

EdgeUSB Windows NT 4.0 USB Stack Specifications

High-performance Microsoft-compatible USB driver stack with WDM and Plug and Play (PnP) emulation for Windows NT 4.0 and Windows NT Embedded

EdgeUSB is a software driver stack that adds Microsoft-compatible USB support to Windows NT 4.0 and Windows NT Embedded. It emulates the WDM, PnP, and USBDI interfaces provided by Microsoft in Windows 98 and Windows 2000. EdgeUSB supports USB class drivers which are source- and binary-compatible with existing USB drivers for Windows 95, Windows 98 and Windows 2000.

- Full hot-swap Plug and Play support
- Compatible with USB v1.1 spec
- High performance (faster than Windows 98 stack)
- Shipping since October 1998 in thousands of installations
- Supports OHCI and UHCI host controllers, and up to 5 levels of hubs
- WDM USB drivers for Windows 95/98/2000 require little or no source code changes to run under EdgeUSB. In many cases EdgeUSB can run unmodified WDM driver binaries!

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Why EdgeUSB?

EdgeUSB for Windows NT4 and Embedded NT is a high-performance, Microsoft-compatible software stack for USB. It provides developers, integrators, and peripheral vendors with production-quality support for USB peripherals on Windows NT. EdgeUSB provides binary compatibility with the USBDI interface supplied by Microsoft in Windows 95/98/2000. This permits existing WDM (Windows Driver Model) USB drivers to run on Windows NT and Embedded NT with little or no modifications. Most drivers can be up and running on NT in under a day. ([Top of page](#))

Plug and Play support

EdgeUSB offers both developers and end-users all the benefits of Plug and Play support found in Windows 95/98/2000, including hot insertion/removal of devices and dynamic loading/unloading of the corresponding drivers. EdgeUSB handles all USB bus enumeration details, just like the Microsoft USB stack. Since Windows NT does not support the .INF file format used by WDM, EdgeUSB implements a simple and extensible registry-based mechanism to bind drivers to devices. In addition, EdgeUSB comes with a setup utility (source provided) that installs the EdgeUSB stack and additional class drivers with *no reboot needed* . End-users can install the driver stack, plug in USB devices, and be running in 3 minutes. ([Top of page](#))

Microsoft-compatible USBDI, WDM, and PnP interfaces

EdgeUSB offers exacting emulation of the WDM, PnP (Plug-n-Play), and USBDI interfaces expected by WDM USB drivers for Windows 95, Windows 98, and Windows 2000. EdgeUSB implements API interfaces, data structures, and IRP parameters that are a binary-compatible subset of the Microsoft-provided USBDI interface. Drivers to be run on top of EdgeUSB can be compiled with the Microsoft-provided USB include files and libraries (USBDI.H, USBD.LIB, etc.). In fact, in many cases, the EdgeUSB stack can directly run unmodified WDM USB drivers. ([Top of page](#))

EdgeUSB architecture

The Digi International USB stack consists of two kernel-mode drivers and two optional user-mode applications. The first driver, USBD.SYS, contains the hardware drivers for both UHCI and OHCI host controllers (corresponding to the Microsoft UHCD.SYS and OPENHCI.SYS), as well as the Microsoft USBDI API interface (corresponding to USBD.SYS). The second driver, USBHUB.SYS, corresponds to the Microsoft driver of the same name and contains the USB bus enumerator and hub driver. This driver also generates the IRPs necessary to simulate the WDM PnP environment.

The first optional component, IONUSB, is a user-mode background service that monitors USB add/remove events and invokes device-specific DLLs on an as-needed basis. This provides a facility similar to the CoInstaller mechanism in Windows 2000. The IONUSB service is optional and does not need to be installed unless peripherals require user-mode hooks in order to install.

The second optional component, USBTRAY, is a user-mode GUI applet that places an icon in the system tray. It provides a display of the USB device tree similar to the Microsoft USBVIEW utility. USBTRAY aids in problem determination by showing diagnostic information on the USB chipsets, hubs, and devices in the system.

Lastly, EdgeUSB also provides a full-featured graphical setup utility that installs that USB stack and the vendor's associated peripheral drivers. The setup utility is able to perform an initial EdgeUSB install or upgrade without requiring a reboot. Once the driver files are copied from the installation media, the USB stack is dynamically started, the USB bus is enumerated and the necessary peripheral drivers are dynamically loaded. Source code is provided to the setup program so that the vendor may customize the installation process for its own peripherals. ([Top of page](#))

What about the other guys?

Don't settle for USB "toolkits" or ports of generic USB stacks from other vendors. EdgeUSB is a field-proven

product that has been designed from the ground up to run existing WDM USB class drivers on Windows NT with little or no changes. Digi International has been using its own EdgeUSB stack since October 1998 to support its full line of USB converter products. There are no development toolkits, include files, or libraries needed for EdgeUSB. Existing drivers often can be used unmodified on Windows NT. If any driver changes are required, they are usually minor and can be made using the original header files and libraries (USBDI.H, USBD.LIB, etc) supplied in the Microsoft DDK.

Some vendors offer USB "driver development toolkits" which claim source-code compatibility for USB drivers between Windows NT and Windows 98/2000. However, these packages are actually extension libraries with a proprietary API that translates to the underlying USB stack. Such libraries require you to rewrite your existing WDM driver in order to use the extension library. EdgeUSB is **binary compatible** with the Microsoft interfaces and requires little or no code changes.

Still other vendors offer a generic USB stack which has been ported to Windows NT and does not offer true WDM and PnP compatibility. In contrast, EdgeUSB was written from the ground up for Windows NT WDM/PnP support. ([Top of page](#))

A robust, field-proven product

Digi International originally developed EdgeUSB as a means to support its family of USB connectivity products on Windows NT 4.0. This USB support has been shipping since October 1998 and is used in all Digi International converter products. EdgeUSB has been field-tested in thousands of end-user installations and proven on hundreds of different PC platforms from such major vendors as Dell, Compaq, Gateway, IBM, and Micron, in addition to many Ôwhite boxÕ vendors.

Several major peripheral vendors have committed to EdgeUSB to support their devices on Windows NT 4.0. Peripherals that have been supported with EdgeUSB include modems, serial and parallel converters, PS/2 converters, Ethernet converters, scanners, video and still digital cameras, and floppy disk drives. ([Top of page](#))

High performance

EdgeUSB has been tuned to increase throughput on the USB bus while decreasing CPU utilization. For example, on a 400MHz Pentium II system, EdgeUSB can saturate the USB bus with bulk transfers while using less than 5% of the CPU. In fact, EdgeUSB bulk pipe performance exceeds that of the Microsoft stack in Windows 98! EdgeUSB also implements proprietary buffering techniques to compensate for the increased latency found in Windows NT 4.0 as compared to Windows 98/2000. ([Top of page](#))

Case study: EdgeUSB used by Hewlett-Packard

Hewlett-Packard needed a high-performance Windows NT solution for their USB-attached PhotoSmart S20 scanner. A high-resolution color photo scanner, the PhotoSmart S20 can generate over 8Mbits/sec of bulk traffic ø enough to saturate the USB bus for extended periods of time. EdgeUSB supported the data rates needed by the PhotoSmart S20, and its sophisticated buffering permitted these rates to be sustained even when used on 200MHz Pentium-class PCs with high-latency IDE hard drives. In addition, Hewlett-Packard did not even have to recompile their class driver for NT ø the Windows 95 driver binary was used unmodified. ([Top of page](#))

Windows NT Embedded support

EdgeUSB fully supports Windows NT Embedded, and includes Component Description (.KDF) files and documentation for incorporating the EdgeUSB drivers into the repository and building an operating system target image. In addition, EdgeUSB is designed so that user-mode components may be removed from the target image in cases where NT Embedded is being used with a headless display or where the user-mode functionality is not required. ([Top of page](#))

Seamless upgrades to Windows 2000

The EdgeUSB architecture is designed to upgrade smoothly to Windows 2000. When an NT 4.0 system containing EdgeUSB is upgraded to Windows 2000, the Windows 2000 setup program silently replaces the EdgeUSB drivers with the Microsoft-provided Windows 2000 USB stack, thereby insuring a trouble-free upgrade for end-users. When the upgrade is complete, Windows 2000 takes control of the USB bus, enumerates the bus for devices, and prompts the user, if necessary, for Windows 2000 versions of the drivers for the USB peripherals. ([Top of page](#))

Porting to EdgeUSB

In some cases, minor source code changes must be made to an existing WDM driver to run on NT. If necessary, these changes can usually be made in under a day. Complete information is provided in the EdgeUSB documentation, but to summarize, there are three main areas where existing drivers may need to be recompiled:

1. Power Management APIs. Because the NT kernel does not support power management, any calls to WDM Power APIs (such as PoStartNextPowerIrp) must be removed. Code which handles Power IRPs (such as MN_SET_POWER) can be removed, but this is not required; such code will simply never be executed because EdgeUSB does not send power IRPs to client drivers.
2. DeviceInterface APIs. NT does not support the GUID-based "DeviceInterface" functions. In most cases this is as simple as removing the call completely (as in IoSetDeviceInterfaceState), or changing the call to one available in NT (such as changing IoRegisterDeviceInterface to IoCreateSymbolicLink).
3. Hidden OS dependencies. For example, a WDM USB driver for Windows 9x which has VxD calls, or an application which detects NT 4, and then refuses to load because it assumes that NT 4 doesn't support USB. ([Top of page](#))

Pricing and Availability

Perhaps the best way to evaluate EdgeUSB is to see it in action. Simply purchase a standard Digi International Edgeport/2 converter. Windows NT 4.0 support comes standard with all Digi International USB products, and uses the same EdgeUSB driver stack available to licensees. This permits a prospective customer to evaluate the stack in a working product, complete with a no-reboot installer and built-in hot-swap Plug and Play support.

EdgeUSB has been shipping since October 1998 and is available immediately. EdgeUSB is available with binary licensing (using either per-unit royalties or unlimited royalty buyout), and is also available in source-code form in certain cases. Annual support and update agreements are also available. Please contact the Digi International sales department for more information and a quotation. ([Top of page](#))

Features

- Supports v1.1 of USB spec
- Supports complete Plug and Play functionality, including:
 - Hot-insertion of devices
 - Hot-removal of devices (even while application has device open)
 - Dynamic loading and unloading of drivers
 - Initial installation of driver stack without rebooting
- Implements binary-compatible subset of Microsoft USBDI interface, including:
 - Binary-compatible IRP (I/O Request Packet) parameter/request values
 - Binary-compatible URB (USB Request Block) structures and parameter/request values
 - Binary-compatible USBDLIB library functions (USBD_CreateConfigurationRequest(), etc.)
- Implements binary-compatible subset of Microsoft WDM PnP (Plug and Play) interface, including:
 - Binary-compatible IRP (I/O Request Packet) parameter/request values for `TART_DEVICE` and `REMOVE_DEVICE`
- Power management is not currently supported
- Supports Control, Bulk, and Interrupt Transfer types.
- Isochronous Transfers are not currently supported. Contact Digi International for more information.
- Fully interrupt-driven for high performance
- Supports unlimited number of concurrent overlapped requests (URBs) from multiple drivers simultaneously
- Supports an unlimited number of Host Controllers, Hubs, Devices, and client drivers.
- Sophisticated buffering technology permits sustained saturation of bus with Bulk transfers even though NT 4 kernel has not been tuned for minimal latency.
- Exceeds bulk transfer throughput of built-in Windows 98 USB driver stack
- Optional user-mode background service can call user-mode DLLs on device insertion and/or removal
- Optional user-mode system tray applet for status and troubleshooting
- Shipping since October 1998 in thousands of installations
- Field-tested compatibility with hundreds of desktop and mobile platforms
- Used by several major peripheral vendors including Hewlett-Packard
- In many cases can run *unmodified* WDM driver binaries ([Top of page](#))

System requirements

- Pentium, Pentium II, Celeron, and Pentium III motherboards
- All Intel chipsets supported, including 82371AB/EB/SB and 810/810E/820
- Many third-party chipsets supported, including VIA and ALi
- Supports following USB host controllers:

- UHCI controllers from Intel and VIA
- OHCI controllers from CMD, NEC, SymbIOS, OPTi, and Lucent
- 32MB RAM minimum, 64MB recommended
- Run time driver memory usage is as follows:
- 80K nonpaged code/data for driver stack (USBD and USBHUB)
 - 4.1K additional nonpaged data per device endpoint
 - 256K paged code/data for optional user-mode components ([Top of page](#))