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The demand for computing power obviously increases as the complexity of an individual machine or a plant rises. Beckhoff offers a scalable range of CPUs – from ARM or Intel® Atom™-based processors for entry-level controllers to modern “Core i” series processors, to many-core server systems for high-end control applications. For example, the C6670 industrial server with 12, 24, or 36 physical cores offers abundant computing power for demanding control tasks in many-core control for greater intelligence in the Smart Factory large production facilities (page 14).

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eXtreme Fast Control (XFC) with the compact AX8000 multi-axis servo system

Embedded PC enables flexible, integrated control solution

Flywheels support energy grids of the future

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10 years of success with Beckhoff France

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Prolight + Sound, Ligna, Anuga FoodTec

Trade shows and events 2015

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imprint

PC Control – The New Automation Technology Magazine
Published:
Beckhoff Automation GmbH & Co. KG
Huebnerweg 20
33415 Verl/Germany
Phone: +49 (0) 5246 963-0
info@beckhoff.com
www.beckhoff.com

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Picture proof:
Erwin Vanvuchelen, Belgium, p. 46 – 47
Marostica, Italy, p. 54 – 55
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Shanghai Tofllon Science and Technology Co., Ltd., China, p. 50 – 51
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Graphic Design: www.aiplus.de
Printed by: Richter Druck- und Mediencenter, Germany
Circulation: 30,500
Managing Director Hans Beckhoff is satisfied: “We can look back on a successful financial year. We are especially happy that this growth pattern extended to all regions and market segments. All continents contributed with new applications in areas ranging from industrial engineering and energy generation to building automation and the entertainment industry.”

Exports in 2014 accounted for 62 % of the company’s total turnover; of that, 29 % was generated in Europe (outside of Germany), 22 % in Asia, 10 % in North America, and 1 % in the remaining countries worldwide in which Beckhoff operates. “We’ve grown in all regions of the world, but especially in Asia and above all in China (+38 %). We are pleased to see healthy growth also in other regions – for example in southern Europe, with Spain (+10 %) and Italy (+19 %) delivering significant increases,” notes Hans Beckhoff.

**PC control technology wins new projects worldwide**

“Beckhoff has achieved average growth of 16 % annually during the period from 2000 to 2014. This positive performance can be traced back to our leading-edge technology, which has helped build our strong reputation worldwide. Our high-performance technology platform of PC-based automation software, Industrial PCs, distributed I/O components and Drive Technology can be universally used in a multitude of applications,” Hans Beckhoff explains, detailing the company’s rising market share in a wide variety of industries. “Our product innovations contribute similarly to our sustained growth. For example, we have won many new customers worldwide with the introduction of new product groups such as e.g. our state-of-the-art XTS drive system,” adds the Managing Director.

In terms of technology, Beckhoff customers are ideally positioned through the use of PC-based control. This is also true for the implementation of Industry 4.0 concepts. “Our ongoing research and development is a driver of advances in automation technology and that’s why we offer our customers a technological ‘head start’, due in large part to innovations such as the many-core control concept introduced with the C6670 many-core Industrial PC. With this high-end platform we can deliver what we believe are the most powerful control systems on the market today,” emphasizes Hans Beckhoff. He continues: “With processor options reaching as high as 36 cores and 2,048 GB of RAM we offer our customers a level of performance today that will be the industry standard in 2020.”

“Technology is one aspect of our company. The other is our 35 years of experience in automation paired with a pronounced company culture of trust and stability. All these are the factors on which our sustained growth is based,” says Beckhoff.

**Strengthening global sales channels**

Beckhoff Automation also continues to expand on a global scale. Following the establishment of a subsidiary company in the Czech Republic and representative offices in Saudi Arabia, Egypt, and Indonesia in 2014, Beckhoff is primarily investing in strengthening its existing sales network in 2015. “We are represented in over 70 countries worldwide with 34 subsidiary companies and distributors. Our focus this year will be on enhancing the density of our existing sales network. This includes adding more regional branch offices throughout all countries. We are particularly pleased to establish a larger office in Silicon Valley this year. Not only is German automation technology very much in demand in
California, we also want to benefit from the spirit and the speed of technological development in this area,” says Beckhoff.

**Training initiative for over 180 junior employees**

Beckhoff currently has approximately 2,800 employees worldwide; of these, almost 2,000 work in Germany, with about 1,800 at the company’s headquarters in Verl. Trained engineers account for almost one-third of the workforce. “We are again investing heavily in research and development in 2015, allocating funds of roughly 40 million euros,” Hans Beckhoff announces. “As a technology-driven company whose success is based on supplying its customers with new ideas and technology, we have a very great demand for skilled engineers. We are always happy to add fresh new talent to our roster.”

Current Industry 4.0 projects, which are part of the “it’s OWL” Leading-Edge Cluster, also contribute to the company’s progress. “The Leading-Edge Cluster has developed very successfully. This East-Westphalia-based alliance between companies, universities, and scientific centers of competence was only founded in 2011, but is already highly regarded as a pioneer for Industry 4.0 in Germany and even in Europe,” Beckhoff points out.

A strong commitment to developing young talent is part and parcel of the corporate mission pursued by Beckhoff. At present, 90 young professionals are undergoing apprenticeships in a total of seven occupation types. In addition, 90 students receive practical training in the fields of mechatronics/automation and industrial engineering at the Gütersloh branch of the Bielefeld University of Applied Sciences. The first two study intakes have already graduated and are now working in various departments of the company. “This is a very successful program for both the young engineers and Beckhoff. We will keep it going and continue to support the university’s Gütersloh location,” says Hans Beckhoff.

“Beckhoff has achieved average growth of 16 % annually during the period from 2000 to 2014. This positive performance can be traced back to our leading-edge technology, which has helped build our strong reputation worldwide.”
Hannover Messe 2015 – the world’s largest trade show for Industry 4.0

This year’s Hannover Messe was once again a comprehensive platform for information about Industry 4.0. Roughly 6,500 companies from 70 countries presented their innovations to the 220,000 industry visitors attending the show. At the Beckhoff booth in hall 9, visitors from all over the world, customers, international delegations and students from the “Tec2You” young professionals program in East Westphalia were able to experience Industry 4.0 applications “live”. Highlights included the new EJ modules, the multi-axis AX8000 servo drives, and the many-core machine controller for maximum computing performance in the Smart Factory.

Trade show TV: www.beckhoff.com/hmi
it’s OWL: Hans Beckhoff explains the current research project status to Günther Hermann Oettinger, EU Commissioner for Digital Economy and Society.

Extended I/O: Even standard portfolio components work in extreme environmental conditions.
How does the Smart Factory add value?

Josef Papenfort: For Beckhoff, Industry 4.0 is much more than a buzzword. Rather, it is the logical continuation of the convergence of information and communication technology (IT) with automation technology (AT), focused primarily on communication and networking. Many customers have been globally linked for decades. Individual machines in a Smart Factory will exchange more and more data between one another. Added to that the vertical exchange of data with MES and ERP systems and also with the Cloud. The key to this is PC-based control technology from Beckhoff, which provides the efficiency of built-in communication capabilities. In addition to physical networking, you need protocols that serve each of the various levels in a modern production environment. To provide real-time control communication capability on the fieldbus level, Beckhoff introduced EtherCAT to the market in order to provide a consistent standard for use around the world. In addition, when coupled with OPC UA, which includes features such as built-in security and data encryption, you can communicate vertically in the control pyramid. Engineering plays a significant role as well. Software creation with modern programming languages like IEC61131-3 3rd Edition and C/C++ along with other valuable software tools such as MATLAB®/Simulink® lowers engineering costs.

What is the general mood in the automation industry regarding Industry 4.0? Where do you see the greatest opportunities and the highest hurdles?

Josef Papenfort: Industry 4.0, which was originally a German concept, has become a worldwide topic, and for good reason. The grand vision of globally-linked Smart Factories can become reality only if we have standards that are recognized and implemented worldwide, particularly in the areas of communication and security. Accomplishing this requires significant discussion, development and adaptations. While this gives rise to plenty of competition, the key is to use this situation to your strategic advantage – one of the core goals of any company. Companies like Beckhoff are accustomed to moving in new directions to meet market needs by continuing to invest in innovative developments that support the advancement of Industry 4.0. Having an open and supportive political environment, plus employees who are well-educated and highly customer-oriented are the main prerequisites to succeed in these efforts.
What aspects of the Smart Factory can you realize today, and which do you want to realize in the future? To what extent does Industry 4.0 match your current product developments?

Ursula Frank: With the company’s PC-based control technology, Beckhoff provides the basic foundation necessary to build networked Smart Factories – needless to say, a great deal of unexploited potential still remains. Engineers from Beckhoff are highly adept at leveraging rising processor performance, advanced Internet technologies, new findings in software engineering, and other technological enablers with their own ideas and new products in the areas of engineering, performance enhancements, and communication. The research conducted within the BMBF (German Federal Ministry of Education and Research) sponsored “it’s OWL” Leading-Edge Cluster also provides new momentum. In the “Scientific Automation (ScAut)” lead project, for example, we integrate new findings in engineering into automation technologies, providing intelligent solutions for analyzing and optimizing manufacturing processes. Early solutions in the areas of measurement technology and condition monitoring are already available. Furthermore, in the “eXtreme Fast Automation” (efa) project, we research the use of many-core technologies in combination with extremely fast control technology. The goal is to supply high-performance control technologies as the platform for flexible, fail-safe, and resource-efficient Smart Factories.

Besides the implementation of the technical concepts, how will Industry 4.0 transform industrial operations from your perspective?

Ursula Frank: Industry 4.0 will have a significant impact on the way we work. Existing value chains will be broken up and replaced by processes that are more flexible and more tightly networked than ever before. This requires all players in the value chain to think in new ways – from management to the employees on the shop floor. It also requires appropriate IT solutions. The people in the factory will most of all see new forms of interaction between man and machine. For example, machines may adapt their behavior to the respective operator, or operators could potentially interact with the production via “smart watches” or other devices that serve as a wearable HMI. These changes will contribute not only to more efficient and resource-conserving production processes, but also to better working conditions.

Published in Elektrotechnik 04/2015. Vogel Business Media, www.elektrotechnik.de

Further information:
www.beckhoff.com/industry40
With the company’s C6670 industrial server, Beckhoff has brought to market one of the most powerful, if not the most powerful, machine controller to-date, equipped with up to 36 processor cores. This immense level of performance is harnessed most effectively via TwinCAT 3.1 automation software, exploiting the potential of each individual core to its fullest. In this interview, Managing Director, Hans Beckhoff explains the benefits of such many-core machine controllers with regard to current applications and their potential for future innovations.

“The C6670 industrial server provides the ideal platform to evaluate what a 24-core or 36-core computer can provide for the respective customer application. Machine manufacturers should take advantage of this opportunity since employing such a powerful controller already delivers tangible application benefits for sophisticated automation tasks today.”

Interview with Hans Beckhoff about enhanced machine intelligence with many-core control technology

The industrial server as high-performance controller, automation server, and visionary production platform

With the company’s C6670 industrial server, Beckhoff has brought to market one of the most powerful, if not the most powerful, machine controller to-date, equipped with up to 36 processor cores. This immense level of performance is harnessed most effectively via TwinCAT 3.1 automation software, exploiting the potential of each individual core to its fullest. In this interview, Managing Director, Hans Beckhoff explains the benefits of such many-core machine controllers with regard to current applications and their potential for future innovations.
With its up to 36 processor cores, the C6670 industrial server represents a quantum leap in terms of processing performance for machine control. How did this idea come about?

Hans Beckhoff: Since the CPUs in PCs are among the most powerful processors available today, we offer cutting-edge performance with our PC-based control technology. We continuously push the envelope in automation, based on the advances made in modern processor technology as predicted by Moore’s Law. Current “starter processors” feature four or eight cores, but processors with up to 64 cores will be considered standard in only a few years. We believe that machine designers should be able to employ a many-core platform already today, either for highly demanding automation tasks or as a visionary operating platform.

What are the benefits of such a visionary operating platform?

Hans Beckhoff: Development towards more and more processor cores will continue unabated. When you have 10 or 20 times more computing performance at your disposal, you can base your machine control technology on a whole new set of innovative concepts. However, since three to five years is not a lot of time to develop a totally new software architecture, the users of automation technology would be well advised to begin this endeavor today. The C6670 industrial server provides the ideal platform to evaluate what a 24-core or 36-core computer can provide for the respective customer application. Machine manufacturers should take advantage of this opportunity since employing such a powerful controller already delivers tangible application benefits for sophisticated automation tasks today.
“Since the CPUs in PCs are among the most powerful processors available today, we offer cutting-edge performance with our PC-based control technology. We continuously push the envelope in automation, based on the advances made in modern processor technology as predicted by Moore’s Law.”

**To what extent are control applications actually suited for such a multi-core architecture?**

**Hans Beckhoff:** Automation technology is the ideal area for multi-core architectures, because modern machines comprise a wide range of function modules and many positioning axes. These all operate simultaneously and can be very effectively mapped via individual control programs that run side-by-side. TwinCAT 3 provides optimal support for this approach with its many-core-focused features, such as many-core PLC and motion or core isolation, making the parallel control architecture easy to implement. In addition, the high-performance EtherCAT communication bus is able to transmit even huge data volumes deterministically and with short cycle times. This enables machine builders to test the parallel control architecture on their machine and use the results to develop next-generation control technologies.

**Which application benefits of the C6670 industrial server can you already implement today?**

**Hans Beckhoff:** We already encounter many highly complex automation applications, such as in wind farm simulations, for example. A single C6670 can reduce the amount of computer hardware required by taking the place of several conventional PCs. This also enables you to replace the data communication between multiple computers with much faster software-to-software communication. Particularly in machine engineering, we see the tendency to implement many more motion axes, operating them in an ever more dynamic manner and with more complex algorithms. The tremendous performance of the industrial server eliminates many restrictions in machine design. For instance, you can have 200 or more adjustable axes plus integrated measurement functions and condition monitoring features – all of which falls in line with our concept of Scientific Automation. You can even integrate a vision system – most of which...
Many-core machine control

Acting as what is likely the most powerful automation controller in the world, the C6670 industrial server opens the door to new options in machine control. The immense computing performance is provided by the following capabilities:

- 1 million PLC commands in just 100 μs
- CPU: 12, 24 or 36 Intel® Xeon® processor cores, 2.2 GHz, 2 x 30 MB L2 cache
- RAM: 64 GB to 2 TB
- I/O: Fast multi-channel EtherCAT

TwinCAT 3.1 software supports parallel PLC programming and modular engineering with special many-core features:

- Parallel control architecture (PCA)
- Many-core real-time with many-core PLC and motion, many-core C++ runtime, many-core MATLAB®/Simulink® runtime
- Up to 256 processor cores and up to 64 PLC tasks per core with easy assignment of tasks to the respective cores

are still running on separate computers these days – into such a centralized computing platform and make image processing more of a standard feature on the machine.

Does this mean that you can develop more powerful machines and systems for all industries?

Hans Beckhoff: Yes, you can, especially in areas where our eXtreme Fast Control (XFC) technology is employed. Many-core control and XFC increase not only the performance of machines and systems – they also improve the product quality with their highly precise and extremely fast control processes, while minimizing the consumption of energy and raw materials. In summary, they deliver significant economic advantages as well as sustainability benefits.

Is the C6670 industrial server suited only for centralized control concepts or also for distributed designs?

Hans Beckhoff: The industrial server is mainly a central data processing unit that makes computing, storage and communication capacities available locally. With our modular and scalable control technology, however, we support both concepts as a rule. A large assembly line, for example, is ideal for an automation architecture that features small, distributed controllers. For a packaging or tooling machine with many coordinated movements and conditions, on the other hand, a centralized solution would be the better option. However, our server technology has become so powerful that these distinctions are becoming rather fluid. In concepts with a modular, aggregate-oriented design of controller and machine, the intelligence could be implemented either locally in the individual modules or in a central industrial server using appropriate software modules and fast EtherCAT communication technology.

What about applications with typical server functionalities?

Hans Beckhoff: With its enormous processing performance, the C6670 is also capable of providing true server functions in industrial applications such as those promoted via Industry 4.0. For instance, you might transfer complex mathematical functions to the industrial server in order to enable less powerful controllers to handle the condition monitoring, such as for vibration analysis tasks. This would be a so-called “service-based” concept, where complex automation services run on a powerful server in order to remove some of the workload from the actual machine controller. If you have a communication bandwidth that is sufficiently fast and deterministic, such a server could even run in the Cloud. With the C6670, however, you can provide the necessary performance on-site at the machine or line.

Further information:
www.beckhoff.com/many-core-control
The Beckhoff philosophy centers on PC-based control technology. With ever more powerful PCs, it is possible to realize a central machine control system in which all PLC, motion, robotics, and CNC applications run on a single Industrial PC. Beckhoff uses the term “Scientific Automation” to describe the combination of conventional automation tasks with solutions from engineering science that go beyond the limits of conventional control. For example, it is now possible to integrate demanding applications such as image processing, measurement technology, and condition monitoring into standard control software. The goal is to gather data not only on the quality of manufactured products, but also to continuously monitor the current machine and equipment status. This is a prerequisite for fail-safe, cost-effective production.

Computing power fully leveraged with TwinCAT 3

The demand for computing power obviously increases as the complexity of an individual machine or a plant rises. Beckhoff offers a scalable range of CPUs – from ARM or Intel® Atom™-based processors for entry-level controllers to modern “Core i” series processors, to many-core server systems for high-end control applications. For example, the C6670 industrial server with 12, 24, or 36 physical cores offers abundant computing power for demanding control tasks in large production facilities. This many-core machine control system includes two Intel® Xeon® processors, each of which combine a number of cores in a single package. Each package has its own internal cache and memory. These systems therefore have two separate physical main memories, resulting in significantly increased access speed. For users, and therefore also for real-time applications, these two main memories appear as a single large memory. Due to their memory architecture, such systems are sometimes referred to as “Non-Uniform Memory Access” (NUMA) systems.

The current TwinCAT software version 3.1 can use up to 256 cores in a targeted manner. As a result, users have the complete range of latest generation processors available for automation applications. The number of cores and the corresponding computing power can be configured as required for running real-time applications. Such applications can specify cores for running Windows, as well as cores that are not used by Windows – so-called isolated cores. When using cores for Windows, the processor time is divided into real-time and Windows time. The proportion of real-time is limited by the “CpuLimit” parameter and can be set between 10 and 90 percent. Switching between real-time and Windows takes place cyclically with a freely selectable base time;
task cycle times are derived as multiples of the base time. Isolated cores do not have to switch between real-time and Windows, so that the full power of the processor is available for real-time applications. The use of isolated cores is recommended for fast tasks with cycle times of 100 μs or less. When using NUMA systems with many real-time cores, it makes sense to isolate a complete processor, so that the cache of the isolated processor is exclusively available for real-time operations.

From TwinCAT modules to the cores
In TwinCAT, individual automation tasks are realized as modules. Modules may be for motion control, PLC or C++ applications, for example. These modules are assigned to individual tasks of the TwinCAT system and executed cyclically based on a user-defined sampling rate, i.e. the cycle time. The tasks are then distributed to the available real-time cores, and typically several tasks are performed on one core. Therefore, the tasks are assigned priorities to define the execution sequence; priorities control the execution sequence of tasks. The higher the priority, the more accurately a task is executed. Processing of tasks with lower priorities can be interrupted by tasks with higher priorities. As a general rule: “The shorter the cycle time, the higher the priority.”

As an example, Figure 1 shows the execution sequence of the tasks for a typical motion control application with PLC and C++ software components. The real-time proportion is limited to 90 percent of the base period (here 200 μs), so that Windows (OS) is always allocated at least 10 percent of the computing capacity. This ensures that the Windows operating system is always guaranteed to be active for a minimum time within a base time. Motion Control NC PTP is divided into an SAF task (German: “Satz-Ausführungs-Task”, English: “block execution task”) with a cycle time of 200 μs and computing time of 30 μs and an SVB task (German: “Satz-Vorbereitungs-Task”, English: “block preparation task”) with a cycle time of 400 μs and a computing time of 100 μs. The C++ task and the PLC task both run with a cycle time of 200 μs and a computing time of 40 μs and 60 μs respectively. To comply with the cycle time, the computing time obviously has to be shorter than the required cycle time, which is the case in this example. The tasks are executed according to the priorities 1, 2, 3 and 4 in the sequence SAF, C++, SPS and SVB, as indicated. All tasks are activated at time 0 μs, and the TwinCAT real-time scheduler processes them sequentially, based on the specified priorities. The tasks SAF, SPS, and C++ have a cycle time of 200 μs and are therefore reactivated at 200 μs. At this point in time, the SVB task has not yet been completely processed. The tasks
with shorter cycle times, which were assigned priorities 1 to 3, are prioritized over the SVB task, which has a priority of 4. This ensures that they comply with the cycle time, as in the previous cycle, and are not “held up” by the SVB task. Processing of the SVB task then continues. If a task repeatedly misses its activation, a cycle timeout error (Exceed) is triggered. However, the task reporting a timeout may not be responsible for the timeout. It is therefore always advisable to examine the task runtimes of the higher-priority tasks on the core.

In this example, the computing power of the Industrial PC is fully utilized. To extend the application, it is possible to distribute it to two cores. Figure 2 shows a possible distribution. In this configuration, all tasks except the PLC task are assigned to a separate core. Note that in the single-core configuration, the PLC task is executed after SAF and C++. Since each core calculates the execution sequence locally for the tasks assigned to it, the PLC starts with the SAF task on the second core in parallel. Thanks to the additional computing power, the SVB task is calculated within the first cycle, making more computing time available for additional tasks on both cores. This can be used either for an extension of the existing application or for other modules.

Alternatively, the additional computing power can be used to increase the sampling rate for the existing application. In this case, the cycle time of one or more tasks should be reduced. Such an example is shown in Figure 3. On both cores, the base time is halved to 100 μs; in addition, the second core is isolated. The latter is indicated by the absence of the “OS” proportion in the execution sequence. On the first core, the length of a single Windows time remains unchanged at 20 μs, i.e. the real-time limit is 80 percent in this case. Therefore, 20 percent of the computing power of the first core is available for Windows. The cycle times of the SAF, C++, and PLC tasks are reduced to 100 μs. As a result, the sampling rate of these tasks doubles. Although the SVB task is now interrupted more frequently, the calculations for all tasks are completed before their next activation. In such an approach, the available bandwidth on the connected fieldbus must be adequately dimensioned, because the number of fieldbus telegrams per unit of time doubles, resulting in increased overall fieldbus load.

A distribution to more than one core makes sense, for example, in cases with many computationally intensive instances of a module, which can be calculated independently. One such application example would be condition monitoring.
In principle, each module does not need to be assigned a separate task, as in the example above. Depending on the computational requirements of a single module, several modules can be assigned to a task. The resulting task runtime must not exceed the required cycle time of a module. Otherwise, further modules have to be assigned to an additional task and executed on a separate core. Naturally, the behavior greatly depends on the respective application. In any case, it is advisable to commission the system step-by-step. If modules with different cycle times must be processed, they should always be assigned separate tasks with suitable configuration.

Summary
These days, any gain in computing power is increasingly achieved by increasing the number of cores per processor instead of a significant increase in processor clock speed. TwinCAT 3.1 supports this trend and enables the use of single-core systems, multi-core systems, and indeed many-core or NUMA systems from the server segment. The increased computing power can be used to migrate existing systems with several Industrial PCs to a single PC, or to expand and increase the control quality of an individual Industrial PC. This article describes the reduction of task cycle times through distribution across a multi-core system, based on a typical motion control application, as an example. Another example is Scientific Automation, which can complement existing systems with sophisticated measuring or image processing applications. This enables enhanced system monitoring or optimization during runtime. Beckhoff continuously develops this technology further and in this way enables customers to use cutting-edge Industrial PC systems for automation to increase performance and to ensure higher availability while retaining the benefits of centralized control systems.

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Further information:
www.beckhoff.com/TwinCAT3
www.beckhoff.com/many-core-control
The eXtended Transport System replaces complex mechanics with software functionality

**XTS: Innovation potential – from motion tasks to intelligent Industry 4.0 elements**

The eXtended Transport System (XTS) from Beckhoff opens up new solutions to realize compact, highly dynamic machine concepts. Even motion tasks that are nearly impossible to solve with mechanical engineering, or only achieved with considerable effort, can be conveniently and flexibly realized via software. Innovation potential thrives wherever creativity and machine design come together – be it in the simple linear motion of a “carriage mover”, or as an intelligent transport system within an Industry 4.0 application. The great variety of application possibilities are described below and illustrated based on current Beckhoff tradeshow exhibits.

The innovation potential of XTS is by no means limited to solving highly complex motion challenges. The system offers finely scalable customization options in terms of application requirements, e.g. relating to geometry, number of movers and functionality. It starts with simple applications, such as the purely linear movement of a carriage mover or the extension with a second mover to an XY table. The closing of the modular geometry, consisting of motor modules and guide rails, results in a continuous linear system with a number of movers that can be adapted to individual requirements. The full range of functions can be increased further by combining several XTS systems, using comprehensive TwinCAT function blocks and integrated robotics. If all these features are consistently leveraged in conjunction with condition monitoring and object-oriented programming, the result is a highly intelligent machine or production module, as envisioned by Industry 4.0 initiatives (Figure 1).

![Figure 1: The Industry 4.0 XTS demo illustrates an innovative manufacturing process. The captured condition monitoring and energy data are stored in the Cloud, together with data acquired by a second pilot system.](image)

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![Figure 1: The Industry 4.0 XTS demo illustrates an innovative manufacturing process. The captured condition monitoring and energy data are stored in the Cloud, together with data acquired by a second pilot system.](image)
Simple carriage mover and XY table functionality

Even for simple linear movements, XTS offers numerous advantages, thanks to its dynamic movement possibilities in combination with the replacement of mechanical functions through software. It deals with the tasks of a conventional linear motor with a movable carriage, although it is much easier to adapt to the respective application: with one or more motor modules, a suitable length can be selected with little effort. Furthermore, several of the wireless movers can be used if necessary, which greatly improves the flexibility in the application.

One example of how the ability to implement highly dynamic movements can be further increased with minimal mechanical effort is the functionality of an XY table (Figure 2). To this end, the carriage mover is simply equipped with a conventional linear bearing and supplemented by a second mover with a linear guide that is turned by 45°. The required motion in X direction can now be realized with jointly and similarly moving movers. The motion of the movers, relative to each other, creates the required Y motion via the two linear guides. In this way it is possible to realize any movement, including circular movements, e.g. for applying adhesives.

Figure 2: Using two movers with differently positioned linear guides, it is relatively easy to construct an XY positioning table based on the movement of the movers relative to each other, as shown in this demo with manual (foreground) and automatically following positioning table.

Here the system-related benefits of XTS come to fruition: the transport system is ready for use immediately after installation. Since power electronics and displacement measurement are included in the XTS motor modules, and the movers are completely passive, the measuring system does not have to be calibrated and the drag chains needed for conventional XY tables are no longer required. The result is an extremely compact, durable, and highly dynamic XY system. XYZ movements can be realized in a similar way with additional movers and corresponding kinematics.

Continuous linear drive with modular geometry

Due to the modular structure of XTS, it is not only possible to easily adapt the length to the respective application, but also to build a closed, continuous linear system using 180° curve modules. In addition, various curved motor modules are available, 22.5° inside or outside curve, plus 45° outside curve, which can be used to construct virtually any path shape. Examples include an S-shaped track (Figure 3) and a full circle (Figure 4).

Even during cornering, the movers remain under full control of the control computer, making controlled movements, i.e. defined process sequences, possible even at the deflection points. In this way, the transport system can be optimally adapted to the machine design. The XY table principle explained above works in this type of continuous section. The application benefits from mobile positioning tables, which can move continuously from one machining station to the other, in order to enable processes that apply adhesives or press on packaging lids, for example.

Rotary transfer machines are one of the many application possibilities of a circular XTS system. Currently available motor modules can be used to implement a full circle with a diameter of approx. 1.60 m (22.5° modules) or 70 cm (45° modules). Alternative guide rails are available for applications involving heavier weights, as shown in Figure 4. Furthermore, the motor modules can deliver their impressive dynamics with high forces up to 100 N. The range of XTS applications can be further extended with special guide rails from third-party suppliers, e.g. for high temperatures, aggressive agents, or heavy contaminants.

Despite all these features, XTS is by no means too costly or complex, even for essentially simple rotary table applications. If one of the processing steps takes significantly longer than the others, one could simply provide multiple instances of the respective station and integrate them into the process via software, thereby significantly increasing machine throughput with little effort. Other tangible
benefits arise from the high dynamics of XTS. Historically, conventional rotary tables are too expensive when the diameter exceeds 70 cm in applications with a desired cycle time of one second. Further benefits of XTS result from the lower weights that have to be moved, which reduces the number of required mechanical components as well as energy use.

**Complex geometries and movements**

Other ways to increase functionality, in the quest to solve challenging machine tasks, include combining several transport systems, whereby the installation position of each XTS can be freely selected. Figure 5 shows a product demo with a continuous XTS system and two linear XTS systems positioned at right angles to it. Each individual mover is represented as a servo axis, and a single Beckhoff Industrial PC with TwinCAT controls them all. Such a system is very efficient for sorting products, for example, and product changeovers are very flexible and quick to implement.

The motion functions that can be realized with XTS can go far beyond simple “Move from A to B” instructions, and not just in conjunction with complex geometries of the type described above. Additional features include automatic reversal of several movers for collision and jerk avoidance, mutual synchronization for holding or shaking processes in packaging applications, or for the XY function referred to above. This and other application-specific movement functions can be easily implemented with TwinCAT, using ready-made motion modules, resulting in a high degree of engineering efficiency. Virtually every mover is instantiated as an object-oriented program part, which reduces basic functions such as “dynamic backup with distance control” to simple parameterization, providing faster machine cycles through efficient program sequences.

**Seamless integration of robotics**

For applications requiring even more complex machining operations, XTS can be seamlessly integrated with robotics (Figure 6). TwinCAT Kinematic Transformation offers four different levels for this purpose, up to Level 4 with serial 6-axis kinematics, hexapod, and 5D kinematics. Using the mxAutomation library, commands can be sent directly from the PLC to a KUKA robot equipped with the KR C4 control system. Stäubli robots are also easy to integrate in TwinCAT.

The system benefits from the highly and appropriately scalable computing power of Beckhoff Industrial PCs, which can process XTS movements as well as robot kinematics on one CPU. This simplifies program handling and synchronization of subprocesses. Plus, the usual interfaces between the standard controller and the robot control are no longer required, which simplifies the exchange of variables.

**Individualized product transport with XTS as an intelligent Industry 4.0 module**

Offering high innovation potential, XTS seeks to make production processes more efficient and, above all, flexible. For this reason alone, it is ideal as a modern machine element from an Industry 4.0 perspective (Figure 7). A closer look makes this even clearer: in a traditional packaging or assembly process, the product is moved by a transport system and has to be repeatedly recognized, gripped, and possibly analyzed. In sensitive areas, such as medical and food technology, this results in a large number of mechanical components and sensors. In contrast, XTS enables the product to only be picked up once and then transported through the entire process with the same mover. Accordingly, the control program always “knows” where the product is and in what state.

This is supported by the object-oriented programming approach of TwinCAT, whereby each mover is mapped as a software module. Based on this direct
mapping of mover images and products, the “intelligent and self-organizing product”, defined by Industry 4.0 as a vision of the future, can essentially already be implemented today. With each mover implemented as a software instance, it is quite easy to “carry through” or track and document not only the current process steps, but also quality data and error messages, for example. This information can be used directly in the production process. If, for example, an error occurs in the sterilization of food packaging, the affected pack, which is uniquely defined via the mover, can be taken through the entire process without printing or filling. At the end, the empty pack is simply discarded as a reject, without wasting additional material or filling content. The process cycle is controlled independently by each mover program, e.g. by automatically activating the next processing station, as soon as the previous mover has left this location.

A wide range of additional system data are already integrated into XTS, which can be used for efficient process management. For example, the speed-control demo shown in Figure 3 continuously monitors the distance between the sensor flag of movers and the motor module. Based on this value, the software detects whether the weight of the mover has changed, i.e. whether the ball has fallen out of the bowl due to excessive speed. This information can be utilized in many ways: is the product to be processed still in the workpiece carrier? Is the weight correct after processing? Was too much or too little adhesive applied? Typical condition monitoring also benefits from the information, for example, by making it possible to detect contamination on the guide rail or damage to bearings or rollers.

Further information: www.beckhoff.com/XTS

Author: Uwe Prüßmeier, Product Manager Fieldbus Systems, Drive Technology, XTS, Beckhoff
For extreme temperatures and environments

Beckhoff offers a wide range of products for harsh operating conditions, such as extreme temperatures or mechanical stresses due to shock and vibration. The most significant benefit is that these higher requirements can be met with standard Beckhoff I/O components without added costs. This allows the exceptionally versatile standard portfolio of Bus Terminals, EtherCAT Terminals, and EtherCAT Box modules to be used in difficult environmental conditions.

Many industries and areas of application place increased demands on the load capacity of automation components, due to difficult environmental conditions. Examples include presses, wind turbines, and all applications in which shock and vibration stresses or high temperatures can occur during day-to-day operations.

Such demanding applications require a suitably robust I/O system, as well as the flexibility that a standard portfolio offers with its variety of components and signals. Beckhoff has implemented this level of performance with extended specifications for a large number of the company’s Bus Terminals, EtherCAT Terminals, and the IP 67 rated EtherCAT Box modules from the EP and ER series.

Extended temperature range and increased mechanical load capacity

Even in standard versions, Beckhoff I/O components are designed for extended temperatures, ranging from -25 to +60 °C. The I/O system can thus withstand extreme heat and cold, and provide increased climatic resistance.

The “Extended” components also offer greater mechanical load capacity. For instance, the IP 20 terminals are vibration-proof up to 5 g (according to EN 60068-2-6) and shock-resistant up to 25 g (continuous shock for 6 ms, EN 60068-2-27). The Extended EtherCAT Box modules can even withstand continuous shocks up to 35 g for 11 ms.

Optional coating of the PCBs in Beckhoff IP 20 terminals and Embedded PCs is also available at a minimal cost. This coating offers the electronic sub-assemblies of the IP 20 I/O components improved protection against harmful environmental influences.

Through the extended properties of the standard portfolio of EtherCAT Terminals from Beckhoff, high-performance EtherCAT communication can be used under challenging mechanical loads and extreme environmental conditions without added costs.

Further information:
www.beckhoff.com/Extended-I0
Demand for higher processing power keeps increasing in order to meet the wide range of requirements for controlling, operating and monitoring machines. At the same time, there is a desire to avoid moving parts such as cooling fans, in the interest of simpler maintenance. The ideal solution in this area has arrived with the new CP27xx Panel PC series, which combines high-performance Industrial PC (IPC) technology and fanless design with an advanced multi-touch display panel. This powerful, all-in-one device is perfect for direct installation in control cabinets.

The CP27xx built-in Panel PCs are fanless and compact, while offering multi-touch functionality in conjunction with high processing power from the integrated 1.4 GHz Intel® Celeron® processor or Intel® Atom™ CPU with up to four cores. The new models are available in eight display sizes between 11.6” and 24” (in landscape or portrait orientation), which can be used to implement dual-touch functionality up to 5-finger multi-touch applications, depending on the operating system.

Thanks to protection class IP 65 at the front (IP 20 at the rear) and the wide operating temperature range between 0 and 55 °C, the devices are suitable for a wide range of applications. They are user-friendly because all connections are conveniently located in the lower section at the back, and all components are easy to reach. In addition, two slots for CFast cards are handily accessible from outside. A plug connector panel facilitates connection of motherboard interfaces in the connection section. Pull-out clamping levers enable fast installation without loose parts. An optional PCIe module slot provides the user with greatest possible flexibility: Via this interface, e.g. two additional independent Ethernet or EtherCAT ports can be integrated into the device.

The features offered by the CP27xx series include: 2 GB DDR3L RAM (expandable to 8 GB), CFast card (2 GB, expandable to 32 GB; extended temperature range), on-board dual Ethernet adapter with 10/100/1000Base-T connection and on-board SATA RAID 1 controller (Intel® Rapid Storage Technology). Equipped with two independent Ethernet interfaces the Panel PCs are ideally suited for use as a compact central processing unit within an EtherCAT control system. A third independent Ethernet interface is available as an option. Four USB 2.0 ports are available for additional standard connections.

Further information:
www.beckhoff.com/CP27xx
Machine operation in transition: Multi-touch in industrial applications

How has the operation of machines changed in the last 10 years?
In early 2007, we saw the introduction of the first generation iPhone — the major jumping-on point for multi-touch control in the consumer marketplace. In 2012, Beckhoff presented the first multi-touch panels suitable for industrial applications with its new CP2xxx and CP3xxx models. The resulting transition from basic single-finger interaction to dynamic multi-finger operation and gestures was certainly the greatest change in the last ten years and offers the user the possibility to realize entirely new control concepts.

What challenges do you foresee in machine operation with touch panels and similar devices?
Beckhoff is already offering the necessary hardware with its popular multi-touch panels for industrial applications. The HMI, which so far has been used on a classic touch panel, can also be used without problems on a multi-touch device. Numerous tools are already available for the integration of multi-finger operation and gestures. The integration is partly already supported by the TwinCAT 3 PLC HMI. Beyond that Beckhoff is developing an HMI that will offer full support for all multi-touch features.
Machine operators must frequently work wearing gloves, but many touch panels don't work that way. What are your solutions for this problem?
When we developed our multi-touch products, we accumulated a wide range of expertise in projected capacitive touch screen technology (PCT). This enables us to configure the properties of our touch controller in such a way that it can be operated with various kinds of gloves.

Many machine operators miss the "touch and feel" feedback when working with touch panels. What are your solutions in response to this complaint?
A survey conducted by the Fraunhofer Institute shows that many operators wish to continue using classic mechanical operating elements. For our standard panels, we offer the option of integrating a full keyboard into the housing. Our customers can also customize their multi-touch panels. Many take advantage of this capability to implement a wide range of operating elements such as special PLC keys, incremental encoders, or key switches. Customers can also integrate membrane keys.

Pressing a key is easy on a touch panel. What safety measures prevent faulty or accidental entries?
The problem of erroneous entries is much older than multi-touch devices, as people can also hit the wrong key on less advanced single-touch devices. To prevent errors, Beckhoff adds a confirmation requirement to the interface. This is also where multi-touch operation comes in handy, because developers can easily add a confirmation button to the function button. The panel accepts the entry only when both buttons are pressed simultaneously. If you position these buttons on opposite sides of the screen, for example, you even force the operator to use both hands.

Certain industries – medical technology comes to mind – have very high requirements regarding cleanliness, which necessitates the use of special materials. What other reasons are there?
Besides the pharmaceutical industry, the food industry also has special requirements regarding the surface and material of Control Panels and Panel PCs. Beckhoff offers devices in stainless-steel housings and with flush-mounted touchscreens for such applications. They can also feature multi-touch operation, and if the customer requires special shatter protection, we can apply a protective foil at the factory.

Touch panels often replace the keyboard-and-mouse combination. Many feature gestures as a new way to control machines. How long will it take for gesture-based operation to become widespread?
Devices that support gesture-based operation are already established on the market, as machine operators are already familiar with this kind of operation from their smartphones and tablets. You may even say that young people expect gesture-based controls when they encounter any kind of touchscreen. All that remains is to integrate this functionality into existing control concepts or design new visual interfaces. Here, too, there are numerous examples that show that the broad introduction is already in full swing.

What are the pros and cons of gesture-based control?
I don’t really see any cons, because gesture-based control is an enhancement of the classic touch interaction. Any worries that the operator might be overtaxed are not justified either, because gesture-based control does not have to be a requirement. Particularly in the first phase of the introduction of these products, many customers ran existing applications on multi-touch panels in the classic 4:3 format without activating multi-finger operation or gestures. Multi-touch is still an optional function. There are also advantages in the increasing usability and operating reliability if intuitive gestures are used in the visualization.

Is the kind of voice control we see in smartphones a topic of interest for industrial applications?
In a study, subjects used the voice control feature of their data glasses in addition to a touchpad in order to display additional information as needed, directly in their field of vision. This kind of voice control makes it possible to further enhance the traditional human-machine interface in industrial applications. For most applications, however, voice control will be difficult to implement because the surrounding environments in industrial applications are often not conducive to this type of technology.

Will touch operation replace electromechanical inputs?
If yes, why?
Touch operation is taking over more and more functions from electromechanical keys. I believe that this process will continue and minimize the number of physical keys in the human-machine interface. How long this will take is difficult to predict. Many machine manufacturers want to have certain keys in the operator’s field of vision at all times, irrespective of the screen content. In any case, a certain amount of safety-related control elements will always be there, such as emergency stop buttons or confirmation buttons on robots.
IO-Link box modules offer an extensive IP 67 product range for making cost-effective point-to-point connections directly in the field. The basis for data transmission is the IO-Link protocol, which is a communication technology for sensors and actuators that is “below the fieldbus level” and is standardized according to IEC 61131-9.

These modules supporting IO-Link communication provide benefits particularly when complex sensors must be connected. Previously, Beckhoff already made it possible to integrate up to four IO-Link devices via an IO-Link master, such as with the EP6224 EtherCAT Box (IP 67), the EL6224 EtherCAT Terminal, or the KL6224 Bus Terminal (both IP 20). If such a master is present, the new IO-Link box modules now enable simple integration of further sensor signals, locally in the field via a simple sensor cable and which are then transferred collectively to the IO-Link master.

The comprehensive IP 67 I/O portfolio from Beckhoff is thus extended for even more applications. With a total of 24 bus systems, the IP 67 I/O modules support all common communication protocols, and therefore heterogeneous applications. The best performance by far, however, can be achieved by using EtherCAT Box modules throughout, so that the full functionality of EtherCAT can be harnessed without limitation.

Cost-effective and flexible sensor connections, even in extremely harsh environments

The IO-Link box modules enable connection of binary sensors as well as complex sensors and actuators. The connection between the modules and the respective IO-Link master is completed through an M12 connecting line (Port Class A). In the case of modules with increased power consumption, an additional voltage infeed is possible (Port Class B). Economical wiring is offered through the use of unshielded industrial cables. The modules are designed according to IO-Link specification V1.1; the range of the point-to-point connection is 20 m, according to specifications. No separate IO-Link configuration tool is required, since it is integrated directly in the TwinCAT software system. The connected IO-Link devices can be universally identified, diagnosed, and if necessary simply replaced without parameterization having to be carried out again.

Thanks to the compact form factor and different available designs, including the tried and tested plastic housing (EPI) or the extra robust die-cast zinc housing (ERI), the IO-Link box modules can be used in a wide range of application environments. Binary sensors can be connected to 8- or 16-channel modules with an M8 or M12 screw connection. The universal digital I/O modules with 8 or 16 freely usable input/output channels are highly flexible in use. The 4 channel analog input box or “combi box” with two analog inputs and two analog outputs can be used to record and transfer analog signals locally in the field.

Further information:
www.beckhoff.com/IO-Link-Box
The AX8000 multi-axis servo system can be used to configure multi-channel drive solutions in an exceptionally compact form factor. A special feature is the eXtreme Fast Control (XFC) technology from Beckhoff, which provides very short processing times for EtherCAT frames. With TwinCAT supporting drive control, users can create motion control IP (Intellectual Property) with algorithms that are executed by the CPU/FPU of the motion controller. This reduces development costs and enables innovative motion control concepts.

Not so long ago, it was normal for automation systems that the PLC, motion control (CNC), and fieldbus were not synchronized. In large systems based on PROFIBUS, for example, this could easily lead to response times of several hundred milliseconds.

**State-of-the-art control technology**

Today, it is common practice to use Industrial PCs in automation to handle PLC, CNC, and visualization from a single hardware device. Another trend points toward increased implementation of Ethernet-based fieldbuses, such as EtherCAT, in new machines. Using state-of-the-art technology, it is quite easy to operate PLC, CNC and fieldbus with synchronized cycle times in the millisecond range. The achievable cycle times primarily depend on the size of the machine, the computing power of the processor, and the configuration of the fieldbus. For CNC-equipped machines, the cycle time of motion control and EtherCAT as the fieldbus is generally around 1 ms. The controlled servo drives feature higher internal clock frequency, using fine interpolation algorithms to ensure the required path accuracy.
Figure 1 shows the usual time sequence of responses to a process event. One by one, the processor reads the fieldbus process image, executes the PLC and CNC routines, and provides the calculated data words for output with the next fieldbus cycle. The trigger signal for sampling (input) or hold (output) is the EtherCAT Distributed Clocks (DC) signal – represented in the images with red arrows. Between sampling of the inputs and the passing of frames, the EtherCAT slaves have time to provide the data for online processing in an EtherCAT ASIC or FPGA. Similarly, this applies to processing of the output signals up to their activation with the next DC.

Since all cycle times are synchronized, the response time from the sampling operation is completely deterministic. An unwanted – and for the user often surprising – effect is the resulting response time of approximately 2 – 3 cycles, i.e. 2 – 3 ms at a cycle time of 1 ms. For responses via motion control, an additional factor is the systemic delay associated with fine interpolation of exactly one cycle. The overall delay for a motion control response is 3 – 4 cycles. In cases where a CNC machine has to respond quickly to high forces or torques – for closed-loop control – the delay time described above affects the behavior of the control system.

**Communication with twice fieldbus update rate**

One option to reduce the system reaction time is to divide the normal EtherCAT read/write cycle into two frames:

- The input signals are made available to the Industrial PC with an EtherCAT read frame immediately after sampling the process data with a DC signal. In current Industrial PC hardware, the time-controlled sending feature can be used for this frame, in order to prevent any latency due to processor handling. The output data are updated with a separate EtherCAT write frame, which is sent immediately after the processor has executed the algorithms.

Figure 2 illustrates the time-optimized sequence of a response to a process event. The resulting response time is only 1 – 2 cycles, as one cycle was saved. For a response via motion control, with about 2 – 3 cycles instead of the previous 3 – 4 cycles, this corresponds to a reduction in delay time of 30 percent.
Race to the bottom for cycle times

In a second step, the cycle time can be reduced further to 125 μs, for example. It should be noted for EtherCAT communication, the time tolerances now become lower. However, sending and receiving at a 125 μs cycle time is easily achievable with a suitably configured, high-performance Industrial PC. Typically, a time window of around 80 μs remains for the (usually parallel) processing of algorithms.

At 125 μs, it may make sense to distribute the CNC to multiple cores. One core may calculate the maximum possible path speed using look-ahead algorithms, for example, and another core could generate the current set command values for the drives.

A cycle time of 125 μs is comparatively short for a standard drive. In order to reduce the load, the position control can also be configured to 125 μs. Fine interpolation is then no longer required, which reduces the system reaction time by the fine interpolation cycle to 3 – 4 cycles or around 500 μs (Fig. 4). However, without fine interpolation it is necessary that, in addition to the position command, the speed feedforward, and often the acceleration feedforward as well, is

For this method, it is important that the signal processing in the EtherCAT slave is time-optimized.

First steps to optimizing cycle times

A significant reduction in system reaction time can be achieved by selecting significantly smaller cycle times. In a first step, a reduction of the cycle time from 1 ms to 250 μs is considered. This reduces the system reaction time (about 4 cycles) from 4 ms to only 1 ms, and 250 μs is easily achievable with EtherCAT-based communication and advanced drive technology. Naturally, the load on the IPC depends on the application and the processor type.

At 250 μs, it may be sensible to distribute the routines for CNC and PLC to multiple processor cores. Parallel processing enables efficient utilization of advanced multi-core processors. However, for an event that is first processed by the PLC and then by the CNC, parallel processing increases the system reaction time by one cycle to 1.25 ms (Fig. 3).
Figure 5: With the AX8000 servo drive, EtherCAT set and actual values can be copied within the FPGA via DMA without significant delay.

Figure 6: The AX8000 can handle process data with VHDL algorithms (in hardware). This enables a longer processing time for IPC algorithms or faster cycle times.

calculated by the central processor and made available via EtherCAT. Optionally, XFC oversampling technology can be used: In a CNC task call, a sequence of, for example, four set values with corresponding feedforward signals is calculated by the IPC and transferred to the AX8000 with a common EtherCAT frame. The drive takes over the set values sequentially with a cycle time that is four times shorter, compared with the CNC.

Signal processing in the AX8000 multi-axis servo system
In drive technology, the wheat is separated from the chaff, so to speak at cycle times below 125 μs: Achieving an EtherCAT cycle time of 62.5 μs is not difficult. However, simultaneously ensuring that the power semiconductors respond as specified just a few μs after the EtherCAT frame has arrived – triggered by the Distributed Clocks signal – is a challenge.

The multi-axis servo system AX8000 meets this challenge in every respect. To the outside, the AX8000 communicates via the supply module using EtherCAT with standard Ethernet technology. Internally, the AX8000 uses the EtherCAT Terminal system bus (E-bus), which delays the Ethernet frames by only a few nanoseconds. The core component of the axis modules is a powerful FPGA, which integrates programmable logic and a dual-core ARM CPU on a single silicon chip.

The programmable logic is mainly used by configured and connected VHDL IP (Intellectual Property) modules:
- Drive core, field-oriented motor control, coded in VHDL
- EtherCAT IP core, on-the-fly processing of EtherCAT frames
- Feedback IP, such as OCT (One Cable Technology) for interfacing encoders
- Flexible DMA unit

Drive IP core; VHDL-coded, field-oriented motor control
The entirely hardware-implemented (VHDL) current controller combines the advantages of analog and digital control technology. This enables a response to unwanted control deviations, for example, within just one microsecond, without an overcurrent shutdown being triggered.
Ethernet frames. In larger systems, the required cycle time can be achieved by subdividing the fieldbus communication to several parallel strands.

**Motion Control IP**

In recent years, many teams have been engaged in research and development of innovative algorithms for synchronous, reluctance and asynchronous machines, or specific projects such as linearization of toggle kinematics. Due to the lack of open, standardized interfaces, time and again individual hardware components are created in small quantities.

So far, the concept of intellectual property (IP) has not been applied to motor control. Manufacturers usually do not disclose the device architecture to machine builders or end customers. This is mainly due to the low computing power of the microcontrollers or DSPs used in the past, which are usually programmed in Assembler or hardware-oriented “C”.

The use of IP is an obvious choice, however, for a TwinCAT-based servo drive. Thanks to the hardware available today, the programming of a drive is much less time-critical. The number of tasks required within a drive is reduced, due to the fact that some of the algorithms within the FPGA are implemented in VHDL. Complex algorithms can be calculated with the high-performance ARM CPU with FPU. In addition, the power of the installed processor is used much more efficiently through the use of compiler technology.

**Feedback IP, such as OCT, enables interfacing of encoders**

All Beckhoff servomotors from the AM8000 family are equipped with One Cable Technology (OCT) as standard, which consolidates power and feedback in a single cable. Communication with the encoders integrated in the motors takes place via an OCT feedback IP implemented in the FPGA, where it is internally synchronized with the EtherCAT DC signal. Optionally, EnDat encoders can also be used.

**Flexible DMA unit**

Instead of connecting these IP blocks using many signal paths and multiplexers, two options are supported within the FPGA. The data words are either read or written by the processor, or they are copied with nanosecond precision with a DMA unit, independent of the processor. Figure 5 shows a simplified block diagram of the FPGA functionality. In this way, it is possible to transfer set values that are triggered by the DC signal, for example from the EtherCAT IP dual-port RAM to drive IP registers, within a few nanoseconds. Similarly, an actual value can be copied – also time-triggered – from the encoder to the EtherCAT IP dual-port RAM, which is then sent to the controller, next time the corresponding EtherCAT frame is processed again.

The exceptionally low latency time in combination with VHDL control technology (i.e. in hardware) allows EtherCAT frames with set values to be processed just before the DC signal, or EtherCAT frames to be processed shortly after the DC signal for the transfer of the actual values. The extremely low latency time enables the IPC algorithms to take more time. Alternatively, the cycle time can be reduced, as shown in Figure 6.

In practice, this means that the AX8000 can process two frames per cycle, even at a cycle time of only 62.5 μs. However, it should be noted that such high performance is only possible in rather small subsystems with relatively short Ethernet frames. In larger systems, the required cycle time can be achieved by subdividing the fieldbus communication to several parallel strands.
Miele: Best practices for control, safety and measuring technology

At a highly automated facility in Oelde, Germany, high end appliance manufacturer, Miele produces around 300,000 electric ovens and cookers per year, all of which are comprehensively tested before delivery. To this end, the corresponding manufacturing cells are equipped with semi- and fully-automatic testing stations. These stations benefit from integrated engineering and the close interaction of standard control, safety, and measurement technology, all powered by the TwinCAT 3 automation software suite.

The high quality Miele ovens and cookers are designed for the European and North American markets. Export share at Miele is over 70 percent, which is reflected in seven country-specific voltage versions and corresponding appliance tests. Maik Hartmann, a member of the industrial engineering dept. for electrical equipment at the Miele facility in Oelde, comments on the new manufacturing and testing concept, which was implemented in 2013: "Originally, the appliances were produced in an assembly line with several integrated and consecutive testing stations. With the goal of 'production cycles based on customer demand', the system was converted to production in U-shaped assembly cells, resulting in an extended variety of tasks for all staff, including appliance testing, and improved productivity overall."

Thorsten Nagel, also from the industrial engineering dept. for electrical equipment at the Miele facility, describes specific advantages: "With the previous three synchronized assembly lines, the cycle time of the conveyor belts was between one and three minutes, depending on the line and device type, which corresponded to the working cycle of a worker for each appliance. Now, the work comprises the complete assembly and testing of an appliance, which takes around 30 minutes and enhances job satisfaction for the workers. In addition, the changeover effort was quite high in the past, with associated cycle time losses and fluctuating staffing requirements, due to the high number of appliance variants (around 800) and the large variety of lot sizes between one and ten. With the new concept that offers a total of seven assembly cells, we were able to increase the volume and variant flexibility while reducing lead times. This means that any device can be manufactured any day, basically without the need to plan ahead, which enables us to respond much better to rapidly changing customer demand and short-term orders."

Assembly cells with fully and semi-automatic testing stations
Depending on the intended production capacity, each of the seven production cells has one or more semi-automatic testing stations – 17 in total. In addition, there are nine automatic stations in the conveying segments of the assembly
cells, which monitor the tests and the presence of “test content”, forward the appliances to the central packing area and generate delivery notes, or divert them for repair if faults are found.

The actual functional testing, i.e. the statutory safety inspections, protective conductor measurements and high voltage tests, as well as numerous function tests, are carried out by a worker in the semi-automatic testing stations, based on a guided test sequence. Depending on the design of the around 1,000 appliances produced each day, the tests take between two and three minutes. Thanks to the underlying automation technology, all values can be logged in a central database.

Flexible and open control technology required
In order to integrate the test stations in the respective production environment, flexible and open control technology is required, just like in the previous production line environment. Maik Hartmann continues: “From the outset, we benefited from the Beckhoff Bus Terminal system, which enables us to implement a uniform and compact I/O architecture. An additional benefit is the openness regarding the different bus systems, so that it was also quite easy to operate the test stations in a CANopen or PROFINET environment.” Thorsten Nagel agrees: “By leveraging the modular Bus Terminal technology, it is easy to log the numerous test signals and integrate them into the system. A key factor for efficient individual testing stations, particularly in the new assembly cells with their extended task requirements, is an error-free and comfortable dialogue with the tester. It therefore made sense to use not only the I/Os, but also PC-based control technology from Beckhoff.”

According to the two Miele experts, these system benefits enable uniform, well-structured control hardware. Due to its high degree of flexibility, PC-based control can be extended easily to cover new testing requirements. EtherCAT offers particular advantages as a communication system that is not only extremely powerful, but also offers the choice of bus topology based on the individual

At a glance:

Solutions for testing station automation
Testing and automatic workstations in oven and cooker production

Customer benefits
Control, safety, and measurement technology with integrated software and hardware

Applied PC Control
– TwinCAT 3: Consistent engineering and runtime system, integrated into Visual Studio®
– TwinSAFE: Safety technology, seamlessly integrated within standard control technology
– EL34xx: EtherCAT power measurement terminals for integration of measurement functions
– EL6614: Ethernet switch port terminal for integration of TCP/IP-capable measuring devices and sensors
– CP3919, CP2219: Multi-touch Control Panels and Panel PCs for convenient operation
requirements. This is complemented by excellent diagnostic capabilities, which facilitate working from the development environment right into the fieldbus or I/O level.

**TwinCAT 3 as integrated and consistent software**

With the transition to the new manufacturing and testing station concept, the new TwinCAT 3 software generation was introduced as the automation suite. According to Maik Hartmann, the biggest advantages of the platform include integration into the Visual Studio® engineering environment and integrated TwinSAFE safety functionality.

The given software structure of a testing station comprises the internally developed “Miele testing and workstation” (MPA), which provides visualization and data exchange with the ERP level. Additionally, the system reads the device-specific test sequences from the central production database, for example. As a subordinate system, which is linked to the MPA via ADS communication, TwinCAT 3 deals with traditional control tasks and I/O data processing. Particularly with respect to this overall architecture, TwinCAT 3 offers the decisive advantage, according to Thorsten Nagel: “Thanks to the full integration of TwinCAT in Visual Studio®, we can now work consistently in a single development environment. This makes project development much easier. In the past, we had to use a large number of tools – for different PLC generations, robot and safety controllers, as well as special real-time operating systems – which weren’t even able to run on the same computer in some cases. An additional benefit was the straightforward and efficient nature of porting the existing TwinCAT 2 projects to TwinCAT 3.”

According to Maik Hartmann, the seamless integration of safety technology is another important aspect relating to the use of TwinCAT: “The semi-automatic testing stations include a light curtain, emergency stop, and a door contact switch as safety elements. In addition, we have to meet the safety requirements of the Low-Voltage Directive, to ensure safe switching of the test voltages. All
this can be configured in a unified engineering environment with the TwinSAFE Editor. TwinSAFE also results in a significant reduction in hardware requirements, because the previously required special safety systems, and the corresponding cabling and communication efforts are a thing of the past now that we use Safety over EtherCAT, the TwinSAFE EL6900 logic terminal and the TwinSAFE I/O terminals."

Control technology with advanced measurement functionality
The project design is further simplified with the direct integration of measurement technology into the control technology. The EL3403 three-phase power measurement terminals (up to 500 V AC) and EL3413 (up to 690 V AC) are used to check the function of the heating elements installed in the ovens as well as compliance with the power limit values. They are also used for high voltage tests. The EL3413 power measurement terminals, which are designed for up to 690 V AC, are also used to test the pin assignment of the 16-pin connector for the hob and the correct allocation of the energy regulators.

The openness of PC-based control technology has additional benefits: other measuring devices and sensors required for the appliance tests can also be integrated with little effort. Maik Hartmann notes that: "To avoid the need for additional interfaces or communication modules, we chose TCP/IP-capable devices – a high voltage meter and a hand-held scanner for the testing station and a bar code scanner for the automatic workstation. These can be integrated via the EL6614 Ethernet switch port terminal and supplied with the current parameter set via TCP/IP."

Further information:
www.miele.com
www.beckhoff.com/TwinCAT3
Embedded PC enables flexible, integrated control solution

The modular design of TROX air handling units enables them to cover a wide range of challenging applications. Flexibility, openness, robustness as well as ease of use and installation are just some of the benefits found with the Beckhoff Embedded PC and TwinCAT control platform implemented within the integrated measurement and control (MC) solution.
Since the founding of the company in 1951, TROX GmbH in Neukirchen-Vluyn, Germany, has developed and produced components, devices, and systems for air conditioning applications, as well as fire and smoke protection solutions. The company’s broad expertise in applications for airports, hotels, hospitals, shopping centers, office buildings, and sports facilities is particularly evident in its X-Cube air handling units, which were introduced in 2012. The central X-Cube air handling units are freely configurable and optionally equipped with an integrated measurement and control (MC) solution. Due to the flexibility of their design, systems with flow rates of up to 150,000 cubic meters have already been manufactured. Additionally, with the expansion of integrated MC functionalities in recent years, they are now able to accommodate the company’s volume flow controllers and fire dampers, as well.

X-Cubes are available in basic versions for office buildings, sanitary versions for hospitals and labs that meet the German AHU Guideline 01 (RLT-Richtlinie 01), as well as weatherproof versions for outdoor installation. The modular design and minimized wiring through the consistent use of fieldbus technology ensures low installation and maintenance cost. X-Cubes can be configured as supply units, extraction units, or a combination thereof, and arranged side-by-side or on top of each other.

Open control technology for flexible and powerful MC system

The broad functional requirements of the MC solution place high demands on the processing performance of the underlying control hardware, as well as on the system’s adaptability to the respective operating conditions. According
The standard X-Cube controller is a CX8090 Embedded PC. In applications where more processing power or a certified BACnet building controller are needed, a CX9020 can also be used.

The broad spectrum of X-Cube applications ranges from simple air supply and extraction units to complex systems that include fire dampers, volume flow controllers, and other TROX products. With the modular control system from Beckhoff, TROX can now implement the right solution for any set of requirements, no matter how simple or sophisticated. At its core is an Embedded PC from the CX series – in most cases a CX8090 with a switched Ethernet port. If the client requires a certified BACnet building controller or more computing power, a CX9020 is used. On the software side, the system uses TwinCAT with...
the XML Data Server, BACnet/IP, Modbus TCP Server, PLC Modbus RTU, and SMS/SMTP Server libraries.

Even complex systems rarely require more than 20 physical I/Os such as the KL340x or KL440x analog I/O, KL1809 or KL2808 HD Bus Terminals, or the EL6201 AS Interface Master Terminal. The fieldbus-based control system can handle plenty of data points – larger systems with fire dampers, volume flow controllers, and other similar devices can have more than 1,000 of them.

The compact, modular control system handles all basic functions, such as the bus communication with the actuators and sensors, as well as with various modules (for example, humidifiers). It offers diagnostic functions that permanently monitor the components and respond in case of a malfunction. In addition to these internal tasks, the Embedded PC supplies a web-based user interface for device settings and status checks. The controller’s third task is communication with the building management system.

The most important requirement for designing the TROX control solution was the ability to easily adapt the system’s processing power and number of I/Os to the customer’s specific needs. For more demanding systems, TROX can easily employ a more powerful controller without having to modify the standard software. One critical feature of Embedded PCs is their ability to store software and settings on a standard SD card. It not only simplifies any necessary controller replacements, but also provides an easy-to-handle backup of the unit’s settings and diagnostic data.

Further information:

www.trox.de/en
www.beckhoff.com/building
Traditional high volume printing methods such as gravure and web offset printing are battling against economic challenges; sheet-fed offset printing can look to the future only with cautious optimism today. Digital printing, on the other hand, promises better prospects, with the largest potential for inkjet printing. This is confirmed by Florian Fässler, Product Manager of Digital Printing at the Digital Competence Center (DCC) of Wifag-Polytype Technologies AG in Fribourg, Switzerland. He says: “As one of the three most renowned manufacturers worldwide, the former Wifag machine factory developed and manufactured newspaper printing machines. Since very few companies buy newspaper printing machines these days, the company decided not to develop any further new models in this area. In fact, digital inkjet printing is set to become the future for all departments of Wifag-Polytype Holding.”

In Florian Fässler’s estimation, the major challenges associated with digital printing are flexibility, on the one hand, and the productivity of printing, on the other. Only in finding balance here can printers profitably address the current trend towards individualization and personalization of materials. Digital inkjet printing is a matrix print method that generates a printed image consisting of a dot matrix. These matrix printers are familiar from office and home environments, where they are widely used as photo printers. However, these devices are characterized by slow printing speed, which is not acceptable for industrial printing.

**Ultra-fast technology for sensitive print heads**

The heart of an inkjet printer is the print head, through which a print image is generated by the targeted shooting or deflection of small ink droplets. “The print head is a commercially available system that is connected to our own printing units and the special Calmar electronics,” Florian Fässler explains. The print heads have quite a primitive interface. For example, there are no print heads with a USB interface. The Calmar project group’s particular achievement is the realization of control electronics that are industrially compatible and usable for all printing machines.

“The systems available on the market consisted of very complex electronic systems,” says Florian Fässler. “These were difficult to adapt, and scaling was not a simple process. Above all, they were not necessarily suitable for industrial
integration.” However, the Calmar project team had planned to develop a robust electronic control system that could be integrated with a fieldbus. This was coupled with the goal of developing a platform of products that could enable simple and flexible usage.

In the evaluation phase, the project team decided to integrate EtherCAT and eXtreme Fast Control (XFC) from Beckhoff. Florian Fässler explains: “The reason we chose Beckhoff and EtherCAT is the openness of the technology. When we started our development activities three years ago, there was no comparable deterministically designed, fast and open system. This technology concept could be implemented into an FPGA, and the EtherCAT communication was simple to integrate and execute.”

From interface to automation module
An important reason for the integration of EtherCAT and XFC into the Calmar electronics is the extremely fast operation of the bus and control system. EtherCAT is a deterministically operating bus with short cycle times and high data rates. The XFC technology from Beckhoff supplements this functionality with Distributed Clocks for a synchronized system time and a maximum deviation of less than 100 ns, as well as with highly precise Time Stamp functions for process data. Florian Fässler says, “For the synchronization of print heads, all associated controllers must be started at the same time. That means that all the tasks in every controller have the same time base and start simultaneously with the control sequence. The Distributed Clocks system ensures that all devices receive the Time Stamp within one cycle. The cycle time of 2 ms is evaluated by the system simultaneously.”

For the integration of the Calmar electronic system, the project team created its own EtherCAT interface based on the EtherCAT IP Core ET1810 or ET1811. This enables both EtherCAT communication and application-specific functions to be implemented on an FPGA – all in a simple and convenient way, according to Florian Fässler: “The acquired tool made implementing the EtherCAT interface easy; it is very well documented.” The result is a notable success, and Wifag-Polytype now has a flexible and robustly usable automation module in the Calmar electronics. Florian Fässler continues: “We can now conveniently engineer the print system with a configurator, regardless of whether it has two, 40, or even more Calmar cards. It is now much simpler to design and automate inkjet printing machines. In addition, there are more extensive diagnostic options available to us. Ultimately, we have an automation module that is ideal for industrial applications.”

Secure on the inside, yet open to external connections
The Calmar control solution serves as an automation module for the digital printing machines from Wifag-Polytype Technologies AG, and is also marketed as an individual device within the framework of an OEM business model. The company’s own expertise is also available to OEM customers as a service. Florian Fässler explains: “The PLC architecture and the source code are open for OEM customers; the Calmar-specific libraries as well as the control room application can be adapted and extended on request. Connections to the outside world are also open, whether to ERP, MES, or other databases.”

Wifag-Polytype Technologies AG acts with similar consistency within the Calmar project group: the team, which consists of both hardware and software specialists, works with .NET technology. The visualization is based on Microsoft Visual Studio®, into which TwinCAT 3 is integrated. “Visual Studio® is considered by some as perhaps something new or a special application for standard automation, but for us it’s a part of daily business. Our machines communicate over TwinCAT with the control room application, which was developed in .NET/Visual Studio®. The control room application takes care of the visualization,” comments Florian Fässler.
Innovative storage solution balances grid fluctuations

Flywheels support energy grids of the future

Increased usage of renewable energy in power production often leads to grid fluctuations. These spikes and dips in energy production must be balanced in order to ensure that power supplies remain reliable. Flywheels are ideal for this purpose: By storing excess energy and releasing it back into the grid when required, they can respond to grid variations in a split second. Technology innovator Temporal Power, based in Mississauga, Ontario, Canada, uses this technology in its high-performance energy storage and regulation systems to provide a new avenue for grid balancing and support in alternative energy implementations.
The flywheel storage system designed by Temporal Power during commissioning. Key factors for the decision to use EtherCAT were the high speed and the fast response time of the communication system.
Feeding power from renewable power sources into energy grids often results in frequency fluctuations. If the power generation is higher than what is consumed, the frequency rises. Alternatively, if there is too much load and not enough generation, the reverse happens and the frequency drops below recommended levels. Traditional assets used to avoid outages stemming from such frequency fluctuations include gas generation and hydroelectric systems. However, the process is resource-intensive, and these systems are much slower to react, requiring time to reach full power. Flywheel energy storage provides an ideal solution, particularly the systems designed and manufactured by Temporal Power.

The efficiency and value of the Temporal Power systems led Canadian energy storage developer NRStor to choose their flywheel system. In 2014, NRStor opened a 2 MW storage array that employs Temporal Power’s flywheel-based frequency regulation technology in Minto, Ontario. This innovative project has not gone unnoticed, highlighted by Temporal Power’s recent naming as the 2014 Company of the Year by the Ontario Energy Association.

A new “spin” on renewable energy storage

The basic premise of a flywheel-based energy storage system centers around a rotating steel cylinder, suspended by bearings inside a vacuum chamber to reduce friction, and connected to a combination electric motor and electric generator. Energy from the source is applied to the flywheel assembly, causing it to spin at very high speed, up to around 12,000 RPM. Once at speed, the power is disconnected and the combination of the vacuum-sealed system and high-tech bearings allows the mass to continue spinning with minimal loss from friction. When drawing the power back out of the system, the kinetic energy from the flywheel is transferred back into the grid.

Traditional mechanical bearings can cause significant losses in the kinetic potential energy as a result of friction. “Temporal Power’s proprietary magnetic bearings significantly reduce friction and enable the system to achieve 97% mechanical efficiency,” said Jeff Veltri, President and CTO at Temporal Power. “This design methodology offers a next-generation power solution that is both robust and environmentally sound,” added Cameron Carver, Temporal Power CEO.
Faster, more powerful systems for exceptional energy storage

With plans for future energy storage installations already in the works, Temporal Power is ideally positioned to address the rapidly growing need for alternative energy storage. As rising consumer energy use shows no signs of slowing down, energy utilities remain on the lookout for cost-effective, reliable solutions to regulate the energy grid and keep customers' lights on. “The PC- and EtherCAT-based systems have exceeded expectations in our flywheel installations,” noted Jeff Veltri. “Response time for flywheel control is now literally 100 times faster, moving from 500 ms down to the current level of 5 ms. The TwinCAT 3 platform offers excellent integration between the PLC and I/O layers of the software, as well as offering far better information management capabilities with a wide range of standard IT tools. This allows us to make changes in the field more quickly and flexibly. We look forward to new developments with PC-based control technology and finding ways to continue our partnership with Beckhoff in the future.”

Grid monitoring with EtherCAT:

Response times in the millisecond range

In the earliest stages of development, Temporal Power sought to reduce latency with a faster, more robust communication system for data transfer. The Beckhoff system now used consists of a CX2020 Embedded PC with directly connected I/O terminals, EtherCAT as the communication system, and TwinCAT 3 as the automation software. “The PC-based control platform offered us an ideal solution for our application,” said Jeff Veltri. “Thanks to EtherCAT’s high response speed, the system now has the potential to provide much tighter control of frequency regulation, allowing our high-performance flywheel system to follow the signal that comes from the grid operator with minimal delay.” As opposed to traditional systems, Temporal Power’s flywheel can pull energy in and push energy out continuously. “This is a function of the robust thermal management and monitoring system built on PC-based control,” Jeff Veltri noted.

With the need to quickly and accurately measure the voltage on the grid, Temporal Power relies on fast, high-precision EL3773 XFC terminals with power monitoring and oversampling – offering six-channel, simultaneous power measurement and sub-100 μs response times for data transfer to the control system. Based on EtherCAT’s distributed clocks functionality, measured values can be synchronized with very high precision (1 μs), and internal sampling times of 10 ns can be achieved. Jeff Veltri continues: “In our application, we’re not simply acting as a generator; we are actively providing grid support. Thanks to the high speed of the EL3773, we can respond to a frequency drop with immediate voltage support to the grid.”

IP 67 I/O modules save space in electrical cabinets

The robust design of the EtherCAT Box modules has drastically reduced electrical cabinet needs on the flywheel portion of Temporal Power systems. The fully-sealed I/O modules with IP 67 rating are mounted directly onto the flywheels, saving space and reducing costs. “The EtherCAT Box modules work very well for our installation needs. Since the flywheel systems are located in vaults below ground, we need protection from moisture, vibration, and temperature variation,” according to Jeff Veltri.

Further information:
www.temporalpower.com
www.nrstor.com
www.beckhoff.ca
Consistent system openness in building automation

With 11 facilities and over 1,100 beds, nursing and retirement home operator Anima Care is a major organization in Belgium’s nursing home sector. The company was founded in 2007, growing predominantly by acquiring existing facilities. However, since 2012, the company has built and opened no less than four new projects. Based on experience with different building automation systems, Anima Care’s managers decided to focus on a single open platform for the future, leaving room for easy enhancements and adjustments, ensuring a high degree of interoperability. The company recently implemented this plan in its newly built “Au Privilège” retirement home in cooperation with FixSus, a new Belgian company that specializes in integrated building automation solutions.

Luc Devolder, head of technology Anima Care, knows from previous experience that openness cannot be taken for granted in the building automation industry: “In the past, we grew predominantly through acquisitions of existing homes, which forced us to deal with a multitude of different building control systems. In some facilities we were barely able to gain insight into how the technical systems worked and how much energy they consumed, due to the fact that the systems were closed solutions. This level of diversity also forced us to deal with different suppliers all over the place, and the nature of these relationships made changes very difficult.” Because of this experience, Luc Devolder wanted to install an open building automation system in all his new construction projects. “I have an industrial background, so this pushed me toward implementing the rules I learned there into our building automation systems as well. Together with FixSus, we developed a solution that is transparent and essentially makes us independent of specific suppliers.”

Open systems down to the individual components

The “Au Privilège” retirement home, which opened in August 2014 in Haut-Ittre, demonstrates how this works in practice. The entire building management system, from boiler controls to lighting control panels to the access control system and the in-house communication system, runs on a single CPU, a
Beckhoff CX5020 Embedded PC. Components such as light switches are linked to EtherCAT Terminals via conventional wiring. There are some exceptions, though. The Modbus-based room thermostats, for example, communicate with the controller via a serial EL6021 EtherCAT Terminal.

"If you decide to install an open system, you must implement the concept consistently, down to the individual components," Luc Devolder notes. This means that light switches – keeping with the previously mentioned example – are normal units that you can buy in any home improvement store, and can therefore be replaced at any time. They are not linked to the bus system, do not have individual addresses, require no configuration, and are connected via standard 24-volt wiring. He continues: "I believe that an open system must, most importantly, be easy to use. This means that the I/O units must be easily replaceable without having to adapt the entire system." Anima Care applied the same concept to its more complex systems, such as heating and ventilation. Even the heating system’s cascade control is not implemented separately, but as a fully integrated portion of the building management system. "This requires us to pay attention to openness, even for the smallest component. For example, all I/Os must be directly controllable from the central PC platform."

Entire building management system on a single flash memory stick

The building management system at “Au Privilège”, which was developed by FixSus, is called TIBA, or Total Integrated Building Automation. FixSus Managing Director Koen Verschuere explains: “After launching in 2009, we quickly won over several large customers who were looking for open systems. The large players in the building automation field use proprietary platforms, which ties the customer to a single supplier, including all modification and maintenance services. We wanted to break this trend. At the time, we tested several open systems from the industrial automation field and the Beckhoff Embedded PC series, along with the integrated I/O terminal system, looked like the best choice in terms of both performance and price."

The new retirement home has approximately 3,000 I/Os installed in total. “These are connected via EtherCAT Terminals with a CX5020 that has an Intel® Atom™ processor running Windows CE. Our entire building management system is stored on a flash memory stick. This delivers the advantage that a CPU failure can be remedied simply by inserting a backup memory stick into the new CPU, bringing the whole system back to full operation,” explains Luc Devolder.

Energy cost savings of up to 50 percent

Another great advantage of the PC platform is the ability to log all statuses, which takes about four seconds for this installation. During this time, a server at FixSus downloads all the data and uses it to perform various analyses. “Based on this data, we can analyze specific functions and make improvements. This has enabled us to implement up to 50 percent in energy cost savings, compared to similar projects,” explains Koen Verschuere. “Further benefits of the open system include our ability to log in remotely, check the current status, and make any necessary modifications. Customers who operate several facilities can thus administer all of them from a single location or ask us to perform this function as a service provider,” Verschuere notes.

Flexible expandability

To ensure the openness and flexibility of its system, FixSus developed the programming and the interfaces of its building management system completely in-house. The entire software is contained in modules, which can be reused and/or modified as needed. “For example, if the client decides to control the parking lot illumination with motion sensors, the required hardware can be connected relatively easily. The software requires only an additional module,” says Verschuere. These modules can be adapted and enhanced with new features without any system restrictions.
Thermal spraying is a coating process in which molten or heated material is sprayed onto a surface. Seeking to improve spraying quality, experts from Sichuan University, China created a 9-axis system in which a 3-axis rotary table works together optimally and simultaneously with a 6-axis robot. The system reaches its full potential by utilizing the performance benefits of open and fast control systems from Beckhoff.

Deyang Dongqi Surface Engineering Technology Co. Ltd., headquartered in the Chinese province of Sichuan, specializes in the creation of mechanical and electrical systems for machines used in surface treatment. In order to optimize the surface treatment process and the spraying quality in robot-based thermal spraying, the company turned to the School of Electrical Engineering and Information Technology (SEEI) located at Sichuan University.

Due to the relatively complex surfaces of the workpieces to be treated, and to make the thermal spraying process more flexible, the project developers suggested building a 3-axis rotary table as a clamping fixture in addition to the 6-axis robot already employed, providing the ability to optimally position the workpiece. The challenge of this 9-axis system is that the 3-axis rotary table developed independently by the SEEI, Sichuan University has an extended external axis which must move in perfect synchronization with the robot that guides the spray gun.

TwinCAT and EtherCAT solve time-critical motion control applications

In order to solve this task, numerous control platforms were evaluated by the experts of SEEI, Sichuan University: “Ultimately, we opted to use PC-based control technology, offering maximum flexibility and the best price-to-performance ratio. The wide range of available components and excellent collaboration between Beckhoff China and Sichuan University swung the search in favor of a PC Control solution. A further deciding factor was that TwinCAT software from Beckhoff represents an efficient and uniform automation platform.”

In order to ensure operational reliability of the rotary table, the CNC system must control three servo drives simultaneously, while also reading the force sensors and angle encoders for five ropes. TwinCAT NC 1 automation software for interpolated path movements is ideally suited to these kinds of complex machine kinematics, with high requirements for real-time transformation in the
In order to improve the quality in thermal spraying, the developers at SEEI, Sichuan University utilized a 3-axis rotary table working simultaneously with the 6-axis robot.

CNC. The Beckhoff CP2216 built-in Panel PC with 15.6-inch multi-touch display supplies sufficient computing power for the control of the rotary table system and communication with the robot controller. In addition, EtherCAT provides very fast data communication, enabling extremely short process image update times – the CNC operates with processing times of 2 ms, the electronic cam plates with 1 ms, and the drive control cycles with 250 μs.

**Significant time savings with TwinCAT**

TwinCAT offers ready-to-use Motion Control function blocks, which shortens the development period, facilitates improved programming processes, and radically accelerates commissioning. This also significantly reduces the overall time invested in the engineering process. The research director of the project, Prof. Songyi Dian from SEEI, Sichuan University has said: “We see extraordinary time savings of up to 70 %.”

Control of the 3-axis rotary table encompasses methods for the adjustment of the yaw, pitch, and roll angles. With the aid of electronic cam plates and the 3-axis interpolated Motion Control provided by TwinCAT NC I, as well as the modern PC- and EtherCAT-based control technology, the system ensures precise control of the five servomotors from the Beckhoff AM8000 series. Also from Beckhoff, the AX5000 Servo Drives used here fully leverage the performance of EtherCAT in the Drive Technology.

The AX5112 (12 A rated output current), AX5203 (2 x 3 A) and AX5206 (2 x 6 A) Servo Drives are used to carry out the three position changes of the rotary table. The pitch and roll movements each require two servomotors. This is where the AX52xx 2-channel Servo Drives come in to play, since they can drive two identical or different motors with a total current of up to 6 or 12 A respectively. Electronic gear units, implemented by means of software functions in TwinCAT, solve the problem of the double-motor drive load. This ensures that the accuracy of the drive synchronization meets the application requirements, streamlining the control system.

**Open automation system as an added bonus**

Following completion of the development, Prof. Songyi Dian and his group members from SEEI, Sichuan University see clear advantages in the use of Beckhoff control technology: “PC-based automation components ideally support the precise control of motion thanks to their high performance. TwinCAT and EtherCAT stand out as pillars of the automation solution, due to their unequalled openness. As a result, they are compatible with various fieldbus technologies and can communicate with any subsystem. Through the integration of the rotary table as an extended external axis, the quality of the thermal spraying has noticeably improved and the spraying process has been simplified significantly.”

Further information:
- [www.scu.edu.cn](http://www.scu.edu.cn)
Fully automated visual inspection system complies with highest quality standards

Chinese company Shanghai Tofflon Science and Technology has developed a fully automatic machine that uses light to inspect vials, medicine bottles, or infusion containers for glass fragments, aluminum particles, rubber grains, hairs, fibers, or other contaminants. It also detects damaged containers with cracks or inclusions (microscopic imperfections), automatically removing faulty or contaminated products. A Beckhoff Embedded PC running TwinCAT automation software controls the advanced inspection process.

Shanghai Tofflon Science and Technology Co., Ltd. was established in 1993 and specializes in the development and manufacturing of freeze dryers and complete freeze-drying systems for pharmaceutical production. The company’s Customized Packaging Systems division focuses on the design and implementation of turnkey solutions for complex packaging lines and processes in the pharmaceutical industry. In the future, Tofflon plans to cover all processes before and after the production of freeze-dried pharmaceuticals as well – from washing, drying, and filling bottles, to inspection and final packaging. “Creating an open, consistent, and module-based automation concept requires a scalable and open automation platform. We believe that PC-based control from Beckhoff is the best choice for our design,” explains Wang Yiming, head of technology at Tofflon’s inspection systems department.

PC-based control system running EtherCAT improves processes

Tofflon runs its fully automatic inspection system with a CX5020 Embedded PC leveraging EtherCAT as the fieldbus system, a variety of EtherCAT I/O Terminals, and TwinCAT software as the integrated PLC and Motion Control platform. “Our inspection machine requires a high degree of real-time capability and control cycles in the microsecond range – features that were not possible with conventional PLCs. The EtherCAT-based control platform from Beckhoff enables outstanding synchronization performance far below 100 microseconds, which opens the door to new process improvement opportunities. Compared with the manual inspection of pharmaceutical containers, our automatic visual system delivers considerable quality improvements, detecting 100 percent of contaminants,” explains Tofflon engineer Shi Yonggang.
The inspection machine detects contaminants, cracks, or inclusions (microscopic imperfections) with a high degree of reliability. Faulty containers are automatically removed.

Machine for the fully automatic optical inspection of containers for freeze-dried pharmaceuticals.

Tofflon’s fully automatic inspection machine has already reached volume production.

Tofflon uses EtherCAT as the fieldbus system for its inspection machine. The data is transmitted via EtherCAT Terminals and Bus Terminals.

Further information:
en.tofflon.com
www.beckhoff.com.cn
Bustling with over 28 million passengers annually, Kuala Lumpur International Airport (KLIA) is the 18th-largest in the world. And with a height of 133.8 meters, the control tower for the KLIA2 terminal of the Malaysian capital’s airport complex is the tallest in the world. B&I, a Malaysian trade publication for building automation, talked with three representatives of companies that were involved in the construction of KLIA2 and employed Beckhoff control solutions for their implementation of major operations from jetway controls to waste disposal.

Mr. Patrick Chong, your company, Perkasa Jauhari had the contract for building the control tower for KLIA2. How long have you been using building automation technology from Beckhoff?

Patrick Chong: We started working with Beckhoff in 2012 when we bid for the KLIA2 tower project and sought a capable supplier of advanced building management systems. Our choice to use Beckhoff control systems was based on the company’s convincing references in the building automation field. Beckhoff also provided us with excellent technical support. In the area of free-way construction and maintenance (one of our core competencies), we have our own M&E teams, but for these building automation applications, we wanted to work with an experienced partner.

What challenges did you face during the construction of the KLIA2 tower?

Patrick Chong: With an extreme height of 133.8 meters, the KLIA2 tower is the tallest in the world at this time. The construction alone was an ambitious project in itself, but the difficulty was exacerbated by the aggressive 10-month construction deadline. We also had to meet very high safety requirements and pass extensive tests with regard to the tower’s wind and earthquake resistance.

For its building management system, we employed Beckhoff Bus Terminals and an Industrial PC as a server. We also installed eight control panels, linked directly to the PC.

Mr. Pak Muhamad Asfar, your company specializes in jetways. What did C Two Engineering supply for KLIA2?

Pak Muhamad Asfar: C Two Engineering is a subsidiary of Indonesian jetway manufacturer, Bukaka. At the moment, we are retrofitting jetways at KLIA that Bukaka delivered in the late 1990s to Malaysia Airport Holdings Berhad (MAHB). Their control and automation systems have become so obsolete over the years that getting replacement parts was very difficult and expensive. That is why we proposed a new control solution to the airport, based on a Beckhoff Industrial PC, EtherCAT I/O Terminals, and TwinCAT automation software.

When did the cooperation between C Two Engineering and Beckhoff begin? And what is your experience with PC-based control technology?

Pak Muhamad Asfar: We began working with Beckhoff in 2010. For us, the greatest benefit of the company’s PC-based control solution is its openness. It
allows us to integrate virtually any device or program. Our previous solution, on the other hand, was based on a hardware PLC and offered very limited connectivity to other devices. Another strategic consideration was the fact that the jetways from JBT Corporation, which are currently in use at KLIA, also feature Beckhoff control technology. By standardizing the control platform, MAHB eliminated the need to hire any additional subcontractors for maintenance and repairs in the future. At this time, we are in the process of building a total of 30 jetways for KLIA2; six of them have already been delivered, and the feedback we have received from MAHB is very good thus far. The speed of signals and alarms between the jetway controller and the tower, for things such as usage time, operator ID, and availability, is much higher than before.

Are there any other advantages of the Beckhoff solutions, for example, with regard to system cost?

Pak Muhamad Asfar: The old PLC system used six I/O units per card. Now we are using EtherCAT Terminals with up to 16 channels in a 12 mm housing – a space-saving solution that costs less and reduces maintenance. It also requires less time for installation and wiring. Another advantage is its overall user-friendliness.

Mr. Daniel Tay, where else is the Beckhoff control system being used in addition to KLIA?

Daniel Tay: You can find our control technology in a number of current jetway applications, for example, at Penang International Airport or in Terminal 2 of Changi Airport in Singapore, where 32 jetways are equipped with Beckhoff control units. We deliver the control components and provide local support, while the program for the control system is developed in the USA and shipped directly from there.

You used a different control system in the past. What technical advantages do you see after your switch to Beckhoff?

Magesh Kumar Suppu: The excellent technical support provided by Beckhoff springs immediately to mind. Since their system works with a programming platform that was totally new to us, it was important for us to reach their technical support around the clock to get help in case something malfunctioned or stopped working. The most important reason for our choice to implement Beckhoff technology, however, was system flexibility. The open interfaces allow us to simply link it with other systems, for example, for building management or fire protection. This enables us to configure our waste disposal systems in accordance with the customer’s exact wishes. And since the Beckhoff controls platform is Windows-based, we can write our own programs and easily combine them with TwinCAT. We can also use the PC to communicate with third-party providers. With hardware-based controllers, this always required an extra PC. The Beckhoff system enables changes in the type and scope of the waste processing system with simple software modifications. Monitoring functionality has been increased, as well, since the PC-based controller enables remote access from anywhere using standard Internet connectivity.

Does Stream Environment have plans for any future projects with Beckhoff equipment?

Magesh Kumar Suppu: We have several applications in the works: a district project in Qatar, several restaurant centers, as well as a number of residential projects. In 2014 alone, we used Beckhoff technology in waste disposal systems for 16 residential projects with 3-story and 4-story complexes.

Originally published in Building & Investment | www.b-i.biz

Further information:
www.pjdnbhd.com.my
www.ctwoe.com
www.stream-environment.com
www.beckhoff.com.my
Marostica, a medieval town in the province of Vicenza in northern Italy, is known primarily for a chess game played with living figures. The event follows an old tradition, taking place for visitors every two years in September on the grounds of the marketplace. However, the historic town not only stands for culture, tradition and history; its efficient energy management of the town lighting also proves that, while honoring the past, it is also looking to the future. By means of an intelligent automation solution, the town leaders succeeded in considerably lowering the energy consumption for the lighting of the town center at night without negatively affecting the atmospheric illumination.

Giuseppe Marchiorato, who is responsible for the environmental department as well as the maintenance and the improvement of Marostica’s historic buildings, explains that the council has participated since 2014 in a joint plan of action for sustainable energy, specifically working toward the efficient use of energy. Accordingly, the mayors in the region have agreed to lower CO₂ emissions by at least 20 % by the year 2020. It is a goal that necessitates a series of measures, such as upgrading green spaces, increasing the energy efficiency of public buildings, or the installation of photovoltaic systems.

The administration in Marostica has already taken an important step: the lighting of the historic town center at night, which had previously accounted for 10 % of the total energy requirement of the municipality with its 14,000 inhabitants, now saves a considerable amount of energy through modern automation technology. “The goal of the conversion was to gradually save energy during the night hours, while maintaining safety and an appropriate lighting standard for the historic town center,” explains Giuseppe Marchiorato. The traditional method of simply switching the lamps on and off was replaced by a system that is able to intelligently control lighting scenarios in such a way that the light intensity of the individual light spots or groups of light spots can be varied depending on the time of night or day.

To accomplish this goal, the illumination of the historic town center was divided into five sections, controlled by a Beckhoff CX1010 Embedded PC as a master device, along with four Ethernet controllers from Beckhoff in the BX9000 series that act as slaves. Communication takes place via DALI. The master, to which a twilight switch is connected, controls the switching on of light spots and their luminosity on the basis of preset light scenarios. The lighting is programmed in such a way that the luminosity of the lamps is reduced by 20 % after 10 pm and by 50 % from midnight until they switch off in the morning. Apart from reducing the light intensity, the town administration now also uses energy-saving lamps, which provide a sufficiently bright, warm light. “Over the total switch-on time of the lamps, we save about 40 % of the electricity costs — amounting to around €10,000 per year,” says Giuseppe Marchiorato.

A further benefit of the intelligent lighting control is simplified operation and maintenance. “This can take place both locally and via remote control,” stresses Giuseppe Marchiorato. “If we want to vary the parameters for switch-on and luminosity, as may be required for concerts, markets, or other events, we can...”
change the lighting scenarios in certain parts of the town center both individually and together. The council technician no longer has to stand at the central control console to do this, however; it can be done more easily by remote control via the Internet on a PC, tablet or smartphone.

**PC Control enables flexible system expansion**

Giuseppe Marchiorato also regards the openness of the Beckhoff control solution and its modularity as great advantages which will allow expansion of the lighting system at a later date. "The Beckhoff Bus Terminal I/O system offers a wide range of interfaces, enabling the integration of other bus systems such as EIB/KNX, Modbus, and AS-Interface, and avoids any limitations with future expansions." New functions can simply be realized by adding further Bus Terminals, so the council is planning to gradually convert further light spots. These will be simple to implement, through the modularity of the I/O system.

Further information:
[www.beckhoff.it](http://www.beckhoff.it)
Self-learning robot recycles materials in fully-automated waste sorting facility

With the development of the “ZenRobotics Recycler”, a self-learning robot that reclaims valuable raw materials from the waste stream, Helsinki, Finland-based ZenRobotics Ltd is well on its way to revolutionizing the recycling industry. The system replaces the traditional manual labor during the sorting process and can profitably collect materials for recycling which were previously considered uneconomical. The improved separation of materials provides additional benefits, as recyclers now receive better prices for them. The system is controlled by an Embedded PC that runs the TwinCAT automation software platform.

The ZenRobotics Recycler (ZRR) is a fully-automated waste sorting solution that employs sensor data and “artificial intelligence”. It identifies and reclaims valuable raw materials such as metal, wood, stone, hard plastics, and cardboard from mixed construction and industrial waste. Specially designed for robust performance, the high-speed Cartesian robot identifies objects of different shapes and sizes and is capable of picking up to 2,000 recyclable items per hour. A system with two ZRR robots executes up to 4,000 picks per hour, which is the equivalent of approx. 16,000 tons per annum in a two-shift operation.

Beckhoff helps make automated sorting processes more dynamic

The master computer processes sensor data in real-time, recognizes the objects on the conveyor belt, and computes the target position for the robot positioning. Motion control is handled by a CX2050 Embedded PC, which also controls all of the system’s I/O operations. The master computer sends the commands for the motion axes, gripper movements, and conveyor belt control, among other functions, via the EtherCAT Automation Protocol (EAP). With acceleration up to 3Gs and speeds of up to 3 meters per second, the robot’s axis movements are highly dynamic. Identifying the various objects coming down the conveyor belt based on their size, shape, and material is only possible with self-learning robotic intelligence that rapidly responds to continuous changes and learns from mistakes. Because collisions between the robot’s gripper and objects still happen occasionally, the controller must recognize them quickly to prevent mechanical damage and avoid line stops. “TwinCAT gives us a solid handle on the motion control, because we can respond in real-time,” explains Juha Koivisto, the Project Manager at ZenRobotics.

Each robot operates with four AX5000 Servo Drives that include integrated TwinSAFE option cards, and AM8000 servomotors, all from Beckhoff. “By utilizing the motors’ One Cable Technology, we were able to reduce the wiring requirements by 50 percent,” adds Juha Koivisto. The web-based HMI runs on a Beckhoff CP2915 Control Panel with a 15-inch multi-touch screen. “Our customers love the elegant panel design and the modern operator interface technology,” adds the Project Manager.

He is also very satisfied with the control platform’s modularity and component diversity: “Beckhoff offers a wide portfolio of modular and scalable components, which allowed us to be very flexible in designing the system. The ability to manage PLC and motion control within one programming environment has also become a huge benefit. Another plus was the ease of integrating the Beckhoff PLC with other Ethernet-based technologies over EAP.”
Scalable safety solution addresses customer needs
Since TwinSAFE is an integrated part of the TwinCAT platform that can be easily combined with other system components, individual safety objects can be integrated into the project, or excluded from it. “This function is very useful, for example, if you want to include a non-defined number of individual robots into the project,” explains Juha Koivisto.

The designer can select from various safety features such as SLS (Safe Limited Speed) or SLP (Safe Limited Position) – depending on customer requirements. “Because of the scalability of the TwinSAFE solution, we can offer our customers safety solutions that perfectly match their needs. The integrated TwinSAFE cards in the drives have the advantage that no additional wiring or drive firmware is required. Any functionalities and enhancements are software-based and can be easily updated.”

Efficient recycling based on accurate analytical data
The ZenRobotics Recycler uses several sensor inputs to identify a wide range of objects and/or materials in the waste stream. Consolidating the sensor data makes it possible to more accurately analyze the waste. For the first time, the system can now prepare real-time statistics of the composition, as well as tracking the weights and values of the waste stream. Unlike other sorting methods, the robotic waste sorting system is able to process specific components with a high degree of accuracy. It can even process multiple components simultaneously, which improves the efficiency of the waste processing system. “Our customers continuously receive software updates, because the ZenRobotics Recycler constantly learns. The software can be updated for better performance or to sort new materials, which makes this a future-proof investment for more profitable recycling,” stresses Juha Koivisto.

Automation for sustainable success
“The consistent engineering tool, the modular and highly scalable product portfolio of Beckhoff, as well as the scope and quality of their technical support in the development phase, were important factors for the success of our automation solution,” adds Juha Koivisto. “We are already looking forward to the transition to TwinCAT 3 software, which will enable us to shift parts of the higher-level C++ code to the machine controller and further improve the systems’ real-time functionality. We also see great benefits for us in the version management capabilities of TwinCAT 3.”

Further information:
www.zenrobotics.com
www.beckhoff.fi
10 years of success with Beckhoff France

The Beckhoff subsidiary in France officially commenced operations on February 1, 2005. General Manager, Rombaut Keta and his team have been committed to popularizing PC-based control in the French automation market ever since. In an interview with Jean-Sebastien Scandella, editor of Jautomatise, Rombaut Keta talks about the business growth in recent years and his subsidiary's outlook for the future.

You can look back on a successful decade as the General Manager of the French Beckhoff subsidiary. Nevertheless, it must not have been easy to penetrate the French market with "Made in Germany" technology.

Rombaut Keta: You are correct. Back then, the French automation market was dominated by hardware PLCs, and PC-based controllers were certainly a rarity. On the other hand, we did not have to start at "zero" in terms of Beckhoff brand awareness in the French marketplace. Jeambrun Automation started selling Beckhoff components in 1999, but not with high expectations for immediate success. And since France, as Germany’s largest European trading partner, was and still is a significant market for Beckhoff, Hans Beckhoff decided to open an official subsidiary in France and asked me to manage it. It was quite a challenge, but we posted sales of almost 1 million euros the first year – with only three employees. We have grown steadily ever since, both in terms of personnel (now 19) and office locations. Needless to say, we also accumulated plenty of expertise over the years. Today, the PC-based control philosophy from Beckhoff has become firmly established in France. But, most importantly, our first customers continue to put their trust in us and in our technology.
On what do you base the success of Beckhoff in France?

Rombaut Keta: What sets Beckhoff apart is our innovative technology, which is based on four pillars: (a) TwinCAT automation software at the center of the controller, (b) the Industrial PC as the standard hardware platform on which all automation functions run, including motion control, robotics, and measurement technology, (c) our universal I/O Terminals, and (d) our Drive Technology. And since our solution is more open, more flexible, and more scalable than comparable solutions, it provides our customers with significant competitive advantages.

With the very successful development of EtherCAT, Beckhoff has set another milestone in automation technology. In many industries, this fast, Ethernet-based communication system has become an accepted standard because of its openness, high performance, and reliability.

At the center of the Beckhoff control philosophy is the idea that hardware components can be replaced with software functionalities. This simplifies the control system architecture and the engineering, while improving system communication, and reducing costs.

What is your outlook for Beckhoff France in the coming years?

Rombaut Keta: In France, we are aiming for sales of 10 million euros in 2015. Our core business continues to be manufacturing systems engineering, but we are working hard to gain market share in other industries where our technology is highly beneficial, such as measuring systems, building automation, and infrastructure projects.

We continue on a course of expansion, both in terms of personnel and office locations. To provide our customers with the best possible service and support, we have opened a sales office in Metz-Tessy (2012) and a technical office in Bras-sur-Meuse (2013), with more locations to follow in 2015.

Published in: Jautomatise N° 99, March/April 2015

Further information:
www.beckhoff.fr
In a major new partnership of global proportions, the EtherCAT Technology Group (ETG) and the OPC Foundation signed a memorandum of understanding at Hannover Messe 2015. Instead of focusing on extending their own technology into each other’s core segment (horizontal and vertical communications technologies), the parties agreed to cooperate in the development of common interfaces for Industry 4.0 and the Internet of Things (IoT).

Both organizations agree that their respective technologies complement each other perfectly – EtherCAT as a highly capable, real-time Ethernet fieldbus for machines and system controllers with the EtherCAT Automation Protocol (EAP) for lean data traffic between masters, and OPC UA for scalable communication with integrated security up to the MES/ERP level and the Cloud.

The memorandum of understanding was signed by Martin Rostan, Executive Director of the ETG, and Thomas J. Burke, President and Executive Director of the OPC Foundation. “With this agreement, we are laying the foundation for the standardized integration of EtherCAT systems into Industry 4.0 and IoT architectures. The Technical Committee of the ETG determined in October 2014 that we consider OPC UA the tool of choice for connecting with the Cloud and the IT world. Subsequent developments have proved us right, which is why we are very pleased to announce this cooperation for the rapid definition of standardized interfaces,” said Martin Rostan. Tom Burke added: “EtherCAT is one of the leading technologies on the field level and provides an ideal complement to our functionality. OPC UA is not a competitor of fieldbuses; it seeks to enable the consistent, safe, and scalable communication of such systems into the IT world. Thanks to the common development of interfaces between both our associations, we expect quick and practice-oriented results which, of course, we will all welcome.”

Martin Rostan, Executive Director of the ETG, and Thomas J. Burke, President and Executive Director of the OPC Foundation, after signing the agreement on the definition of common interfaces (from left to right).
ETG news now available on Twitter and LinkedIn

Providing even easier access to timely news and event information for anyone who’s interested in all things EtherCAT, the EtherCAT Technology Group (ETG) recently expanded its social media activities. In addition to the organization’s official profile on LinkedIn, the ETG now also maintains an official Twitter account under the handle “@EtherCAT_Group”.

Further information:
www.twitter.com/EtherCAT_Group
www.linkedin.com/company/ethercat-technology-group

2015 Spring European EtherCAT Plug Fest

The interest in EtherCAT Technology Group (ETG) interoperability meetings, also known as EtherCAT Plug Fests, further increased in 2015. This can be attributed in large part to the rising number of EtherCAT products available on the market, as well as the events’ significant support role in the development process of devices.

The 70 participants brought 12 EtherCAT master and 42 EtherCAT slave devices to this year’s event in Hamburg, Germany, setting a new ETG record in terms of master/slave combinations tested. Additionally, with the presence of five EtherCAT slave controller manufacturers, the Plug Fest saw more EtherCAT chips than ever before. One of these manufacturers was Trinamic Motion Control, which took the opportunity as the event’s host to introduce its TMC8460 as the first product in the company’s new family of EtherCAT slave controllers.

ETG representative, Dr. Guido Beckmann explained: “Our Plug Fests are especially useful for EtherCAT devices that are still in the design stage, because they help developers get in-depth answers to open questions and identify any necessary changes with regard to interoperability and conformity before the market launch.”

In addition to the EtherCAT Plug Fests in Europe, the ETG holds similar events in Asia and North America on an annual basis.

Further information:
www.ethercat.org/events
The highly successful Prolight + Sound 2015, international trade show for technology and services in the areas of entertainment, integrated systems and creation, which took place from 15th to 18th April in Frankfurt, Germany, reflects an upward trend in the entertainment industry: More than 42,000 trade visitors from all over the world gathered in Frankfurt to learn about the available products and services in the event industry. “The motto of our trade show presence is ‘Enabling your creativity with PC-based control’”, explained Michel Matuschke, Vertical Market Manager Stage and Show Technology with Beckhoff. “Here, system integrators and end-users not only find the necessary components, but also the required expertise and application support to technically implement the creative ideas of their artists and designers.”

The Beckhoff PC-based control technology is modular and open and therefore ideally suited to the applications in stage and show technology. “Since all relevant stage technology interfaces and protocols for lighting, audio and multimedia – like e.g. DMX, sACN, ArtNet, SMPTE timecode and PosiStageNet – are already integrated into our technology platform, there are essentially no limits on the ways in which our customers can implement their creative ideas – nor on the ways in which they can incorporate and use our components”, said Michel Matuschke.

Further information:
www.beckhoff.com/prolight-sound
The organisers of the Anuga FoodTec in Cologne drew a positive balance after three trade show days with a record number of exhibitors and visitors: more than 45,000 trade visitors took the opportunity to sound out the product ranges of the 1,500 exhibitors.

The trade show was also a success for Beckhoff. “Automation technology is a decisive factor if you want to rethink and optimize production processes in food production and packaging. Thanks to its openness, the universal control platform from Beckhoff can easily be used not only for retrofits and extensions of existing plants, but also as a seamlessly integrated, coordinated complete system for the automation of entire plants. More and more notable machine manufacturers are making use of the possibility to universally automate entire applications with control technology from Beckhoff, for example in the filling and packaging sector”, reports Frank Würthner, Branch Management Packaging Technology.

Further information:
www.beckhoff.com/anugafoodtec

Ligna 2015, the world’s leading trade fair for woodworking machinery, plants and tools has come to a successful conclusion in Hanover. 1,567 exhibitors presented pioneering solutions and technologies plus innovative production plants to 96,000 specialist visitors.

Stefan Sieber, Business Manager for the wood processing industry at Beckhoff commented: “High-end furniture manufacturers are increasingly becoming interested in how they can themselves use automation to make their production processes more flexible, rather than leaving this solely to their suppliers in the mechanical engineering sector, because it is individualized production that is the key to their success.”

Further information:
www.beckhoff.com/ligna
Trade shows 2015

Europe

Germany

Husum Wind
September 15 – 18, 2015
Husum
Hall 5, Booth 825
www.husumwind.com

FachPack
September 29 – October 01, 2015
Nuremberg
Hall 3A, Booth 331
www.fachpack.de

Motek
October 05 – 08, 2015
Stuttgart
Hall 9, Booth 9108
www.motek-messe.de

FMB – Zuliefermesse Maschinenbau
November 04 – 06, 2015
Bad Salzuflen
Hall 20, Booth E14
www.forum-maschinenbau.com

SPS IPC Drives
November 24 – 26, 2015
Nuremberg
Hall 7, Booth 406
www.mesago.de/sp

Denmark

HI
September 22 – 24, 2015
Herning
Hall E, Booth 4140
www.hi-industri.dk

Finland

Suomen Asuntomessut
July 10 – August 09, 2015
Vantaa
www.asuntomessut.fi

ValoLight
September 09 – 13, 2015
Helsinki
www.valolight.fi

Automaatio
October 06 – 08, 2015
Helsinki
Hall 6
www.messukeskus.com

Klippeistö
November 18 – 20, 2015
Helsinki
www.messukeskus.com

France

Smart Industries
September 15 – 17, 2015
Paris
www.smart-industries.fr

Hungary

DCS - Distributed Control Systems
October 20 – 22, 2015
Lillafüred
http://dcs.afki.hu

Italy

EMO Milano
October 05 – 15, 2015
Milan
www.emo-milan.com

ITMA
November 12 – 19, 2015
Milan
www.itma.com

Sweden

Elmia Fastighet
September 22 – 24, 2015
Jönköping
www.elmia.se/fastighet

United Kingdom

PPMA Show
September 29 – October 01, 2015
Birmingham
NEC, Booth H50
www.ppmshow.co.uk

Tabexpo
October 20 – 23, 2015
London
Booth F40
www.tabexpo-london.com

Engineering Design Show
October 21 – 22, 2015
Coventry
Ricoh Arena, Jaguar Hall, Booth D15
www.engineering-design-show.co.uk

Africa

South Africa

The Control Roadshow Port Elizabeth
August 27, 2015
Port Elizabeth
Booth 24
www.whatstnewinprocessing.co.za

Asia

China

Zhengzhou Industrial Exposition
August 21 – 23, 2015
Zhengzhou
www.hm-zif.com

AHTE
August 26 – 28, 2015
Shanghai
www.shanghaiahte.com
SIBT  
September 23 – 25, 2015  
Shanghai  
www.sibt.com.cn

China Wind Power  
October 23 – 25, 2015  
Beijing  
www.chinawind.org.cn

CeMAT Asia  
October 27 – 30, 2015  
Shanghai  
www.cemat-asia.com

Industrial Automation Show  
November 03 – 07, 2015  
Shanghai  
www.industrial-automation-show.com

India  
Automation  
August 24 – 27, 2015  
Mumbai  
Hall 1, Booth D-07  
www.iemcommunications.com

Engimach  
December 03 – 07, 2015  
Ahmedabad  
Hall 12, Booth E15  
www.engimach.com

Canada  
CMTS  
September 28 – October 01, 2015  
Mississsauga  
Hall 1, Booth 1509  
www.cmts.ca

Japan  
Japan Pack  
October 13 – 16, 2015  
Tokyo  
www.japanpack.jp

System Control Fair  
December 02 – 04, 2015  
Tokyo  
www.scf.jp

Pack Expo Las Vegas  
September 28 – 30, 2015  
Las Vegas  
Hall South, Booth 6163  
www.packexpolasvegas.com

Fabtech  
November 09 – 12, 2015  
Chicago  
Hall South, Booth 3586  
www.fabtechexpo.com

USA  
Process Expo  
September 15 – 18, 2015  
Chicago  
Booth 3234  
www.myprocessexpo.com

For additional information on our worldwide subsidiaries’ and partner companies’ trade show schedules please check:  
www.beckhoff.com/trade_shows