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Microsoft® Windows Embedded Developer Center

Develop customized embedded devices

Why Windows Embedded

Today, the Windows Embedded family of operating systems includes Windows CE and Windows XP Embedded. Windows CE is built from the ground up for small-footprint devices, while Windows XP Embedded is a componentized version of the Windows operating system.

Microsoft's mission in this thriving embedded market is to deliver adaptable and scalable platforms for 32-bit, connected devices that enable rich applications and services. To this end, a dedicated group with strong executive sponsorship was formed at Microsoft to support the research and development of the Windows Embedded family of products as well as the internal and external customers who use them. The strategy of the Embedded Devices Group (EDG) has been to deliver the best software building blocks and tools to enable those rich devices and device experiences; invest in selected, go-to-market solutions such as the Pocket PC and Windows CE for Automotive; and enable users to take advantage of rich applications and services.

Microsoft officially entered the embedded marketplace in November of 1996 with the release of Windows CE 1.0. Windows CE was designed from the ground up to provide embedded developers with the ability to extend the sophisticated software environment of today's personal computer into the embedded world, according to Craig Mundle, then Senior VP of the Consumer Platforms Division at Microsoft. Windows CE originally was developed for original equipment manufacturers (OEMs) building small, resource constrained—primarily handheld and Personal Information Manager (PIM) devices. Windows CE saw significant improvements with subsequent versions of the operating system, including a simplified, wizard-based operating system configuration, export software development kits (SDKs) to enable application development, multimedia support with version 2.12, and enhanced Internet capabilities and support for hard real time with Windows CE 3.0. Now in its fourth generation, Windows CE offers a time-tested and sophisticated feature set consisting of the latest technologies for developers that create smart-mobile and small-footprint devices.

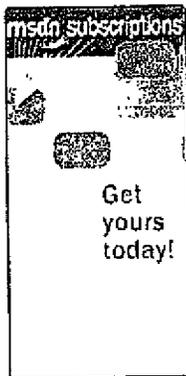
After the release of Windows CE, Microsoft quickly discovered that many embedded developers were building a wide range of non-PC devices that were neither small nor resource constrained and could benefit from a PC-based architecture, an enhanced set of features, richer functionality and greater scalability than what Windows CE could provide at the time. In 1999, to complement its embedded offerings, Microsoft delivered Windows NT Embedded to the market, thereby providing embedded developers with greater choice and flexibility as well as access to the rich Windows feature set. For

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example, customers used Windows NT Embedded to build manufacturing, telecommunications, and multimedia devices. In 2001, Microsoft released Windows XP Embedded, the successor to Windows NT Embedded, which provides a wealth of new features created for the mainstream operating system, and is available for the embedded marketplace in componentized form. Between Windows CE and Windows XP Embedded, Windows Embedded operating systems are now servicing a wide variety of embedded devices—ranging from small, handheld PIM devices to large industrial automation machines—all with highly customized device designs, requiring a flexible platform, easy-to-use development tools, and access to the latest networking, communications, and multimedia technologies.

Together, the products that comprise the Windows Embedded Family provide embedded developers with the flexibility to select the platform that is right for their embedded projects. Windows Embedded operating systems enable greater developer productivity through streamlined development tools as well as faster time-to-market for original equipment manufacturers and embedded developers seeking to address the demand for specialized and embedded devices.

Products

Windows CE

In developing Windows CE, the development team focused on four key areas: the first was providing scalable wireless technologies to flexibly connect mobile devices; the second was providing reliable, core operating system services for demanding real-time designs; the third was enabling rich personalized experiences that span devices, PCs, Servers and Web Services; and the fourth was delivering a rich, easy-to-use, end-to-end tool set. Based on these design goals, Windows CE has been optimized for the next generation of smart, connected devices requiring rich networking, hard real time, smaller footprints, as well as rich multimedia and Web browsing.

The enhanced end-to-end tools included with Windows CE ensure that you can rapidly build smart designs running rich applications on the latest hardware. Windows CE also includes emulation technology to enable developers to do their development and testing using a Windows 2000 or Windows XP Professional workstation without additional hardware investment.

Windows CE has been optimized for mobile devices such as personal digital assistants (PDAs), Smart Phones, Web pads as well as set-top boxes and residential gateways, among others. Devices such as these, built on Windows CE, enable users to remotely authenticate, authorize, administer, and update new applications and operating system services. With broad wireless support for personal area networks (PANs), local area networks (LANs), and wide area networks (WANs)—including Bluetooth and 802.11—an embedded device can stay connected anywhere, anytime. In addition, data produced, consumed, stored and transmitted by these devices stays secure with either local or network security.

Windows CE also offers reliable core operating system services to

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support the most demanding real-time embedded designs across a breadth of devices. For example, embedded developers can now enable low-latency, bounded, deterministic system performance with hard real-time operating system (RTOS) kernel support. The Windows CE platforms real-time performance has been validated in a variety of factory-floor implementations.

With support for the .NET Compact Framework, Extensible Markup Language (XML), Simple Object Access Protocol (SOAP), Passport and Instant Messaging, Windows CE enables developers to easily create rich personalized experiences that span devices, PCs, Servers and Web Services. This support, combined with the rich multimedia and Web browsing capabilities in Windows CE, results in smart .NET-enabled devices.

Windows XP Embedded

In developing Windows XP Embedded, the development team focused on three key areas: the first was componentizing the latest Windows technologies so that embedded developers could have easy access to the richest feature set possible; the second was incorporating the latest embedded-enabling capabilities into Windows XP Embedded; and the third was delivering a powerful new set of end-to-end development tools to enable a more efficient and streamlined development process.

By componentizing Windows XP Professional, Windows XP Embedded enables developers to utilize the latest technologies that the Windows platform has to offer while at the same time achieving a reduced footprint. Building upon a proven code base and offering over 10,000 operating system feature and service components, Windows XP Embedded offers a broad range of new and enhanced capabilities. The benefits of these features include industry-leading reliability, security, and performance. Additionally, Windows XP Embedded includes the latest multimedia and Web browsi

Windows XP Embedded also includes embedded-specific functionality that enables developers to easily address the unique requirements of the embedded marketplace. Embedded devices demand flexibility with regard to the hardware components that are used, the level of functionality the device offers and the usage scenarios that are enabled. Window XP Embedded incorporates the latest embedded-enabling capabilities such as headless support, support for Enhanced Write Filter and El Torito CD, the Power Management Control Library, along with flexible boot and storage options.

Application Development

Developers writing applications targeted at a device running one of the Windows Embedded operating systems have a choice of tools. Applications for Windows CE may be developed using Platform Builder 4.0, or eMbedded Visual C++ 4.0

- Platform Builder can be used to develop Win32 applications and DLLs (which can expose functions, resources, or be a device driver) or to incorporate applications developed using eMbedded Visual C++ 4.0 into a device image. Platform Builder also provides the ability to generate custom Software Development Kits (SDKs) which install into eMbedded Visual C++ providing application developers the ability to target a custom device.

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- **Embedded Visual C++ 4.0** can be used to develop Win32 applications and DLLs, and can also be used to develop applications based on the Microsoft Foundation Classes (MFC), or Active Template Libraries (ATL).

Smart Device Extensions for Visual Studio .NET is a set of enhancements that extend Visual Studio .NET, enabling developers to develop, debug, and deploy applications for devices running the .NET Compact Framework. For additional information about the .NET Compact Framework and the Smart Device Extensions visit: <http://www.qotdotnet.com/team/netcf/>.

Applications for Windows XP Embedded may be developed using any toolset that allows targeting a Windows XP Professional system, including tools such as Visual Studio .NET, Visual C++, and Visual Basic. Applications may use the full Win32 application programming interface (API) and additional services such as Component Object Model (COM), assuming that these capabilities are included in the specific Windows XP Embedded run-time image. Also, an application may use all of the additional technologies supported by Windows XP Professional, including COM+, DirectX, and .NET technologies.

Customers

The Windows Embedded family of operating systems provide developers with the building blocks to create a wide variety of embedded devices, for example, industrial control systems, mobile and handheld devices, set-top boxes, retail point of sale devices, and thin clients. Developers can choose only those components of the operating system needed to satisfy device design requirements.

Windows Embedded customers can be categorized within two groups: original equipment manufacturers (OEMs) and their partners who customize an operating system to meet specific design needs, and groups within Microsoft that are building specific device platforms, such as Pocket PC.

Windows Embedded operating systems are optimized for use by OEM customers who are building Windows Powered devices. Each operating system provides the tools developers need to create highly customized platforms for embedded devices. The Windows Embedded family of products are designed for OEMs building deadd only the necessary features and technologies required by a design specification. The highly modular nature of the Windows Embedded family of products offers external customers the ability to not only innovate and differentiate through hardware but with the platform and applications as well. In other words, these operating systems serve as the glue with which OEMs can build customized embedded devices. An OEM has the flexibility to choose the operating system that best serves its device design needs. If an OEM is creating a client device, the embed ed developer can choose between Windows CE or Windows XP Embedded, depending on the functionality and hardware requirements of the device.

Other divisions of Microsoft provide complete platforms to the embedded market by combining a modified Windows Embedded operating system with specifically designed applications which have been optimized for their particular device category or vertical industry need. One such division is the Pocket PC group, which

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makes a complete platform, the Pocket PC, optimized for Personal Information Manager (PIM) handheld devices. OEMs such as Compaq and Hewlett Packard then take the Pocket PC platform as is, and differentiate on hardware capabilities, form factor design, and applications before taking their devices to market. The Windows CE for Automotive team is another example. This team works with makers of in-dashboard electronics equipment and delivers their Windows CE for Automotive platform to these companies who are then able to differentiate in a number of ways before reselling to car manufacturers. The operating system for Windows Powered Smart Displays portable display panels that let you access the data and applications on your home computer using a secure wireless connection and a wide range of input methodologies—runs on the Windows CE platform as well.

Benefits of Partnering with Microsoft

The Microsoft Windows Embedded platform—consisting of Windows XP Embedded and Windows CE—provides the best set of technology, tools, and resources to get your device to market faster. Regardless of which operating system you ultimately choose, using either software platform in the Windows Embedded family provides important benefits for your business, including:

Access to the world's leading technology portfolio

- Windows Embedded operating system platforms provide a comprehensive and scalable set of operating system technologies. These rich technologies are delivered as a set of professionally tested components, which allow you to flexibly build reduced-footprint designs that incorporate your choice of Windows-based features and services. Microsoft has a proven track record in the operating system space and it is this work that is at the core of what Microsoft does, whether it is for the desktop, for servers, or for embedded devices. Microsoft operating system technology has been deployed in the broadest and most demanding environments, and is at the forefront of providing the most solid foundation for development of the next generation of 32-bit devices.
- Industry-leading features are combined with a highly productive set of end-to-end operating system and application development tools to enable rapid development. Both the Windows CE and Windows XP Embedded development tools allow rapid prototyping and device bring-up with complete, integrated development environments (IDEs). The software platforms also enable developers to take advantage of industry-standard application development tools such as Visual Studio .NET and eMbedded Visual C++ 4.0, to more efficiently develop both managed and native code.
- Each Windows Embedded operating system provides support for a broad range of hardware and software. For example, Windows XP Embedded, based on the same binary code as Windows XP Professional, supports all Windows XP Professional device drivers and has an extensible model that enables even broader support for additional third-party device drivers. Windows XP Embedded supports any Win32 application that runs on Windows XP Professional, with no porting required. Windows CE supports a subset of the Win32 APIs, enabling application developers to use their knowledge of Win32 to easily create or port applications using familiar tools. Windows CE supports four processor families—ARM, MIPS, x86, and SH0; and provides support for multiple Board Support Packages (BSPs) for each type of processor.

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Unparalleled business value and agility

- Windows Embedded operating system platforms enable faster time-to-market. A comprehensive set of componentized features combined with productive tools enables greater efficiency and reduces project duration. These complete platforms also enable you to maximize innovation by giving you the freedom to focus on value-add applications and services, enabling you to quickly release differentiated products and stay a generation ahead.
- Windows Embedded operating system platforms enable lower cost-to-market. These comprehensive platforms enable you to lower the cost of entry into targeted markets by decreasing the duration (and overall cost) of a project, especially in terms of the time required for custom development and the need to license third-party Intellectual Property.
- Windows Embedded also provides a proven and flexible business model that is based on shared success. Windows Embedded licensing is structured to provide low up-front investment so that the vast majority of your expenditure happens after your device is shipping and is successful. The Windows Embedded business model also ensures that you maintain access to, and distribution of, your Intellectual Property. Windows Embedded source programs provide additional development flexibility by enabling increased customer and developer community access to Microsoft source code while preserving the intellectual property protections essential for a healthy software business ecosystem. Microsoft also enables great choice by providing the flexibility to work with Microsoft and our embedded operating systems in the ways that are most appropriate to your needs. Partnering opportunities range from utilizing our basic infrastructure technologies; to utilizing our toolkits and embedded operating system platforms to build your complete customized solution; to licensing one of our complete go-to-market solutions. Microsoft is committed to providing the flexibility to enable you to use our technologies in the way that best suits your needs.

Commitment and support that will sustain your long-term market leadership

- Windows Embedded operating system platforms are backed by industry-leading research and a dedicated development organization that is committed to your success. Windows Embedded technology is professionally maintained and offers a long-term, flexible support roadmap that enables you to receive the type of support that is best suited to your needs.
- Windows Embedded provides a long-term innovation roadmap. Through close customer collaboration and investment in the technology that our customers care about, Windows Embedded provides a predictable product roadmap that enables you to more efficiently manage your product lifecycles and accelerate the ongoing delivery of compelling products.
- Windows Embedded enjoys a large and dynamic partner base. A worldwide network of over 1,800 partners in 55 countries provides you with an ecosystem of resources that can offer value-added solutions and assist you in more quickly bringing your rated sources.

The guiding principle of the embedded business model at Microsoft is simple when our embedded customers are successful, we're successful. The tools available to make this happen are plentiful — from full physical or downloadable evaluation versions of our embedded products, to Shared Source, to an extensive partner network and a thriving community ecosystem — Microsoft is committed to ensuring your success by providing the software building blocks you need and a wide range of tools to enable you to

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deliver successful devices in today's challenging markets.

Customer Evidence

Microsoft is fully committed to delivering the embedded operating system platforms required by original equipment manufacturers (OEMs) creating the next generation of embedded devices. Already with years of research into the needs of these customers, Microsoft continues to invest research and development resources to meet the demands of the embedded marketplace.

Customers delivering devices built on these Windows Embedded operating systems include such OEMs as:

- ABB Robotics
- ActiveLane
- Bally Gaming and Systems
- Beckhoff
- Casio Computer Co., Ltd
- Compaq Computer Corporation
- Cyberbank Corporation
- Dell Computer Corporation
- Fujitsu Limited
- Fujitsu-Siemens Computers
- Hewlett-Packard Company
- Hitachi, Ltd.
- IceBox, LLC
- IBM
- Impactra Co., Ltd
- Intermec Technologies Corporation
- Komatsu Ltd.
- Motorola, Inc.
- National Semiconductor
- NCR Corporation
- NEC Corporation
- Nortel Networks
- Panasonic
- Philips
- Samsung Electronics
- Siemens AG
- Symbol Technologies
- Thomson
- Toshiba Corporation
- ViewSonic Corporation
- Wincor Nixdorf
- Wyse Technologies, Inc

Because of the breadth of choice offered by the Windows Embedded family, these and other customers have been able to match their device and appliance needs with the right Windows Embedded operating system. Hitachi, Ltd., for example, evaluated Windows CE alongside other embedded operating systems before building one of the world's first personal digital assistants (PDAs) with wireless communications for high bandwidth connectivity. Hitachi chose to base its new device on Windows CE because of mobile features, including the latest wireless connectivity, such as 802.11 and Bluetooth, as well as security support, interoperability with .NET-enabled applications, and an integrated development tool set. The powerful development tools and integrated functionality in Windows CE enabled Hitachi to build a prototype of its new broadband PDA in just six months.

To meet demands for simpler, more flexible devices that offer greater ease of management and connectivity to enterprise systems, Wincor Nixdorf adopted the Windows XP Embedded operating system for its next generation of BEETLE POS products. Wincor Nixdorf is a leading provider of solutions for companies that use point-of-sale (POS) systems, such as retail businesses. The wide selection of connectivity features available with Windows XP Embedded allowed

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Each of these OEMs had operating system needs dictated by the device design and market requirements. In the case of Hitachi's small PDA, Windows CE allowed for a small footprint along with the latest wireless technologies. Wincor Nixdorf wanted a PC-like architecture that would easily integrate with back-end systems. Additionally, the design of the retail point of sale device was not as resource constrained as many small, mobile devices, so Windows XP Embedded was the right choice for the BEETLE POS. In each case, the Windows Embedded family of operating systems offered these companies the flexibility to choose the operating system that best met those requirements.

Conclusion

Microsoft has demonstrated and continues to make a strong commitment to the embedded market. With the Windows Embedded family, Microsoft provides embedded developers and OEMs the flexibility to choose between two embedded operating systems that are designed for different types of embedded designs. While each operating system is optimized to meet particular devices requirements and platform needs, partnering with the Windows Embedded family offers benefits that include: a proven track record, powerful end-to-end development environment, real-time support, a vibrant ecosystem of partners, a thriving developer community, and the strength of the Windows Powered brand.

For More Information

For additional information about the features and benefits of the Embedded family of products, visit Windows Embedded home page at <http://msdn.microsoft.com/embedded/default.aspx>.

For additional technical documentation, visit [Embedded Operating System Development](#) on MSDN (<http://msdn.microsoft.com>). There you will find technical articles, and the product documentation for [Windows CE](#) and [Windows XP Embedded](#). The online documentation and context-sensitive Help provide comprehensive background information and instructions for using each of these products.

If you would like to evaluate Windows CE or Windows XP Embedded, download or order the [Windows Embedded Evaluation Kit](#).

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