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Mulcahy et al.

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(54) **PLURALITY OF INTERFACE FILES USABLE FOR ACCESS TO BIOS**

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Related U.S. Application Data

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(51) **Int. Cl.**
G06F 9/445 (2006.01)
G06F 9/455 (2006.01)

(52) **U.S. Cl.**
CPC ***G06F 9/44505*** (2013.01); ***G06F 9/455*** (2013.01)

(58) **Field of Classification Search**
CPC G06F 9/44; G06F 9/445
See application file for complete search history.

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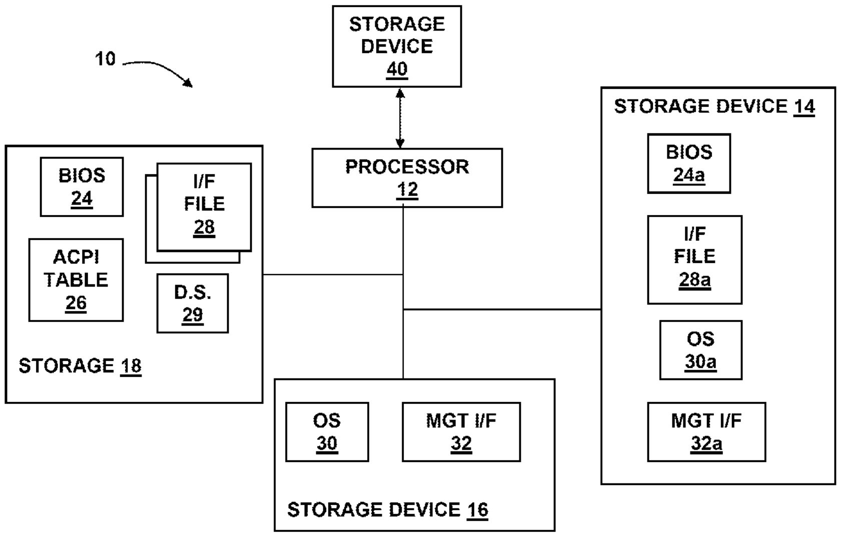
(57) **ABSTRACT**

A computer may comprise a processor and first storage device coupled to the processor. The first storage device contains a basic input/output system (BIOS) executable by the processor. The system may also comprise a second storage device coupled to the processor. The second storage device may contain a management interface usable by an operating system to access the BIOS. A plurality of interface files may also be provided, each interface file being usable by the management interface to access the BIOS and each interface file defining one or methods for use by the interface or BIOS. Upon execution of the BIOS, the processor is to determine a configuration of the system and, based on the determined configuration, to select a particular interface file for use during run-time.

8 Claims, 4 Drawing Sheets



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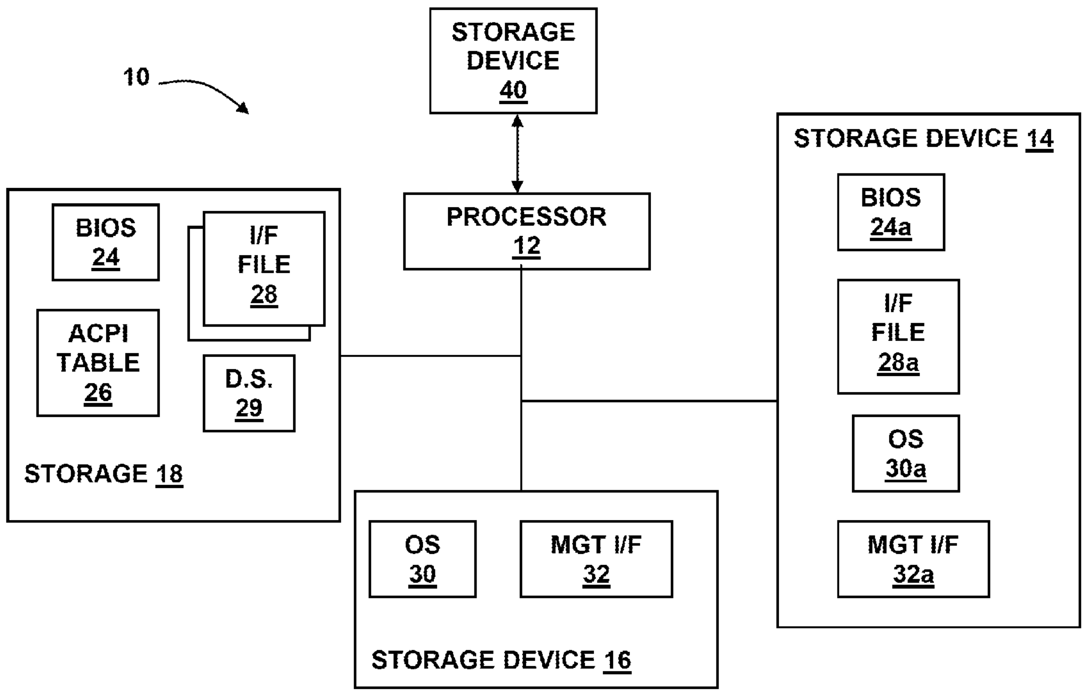
10
STORAGE DEVICE 40
PROCESSOR 12
STORAGE DEVICE 14
BIOS 24a
I/F FILE 28a
OS 30a
MGT I/F 32a
BIOS 24
I/F FILE 28
ACPI TABLE 26
D.S. 29
STORAGE 18
OS 30
MGT I/F 32
STORAGE DEVICE 16

FIG. 1

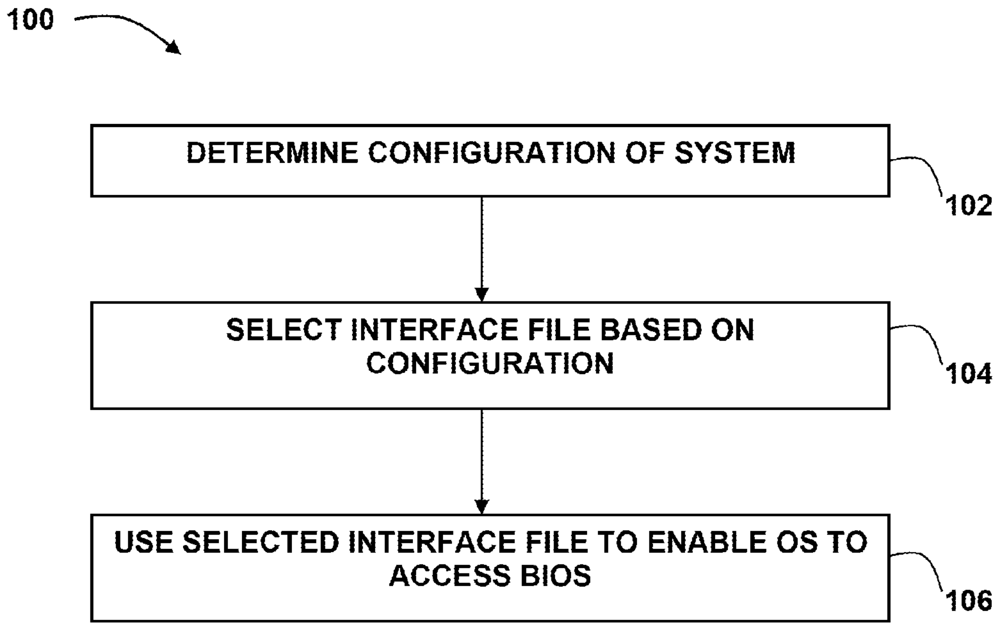
100
DETERMINE CONFIGURATION OF SYSTEM
102
SELECT INTERFACE FILE BASED ON CONFIGURATION
104
USE SELECTED INTERFACE FILE TO ENABLE OS TO ACCESS BIOS
106

FIG. 2

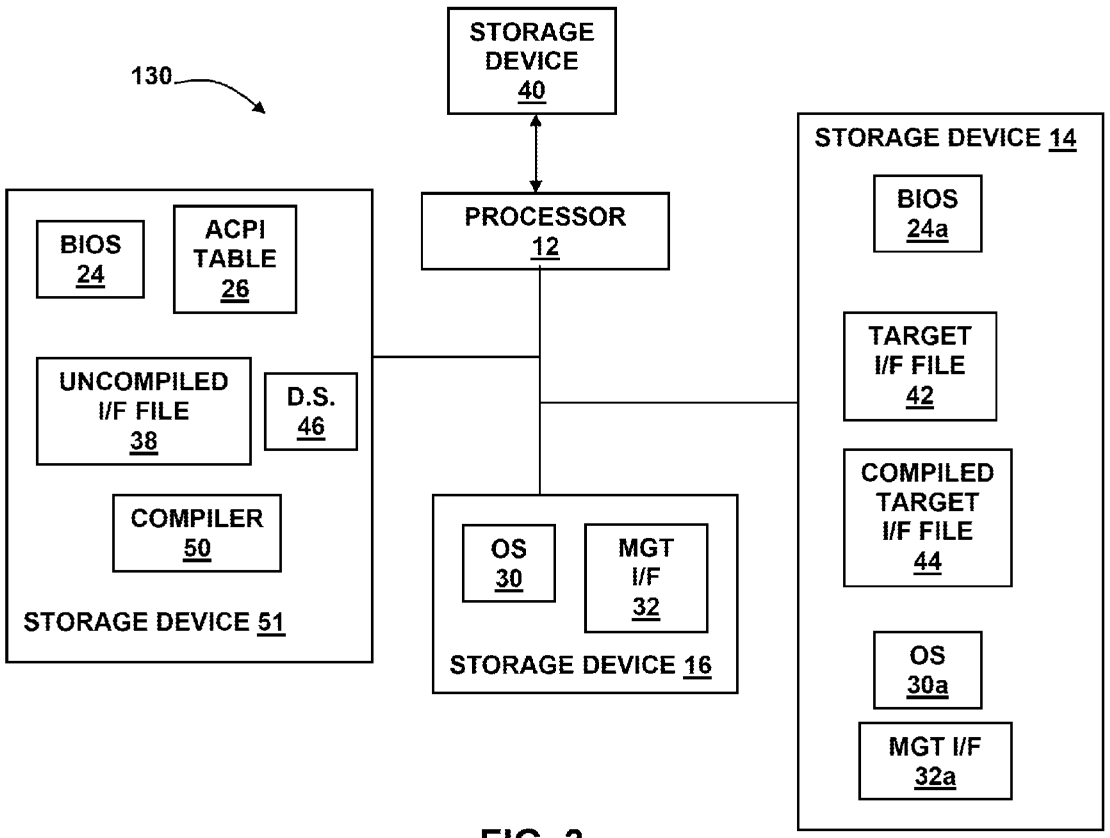
130
STORAGE DEVICE 40
PROCESSOR 12
STORAGE DEVICE 14
BIOS 24a
TARGET I/F FILE 42
COMPILED TARGET I/F FILE 44
OS 30a
MGT I/F 32a
BIOS 24
ACPI TABLE 26
UNCOMPILED I/F FILE 38
D.S. 46
COMPILER 50
STORAGE DEVICE 51
OS 30
MGT I/F 32
STORAGE DEVICE 16

FIG. 3

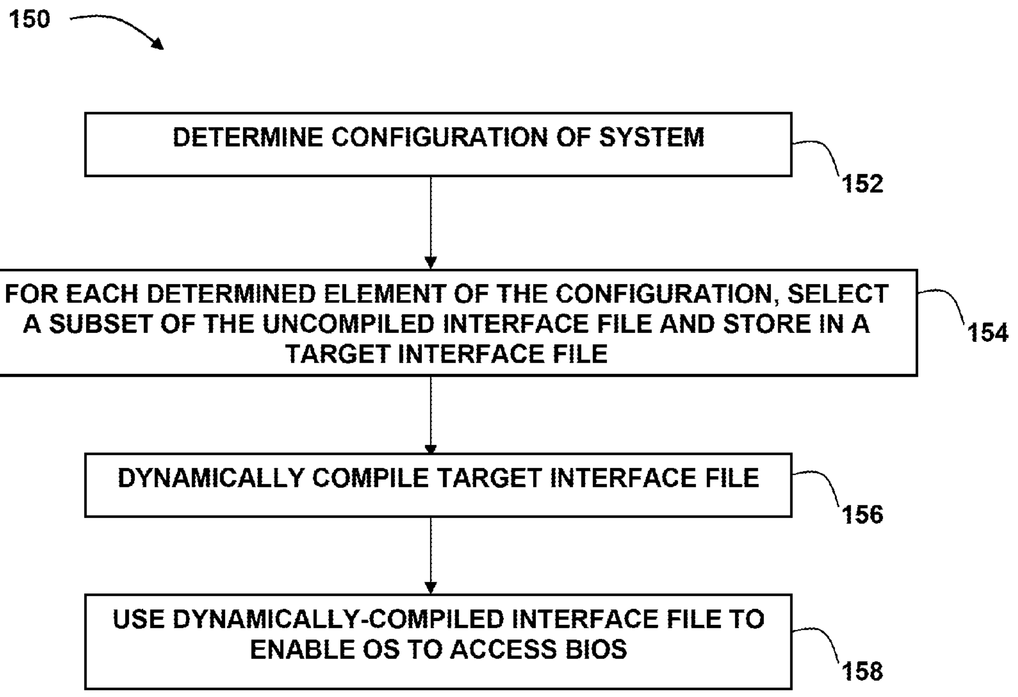
150
DETERMINE CONFIGURATION OF SYSTEM
152
FOR EACH DETERMINED ELEMENT OF THE CONFIGURATION, SELECT A SUBSET OF THE UNCOMPILED INTERFACE FILE AND STORE IN A TARGET INTERFACE FILE
154
DYNAMICALLY COMPILE TARGET INTERFACE FILE
156
USE DYNAMICALLY-COMPILED INTERFACE FILE TO ENABLE OS TO ACCESS BIOS
158

FIG. 4

PLURALITY OF INTERFACE FILES USABLE FOR ACCESS TO BIOS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 13/384,597, filed Jan. 17, 2012, titled "Plurality of Interface Files Usable for Access to BIOS," which is the U.S. National Stage under 35 U.S.C. §371 of International Patent Application No. PCT/US2009/054964, filed Aug. 25, 2009, which are hereby incorporated herein by reference in their entirety for all purposes.

BACKGROUND

A computer system includes a basic input/output system (BIOS) which provides access to low level hardware devices such as keyboards, disk drives, etc. In some systems, an interface, such as the Windows Management Instrumentation (WMI), provides the operating system with access to the BIOS. An interface file, such as a managed object format (MOF) file, is also provided to provide access by the operating system to the BIOS. A MOF file describes classes and methods that are available to the operating system and any applications running thereon. The WMI interface defines the interface to BIOS, and the MOF file defines the data structures and the methods that are supported by the BIOS.

BRIEF DESCRIPTION OF THE DRAWINGS

For a detailed description of illustrative embodiments of the invention, reference will now be made to the accompanying drawings in which:

FIG. **1** shows a system in accordance with various embodiments;

FIG. **2** shows a method in accordance with various embodiments;

FIG. **3** shows a system in accordance with another embodiment; and

FIG. **4** shows a method in accordance with another embodiment.

DETAILED DESCRIPTION

Different configurations of computer systems have different low level functionality. For example, one computer system might have temperature sensors while another computer system does not. The BIOS in the former computer system would provide support to access the temperature sensors. The BIOS in the latter computer system (no temperature sensors) would not need to provide such support.

The MOF file typically is compiled before its installation in the computer system and thus before the computer is assembled from its constituent parts. Computers usually do not have the ability to edit or replace their MOF file with a new MOF file. Because, the MOF file is static and because a variety of computer system configurations are generally made available in the computer market, in at least some instances, a MOF file that can support any computer system configuration is included in each computer system. Such a MOF file may provide support for a device (e.g., a temperature sensor) or other type of configuration element (e.g., security credential) that may not exist in the particular system in which that MOF file is used.

In accordance with various embodiments, a plurality of interface (MOF) files are provided in non-volatile storage of an electronic system such as a computer. Logic, such as the BIOS of the system, is executed by the processor to determine the configuration of the system and selects an appropriate interface file from among the multiple possible interface files and uses the selected interface file to permit the operating system or applications running under the operating system to access the BIOS. In other embodiments, an uncompiled interface file is provided from which, based on the system configuration, a suitable compiled interface file is generated.

FIG. **1** shows a system **10** in accordance with various embodiments. The system illustrated in FIG. **1** is that of a computer, but may be representative of other types of systems in other embodiments. As shown, system **10** comprises a processor **12** coupled to three storage devices **14**, **16**, and **18**. Storage device **14** comprises volatile storage such as random access memory and as such is referred to as "memory." Storage device **16** comprises non-volatile storage such as a hard disk drive (HDD) **16** and is referred to as a "HDD." Storage device **18** also comprises non-volatile storage such as any form of read-only memory (ROM) and as such is referred to as a "ROM." The ROM **18** may comprise a non-programmable ROM, a programmable ROM (PROM), an electrically-erasable PROM (EEPROM), and the like. The ROM **18** stores the system's basic input/output system (BIOS) **24** and may also be referred to as the "system ROM." Any one or a combination of the storage devices **14-18** are referred to herein as computer-readable storage media.

The BIOS **24** comprises code that is executed by the processor **12** during system initialization to perform a power-on self-test (POST). The BIOS **24** also comprises code that provides access to various hardware devices including, for example, keyboard, mouse, temperature sensors, disk drives, etc. During or after boot-up of the system **10**, the BIOS **24** in accordance with at least some embodiments is copied to memory **14** and executed from memory **14** thereafter. The copy of BIOS **24** in memory **14** is represented as BIOS **24***a* in FIG. **1**.

The various storage devices **14-18** couple to the processor through one or more busses and/or intervening logic (e.g., a bridge device). While one illustrative architecture for system **10** is shown in FIG. **1**, in other embodiments, different architectures can be used.

Referring still to FIG. **1**, the HDD **16** stores an operating system (OS) **30** and a management interface **32**. The OS **30** and management interface **32** comprise code that is executable by the processor **12**. The OS **30** provides a platform on which one or more applications can execute. The management interface **32** provides an interface usable by the OS **30** to access the BIOS **24** (references herein to BIOS **24** include BIOS **24***a* as well). In accordance with at least one embodiment, the OS **30** comprises the WINDOWS® or WINDOWS VISTA® operating systems and the management interface comprises the Windows Management Instrumentation (WMI) both from Microsoft Corp. Upon boot-up of system **10**, the OS **30** and management interface **32** are copied to memory **14** and are illustrated in FIG. **1** as OS **30***a* and management interface **32***a*. References herein to OS **32** include the copy of the OS in memory **14** (OS **30***a*). Similarly, references herein to management **32** include the copy of the management interface in memory **14** (management interface **32***a*).

In the embodiment of FIG. **1**, the system ROM **18** also stores a plurality of interface files **28**. In other embodiments, the interface files **28** are stored elsewhere besides on the system ROM **18**. Each interface file **28** describes classes and methods that are available to the OS **32** and any applications running thereon. In accordance with at least one embodiment, each interface file **28** is a management object format (MOF) file. In accordance with various embodiments, during system initialization or boot-up, the processor **12** of system **10** determines the system's configuration and selects an interface file **28** suitable for that particular configuration. The selected interface file **28** is selected for use during run-time (after the operating system has loaded) of system **10** and copied to storage device **14** for subsequent use from storage device **14**. The copy of the interface file in storage device **14** is represented as interface file **28*a*** in FIG. **1**. In accordance with at least some embodiments, the use of the selected interface file **28** may be as follows: the OS **32**, or an application running under the OS **32**, may initiate a request for data or call for a particular method to the management interface **32** for data. The management interface **32** generates a system management interrupt (SMI) which, in turn, is processed by the BIOS **24**. BIOS **24** retrieves the requested data or performs the called method, and provides the retrieved data or status resulting from the execution of the called method to the logic (OS **32** or application) that initiated the access to BIOS in the first place. The interface files **28** shown in the example of FIG. **1** are pre-compiled files. That is, the interface files **28** stored on system ROM **18** were compiled prior to being loaded onto system ROM **18**. Once an interface file **28** is selected, that file then can be executed without having to compile the file as the file is already compiled in this embodiment.

The processor **12** can determine the configuration of the system **10** in accordance with any of a variety of techniques. For example, one or more non-volatile storage devices **40** (e.g., complementary metal oxide semiconductor (CMOS) storage devices) may store some or all, of the configuration information associated with the system **10**, or at least enough of the configuration sufficient for the selection of the interface file **28**. Such configuration information may include, for example, presence of hardware devices such as a case lock and/or temperature sensors, verified security credentials, and the operating system executing in the system **10**.

In accordance with another embodiment, the configuration of the system **10** can be determined by the BIOS **24** issuing calls to all possible configuration elements for each such element, if present, or associated logic to reply to the call with information indicating whether that element is present. If the element is present, the element will reply to the call; if the element is not present, no reply will be issued. For example, the BIOS **24** may issue calls to all hardware devices that conceivably may be present in the system to ascertain whether each such device is present or absent. Further, BIOS **24** may issue calls to detect the presence or absence of non-hardware configuration elements such as security credentials.

Via whatever mechanism or procedure is used to determine the configuration of the system **10**, the interface file **28** most suitable for use in a system with that particular configuration is selected for use. In some embodiments, a data structure **29** (e.g., a look-up table) may be stored in the system ROM **18**. Such a data structure **29** may provide a mapping between various configurations and interface files **28**. Thus, upon determining the configuration for system **10**, the data structure **29** is accessed to look-up the corresponding interface file. In other embodiments, logic that selects the correct interface file **28** for a given configuration may be hard-coded into code such as BIOS **24**.

In some embodiments, the system ROM **18** also stores an Advanced Configuration Power Interface (ACPI) differentiated system description table **26**. The interface file **28** is selected for use in some embodiments by embedding in the ACPI table **26** a secondary system description table containing the selected MOF file.

The selected interface file **28** is used during run-time (i.e., after the OS **30** begins to execute) to enable the OS **30** to access the BIOS **24**. For example, the interface file **28** allows users to perform various actions through interaction with the OS such as changing BIOS configuration options, viewing temperature sensor data, performing security operations, etc.

FIG. **2** illustrates a method **100** implemented on system **10**. Each action depicted in FIG. **2** is performed by the processor **12** in accordance with at least some embodiments. At **102**, the processor **12** determines the configuration of the system **10**. At **104**, one of the plurality of interface files is selected by the processor **12** based on the system's configuration. At **106**, the processor **12** retrieves and uses the selected interface file to enable the OS **30** to access the BIOS **24** during run-time.

As noted above, the interface files shown in FIG. **1** may have been compiled prior to being loaded onto system ROM **18**. In other embodiments, the interface files **28** may not be pre-compiled and may be plain text files that will need to be compiled by system **10** prior to being used. In some embodiments, system ROM **18** stores only a single, uncompiled interface file. FIG. **3** illustrates an embodiment of a system **130** in which an uncompiled interface file **38** is stored on a system ROM **51**. The system ROM **51** in this embodiment comprises BIOS **24**, ACPI table **26**, a data structure **46**, and a compiler **50** as shown.

FIG. **4** illustrates a method **150** for use with an uncompiled interface file **28**. The method **150** in FIG. **4** (discussed in reference to FIG. **3** as well) is performed by the processor **12** in accordance with at least some embodiments. At **152**, the configuration of the system **130** is determined as explained previously. At **154**, for each configuration element of the configuration so determined, the method comprises selecting a subset of the uncompiled interface file **38** and storing said selected subset to a target interface file **42** created in memory **14** and dynamically assembled during system configuration or during run-time. A particular configuration element can be mapped to a section of the text of the interface file **38**, at **154**. For example, at **152** it may be determined that a temperature sensor is present in the system **130**. If a temperature sensor is present, it can be mapped to a section of the uncompiled interface file **38** that relates to accessing and using such a temperature sensor. In some embodiments, a data structure (D.S.) **46** is provided on, for example, system ROM **51**. Such data structure **46** maps the configuration elements to the corresponding portions of the interface file **38**.

Once the target interface file **42** is created in memory **14** from the uncompiled interface file **38**, the target interface file **42** is compiled (**156**) to produce compiled target interface file **44**. A compiler such as a MOF compiler may be provided on system ROM **18** for this purpose. At **158**, the dynamically-compiled interface file **44** is used as explained previously.

The above discussion is meant to be illustrative of the principles and various embodiments of the present invention. Numerous variations and modifications will become apparent to those skilled in the art once the above disclosure is fully appreciated. It is intended that the following claims be interpreted to embrace all such variations and modifications.

What is claimed is:

1. A computer, comprising:

a processor;

first storage device coupled to said processor, said first storage device containing a basic input/output system (BIOS) executable by said processor;

second storage device coupled to said processor, said second storage device containing a management interface usable by an operating system to access said BIOS; and

a plurality of interface files stored in said computer, each interface file usable by said management interface to access said BIOS and each interface file defining one or more methods for use by said management interface;

wherein, upon execution of said BIOS, said processor is to determine a configuration of said computer, by accessing a value from a third storage device, and, based on said determined configuration, to select a particular interface file for use during run-time.

2. The computer of claim **1** wherein said first storage device contains said plurality of interface files.

3. The computer of claim **1** wherein said plurality of interface files comprises managed object format (MOF) files.

4. The computer of claim **1** wherein each of said plurality of interface files is compiled before storage on said computer.

5. The computer of claim **1** wherein said first storage device is a read-only memory and said plurality of interface files are contained on said read-only memory with said BIOS.

6. A computer, comprising:

a processor;

first storage device coupled to said processor, said first storage device containing a basic input/output system (BIOS) executable by said processor, a plurality of compiled interface files, each interface file defining classes and methods for accessing the BIOS, and a data structure that includes a mapping between computer configurations and individual interface files; and

second storage device coupled to said processor, said second storage device containing a management interface usable by an operating system to access said BIOS;

wherein, upon execution of said BIOS, said processor is to determine a configuration of said computer and, based on said the mapping in the data structure, to select a particular interface file from among the plurality of interface files for use during run-time and copy the selected interface file from the first storage device to a different storage device.

7. The computer of claim **6** wherein the plurality of interface files comprises managed object format (MOF) files.

8. The computer of claim **6** wherein, upon execution of the BIOS, the processor is to determine the configuration by accessing a value from a third storage device.

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