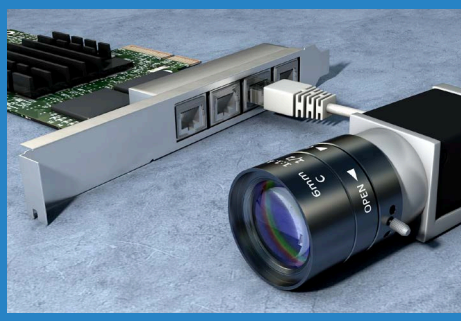
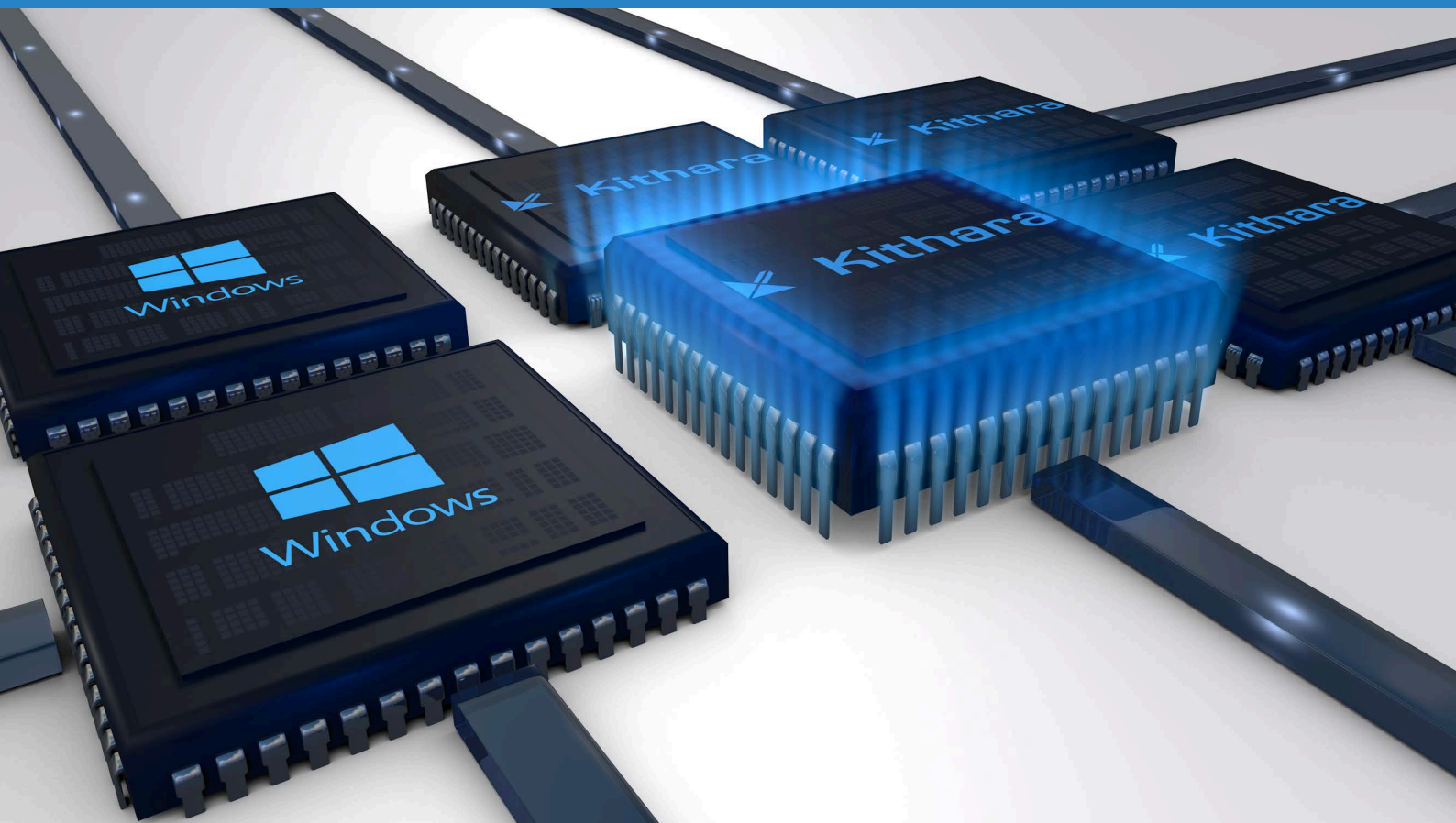
Kithara

THE PULSE OF REALTIME



»RealTime Suite«™

- Real-time extension for Windows®
- Automation with EtherCAT®
- Image processing in real-time



Kithara Software is an innovator for the development of industrial real-time solutions, specifically for Windows® operating systems. We here at Kithara focus especially on those fields that require time-critical application such as hardware-dependent programming, communication, automation and machine vision. In the process of development and advancement of our products we put particular emphasis on powerful and guaranteed real-time, high accessibility and individual customer satisfaction. To meet any possible requirements in the fields of robotics, measurement and control engineering as well as automation technology, we provide a wide array of real-time modules for the implementation of sophisticated and advanced technologies.


Uwe Jesgarz
Manager

Some of our customers

ALSTOM · Audi · BMW · BOMBARDIER · BOSCH · DAIMLER · DB · DIEHL · DLR · EADS · Fraunhofer Gesellschaft · HEIDELBERG · Hundegger · KMW Krauss-Maffei Wegmann · KROHNE · LIEBHERR · Max-Planck-Gesellschaft · MTU Aero Engines · NXP founded by Philips · PHILIPS · Physikalisch-Technische Bundesanstalt · SCHOELLER · SENNHEISER · RENK · SICK · SIEMENS · ThyssenKrupp · Volkswagen · ZEISS · ZF

Our partners

BECKHOFF · esd · EtherCAT · PEAK System · MVTec Software GmbH

Introduction – Our Products

Windows® is optimally suited for the implementation of industrial applications since it is:

» **popular**: intuitive and familiar user interface
» **efficient**: utilization of up-to-date technologies
» **advanced**: use of the latest communications interfaces
» **productive**: powerful development environments and tools
» **cost efficient**: low implementation and training costs
» **future-proof**: long-living due to its high market share and continual further development

Windows® itself, however, is not real-time capable. The »RealTime Suite«™ complements Windows with the missing real-time capability:

» Suitability of Windows® for time-critical applications
» Deterministic behaviour
» Extremely low maximum reaction times
» Familiar programming language and tools
» Efficient and easy-to-apply functions
» Short training time—cost efficient development

The »RealTime Suite«™ makes it possible to have both real-time control and visualization within the same system. The real-time application is provided the highest system priority while not negatively affecting Windows, which, at the same time is responsible for visualization and user interaction. In this way the combination of Windows® and the »RealTime Suite«™ allows for the implementation of diverse solutions.

Among the fields of application of the »RealTime Suite«™ are:

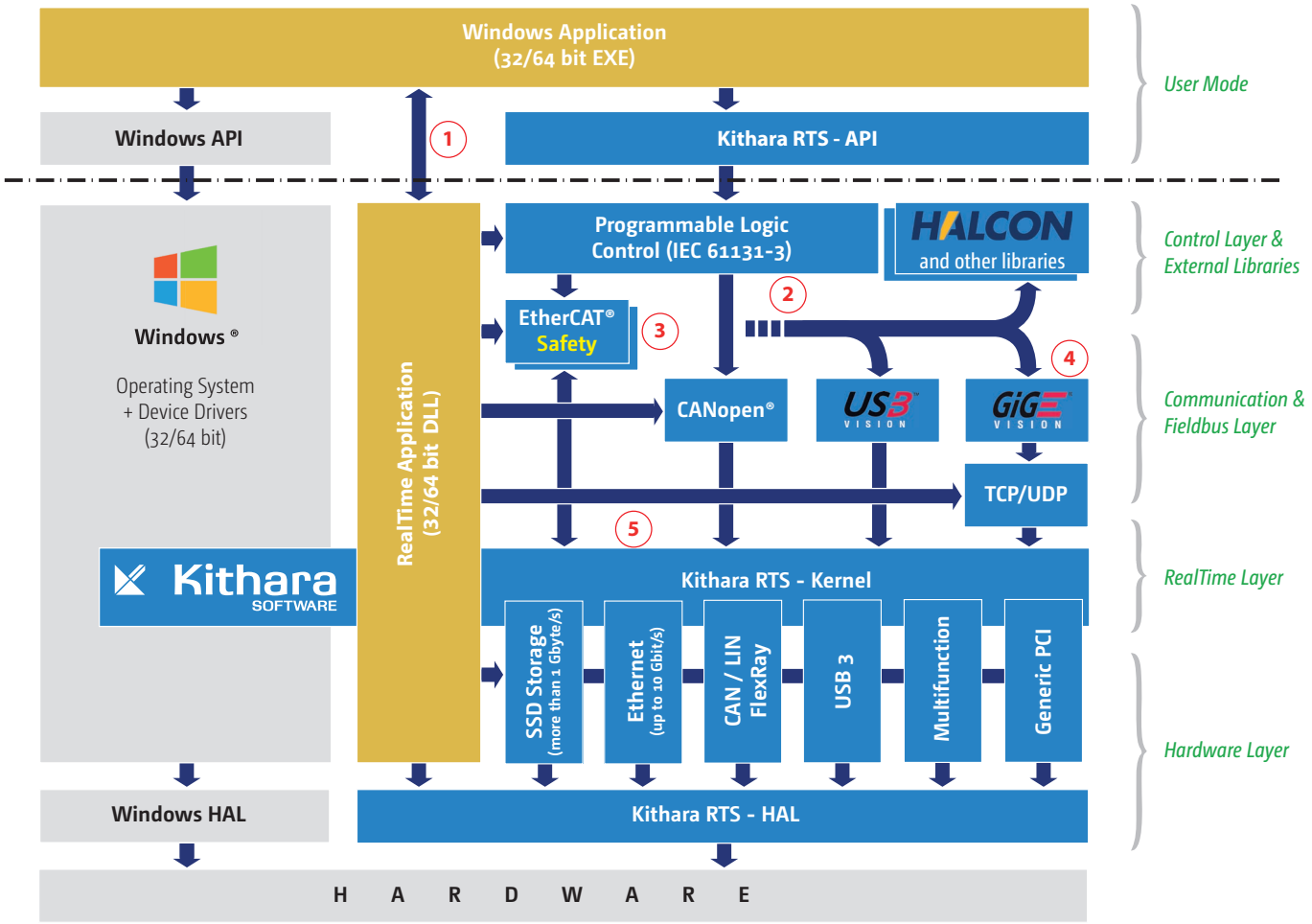
» Mechanical engineering, special purpose machines and test systems
» Product automation and quality assurance
» Laboratory automation and mobile applications
» Commissioning as well as measurement stations and test benches
» Medical engineering
» Science and research

Summary:

» No separate real-time system required, communication between the two systems not necessary
» A single homogenous solution instead of several different systems allows for an easy development progress
» Common developer tools and tool chain
» Reduction of time to market, costs and ressource consumption

Kithara »RealTime Suite«™ and Windows®—the basis for successful real-time solutions!

By courtesy of:
Renk Test System GmbH, Augsburg



① Shared memory, pipes, mailslots, sockets, events and semaphores are available for the communication and synchronization between application and the real-time component.

② The PLC Module allows for the programming of control sequences according to IEC 61131-3 in different languages.

③ The EtherCAT Master is one example for Industrial Ethernet protocol controllers in order to run efficient automation solutions. Field bus protocols, such as a CANopen Master, are supported as well.

④ Image data from GigE Vision® and USB3 Vision™ cameras can be captured in real-time and processed with HALCON™ as well as other libraries.

⑤ The priority-based, preemptive real-time multi-tasking environment allows for the assignment of dedicated CPU cores combined with low jitter times.

The Concept

Our scheme for the theme.

»RealTime Suite«™ – Concept

The »RealTime Suite«™ is a modular real-time extension for Windows® operating systems that combines hardware-dependent programming, communication, automation protocols, real-time control as well as image capture and image processing in a single real-time system. Due to seamless integration of the modules, users receive all necessary components in one piece.

The efficient real-time Ethernet communication over TCP and UDP is the basis for both socket communication including image capturing with GigE Vision® cameras as well as for modern Industrial Ethernet protocols. Communication is supplemented by real-time drivers for CAN and UART interfaces.

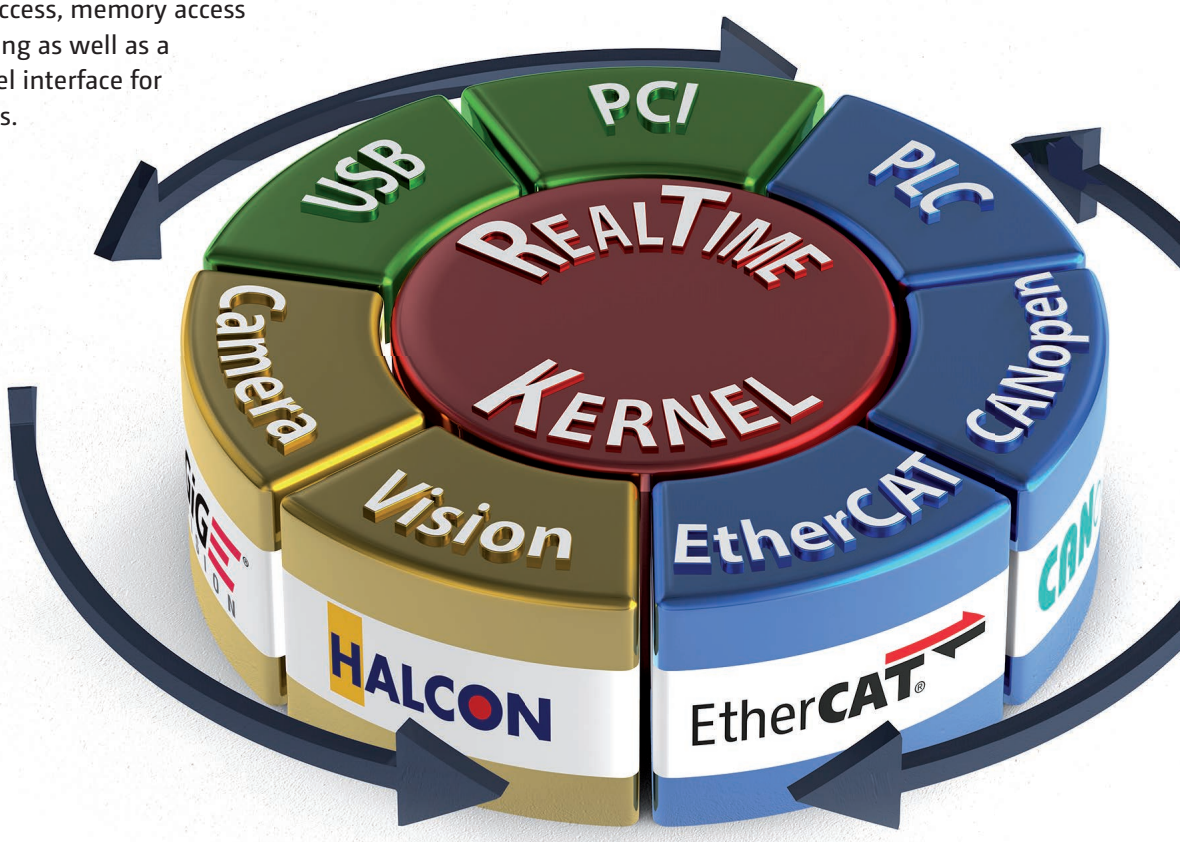
Among the supported automation protocols is a comprehensive EtherCAT® master implementation including Distributed Clock, Safety-over-EtherCAT®, hotplug capability and cable redundancy. Furthermore, a CANopen® master is provided via a range of different CAN interfaces, which can also be integrated into EtherCAT®.

Hardware-dependent programming includes direct I/O access, memory access and interrupt handling as well as a convenient high level interface for multifunction boards.

For the support of traditional automation, a Soft-PLC, compatible with IEC 61131-3, is part of the real-time system. The compiler of the Soft-PLC generates highly efficient binary code from Instruction List or Structured Text.

For the processing of image data captured by GigE Vision® or USB3 Vision®, it is possible to run comprehensive image processing libraries, such as HALCON™ or OpenCV, within the real-time environment.

The software is accessible and intuitive. With the use of its familiar programming languages and programming environment, the »RealTime Suite«™ is designed to be highly user-friendly. The operating system Windows® is both the developer platform and host system for execution, rendering a separate real-time system obsolete. This successfully minimizes expenditure of time and development costs.

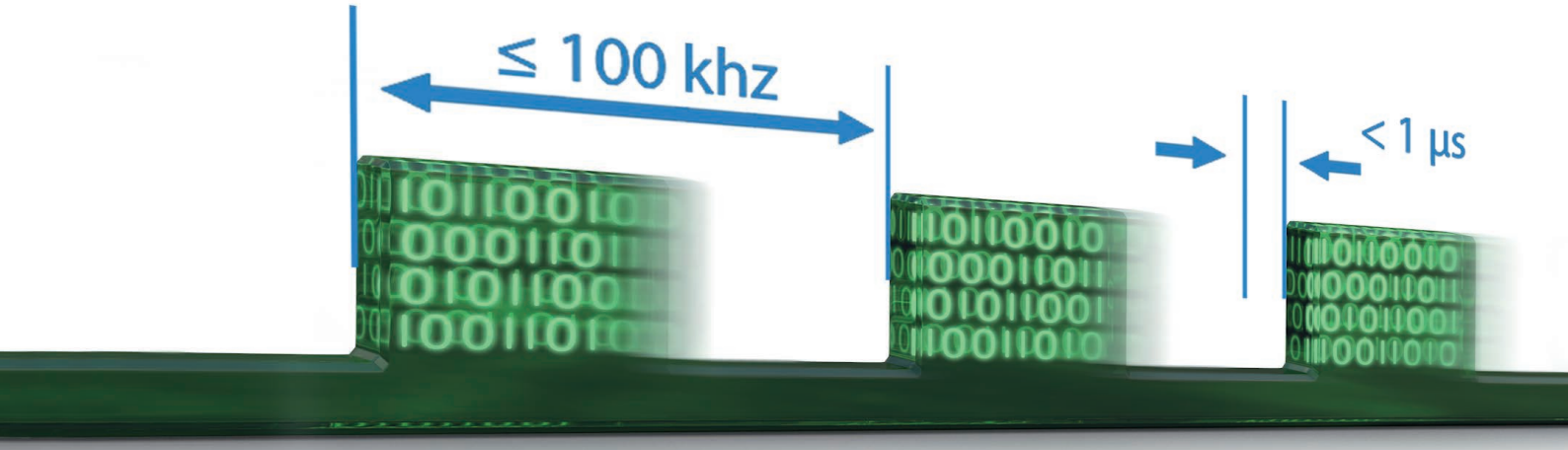


“Hard” Real-Time
for Windows® Platforms

As the ideal platform for the development of industrial applications, the operating system Windows® is supplemented by the »RealTime Suite« with the missing real-time capability. The timers offer frequencies of several kilohertz with deviations of only a few microseconds.

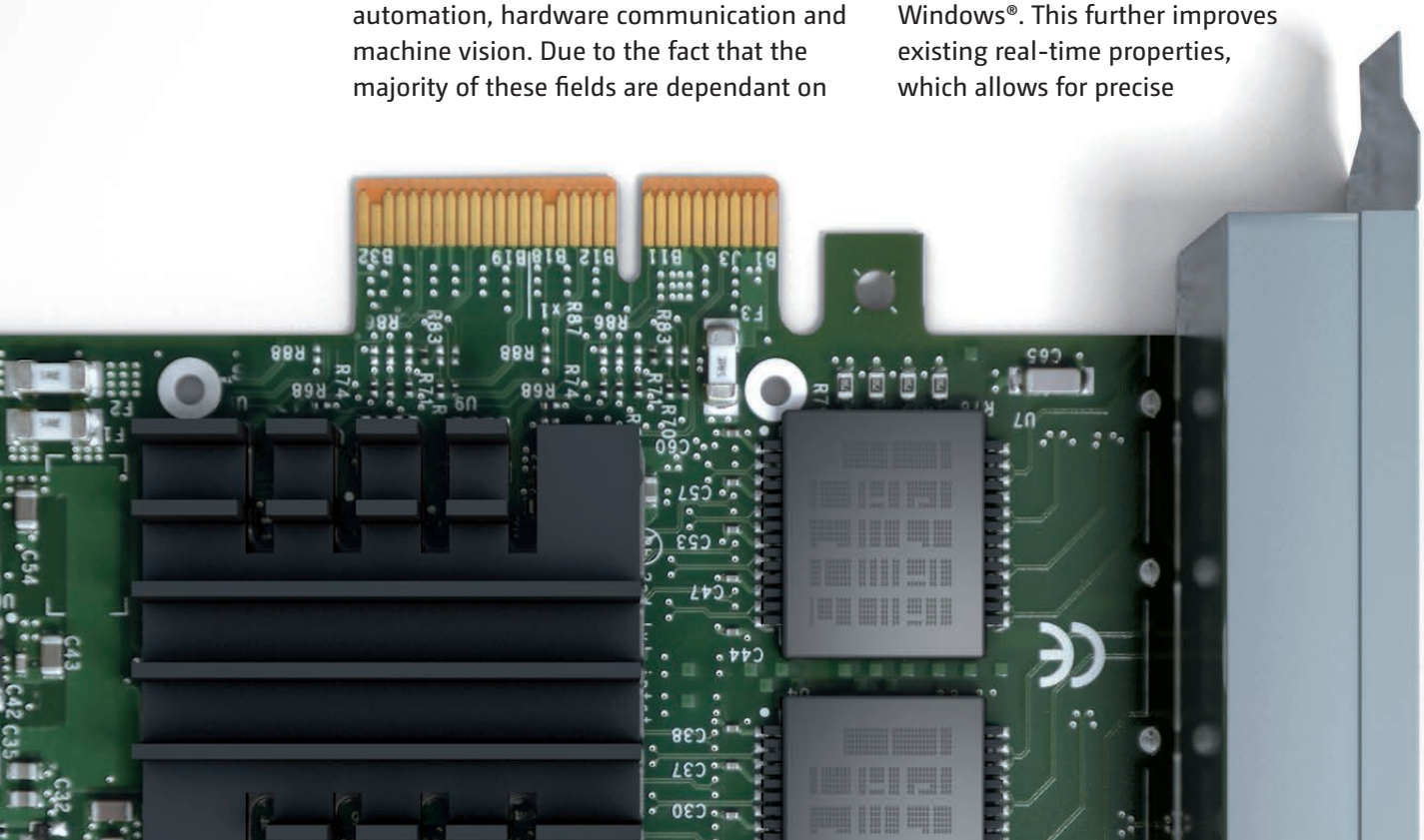
time-critical execution, the real-time system also represents the basis for other modules.

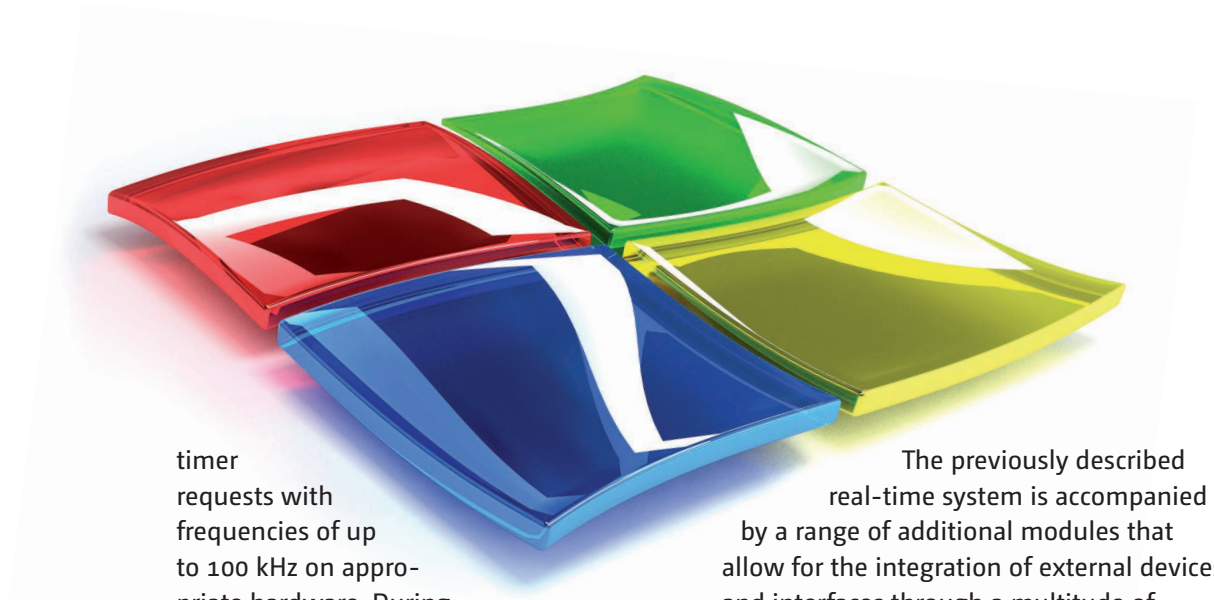
The »RealTime Suite« always assumes the highest system priority in order to guarantee “hard” real-time capabilities. Depending on the utilized operating system platform, unused computing power is assigned to the Windows® system.



The »RealTime Suite« provides a variety of different modules for the development of powerful applications for the fields of automation, hardware communication and machine vision. Due to the fact that the majority of these fields are dependant on

With the Dedicated Mode, individual logical CPU cores can run completely autonomous and without any interference from Windows®. This further improves existing real-time properties, which allows for precise

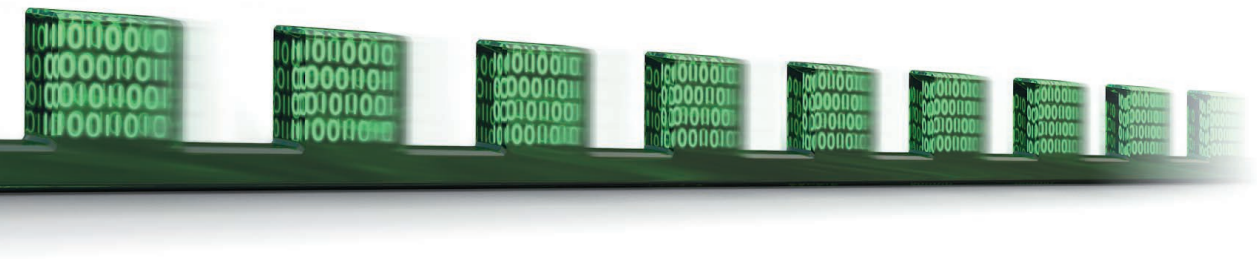




timer requests with frequencies of up to 100 kHz on appropriate hardware. During the real-time booting process, the system analyzes and calibrates the hardware, for example the available internal clocks.

The real-time system does not just enable users to run individual timer routines. The preemptive multi-tasking system provides threads with up to 255 priority levels, thus ensuring that crucial tasks with the highest priority are executed first. Tasks with a lower priority level are immediately interrupted and continue right after the interruption at the same point where they stopped. For the synchronization among tasks and the rest of the system, task priority can be adjusted dynamically. Also available are events, semaphores, mutexes, data and message pipes, sockets and shared memory. Individual real-time tasks can be specifically allocated to the different logical CPUs in order to further optimize performance and integrity of special tasks as well as the scalability of the entire system.

The previously described real-time system is accompanied by a range of additional modules that allow for the integration of external devices and interfaces through a multitude of communication links and access paths as well as specialized functions. In addition, two powerful tools for diagnosis and analysis, the Kernel Tracer and the Performance Analyzer, can be utilized to make the development process even more efficient and flexible.



The Real-Time System

Powerful and accurate.

Hardware Access and Communication in Real-Time

Several modules included in the »RealTime Suite« serve the purpose of connecting to different hardware interfaces. Through access to the PC's I/O registers, physical memory and interrupt handling, drivers for individual hardware devices or plug-in cards can be developed. Additionally, for many popular communication interfaces the »RealTime Suite« provides a number of preset real-time drivers.

Especially for time-critical functions in industrial fields, Ethernet applications have become increasingly significant. For this purpose, all conventional Gigabit network controllers by Intel® and RealTek are supported by specially developed drivers for real-time Ethernet communication. This way, real-time functionality is also available for Ethernet cards with data rates of up to 10 Gbit/s. All the features and advantages of Ethernet, such as the utilization of flexible and cost efficient standard hardware, can be used as efficiently but are further enhanced by real-time capabilities. Every special hardware feature of the controllers can be used, such as jumbo frames or improved data flow control through interrupt optimization.

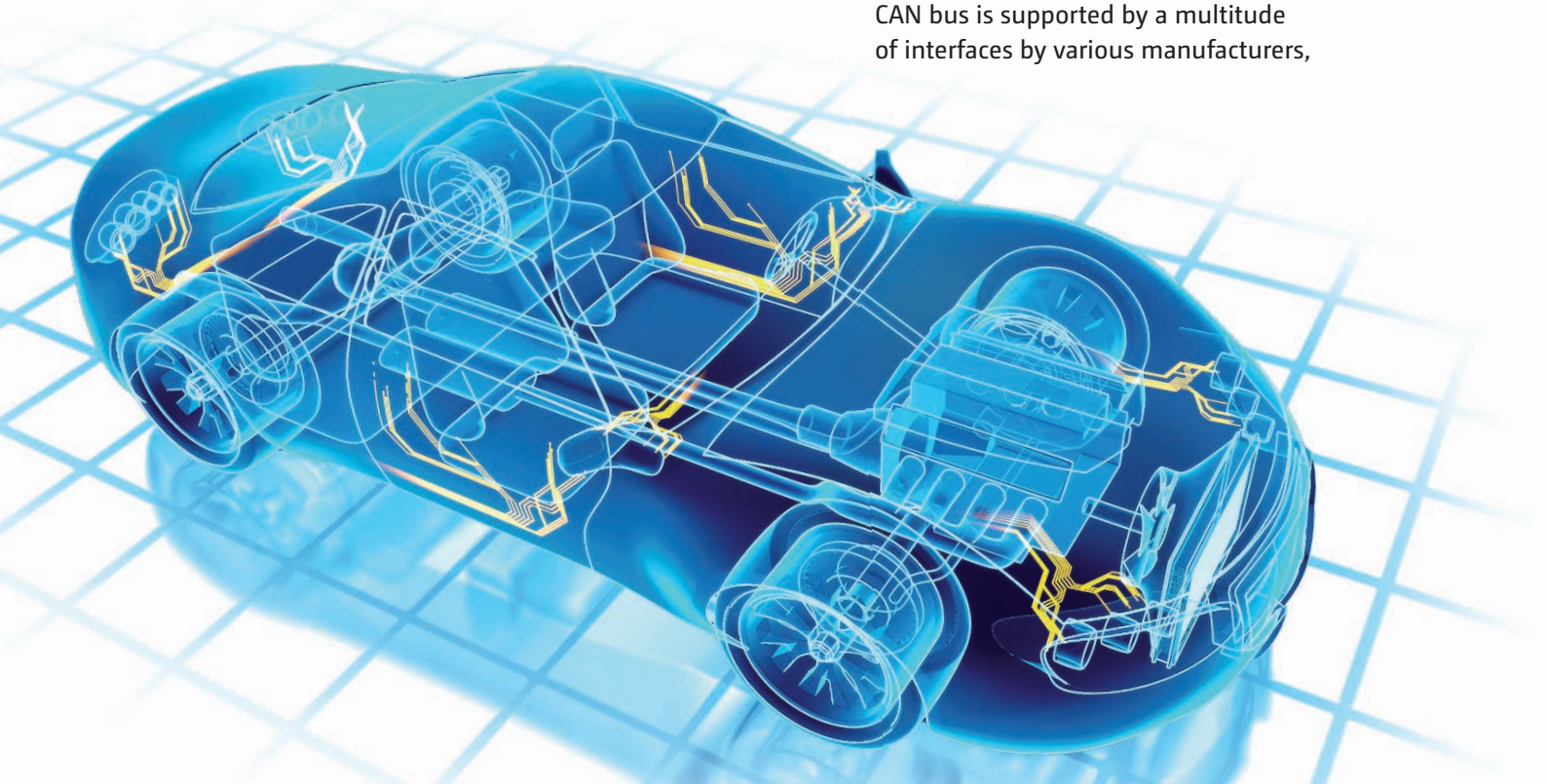
In order to achieve real-time capabilities, the network controllers are accessed directly. In this manner, the full bandwidth is made available and the immediate reaction of incoming data packets is done in real-time. For guaranteed real-time network communication, any interfering influences by Windows actions that otherwise would negatively influence transfer rates and reaction times, are strictly bypassed.

No Contradiction

Truly hard software.

To support the application of socket communication in real-time, a special driver layer for datagram-oriented (UDP) or stream-oriented (TCP) communication applications are available.

Bus systems that are mainly used in the automotive field, such as CAN, LIN and Flexray™, can also be accessed in real-time, an indispensable requirement for the development of automotive test systems. The universally and flexibly applicable CAN bus is supported by a multitude of interfaces by various manufacturers,



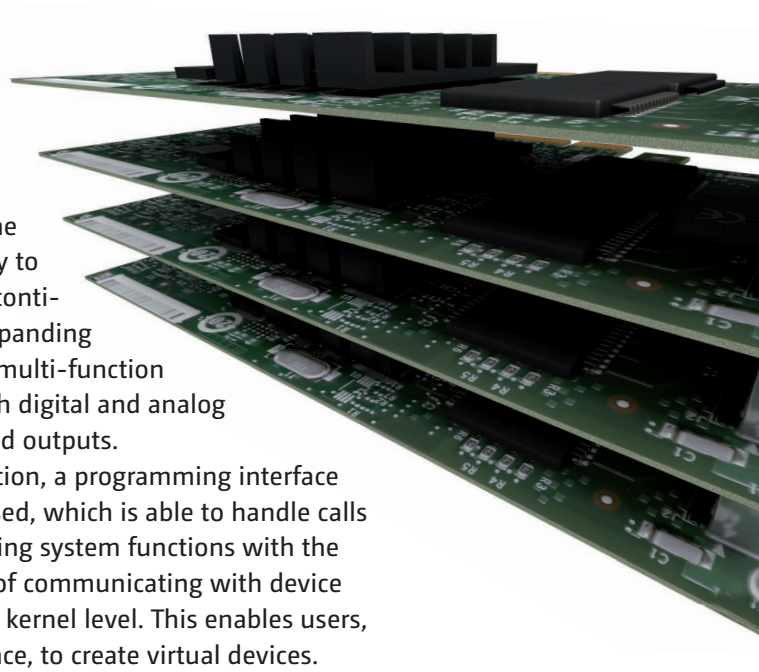
among them PCI and PCIe cards as well as USB-to-CAN adapters. The UART-based LIN bus allows for the development of cost efficient single-wire networking of single car parts and the connection to higher-level CAN systems. Real-time capable Flexray™, on the other hand, is highly suitable for safety-critical applications in automobiles, thanks to two independent data channels and high transfer rates.

Real-time capability for these three bus systems is especially important in the fields of product development and integration as well as for test system manufacturers in quality assurance of integrated mechatronic components.

It is now even possible for USB 3.0 to benefit from real-time communication by using a specially programmed and easy-to-apply access to the Extensible Host Controller Interface (XHCI).

Among the fields of application for real-time hardware communication are image capturing with cameras using the GigE Vision® or USB3 Vision® standard and sophisticated automation tasks with EtherCAT® or other Ethernet-based protocols.

Additional modules include real-time drivers for serial and parallel interfaces (COM, LPT) as well as the possibility to access a continually expanding range of multi-function cards with digital and analog inputs and outputs.



In addition, a programming interface can be used, which is able to handle calls of operating system functions with the purpose of communicating with device drivers at kernel level. This enables users, for instance, to create virtual devices.

Software Solutions
for PC-based Automation

Standardized protocols have become an integral and crucial part in meeting rising requirements in automation engineering. When it comes to field busses in this sector, EtherCAT®, an open and fast Industrial Ethernet variant, has enjoyed a rapid increase in popularity. In order to meet this increasing demand, an efficient EtherCAT® master is included in the »Real-Time Suite«™.

EtherCAT®

Or whatever you connect.

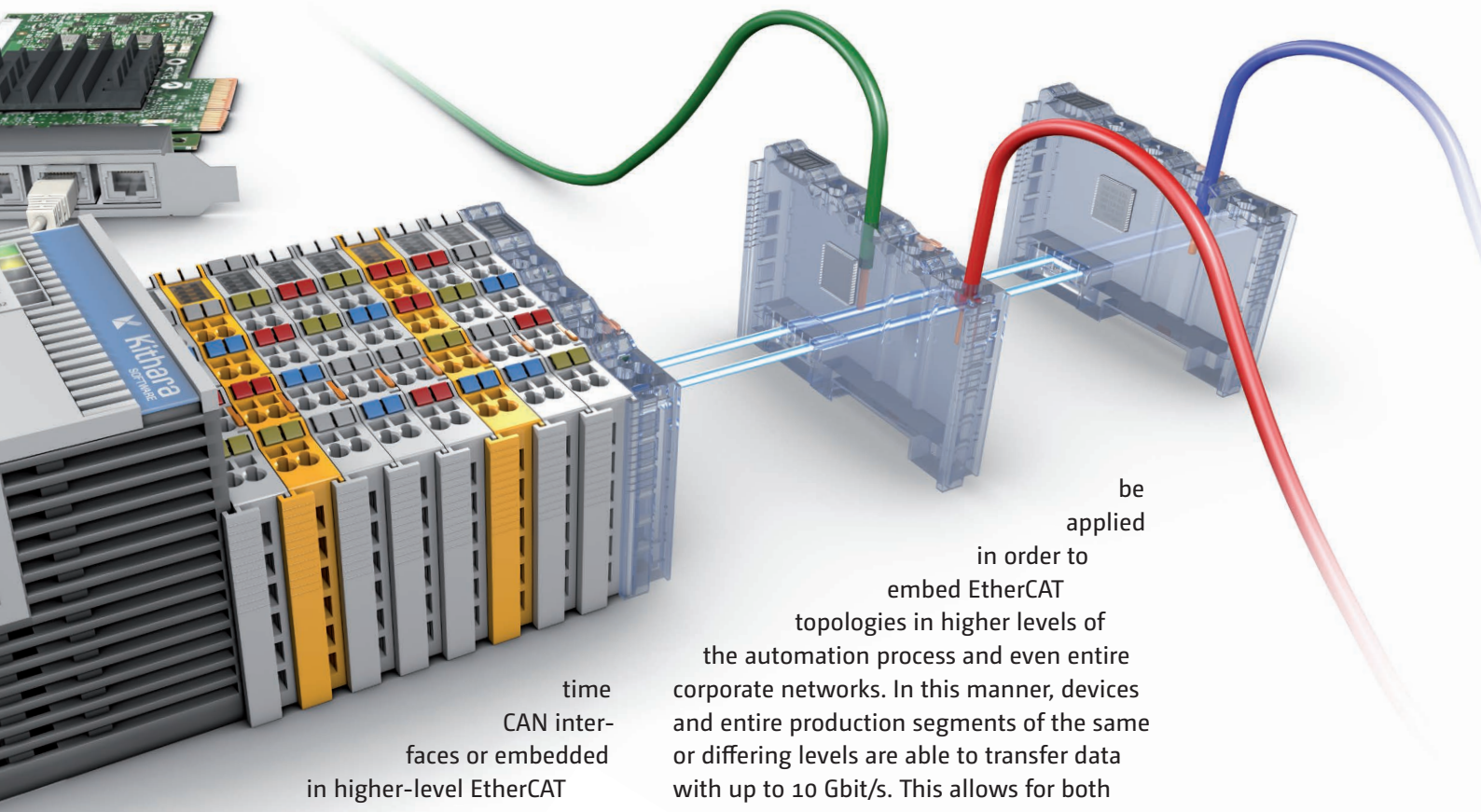
The real-time environment integrated in the EtherCAT® master executes application code at kernel level to achieve even “hard” real-time capabilities. This opens up the possibility for real-time factory automation with cycle times down to 50 µs and below. The master also provides all necessary mechanisms for effective automation solutions, from the automatic determination of the connected topology to the support of slaves with distributed clocks (DC) and even special features such as hot-connect functionality and cable redundancy.

For the implementation of particularly safe applications, Safety-over-EtherCAT® (FSoE) can be integrated as well. In this case, the EtherCAT® master ensures the transfer of data packets between safety inputs and outputs as well as the safety logic controller. This way, applications up to SIL3 are made possible without the need of separate cabling, such as for emergency stops.

Another special feature is the implementation of PCs as actual EtherCAT slaves, thus creating highly flexible and scalable interfaces within EtherCAT networks. Using specific PCIe cards, PCs can communicate in real-time within higher-level EtherCAT topologies while running as regular slaves. EtherCAT PC slaves benefit from the graphical user interface and input options of standard PCs and can be specialized for a multitude of different tasks, such as swapping out computing power.

Also available is a CANopen® master which can be run with the supported real-

EtherCAT® CANopen®



time CAN interfaces or embedded in higher-level EtherCAT networks.

Any devices, objects or variables that are accessed through EtherCAT® or CANopen® can also be programmed with a Soft PLC implementation according to IEC 61131-3, which is also a part of the »RealTime Suite«.

The EtherCAT® Automation Protocol can be applied in order to embed EtherCAT topologies in higher levels of the automation process and even entire corporate networks. In this manner, devices and entire production segments of the same or differing levels are able to transfer data with up to 10 Gbit/s. This allows for both master-master communication but also the connection to superior production systems (MES, ERP) and even whole departments (logistics, distribution etc.). This total networking of automated installations makes EAP the definite basis for the implementation of cyber-physical systems.

Industrial Image Processing
in Real-Time

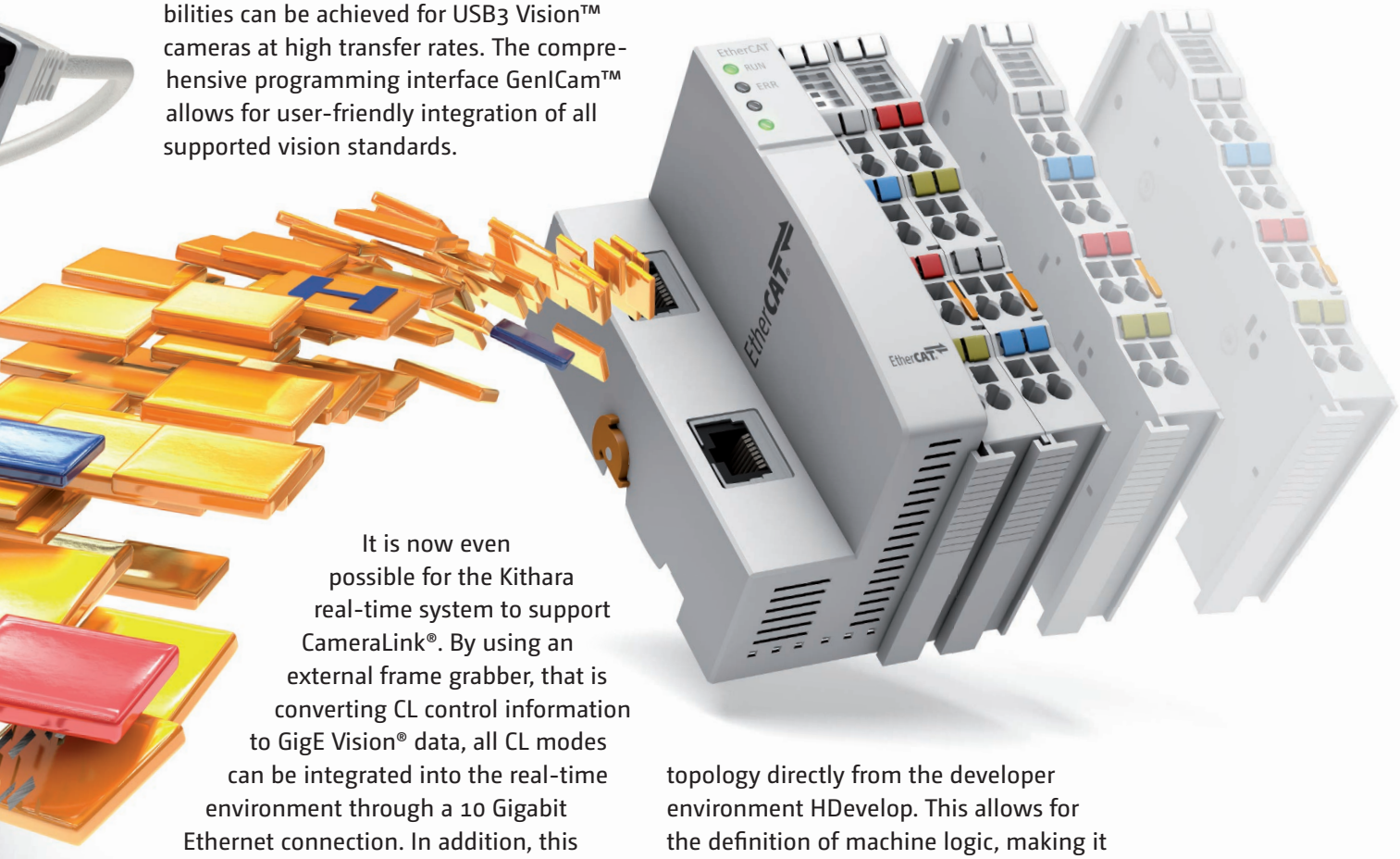
Many automation systems are also dependent on efficient machine vision solutions, whether it may be for production, packaging, monitoring or quality assurance. However, the appropriate vision interface standards for industrial cameras as well as the utilization of image processing libraries require guaranteed short reaction times to meet varying demands. The Kithara »RealTime Suite« is a leading innovative function library in the field of real-time industrial image capture and processing.

The key benefit of combining image capture and processing as well as the integration with automation protocols within a single real-time cycle is the possibility to immediately transmit the result of the algorithm-based image analysis to the main process without exiting the real-time context. This way, devices and systems down to sensor/actuator level can be controlled directly.

Ethernet-based camera systems are provided a real-time capable GigE Vision® driver, which responds to incoming complete camera images within a few microseconds. Also supported are link aggregation (up to 250 Mbyte/s) and 10 Gigabit Ethernet for all cameras according to the GigE Vision® standard. The benefits of GigE Vision® are congruent with those offered by Ethernet itself, such as the use of cost-efficient, interchangeable and standardized hardware as well as high data rates and cable lengths.

Equally flexible but even more cost-efficient is the application of the rapidly growing USB3 Vision™ standard. Based on real-time drivers for USB 3.0 real-time capa-

bilities can be achieved for USB3 Vision™ cameras at high transfer rates. The comprehensive programming interface GenICam™ allows for user-friendly integration of all supported vision standards.



It is now even possible for the Kithara real-time system to support CameraLink®. By using an external frame grabber, that is converting CL control information to GigE Vision® data, all CL modes can be integrated into the real-time environment through a 10 Gigabit Ethernet connection. In addition, this enables users to increase the short cable length to Ethernet levels.

The processing and analysis of image data is also carried out in real-time. For this purpose, user-provided algorithms as well as various external image processing libraries such as HALCON™ or OpenCV are usable.

For users of MVTec's HALCON™ library, the "Halcon Logic Controller" (HLC) is available, presenting an effective tool to access the digital and analog I/Os of an EtherCAT® topology directly from the developer environment HDevelop. This allows for the definition of machine logic, making it possible to control devices directly within the machine vision environment. With this, real-time sequences can be individually developed, configured and executed.

Image Capture and Image Processing in Real-Time

Yes, this is possible.

»RealTime Suite«™ – Modules

Real-Time System

Clock

RealTime

MultiTasking

Dedicated

» Clock: monitoring of system time in different predefined or user-specific time formats, resolution up to 0.1 µs; highly accurate short-time delays; long-term synchronization with EtherCAT Distributed Clocks (DC) and IEEE 1588

» RealTime: programming of highly accurate real-time timers due to highest system priority; max. programmable frequency >20 kHz, jitter in microsecond range

» Multitasking: priority-based, preemptive real-time multitasking; up to 255 priority levels, prevention of priority inversion caused by priority inheritance, dynamic priority adjustments; events, semaphores, mutexes, timer, support of multiple core CPUs, tasks can be assigned to individual cores

» Dedicated: operation of single or multiple cores dedicated exclusively to real-time mode; max. programmable task frequency up to 100 kHz and more; jitter times of less than 1 µs. Speedloop mode

Automation

EtherCAT®

CANopen®

IEC 61131-3

for timer frequencies up to 1 MHz

» EtherCAT®: EtherCAT® Master in real-time (up to 50 µs cycles), automatic determination of EtherCAT topologies, process data and service data communication (PDO+SDO), mailbox communication and CoE; Distributed Clocks (DC), Safety-over-EtherCAT® (FSoE), Ethernet-over-EtherCAT® (EoE), File-access-over-EtherCAT® (FoE), ServoDrive-Profile-over-EtherCAT® (SoE), hot-connect capability for dynamic topologies, cable redundancy, EtherCAT® Automation Protocol (EAP) for data transfer at control level with up to 10 Gbit/s, PC as EtherCAT slave via PCIe card

» CANopen®: CANopen® Master in real-time, automatic determination of CANopen topologies, management of CANopen slave states, process data and service data communication (PDO+SDO), mailbox communication

» IEC 61131-3: Soft-PLC implementation according to IEC 61131-3, supports Instruction List (AWL/IL), Structured Text (ST), PLC code is compiled into real-time DLL, access to EtherCAT® topologies

Communication

Ethernet

UART

USB 3

CAN / LIN

FlexRay

» Ethernet: up to 10 Gigabit/s in real-time; polling or event-triggered; UDP/TCP, IP and MAC multi-cast, broadcast, jumbo frames depending on used controller; automatic address determination via ARP support, server or client

» USB 3.0 in real-time, direct control of the XHCI; Low/Full/High and SuperSpeed; control, bulk, interrupt and isochronous transfer; plug&play, power management

» UART: serial communication in real-time with specific hardware drivers on UART-16550-compatible hardware, signal and handshake lines directly accessible; handlers for all interface events

» CAN: CAN 2.0A & 2.0B in real-time; highly accurate time stamps for every received CAN message; filter, RTR mode, independent API for boards of different manufacturers (PCI, PCIe, USB); support of CAN-FD in preparation

» LIN: in real-time, based on USB-to-LIN module by PEAK or LIN level converter

» FlexRay: in real-time, based on PCIe card PMC II by Eberspächer

Image Processing

- Camera: Image capture with GigE Vision® cameras or USB3 Vision™ cameras in real-time, support of GigE Vision® Version 2.0, polling or event-triggered, multiple simultaneous cameras, hotplug capability, error handling, configuration according to GenICam 2; support of link aggregation (up to 250 Mbyte/s) and 10 GbE (1,250 Mbyte/s)
- Vision: execution of external image processing libraries in real-time with HALCON™ or OpenCV, others on request

Camera
Vision

Hardware Access

- IoPort: access to all I/O registers of the PC; determination of PC configuration data and resource information
- Memory: access to external physical memory (dual ported RAM), allocation for external hardware (DMA memory)
- Interrupt: handling of hardware interrupts (PCI, PCIe, ISA, PC104, PC104+, Cardbus, ExpressCard)
- MultiFunction: support of multifunction boards with vendor-independent API, bit-wise or word-wise digital I/O, analog I/O as single value, channel sequence or unlimited mode with half-full interrupts

IoPort
Memory
Interrupt
MultiFunction

Base Functions

- Base / Kernel: functions for: opening the driver, device handling, debugging support, system information, application threads, events, callbacks, shared memory, data pipes and message pipes, fast mutex objects
- System: interception of system events, such as faults and system crashes at kernel level (e.g. FailSafe Handler/ “BlueScreen Handler”)
- Device: Windows API for device communication (ReadFile, WriteFile, DeviceIoControl), any device names possible, for example virtual “COM ports”
- Keyboards: PS/2 keyboard module (only 32-bit); interception of CTR-Alt-Del, Alt-Tab etc.; simulation of keyboard input

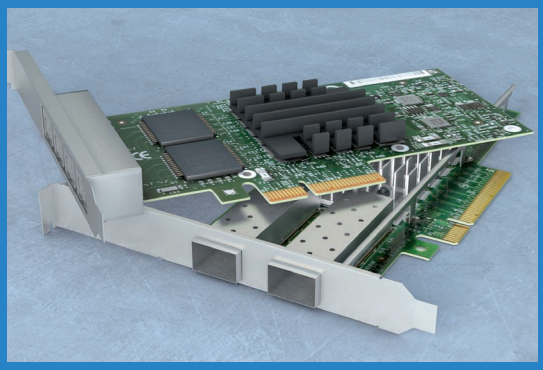
Base / Kernel
System
Device
Keyboard

Libraries

- RunTime Library: mathematical/ trigonometrical as well as string and memory functions in real-time
- SigProc: real-time control with PID algorithm; digital signal processing in real-time; 20 predefined or user-defined filters; low-pass/high-pass/band-pass or band-stop, Chebyshev, Hanning, Hamming

RunTimeLib
SigProc

For the latest list of features, suported hardware, operating systems and programming languages, visit our web site at www.kithara.de
We recommend downloading a trial version. Please contact us for any questions regarding your project!



Headquarter / Worldwide

Kithara Software GmbH

Alte Jakobstr. 78 ▪ 10179 Berlin | Germany
fon: +49 30 · 2789 673 – 0 ▪ fax: – 20
info@kithara.com ▪ www.kithara.com

Visit us also on: