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Myers et al.

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(54) **METHOD AND SYSTEM FOR CONFIGURATION MANAGEMENT DATABASE SOFTWARE LICENSE COMPLIANCE**

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(22) Filed: **Dec. 9, 2009**

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Related U.S. Application Data

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(51) **Int. Cl.**
G06F 21/00 (2013.01)

(52) **U.S. Cl.**
USPC **726/26**; 726/6; 726/10; 713/156; 713/157; 705/59

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

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BMC Remedy IT Service Management 7.5.00 Configuration Guide, Jan. 2009, © 1998, 2003, 2005-2006, 2009 BMC Software, Inc.
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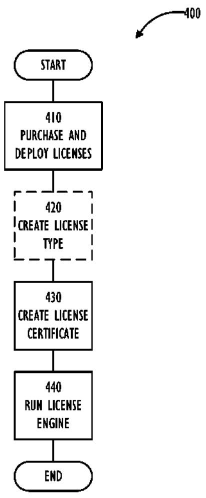
Assistant Examiner — Jeremiah Avery

(57) **ABSTRACT**

A software license engine allows an enterprise to model software license contracts and evaluate deployment of software for compliance with the software license contracts. Deployment of software products in the enterprise is modeled in a configuration management database. The software license engine maintains a license database for connecting software license contracts with software deployment modeled by the configuration management database. Users of the software license engine may use license types that are predefined in the software license engine or may define custom license types. The software license engine may indicate compliance or non-compliance with the software license contracts.

20 Claims, 15 Drawing Sheets



400
START
410 PURCHASE AND DEPLOY LICENSES
420 CREATE LICENSE TYPE
430 CREATE LICENSE CERTIFICATE
440 RUN LICENSE ENGINE
END

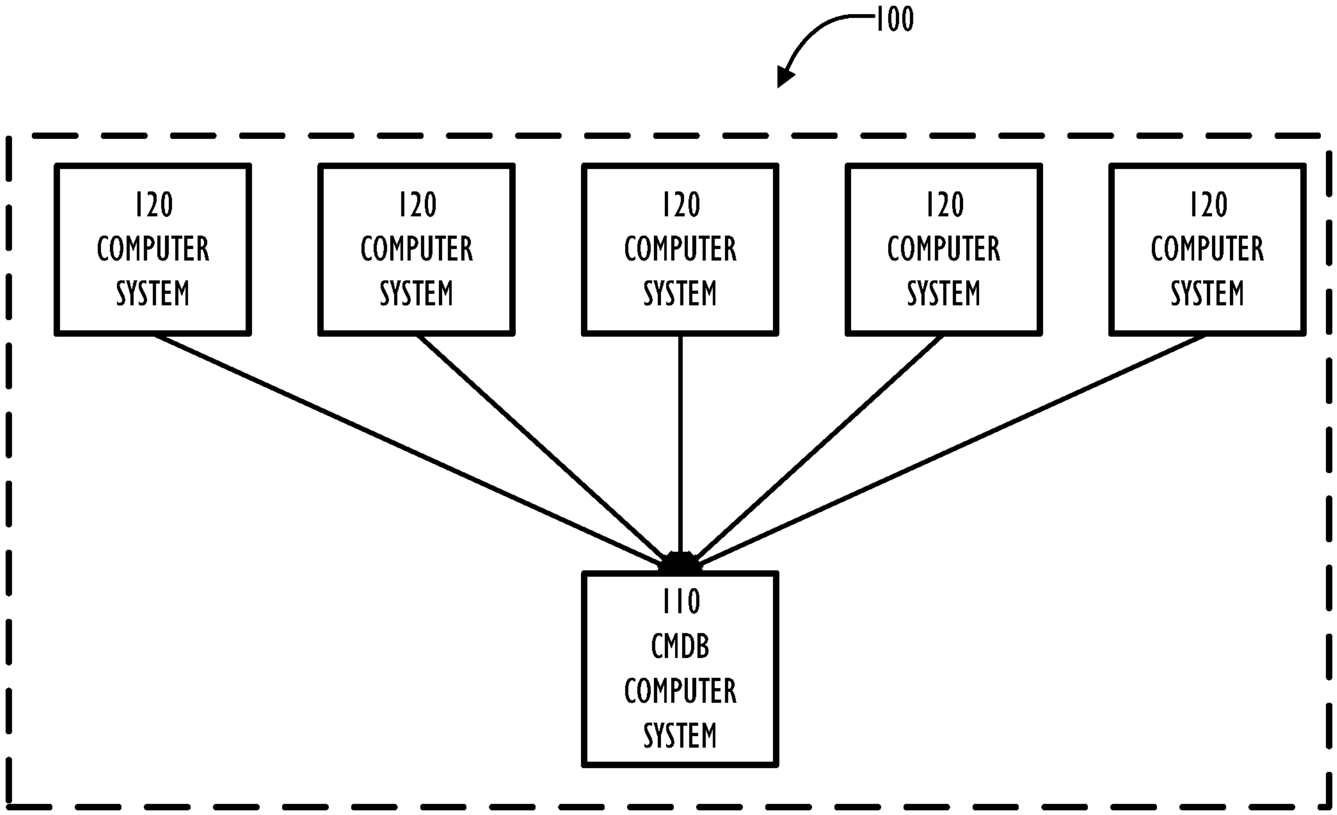

100
120 COMPUTER SYSTEM
120 COMPUTER SYSTEM
120 COMPUTER SYSTEM
120 COMPUTER SYSTEM
120 COMPUTER SYSTEM
110 CMDB COMPUTER SYSTEM

FIG. 1

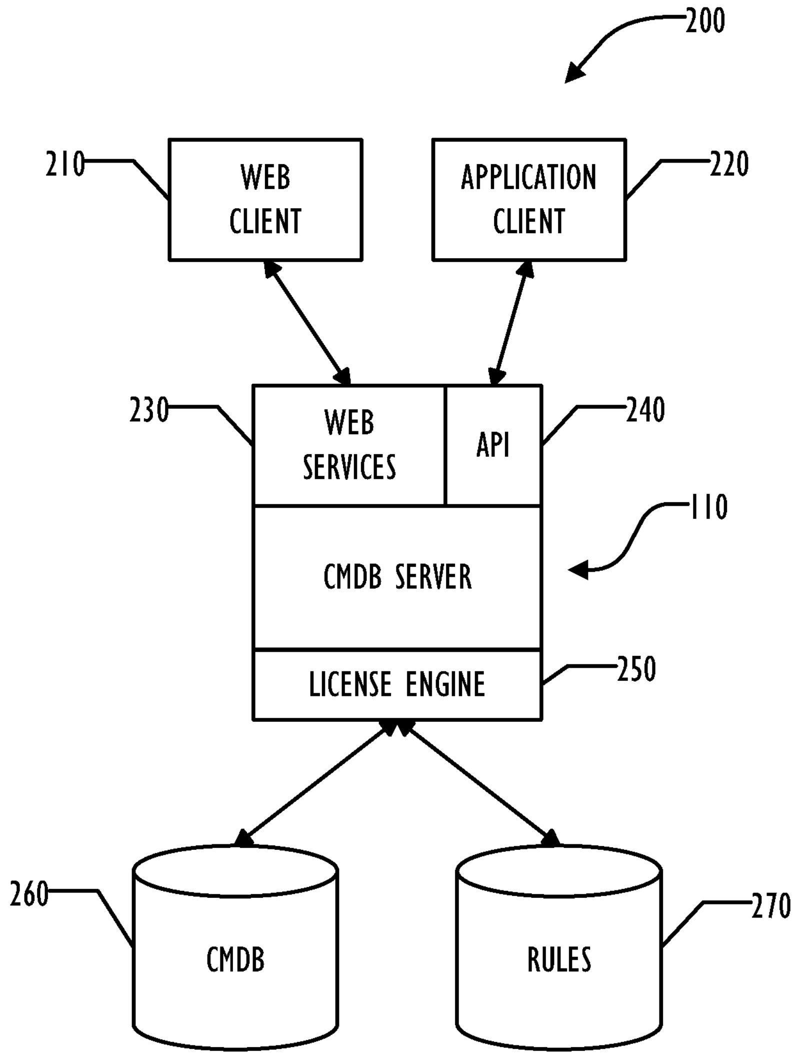

200
210
WEB CLIENT
APPLICATION CLIENT
220
230
WEB SERVICES
API
240
110
CMDB SERVER
LICENSE ENGINE
250
260
CMDB
RULES
270

FIG. 2

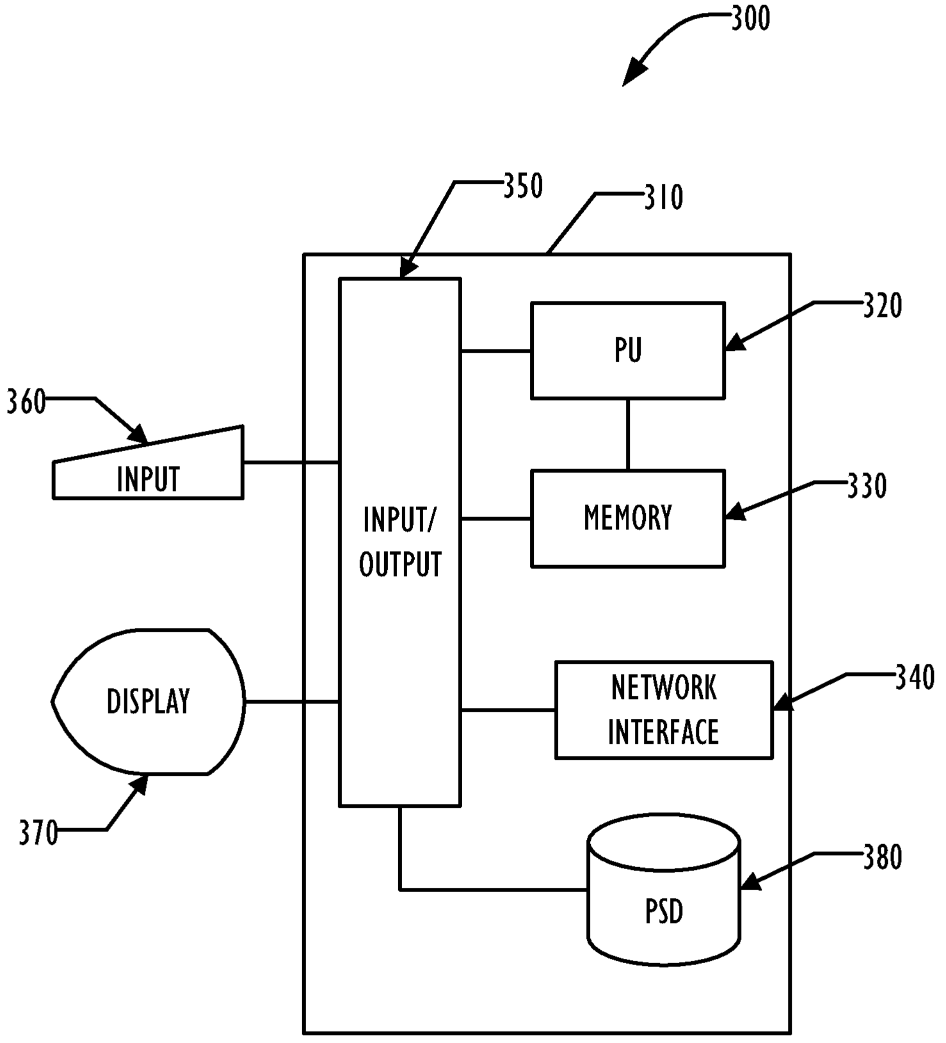

300
350
310
320
PU
360
INPUT
INPUT/
OUTPUT
MEMORY
330
DISPLAY
NETWORK
INTERFACE
340
370
PSD
380

FIG. 3

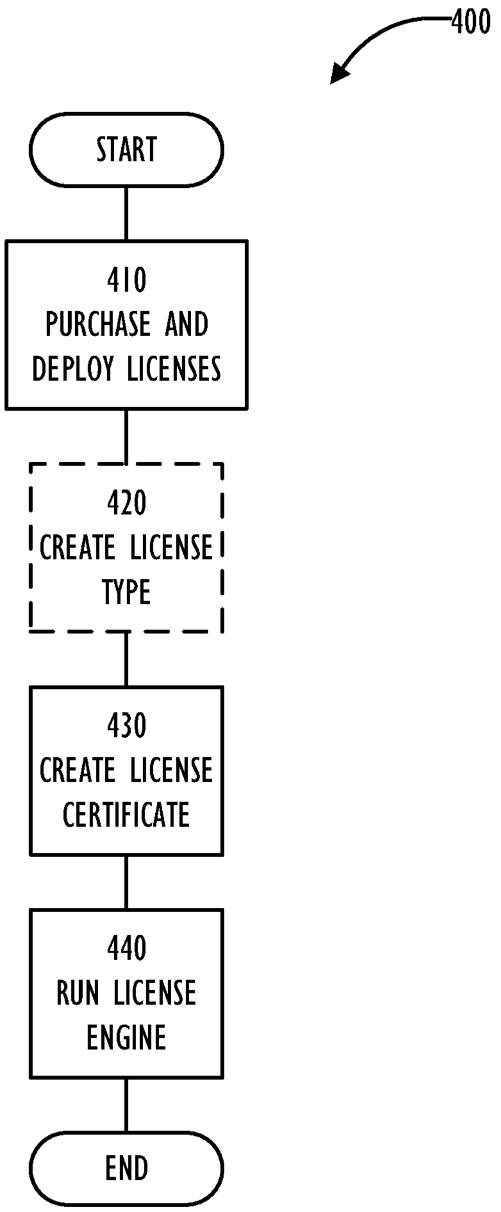

400
START
410
PURCHASE AND
DEPLOY LICENSES
420
CREATE LICENSE
TYPE
430
CREATE LICENSE
CERTIFICATE
440
RUN LICENSE
ENGINE
END

FIG. 4

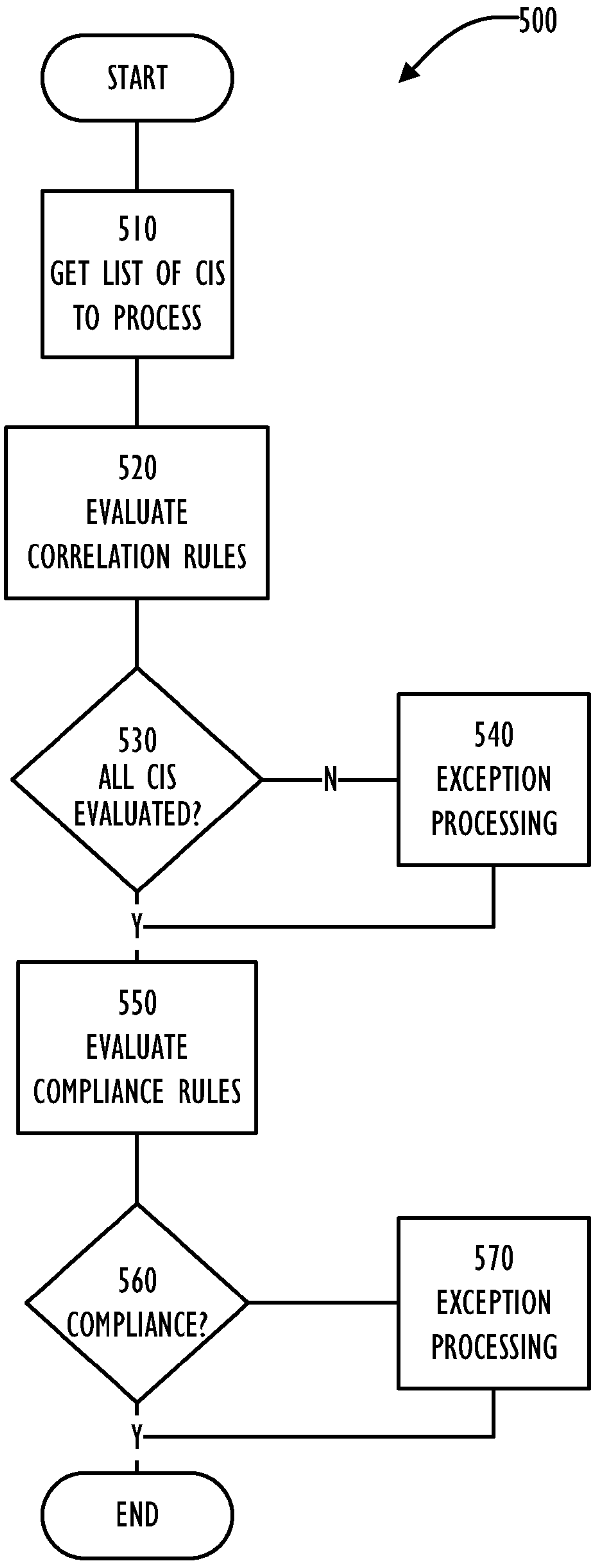

500
START
510
GET LIST OF CIS TO PROCESS
520
EVALUATE CORRELATION RULES
530
ALL CIS EVALUATED?
N
540
EXCEPTION PROCESSING
Y
550
EVALUATE COMPLIANCE RULES
560
COMPLIANCE?
570
EXCEPTION PROCESSING
Y
END

FIG. 5

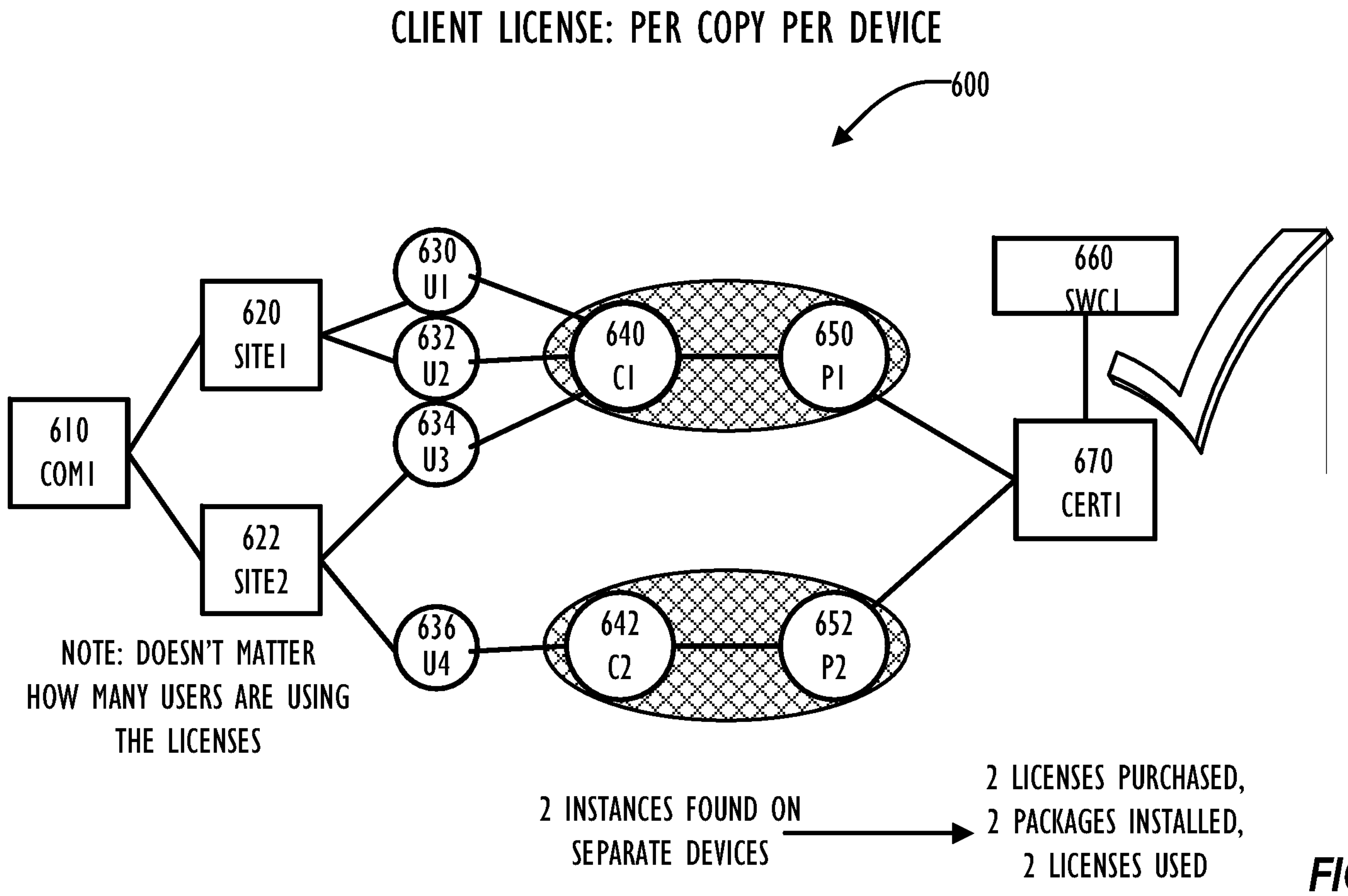

CLIENT LICENSE: PER COPY PER DEVICE
600
610 COM1
620 SITE1
622 SITE2
630 U1
632 U2
634 U3
636 U4
640 C1
650 P1
642 C2
652 P2
660 SWC1
670 CERT1
NOTE: DOESN'T MATTER HOW MANY USERS ARE USING THE LICENSES
2 INSTANCES FOUND ON SEPARATE DEVICES
2 LICENSES PURCHASED, 2 PACKAGES INSTALLED, 2 LICENSES USED

FIG. 6

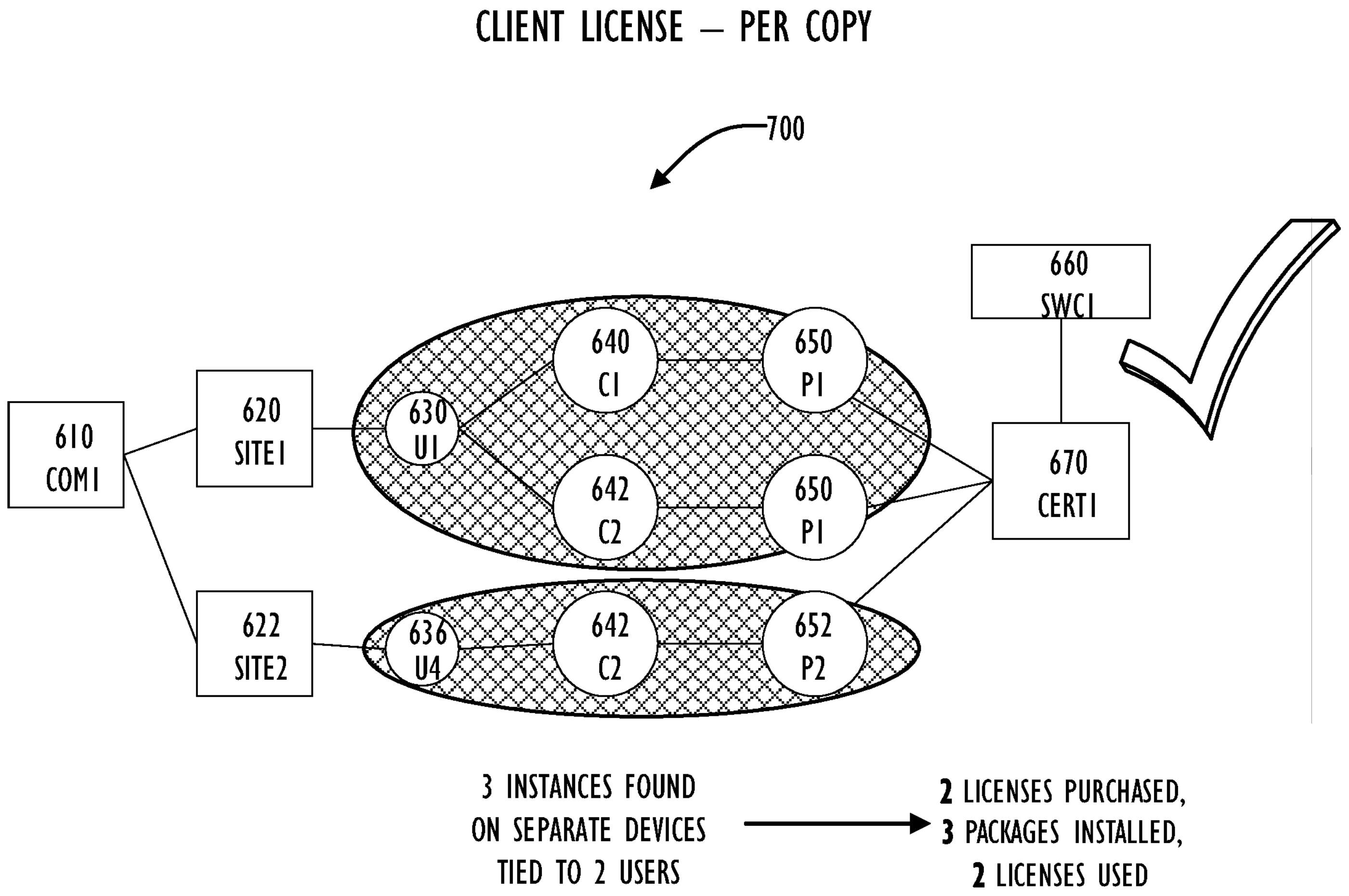

CLIENT LICENSE – PER COPY
700
610 COM1
620 SITE1
622 SITE2
630 U1
636 U4
640 C1
642 C2
642 C2
650 P1
650 P1
652 P2
660 SWC1
670 CERT1
3 INSTANCES FOUND ON SEPARATE DEVICES TIED TO 2 USERS
2 LICENSES PURCHASED, 3 PACKAGES INSTALLED, 2 LICENSES USED

FIG. 7

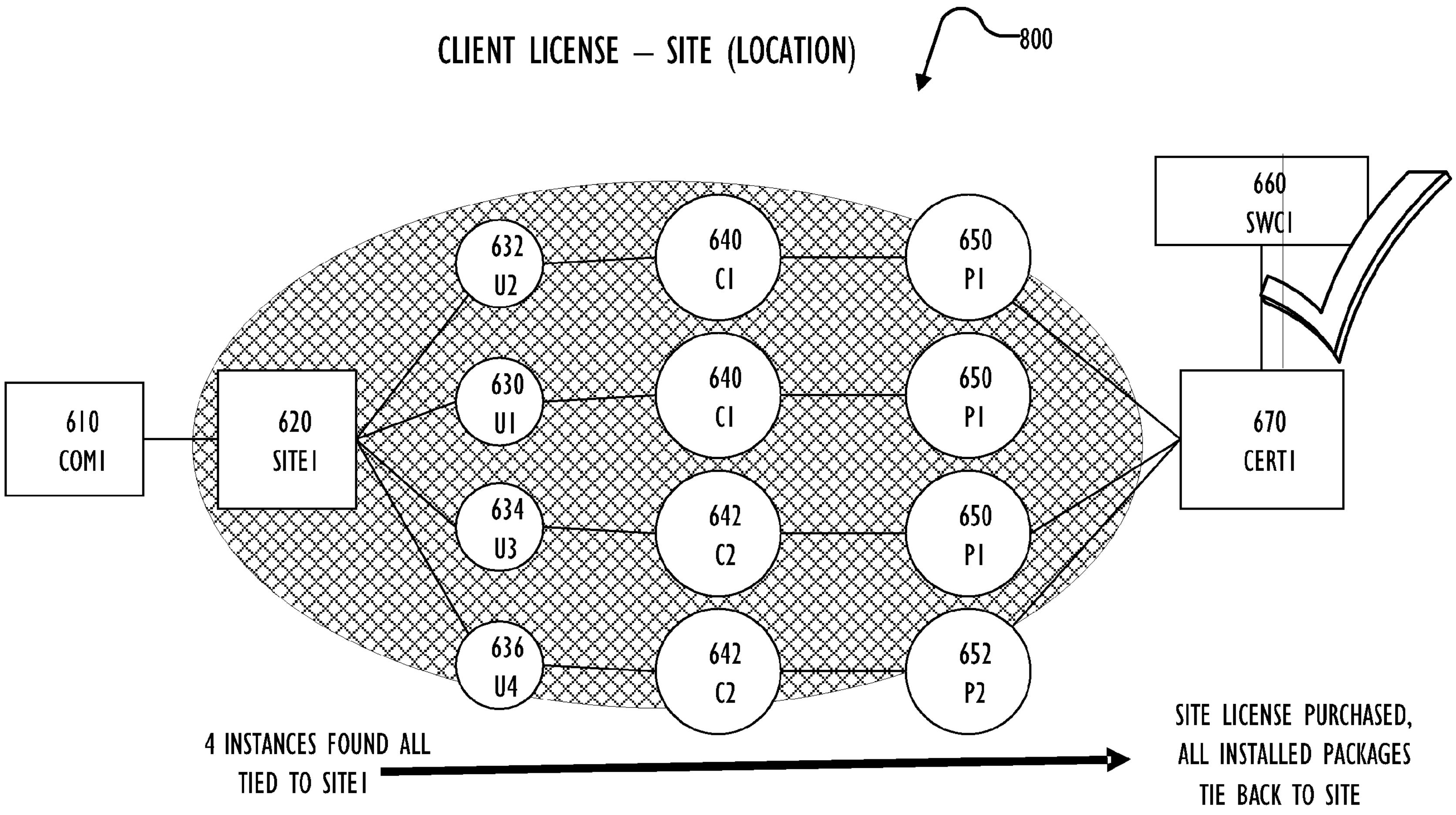

CLIENT LICENSE – SITE (LOCATION)
800
610 COM1
620 SITE1
632 U2
630 U1
634 U3
636 U4
640 C1
640 C1
642 C2
642 C2
650 P1
650 P1
650 P1
652 P2
660 SWC1
670 CERT1
4 INSTANCES FOUND ALL TIED TO SITE1
SITE LICENSE PURCHASED, ALL INSTALLED PACKAGES TIE BACK TO SITE

FIG. 8

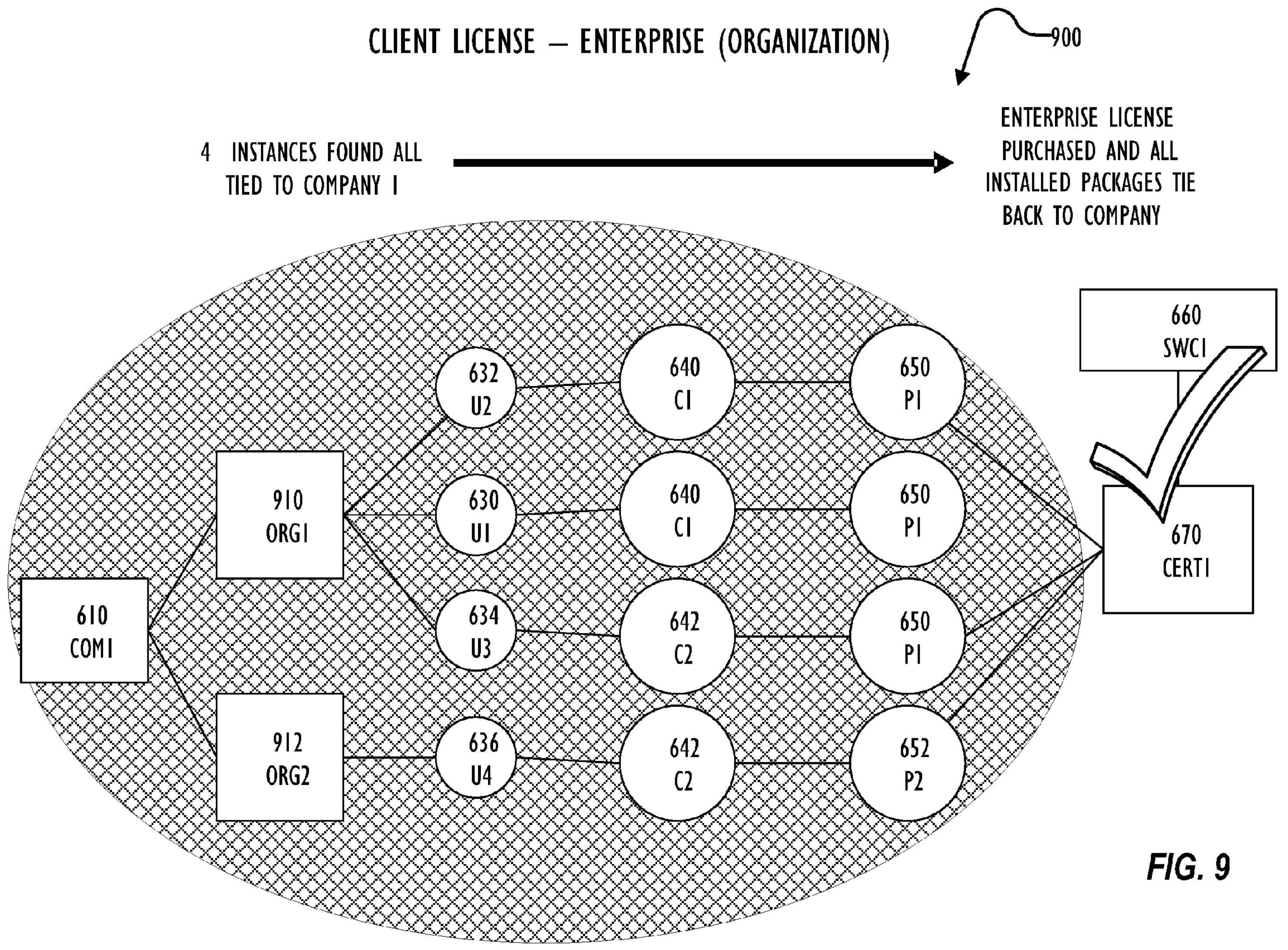

CLIENT LICENSE – ENTERPRISE (ORGANIZATION)
900
4 INSTANCES FOUND ALL TIED TO COMPANY 1
ENTERPRISE LICENSE PURCHASED AND ALL INSTALLED PACKAGES TIE BACK TO COMPANY
610 COM1
910 ORG1
912 ORG2
632 U2
630 U1
634 U3
636 U4
640 C1
640 C1
642 C2
642 C2
650 P1
650 P1
650 P1
652 P2
660 SWC1
670 CERT1

FIG. 9

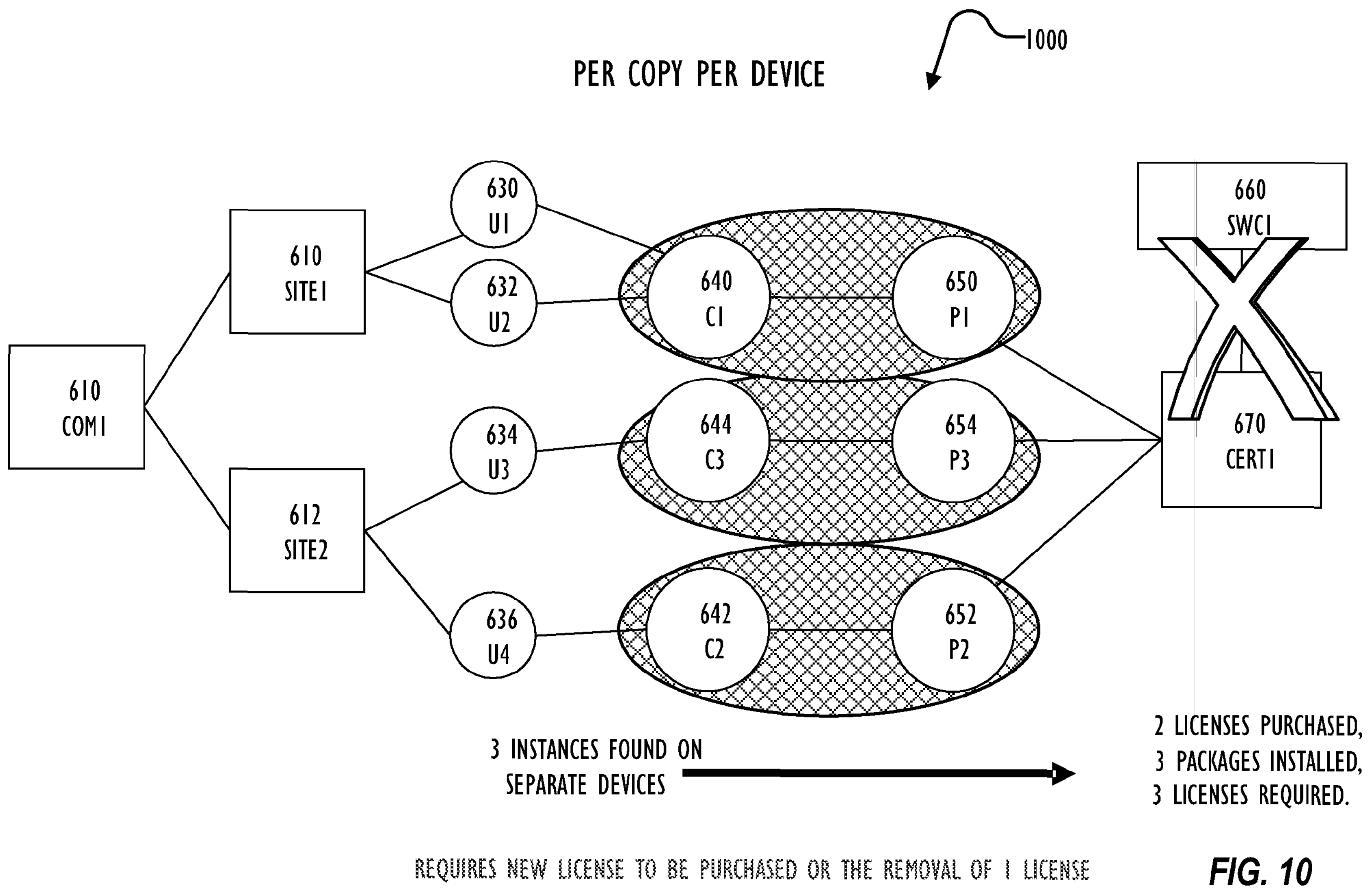

PER COPY PER DEVICE
1000
610 COM1
610 SITE1
612 SITE2
630 U1
632 U2
634 U3
636 U4
640 C1
644 C3
642 C2
650 P1
654 P3
652 P2
660 SWC1
670 CERT1
X
3 INSTANCES FOUND ON SEPARATE DEVICES
2 LICENSES PURCHASED, 3 PACKAGES INSTALLED, 3 LICENSES REQUIRED.
REQUIRES NEW LICENSE TO BE PURCHASED OR THE REMOVAL OF 1 LICENSE

FIG. 10

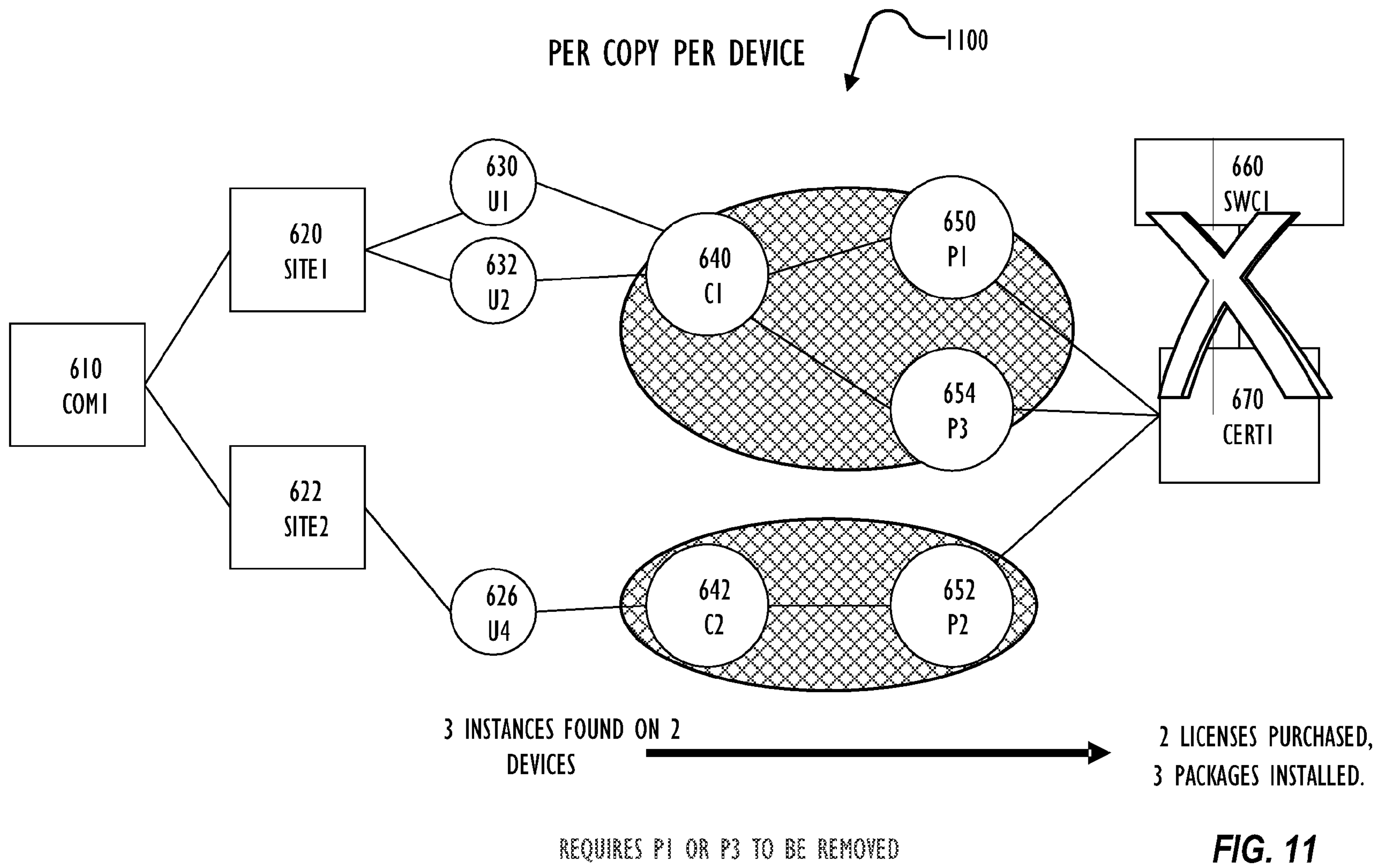

PER COPY PER DEVICE
1100
610
COM1
620
SITE1
622
SITE2
630
U1
632
U2
626
U4
640
C1
642
C2
650
P1
654
P3
652
P2
660
SWC1
670
CERT1
X
3 INSTANCES FOUND ON 2 DEVICES
2 LICENSES PURCHASED, 3 PACKAGES INSTALLED.
REQUIRES P1 OR P3 TO BE REMOVED

FIG. 11

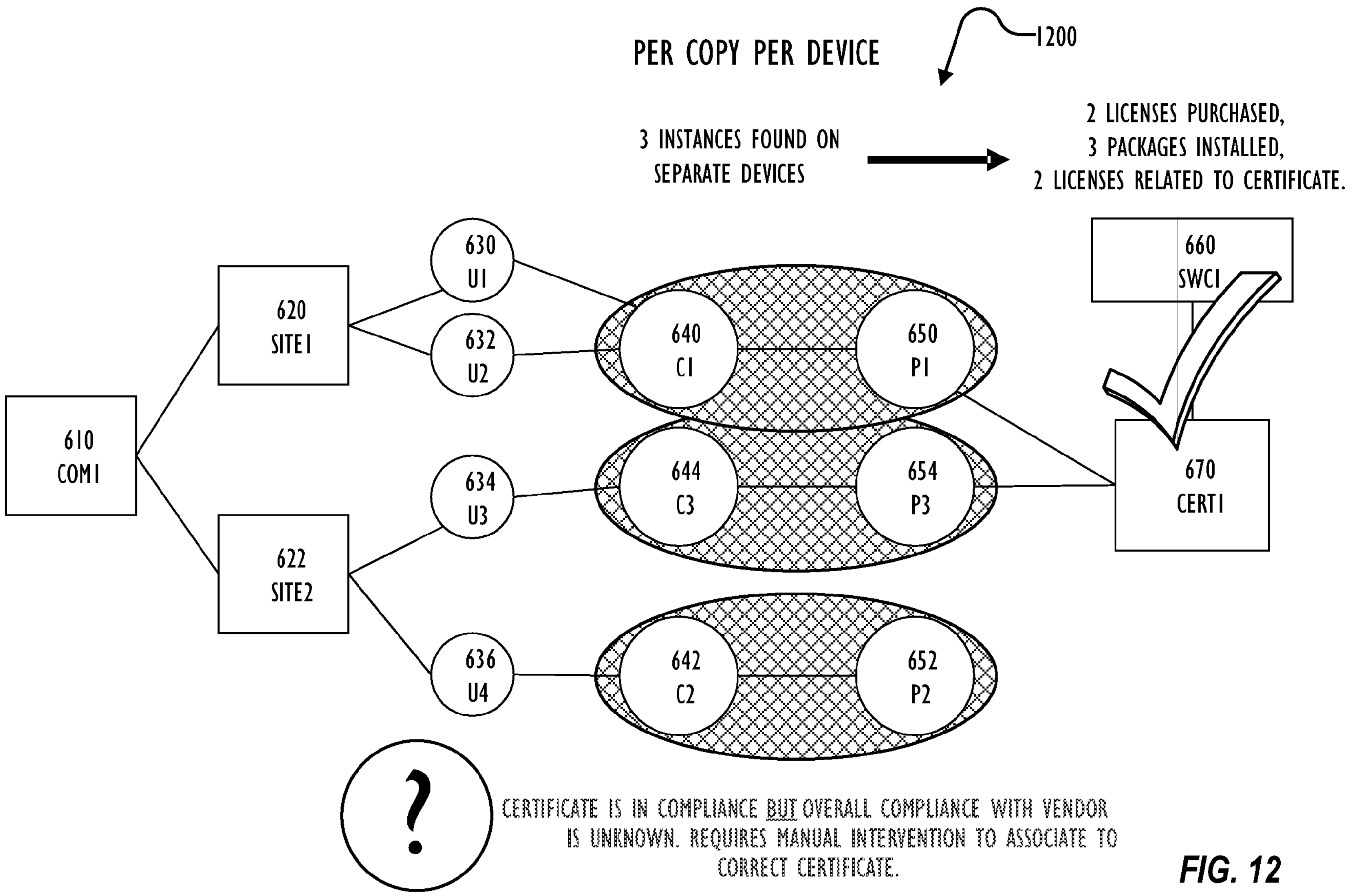

PER COPY PER DEVICE
1200
3 INSTANCES FOUND ON SEPARATE DEVICES
2 LICENSES PURCHASED, 3 PACKAGES INSTALLED, 2 LICENSES RELATED TO CERTIFICATE.
610 COM1
620 SITE1
622 SITE2
630 U1
632 U2
634 U3
636 U4
640 C1
644 C3
642 C2
650 P1
654 P3
652 P2
660 SWC1
670 CERT1
?
CERTIFICATE IS IN COMPLIANCE BUT OVERALL COMPLIANCE WITH VENDOR IS UNKNOWN. REQUIRES MANUAL INTERVENTION TO ASSOCIATE TO CORRECT CERTIFICATE.

FIG. 12

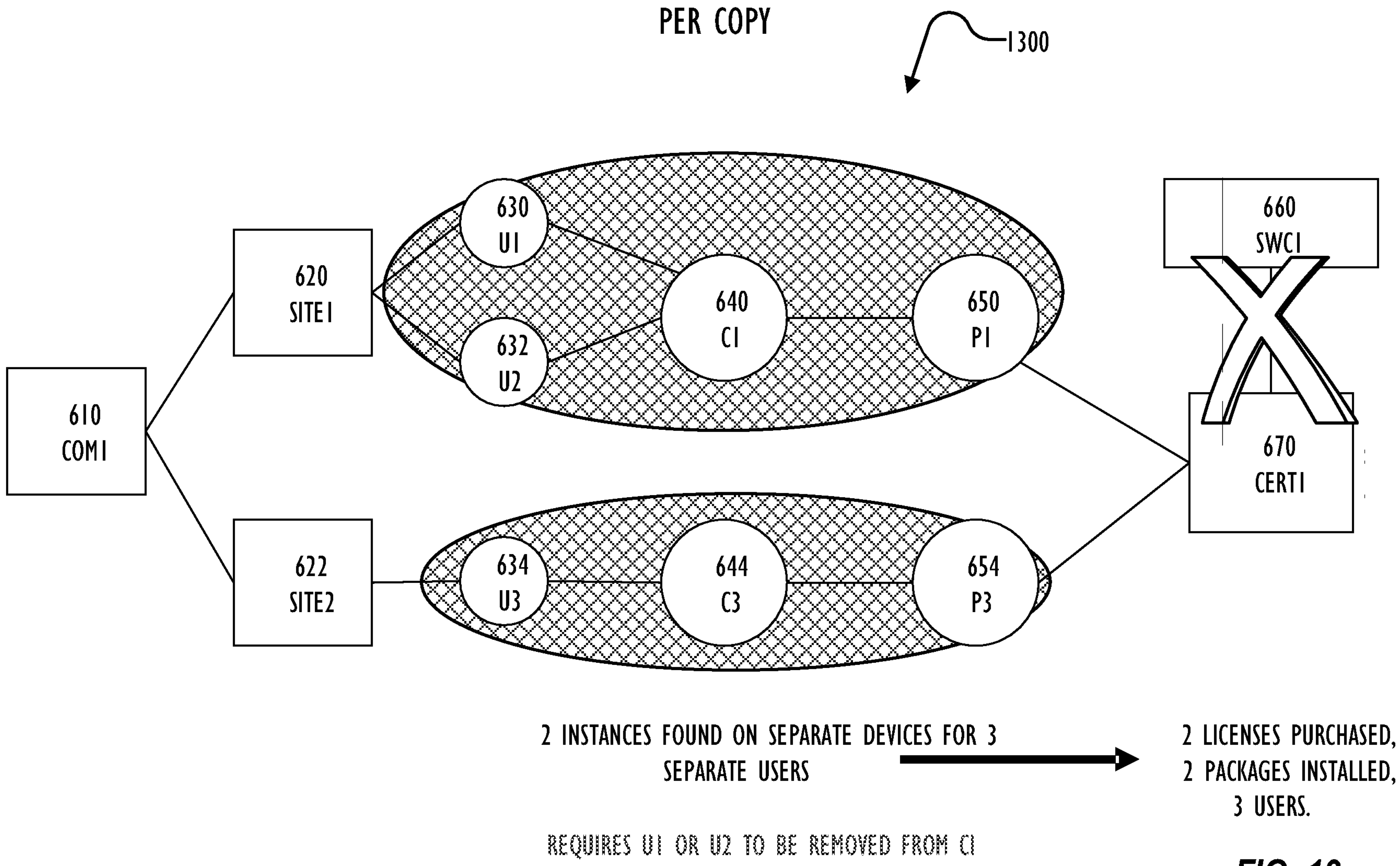

PER COPY
1300
610
COM1
620
SITE1
622
SITE2
630
U1
632
U2
634
U3
640
C1
644
C3
650
P1
654
P3
660
SWC1
670
CERT1
X
2 INSTANCES FOUND ON SEPARATE DEVICES FOR 3 SEPARATE USERS
2 LICENSES PURCHASED, 2 PACKAGES INSTALLED, 3 USERS.
REQUIRES U1 OR U2 TO BE REMOVED FROM C1

FIG. 13

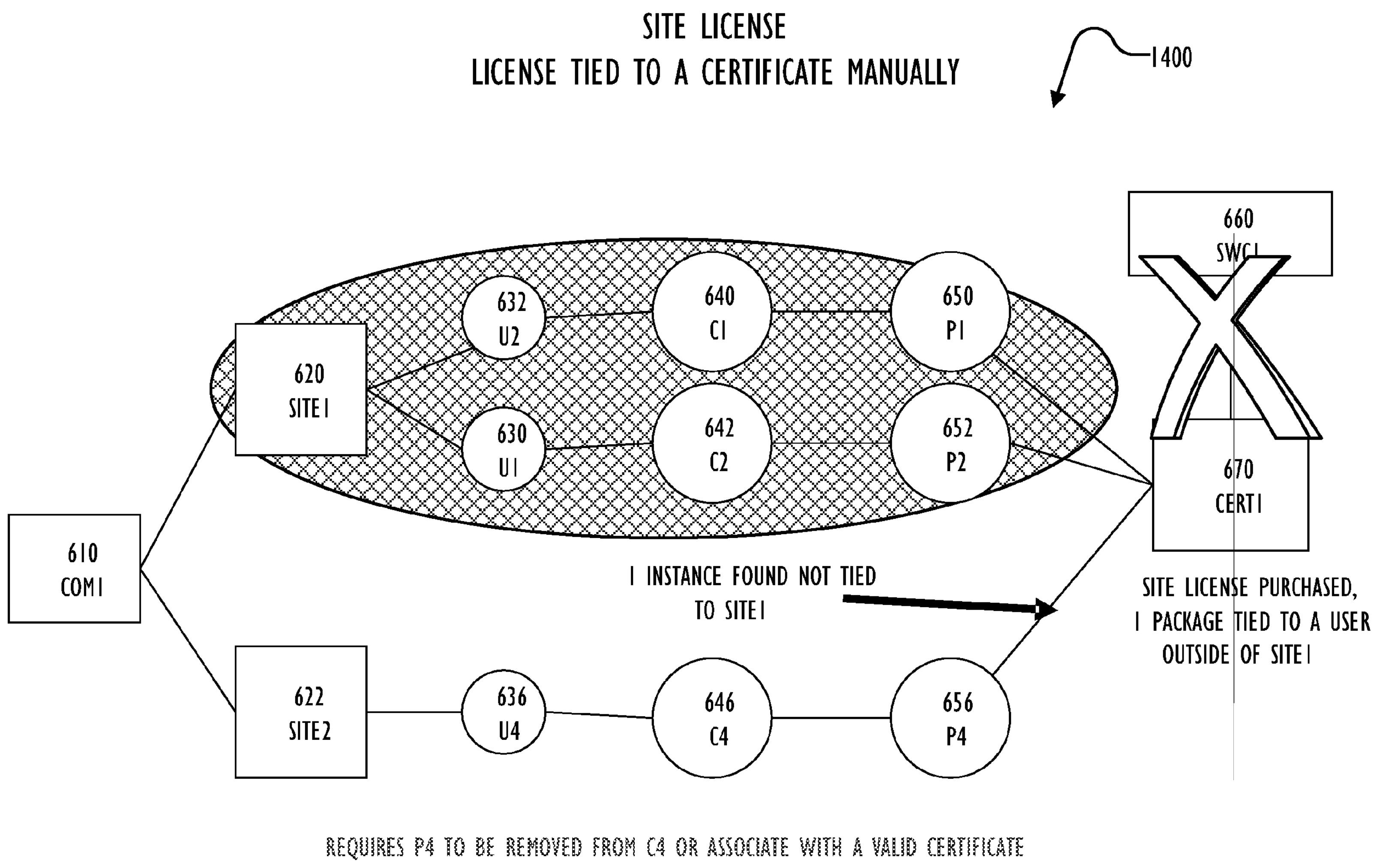

SITE LICENSE
LICENSE TIED TO A CERTIFICATE MANUALLY
1400
660 SWC1
620 SITE1
632 U2
630 U1
640 C1
642 C2
650 P1
652 P2
670 CERT1
610 COM1
1 INSTANCE FOUND NOT TIED TO SITE1
SITE LICENSE PURCHASED, 1 PACKAGE TIED TO A USER OUTSIDE OF SITE1
622 SITE2
636 U4
646 C4
656 P4
REQUIRES P4 TO BE REMOVED FROM C4 OR ASSOCIATE WITH A VALID CERTIFICATE

FIG. 14

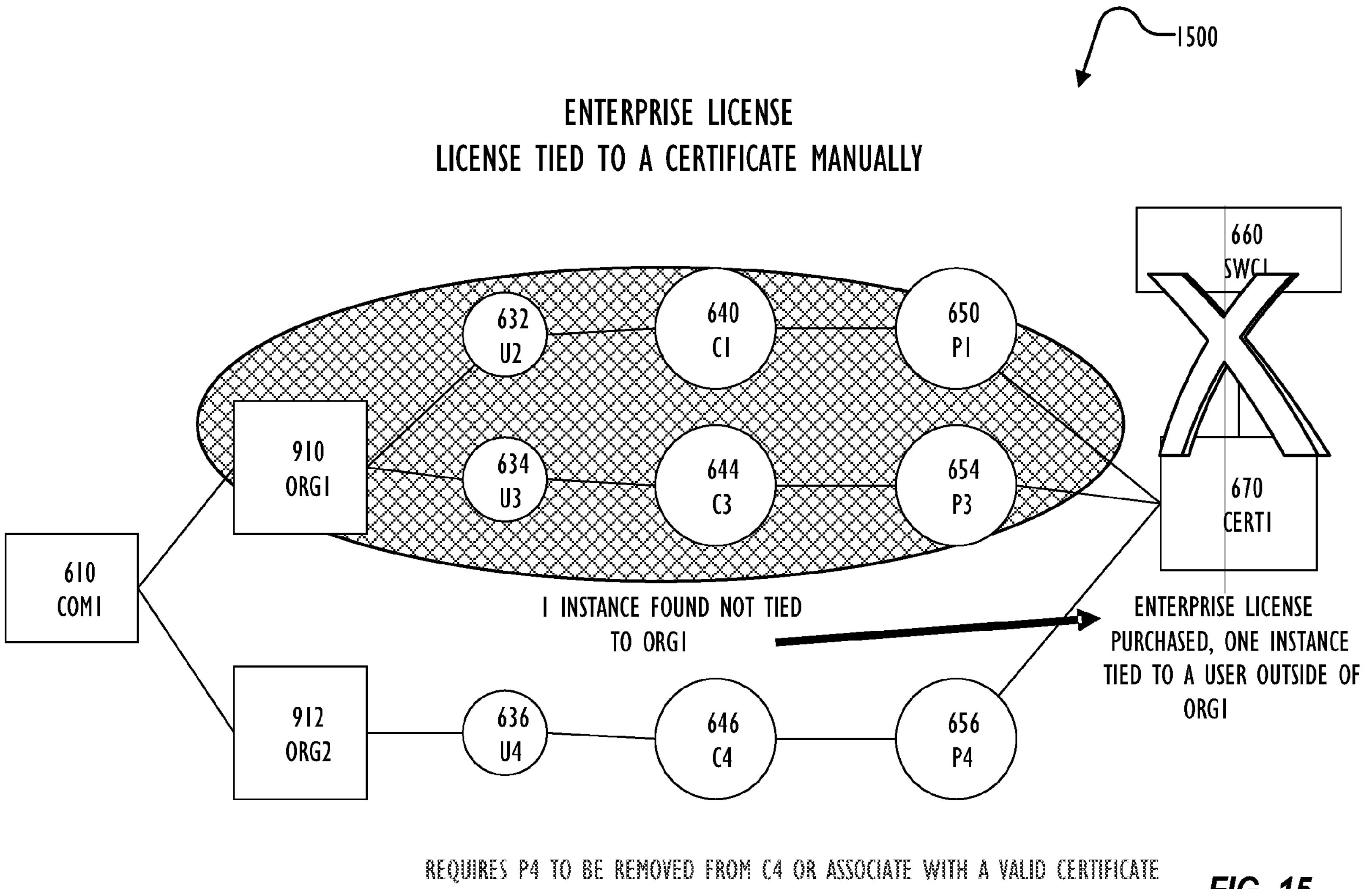

1500
ENTERPRISE LICENSE
LICENSE TIED TO A CERTIFICATE MANUALLY
660 SWC1
670 CERT1
610 COM1
910 ORG1
912 ORG2
632 U2
634 U3
636 U4
640 C1
644 C3
646 C4
650 P1
654 P3
656 P4
1 INSTANCE FOUND NOT TIED TO ORG1
ENTERPRISE LICENSE PURCHASED, ONE INSTANCE TIED TO A USER OUTSIDE OF ORG1
REQUIRES P4 TO BE REMOVED FROM C4 OR ASSOCIATE WITH A VALID CERTIFICATE

FIG. 15

METHOD AND SYSTEM FOR CONFIGURATION MANAGEMENT DATABASE SOFTWARE LICENSE COMPLIANCE

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority to U.S. Provisional Application Ser. No. 61/165,505 entitled "A Method and System for Configuration Management Database Software License Compliance" filed Mar. 31, 2009 and which is incorporated by reference in its entirety herein.

BACKGROUND

This disclosure relates generally to the field of ITIL®-based (Information Technology Infrastructure Library) Configuration Management Databases (CMDBs). (ITIL is a registered trademark of The Lords Commissioners of Her Majesty's Treasury acting through The Office of Government Commerce and Central Computer and Telecommunications Agency, United Kingdom.) ITIL-based CMDBs are emerging as a prominent technology for Enterprise Management Software.

The usefulness of these CMDBs is dependent on the quality, reliability, and security of the data stored in them. A CMDB often contains data about managed resources known as Configuration Items (CIs). ITIL version 3 defines a CI as "Any Component that needs to be managed in order to deliver an IT Service. Information about each CI is recorded in a Configuration Record within the Configuration Management System and is maintained throughout its Lifecycle by Configuration Management. CIs are under the control of Change Management. CIs typically include IT Services, hardware, software, buildings, people, and formal documentation such as Process documentation and [Service Level Agreements]." The CMDB serves as a point of integration between various IT management processes. Data from multiple sources often needs to be managed directly or by reference in commercial CMDBs.

One kind of CI that may be managed in a CMDB is a software asset. Organizations can acquire software in different manners. Software can be built for a specific purpose within the company. Software can be purchased from a software vendor or outsourcer. Software can be acquired through an acquisition or merger between companies, or between departments within a single company. Software asset management is a core component of an overall asset management policy. IT Infrastructure Library (ITIL) in the Software Asset Management Book defines software asset management as "all of the infrastructure and processes necessary for the effective management, control and protection of the software assets within an organization, throughout all stages of their lifecycle." ITIL indicates that the following processes make up the holistic approach to software asset management:

Overall management processes—The management processes surrounding the other software assets management processes. The overall management processes are related to change management.

Core asset management processes—Identification of software assets, including maintaining this information in the configuration management database (CMDB).

Logistic processes—Control of the software asset lifecycle. These processes include procurement, deployment, and end of life.

Verification and compliance processes—Verification and compliance of software asset management policies and procedures.

Relationship management processes—Software contract management.

Conventional CMDBs, however, do not provide adequate capability for that an enterprise is in compliance with the terms of its software license contracts.

SUMMARY

In one embodiment, a method is disclosed. The method comprises storing a first model of deployment of a software product in a configuration management database (CMDB); storing a second model of a software license contract for the software product in a license database; and evaluating compliance of the software license contract. Evaluating compliance comprises connecting the first model and the second model; comparing the first model and the second model; and generating an exception indication if the act of comparing the first model and the second model indicates non-compliance with the software license contract.

In another embodiment, a system is disclosed. The system comprises a server computer, which comprises a processor; a configuration database, coupled to the processor; a license database, coupled to the processor; and a program store, coupled to the processor, on which is stored instructions for the processor, wherein the instructions cause the processor to perform the method disclosed above.

In yet another embodiment, a computer readable medium is disclosed. The computer readable medium stores instructions for a programmable control device that cause the programmable control device to perform the method disclosed above.

In yet another embodiment, a networked computer system is disclosed. The networked computer system comprises a plurality of computers on which software products are deployed; and one or more configuration management database computers, communicatively coupled to the plurality of computers, programmed to perform the method disclosed above.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows, in block diagram form, an example of a collection of computer systems of an enterprise that are managed by a CMDB according to one embodiment.

FIG. **2** shows, in block diagram form, a CMDB system according to one embodiment.

FIG. **3** shows, in block diagram form, an example computing device used for the credential server or client according to one embodiment.

FIG. **4** shows, in flowchart form, an example technique for monitoring and verifying software license compliance according to one embodiment.

FIG. **5** shows, in flowchart form, an example of a technique employed by a license engine according to one embodiment; and

FIGS. **6-15** show, in graph form, examples of compliance and non-compliance determined by a license engine according to one embodiment.

DETAILED DESCRIPTION

Various embodiments disclosed herein provide the ability to use a CMDB to monitor and verify software license compliance in an enterprise. Using a variety of rules related to different license types, a license engine may associate license certificates with software contracts, and evaluate compliance with some of the terms of those contracts. When a non-compliance event is discovered, the enterprise may take appropriate action to bring the software assets represented by the CIs in the CMDB into compliance with the license contracts under which the software was acquired.

In the following description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the invention. It will be apparent, however, to one skilled in the art that the invention may be practiced without these specific details. In other instances, structure and devices are shown in block diagram form in order to avoid obscuring the invention. References to numbers without subscripts are understood to reference all instance of subscripts corresponding to the referenced number. Moreover, the language used in this disclosure has been principally selected for readability and instructional purposes, and may not have been selected to delineate or circumscribe the inventive subject matter, resort to the claims being necessary to determine such inventive subject matter. Reference in the specification to "one embodiment" or to "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiments is included in at least one embodiment of the invention, and multiple references to "one embodiment" or "an embodiment" should not be understood as necessarily all referring to the same embodiment.

FIG. **1** is a block diagram illustrating a CMDB server **110** that manages a collection of computer systems **120** for an enterprise **100**. Each of the computer systems **120** has hardware and software components, including network connectivity components that are modeled as CIs in the CMDB server **110**. Although illustrated here as a single CMDB server **110** for clarity, a CMDB may comprise a plurality of computer systems that together provide the services of the CMDB server **110**. The computer systems **120** may be any types of computer systems, including laptop, desktop, blade server, and mainframe computers. In addition to modeling the organizational structure of the enterprise **100** and the hardware components of the computer systems **120** as CIs, the CMDB server **110** may model the software product packages or components installed on each of the computer systems **120**, as well as the software contracts under which that software is licensed. Discovery of those hardware and software components is preferably an automated process, but the techniques for discovering and storing the information modeled by CIs for hardware and software components in the CMDB server **110** is outside the scope of the present invention.

FIG. **2** is a block diagram illustrating a system **200** according to one embodiment with the CMDB server **110** of FIG. **1** and a pair of clients **210** and **220**. The CMDB server **110** may comprises a number of software components, including a web services component **230** for interacting with a web client computer **210**, and an Application Programming Interface (API) **240** for interacting with an application client computer **220**. The application client computer **220** may be a computer running any application designed to interact with the CMDB server **110** through the API, including, for example, a desktop computer with a CMDB client application running in a Microsoft WINDOWS® environment (WINDOWS is a registered trademark of Microsoft Corporation) that provides a graphical user interface (GUI) to the user of the client computer **220**; however, an application may interact with the CMDB server **110** without a GUI.

The CMDB server **110** also comprises a license engine **250** for performing the functionality described in more detail

below related to software license compliance. The CMDB server **110** may include other software components for providing CMDB functionality as desired.

Data for the CMDB server **110** is illustrated as stored in a CMDB datastore **260** and a license datastore **270**. The CMDB datastore **260** comprises the storage for the conventional CMDB data, including CIs. Although shown as a single unit in FIG. **2**, the CMDB datastore **260** may be implemented as a plurality of storage units as desired. The techniques for storing the data in the CMDB datastore **260** are outside the scope of the present invention. The license datastore **270** is illustrated as a separate datastore for clarity, but may be integrated with the CMDB datastore **260**. The license datastore **270** provides storage for to model software contracts, including rules against which the CIs are evaluated for software license compliance and other information necessary for processing those rules. The CMDB datastore **260** and the license datastore **270** may be implemented as a collection of flat files, a structured query language database, or in any other way desired.

Referring now to FIG. **3**, an example computer **300** for providing the CMDB server **110** is shown. Example CMDB server computer **300** comprises a system unit **310** which may be optionally connected to an input device or system **360** (e.g., keyboard, mouse, touch screen, etc.) and display **370**. A program storage device (PSD) **380** (sometimes referred to as a hard disc) is included with the system unit **310**. Also included with system unit **310** is a network interface **340** for communication via a network with other computing and corporate infrastructure devices (not shown). Network interface **340** may be included within system unit **310** or be external to system unit **310**. In either case, system unit **310** will be communicatively coupled to network interface **340**. Program storage device **380** represents any form of non-volatile storage including, but not limited to, all forms of optical and magnetic storage elements including solid-state storage, including removable media, and may be included within system unit **310** or be external to system unit **310**. Program storage device **380** may be used for storage of software to control system unit **310**, data for use by the credential store system **300**, or both.

System unit **310** may be programmed to perform methods in accordance with this disclosure (examples of which are in FIGS. **4-5**). System unit **310** comprises a processor unit (PU) **320**, input-output (I/O) interface **350** and memory **330**. Processing unit **320** may include any programmable controller device including, for example, one or more members of the Intel Core®, Pentium® and Celeron® processor families from the Intel and the Cortex and ARM processor families from ARM. (INTEL, CORE, PENTIUM, and CELERON are registered trademarks of the Intel Corporation. CORTEX is a registered trademark of the ARM Limited Corporation. ARM is a registered trademark of the ARM Limited Company.) Memory **330** may include one or more memory modules and comprise random access memory (RAM), read only memory (ROM), programmable read only memory (PROM), programmable read-write memory, and solid-state memory. One of ordinary skill in the art will also recognize that PU **320** may also include some internal memory including, for example, cache memory.

Similar computer systems may be used as clients for accessing the CMDB server **110**, such as the web client **210** and the application client **220** of FIG. **2**.

FIG. **4** is a flowchart illustrating a technique **400** for performing software license compliance monitoring and verification according to one embodiment. In block **410**, the software licenses are purchased or otherwise acquired and deployed on the computer systems **120** of the enterprise **100**.

Information about the software contracts is stored as CIs in the CMDB datastore **260** using one or more of the clients **210/220**. Table 1 illustrates an example of information that may be stored about a software contract according to one embodiment. The information listed below is illustrative only and other collections of information about software contracts may be used as desired.

TABLE 1

Software Contract Information

Field name	Description
ID	A unique alphanumeric value.
Summary	Brief description of the contract.
Term	Select the applicable term: Fixed—Contract expires at the expiration date. Never Ending—Contract never expires. Rolling Contract—Contract automatically renews at the expiration date
Status	Select the applicable status of the contract: Draft—The contract has never been executed but is going through the process of being executed. Draft status may be used for contracts that are in negotiation or pending signature. Executed—The contract that is executed and valid. Executed contracts include active contracts that have started. An executed contract may have additional status information, including status reasons, such as: active, change pending, on hold, requires attention, under renegotiation. Historical—The contract is not valid. Historical contracts include contracts that have expired, been terminated, or been canceled. Delete—The contract is scheduled for deletion.
Company	The company associated with this contract.
View	Access Select who can view or modify this contract: Public—Anyone who can access contracts can view or modify the contract. Internal—Only people in the support group managing this contract can view or modify the contract.
Supplier Name	The supplier associated with this contract.
Cost Center	The cost center that owns this contract.
Support Company	The support company associated with this contract.
Support Organization	The support organization associated with this contract.
Notification Group	The notification group associated with this contract.
Notification Contact	An individual to receive notifications for this contract.
Owner Group	The group responsible for this contract.
Owner Contact	An individual responsible for this contract.
Expiration Date	Date contract expires. When a contract expires, individuals are notified first, then groups.
Notification Date	When the contract expires, the notification contact and the owner contact are notified on this date.

Some of the information listed in Table 1 above may be optional and omitted as desired when entering information about a software contract into the CMDB datastore **260**.

After the information about each software contract deployed is entered into the CMDB datastore **260**, in one embodiment in block **420** a new license type may be created, if needed. Block **420** is shown in dashed lines, indicating that this block may omitted if all necessary license types have already been created or in embodiments which do not provide for creation of custom license types.

License types may be used for software license management. In one embodiment, a license type wizard allows administrators with appropriate permissions to create custom license types for license certificates. After the license type wizard has been completed and the license type has been saved, the license types are used when a contract manager or software asset manager creates certificates in block **440**, as described below.

When the license engine runs, company and product information and answers to correlation rules questions supplied when the certificate was created are used to determine which CIs should be connected to the license certificates. Compliance is also calculated based on the answers to questions supplied and the configured compliance actions that act on these values. In one embodiment, a default behavior for connection compares the company information and product categorization in license certificates with CIs to determine which CIs to connect to a license certificate. In one embodiment, a default behavior for compliance queries license certificates that match a license type and tests the result of the query against compliance criteria.

In one embodiment, license types may specify the following information:

(1) What questions a contract manager or software asset manager must answer when adding a new software license certificate.

(2) How connection questions are used to select CIs from the CMDB datastore **260**.

(3) How compliance is computed based on compliance questions and actions specified during license type creation, such as relating CIs to a license certificate or creating exceptions.

In one embodiment, the CMDB server **110** provides a default set of pre-defined license types, as illustrated in Table 2 below. These license types are illustrative and by way of example only, and other license types may be provided as pre-defined license types.

TABLE 2

License Types

Contract type	Description
Enterprise	An enterprise license type licenses all of the software from a manufacturer that is being used by a given company. There is one enterprise license per company. Anyone in the company can use the license. This license type is set to non-groupable. Connection Uses the default certificate criteria for connections. Compliance One computed compliance question is specified for number of licenses deployed. The certificate for this license type is always compliant.
Site	A site license type licenses all of the software from a manufacturer that is being used by a given site. A site license applies to a single site within a company. If a site license applies to multiple sites within a company, the contract manager or software asset manager can add a site license certificate for each site. This license type is set to non-groupable. Connection Uses the default certificate criteria for connections. In addition, one connection question exists for this license type, which is "Enter Certificate Site?" When the license type is created, this question maps to the site of the computer system on which the product is installed.

TABLE 2-continued

License Types	
Contract type	Description
	For each product that matches the default certificate criteria for connections, the site of the computer system on which the product is installed is used to connect the product to the license certificate for that site. For example, a contract manager creates a license certificate with the default certificate criteria for connections: Company = XYZ Services Manufacturer = Microsoft Product = Visio The contract manager specifies this Site license certificate is for BackOffice Support. A copy of Microsoft Visio is installed on a computer in Frontoffice Support. That product is not connected to the license certificate. A computer in BackOffice Support Services has both Microsoft Visio and Microsoft Word installed. Microsoft Visio is connected to the site license, but Microsoft Word is not (perhaps it is connected to an Enterprise license).
	Compliance
	One computed compliance question is specified for number of licenses deployed. The certificate for this license type is always compliant.
Per instance	Each instance of the license is counted as one license consumed. Any instance of software found requires a license. This license type is set to groupable.
	Connection
	Uses the default certificate criteria for connections.
	Compliance
	The following compliance question is asked: Number of licenses purchased? Breach warning level 1? Breach warning level 2? Number of licenses deployed (computed question) The answers to this question are used to: Determine the number of software instances related to the certificate Set the certificate to not compliant, if the number of software instances related to a certificate is greater than the number purchased.
	Example
	Two instances of BMC Atrium CMDB Enterprise Manager were found. In this situation, two licenses are required.
Per copy per device	The number of copies per device is counted as one license consumed. If the number of copies per device is exceeded, the license is out of compliance. The per device number specified for a license type determines how many copies can be installed on each device. This license type is set to groupable.
	Connection
	Uses the default certificate criteria for connections.
	Compliance
	The following compliance questions are asked: Number of licenses purchased? Breach warning level 1? Breach warning level 2? Number of copies allowed per device? Number of licenses deployed (computed question). The answers to these questions are used to compute compliance: If any devices have more than the allowable number per device, the certificate is marked as not compliant. Also, if the number of software licenses related to a certificate is greater than the number purchased, the certificate is marked as not compliant.
	Example
	Two copies of Microsoft Word were found on a computer, but only one license exists. If the number of copies allowed on a device is one, this is not compliant.
Per copy	This license type is per copy per user. Each unique user (since, for example, there could be two software items linked to one user) is counted as one license consumed. If a user is not linked to a license, it is assumed that one license is consumed. This license type is set to groupable.
	Connection
	Uses the default certificate criteria for connections.
	Compliance
	Compliance is computed based on the number of unique individuals using a software product. The following compliance question will be asked: Number of licenses purchased? Breach warning level 1? Breach warning level 2? Number of licenses deployed (computed question). The answers to these questions are used to determine the number of unique individuals connected to a product. If the number counted is greater than the number of licenses purchased, the license certificate is set to not compliant.
	Example
	Two copies of an application were found on separate computers owned by one user and only one license exists. This situation is compliant, because only one license is required.
Fixed	This license type requires a license for every user using the product.
	Connection
	Uses the default certificate criteria for connections.
	Compliance
	Compliance is computed based on the number of individuals using a software product, not the number of installations.
Floating	This license type is per concurrent user.
	Connection
	Uses the default certificate criteria for connections.
	Compliance
	Compliance is computed based on the maximum number of concurrent users. The number may be unlimited.

Preferably, custom license types in addition to the those listed in Table 2 above may be defined.

After any new license types are created to handle the terms of the new software contracts terms, license certificates may be created in block **430**, to link software contracts to CIs. A license certificate indicates the right to deploy software in the environment managed by the CMDB server **110**. In one embodiment, a license certificate comprises the information listed in Table 3 below. The information disclosed in Table 3 below is illustrative and by way of example only, and other license certificate information may be used.

TABLE 3

License Certificates

Field name	Description
Company	This information comes from the software
Software Contract ID	contract.
Certificate ID	The certificate ID identifies the license certificate in listings and reports. It does not have to be unique.
Summary	This field provides additional space to describe the certificate.
Status	Initially set to Draft.
License Category Type	Select from Client, Server, or Mainframe.
License Type	The appropriate license type. The license type determines the connection questions and the compliance questions.
Cost Center	This information comes from the software contract, but can be changed.
Effective Date	The date that the license becomes effective.
Expiration Date	The date that the license expires. If the license does not expire, this field may be left blank.

In some embodiments, one contract may have multiple certificates, and software compliance may be tracked at the software level.

In one embodiment, the license engine **250** may ask for additional information when creating the license certificates. This information may comprise connection details, to allow the license engine **250** to connect the license certificate to CIs. The information may also include compliance information. For example, the license engine **250** when creating a per copy license certificate may ask how many licenses were purchased. For a site license, the license engine may ask the identity of the location for which the license was purchased. For a per copy per device license, the license engine **250** may ask how many licenses were purchased and how many copies per device are allowed under each license. Other questions may be asked depending typically on the license type. The additional information supplied in response to those questions may be included in the license certificate as it is stored in the license datastore **270**.

In one embodiment, script-based rules may be created for additional custom license types to represent complex license entitlements, allowing a user of the license engine **250** to add and configure new license types without changes to the code of the license engine **250**. For example, a license type may be created with rules for an application that executes in a virtual machine, where the rules are based on the number of physical processors on the physical machine. Because of the relationships available from the CMDB datastore **260**, the license model for this license type may navigate back to the physical hardware to understand the number of processors when checking compliance.

In one embodiment, license certificates may be grouped into certificate groups. Certificate groups consolidate the tracking of license certificates. A master certificate is grouped with individual child license certificates. The CIs may be attached to the master certificates. License allocation numbers are attached to the child license certificates. For example, under the same software contract, 200 licenses for Microsoft Word are purchased. Later, 100 more licenses are purchased. Two CIs are created in the CMDB **260**, one for each license purchase. In this example, it does not matter which CI is attached to a specific license certificate. For compliance, it only matters that the licensee does not exceed 300 Microsoft Word instances for the contract. By grouping license certificates and attaching the CIs to a master certificate for the group, the licensee may gain flexibility in how the license

certificates are applied. On the master certificate, in one embodiment, the sequence to which license certificates are allocated to matching CIs may be specified. When the first license in the sequence is fully used, the License Engine may apply CIs to the next license certificate. As a result, one or more of the last certificates in the sequence may be out of compliance, while earlier certificates may be in compliance.

Certificate groups may also help avoid unnecessary warnings in some embodiments. Consider the preceding Microsoft Word license example. In one embodiment, the license engine **250** may provide warning indications when a license certificate is nearly completely applied. If the license certificates are not grouped, in such an embodiment, for example, the license engine **250** may generate a warning when 190 CIs are attached to the first license certificate. Although there is another license certificate that is valid for 100 instances, the first certificate would be approaching the maximum usage. If, however, the certificates are grouped, for compliance checks, that is equivalent to having one certificate for 300 instances and a warning may be generated only when the last certificate in the sequence approaches being completely allocated.

When a certificate expires, the license engine **250** may check for compliance in one embodiment. If there are enough licenses remaining in the group in other certificates, the license engine **250** may not generate a warning or non-compliance indication. If a license certificate is not part of a group, when it expires, all the related CIs are out of compliance.

Returning to FIG. **4**, after the license certificates are created, then in block **440**, the license engine **250** is run. The license engine evaluates the status of the software licenses modeled in the CMDB **260** against the license certificates created in block **430**.

FIG. **5** is a flowchart illustrating an overview of a technique **500** for evaluating software license compliance by the license engine **250** according to one embodiment. In block **510**, the license engine obtains a list of CIs to process. This list may be specified directly by a user of one of the clients **210**/**220** or may be automatically generated by an update to the CMDB **260** that adds software contracts or instances of deployment of software on one of the computer systems **120** of the enterprise **100**.

Then in block **520**, correlation rules may be evaluated to connect each of the identified CIs to license certificates. In block **530**, if any CIs are not connected to license certificates by the correlation rules, or if the license engine **250** determines that multiple license certificates would match to a CI, then in block **540** any desired exception processing may be performed.

In block **550**, compliance rules may be evaluated to determine whether each of the software CIs complies with the terms of the software contract. In block **560**, if any CI is not in compliance, then any desired exception processing may be performed.

Exception processing as performed in blocks **540** and **570** in one embodiment may be simply producing an error message or report indicating the exception. The exception may indicate a non-compliance condition. In one embodiment, additional exceptions may be triggered when a software license contract is in compliance but is within a window of near non-compliance, such as when nearly all of the purchased licenses have been deployed. Such warning indications may allow preventative measures to be taken before a non-compliance condition exists.

In other embodiments, more sophisticated exception processing may be performed. For example, in one embodiment, a noncompliance exception indicating that more instances of a particular software are deployed than are licensed may automatically trigger a request to purchase sufficient additional license to bring the enterprise **100** back into compliance. In another embodiment, the same situation may trigger an analysis to attempt to determine which, if any, of the existing instances of the software may exceed the need of the enterprise **100** need for the software, and in a further embodiment, may trigger the removal of a software package from one or more computer systems **120**.

In one embodiment, a compliance exception may be generated at multiple levels. The multiple levels may be defined as desired by the person creating the compliance rules, but typically relate to how much the particular CI is out of compliance. For example, if a software contract acquires 100 licenses for a particular software package, and the license engine **250** discovers that 101 licenses are in use, a compliance rule may trigger a Breach Level **1** exception, but if the license engine **250** discovered that 110 licenses are in use, a Breach Level **2** exception may be signaled. In one embodiment, up to three levels of non-compliance exceptions may be signaled by the license engine **250**.

In one embodiment, compliance results may be rolled up to consolidate compliance reporting at higher levels than a single contract. For example, in such an embodiment compliance results may be reported for the entire organization or for a particular software product or vendor.

FIGS. **6-15** are graphs illustrating examples of compliance and non-compliance that may be determined by the license engine **250**. In FIG. **6**, a graph **600** illustrates compliance with a per copy per device license. Company **610** has purchased two licenses for some software, which is used at two different sites (**620** and **622**) by four users. In this example, the software contracts do not limit the number of users that may use a given copy of the licensed software. Users **630** and **632** use the software at Site **620**, and the software is installed once as package **650** on computer **640**. Users **634** and **636** use the software at Site **622**, also part of company **610**. The software is installed on computer **642** as package **652**. The license engine **250** connects certificate **670** to contract **660**. Because the 2 instances of the software found installed in the CMDB **260** match the 2 licenses purchased by company **610**, only 2 licenses are in use, and the company **610** complies with software license contract **660**.

FIG. **7** is a graph illustrating example **700**, in which the software contract **660** is a per copy license, which allows 2 separate users to have a copy of the software. As before, the software is installed for two sites **620** and **622** of company **610**. In this example, however, the software is installed twice by user **630**, once as package **650** on computer **640**, and once as package **650** on computer **642**. In addition, user **636** has installed the software on computer **642** as package **652**. Although there are three instances of the software installed on two separate devices, the three instances are associated with only two users. Therefore, only two per copy licenses are used, and the company **610** complies with software contract **660**.

FIG. **8** is a graph illustrating example **800**, in which software contract **660** is a site license. In this example, four instances of the software are found installed, with user **632** installing package **650** on computer **640**, user **630** installing package **650** on computer **640**, user **634** installing package **650** on computer **642**, and user **636** installing package **652** on computer **642**. Because all installed packages tie back to site **620**, the software contract **660** is in compliance.

FIG. **9** is a graph illustrating example **900**, in which software contract **660** is an enterprise-wide license. In this example, company **610** has two divisions or organizational units **910**, **912**, which may be at different sites or the same site. Users **630**, **632**, and **634** are tied to organizational unit **910**, and user **636** is tied to organizational unit **912**. The four instances of the software illustrated in FIG. **9** are all tied to company **610**, thus the enterprise software contract **660** is in compliance.

FIGS. **10-15** illustrate various non-compliance scenarios. In FIG. **10**, example **1000** is illustrated by a graph in which software license **660** is a per copy per device type of license, with two licenses for the software. In this example, three instances are found on three separate devices: package **650** is installed on computer **640** for use by users **630** and **632**, package **654** is installed on computer **644** for use by user **634**, and package **652** is installed on computer **642** for use by user **636**. Thus, the software license contract **660** is not in compliance, and the license engine **250** generates a non-compliance exception, indicating that the company **610** is out of compliance with the license. To bring the company **610** back into compliance, either one new license may be purchased, or one of the three instances **650**, **654**, and **652** removed.

FIG. **11** is a graph illustrating example **1100**, in which another per copy per device software contract **660** is considered. In this example, company **610** has acquired two licenses. Although the licensed software is only installed on two computers **640** and **642**, two packages **650** and **654** of the software are installed on computer **640**, while one package **652** is installed on computer **642**. Thus there are three licenses used, one more than allowed by the contract **660**, and company **610** is not compliant with contract **660**.

FIG. **12** illustrates a scenario **1200** where another per copy per device contract **660** is evaluated by the license engine **250**. In this example, company **610** is in compliance with the contract **660** as indicated by certificate **670**, because two instances **650** and **654** of the software are installed, one on each of computers **640** and **644**. But in this example, the connection or correlation phase of the license engine **250** processing discovers that there is no license certificate corresponding to the instance **652** installed on computer **642** for user **636** associated with site **622**. In this scenario, overall compliance with the software vendor is unknown, because of the CI that cannot be connected to a software contract through a license certificate. The license engine **250** may flag this as a connection exception (in block **540** of FIG. **5**), requesting intervention by a contract or asset manager to resolve the connection exception. For example, this scenario may indicate that the asset or contract manager omitted information when creating the license certificate or software contract data in the CMDB **260**, which if corrected and the license engine rerun would indicate compliance. Or in another example, this scenario may indicate that an additional license may need to be acquired or that the instance **652** may need to be removed.

Example **1300** in FIG. **13** illustrates a per copy license contract **660** in which two licenses were purchased for company **610**. Only two instances **650** and **654** of the licensed software are installed on two computers **640** and **644**, but the instance **650** is associated with two users **630** and **632**. Thus, three users of the two installations are found by the license engine **250**, and an exception may be indicated that the contract **660** is out of compliance. In this scenario, either user **630** or **632** may be removed to achieve compliance.

In FIG. **14**, example **1400** is a graph illustrating a scenario where a site license was purchased in contract **660**, but the license engine discovers that one additional instance of the licensed software was installed as package **656** on computer **646** for user by user **636** at site **622**. The package **656** is not, therefore, at a site defined by the contract **660**. Thus, the license engine generates a non-compliance exception. To bring the company **610** back into compliance, either the package **656** may be removed or a license acquired for the user at site **622**.

FIG. **15** is a graph illustrating example **1500**, in which company **610** obtained an enterprise license for organizational unit **910**. So both instances **650** and **654** that are associated with organizational unit **910** are in compliance with the contract **660**, but the license engine **250** discovers that there is one instance **656** of the software installed that is tied to a user **636** of another organizational unit **912**. Either the instance **656** may be removed from computer **646** or an additional license may be obtained and associated with a valid license certificate to bring the company **610** into compliance with its contractual obligations.

As described above, various embodiments allow contract or asset management personnel of an enterprise to evaluate software usage of their organization and determine whether the organization complies with software license contracts that are modeled in a CMDB. Where the organization is not in compliance, the license engine identifies the non-compliance and provides information that may allow the contract or asset manager to address the problems and bring the organization into compliance.

Because the license engine **250** is integrated with the CMDB server **110** and CMDB datastore **260**, the various embodiments may allow for immediate and automatic feedback on the effect on software compliance of changes to the infrastructure modeled by the CMDB, in addition to on-demand runs of the license engine **250**.

It is to be understood that the above description is intended to be illustrative, and not restrictive. For example, the above-described embodiments may be used in combination with each other. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention therefore should be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein."

What is claimed is:

1. A computer-implemented method, comprising:

modeling deployment of a software product and a software license contract for the software product;

storing a first model of the modeled deployment of the software product in a configuration management database (CMDB) by storing information related to the software product as a first configuration item in the CMDB and by storing information related to the software license contract as a second configuration item in the CMDB;

storing a second model of the modeled software license contract for the software product in a license database by generating a license certificate corresponding to the software license contract and storing the license certificate in the license database; and

evaluating the deployment of the software product for compliance with the software license contract, comprising:

connecting and comparing the first model and the second model by comparing the first configuration item with the license certificate and connecting the license certificate with the second configuration item responsive to comparing the first configuration item with the license certificate; and

generating an exception indication if the act of comparing the first model and the second model indicates non-compliance with the software license contract.

2. The method of claim **1**, wherein the act of storing a first model comprises:

storing a third configuration item in the CMDB modeling at least a portion of an organizational structure;

storing a fourth configuration item in the CMDB modeling a hardware element on which the software product is deployed.

3. The method of claim **2**, wherein the act of connecting the first model and the second model comprises:

comparing the third configuration item with the license certificate; and

comparing the fourth configuration item with the license certificate.

4. The method of claim **2**, wherein the act of connecting the first model and the second model comprises:

comparing one or more of the third configuration item, the fourth configuration item, and the first configuration item with the license certificate; and

connecting the license certificate with the second configuration item responsive to the act of comparing one or more of the third configuration item, the fourth configuration item, and the first configuration item with the license certificate.

5. The method of claim **1**, wherein the act of evaluating is performed on demand.

6. The method of claim **1**, wherein the act of evaluating is performed automatically responsive to a change in the CMDB.

7. The method of claim **1**, wherein the act of connecting the first model and the second model comprises:

generating an exception indication if the first model cannot be connected to the second model.

8. The method of claim **1**, wherein the act of connecting the first model and the second model comprises:

generating an exception indication if the first model can be connected to a plurality of models in the license database.

9. The method of claim **1**, further comprising:

outputting a result of the act of evaluating compliance from a license engine computer.

10. The method of claim **1**, wherein the act of evaluating compliance further comprises:

indicating a suggested action for achieving compliance if the act of comparing the first model and the second model indicates non-compliance with the software license contract.

11. The method of claim **1**, further comprising:

generating the second model, comprising:

receiving a selection of a license type corresponding to the software license contract; and receiving license contract data corresponding to the selected license type.

12. The method of claim **11**, wherein the act of generating the second model further comprises:

providing a plurality of predetermined license types.

13. The method of claim **11**, wherein the act of generating the second model further comprises:

allowing a user to define a custom license type.

14. The method of claim **1**, wherein the act of storing a second model comprises:

generating a first license certificate corresponding to the software license contract;

generating a second license certificate corresponding to the software license contract;

generating a master license certificate, grouping the first license certificate and the second license certificate; and

storing the master license certificate, the first license certificate, and the second license certificate in the license database, and wherein the act of comparing the first model and the second model comprises:

comparing the master license certificate with the first model, comprising:

comparing the first license certificate with a first portion of the first model; and

comparing the second license certificate with a second portion of the first model.

15. The method of claim **14**, wherein the act of generating an exception indication comprises:

generating a first exception indication corresponding to the first license certificate if the act of comparing the first license certificate indicates non-compliance with the software license contract;

generating a second exception indication corresponding to the second license certificate if the act of comparing the second license certificate indicates non-compliance with the software license contract; and

generating an exception indication corresponding to the master license certificate responsive to the generation of either the first exception indication or the second exception indication.

16. A system, comprising:

a server computer, comprising:

a processor;

a configuration database, coupled to the processor;

a license database, coupled to the processor; and

a program store, coupled to the processor, on which is stored instructions for the processor, wherein the instructions cause the processor to perform the method of claim **1**.

17. The system of claim **16**, wherein the server computer further comprises:

a database, comprising the configuration database and the license database.

18. The system of claim **16**, further comprising:

a client computer, adapted to communicate with the server computer, wherein the client computer requests the processor to execute the instructions that cause the server processor to perform the method of claim **1**.

19. A non-transitory computer readable medium with instructions for a programmable control device stored thereon wherein the instructions cause the programmable control device to perform the method of claim **1**.

20. A networked computer system comprising:

a plurality of computers on which software products are deployed; and

one or more configuration management database computers, communicatively coupled to the plurality of computers, programmed to perform the method of claim **1**.

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