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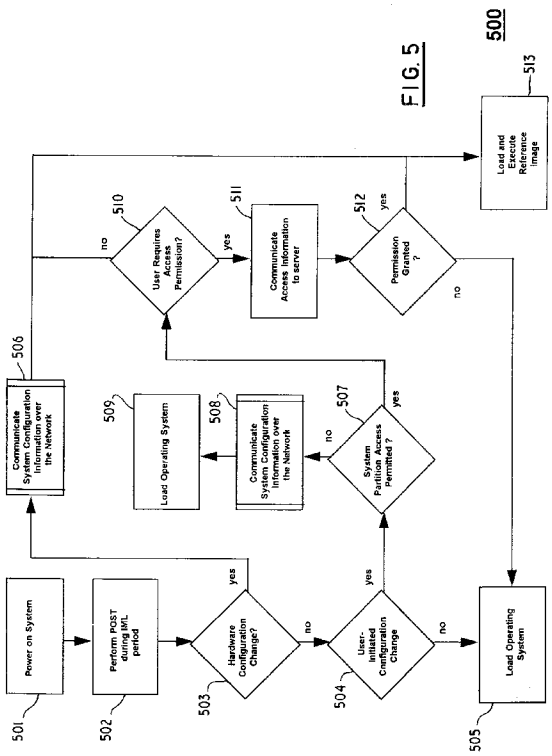
(54) Information processing system.

(57) An information handling network 150 includes a plurality of information processing systems 102 having a predetermined system configuration operating under the control of a corresponding number of operating systems where during a initial microcode load (IML) period prior to loading the operating systems a change in the system configuration is detected based on the predetermined system configuration. Upon detecting the change, a communication adaptor device 231 is activated for communicating certain configuration information over the network before loading the operating system.

FIG. 5



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The present invention relates to an information processing system connected to an information handling network, and more particularly to such systems which store a predetermined system configuration.

Personal computer systems in general, and IBM personal computers in particular, have attained widespread use for providing computer power to many segments of today's society. A personal computer system can usually be defined as a desk top, floor standing, or portable computer that includes a system unit having a system processor, a display monitor, a keyboard, one or more diskette drives, a fixed disk storage, an optional pointing device such as a "mouse," and an optional printer. These systems are designed primarily to give independent computing power to a single user or small group of users and are inexpensively priced for purchase by individuals or businesses. Examples of such personal computer systems are sold under the trademarks: IBM's PERSONAL COMPUTER, PERSONAL COMPUTER XT, PERSONAL COMPUTER AT and IBM's PERSONAL SYSTEM/2 (hereinafter referred to as the IBM PC, XT, AT, and PS/2, respectively) Models 25, 30, 50, 55, 57, 60, 65, 70, 80, 90 and 95.

These systems can be classified into two general families. The first family, usually referred to as Family 1 Models, uses a bus architecture exemplified by the AT computer and other "IBM compatible" machines. The second family, referred to as Family 2 Models, uses IBM's MICRO CHANNEL bus architecture exemplified by IBM's PS/2 Models 50 through 95. The bus architectures used in Family 1 and Family 2 models are well known in the art.

The IBM PC and XT were the first models of the IBM personal computer line and used the Intel 8088 processor. The next significant change to IBM personal computer systems was the AT which used the Intel 80286 processor. The PS/2 line spanned several of the Intel processors. A system similar to the IBM PC and XT was a version of the PS/2 Model 30 which used an Intel 8086 processor. The PS/2 Models 50 and 60 both used the Intel 80286 processors. The Intel 80386 processor is used in the IBM PS/2 Model 80 and certain versions of the IBM PS/2 Model 70. Other versions of the IBM PS/2 Model 70, as well as the PS/2 Models 90 XP 486 and 95 XP 486, use the Intel 80486 processor. A variety of commonly available and well known software operating systems, such as a DOS or an OS/2 operating system, can operate on such processors.

Beginning also with the earliest personal computer system of the Family 1 models, such as the IBM PC, it was recognized that a goal of achieving software-hardware compatibility would be of great importance. In order to achieve this goal, an insulation layer of system resident code, also referred to as "microcode," was established between the hardware and the software. This code provided an operational interface between a user's application program/operating system and the hardware device to relieve the user of the concern about the characteristics of hardware devices. Eventually, the code developed into a basic input/output system (BIOS), for allowing new hardware devices to be added to the system, while insulating the application program/operating system from the peculiarities of the hardware devices. The importance of BIOS was immediately evident because it freed a device driver from depending on specific hardware device characteristics while providing the device driver with an intermediate interface to the hardware device. Because BIOS was an integral part of the computer system and controlled the movement of data in and out of the system processor, it was resident on a system planar board of the system unit and was shipped to the user in either a read-only memory (ROM) or an erasable programmable read-only memory (EPROM). For example, BIOS in the original IBM PC occupied 8K bytes (a kilobyte or "K byte" refers to a quantity of 1024 bytes) of ROM resident on the planar board. In addition to the ROM, the planar board included the system processor, a main random access memory (RAM), and other components which were fixed in a substantially coplanar relationship on the board. The ROM also contained a power-on self test (POST) program which was used to test and initialize the computer system. The accumulation of code resident in the computer system ROM became known as the "system firmware," or simply "firmware." Thus, the firmware included a POST portion and a BIOS portion. Sometimes, BIOS was defined to include the POST program.

As new models of the personal computer family were introduced, the firmware had to be updated and expanded to support new hardware devices such as input/output (I/O) devices. As could be expected, the firmware started to increase in memory size. For example, with the introduction of the IBM PERSONAL COMPUTER AT, the firmware grew to require 32K bytes of ROM. With the introduction of the IBM PERSONAL SYSTEM/2 computer system with MICRO CHANNEL architecture, a significantly new BIOS, known as Advanced BIOS, or ABIOS, was developed. However, to maintain software compatibility, BIOS from the Family 1 models had to be included in the Family 2 models. The Family 1 BIOS became known as Compatibility BIOS or CBIOS. Thus, BIOS evolved to include more than one type of BIOS such as the Compatibility Basic Input Output System (CBIOS) and the Advanced Basic Input Output System (ABIOS). Present architectural definitions for personal computer systems allow for up to 128K bytes of system address space for firmware (system firmware address space).

Today, with the continuing development of new technology, personal computer systems are becoming more sophisticated and are being enhanced more

frequently. Because the technology is changing rapidly and new I/O devices are being added to the personal computer systems, effecting modifications and extensions to the firmware have become significant problems in the development cycle of personal computer systems.

With introduction of MICRO CHANNEL architecture, IBM offered a new configuration procedure known as Programmable Option Select (POS). POS is designed to make installation and expansion of system enhancements much easier and less confusing than in previous PCs by eliminating the need for configuring a system using DIP switches, jumpers and headers. Using low power, battery packed CMOS memory PS/2 systems can remember their hardware configuration. The configuration includes the identity of expansion devices and how the expansion devices function in relation to the rest of the system. Every expansion card designed for Micro-Channel has a unique identifying number. When the system boots up, the PS/2 system compares the installed options with the information in its non-volatile memory to detect changes to insure the integrity of its setup. The setup files are automatically incorporated into the file system during configuration procedure using a Reference Diskette. In some IBM PS/2 models, such as the models 70 and 80, the reference diskette comprises a floppy diskette which accompanies the computer system and stores the system configuration information. Although, the configuration procedure of the PS/2 systems is fairly simple, and easy to perform, the reference diskette must be handy or conveniently stored nearby. It is however, possible to lose or misplace the reference diskette after some period of time from the last system configuration. Therefore, it became desirable to store a copy of reference diskette on the DASD.

In the U.S. patent 5,128,995 issued to Arnold et al. and assigned to the assignee of the present application, an apparatus for loading a system reference diskette image from a system portion of a DASD is disclosed in which the DASD has a protected region for storing a boot record, a BIOS image and a system reference diskette. (It is assumed that the reader of the present application is familiar with US 5,128,995). The reason for protecting a portion of DASD arises from the need to prevent contamination and corruption of BIOS. During certain system operation, such as when the processor is under the control of the operating system or when it is running an application, the DASD controller is configured to ignore the protected region.

Other arrangements for storing, loading and initializing IML images are described in U.S. Patent Application Serial No. 07/398,865, entitled "Initial BIOS Load for a Personal Computer System," (EPA 419005), U.S. Patent Application Serial No. 07/777,844, entitled "Programmable Firmware Store for a Personal Computer System," (JP 5216654), and U.S. Patent Application Serial No. 07/799,486, entitled "Automated Programmable Firmware Store for a Personal Computer System," (JP 5233272), which indicate the state of the art in this area.

Increasingly, personal computer systems are linked together to provide an information handling network (e.g., a Local Area Network or LAN) so that a plurality of information processing systems can exchange information, share I/O devices, and utilize a particular direct access storage device (DASD), such as a particular hardfile or diskette. Typically, the information network includes a number of information processing systems known as "clients" and at least one administrator processing system known as "server" all of which are connected or networked with each other via a communication medium, such as copper wire and/or fiber optic cables. Typically, network communications by sub-system components (i.e., client systems or server system) are handled via communication adapter devices which are compliant with one or more network communication protocols, such as Token Ring or Ethernet.

Obviously, the primary advantages of a networked information handling system is its ability to provide for communication of various types of information among a plurality of information processing systems. Among the information that may be communicated within the network is information relating to status and/or configuration of the system itself. The configuration information may be processed in various fashions, for example, to perform diagnostics or to inform other networked information processing systems of each others configuration and capabilities.

Conventionally, the system configuration information has been utilized to detect faulty conditions within large networked systems. For example, IBM's system 390 is designed to monitor performance within a networked system in real time. Upon detection of a faulty condition, a diagnostic routine is performed to isolate the faulty condition to a defective system component. Thereafter, information relating to the detected faulty condition and the diagnosis result are communicated to a central station via a modem on a telephone line.

The real time fault monitoring and fault communication capability of prior art systems are generally incorporated within the system hardware architecture and/or within the operating system or an application software. Unfortunately, the real time fault detection as implemented in the large computer system networks is not suitable for smaller information handling systems, such as those comprising personal computers. This is partly because the existing defacto standard operating systems, such as DOS and WINDOWS, do not support the fault analysis and reporting capability which is available in the larger systems.

More importantly, the present central processing power of personal computer systems makes real time configuration monitoring, fault detection and reporting impractical. Thus a problem remains with respect to personal computers, whose operating systems and CPU power do not support communication of system configuration information in real time over the network.

Accordingly, the present invention provides an information processing system including:

a system memory into which an operating system may be loaded for controlling the information processing system;

means for connecting the information processing system to an information handling network;

storage means for storing information concerning a predetermined system configuration;

detection means for detecting a change in system configuration based on the system configuration determined during an initial microcode load period prior to loading the operating system into the system memory;

and means for communicating system configuration information over said network upon detecting a change in the system configuration prior to loading the operating system.

Such an approach provides much greater flexibility than in the prior art. For example, if the operating system that is to be loaded into system memory in fact is downloaded from over the network, then it is possible to make the selection of operating system dependent on the most recently detected system configuration.

In a preferred embodiment, the information processing system further includes: user activated means for changing the system configuration; and means for allowing or disallowing a user activated change in the system configuration in response to an authorization signal received over the network from another processing system.

It is also preferred that the system includes means for receiving configuration information communicated from another information processing system over the information handling network.

In a preferred embodiment, said means for connecting the information processing system to an information handling network comprises a communications adapter, and said communicating means includes means for collecting system configuration information upon detecting a change in the system configuration, and means for activating said communication adaptor prior to loading the operating system for communicating the system configuration information. Said collection means includes means for loading a diagnostic program into the system memory upon detecting a change in the system configuration; said diagnostic means including a driver for creating the configuration information based on the stored predetermined system configuration and the detected change in the system configuration.

Such information processing systems are preferably linked together by an information handling network including at least one administrator processing system including: monitor means for monitoring at least a portion of the communications over the information handling network; and means for receiving the system configuration information communicated by an information processing system upon detecting a change in its system configuration. Typically in such an arrangement, the adminstrator processing system provides said authorisation signal which determines whether or not a user activated change will be allowed or disallowed.

The invention further provides a method of operating an information handling network comprising a plurality of information processing systems, comprising the steps of:

storing a predetermined system configuration for a first information processing system;

detecting a change in the system configuration of said first information processing system from the predetermined system configuration during an IML period prior to loading the operating system for said first information processing system;

collecting system configuration information upon detecting the change and communicating the system configuration information over the information handling network prior to loading the operating system at said first information processing system; and

loading an operating system for said first information processing system.

Generally a change in system configuration is detected by comparing the predetermined system configuration to the current system configuration.

Viewed from another aspect, the invention also provides a processing system capable of operating in an information handling network under control of an operating system, comprising: a central processing unit; a system memory; a communication adaptor for communicating over the information handling network; storage means for storing a predetermined system configuration; detection means for detecting a change in the system configuration based on the predetermined system configuration during an initial microcode load (IML) period prior to loading the operating system into the system memory; collection means for collecting a system configuration information upon detecting the change in the system configuration; and means for activating said communication adaptor prior to loading the operating system for communicating the system configuration information.

Thus in an information handling network comprising a plurality of information processing systems operating under the control of a corresponding number of operating systems, each information processing

system typically has a predetermined system configuration. The processing system includes detection means for detecting a change in the system configuration based on the predetermined system configuration during an initial microcode load (IML) period prior to loading the operating system. The processing system also includes communication means for communicating the system configuration information over the network upon detecting the change in the system configuration prior to loading the operating system.

The information handling network may further include an administrator information processing system which has means for monitoring communication over the network and receiver means for receiving the system configuration information as communicated over the network.

The system configuration information may comprise identification for an information processing system where the change in the system configuration is user activated. The administrator information processing system typically includes means for providing an authorization signal allowing or disallowing the user initiated system configuration change.

An embodiment of the invention will now be described in detail by way of example only, with reference to the following drawings:

Fig. 1A is a perspective view of a typical personal computer system;

Fig. 1B is a diagram of an information handling network including multiple personal computer systems;

Fig. 2 is a block schematic diagram of a unified planar board for the computer system of Fig. 1A;

Fig. 3 is a block schematic diagram of an alternative planar board for the computer system of Fig. 1A;

Fig. 4 is a block schematic diagram of a processor card for use with the alternative planar board of Fig. 3;

Fig. 5 is a flow diagram of steps taken for communicating system configuration information over the information handling network of Fig. 1B; and

Fig. 6 is a more detailed flow diagram of some of the steps taken in the flow diagram of Fig. 5.

Referring now to the figures, and in particular to Fig. 1A, there is shown a personal computer system 100 which is capable of operating within an information handling network. The personal computer system 100 comprises a system unit 102 having a suitable enclosure or casing 103, output device or monitor 104 (such as a conventional video display), input devices such as a keyboard 110, an optional mouse 112, and an optional output device such as a printer 114. Finally, the system unit 102 may include one or more mass storage devices such as a diskette drive 108 (operable with a diskette - not shown) and a direct access storage device (DASD) 106, also known as hard file.

Referring to Fig. 1B, an information handling network 150 is shown. The information handling network 150 comprises a plurality of information processing systems 102 and 102B one or more of which may be identical to the personal computer system 100 of Fig 1A. The processing system 102 is a server which acts as an administrator processing system within the information handling network 150. The processing systems 102B comprise client systems. Typically, The client systems (102B) are identical to the unit 102, except that systems 102B may include no DASD 106 in which case these systems (102B) are referred to as "medialess clients." The information processing systems (102 and 102B) are networked with each other in a well known manner and communicate information signals over the information handling network 150 via cables 160.

In operation, the information processing systems 102 and 102B functions under the control of an operating system, such as IBM's OS/2 operating system or DOS operating system which are suitably loaded after an initial micro load (IML) period. The operating system typically utilizes BIOS which is loaded into the system memory during the IML period. BIOS provides an interface between the hardware devices and the operating system software to enable a programmer or user to program his machine without an in-depth operating knowledge of a particular hardware device. For example, a BIOS diskette module permits a programmer to program the diskette drive without an in-depth knowledge of the diskette drive hardware. Thus, a number of diskette drives designed and manufactured by different companies can be used within the system 100. Also, loaded during the IML period is POST program which performs a self test of the system hardware upon power on to determine system configuration. POST stores the system configuration in a storage device, such as an NVRAM. As such, POST may detect a system configuration change by comparing predetermined system configuration to the current system configuration. BIOS and POST more clearly defined in the IBM Personal System/2 and Personal Computer BIOS Interface Technical Reference 1991. It is assumed that the reader of the present application is generally familiar with the material in that document.

Referring now to Fig. 2, there is shown a block diagram of a unified planar 200 of the information processing system 102 or 102B. The planar 200 includes a printed circuit board (PCB) 201 upon which are mounted or connected a number of input/output bus connectors 232 having I/O slots, a processor 202 which is connected by a high speed CPU local bus 210 under control of a bus control unit 214 to a memory control unit 256. The unit 256 is further connected to a main memory such as volatile random access memory (RAM) 264. Any appropriate processor 202

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