

EtherCAT: Benefits for the user

Widely supported, wide open technology



Michael Jost, Beckhoff Product Manager for Bus Terminals and EtherCAT

→ PC-Control asked Michael Jost and Uwe Prüßmeier, both Beckhoff Product Managers for Bus Terminals and EtherCAT Terminals, about the suitability for practical operation, openness and tangible user benefits of the new EtherCAT-based Bus Terminal technology.

PC-Control: EtherCAT opens up new dimensions for industrial data communication. But is it actually designed in a truly application-oriented fashion?

Michael Jost: Definitely. This is guaranteed by our extensive EtherCAT communication experience gained in the field since 2003. Additional factors are compatibility with the existing Bus Terminal range – and the associated wide range of products – as well as the fact that the system is based on technology that has been tried and tested thousandfold in practice. EtherCAT is by no means an exotic product, either in the field of fieldbus communication or when compared with other Ethernet-based systems. This is indicated not least by the broad support from a wide range of automation providers and users within the EtherCAT Technology Group (ETG). The list of more than 380 ETG members, accessible via www.ethercat.org, is a clear demonstration of this support.

PC-Control: As a result of this, has EtherCAT demonstrated its openness?

Michael Jost: EtherCAT is clearly an open technology, driven by a wide range of committed companies. However, openness also has a range of other aspects to consider. EtherCAT is fully compatible with the Ethernet of the IT world and, therefore, with internet technologies such as web server and FTP. In terms of practical application, the concept is also open. For example, operation with switches and routers or mixed operation with other communications protocols is possible. In addition, the EtherCAT protocol was not only made available openly, but also included in the IEC specification.

PC-Control: What exactly does openness mean in practice?

Michael Jost: The whole Beckhoff system – including EtherCAT, terminals, and the TwinCAT automation software – is open, flexible and at the same time easy to handle. This results in significant benefits for the user. Many specialized automation users can even do without our high-performance TwinCAT master by writing their own customized masters and using EtherCAT and the Beckhoff I/O system as a basis. Currently, there are more than 50 specialized masters from other suppliers who have only implemented some of the TwinCAT functions for their applications.

PC-Control: Does the development of EtherCAT Terminals mean that Bus Terminals have reached the end of the road?

Uwe Prüßmeier: No, definitely not. The Bus Terminal as a basic automation component will continue to play an important role in new automation concepts. Some of our customers continue to use traditional fieldbus systems such as PROFIBUS, CANopen or our Lightbus. The bus-neutral Bus Terminal system is ideally suited for this purpose. In addition, it offers a very practical signal variety. Full implementation of an E-bus to all K-bus Terminals will still take some time. In many sectors, the Bus Terminal will remain the standard. Examples are building automation, where the high performance offered by EtherCAT Terminals is not required. Here, our preferred solution remains Ethernet TCP/IP plus standard Bus Terminals.

PC-Control: Are both I/O systems being developed further in parallel?

Uwe Prüßmeier: Yes! Whenever we integrate new signal types in our control concept, we offer associated terminals for both systems. Both systems will continue to be maintained in parallel, with the exception of certain terminals due to the technology involved: for example, due to the high data volume, the EL6224 IO-Link terminal is only available for E-bus, because analog value sampling with 10 µs would not be meaningful in a PROFIBUS system.

PC-Control: FPGA-based EtherCAT Terminals have already been available for 3 years. When will terminals with EtherCAT ASIC be available?

Michael Jost: Currently more than 100 EtherCAT Terminals with ASIC are being developed. The first terminals with ASIC will be delivered during the first quarter of 2007. From a functional point of view, it is largely irrelevant for our customers whether the communication is realized via an ASIC or an FPGA. Some terminals will continue to operate with FPGAs in the long run. The quality of the solution is not influenced by the type of EtherCAT slave controller. Some terminals, such as the 8-channel versions, can only be realized with ASIC, because it requires significantly less space on the board.



Uwe Prüßmeier, Beckhoff Product Manager for Bus Terminals and EtherCAT

PC-Control: Everyone has been talking about Industrial Ethernet for some time now. However, does it really offer increased performance, for example in the form of EtherCAT?

Uwe Prüßmeier: Definitely. One could even refer to a quantum leap in terms of performance. The impressive technical parameters, e.g. the available system size of up to 65,535 devices or the processing of 1,000 distributed I/Os in 30 μ s, are almost irrelevant. Network size and speed have increased to such an extent that the technical limits for automation applications simply no longer exist, i.e. the data quantity to be transferred or the required transfer time are generally no longer relevant system design factors.

PC-Control: What benefits does this kind of quantum leap offer for practical applications?

Uwe Prüßmeier: There are several aspects. Fast EtherCAT Terminals, which can be configured as extensive systems, open up new areas of application that, in the past, were unable to benefit from bus communication for technical reasons. In addition, the new terminals are also more cost-effective. The shift in capacity limits beyond the actual application requirements leads to a significant reduction in the design and commissioning effort, whereas in the past, borderline cases and their handling used to be one of the main challenges for system designers.

PC-Control: New technologies are always associated with a certain risk. Can users be sure that EtherCAT will deliver?

Uwe Prüßmeier: Yes, absolutely. This is already apparent from the continuity within our terminal system, i.e. EtherCAT enables the tried and tested and comprehensive range of K-bus Terminals to be integrated as required. In addition, Beckhoff has contributed extensive know-how based on numerous applications and terminal developments to the EtherCAT technology. Another factor is that EtherCAT Terminals use proven mechanical and electronic components with optimum performance data.

EtherCAT-based precision

The high data throughput offered by the EtherCAT Terminals is not an end in itself – it enables unprecedented terminal block functionality. A good example are distributed clocks for ensuring high-precision synchronization: in contrast to fully synchronous communication, where synchronization quality suffers immediately in the event of a communication fault, distributed aligned clocks have a high degree of tolerance for possible fault-related delays within the communication system. With EtherCAT, data exchange is purely hardware-based. Since the communication utilizes a logical (and thanks to full-duplex Fast Ethernet, also physical) ring structure, the “mother clock” can determine the run-time offset to the individual “daughter clocks” – and vice versa – simply and accurately. A network-wide time base with a jitter of significantly less than 1 μ s is thus available.

However, high-resolution distributed clocks are not only used for synchronization, but can also provide accurate information about the local data acquisition time. Thanks to new extended data types, very precise time stamps can be assigned to measured values. For example, the digital EL1252 input terminal can register fast binary control signals from the process level and identify them with a time stamp that indicates the time of the last edge change with a resolution of 1 ns. In conjunction with the digital EL2252 input terminal (also with time stamp), the EL1252 enables responses with equidistant time intervals, largely independent of the bus cycle time. Overall, the higher temporal resolution offered by the EtherCAT Terminals leads to higher mechanical precision of the automated machine and reduced cycle time and, therefore, reduced CPU costs.

Oversampling data types for high-resolution measurements are offered by the 2-channel analog input terminal EL3702, for example, which scans signals in the range between -10 and +10 V with an adjustable integer multiple (oversampling factor n) of the bus cycle time. For each of these so-called microcycles, the EtherCAT Terminal generates a set of process data that is collected and transferred during the next bus cycle. This procedure enables the temporal resolution of the analog input signals to be increased to n times the bus cycle time. In conjunction with the analog EL4702 output terminal (also with oversampling), here too responses with equidistant time intervals, e.g. in the event of a threshold value being exceeded, become possible.