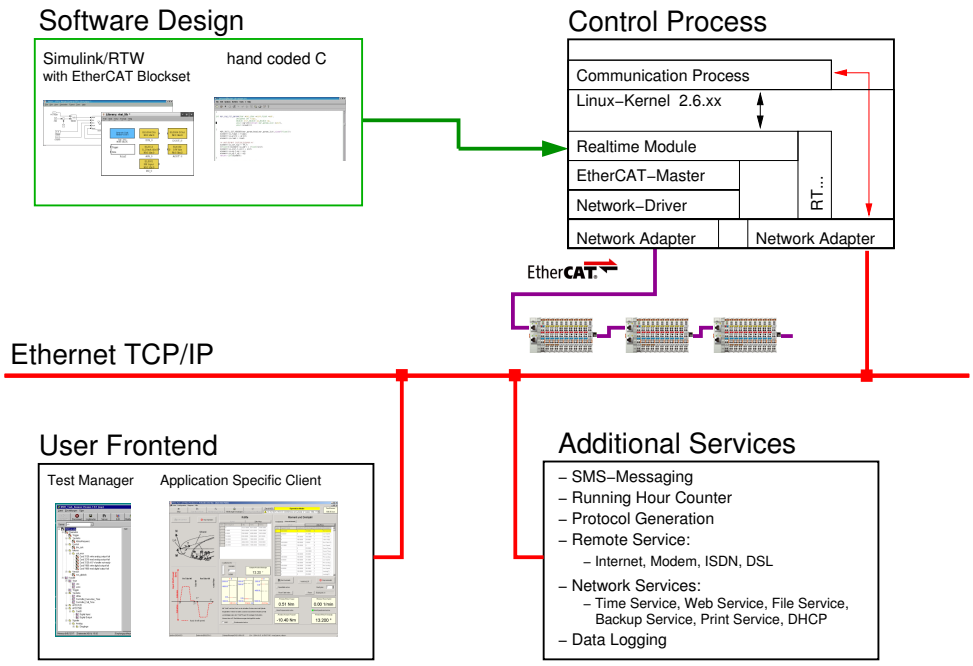

Figure 1: EtherLab® overview

Some basic features of EtherLab®:

- Open Source
- Hard real time
- MATLAB/Simulink/RTW® code generation
- EtherCAT® blockset for MATLAB/Simulink®
- Multi client, -user, -server, -tasking
- Additional services
- Industrial grade I/O stations
- Small hardware costs
- Flexibility
- Windows® and Linux® frontend

2.1 Hardware

As hardware components, a control PC and one or more operator PCs are needed. Furthermore, components of the EtherCAT® technology are used. Fig. 2 and Fig. 3 show EtherCAT® slaves made by Beckhoff. All components are interconnected via Ethernet technology.

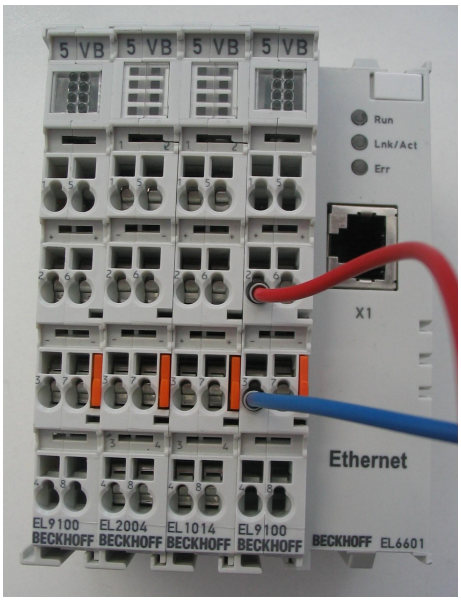

Figure 2: Beckhoff EtherCAT® Terminals

Figure 3: Beckhoff EtherCAT® Fieldbus Box

The control and the aquisition of the measured data is done by an industrial PC and the respective EtherCAT® components. It is recommended to connect the PC and the EtherCAT® components to an uninterruptible power supply (UPS), so that no data are lost in case of power failure.

The operator PC is only connected to the control PC via network. Further visualization clients can also be connected via network.

For more information about EtherCAT® technology see: ETG EtherCAT Brochure.

2.2 Software

A real time Linux® is installed on the control PC. The control software with control algorithms, state machines and watchdogs is programmed as a loadable kernel module via MATLAB/Simulink®. The control of the EtherCAT® components is also done out of this environment. The communication between control process and operation/visualisation process is done via a TCP/IP connection combined with an XML-based syntax.

For the storage and the analysis of the logged data, and report generation, there are separate software modules, that work outside the real time context.

There can be a file server running on the control PC, that makes the logging data visible and distributes the visualization software to the operator PCs.

Optional, the aquisition, post-processing and archiving of the logged data can be done with the “Data Logging Server” (DLS).

The software “Testmanager” allows full operation and visualization of the control process. It displays the requested values on scrolling graphs, diagrams bars and scales, that can be freely configured by the user. The display can even be adjusted to the available communication bandwidth (fig. 4).

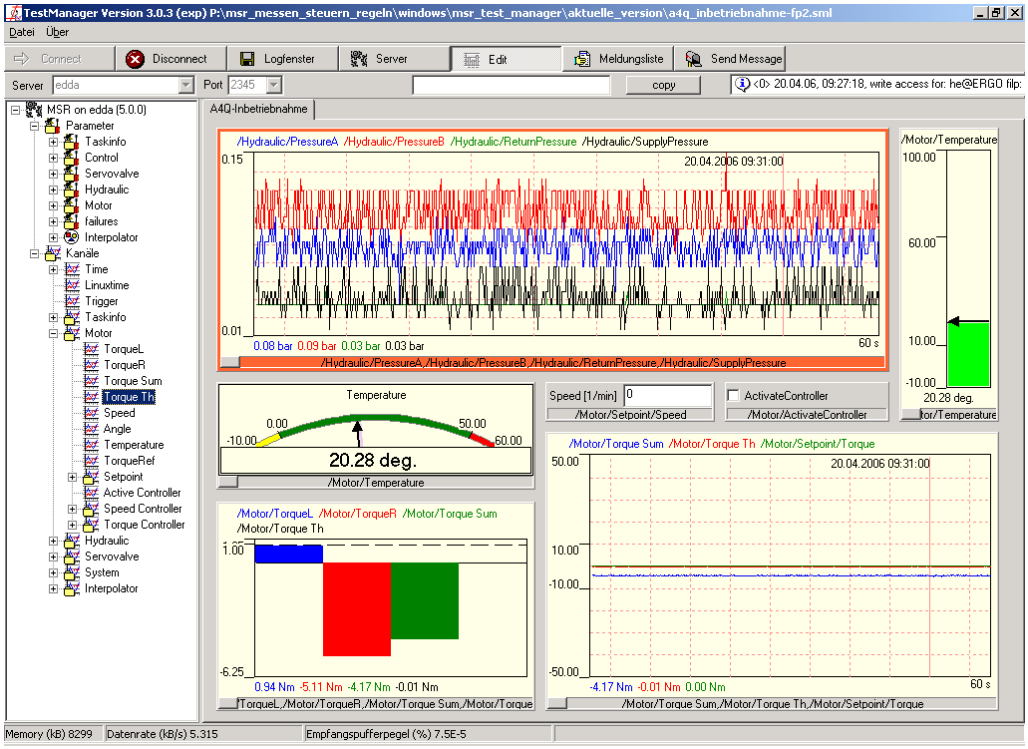

Figure 4: Testmanager

The testmanager is provided as stand-alone executable, which offers the following advantages:

- No setup necessary.
- No manipulation of the registry.
- No additional DLLs necessary (special Testmanager controls are provided as plugins in form of DLLs).
- Installation and version control from a central fileserver.

3 Control Program

The real time control program can be created with MATLAB/Simulink/RTW®. For the connection to EtherLab® there is the EtherLab® blockset, that supports the use of EtherCAT®components in MATLAB/Simulink®.

Optional, the control program can be hand-coded in C.

4 EtherLab Worldwide

Figure 5: EtherLab Worldwide

5 Application Example

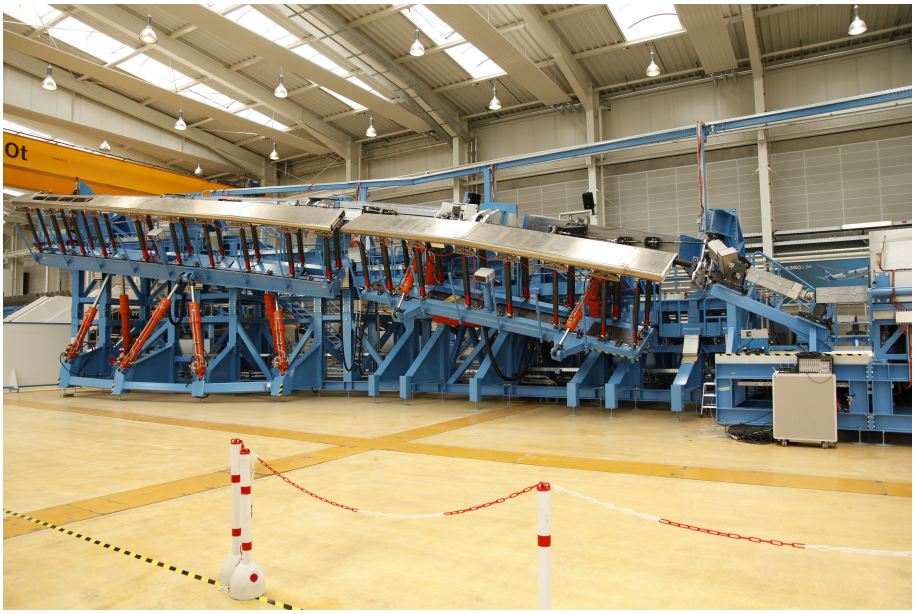

Figure 6: Test Rig with EtherLab Technology

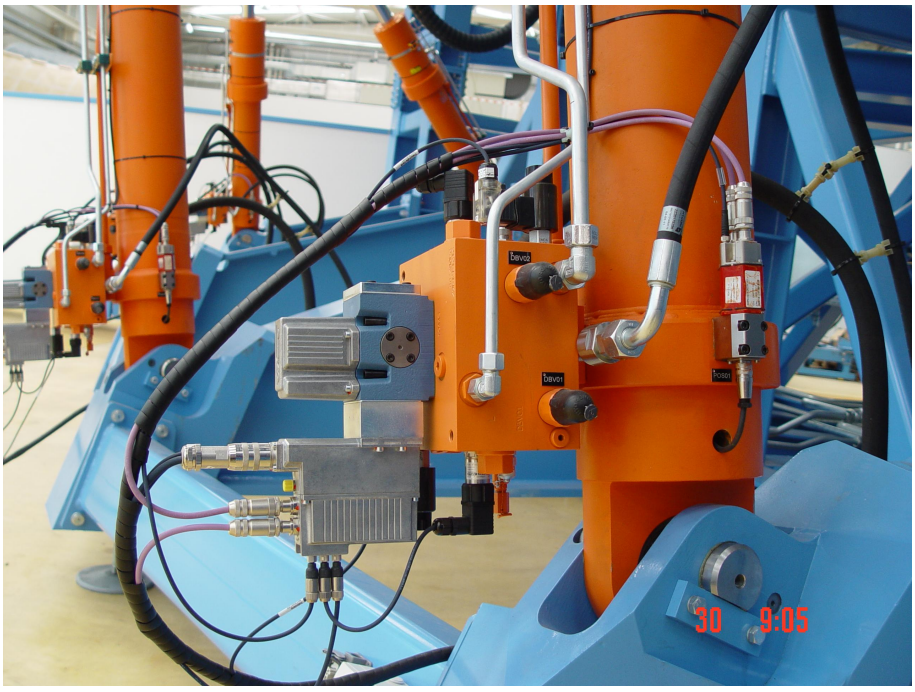

Figure 7: Test Rig with EtherLab Technology

6 License

All EtherLab® components are provided as open source. The whole source code is published by the Ingenieurgemeinschaft IgH under open-source licenses (mostly GPL/LGPL). See the respective COPYING files in the software sources.

7 Support

The EtherLab® software components are available on the EtherLab® homepage (http://etherlab.org). The use of all components of free of charge. See chapter 6 for more details on licensing.

Furthermore IgH is willing to provide training classes or make software modifications for you. Do not hesitate to contact us, we would like to submit you an offer.

8 Links

- www.igh-essen.com
- www.ethercat.org
- www.beckhoff.com
- www.mathworks.com