

Windows CE 5.0 in automation technology applications

→ Since the release of version 3.0, more and more industrial automation users are switching to Windows CE. Of special interest – in addition to real-time capability and comprehensive network functions – is the fact that Windows CE supports advanced software tools such as XML and .NET. The new CX1020 Embedded PC from Beckhoff is based on Windows CE 5.0. Ramon Barth, manager software development at Beckhoff, provides an outline of some of the new features.

With version 5.0 Windows CE has matured further, reducing the gap with desktop Windows. Due to its real-time capability and its small “footprint,” Windows CE is quite suitable for general embedded applications. Windows CE 5.0 supports OEMs dealing with automation technology even better than before and enables them to concentrate on their own core competency. The new licence conditions and the low basic price for the core version make the Windows CE product increasingly interesting.



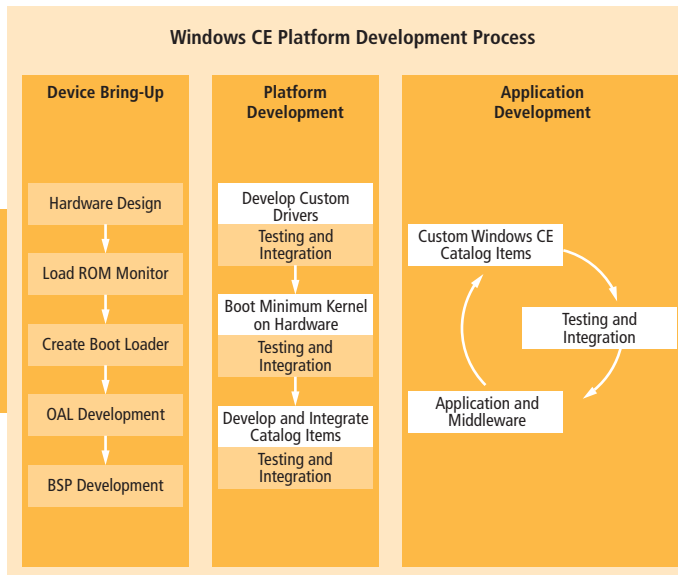
Windows CE 5.0 from Microsoft offers new operating system features (including hardware support) and the “Platform Builder” development system. Windows CE 5.0 includes many innovations, none of which are revolutionary on their own, but overall, the modifications and extensions round out the existing operating system features. Windows CE reduces the development gap compared with desktop Windows while retaining its significantly smaller “footprint.” The smallest Windows CE implementation only requires approx. 300 kB of ROM. The size of the core version of the Windows CE platform for the CX1000 Embedded PC from Beckhoff is approx. 8 MB – there had not been special attention paid to size optimization during its development.

Quality for short time to market

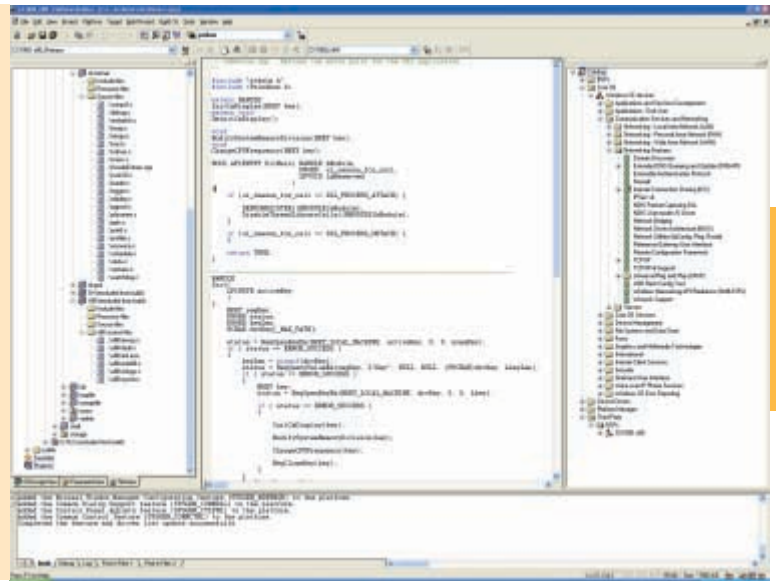
Following requests from many OEM customers, Microsoft fundamentally revised the OAL (OEM adaptation layer), BSPs (board support packages) and device driv-

ers provided for Windows CE in terms of performance, portability and maintenance. Microsoft now talks about “production quality”. This means: OALs and device drivers were revised with particular attention to maintainability and portability. The monolithic structure of the previous OAL version made adding or removing functions for adapting the software to different hardware configurations quite difficult. Componentizing of the OAL makes reusing code and hardware adaptation within a processor family much easier. Ultimately, this results in shorter development times for the OEM. Particularly for automation technology, where products are often sold in small or medium quantities, this is an essential factor. No OEM wants to invest man-years in the development of the operating system platform.

The documentation is an additional time-saving tool. For Windows CE 5.0, the help system and the content of the “Platform Builder” development tool has been revised and expanded.



“Development Process” Windows CE platform



“Platform Builder” 5.0

Windows CE includes CETK (Windows CE Test Kit) as support for OEM quality assurance efforts. For CE 5.0, this feature was fundamentally revised with simpler operation in mind. The number of individual tests available was increased from 30 to 50. Many aspects of an embedded device can, thus, be checked with ready-made, standardized tests without having to write special test code. The new OAL cache test, for example, checks the memory system of a Windows CE device. It can detect faults in memory chips or in the OAL implementation.

Improvements in the “Platform Builder”, the development environment for Windows CE platform design, also increase the productivity. The “Platform Builder” (PB) is essentially a graphical user interface (GUI) for the command line-based Windows CE build process. Specifically, PB 5.0 standardizes the Windows CE for IDE and command line creation process. This results in simplified handling for the developer. Even though the new build options shorten the development process, it is still relatively demanding, which is why it is advisable to use a high-performance PC for development tasks (3.x GHz CPU, 512 MB RAM and fast hard disk system, e.g. SATA RAID 0). Ultimately, the efficiency of the “Platform Builder” depends on the product philosophy of the device manufacturer: Beckhoff, for example, offers customer-specific Windows CE configurations for its devices, which involves intense utilization of the PB. Other providers offer a device type with a fixed Windows CE configuration.

Convenience and availability through up-to-date hardware

Apart from improvements to existing features, interesting new hardware support features have been introduced. The PCMCIA/PC card architecture was fully revised; for example, it now supports 32-bit card bus controllers, which significantly increases the number of available controllers and interface cards. This particularly applies to 100-Mbit Fast Ethernet adapters and 802.11g 54-Mbit WLAN cards, for which the PCMCIA interface offers insufficient data throughput. Another issue is USB 2.0. Automation technology offers a growing number of devices and chips for this interface. Windows CE 5.0 now also provides driver support. Particularly noteworthy are the USB 2.0 EHCI host controller driver and the

USB function controller drivers. For example, they enable the OEM to connect the automation device with a PC as a “mass storage” device via USB. In this way, the end user benefits from convenient access to the device data.

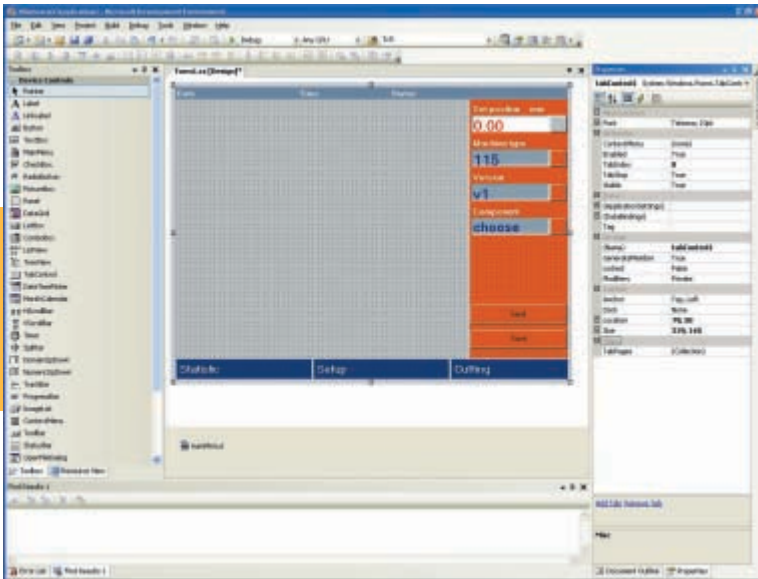
Support for advanced technologies such as USB 2.0 is also important from the point of view of component availability and applicability of Windows CE on modern PCs. The first thought that usually comes to mind in conjunction with Windows CE are small devices with rather low computing capacity, but Windows CE can just as well be used on a modern PC. Microsoft and various chip manufacturers offer suitable drivers. On a Pentium-M-based Embedded PC with Windows CE 5.0, for example, real-time applications with cycle times of 100 µs or large machine control tasks can be realized. Performance-hungry Windows CE SCADA applications can also be satisfied with modern PC technology.

Graphics performance for intelligent monitors

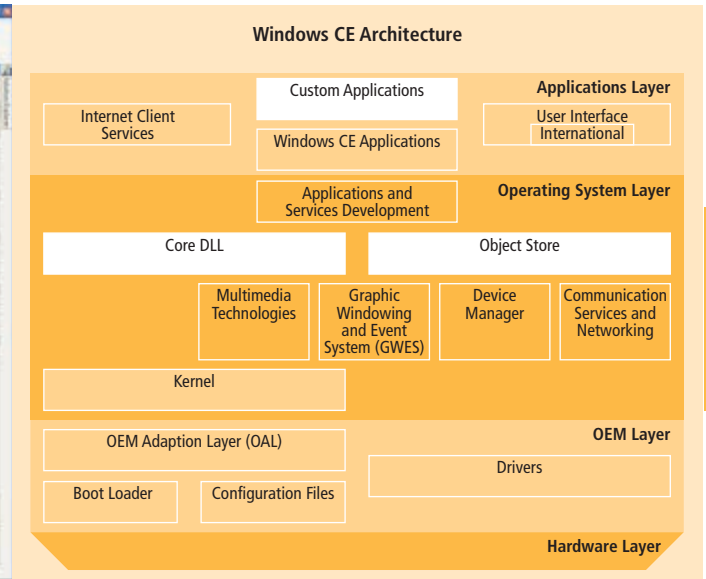
Many applications use Windows CE as the operating system for visualization systems. The fact that Windows CE version 5 introduces a range of optimizations and extensions such as Direct3D-Mobile (Mobile refers to a “light” version) is good news. “Thin client” applications, in which the Windows CE device is used as an intelligent screen for a remote server, benefit from a revised RDP implementation (RDP = remote desktop protocol). On one hand, Windows CE now supports RDP 5.5 (instead of 5.1), on the other hand, an optimized process architecture promises performance improvements by up to 30%. Due to their low computing power and memory requirements, “thin clients” can be operated with passively cooled processors and flash memory, enabling robust configuration of industrial operating stations. One or several of these “screens” can be connected with a server via Ethernet-based media.

Efficient application development with advanced software tools

Windows CE 5.0 forms the basis for further intelligent device developments from Microsoft. .NET Compact Framework 2.0 and Visual Studio 2005, for example, require CE 5.0 embedded devices. These new tools are very interesting for software



Visual Studio 2005, development environment



Windows CE system architecture

developers. They offer optimized speed and version 2.0 with .NET CF closes certain gaps compared with .NET Framework for the desktop, making multi-platform development much easier. In addition to the functionality already provided by version 1.0, “.NET CF-2.0” now supports COM interoperability, user controls, XPath and a complete ADO.net, for example. Another useful new feature is automatic adaptation of the visual elements to the screen resolution and orientation.

Visual Studio 2005 offers new graphic design tools for creation of user interfaces in WYSIWYG (What You See Is What You Get) mode. Furthermore, Visual Studio 2005 offers exciting new features for the C++ developer community. Previously, C++ programs for Windows CE-based devices were written with embedded Visual C++. VS 2005 integrates this process into the general Visual Studio environment and features the same compiler front end as the desktop compiler. This facilitates migration from Win32 applications. Furthermore, C++ developers are provided with a modern compiler that meets current standards.

In addition, the debugging interface in Windows CE was completely revised, greatly assisting the development of software for Windows CE devices. Windows CE 5.0 introduces an integrated interface for communication between the development PC and the Windows CE based device. This infrastructure is referred to as “core connectivity” and is supported by “Platform Builder” (IDE for development of the Windows CE platform) and Visual Studio 2005. However, it should be noted that version 5 of Windows CE still only offers a subset of the functions available in Windows XP, which is understandable given its much smaller size. Usually this does not equate to restricted functionality, since Windows XP includes many of the missing API functions purely for compatibility reasons. However, this fact has to be taken into account in the development of migration-capable software.

Windows CE 5.0 devices come with “Windows CE Error Reporting”, a “Dr. Watson”-style tool for improved troubleshooting. When an application crashes, the tool saves information that can support the debugging efforts of the software developer. Even though “Dr. Watson” is a rather unwelcome guest with users, the log files facilitate the detection of application errors. Only time will tell how often the option of uploading the log files to “watson.microsoft.com” will be used in practice.

Thanks to the separate address spaces for processes under Windows CE, application errors have no impact on the stability of the overall system. TwinCAT CE from Beckhoff, for example, continues to run as a real-time Windows CE process, while another process may write its application errors into the Dr. Watson file. It should be noted that, thanks to TwinCAT CE, Windows CE devices can also be programmed with the IEC 61131-3 programming languages. This is an efficient approach for most automation applications without a visual display.

Network and communication

Comprehensive network functionality has been one of the fundamental features of Windows CE right from the start. Here too, version 5.0 offers improvements such as peer-to-peer networking (API and protocol configuring server-less networks consisting of equal network devices) and improved performance for TCP/IP routing and bridging. Peer-to-peer support simplifies the configuration of machine systems with distributed Windows CE nodes. Today, networking of automation devices via Ethernet is state of the art in automation technology applications. However, like with all communication technologies, problems can still occur. Network monitors that record the data traffic are often used for diagnostic purposes. The “NDIS Packet Capturing” component of Windows CE 5.0 supports recording of network telegrams directly on the Windows CE device. The sample implementation supplied with the source code saves the data traffic in a format that is compatible with the “Microsoft Windows Network Monitor”. The code can be modified if an alternative data format is preferred.

In terms of network functions, device manufacturers will also be interested in the “Remote Configuration Framework”, the basic infrastructure for creating web-based user interfaces for devices without visual displays offered by Windows CE 5.0. Windows CE’s speech input interface offers a somewhat different type of communication, the benefits of which may not be immediately apparent in the context of automation. This function enables the realization of speech-controlled applications for building automation, for example. This was used for speech-controlled doors at the Chelsea Flower Show 2004 (the world’s largest flower and garden fair). PLC programmers can easily link speech commands and local PLC variables via an XML file.

As a provider of PC-based control technology, Beckhoff benefits from the utilization of different Windows operating systems. Beckhoff is able to offer a uniform technology based on the same basic code, ranging from very small Windows CE devices to very powerful PCs with Windows XP.

Licensing

With Windows CE 5.0, the license conditions for utilizing and changing the Windows CE source code were modified. All licensees now have access to the source code (shared source) and can modify it. They even have permission to sell the derivatives commercially. Licensees retain ownership of their derived code and do not have to share their modifications with Microsoft, partners or competitors. A device manufacturer may, for example, optimize the scheduler in the Windows CE kernel for his applications and sell the modified Windows CE with his devices. No disclosure whatsoever of the modification is required, so that the "know-how" of the device manufacturer remains protected.

The costs for an individual core version license remain unchanged at US\$ 3.00, as introduced with version 4.2. Considering the low price, the core version offers significant scope. With this version, the device manufacturer receives a fully equipped operating system with full network support, web/FTP server, graphic user interface and additional libraries. Not included are Internet Explorer and tools for displaying office documents. These are available with the "Professional" or "Professional Plus" versions.

Benefits for end users

In general, users are more interested in the features of the overall device than those of the operating system. Benefits offered by an operating system, therefore, tend to have indirect effects on users. For example, a device manufacturer being able to free up capacities for the development of the actual device function on the basis of a simple and time-saving operating system adaptation, enabling improvement of the functionality of the device. Users rarely utilize the operating system directly, but rather the applications running on it. Similarly, automation technology typically does not use standard programs such as Internet Explorer or Word, but programs such as visualization interfaces or PLC systems that are developed for special tasks.