

## CHAPTER 7

# Improved Device Support

Windows 95 features improved support for hardware devices and peripherals including disk devices, video display adapters, mice, modems, and printers. In Windows 3.1 device drivers were, for the most part, monolithic and are complex for device manufacturers to develop. Windows 3.1 simplified printer driver development by using a mini-driver architecture, which provides printer device-independent code in a universal driver written by Microsoft, and device-dependent code that communicates directly with the printer written by the Independent Hardware Vendor (IHV). The mini-driver architecture increased the stability of the driver support for the printer and decreased the amount of time needed for a printer manufacturer to develop driver support for a new printer. While it is still possible to write monolithic drivers in Windows 95, we recommend that IHVs use the mini-driver model because of the advantages it provides.

## Device Driver Philosophy in Windows 95

Windows 95 extends the mini-driver architecture for printer drivers used in Windows 3.1 to the architecture for drivers of other system components. The driver philosophy that Windows 95 uses is based upon a mini-driver/mini-port layered model that provides the following benefits:

- **Leverages IHVs hardware knowledge**

IHVs know their hardware. They understand the various I/O mechanisms that the hardware supports, and they know the commands that the hardware device will respond to. The mini-driver model allows the IHV to implement the device-dependent portion of the code used to interact with the hardware device.

- **Leverages Microsoft Windows knowledge**

Microsoft developed the universal driver code, which is the layer of code that sits between the API layer of device interaction (as used by other Windows-components) and the device-dependent code that controls the device. The development team that wrote the Windows components above the API layer understands the mechanisms available from the operating system for interacting with the code. This leverages Microsoft's knowledge of the operating system, with the IHVs knowledge of their hardware.

- **Increases system stability and reliability**

Since the universal driver is the mechanism through which the Windows components communicate with the device, this components receives a high level of scrutiny and debugging. Through extensive use and testing, the universal driver code is made stable and reliable. Because the IHV no longer has to write the code that would be considered device-independent (as when they wrote monolithic drivers), the code required for driver-dependent functions for interacting with the hardware device is minimized. This reduces the complexity of the code that it necessary, and simplifies the driver development process. A simplified, less-complex driver will promise to be more stable and reliable than a traditional monolithic driver.

- **Increases forward compatibility**

Forward compatibility is ensured by allowing the device-independent code to continue to evolve, and encapsulating the device-dependent code in a mini-driver. The mini-driver model would also simplify the extensibility of the driver an IHV would provide if new functionality was developed in the hardware device. The IHV would not need to completely rewrite the entire device driver, they would just add new functionality to the mini-driver (if even necessary).

**u Supports OEM/IHV innovation**

The mini-driver model provides mechanisms for IHVs to add special device functionality support beyond what would be considered as a base set of required functionality. The mini-driver model doesn't require an IHV to sacrifice any flexibility to simplify the driver development process.

Windows 95 uses the mini-driver/mini-port layered model for components throughout the operating system, including printers, display devices, modems, communication devices, and mice.

## Better Disk Device Support

In addition to providing compatibility with existing MS-DOS and Windows-based disk device drivers, Windows 95 provides better disk device support than is available under Windows 3.1. Windows 95 features a new block I/O subsystem that provides broader 32-bit disk device support as well as improved disk I/O performance. In addition, disk mini-port device drivers written for use with Windows 95 are compatible with Windows NT, and vice versa.

Windows 95 also enhances the disk device support provided in MS-DOS and Windows 3.1 to provide improved support in the following areas:

**u Support for large media using logical block addressing, including hard drives with greater than 1024 cylinders**

Extensions to the Int 13h disk controller support are provided in the protected-mode disk handler drivers to support disks with cylinder numbers greater than 1024. (Windows 3.1 did not provide support for this in the 32-bit disk access drivers.)

**u Better support for removable media including electronic lock, unlock, and eject commands**

Windows 95 better supports removable media devices and allows the system to lock or unlock the device to prevent the media from being removed prematurely. Windows 95 also supports an eject mechanism for devices that support it, so that users can use software control to eject media from a device (for example, new floppy drives that support software-based media ejection).

## Support for IDE Drives and Controllers

Windows 95 provides improved support for IDE drive configurations. The enhanced support includes:

### **u Support for large IDE disk drives**

IDE drives are also emerging onto the market that support a logical block addressing (LBA) scheme that allows them to exceed the 1/2 gigabyte (528MB) size limitation. Support for large IDE disk drives as large as 137G will be provided by the Windows 95 operating system. While this support may be provided in real-mode today, Windows 95 provides this support in a protected-mode disk driver.

### **u Support for Alternate IDE Controller**

Windows 95 also allows the use of two IDE controllers in a PC, or the combination of an IDE controller in a laptop and an alternate controller in a laptop docking station (available, for example, in some Compaq laptop/docking station combination products). While this support may be provided in real-mode today, Windows 95 provides this supports in a protected-mode disk driver.

### **u Support for IDE-based CD-ROM Drives**

The majority of disk devices in personal computers today use an IDE-based hard disk controller. Adding a CD-ROM drive typically requires adding an additional controller card to provide either SCSI or a proprietary interface for connecting to the CD-ROM drive. A new crop of inexpensive CD-ROM drives that connect to IDE-compatible disk controllers are emerging onto the market, and Windows 95 recognizes and supports these devices.

## Support for SCSI Devices and Controllers

Windows 95 provides great support for SCSI disk devices—something not available in Windows 3.1. The support in Windows 95 for SCSI devices includes:

- u Broad support for popular SCSI controllers  
Windows 95 includes 32-bit disk device drivers for popular SCSI controllers from manufacturers such as Adaptec™, Future Domain, Trantor, and UltraStor, providing great support right out of the box.
- u Compatible with Windows NT mini-port drivers  
Windows 95 supports the use of Windows NT mini-port SCSI drivers under Windows 95 without modification or recompiling. Compatibility with Windows NT-based mini-port drivers ensures broad device support for disk devices under Windows 95, while simplifying the driver development efforts for hardware manufacturers.
- u ASPI/CAM compatibility for MS-DOS–based applications and drivers  
Support for the Advanced SCSI Programming Interface (ASPI) and Common Access Method (CAM) allowing application and driver developers to submit I/O requests to SCSI devices is provided in Windows 95. This will allow existing MS-DOS–based applications and drivers that use the ASPI or CAM specification to work properly under the Windows 95 operating system.
- u 16-Bit and 32-Bit ASPI for Windows–based clients and applications  
In addition to MS-DOS–based compatibility with ASPI, Windows 95 also includes 16-bit and 32-bit drivers to support Windows–based ASPI clients and applications.

## Support for ESDI Controllers

Windows 95 provides 32-bit disk driver support for ESDI controllers in addition to supporting IDE and SCSI disk devices.

## High-Speed Floppy Disk Driver

As with its hard disk controller support, Windows 95 also provide protected-mode support for communicating with floppy disk controllers. Windows 95 provides Int 13h hard disk controller support as 32-bit device drivers resulting in improved performance, stability, and robustness of the system. Windows 95 provides floppy disk controller support as a 32-bit device driver, and offers improved performance for file I/O to floppy disk drives, plus improved reliability of the system.

Users can now effectively format a disk or copy files to/from a disk while performing other tasks.

## Better Display Adapter and Monitor Support

Video display adapter and monitor support in Windows 95 is another area that has received a lot of attention during the design phases of Windows 95.

### Summary of Improvements Over Windows 3.1

Windows 95 addresses many of the problems inherent in Windows 3.1 display drivers and provides enhanced functionality and easier setup and configuration. Benefits of the new display driver support in Windows 95 includes:

- u More stable and reliable video display adapter drivers
- u Many more video cards supported by drivers in the box
- u A mini-driver architecture that makes it easier for IHVs to write video display drivers
- u Support for new features including the ability to change video resolution on-the-fly without needing to restart Windows 95 (important for hot/warm docking support)
- u Video driver support for mobile computing docking/undocking providing functionality to autoswitch between video card in laptop and video card in a base unit
- u Consistent and unified installation and configuration of display drivers and display properties such as colors, wallpaper patterns, and screen saver
- u Image Color Matching support for device-independent color usage, which Microsoft worked in conjunction with Kodak to offer
- u Support for new generation of hardware and device functionality such as Energy Star Monitors conforming to the VESA Display Power Management Signaling (DPMS) specification, and detection of monitor properties such as maximum resolution supported when used in conjunction with monitors that support the VESA Display Data Channel (DDC) specification

## Improved Driver Stability and Reliability

By using a mini-driver architecture for video display adapter drivers, Windows 95 better supports the range of products offered by IHVs and provides more stable and reliable drivers. Windows 95 provides a universal driver to support device-independent code and functionality normally handled by a monolithic video display driver, and supports device-dependent code in a display mini-driver. The mini-driver uses the Windows 95 graphics device independent bitmap (DIB) engine, providing a better mechanism for manipulating memory bitmaps (including improved performance).

Because the mini-drivers are simpler than a monolithic display driver, they are easier to write and to debug. Extensive testing on a less-complex driver results in better stability and reliability in the overall operating system.

Furthermore, to ensure broad display adapter device support in Windows 95, Microsoft is developing many of the display drivers in-house with cooperation of all major display controller IHVs. The development teams at Microsoft are also working closely with IHVs to write additional display drivers, and assisting IHVs with optimizing their display drivers and doing performance tuning to enhance the speed at which information is displayed by the driver. The development effort will result in improved graphic performance over Windows 3.1 and native Windows 3.1 display drivers.

The use of the mini-driver architecture for display drivers in Windows 95 leverages the development experience that Microsoft has for writing fast, reliable graphics code, with the engineering experience of IHVs, allowing them to concentrate on delivering high-performance hardware accelerated display adapters.

## Improved Video Display Performance

In addition to more stable and reliable video display adapters in Windows 95, display drivers also should benefit from improved performance. The mini-driver architecture for display drivers in Windows 95 is centered around a new 32-bit DIB engine that features 386/486 optimized code for fast, robust drawing for high resolution and frame buffer-based display adapters. The use of a universal driver to provide the device-independent display adapter support, instead of requiring each IHV to redesign this code, results in allowing base functionality to be optimized and thus benefits all mini-driver display drivers.

For example, graphics performance at 256 colors is dramatically improved on unaccelerated Super VGA graphics controllers such as the Tseng Labs ET4000, which has received benchmark results of over 90% faster than Windows 3.1! Windows 95 includes drivers for nearly all popular graphics accelerators, and has been shown to benchmark faster than Windows 3.1 on the following models/chipsets:

ATI Ultra (mach8), Ultra Pro (mach32), Ultra Pro Turbo (mach64)  
Cirrus Logic 5426/28/29/34  
Compaq QVision  
S3 911/924/801/805/928  
Tseng Labs ET4000 W32i  
Western Digital 90C31/33  
IBM XGA, XGA/2

### Support for More Video Display Adapters Than Windows 3.1

Setup in Windows 95 includes support for automatically detecting the video display adapter installed in the PC and installing the appropriate Windows 95 display driver. While Windows 95 supports the use of display device drivers written for use with Windows 3.1, Microsoft is working closely with IHVs to provide Windows 95-specific display drivers that take advantage of new features and functionality available in Windows 95. For example, efforts are on going to assist third-parties in implementing extensions to support plug and play detection, on-the-fly resolution changes, and re-architecting display drivers to leverage the mini-driver model.

### Robustness Improvements

The video drivers provided with Windows 95 are stringently tested to ensure greater reliability and stability than drivers for Windows 3.1.

In addition to a better quality of video drivers, Windows 95 includes mechanisms to ensure that bad or incompatible video drivers cannot prevent user from accessing the system. If a video driver fails to load or initialize when Windows 95 is started, Windows 95 defaults to the generic VGA video driver. This ensures that a user can get into Windows 95 to fix the system, given that driver configuration is handled through a graphical interface. Under Windows 3.1, a bad video driver would commonly result in returning the user back to an MS-DOS command prompt with no explanation about the failure.

## New Control Panel Enhancements and Customization Properties

Windows 95 consolidates display properties into a common Display area in Control Panel, allowing easy customization the colors, wallpaper, screen saver, and display adapter settings from a single user interface. Access to display properties is as easy as selecting Control Panel from the Settings option from the Start button (or by using the right mouse button to click the desktop), to quickly present the display property sheet to the user.

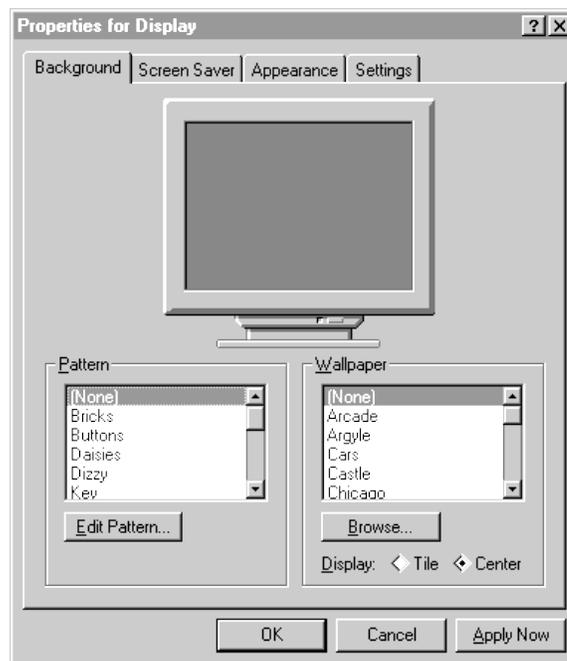


Figure 1. Properties for Display Dialog Box

Through the new consolidated display properties, users now have the ability to:

- u See the appearance of display changes modeled on-screen before the changes are applied. This capability has been referred to as What You See *Before* You Get It (WYSBYGI).
- u Change background settings to select patterns or wallpaper for the desktop.
- u Select a screensaver to be activated after the computer is idle for a specified amount of time.
- u Change window appearance properties for displaying text in title bars or menus such as font face to use, styles of fonts to use including bold or italic, and sizes of fonts to use, providing more flexibility and levels of customization than Windows 3.1.
- u Change the display settings such as number of colors to use with the display driver, or change the size of the desktop area on-the-fly when using display drivers and display adapters that support this functionality.

The work done for consolidated display properties is a further example of how Windows 95 is making it easier for users to use and customize their environment.

### Image Color Matching Support

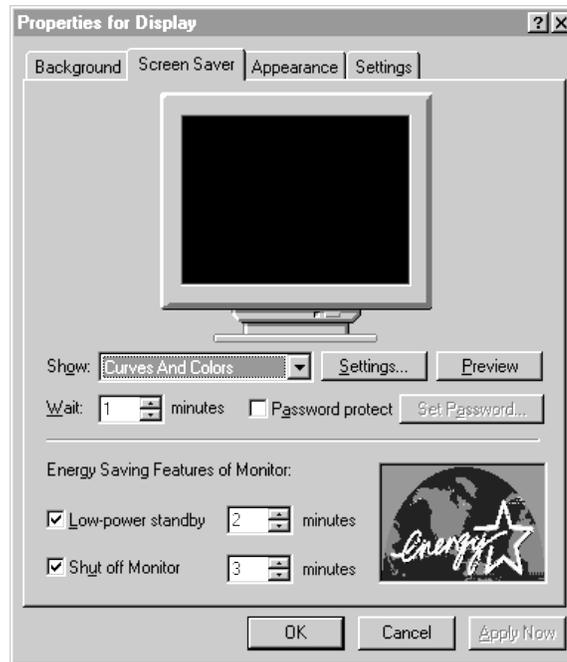
Windows 95 provides image color matching (ICM) support for mapping colors displayed on-screen and colors generated on output devices to provide consistent output. See the discussion of ICM support in the Printing section of this guide.

### Energy Star Monitor Support

Energy Star is an Environmental Protection Agency (EPA)-inspired effort to develop computer hardware and peripherals that conserve power while in idle states. This idea is similar to the standby-mode commonly implemented in laptop computers to save power.

In a PC system, the video display monitor is typically one of the power-hungry components. Manufacturers of newer display monitors have incorporated energy-saving features into their monitors based on the VESA Display Power Management Signaling (DPMS) specification. Through signals from a video display adapter, it is possible under software control to be able to place the monitor in a standby mode, or even turn it off completely, thus reducing the power it uses when inactive.

Users today typically use a screen savers to prevent burn-in of a monitor image. Windows 95 extends this mechanism to provide a time delay setting allowing the user to put the display monitor in a low-power standby mode, as well as a delay setting to turn the monitor off completely. Figure 2 shows the delay settings that a user may specify to enable this capability.



**Figure 2. Screen Saver Settings for Energy Saving Monitor Features**

For example, a user may want to set options to display a specific screen saver after 5 minutes of inactivity, to set the PC to standby after the screen saver has displayed for 10 minutes, and turn off the monitor after 15 minutes of standby.

To take advantage of the Energy Star power-consumption mechanisms, it is necessary to have both a monitor that meets the DPMS/Energy Star specifications, and a video card that meets the VESA DPMS specifications. It is also necessary for the video display driver to support the extensions necessary to control the monitor device. Several manufacturers are presently shipping monitors that are designed to support the Energy Star goals.

## Better Mouse and Pointing Device Support

As with other device drivers, the mini-driver architecture of Windows 95 simplifies mouse driver development and improves virtualization in a protected-mode mouse driver to better support MS-DOS–based applications in the Windows environment.

### Summary of Improvements over Windows 3.1

Mouse support in Windows 95 results in the following improvements over Windows 3.1:

- u Provides smooth, reliable input support through the use of protected-mode drivers
- u Supports more devices by making it easier for IHVs to write drivers, and supports a mini-driver architecture model
- u Makes mouse and pointing devices easy to install and use by supporting Plug and Play
- u Implements mouse driver functionality in a single driver, and eliminates the need to use MS-DOS–based mouse drivers (increasing robustness and saving conventional memory)
- u Support for connecting a mouse *after* Windows 95 has started. This is useful for mobile computer users that may forget to connect a mouse before turning on the computer—gives them a second chance to connect a mouse without restarting the computer.

### Improved Windows Mouse Driver

Windows 3.1 provided support for using the system mouse in an MS-DOS–based application if the application was run within a window. However, support for using a mouse in full-screen mode required an MS-DOS–based mouse driver TSR to be loaded prior to starting Windows.

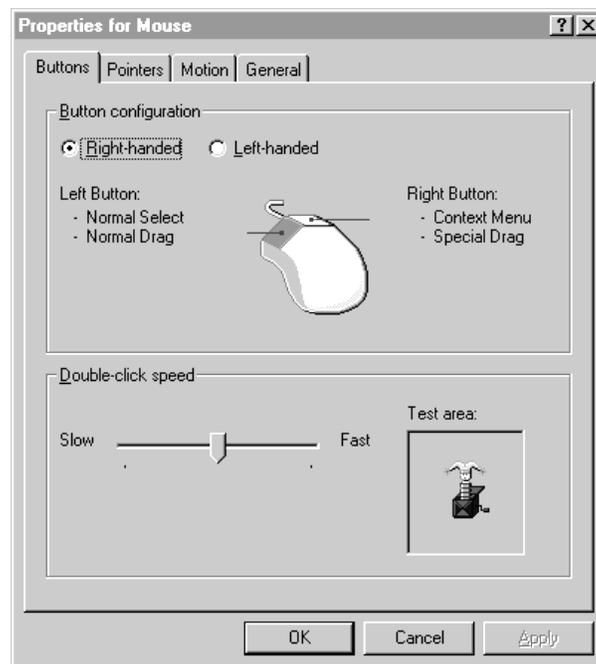
Windows 95 provides mouse support as a protected-mode VxD and eliminates the need to load an MS-DOS–based mouse driver. Better virtualization of mouse interrupt services, which allow protected-mode Windows–based mouse driver to provide mouse support for Windows–based applications, MS-DOS–based applications running in a window, *and* MS-DOS–based applications running in full-screen mode. The improvements in this area result in a zero conventional memory footprint for mouse support in the Windows 95 environment.

In addition to better mouse services, Windows 95 improves the device support to allow the use of serial ports COM1 through COM4 on which to connect a mouse or other pointing device.

## Mouse Control Panel Enhancements

Windows 95 consolidates mouse configuration and customization support into a single Control Panel icon. Windows 3.1 provided rudimentary support for configuring a mouse as part of the Mouse option in Control Panel, and provided more flexible mouse settings in a separate driver-specific applet.

Control over mouse customization options is supported in Control Panel, and uses a tabbed dialog for providing easy access to the different possible settings. Mouse settings accessible through the new interface includes setting the behavior of the mouse buttons, and the behavior of the mouse pointer.



**Figure 3. Properties for Mouse Dialog Box**

## Try It!



Mouse

To see how the improved device support present in Windows 95 will result in broader support for a broader base of hardware and peripherals, you've got to try it!

### Floppy Disk and Multitasking Performance

To see the improvements made in the floppy disk driver, try to perform some common tasks under Windows 95 while you are formatting a floppy disk or copying files to a disk. For example, try navigating through the shell or launching another application. Perform the same tasks under Windows 3.1 to compare the different multitasking behavior.

### New Display Settings

To see the improvements made in the display properties supported by Windows 95, try some of the new options supported by the Display icon in Control Panel. Try changing the desktop background, selecting a screen saver, changing the display appearance, and switching video resolutions on-the-fly (if supported by your video display adapter and monitor).

### Single Mouse Driver

To see the improvements made in mouse driver support to reduce the conventional memory used as facilitated by a single system mouse driver, remove the real-mode mouse driver from your CONFIG.SYS or AUTOEXEC.BAT and (after restarting your PC), run an MS-DOS-based application that supports the use of a mouse. Use an application such as Edit and try the MS-DOS-based application both in a window and full-screen. Note that the mouse is available in both modes, and use the **mem /c** command at the MS-DOS prompt to verify that the mouse driver is not loaded into real mode.