



US009270677B1

(12) **United States Patent**  
**Feeser et al.**

(10) **Patent No.:** **US 9,270,677 B1**  
(45) **Date of Patent:** **\*Feb. 23, 2016**

(54) **COMPLIANCE VALIDATOR FOR RESTRICTED NETWORK ACCESS CONTROL**

(56) **References Cited**

U.S. PATENT DOCUMENTS

- (71) Applicant: **OPEN INVENTION NETWORK LLC**, Durham, NC (US)
- (72) Inventors: **Colin Lee Feeser**, Atlanta, GA (US); **Anthony William Ondrus**, Kennesaw, GA (US); **Mark Jackson Canup**, Atlanta, GA (US)
- (73) Assignee: **Open Invention Network, LLC**, Durham, NC (US)

7,441,180	B1 *	10/2008	Kaczmarek et al.	715/201
7,506,102	B2 *	3/2009	Lev-Ran et al.	711/118
7,509,685	B2 *	3/2009	Lambert	726/27
7,853,687	B2 *	12/2010	Le Moigne et al.	709/224
2002/0170052	A1 *	11/2002	Radatti	717/171
2006/0095382	A1 *	5/2006	Mahlbacher	705/59
2006/0224775	A1 *	10/2006	Lee et al.	709/248
2007/0124803	A1 *	5/2007	Taraz	726/4
2007/0143851	A1 *	6/2007	Nicodemus et al.	726/25
2007/0156694	A1 *	7/2007	Lim	707/9
2007/0203999	A1 *	8/2007	Townesley et al.	709/207
2007/0211722	A1 *	9/2007	Subramanian	370/390
2009/0210701	A1 *	8/2009	Zhang et al.	713/156

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 70 days.

\* cited by examiner

This patent is subject to a terminal disclaimer.

Primary Examiner — Shin-Hon Chen

(74) Attorney, Agent, or Firm — Haynes and Boone, LLP

(21) Appl. No.: **14/175,372**

(57) **ABSTRACT**

(22) Filed: **Feb. 7, 2014**

A method, system, and computer program product for detecting and enforcing compliance with access requirements for a computer system in a restricted computer network. A compliance validation configuration file is created for the computer system. A maintenance service utility is configured to launch a compliance validation executable file at a specified time during operation of the computer system. A digital hash is generated for the compliance validation executable file and for the compliance validation configuration file. A determination is made if the computer system or a computer system user is a member of a configured restricted group. If the computer system or the computer system user is a member of a configured restricted group, a determination is made if a directory site code for a subnet of the restricted computer network to which the computer system is connected corresponds to a configured and allowed site. If the directory site code does not correspond to a configured and allowed site, compliance with access requirements are enforced. Enforcement actions can include a forced logoff of the computer system user, and/or a forced shutdown of the computer system.

**Related U.S. Application Data**

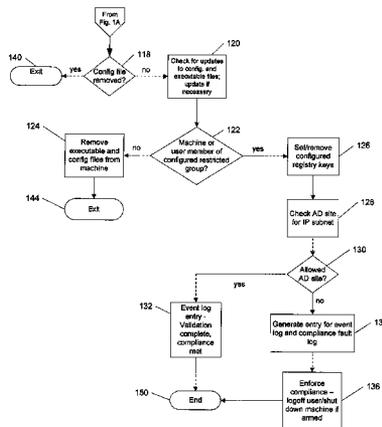
- (63) Continuation of application No. 13/653,837, filed on Oct. 17, 2012, now Pat. No. 8,656,505, which is a continuation of application No. 13/110,177, filed on May 18, 2011, now Pat. No. 8,302,208, which is a continuation of application No. 11/941,546, filed on Nov. 16, 2007, now Pat. No. 7,966,665.

- (51) **Int. Cl.**  
*H04L 29/06* (2006.01)  
*G06F 11/00* (2006.01)  
*G06F 12/14* (2006.01)  
*G06F 12/16* (2006.01)  
*G08B 23/00* (2006.01)

- (52) **U.S. Cl.**  
CPC ..... *H04L 63/10* (2013.01)

- (58) **Field of Classification Search**  
None  
See application file for complete search history.

**18 Claims, 5 Drawing Sheets**



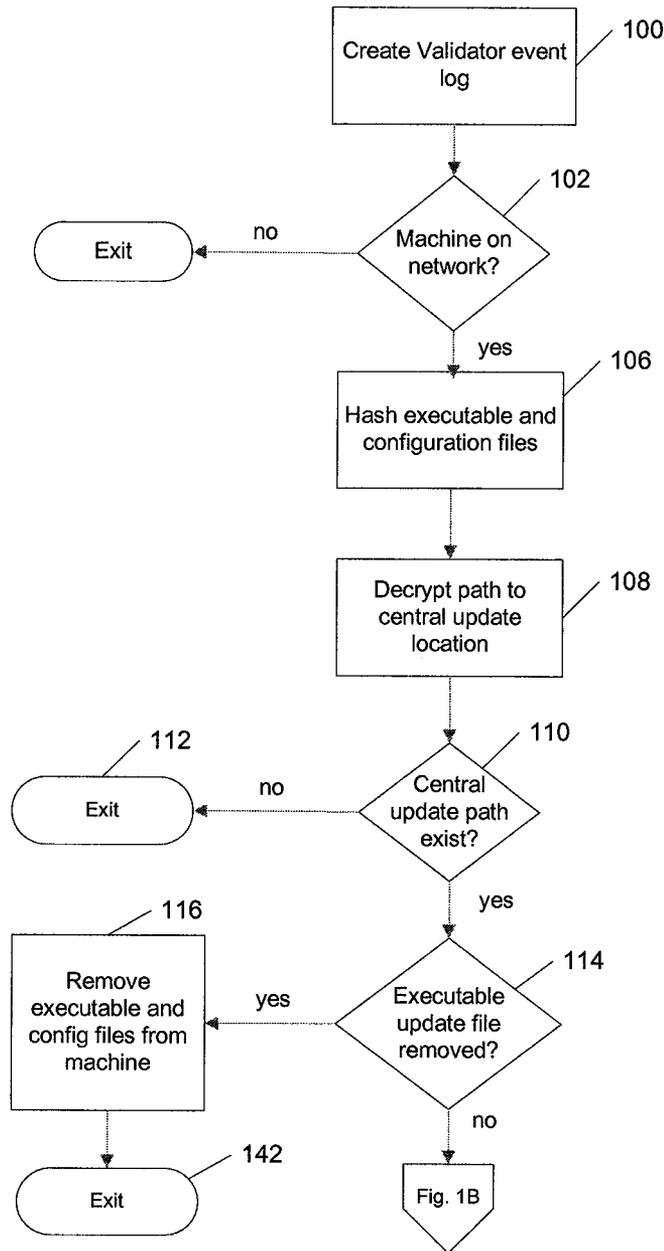


FIG. 1A

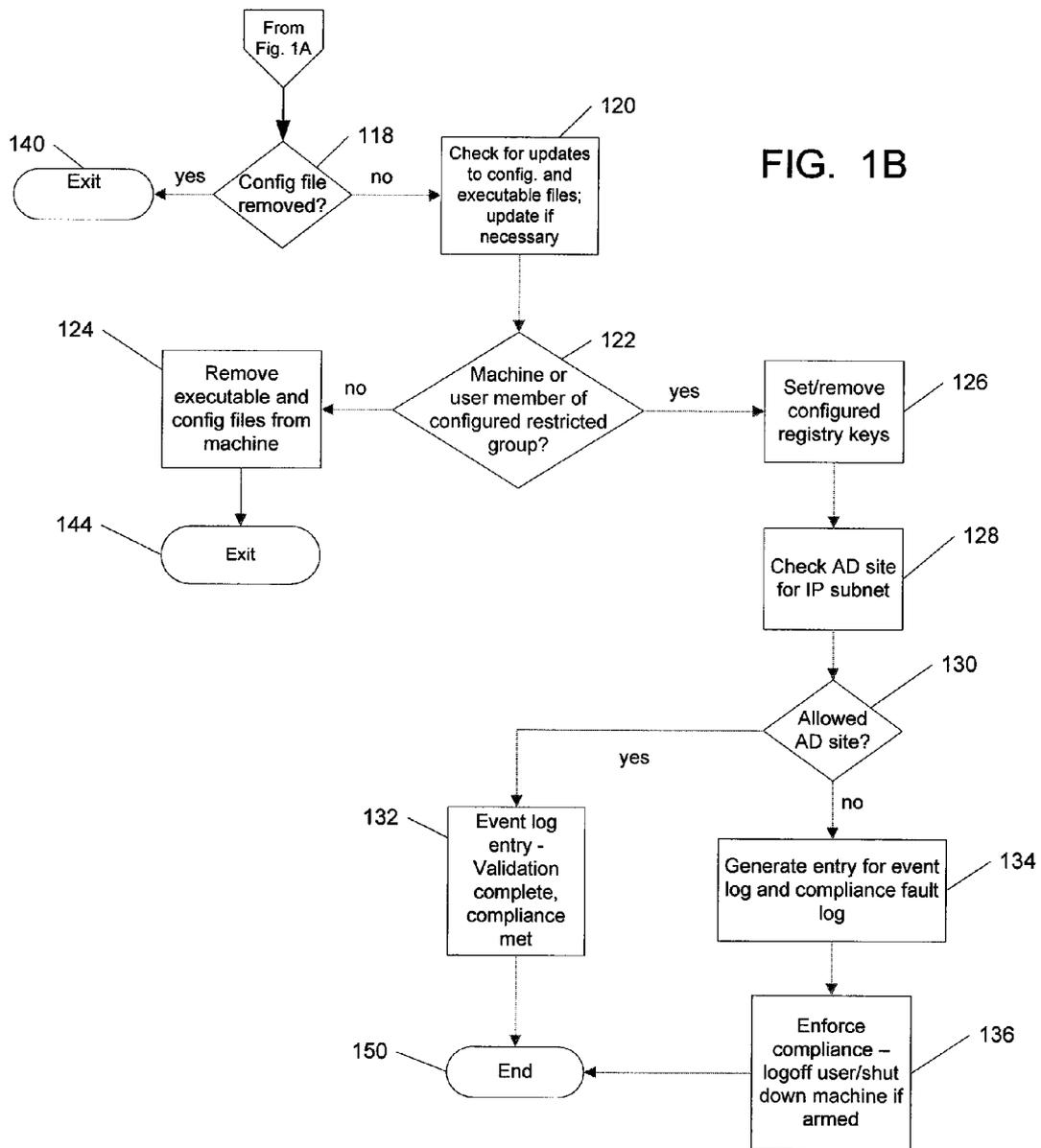


FIG. 1B

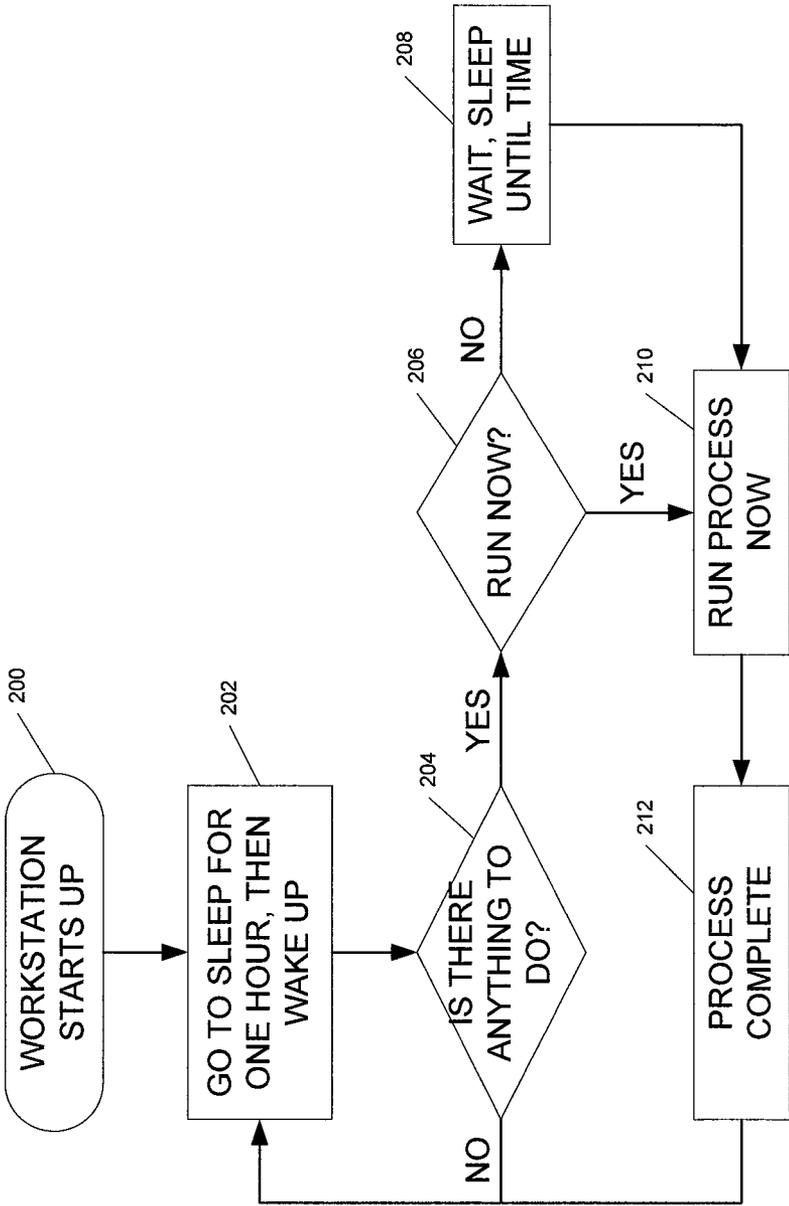


FIG. 2

WORKSTATION MAINTENANCE SERVICE PROPERTIES (LOCAL C...)

GENERAL LOG ON RECOVERY DEPENDENCIES

Service Name: WinMaint

Display Name: Workstation Maintenance Service

Description: Company Windows Maintenance Service

Path to executable: C:\Program Files\Company\Workstation Maintenance\WinMaint.exe

Startup type: Automatic

Service status: Started

Start Stop Pause Resume

You can specify the start parameters that apply when you start the service from here.

Start Parmameters:

OK Cancel Apply

FIG. 3

Registry Editor			
File Edit View Favorites Help			
Name	Type	Data	
Version Check	REG_SZ	(value not set)	
Welcome	REG_SZ	c:\programs\company\	
WinMaint	REG_SZ	0x00000000 (0)	
Compliance Validator	REG_DWORD	0x00000000 (0)	
Symantec	REG_SZ	0x00000000 (0)	
Vapi	REG_SZ	0x00000000 (0)	
VapiVS71	REG_DWORD	-f 5 7 1	
VMware, Inc.	REG_DWORD	0x01499700 (2160000)	
Windows 3.1 Migration Status	REG_DWORD	0x00000ce0 (3296)	
System			
ControlSet001			
ControlSet002			
CurrentControlSet			
Control			
Enum			
Hardware Profiles			

FIG. 4

1

## COMPLIANCE VALIDATOR FOR RESTRICTED NETWORK ACCESS CONTROL

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of and claims priority from U.S. patent application Ser. No. 13/653,837, filed on Oct. 17, 2012, entitled COMPLIANCE VALIDATOR FOR RESTRICTED NETWORK ACCESS CONTROL, now issued U.S. Pat. No. 8,656,505, issued on Feb. 18, 2014, which is a continuation of U.S. patent application Ser. No. 13/110,177, filed on May 18, 2011, entitled COMPLIANCE VALIDATOR FOR RESTRICTED NETWORK ACCESS CONTROL, now U.S. Issued U.S. Pat. No. 8,302,208, issued on Oct. 30, 2012, which in turn is a continuation of and claims priority from U.S. patent application Ser. No. 11/941,546, filed on Nov. 16, 2007 entitled COMPLIANCE VALIDATOR FOR RESTRICTED NETWORK ACCESS CONTROL, now issued U.S. Pat. No. 7,966,665, issued on Jun. 21, 2011, each of which is incorporated by reference herein in its entirety.

### BACKGROUND OF THE INVENTION

The present invention relates generally to information processing on a computer network and, more particularly, to methods and systems for detecting and enforcing compliance with restricted subnet access requirements in a corporate wide area network.

In computer network communications, geographic and other limitations result in a need to create smaller networks called subnets to facilitate communications between locations. In a network containing many Microsoft Windows computing platforms. Active Directory is a network-based object store and directory service that locates and manages resources, and makes resources available to authorized users and groups. Each object has certain attributes and its own security access control list (ACL). Active Directory catalogs file objects with their attributes in a hierarchical arrangement and utilizes naming resolution services such as the Domain Name System (DNS). Active Directory has an important role in identifying security policies across the network.

The physical network structure of Active Directory is based on a unit known as a site. A site includes one or more Internet Protocol (IP) subnets. Many subnets can belong to a single site, but a single subnet cannot span multiple sites. A site can have multiple domains, and a domain can have a number of sites. Sites and domains do not need to maintain the same namespace. On Windows Server systems, a domain controller is the server that responds to security authentication requests within the Windows Server domain. A domain controller contains a copy of the Active Directory. All domain controllers are peers and maintain replicated versions of Active Directory for their domains.

A large enterprise will typically have a wide area network (WAN) with many thousands of workstations that are connected to various servers in the network. To protect data within departments, restrictions will need to be in place to secure and manage sometimes critical information. For example, in the electrical power industry, under certain Federal guidelines it is important to restrict the access of certain parts of an electrical power company from communicating with other parts of the same company. This restricted access also includes being able to bring a computer up on certain segments of the network identified as subnets. Thus, there is

2

a need for a system that provides the ability to discover and control subnet compliance breaches as mandated by new Federal Regulatory Commission (FERC) requirements for gas and electric utilities which prohibit communications between specific parts of the utilities. There is also a need for a system that can audit restricted subnet access.

### SUMMARY OF THE INVENTION

The present invention is directed to a utility for detecting and enforcing compliance where users and/or machines of a particular Active Directory group are restricted from accessing particular subnets of a corporate wide area network based upon Active Directory Site Codes. Concerning the restricted subnets/site codes, the compliance validator utility displays a message to the user when it determines that the machine is on a restricted network. It can also be armed in such a way that, under this scenario, it can be configured to log the user off or even shut the machine down. Alternatively, the compliance validator utility can check for the use of a restricted website as a home page and change the home page to a website that is permitted. The compliance validator utility can also be configured to add or remove registry keys. The utility is designed to be self-updating and centrally configured. All activity is logged to a Windows EventLog. When a compliance violation is detected, a log file is sent to a central location. The compliance validator utility is designed to run from a log-in script and/or a service such as the Windows maintenance server utility or the Task Scheduler application available from Microsoft Corporation.

The compliance validator utility determines if the machine and the user are members of configured restricted groups. If either is true, the utility will perform the following tasks: (1) set and/or remove configured registry keys; (2) check the active directory site code of the IP subnet of the network to which the machine is connected; (3) if the active directory site code is not one of the configured allowed AD sites, display a message and optionally perform the enforcement measure of logging the user off or shutting down the machine; and (4) if a compliance violation takes place, generate a log in the Windows Event Log and send the log to a configured central logging location. The capabilities of the compliance validator utility include the ability to detect tampering such as removing or altering the configuration file. In this instance, the utility will display a message and potentially perform enforcement measures such as logging the user off before shutting down the machine. Executable and configuration files for compliance validator are digitally hashed. The utility will detect a change in the central file for either the executable or configuration file and automatically update the affected file. The paths to the central update location are encrypted to prevent tampering. If a non-restricted machine is logged onto by a restricted user, the compliance validator utility will be installed on the machine. As an option, when a non-restricted user logs onto the machine, the compliance validator utility can be configured to automatically uninstall itself.

In one aspect of the invention, a method, system, and computer program product are provided for detecting and enforcing compliance with access requirements for a computer system in a restricted computer network. The method begins with the step of creating a compliance validation configuration file for the computer system. A maintenance service utility is configured to launch a compliance validation executable file at a specified time during operation of the computer system. The method generates a digital hash for the compliance validation executable file and for the compliance validation configuration file. The method then determines if

the computer system or a computer system user is a member of a configured restricted group. If the computer system or the computer system user is a member of a configured restricted group, the method determines if a directory site code for a subnet of the restricted computer network to which the computer system is connected corresponds to a configured and allowed site. If the directory site code does not correspond to a configured and allowed site, the method enforces compliance with access requirements. Enforcement actions can include a forced logoff of the computer system user, and/or a forced shutdown of the computer system.

The system includes a plurality of components that perform the steps of the method when operated on a computer system. The computer program product includes a computer readable medium having computer instructions embedded therein, the computer readable medium implementing the method when operated on the computer system.

#### BRIEF DESCRIPTION OF THE DRAWINGS

These and other advantages and aspects of the present invention will become apparent and more readily appreciated from the following detailed description of the invention taken in conjunction with the accompanying drawings, as follows.

FIGS. 1A-1B illustrate the processing logic for the compliance validator utility in accordance with an exemplary embodiment of the invention.

FIG. 2 illustrates the high level processing logic for the workstation maintenance utility component that operates in conjunction with the compliance validator utility in accordance with an exemplary embodiment of the invention.

FIG. 3 illustrates an exemplary workstation maintenance utility service properties display.

FIG. 4 illustrates an exemplary workstation platform registry editor.

#### DETAILED DESCRIPTION OF THE INVENTION

The following description of the invention is provided as an enabling teaching of the invention and its best, currently known embodiment. Those skilled in the relevant art will recognize that many changes can be made to the embodiments described, while still obtaining the beneficial results of the present invention. It will also be apparent that some of the desired benefits of the present invention can be obtained by selecting some of the features of the present invention without utilizing other features. Accordingly, those who work in the art will recognize that many modifications and adaptations to the present invention are possible and may even be desirable in certain circumstances, and are a part of the present invention. Thus, the following description is provided as illustrative of the principles of the present invention and not in limitation thereof, since the scope of the present invention is defined by the claims.

Compliance validator is a utility for detecting and enforcing compliance where users and/or machines of a particular Active Directory group are restricted from accessing particular subnets of a corporate wide area network based upon Active Directory Site Codes. Concerning the restricted subnets/site codes, compliance validator will display a message to the user when it determines that the machine is on a restricted network. It can also be armed in such a way that under this scenario it can be configured to log the user off or even shut the machine down.

Alternatively, the compliance validator utility can also check for the use of a restricted website as a home page and change the home page to a website that is allowed. Compli-

ance validator can also be configured to add or remove registry keys. As is well known, in a Microsoft Windows environment, the registry contains information that Windows references during operation, such as user profiles, installed applications, and the types of document that each can create, system hardware information, and ports that are being used. The registry is divided into a number of logical sections called "hives." A registry hive is a group of keys, subkeys, and values in the registry that has a set of supporting files containing data backups. Certain predefined keys are used by Windows systems. They begin with the term "HKEY" which is an abbreviation for hive key. The registry hives that are used by the present invention include: (1) HKEY\_LOCAL\_MACHINE (HKLM), (2) HKEY\_CURRENT\_USER (HKCU), (3) HKEY\_CLASSES\_ROOT (HKCR), (4) HKEY\_CURRENT\_CONFIG (HKCC), and (5) HKEY\_USERS (HKU). The HKLM hive key contains configuration information particular to the computer for any user. The HKCU hive key contains the root of the configuration information for the user currently logged on to a particular computer. This is a subkey of HKU. The HKCR hive key is a subkey of HKLM and provides a view of the registry that merges information from the HKCU and HKLM keys. The HKCC hive key contains information about the hardware profile that is used by the local computer at system startup. The HKU hive key contains all the actively loaded user profiles on the computer.

The compliance validator utility is designed to be self updating and centrally configured. The compliance validator utility logs all activity to the Windows EventLog. When a compliance violation is detected a log file is sent to the central location. The compliance validator tool is designed to run from a login script and/or a service such as a Windows Maintenance Service utility or a Task Scheduler utility.

In the event of an emergency, the compliance validator utility can be easily disarmed, reconfigured or even removed from all machines. If the compliance validator utility is installed on a non-restricted machine through an event such as a restricted user logging on, it can optionally uninstall itself when logged on by a non-restricted user.

In one embodiment, the compliance validator utility performs in the following manner. Compliance validator will only run in one iteration. If another iteration is in memory, it will exit. If one doesn't exist, compliance validator will establish a Windows EventLog folder named "Validator Log." All activity of compliance validator will be logged to this folder which can be reached remotely. Compliance validator will determine if the machine is on a network. If compliance validator determine that the machine is not on a network it will exit. Compliance validator can detect tampering such as removing or altering the configuration file, and will display a message and potentially perform enforcement measures such as logging the user off, or shutting down the machine. Executable and configuration files are digitally hashed. Compliance validator will detect a change in a central file for either the executable or configurable file and automatically update the affected file. The paths to the central update location are encrypted to prevent tampering. If the central update path exists, but the executable update file has been removed, compliance validator will automatically remove itself and the configuration file from the machine.

The registry settings under [RegistryDeletes] will be removed regardless of the value in PerformRegDels. If the central update path exists, but the configuration file has been removed, compliance validator will simply exit. Compliance validator checks to see if the machine and the user are members of configured restricted groups. If either is true, compliance validator will set and/or remove configured registry

## 5

keys, and check the Active Directory (AD) Site Code of the IP Subnet of the network to which the machine is connected. If the AD Site Code is not one of the configured "Allowed AD Sites," the compliance validator utility will display a message and optionally perform the enforcement measure of logging the user off or shutting down the machine. There are seven different settings for this enforcement measure, as follows:

- 0=Logoff
- 1=Shutdown
- 2=Reboot
- 4=Forced Logoff
- 5=Forced Shutdown
- 6=Power Off
- 12=Forced Power Off

If the above compliance violation takes place, a log is generated in the Windows EventLog and also sent to a configured central logging location. If a non-restricted machine is logged onto by a restricted user, compliance validator will be installed. As an option, when the non-restricted user logs onto the machine, compliance validator can be configured to automatically uninstall itself. Also, the registry settings under [RegistryDeletes] will be removed regardless of the value in PerformRegDels.

The following components are required on the local machine for the correct operation of compliance validator:

Validator.exe—the main executable;

Validator.dtd—the configuration file must exist in the same folder as the executable file.

#### Compliance Validator Configuration File

The compliance validator configuration file is arranged in the same format as an initialization (ini) file. Each section is named using a string enclosed within square brackets "[ ]". Each value is given a string name followed by an equal sign ("="), then a string value assigned to the name. The exceptions to this are the enumeration sections. These sections are enumerated according to the number of values required to be checked. The enumerated section for "Home Page Conversions" is delimited with a semi-colon to separate the restricted web page and the replacement allowed web page should the restricted web page be found as the user's home page. This configuration allows for multiple web pages to be checked. The configuration file can be commented using asterisks or semi-colons.

#### Compliance Validator Configuration Sections

[Update]—This section defines the location of the centrally located gold files for both the executable and configuration files. The values of this section are encrypted to prevent tampering. In the event of tampering, the compliance validator utility will display a message and optionally perform enforcement measures.

[Validator Settings]—This section defines main behavior and appearance of the compliance validator utility executable file (Validator.exe).

CentralLog—Defines the location of the log file sent when a compliance violation is encountered.

Banner—The title which shows at the top of the compliance violation message form.

NonComplianceMessage—The message shown in the compliance violation message form.

IEStartupRegKey—The registry key which holds the value determining the user's home page. It is assumed that this key will always be under HKEY\_Current\_User.

IEStartupRegVal—The value to access under IEStartupRegKey.

dnsDomain—The domain DNS suffix for the domain for which the Active Directory configurations are being enforced.

## 6

ShutdownOnError—Boolean value which determines whether enforcement measures are carried out, if armed, when certain errors are encountered which could be construed as tampering.

PerformRegAdds—Boolean value which determines whether the registry settings under [RegistryAdds] are added when a user is determined to be a member of the restricted group.

PerformRegDels—Boolean value which determines whether the registry settings under [RegistryDels] are deleted when a user is determined to be a member of the restricted group. Note that this should normally be false. The [RegistryDeletes] section is used to clean up registry settings under certain conditions regardless of this setting. This setting only affects registry keys and/or values that are removed every time the compliance validator utility is run.

RemoveIfMachineNotInGroup—Boolean value which determines whether compliance validator and all of its settings and files are removed if a non-restricted machine is logged on to by a non-restricted user. At this time, registry settings in [RegistryDeletes] are removed regardless of the value in PerformRegDels.

Armed—Boolean value which determines whether enforcement measures are carried out. The types of enforcement measures are set under [Shutdown Settings].

[RegistryAdds]—Registry keys which can be added at launch time. This can be used to automatically configure a service to run compliance validator on a regular basis. The format for the key settings is as follows:

```
Key Add: reg=HKLM\Software\ Company\Test
Value Add (String): reg=HKLM\Software\
Company\test=test
Value Add (Expandsz): reg=HKLM\Software\
Company\test=% test %
Value Add (Literal %): reg=HKLM\Software\
Company\test=@% test
Value Add (DWord): reg=HKLM\Software\
Company\test=20d
Value Add (the date): reg=HKLM\Software\
Company\test=@date@
Value Add (PC Name): reg=HKLM\Software\
Company\test=@COMPUTERNAME@
```

Several keys can be placed under this section. All will be installed at runtime. The registry hives that are used with the RegistryAdds section include HKLM, HKCU, HKCR, HKCC, and HKU as described above.

[RegistryDeletes]—Registry keys which can be deleted at launch time. The format is as follows:

```
Key Delete: reg=HKLM\Software\ Company\Test
Value Delete: reg=HKLM\Software\ Company\test=""
```

Several keys can be placed under this section. All will be installed at runtime. The registry hives that are used with the RegistryDeletes section include HKLM, HKCU, HKCR, HKCC, and HKU as described above.

[Shutdown Settings]—This section determines how enforcement measures are established.

WaitMilliSecs—The time in milliseconds that the compliance message will be displayed before enforcement measures are carried out.

ShutDownParam—A numeric value which determines the type of enforcement measure which is carried out in the event of a compliance violation. The following settings are allowed:

- 0=Logoff
- 1=Shutdown
- 2=Reboot
- 4=Forced Logoff
- 5=Forced Shutdown

6=Power Off  
12=Forced Power Off

The “Armed” setting under “[Validator Settings]” must be set to true for the above measures to take place.

[User Restricted Groups]—An enumerated section which lists all of the Active Directory group names which will be checked to see if the user is a member. If the user is a member of any of these groups, the compliance check will take place.

[Machine Restricted Groups]—An enumerated section which lists all of the Active Directory group names which will be checked to see if the computer is a member. If the computer is a member of any of these groups, the compliance check will take place.

[Permitted AD Sites]—An enumerated section which lists all of the Active Directory Site Codes for the subnets which the user and machine are allowed to access to remain in compliance.

[Home Page Conversions]—An enumerated section which lists a semi-colon delimited list of restricted and allowed web pages which the user might have set as a home page. If the restricted web page is found as the user’s home page, it will be changed to the allowed web page, only if the user is a member of a configured restricted AD group.

#### Exemplary Compliance Validator Configuration File

The following is an exemplary configuration file for the compliance validator utility, with each separate section name enclosed within square brackets:

```
[Update]
N8uqTFc9TV8UevvqdfWqa/LKysTdlbsYJGotLV4+
  Qw9J6RcXvn/6pxrmA1/kuiHp5Xsj
Pdg1xVgr5qQHIOFvuMebIAyxjEH4a/x6tTwZm9A=
F3VCdYrNDL6ji1ZPKONKaaNgSYgjA/1To/gRuoL+
  HKY6YtQgrJfZYkvG/1waoYwA
2piTQPL+QC4HjScX1YufcVoBuWnj+
  BARPyOqk104yzE=
[Validator Settings]
CentralLog=“\\logs.enterpriseco.com\logs$\Validator”
Banner=“Compliance Check”
NonComplianceMessage=“This is a test of the Company’s
  compliance validation system. For the period of time of
  this message you are being warned that you are not in
  compliance as regards the parameters of this program.
  Please log out and try to connect in an area that is in your
  compliance area. Your machine will now shut down.”
IEStartupRegKey=“Software\Microsoft\Internet
  Explorer\Main”
IEStartupRegVal=“Start Page”
dnsDomain=“Company.com”
PerformRegAdds=true
PerformRegDels=false
RemoveIfMachineNotInGroup=true
ShutdownOnError=false
Armed=false
[RegistryAdds]
reg=HKLM\SOFTWARE\Company\WinMaint\
  ComplianceValidation\Exec=C:\Program
  Files\Company\Validator\Validator.exe
reg=HKLM\SOFTWARE\Company\WinMaint\
  ComplianceValidation\SleepMethod=0d
reg=HKLM\SOFTWARE\Company\WinMaint\Com-
  plianceValidation\Iterative=0d
reg=HKLM\SOFTWARE\Company\WinMaint\Com-
  plianceValidation\Param=false
[RegistryDeletes]
[Shutdown Settings]
MsgSDSecs=“10”
WaitMilliSecs=1000
```

```
ShutDownParam=12
  * ShutsDown machine parameter.
  * 0=Logoff
  * 1=Shutdown
  * 2=Reboot
  * 4=Forced Logoff
  * 5=Forced Shutdown
  * 6=Power Off
  * 12=Forced Power Off
```

```
[User Restricted Groups]
ada-xyz-restricted-users
ACL-XYZ-IRPtrsTm-RW
[Machine Restricted Groups]
ada-xyz-restricted-workstations
;APP-PKI-EFSComputers
[Permitted AD Sites]
PXA
PXD
[Home Page Conversions]
http://today.company.com;/http://companydiv.company-
.com/
```

In the preceding example, XYZ, xyzd, PXA, and PXD are arbitrary designations representing a generic corporation (XYZ), generic corporate division (xyzd), and generic Active Directory sites (PXA, PXD).

FIGS. 1A-1B illustrate the processing logic for the compliance validator utility. Processing begins as indicated in logic block 100 with the validator event log creation. In decision block 102, a test is made to determine if the computer is on the network. If it is, the executable and configuration files for the compliance validator utility are hashed as indicated in logic block 106. If the computer is not found on the network in decision block 102, the compliance validator utility exits.

From logic block 106, the path to the central update location is decrypted, as shown in logic block 108. In decision block 110, a test is performed to determine if the central update path exists. If it does not, the compliance validator utility exits as shown in block 112. If the central update path exists, a determination is made in decision block 114 as to whether or not the executable update file has been removed. If the executable update file has been removed, the executable and configuration files for the compliance validator utility are removed from the computer, as indicated in logic block 116. The process then exits in block 142.

If the executable update file has not been removed (decision block 114), a test is then made to determine if the configuration file has been removed as indicated in decision block 118. If the configuration file has been removed, the process exits in block 140. If the configuration file has not been removed, the process checks for updates to both the compliance validator configuration and executable files, and updates them if necessary, as indicated in logic block 120. Next, in decision block 122, the process determines if either the computer or user is a member of a restricted group. If neither the machine nor user is a member of a restricted group, the compliance validator configuration and executable files are removed from the computer, as indicated in logic block 124. The process then exits in block 144.

In decision block 122, if either the computer or user is a member of a restricted group (or both), the process sets or removes configured registry keys as shown in logic block 126. Next, the Active Directory site is checked for the IP subnet, as indicated in logic block 128. A determination is made if the Active Directory site is an allowed site as indicated in decision block 130. If the Active Directory site is allowed, an event log entry is made indicating validation is complete,

compliance has been met, and the user name. This step is indicated in logic block 132. The compliance validator process then terminates in block 150.

If it is determined in decision block 130 that the Active Directory site is not an allowed site, an entry is generated for both the event log and the compliance fault log, as indicated in logic block 134. The compliance validator then enforces compliance by logging off the user and shutting down the computer, if the process is armed to do so, as indicated in logic block 136. The compliance validator process then terminates in block 150.

The compliance validator tool is designed to automatically configure itself to run with a workstation maintenance utility, referred to herein as WinMaint (acronym for Windows Maintenance Service), that configures workstations to run specific processes at specified times. A preferred embodiment of the workstation maintenance utility is described in a commonly assigned patent application entitled "Workstation Uptime, Maintenance, and Reboot Service," filed on Apr. 11, 2006 as application Ser. No. 11/402,094. This application is incorporated by reference in its entirety herein. Ideally, the compliance validator utility would be set to run once an hour to validate standard subnet compliance. But other settings are possible as discussed herein. The best way to setup the workstation maintenance utility (WinMaint) with the compliance validator utility is to place the required registry keys in the [RegistryAdd] section of the compliance validator configuration file as in the following example:

```
[RegistryAdds]
HKLM\SOFTWARE\Company\WinMaint\Compliance
Validation\Exec=C:\Program
Files\Company\Validator\Validator.exe
HKLM\SOFTWARE\Company\WinMaint\Compliance
Validation\SleepMethod=0d
HKLM\SOFTWARE\Company\WinMaint\Compliance
ValidationIterative=0d
HKLM\SOFTWARE\Company\WinMaint\Compliance
Validation\Param=false
```

Under these circumstances, it would also be appropriate to add keys to be removed upon cleanup to the [RegistryDeletes] section. For example:

```
[RegistryDeletes]
HKLM\SOFTWARE\Company\WinMaint\Compliance
Validation
```

#### Workstation Maintenance Utility

The workstation maintenance utility is a service that enables configuration of a large number of workstations to run specific processes at a scheduled time without every workstation running specific processes at the same time. The workstation maintenance utility can be managed remotely. The time that a workstation is set to run is relative to the startup time of the service or workstation. Since every workstation will have a different startup time, the time the processes are scheduled to run will be at random intervals preventing the potential problem of network overload.

The workstation maintenance utility is installed using a standard installation program such as Microsoft Windows Installer for workstations operating on the Microsoft Windows platform. The command line for workstation maintenance utility can also install and uninstall the service. Once installed as a service, the workstation maintenance utility will check every hour to see if it has anything assigned for it to do. If the workstation maintenance utility has nothing that is ready to be run, it simply goes back to sleep for another hour.

The workstation maintenance utility is command line executable. In an exemplary embodiment in a Windows plat-

form environment, typing WinMaint -? at the command line will display the following message:

SYNTAX:

```
WinMaint [-i] [-u] [-?]
```

-i—Install WinMaint as a service.

-u—Uninstall WinMaint as a service.

-?—This help screen.

The workstation maintenance utility component of the invention can be configured to operate in several ways. In an exemplary embodiment, when the service or workstation is started, the workstation maintenance utility sleeps for one hour before it wakes up and checks if it has any tasks to perform.

There are several possible methods that the workstation maintenance utility can use to determine if a process is ready to be launched. These methods include, but are not limited to, the following:

1. launch the service after the first hour since boot up, and every hour thereafter at the same minute;
2. launch the service after a specified amount of wait time, specified in milliseconds;
3. launch the service on every occasion of a specified day of the week and at a local time zone hour;
4. launch only on a specified date and at a local time zone hour;
5. launch every day during a specified local time zone hour.

The workstation maintenance utility deals in increments of hours in an exemplary embodiment. The minute of launch is determined by the time (i.e., minute) that the workstation or service started up, thereby providing random launch capabilities. When the workstation boots up and the workstation maintenance utility is started, it will sleep for one hour before it checks to see if there is any code to launch. Afterwards, it will check once every hour to see if the conditions are right to launch the given code.

FIG. 2 illustrates the high level processing logic for the workstation maintenance utility component in the exemplary embodiment. Processing begins as indicated in logic block 200 with the workstation start up. The workstation maintenance utility process goes to "sleep" for one hour and then wakes up as indicated in logic block 202. In decision block 204, the workstation maintenance utility determines if there is anything to do. If there is no process to run, the workstation maintenance utility returns to logic block 202 and goes back to sleep for another hour. If it determines there is a process to run, a determination is made as to whether or not to run the process immediately as indicated in logic block 206. The workstation maintenance utility can go back to sleep for an additional period of time (logic block 208) or run the process immediately (logic block 210). When the process completes as indicated in logic block 212, the workstation maintenance utility returns to logic block 202 to wait for the next cycle to begin. It should be noted that once the workstation starts up, the workstation maintenance utility runs continuously.

To launch a particular maintenance procedure the following steps are required: (1) place the executable code in a directory accessible by the workstation; (2) under the registry key, "HKLM\SOFTWARE\Company\WinMaint", create a sub-key with a unique name for the code to be launched; and (3) under the new sub-key, create the set of values from the table below which will cause the code to launch at the specified time.

Table 1

SleepMethod:

0=Launch after the first hour of bootup and every hour afterwards at the same minute.

1=Launch after every specified amount of wait time, specified in milliseconds.

2=Launch on every occasion of a specified day of the week and local time zone hour.

3=Launch only on a specified date and local time zone hour.

4=Launch every day during a specified local time zone hour.

Exec: String Value with the name of the executable code including the path, e.g., C:\Company\WinMaint\UpTime.exe.

Param: String Value can either be blank or contain the parameters to pass to the executable code.

Iterative:

0=Code will not run if it is still in memory.

1=Code will run again even if it is still in memory.

If the Sleep Method value is zero, no other values are required. If the Sleep Method value is one, the user must specify the amount of time in milliseconds to wait before launching the code. The specified time does not begin until one hour after bootup or service start.

When the Sleep Method value is one, the workstation maintenance utility will launch a thread after the first hour which will then go to sleep for the specified amount of time. After the specified amount of time has passed, the thread will then launch the code specified by "Path" and "Exec." When the thread is launched, a flag value in the created application key is set to one to keep the thread from being launched again. After the code is launched, the flag is set to zero. If the computer is rebooted before the specified sleep time has ended, the flag value is automatically reset to zero and the thread will be launched again after an hour has passed.

If the Sleep Method value is two, the user must enter a numeric value representing the day of the week, and a numeric value representing the hour of the day that the code should be launched. The code will be launched every time this day is reached at the hour specified. The code will not launch if an hour is not specified. The range of values for day of the week are zero (Sunday) through six (Saturday). The hour of the day is a numeric value representing the hour to launch the code. The range of values is 0-23. The hour refers to the local time zone.

If the Sleep Method value is three, then the user must enter a month, day, year and hour of the day for the code to be launched. The month is expressed as a numeric value representing the month in which the code should be launched. The range of values is 1-12. The day is a numeric value representing a date that exists within that month. The range of day values is 1-31, but if 31 does not exist in the given month, the code will not be launched. The year is a numeric value representing the year that the code should be launched. The year value will be a four digit number such as 2001. The hour is a numeric value representing the hour to launch the code. The range of values is 0-23. The hour refers to the local time zone.

If the Sleep Method value is four, the user must enter a numeric value representing the hour to launch the code. The range of values is 0-23. The hour refers to the local time zone.

When Sleep Method 2, 3 or 4 is used, the workstation maintenance utility will begin checking after the first hour and continue checking every hour for the correct time specified. The code will usually not launch exactly at the specified hour, but instead within an hour after the specified time has passed. This is based upon what time the workstation was brought up and the service was started. In other words, if the

computer is brought up at 8:04 AM and the Sleep Method is 2 for Sunday at 10:00 PM (or 22 as specified in the 'Hour' value), the code will more than likely launch on Sunday at 10:04 PM.

If the registry value for "Debug" is set to one under "HKLM\SOFTWARE\Company\WinMaint\", this setting will cause the workstation maintenance utility service to detail an activity log file under c:\energyco\logs called WinMaint.log. It is best to use the debug feature only for a short period during troubleshooting since the log file will otherwise continue to grow. It is also a good idea to delete the file when troubleshooting has been completed so that the next time it is needed it starts fresh. To change the debug value, it is necessary to stop and start the service. After setting the debug value for troubleshooting purposes, the debug feature may be turned off by setting the value to zero and stopping and starting the service. All other registry settings can be made without stopping and starting the service. The service will simply re-check the settings each hour.

FIG. 3 illustrates an exemplary workstation maintenance utility service properties editor display. This figure shows the service name, description, path to executable, startup type, and service status. FIG. 4 illustrates an exemplary workstation platform registry editor. The workstation maintenance utility is configured using the registry editor. This figure shows one application ("Compliance Validator") configured to be run by the workstation maintenance utility. Other applications would simply follow the "Compliance Validator" under the "WinMaint" key.

The compliance validator tool is also designed to run with a digital hashing function that can create all the hash files required for proper operation of the tool. The digital hashing function hashes executable and configuration files for the compliance validator tool. The digital hashing function must be able to encrypt text and create a hash file of the encrypted file. The digital hashing function can only open an existing file already encrypted by the digital hashing function, or by another hashing function with the exact same encryption algorithm. However, the invention is not limited to any particular digital hash function. Digital hash functions are well-known in the art and there are many hash functions that would be suitable for use with the compliance validator tool.

The system and method of the present invention have been described as computer-implemented processes. It is important to note, however, that those skilled in the art will appreciate that the mechanisms of the present invention are capable of being distributed as a program product in a variety of forms, and that the present invention applies regardless of the particular type of signal bearing media utilized to carry out the distribution. Examples of signal bearing media include, without limitation, recordable-type media such as diskettes or CD ROMs.

The corresponding structures, materials, acts, and equivalents of all means plus function elements in any claims below are intended to include any structure, material, or acts for performing the function in combination with other claim elements as specifically claimed. Those skilled in the art will appreciate that many modifications to the exemplary embodiment are possible without departing from the scope of the present invention.

In addition, it is possible to use some of the features of the present invention without the corresponding use of the other features. Accordingly, the foregoing description of the exemplary embodiment is provided for the purpose of illustrating the principles of the present invention, and not in limitation thereof, since the scope of the present invention is defined solely by the appended claims.

13

What is claimed:

1. A method, comprising:
  - determining if there are any updates at a location for either a compliance validation executable file or a compliance configuration file, based on a digital hash of the compliance validation executable file and the compliance validation configuration file;
  - automatically updating the compliance validation executable file and the compliance validation configuration file, if any updates are available;
  - determining if a compliance validation executable update file has been removed from the location; and
  - removing the compliance validation executable file and the compliance validation configuration file from a computer system if:
    - the update file has been removed; and
    - either the computer system is not a member of a configured restricted group or a computer system user is not a member of the configured restricted group.
2. The method of claim 1, comprising configuring a maintenance service utility to launch the compliance validation executable file at a specified time during operation of the computer system.
3. The method of claim 2, wherein the step of configuring the maintenance service utility to launch a compliance validation executable file comprises selecting an activation time for the maintenance service utility.
4. The method of claim 1, comprising generating the digital hash for the compliance validation executable file and the compliance validation configuration file.
5. The method of claim 1, comprising determining if the computer system or the computer system user is a member of the configured restricted group.
6. The method of claim 5, comprising if the computer system or the computer system user is a member of the configured restricted group, determining if a directory site code for a subnet of the restricted computer network to which the computer system is connected corresponds to a configured and allowed site.
7. The method of claim 6, comprising enforcing compliance with access requirements if the directory site code does not correspond to the configured and allowed site.
8. The method of claim 7, wherein the enforcing comprises at least one of:
  - automatically logging the user off the computer system;
  - automatically shutting down the computer system; and
  - displaying a message to the user that the computer system is not in compliance with access requirements for the restricted computer network.
9. A system, comprising:
  - a processor that:
    - determines if there are any updates at a location for either a compliance validation executable file or a compliance configuration file, based on a digital hash of the compliance validation executable file and the compliance validation configuration file;
    - automatically updates the compliance validation executable file and the compliance validation configuration file, if any updates are available;
    - determines if a compliance validation executable update file has been removed from the location; and

14

- removes the compliance validation executable file and the compliance validation configuration file from a computer system if:
    - the update file has been removed; and
    - either the computer system or a computer system user is not a member of a configured restricted group.
  10. The system of claim 9, wherein the processor configures a maintenance service utility to launch the compliance validation executable file at a specified time during operation of the computer system.
  11. The system of claim 10, wherein the processor selects an activation time for the maintenance service utility when the maintenance service utility is configured.
  12. The system of claim 9, wherein the processor generates the digital hash for the compliance validation executable file and the compliance validation configuration file.
  13. The system of claim 9, wherein the processor determines if the computer system or the computer system user is a member of the configured restricted group.
  14. The system of claim 13, wherein the processor determines if a directory site code for a subnet of the restricted computer network to which the computer system is connected corresponds to a configured and allowed site if the computer system or the computer system user is a member of the configured restricted group.
  15. The system of claim 14, wherein the processor enforces compliance with access requirements if the directory site code does not correspond to the configured and allowed site.
  16. The system of claim 15, wherein the enforces compliance comprises at least one of:
    - automatically logs the user off the computer system;
    - automatically shuts down the computer system; and
    - displays a message to the user that the computer system is not in compliance with access requirements for the restricted computer network.
  17. A non-transitory computer program product comprising a computer readable medium having computer readable code embedded therein, the computer readable medium comprising:
    - program instructions that determine if there are any updates at a location for either a compliance validation executable file or a compliance configuration file, based on a digital hash of the compliance validation executable file and the compliance validation configuration file;
    - program instructions that automatically update the compliance validation executable file and the compliance validation configuration file, if any updates are available;
    - program instructions that determine if a compliance validation executable update file has been removed from the location;
    - program instructions that remove the compliance validation executable file and the compliance validation configuration file from a computer system if:
      - the update file has been removed; and
      - either the computer system is not a member of a configured restricted group or a computer system user is not a member of the configured restricted group.
  18. The computer readable medium of claim 17 comprising program instructions that launch the compliance validation executable file at a specified time during operation of the computer system.

\* \* \* \* \*