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[54] **ACCESS KEY PROTECTION FOR COMPUTER SYSTEM DATA**

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[52] **U.S. Cl.** **395/652**; 395/186; 395/163

[58] **Field of Search** 395/651, 652, 395/653, 186, 188.01, 163, 164

[56] **References Cited**

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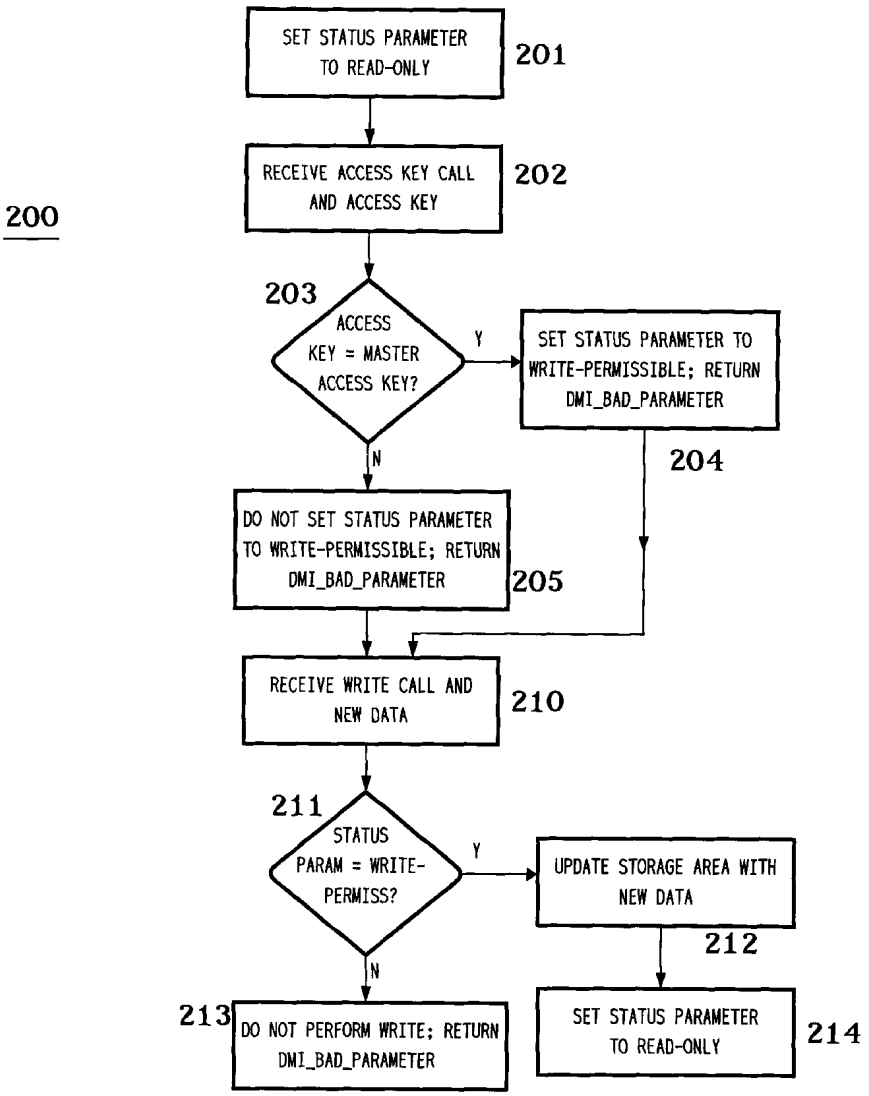
[57] **ABSTRACT**

A status parameter is set for a storage area of a computer system to a read-only status. An access key is received from an access key call by a caller. The status parameter is changed to a write-permissible status if the access key matches a master access key. A request to perform a write to the storage area is received, and the write is allowed only if the status parameter has been set to the write-permissible status. The status parameter is reset to the read-only status after the write is performed.

30 Claims, 2 Drawing Sheets



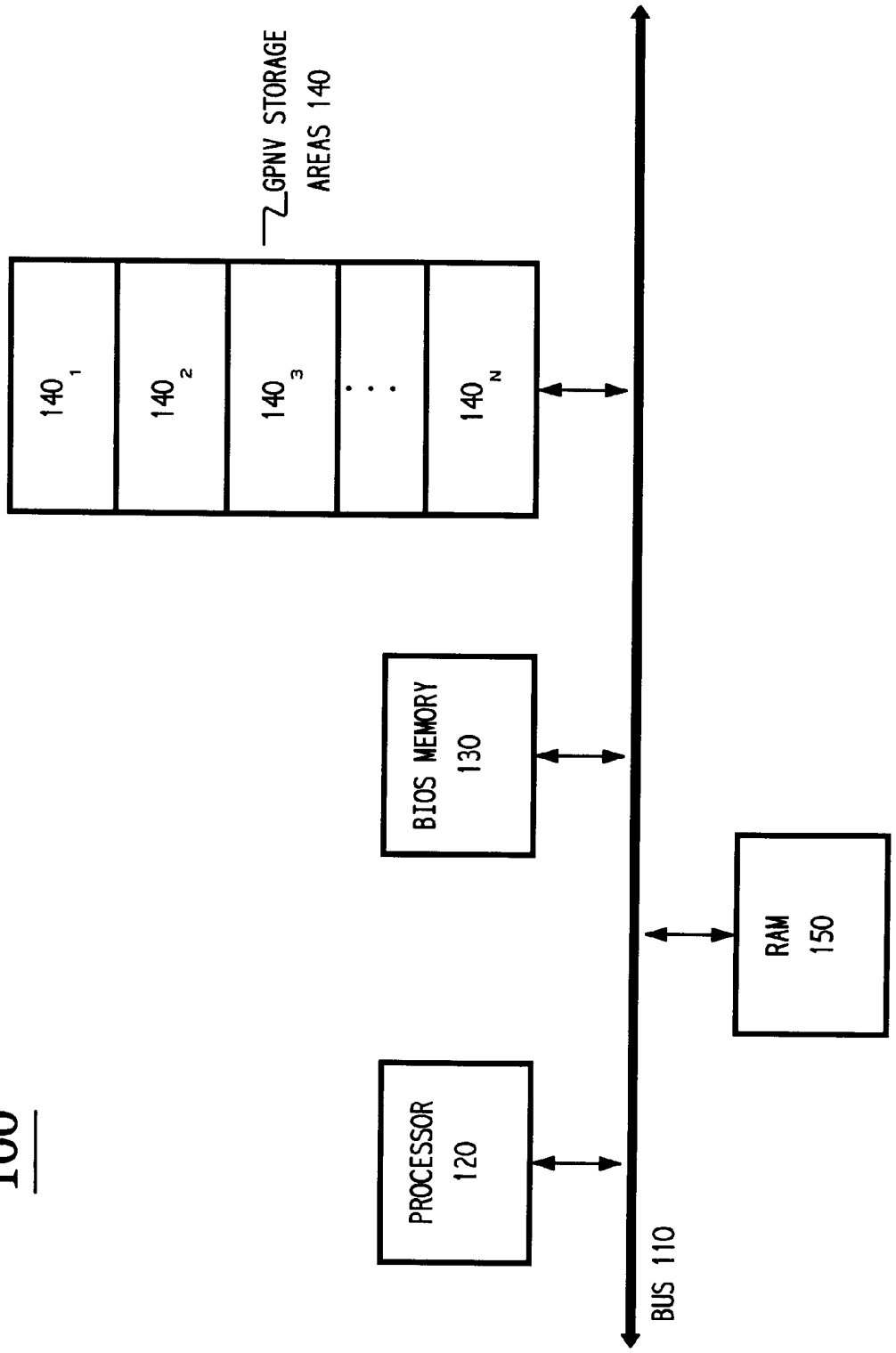
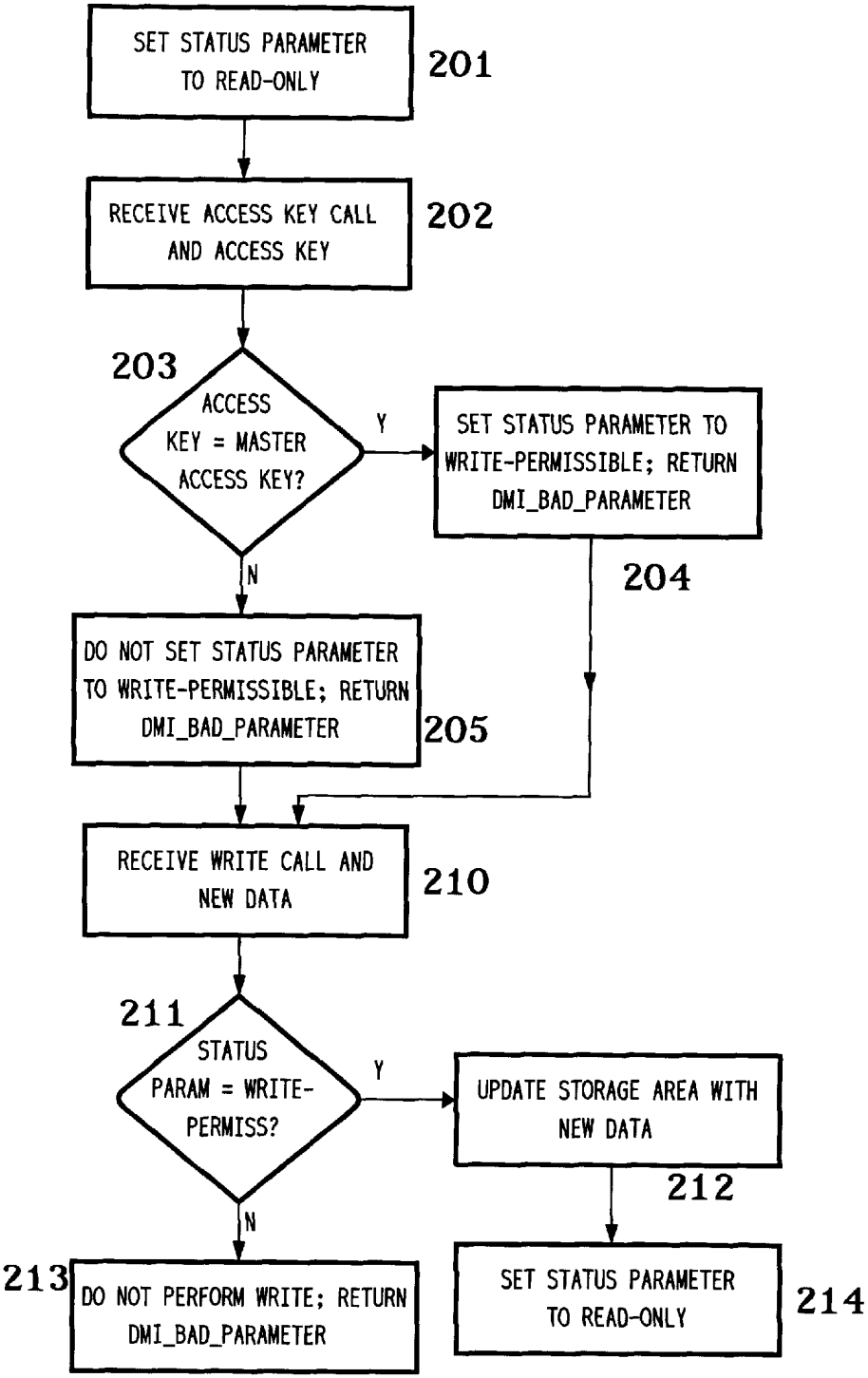


FIG. 1

100

FIG. 2

200



ACCESS KEY PROTECTION FOR COMPUTER SYSTEM DATA

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of data storage in a computer system and, more particularly, to prevention of unauthorized changes to data stored in a computer system.

2. Description of the Related Art

Computer technology is continuously advancing, resulting in modern computer systems that provide ever-increasing performance. One result of this improved performance is an increased use of computer systems by individuals in a wide variety of business, academic and personal applications. With the increased use of and demand for computer systems, a large number of manufacturers, developers, and suppliers of computer systems, components, and software have come into existence to service the demand.

The large number of manufacturers, developers, and suppliers, combined with the flexibility afforded them due to the advances in technology, has resulted in a wide range of methods by which computer systems operate. Typically, in order for different components within a computer system to work together effectively, each must agree on certain specific operating parameters. Often, standards or specifications are adopted or agreed upon by various industries or groups of companies which define certain operating parameters. Thus, if two components comply with the same standard(s) or specification(s), then the two components should be able to work together effectively in the same system.

For example, one such standard is the Plug and Play BIOS [basic input/output system] Specification (version 1.0A, May 5, 1994). A component which conforms to the Plug and Play BIOS Specification should work properly in a system which also complies with the Plug and Play BIOS Specification by simply interconnecting the components to the system. Components that do not comply with the Plug and Play BIOS Specification may require additional configuration steps to be taken by the user before they function properly with one another.

Another current standard is the Desktop Management BIOS Specification (version 2.0, published Mar. 6, 1996) (hereinafter referred to as the DMI BIOS Specification), the entirety of which is incorporated herein by reference. This specification includes a Desktop Management Interface (DMI). The DMI BIOS Specification provides, among other advantages, general purpose nonvolatile (GPNV) data areas which can be accessed to store various data by various applications running on the system.

The DMI BIOS Specification, however, lacks suitably flexible mechanisms to prevent an application from performing an unauthorized modification of data stored in one of these GPNV data areas. For example, a GPNV data area may store vital manufacturing data the modification of which may be done for fraudulent purposes. Thus, it would be beneficial to provide mechanisms for restricting write access to selected GPNV data areas to prevent unauthorized changes to the data stored therein.

Additionally, in order to maintain compliance with the DMI BIOS Specification, any protection against unauthorized updates to GPNV data areas must not violate the DMI BIOS Specification.

SUMMARY

Unauthorized write access to a storage area in a computer system is prevented by setting a status parameter to a read-only status. An access key is received from an access key call by a caller. The status parameter is changed to a write-permissible status if the access key matches a master access key. A request to perform a write to the storage area is received, and the write is allowed only if the status parameter has been set to the write-permissible status. The status parameter is reset to the read-only status after the write is performed.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features, aspects, and advantages of the present invention will become more fully apparent from the following description, appended claims, and accompanying drawings in which:

FIG. **1** shows a block diagram of a computer system in accordance with an embodiment of the present invention; and

FIG. **2** is a flow chart illustrating a method of protecting storage areas from unauthorized writes by using manufacturing access keys, in accordance with an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention provides a mechanism for protecting data saved in a storage area from unauthorized writes by using access keys. The storage area, which typically contains sensitive information such as manufacturing data, may be a GPNV memory or storage area. BIOS sets a status parameter for the storage area, which may also be stored in GPNV memory, to a read-only status. When a call is made, for example a DMI call by a caller, to write to the storage area, the write is not allowed if the status parameter indicates read-only access. A access key call is made by a caller from DMI, which passes an access key to BIOS. If the access key matches a master access key, BIOS changes the status parameter to write status; if not, the status parameter remains set to read only status. Thereafter, when a call is received requesting a write to the storage area, the write is permitted if the status parameter had previously been changed to write status. After the write is performed, the status parameter is reset to read-only status. For purposes of this application, write calls also include erase calls, since an erase call effectively replaces the data stored in a storage area with new data representing zero, null, or some other predetermined data associated with erases. The above-described mechanism is implemented, in one embodiment, on a computer system such as computer system **100** depicted in block diagram form in FIG. **1**.

System Hardware

Computer system **100** comprises a bus **110**, a processor **120**, a BIOS memory **130**, GPNV data storage **140**, and a random access memory (RAM) **150**, interconnected as shown. The BIOS memory **130** stores a sequence of instructions (sometimes referred to as the BIOS) which allows the processor **120** to input data from and output data to input/output (I/O) devices such as display devices and mass storage devices (not shown). In one embodiment, when the system **100** is reset, the contents of BIOS memory **130** are copied into RAM **150** for access by the processor **120**. Alternatively, processor **120** may access the BIOS memory **130** directly via bus **110**. The BIOS memory **130** can be any of a wide variety of conventional nonvolatile data storage devices, such as a read only memory (ROM), Flash memory (sometimes referred to as Flash devices), an erasable programmable read only memory (EPROM) or an electrically erasable programmable read only memory (EEPROM).

In one embodiment of the present invention, the BIOS stored in BIOS memory **130** is compliant with the DMI BIOS Specification. The DMI BIOS Specification includes a DMI, which uses GPNV data areas, shown in FIG. **1** as GPNV storage areas **140**. Thus, when an application desires access to the GPNV storage areas **140**, it must issue one or more DMI calls to one of the procedures provided by the BIOS. These procedures are described in more detail below.

Multiple GPNV storage areas **140** can be used in a computer system. The system **100** as shown includes n GPNV storage areas **140**. In one implementation, n is equal to three. Each of the GPNV areas **140** can be of any size. The GPNV storage areas **140** can be used to store any of a wide variety of information. In one embodiment, the GPNV storage areas **140** are used to store data relating to the identification of hardware components in the system **100**. For example, this identification can include the serial numbers and model numbers of each piece of hardware (e.g., display devices, mass storage devices, multimedia cards, and the like) in the system **100**.

DMI Function Calls

DMI supports a structure access interface and a GPNV storage interface. Various types of information may be stored in GPNV memory and accessed by the GPNV storage interface, for example through DMI functions **56***h* (Read GPNV), which reads the entire specified GPNV contents into a buffer specified by the caller; and **57***h* (Write GPNV), which copies the contents of a user-specified buffer into the specified GPNV memory. Such function calls contain a "handle" to the GPNV storage area of which the read (or write) is requested, and the address of a buffer in which the data is to be stored (or containing the new data to be written). DMI function **55***h* (Get GPNV Information) returns information to a caller about a specified GPNV storage area. The information stored in GPNV storage areas may include manufacturing information, such as the serial number of the motherboard. Data stored in GPNV storage areas that is accessible via the GPNV storage interface will be referred to herein as GPNV data.

"Structures," sometimes referred to as strings because of the strings of data stored therein, may also be stored in GPNV memory and accessed by the structure access interface, for example through DMI function **52***h* (Set DMI Structure), which copies the information for the specified DMI structure from the buffer specified by the caller. These structures are organized in Types and may also contain sensitive information. These Types include system information (Type **1**), which defines attributes of the overall system; base board information (Type **2**), which defines attributes of the system's baseboard, also known as the motherboard or planar; and system enclosure or chassis information (Type **3**), which defines attributes of the system's mechanical enclosures. Each DMI structure has a formatted section and an optional unformatted section. The formatted section of each structure begins with a 4-byte header. Remaining data in the formatted section is determined by the structure Type, as is the overall length of the formatted section. The unformatted section of the structure is used for passing variable data such as text strings. A DMI_Bad_Parameter return code (value **84***h*) is returned after various calls are made, to indicate an invalid parameter or, in the case of a DMI function **52***h* (Set DMI Structure), to indicate an invalid value detected for a to-be-changed structure field. Data stored in DMI structures, which may be stored within a dedicated GPNV storage area, will be referred to herein as structure data.

DMI also provides a control function **54***h*, which provides an interface to perform implementation-specific functions, as defined by a SubFunction parameter and its optional Data values. In particular, SubFunction range 4000 h-FFFFh is reserved for use by BIOS.

In one embodiment, one of the GPNV areas **140** is 128 bytes, a second is 256 bytes, and a third is 384 bytes. The GPNV storage areas **140** can be implemented using any of a wide variety of nonvolatile storage devices, such as blocks of Flash memory cells, EEPROMs, battery-backed complimentary metal oxide semiconductor (CMOS) cells, and the like. Each GPNV storage area may be identified using a 4-byte ASCII identifier. Thus, GPNV storage area $\mathbf{140}_1$ may identified by the identifier "ABCD", storage area $\mathbf{140}_2$ by "ABXY", and storage area $\mathbf{140}_3$ by "GGYN". In one embodiment, GPNV storage area $\mathbf{140}_1$ is a 256-byte storage area used by the BIOS for storing a backup image of CMOS-related information; GPNV storage area $\mathbf{140}_2$ is a 128-byte storage area used by the manufacturer for storing process and test data; and GPNV storage area $\mathbf{140}_3$ is a 384-byte storage area used by DMI BIOS extensions for storing DMI-related information such as manufacturer ID, serial numbers, asset tags, and chassis information, which may be read using the DMI function call **56***h* (Read GPNV Data) or **51***h* (Get DMI Structure) and written with DMI function call **52***h* (Set DMI Structure). Thus, GPNV storage area $\mathbf{140}_3$ may be utilized to store the structure data of Types **1**, **2**, and **3**, described previously.

In one embodiment, GPNV storage area $\mathbf{140}_3$ stores a 4-byte header plus four strings for each of Types **1**, **2**, and **3** structures, in addition to other information. In one embodiment, GPNV storage area $\mathbf{140}_3$ stores, at predetermined offsets, the following strings as illustrated in Table 1, in addition to other information:

TABLE 1

Name	Structure Type	String Number
System Info Manufacturer	1	1
System Info Product Name	1	2
System Info Version	1	3
System Info Serial Number	1	4
Base Board Manufacturer	2	1
Base Board Product	2	2
Base Board Version	2	3
Base Board Serial Number	2	4
Chassis Manufacturer	3	1
Chassis Version	3	2
Chassis Serial Number	3	3
Chassis Asset Tag	3	4

Manufacturing Access Keys

Referring now to FIG. **2**, there is shown a flow chart illustrating a method **200** of protecting storage areas such as GPNV storage areas **140** from unauthorized writes by using manufacturing access keys, in accordance with an embodiment of the present invention. Method **200** provides a means for protecting sensitive data, including both GPNV data and structure data, from unauthorized writes. As explained hereinabove, both GPNV data and structure data may contain sensitive information such as manufacturing data, and may be stored in a certain GPNV storage areas **140**. For purposes of the present invention, "writes" also include erases, since an erase effectively replaces the data stored in a storage area with new data representing zero, null, or some other predetermined data associated with erases. Thus, as used herein, a write call requesting to write to a storage area includes both a write in which old data in the storage area is overwritten with new data supplied by the call, and erases in which the data in a storage area is erased. Therefore, for purposes of this application, a request to write to a storage

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