INTRODUCTION
The majority of hardware connected to Windows-based PC systems does not require a large amount of user configuration after its initial installation. Display monitors, however, are the notable exception. Today’s displays offer users vast control over their configuration, but this is often through cryptic front-panel controls with non-standard interfaces, minimal or no localization and minimal assistance to the user.

Consequently, user frustration with display configuration is high, and often display configuration is not optimal. The set of controls available to the user varies among manufacturers, and even among display models from the same manufacturer. Often, modifying a setting causes changes in other settings, requiring the user to move back and forth among several controls to find the right balance.

In attempting to address these issues, vendors have used various methods to allow the operating system to control the display settings. These controls have taken various forms, but most have several drawbacks, including:

- **Inconsistent Interfaces.** The method of connecting the display to the PC for control either requires additional connections to the display beyond the data connection or requires non-standard signaling over the data connection. The former results in increased manufacturing costs; the latter may mean that the display can work only with specific display adapters.

- **Inconsistent UIs.** The interfaces often do not follow Windows user interface (UI) guidelines, and may have the same drawbacks as the built-in display controls: cryptic controls, lack of localization and interdependent controls.

Both cases can result in increased user confusion and support calls.

Standardization in the control of display configuration provides all-around gains. User confusion and therefore support calls are lessened, and system integration improved. Manufacturing costs of displays are improved as well.

DDC/CI as an Enabling Technology
Windows operating systems use VESA Display Data Channel (DDC) protocols to retrieve Extended Display Identification Data (EDID) data from displays through the display adapter driver, which reports the display as a child device.

The solution to the above problems is for Windows and the display hardware to fully implement VESA DDC Command Interface (DDC/CI) bi-directional control and to create a Windows-based control panel for the display hardware.

In addition to the inter-integrated circuit (I²C) interface for the display itself, many display adapters contain an interface for other on-board devices such as TV tuners or video capture devices. The I²C bus is a standard protocol two-wire (clock and data) serial data bus that is bi-directional, but most display adapter drivers only expose the I²C interface to the non-display devices for Windows Driver Model (WDM) child drivers to use.

Simple changes to what is exposed on the I²C interface and to display adapter drivers allow WDM child display drivers to control displays by way of the DDC/CI standard. The display child driver can in turn be controlled by a standard display control panel extension.

DDC/CI ADVANTAGES
DDC/CI enables two-way communication between monitors and their video adapters, which provides many advantages. Today’s monitors do more than merely display text; the best possible display configuration is mission-critical for applications including digital imaging, pre-press, graphic arts and video production. On-screen colors that don’t match printed output or are off because of an incorrect setting waste valuable time...
and require expensive corrections. Next, having monitor configuration under software control means that end-user software applications can set up the best possible display modes for their screens without having to reboot the PC to a known state. And, lastly, poorly configured monitors can cause unnecessary user eyestrain.

Overall, DDC/CI’s main advantage is its ability to provide the user with increased control over monitor settings (brightness, contrast, color setting, advanced geometry, etc.) from the local system. This capability allows for smarter software that can automatically adjust the monitor to the correct color environment. It also enables access to built-in monitor diagnostics, allowing the system to check the monitor’s condition (total hours running, error condition reporting, etc.), record it and send it back to the manufacturer, thereby reducing the amount of service calls. DDC/CI also provides a better user interface for controls using test patterns and adjustment previews.

**UTILIZING DDC/CI THROUGH NAVISET**

NEC-Mitsubishi Electronics Display has actively worked with Microsoft to make DDC/CI a standard feature of all video add-in cards and chipsets. Another issue has been the desire to control monitor settings and diagnostics not only from a local system but remotely commanded over an existing network (LAN). Efforts to achieve this led to NEC-Mitsubishi’s development of NaViSet software, which was introduced in 2001 with the company’s line of NEC MultiSync FE+ Series CRT monitors.

NaViSet interactive display-system control software provides direct access to all monitor setting controls via a user-friendly, ergonomic and intuitive interface. The software is available in two versions: NaViSet and NaViSet Administrator.

NaViSet is aimed at general end-users and those in companies for whom simple and convenient monitor setting is an important factor. The NaViSet Administrator version, containing extensive network capability, enables all important functions to be comprehensively controlled via the LAN and has been developed especially for IT managers and network administrators. These NaViSet applications will only work with select NEC and Mitsubishi monitors.

It can be difficult for a user to struggle through the On Screen Manager (OSM) menu and to understand some of the highly technical functions available. Thanks to its intuitive interface, NaViSet creates a bridge so that even the most obscure monitor functions can be found and used correctly. It is this point that demonstrates one of the key benefits of this software: the user should not have to learn a new OSM every time he is working with a new monitor or at a different workstation. Rather, the user should just be able to concentrate on his actual work. With NaViSet, matters are greatly simplified and users have the same familiar and easy-to-use software interface available to them with different monitors and in different environments. This can be important in the financial sector, technical design or desktop publishing. This is particularly helpful at a time when new models and technologies are continuously coming into the market. Furthermore, as NaViSet software can equally be implemented for both LCDs and CRTs, it can continue to be used even when changing monitor technologies.

The software itself consists of an installation program and a driver for the local workstation that augments the Windows display-control window. The installation program first automatically carries out a compatibility check and confirms the DDC/CI compatibility of the graphics card, from which the respective monitor can then be detected. NaViSet is then displayed as an additional tab with the name “Monitor settings” in the “Extended display properties” dialogue window.

The functions that are available after installation for software control via DDC/CI are numerous, varied and serve even the most demanding user:

- Both the brightness and the contrast can be adjusted or, if desired, can be reset to the factory setting.
- With the color values, both the color temperature and the RGB values can be changed individually.
NaViSet software provides users with an intuitive graphical interface that makes display adjustments simple and to the user’s exact preferences. These windows, which can be manipulated using a mouse and keyboard, allow users to perform functions such as choosing screen test patterns (left) and adjusting the screen positioning (right).

- Pin-cushion, trapezoid, parallelogram etc. are also available alongside the basic functions for geometry correction; Moiré cancellation and convergence can also be adjusted.
- Even metadata such as the serial number or the date of manufacture can be easily displayed.
- In addition, the refresh rate, desktop resolution, operating time and the power-save time of the monitor can be displayed.

If NaViSet is used with LCD monitors, most of the geometrical functions (required for CRTs) are omitted. Instead, LCD-specific functions for the control of text sharpness, the phase and geometry are included. Otherwise, the complete software interface remains identical to that for CRTs.

**NaViSet Administrator**

The LAN version, NaViSet Administrator, comes in two parts: provider and client software. The provider software is installed on the remote PCs to be monitored and communicates with the monitors via DDC/CI. The communication transport between the PCs and server takes place at the WMI level (Windows Management Instrumentation). If DDC/CI is not available on a workstation, the provider software can at least load the EDID data from the Windows registry and make important monitor metadata available. This metadata can then be used by any management software that uses WMI.

The client component of NaViSet Administrator is the administrator’s central control application. It is responsible for connecting to the remote monitors via the LAN or WMI. The client software also displays the different monitor metadata and executes the comprehensive functions on the local workstation monitor.

**Reading the Metadata**

An indication of the enormous potential created by the large scope of the control software is shown in the following summary of the most important functions. NaViSet Administrator can call up the following data:

- serial number
- refresh rate
- manufacturing data
- visible horizontal and vertical size of the picture area in centimetres
- current resolution of the monitor in pixels
- monitor name from the INF file
- model name from the EDID
- monitor product ID
- time that the monitor has spent in power-on and standby modes (in hours)
- polarity of the videosync signal
- video frequency
- current power status
- current video timing
- current color mode
- whether power-save has been activated
- OSM lock status
- diagnostic data
- power-off timer settings

Many practical uses result from this. Monitors within the organization that are physically suitable for a specific, possibly temporary, use can be quickly located. With reference to the manufacturing data, the probability of failure can be investigated at any time or the costs for the next new procurement can be evaluated and planned for at an early stage. The administrator can very quickly determine the effectiveness of the power-save mode at workstations by collecting and analyzing the status times of all monitors. Furthermore, the power-off settings can be optimally matched to the actual operating times in the company. Another important feature is the ability to determine diagnostic data from a monitor in order to quickly rectify failures or to prevent them.

REMOTE-CONTROLLED MONITORS

An integral function of NaViSet is the remote control of the monitor settings and the manipulation of the electrically erasable programmable read-only memory (EEPROM). The following functions can be controlled remotely (provided they are supported by the monitor):

- demagnetization of the screen using the degauss function
- resetting of all functions to the factory settings (factory reset)
- resetting the colors to standard values
- resetting all geometrical corrections
- auto setup
- OSM lock/unlock
- power-save status
- power on/off/standby
- power-off time setting (timer)
- color-preset settings
- adjustment of the individual control functions

These functions offer many maintenance and asset-management benefits. For example, the degauss function enables all CRT monitors to be demagnetized at regular intervals, quite independently of the user’s normal practice. As a result, predominantly in sensitive graphical environments, possible errors due to incorrect colors and geometrical distortions can be minimized. The same applies for a reset to a preset standard color value, which is particularly important in color-sensitive, color-calibrated environments. The system administrator can thus very quickly correct unintentional setup errors made by unauthorized persons, without having to walk from one workstation to the next each time. Incorrect adjustments to the geometrical functions can also be quickly rectified in this manner (geometrical reset).

The remote control of functions that help to reduce power consumption or increase the life of the monitor is beneficial when the changeover to summer time occurs, when the working hours at certain workstations change or when incorrect settings have to be rectified and then prevented by remotely disabling the OSM. When monitors are remotely switched off by the administrator, the security factor is enhanced in particularly sensitive environments, as a monitor that is switched-off and locked-out is rendered inoperable to anyone illegally trying to access data (for instance at night).
The monitoring of the picture refresh rate also is relevant to the life of the monitor. NaViSet Administrator signals to the central control when an LCD monitor is being operated at more than 60 Hz or with a non-native desktop resolution. In the case of a CRT monitor, NaViSet Administrator sends an alarm message when a frequency of less than 60 Hz is being employed.

**COMPATIBILITY**

NaViSet, NaViSet Administrator and all additional DDC/CI software are supported by Windows 2000 and XP. In addition, NaViSet can make use of the security functions of the latest version of Windows. In order to be able to install NaViSet, Windows XP demands administrator rights, which serves to protect the system against unauthorized access.

### NEC-Mitsubishi monitors compatible with DDC/CI and support NaviSet*

<table>
<thead>
<tr>
<th>Screen Size</th>
<th>NEC CRT:</th>
<th>Mitsubishi CRT:</th>
<th>NEC LCD:</th>
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* As of 7/02. Subject to change.

### FOR MORE INFORMATION


*This white paper was published in and based on information as of July 2002. Technical information is subject to change.*