C H A P T E R   8

Device Support

Microsoft Windows 95 features improved support for hardware devices and peripherals including disk devices, video display adapters, mice, modems, and printers. With Windows 3.1, device drivers were, for the most part, monolithic and complex for device manufacturers to develop. However, 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 for direct communication with the printer written by the IHV. The mini-driver architecture increased the stability of driver support for the printer and decreased the amount of time needed for printer manufacturers to develop driver support for a new printer. In Windows 95, the mini-driver architecture is now available for other types of drivers, and although IHVs can still write monolithic drivers, use of the mini-driver model is recommended because of the advantages it provides.

Device Driver Philosophy

The device driver philosophy of Windows 95 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 their hardware supports, and they know the commands that their hardware device will respond to. The mini-driver model allows IHVs to implement the device-dependent portion of the code used to interact with their hardware device.

- **Leverages Microsoft's 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 model leverages Microsoft's knowledge of the operating system with the IHVs' knowledge of their hardware.

- **Increases system stability and reliability.** Because the universal driver is the mechanism through which the Windows components communicate with the device, this driver receives a high level of scrutiny and debugging. Through extensive use and testing, the universal driver code is made stable and reliable. Because IHVs no longer have to write the code that would be considered device-independent (as they did when they wrote monolithic drivers), the code required for driver-dependent

functions for interacting with the hardware device is minimized. The complexity of the necessary code is reduced and the driver development process is simplified. A less complex driver is presumably 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 by encapsulating the device-dependent code in a mini-driver. If an IHV develops new functionality in a hardware device, the mini-driver model also simplifies modifications to the driver. The IHV doesn't need to completely rewrite the entire device driver; the new functionality can simply be added to the mini-driver (if even necessary).

- **Supports OEM/IHV innovation.** The mini-driver model provides mechanisms for IHVs to add special device functionality support beyond what would be considered the base set of required functionality. The mini-driver model doesn't require IHVs 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.

Disk Device Support

In addition to providing compatibility with existing MS-DOS–based 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:

- **Support for large media using logical block addressing.** 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 hard drives with more than 1024 cylinders in the 32-bit disk access drivers.)

- **Better support for removable media.** Windows 95 provides better support for removable media devices and allows the system to lock or unlock the device to prevent the media from being removed prematurely. Windows 95 also provides 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 the following:

- **Support for large IDE disk drives.** Some new IDE drives support a logical block addressing (LBA) scheme that allows them to exceed the 1/2 gigabyte (528 MB) size

limitation. Support for IDE disk drives as large as 137 GB is provided by the Windows 95 operating system. This support was provided in real-mode before Windows 95, but is provided in a protected-mode disk driver by Windows 95.

- **Support for an alternate IDE controller.** Windows 95 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. This support was provided in real-mode before Windows 95, but is provided in a protected-mode disk driver by Windows 95.

- **Support for IDE-based CD-ROM drives.** The majority of disk devices in personal computers 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, which was not available in Windows 3.1. The following support is available for SCSI devices:

- **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.

- **Compatibility with Windows NT mini-port drivers.** Windows 95 supports the use of Windows NT mini-port SCSI drivers without modification or recompiling. Compatibility with Windows NT–based mini-port drivers ensures broad device support for disk devices under Windows 95, while simplifying driver development efforts for hardware manufacturers.

- **ASPI/CAM compatibility for MS-DOS–based applications and drivers.** Support for the Advanced SCSI Programming Interface (ASPI) and Common Access Method (CAM), which allow application and driver developers to submit I/O requests to SCSI devices, is provided in Windows 95. As a result, existing MS-DOS–based applications and drivers that use the ASPI or CAM specification work properly under Windows 95.

- **16-bit and 32-bit ASPI for Windows–based clients and applications.** In addition to MS-DOS–based compatibility with ASPI, Windows 95 includes 16-bit and 32-bit drivers to support Windows–based ASPI clients and applications.

Support for ESDI Controllers

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

The High-Speed Floppy Disk Driver

As with hard disk controller support, Windows 95 provides 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, resulting in improved performance for file I/O to floppy disk drives, plus improved system reliability.

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

Try It!

Test Floppy Disk and Multitasking Performance

1. Perform 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.

2. Perform the same tasks under Windows 3.1 to compare the different multitasking behavior.

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 include the following:

- More stable and reliable video display adapter drivers

- Support for many more video cards provided by drivers in Windows 95

- A mini-driver architecture that makes it easier for IHVs to write video display drivers

- Support for new features, including the ability to change video resolution on the fly without restarting Windows 95 (important for hot-docking and warm-docking support)

- Video driver support for mobile computer docking and undocking, providing the functionality to autoswitch between the video card in the portable computer and the video card in the base unit

- Consistent and unified installation and configuration of display drivers and of display properties, such as colors, wallpaper patterns, and screen savers

- Image Color Matching support for device-independent color usage, which Microsoft worked in conjunction with Kodak to offer

- Support for new generations 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 the maximum resolution supported when used in conjunction with monitors that support the VESA Display Data Channel (DDC) specification

Driver Stability and Reliability Improvements

By using a mini-driver architecture for video display adapter drivers, Windows 95 improves support for 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 mini-drivers are simpler than monolithic display drivers, 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 developed many display drivers with the cooperation of all major display controller IHVs. Microsoft also worked closely with IHVs to write additional display drivers, and assisted IHVs with optimizing their display drivers and performance-tuning them to enhance the speed at which information is displayed by the driver. This development effort results in improved graphic performance over Windows 3.1 and over native Windows 3.1 display drivers.

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

Video Display Performance Improvements

Not only are the video display adapters in Windows 95 more stable and reliable, but the display drivers should also 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, allows 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 over 90 percent faster than Windows 3.1. Windows 95 includes drivers for nearly all popular graphics accelerators and has benchmarked faster than Windows 3.1 from the following vendors:

- ATI Technologies
- Chips & Technologies
- Cirrus Logic
- Compaq QVision
- Matrox MGA
- S3
- Tseng Labs
- Western Digital

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. Although 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 ongoing to assist third parties in implementing extensions to support Plug and Play detection and on-the-fly resolution changes, and in redesigning 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 better-quality video drivers, Windows 95 includes mechanisms to ensure that bad or incompatible video drivers cannot prevent users from accessing the system. Under Windows 3.1, a bad video driver would commonly result in returning users back to an MS-DOS command prompt with no explanation about the failure. Under Windows 95, if a video driver fails to load or initialize when the system starts, Windows 95 defaults to the generic VGA video driver. Given that driver configuration is handled through a graphical interface, users can then at least get into Windows 95 to fix the system.

New Control Panel Enhancements and Customization Properties

Windows 95 consolidates display properties into a common Display icon in the Control Panel, allowing easy customization of the colors, wallpaper, screen saver, and display adapter settings from a single location. Access to display properties is as easy as selecting Control Panel from the Start button's Settings menu or by right-clicking the desktop to display the appropriate property sheet, which is shown in Figure 46.
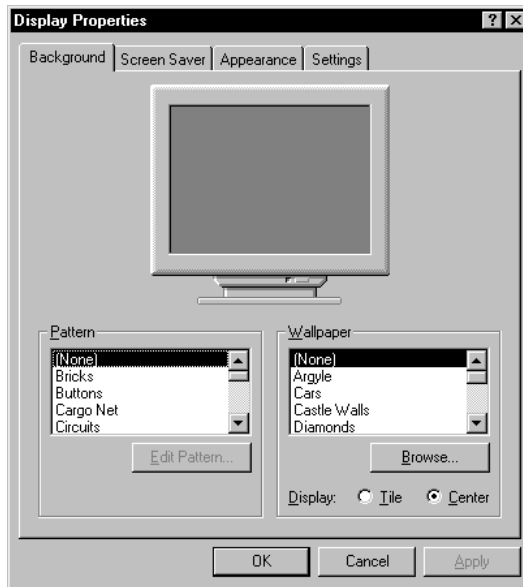
Figure 46. The property sheet for the display

Through the new consolidated display properties, users can now do the following:

- 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).

- Change background settings to select patterns or wallpaper for the desktop.

- Select a screen saver to be activated after the computer is idle for a specified amount of time.

- Change window appearance properties for displaying text in title bars or menus, such as the font, font style (including bold or italic), and font size, providing more flexibility and levels of customization than Windows 3.1.

- Change the display settings, such as the number of colors to use with the display driver, or change the size of the desktop area on the fly (if the display driver and display adapter supports this functionality).

The consolidation of display properties is another example of how Windows 95 makes using and customizing the environment easier for users.

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 consistency. For more information, see the discussion of ICM support in Chapter 11, "Printing."

Energy Star Monitor Support

Energy Star is an effort inspired by the Environmental Protection Agency (EPA) to develop computer hardware and peripherals that conserve power when 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. Based on signals from a video display adapter, software can place the monitor in standby mode or even turn it off completely, thus reducing the power it uses when inactive.

Users typically display screen savers to prevent burn-in of a monitor image. Windows 95 extends this screen saver mechanism to provide a time-delay setting that allows the user to put the display monitor in a low-power standby mode, as well as a delay setting for turning the monitor off completely. Figure 47 shows the delay settings that enable this capability.
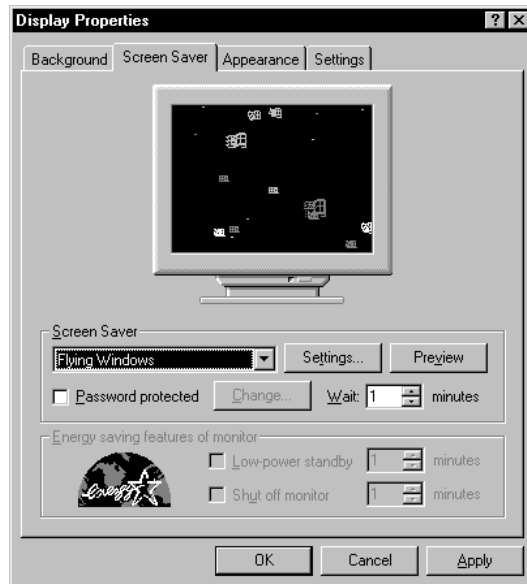
Figure 47. The screen saver settings for monitor energy-saving features

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 to turn off the monitor after 15 minutes of standby.

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

Try It!

Change the Display Settings

1. Open the *Control Panel* and click the *Display* icon. The display property sheet appears.

2. Change the desktop background.

3. Select a screen saver.

4. Change the display appearance.

5. Switch video resolutions on the fly (if supported by your video display adapter and monitor).

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:

- Provides smooth, reliable input support through the use of protected-mode drivers

- Supports more devices by making it easier for IHVs to write drivers, and supports a mini-driver architecture model

- By supporting Plug and Play, makes mouse and pointing devices easy to install and use

- Implements mouse driver functionality in a single driver and eliminates the need to use MS-DOS–based mouse drivers, which increases robustness and saves conventional memory

- Supports connecting a mouse *after* Windows 95 has started. Mobile computer users who forget to connect a mouse before turning on the computer can connect a mouse without restarting the computer

Windows Mouse Driver Improvements

Windows 3.1 provided support for using the system mouse in an MS-DOS–based application running in a window, but using a mouse in an MS-DOS–based application running full screen required that an MS-DOS–based mouse driver be loaded before 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 allows protected-mode Windows–based mouse drivers to provide mouse support for Windows–based applications, for MS-DOS–based applications running in a window, and for 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 for connecting a mouse or other pointing device.

Mouse Control Panel Enhancements

Windows 3.1 provided rudimentary support for configuring a mouse as part of the Mouse option in the Control Panel and also provided more flexible mouse settings in a separate driver-specific applet. Windows 95 consolidates mouse configuration and customization support into a single Control Panel icon and uses a tabbed property sheet, shown in Figure 48, to provide easy access to all the possible settings, such as the setting for the behavior of the mouse buttons and for the behavior of the mouse pointer.
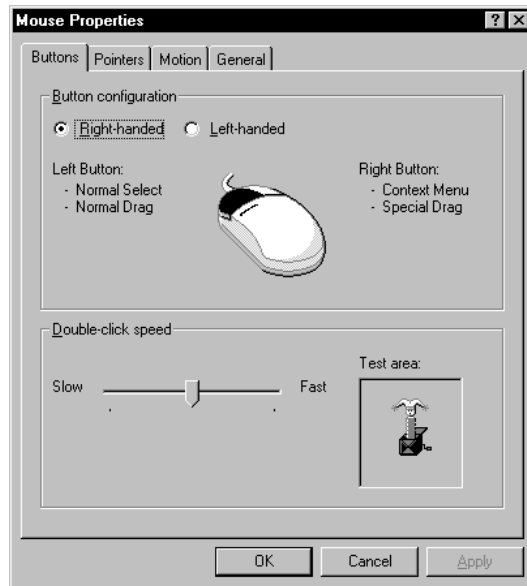

Figure 48. The mouse property sheet

Try It!

Use a Single Mouse Driver

1. 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.

2. Open an application, such as MS-DOS Edit, and use it both in a window and full screen. Notice that the mouse is available in both modes.

3. Type *mem /c* at the MS-DOS prompt and verify that the mouse driver is not loaded in real-mode.