

US006411941B1

(12) United States Patent Mullor et al.

US 6,411,941 B1 (10) Patent No.:

(45) Date of Patent: Jun. 25, 2002

(54) METHOD OF RESTRICTING SOFTWARE **OPERATION WITHIN A LICENSE** LIMITATION

(75) Inventors: Miki Mullor; Julian Valiko, both of

Ramat Hasharon (IL)

Assignee: Beeble, Inc., Newport Beach, CA (US)

(*) Notice: Subject to any disclaimer, the term of this

patent is extended or adjusted under 35

U.S.C. 154(b) by 0 days.

(21) Appl. No.: 09/164,777

Filed: Oct. 1, 1998 (22)

(30)Foreign Application Priority Data

(IL)	21, 1998	May
⁷ G06F 17/60	Int. Cl. ⁷	(51)
	HS CL	

705/53; 705/57 705/57, 58, 59, 1, 50, 52, 53; 713/187,

References Cited (56)

U.S. PATENT DOCUMENTS

4,866,769 A	9/1989	Karp
4,903,296 A	2/1990	Chandra et al.
4,924,378 A	5/1990	Hershey et al.
5,386,369 A	1/1995	Christiano
5,390,297 A	2/1995	Barber et al.
5,479,639 A	* 12/1995	Ewertz et al 395/430
5,490,216 A	* 2/1996	Richadson, III 380/4
5,671,412 A	9/1997	Christiano
5,684,951 A	* 11/1997	Goodman et al 395/188.01
5,754,763 A	5/1998	Bereiter
5,758,068 A	5/1998	Brandt et al.
5,758,069 A	5/1998	Olsen
5,790,664 A	8/1998	Coley et al.
5,826,011 A	10/1998	Chou et al.
5,892,900 A	* 4/1999	Ginter et al 395/186
5,905,860 A	5/1999	Olsen et al.

6,000,030	A	*	12/1999	Steinberg et al 713/200
6,006,190	Α		12/1999	Baena-Arnaiz et al.
6,021,438	Α		2/2000	Duvvoori et al.
6,023,763	Α		2/2000	Grumpstrup et al.
6,052,600	Α	*	4/2000	Fette et al 455/509
6,055,503	Α		4/2000	Horstmann
6,067,582	Α	*	5/2000	Smith et al 710/5
6,073,256	Α		6/2000	Sesma
6,078,909	Α		6/2000	Knutson
6,128,741	Α		10/2000	Goetz et al.
6,173,446	B 1		1/2001	Khan et al.
6,189,146	B 1	*	2/2001	Misra et al 717/11
6,192,475	B 1		2/2001	Wallance
6,198,875	B 1	*	3/2001	Edenson et al 386/94
6,226,747	B 1		5/2001	Larsson et al.
6,233,567	B 1		5/2001	Cohen
6,243,468	B1		6/2001	Pearce et al.
6,272,636	B 1		8/2001	Neville et al.
6,298,138	B1		10/2001	Gotoh et al.

FOREIGN PATENT DOCUMENTS

408286906 A * 11/1996 G06F/9/06 JΡ

OTHER PUBLICATIONS

Dornbusch et al., Destop management software: no need to adjust your set., Infoworld, v17, n37, p60.*

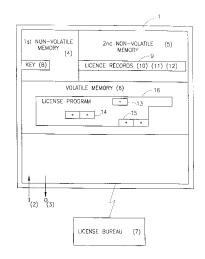
189, 200

Primary Examiner—Hyung-Sub Sough Assistant Examiner—Calvin L Hewitt (74) Attorney, Agent, or Firm-Venable; Robert Kinberg; Jeffri A. Kaminski

(57)**ABSTRACT**

A method of restricting software operation within a license limitation that is applicable for a computer having a first non-volatile memory area, a second non-volatile memory area, and a volatile memory area. The method includes the steps of selecting a program residing in the volatile memory, setting up a verification structure in the non-volatile memories, verifying the program using the structure, and acting on the program according to the verification.

19 Claims, 2 Drawing Sheets





^{*} cited by examiner

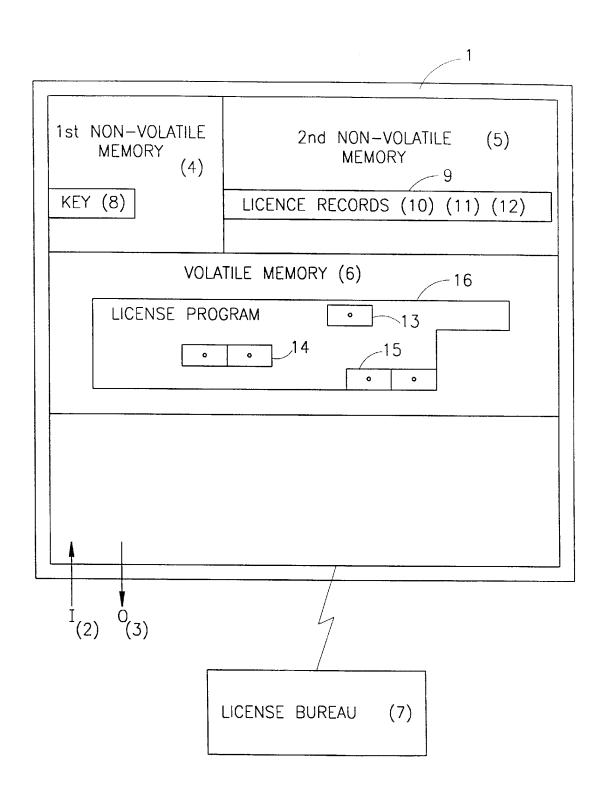


FIG.1

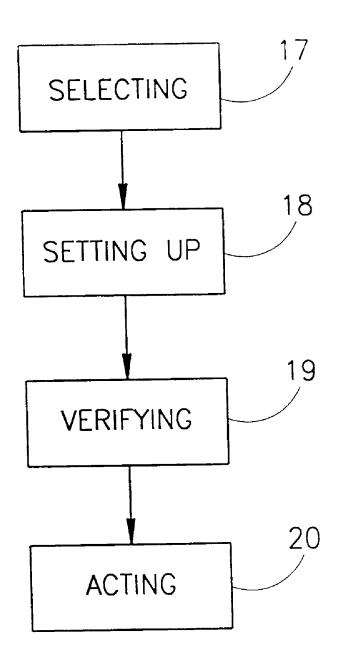


FIG.2

1

METHOD OF RESTRICTING SOFTWARE OPERATION WITHIN A LICENSE LIMITATION

FIELD OF THE INVENTION

This invention relates to a method and system of identifying and restricting an unauthorized software program's operation.

BACKGROUND OF THE INVENTION

Numerous methods have been devised for the identifying and restricting of an unauthorized software program's operation. These methods have been primarily motivated by the grand proliferation of illegally copied software, which is engulfing the marketplace. This illegal copying represents billions of dollars in lost profits to commercial software developers.

Software based products have been developed to validate authorized software usage by writing a license signature 20 onto the computer's volatile memory (e.g. hard disk). These products may be appropriate for restricting honest software users, but they are very vulnerable to attack at the hands of skilled system's programmers (e.g. "hackers"). These license signatures are also subject to the physical instabilities of their volatile memory media.

Hardware based products have also been developed to validate authorized software usage by accessing a dongle that is coupled e.g. to the parallel port of the P.C. These units are expensive, inconvenient, and not particularly suitable for 30 software that may be sold by downloading (e.g. over the internet).

There is accordingly a need in the art to provide for a system and method that substantially reduce or overcome the drawbacks of hitherto known solutions.

SUMMARY OF THE INVENTION

The present invention relates to a method of restricting software operation within a license limitation. This method strongly relies on the use of a key and of a record, which have been written into the non-volatile memory of a computer.

For a better understanding of the underlying concept of the invention, there follows a specific non-limiting example.

Thus, consider a conventional computer having a conventional BIOS module in which a key was embedded at the ROM section thereof, during manufacture. The key constitutes, effectively, a unique identification code for the host computer. It is important to note that the key is stored in a non-volatile portion of the BIOS, i.e. it cannot be removed or modified.

Further, according to the invention, each application program that is to be licensed to run on the specified computer, is associated with a license record; that consists of author 55 name, program name and number of licensed users (for network). The license record may be held in either encrypted or explicit form.

Now, there commences an initial license establishment procedure, where a verification structure is set in the BIOS 60 so as to indicate that the specified program is licensed to run on the specified computer. This is implemented by encrypting the license record (or portion thereof) using said key (or portion thereof) exclusively or in conjunction with other identification information) as an encryption key. The resulting encrypted license record is stored in another (second) non-volatile section of the BIOS, e.g. E²PROM (or the

2

ROM). It should be noted that unlike the first non-volatile section, the data in the second non-volatile memory may optionally be erased or modified (using E²PROM manipulation commands), so as to enable to add, modify or remove licenses. The actual format of the license may include a string of terms that correspond to a license registration entry (e.g. lookup table entry or entries) at a license registration bureau (which will be further described as part of the preferred embodiment of the present invention).

Having placed the encrypted license record in the second non-volatile memory (e.g. the E²PROM), the process of verifying a license may be o commenced. Thus, when a program is loaded into the memory of the computer, a so called license verifier application, that is a priori running in the computer, accesses the program under question, retrieves therefrom the license record, encrypts the record utilizing the specified unique key (as retrieved from the ROM section of the BIOS) and compares the so encrypted record to the encrypted records that reside in the E²PROM. In the case of match, the program is verified to run on the computer. If on the other hand the sought encrypted data record is not found in the E²PROM database, this means that the program under question is not properly licensed and appropriate application define action is invoked (e.g. informing to the user on the unlicensed status, halting the operation of the program under question etc.)

Those versed in the art will readily appreciate that any attempt to run a program at an unlicensed site will be immediately detected. Consider, for example, that a given application, say Lotus 123, is verified to run on a given computer having a first identification code (k1) stored in the ROM portion of the BIOS thereof. This obviously requires that the license record (LR) of the application after having been encrypted using k1 giving rise to $(LR)_{k1}$ is stored in the E^2PROM of the first computer.

Suppose now that a hacker attempts to run the specified application in a second computer having a second identification code (k2) stored in the ROM portion of the BIOS thereof. All or a portion the database contents (including of course (LR)_{k1}) that reside in the E^2 PROM portion in the first computer may be copied in a known per se means to the second computer. It is important to note that the hacker is unable to modify the key in the ROM of the second computer to K1, since, as recalled, the contents of the ROM is established during manufacture and is practically invariable.

Now, when the application under question is executed in the second computer, the license verifier retrieves said LR from the application and, as explained above, encrypts it using the key as retrieved from the ROM of the second computer, i.e k2 giving rise to encrypted license record $(LR)_{k2}$. Obviously, the value $(LR)_{k2}$ does not reside in the E^2PROM database section of the second computer (since it was not legitimately licensed) and therefore the specified application is invalidated. It goes without saying that the data copied from the first (legitimate) computer is rendered useless, since comparing $(LR)_{k2}$ with the copied value $(LR)_{k1}$ results, of course, in mismatch.

The example above is given for clarity of explanation only and is by no means binding.

In its broadest aspect, the invention provides for a method of restricting software operation within a license limitation including; for a computer having a first non-volatile memory area, a second non-volatile memory area, and a volatile memory area; the steps of: selecting a program residing in the volatile memory, setting up a verification structure in the



non-volatile memories, verifying the program using the structure, and acting on the program according to the veri-

An important advantage in utilizing non-volatile memory such as that residing in the BIOS is that the required level of system programming expertise that is necessary to intercept or modify commands, interacting with the BIOS, is substantially higher than those needed for tampering with data residing in volatile memory such as hard disk. Furthermore, there is a much higher cost to the programmer, if his 10 tampering is unsuccessful, i.e. if data residing in the BIOS (which is necessary for the computer's operability) is inadvertently changed by the hacker. This is too high of a risk for the ordinary software hacker to pay. Note that various recognized means for hindering the professional-like hacker 15 may also be utilized (e.g. anti-debuggers, etc.) in conjunction with the present invention.

In the context of the present invention, a "computer" relates to a digital data processor. These processors are found in personal computers, or on one or more processing $\ ^{20}$ cards in multi-processor machines. Today, a processor normally includes a first non-volatile memory, a second nonvolatile memory, and data linkage access to a volatile memory. There are also processors having only one nonvolatile memory or having more than two non-volatile 25 memories; all of which should be considered logically as relating to having a first and a second non-volatile memory areas. There are also computational environments where the volatile memory is distributed into numerous physical components, using a bus, LAN, etc.; all of which should 30 logically be considered as being a volatile memory area.

According to the preferred embodiment of the present invention, there is further provided a license authentication bureau which can participate in either or both of:

- (i) establishing the license record in the second nonvolatile memory; and
- (ii) verifying if the key and license record in the nonvolatile memory(s) is compatible with the license record information as extracted from the application 40 under question.

The bureau is a telecommunications accessible processor where functions such as formatting, encrypting, and verifying may be performed. Performing these or other functions at the bureau helps to limit the understanding of potential 45 software hackers; since they can not observe how these functions are constructed. Additional security may also be achieved by forcing users of the bureau to register, collecting costs for connection to the bureau, logging transactions at the bureau, etc.

According to one example of using the bureau, setting up a verification structure further includes the steps of: establishing, between the computer and the bureau, a twoway data-communications linkage; transferring, from the computer to the bureau, a request-for-license including an 55 identification of the .computer and the license-record's contents from the selected program; forming an encrypted license-record at the bureau by encrypting parts of the request-for-license using part of the identification as the encryption key; and transferring, from the bureau to the 60 computer, the encrypted license-record.

According to another example of using the bureau, verifying the program further includes the steps of: establishing, between the computer and the bureau, a two-way datathe bureau, a request-for-license-verification including an identification of the computer, the encrypted license-record

for the selected program from the second non-volatile memory, and the licensed-software-program's licenserecord contents; enabling the comparing at the bureau; and transferring, from the bureau to the computer, the result of the comparing.

The actual key that serves for identifying the computer may be composed of the pseudo-unique key exclusively, or, if desired, in combination with information, e.g. information related to the registration of the user such as e.g. place, telephone number, user name, license number, etc. In the context of the present invention, a "pseudo-unique" key may relate to a bit string which uniquely identifies each first non-volatile memory. Alternately the "pseudo-unique" key may relate to a random bit string (or to an assigned bit string) of sufficient length such that: there is an acceptably low probability of a successful unauthorized transfer of licensed software between two computers, where the first volatile memories of these two computers have the same key.

It should be noted that the license bureau might maintain a registry of keys and of licensed programs that have been registered at the bureau in association with these keys. This registry may be used to help facilitate the formalization of procedures for the transfer of ownership of licensed software from use on one computer to use on another computer.

Constructing the key in the manner specified may hinder the hacker in cracking the proposed encryption scheme of the invention, in particular when the establishment of the license record or the verification thereof is performed in the bureau. Those versed in the art will readily appreciate that the invention is by no means bound by the data, the algorithms, or the manner of operation of the bureau. It should be noted that the tasks of establishing and/or verifying a license record may be shared between the bureau and the computer, done exclusively at the computer, or done exclusively at the bureau. The pseudo-unique key length needs to be long enough to hinder encryption attack schemes. The establishing of the key may be done at any time from the non-volatile memory's manufacture until an attempted use of an established license-record in the nonvolatile memory. The key is used for encryption or decryption operations associated with license-records. In principle, the manufacturer of the licensed-software-program may specify the license-record format and therefore different formats may, if desired, be used for respective applications.

According to the preferred embodiment of the present invention, the pseudo-unique key is a unique-identification bit string that is written onto the first non-volatile memory by the manufacturer of the is memory media.

According to one, non-limiting, preferred embodiment of 50 the present invention, the first non-volatile memory area is a ROM section of a BIOS; the second non-volatile memory area is a E²PROM section of a BIOS; and the volatile memory is a RAM e.g. hard disk and/or internal memory of the computer.

The present invention also relates to a non-volatile memory media used as a BIOS of a computer, for restricting software operation within a license limitation, wherein a pseudo-unique key is established.

According to the preferred embodiment of the nonvolatile memory media of the present invention, the pseudounique key is established in a ROM section of the BIOS.

BRIEF DESCRIPTION OF THE DRAWINGS

In order to understand the invention and to see how it may communications linkage; transferring, from the computer to 65 be carried out in practice, a preferred embodiment will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:



DOCKET

Explore Litigation Insights



Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time** alerts and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.

