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Poetter et al.

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(54) **NETWORK MODEL UTILIZING PROPERTY SETS**

(71) Applicant: **Unisys Corporation**, Blue Bell, PA (US)

(72) Inventors: **Jared Poetter**, Blue Bell, PA (US); **Michael C Leap**, Blue Bell, PA (US); **Diane E Schaefer**, Blue Bell, PA (US); **Robert A Johnson**, Collegeville, PA (US); **Michael Saunders**, Blue Bell, PA (US); **Robert R Buckwalter**, Blue Bell, PA (US); **Sarah K Inforzato**, Blue Bell, PA (US); **Eugene J Gretter**, Blue Bell, PA (US); **George Karian**, Blue Bell, PA (US)

(73) Assignee: **Unisys Corporation**, Blue Bell, PA (US)

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H04L 9/40 (2022.01)
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(Continued)

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CPC . H04L 63/0823; H04L 9/3263; H04L 63/105; H04L 63/089
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,078,960 A *	6/2000	Ballard	....	H04L 67/1019 709/239
11,606,690 B1	3/2023	Robinson et al.		

(Continued)

FOREIGN PATENT DOCUMENTS

JP	2016-503532 A	2/2016
WO	2017/200037 A1	11/2017

OTHER PUBLICATIONS

Final Office Action received for U.S. Appl. No. 17/386,055, mailed on Jan. 3, 2024, 9 pages.

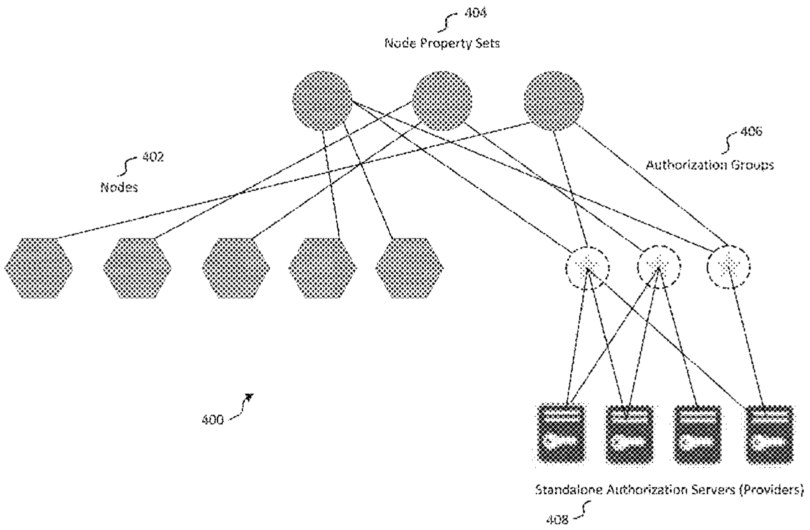
(Continued)

Primary Examiner — Dao Q Ho
(74) *Attorney, Agent, or Firm* — Shook, Hardy & Bacon

(57) **ABSTRACT**

A network model includes nodes, node property sets, authorization groups and authorization servers. The node property sets define how the nodes operate and authenticate. The nodes are member of the node property sets. The authorization groups are associated with the node property set. And, authorization servers are member of the authorization groups. In addition, a network model in a secure network environment has at least one community of interest. The network model includes at least one node being a member of a node property set that defines how the node operates and authenticates.

16 Claims, 11 Drawing Sheets



(51) **Int. Cl.**

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H04L 41/0894	(2022.01)
H04L 41/12	(2022.01)
H04L 41/16	(2022.01)
G06F 9/455	(2018.01)

(52) **U.S. Cl.**

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(56) **References Cited**

U.S. PATENT DOCUMENTS

2006/0282519	A1	12/2006	Trevathan et al.
2009/0100261	A1*	4/2009	Aoshima H04L 63/20 709/229
2011/0154045	A1	6/2011	Lee et al.
2012/0239431	A1	9/2012	Hayashi
2012/0278866	A1	11/2012	Huang
2014/0129835	A1	5/2014	Suryavanshi et al.
2017/0118087	A1*	4/2017	Bergman G06F 11/3051
2017/0171208	A1*	6/2017	Purushothaman H04L 63/20
2017/0374109	A1*	12/2017	Atarius H04L 65/1104
2018/0191730	A1*	7/2018	Deters H04L 63/105
2019/0020656	A1*	1/2019	Arjun H04L 69/40
2020/0177703	A1*	6/2020	Panda H04L 41/12
2020/0319946	A1*	10/2020	Matsuura G06F 9/5083
2021/0234705	A1*	7/2021	Wesby H04L 9/321
2022/0029996	A1*	1/2022	Poetter H04L 41/0843

OTHER PUBLICATIONS

Non-Final Office Action received for U.S. Appl. No. 17/386,055, mailed on May 21, 2024, 10 pages.

Non-Final Office Action received for U.S. Appl. No. 17/386,056, mailed on Jan. 3, 2024, 4 pages.

* cited by examiner

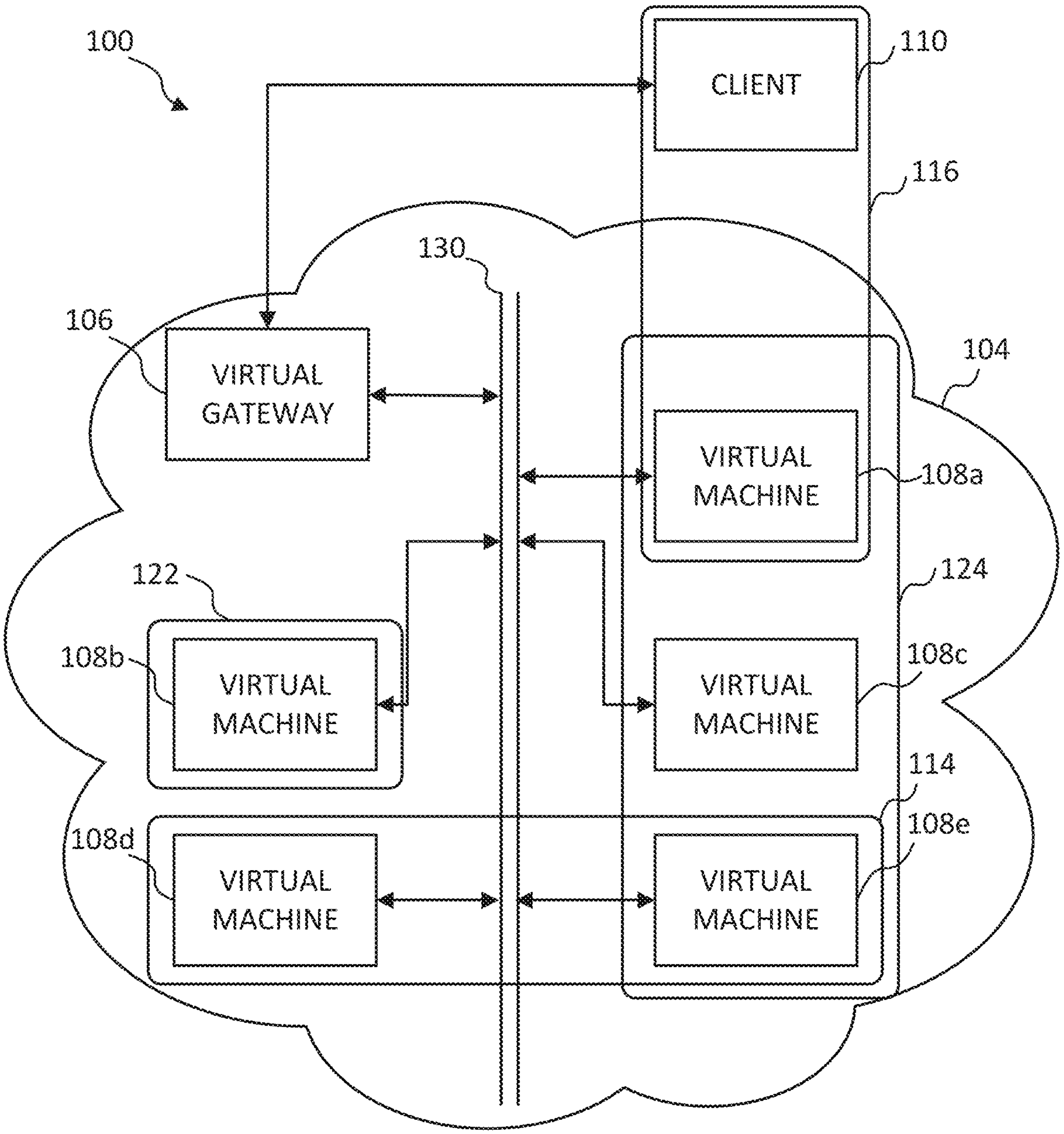

100
CLIENT
110
116
130
106
VIRTUAL GATEWAY
104
VIRTUAL MACHINE
108a
122
124
108b
VIRTUAL MACHINE
VIRTUAL MACHINE
108c
114
108d
108e
VIRTUAL MACHINE
VIRTUAL MACHINE

Figure 1

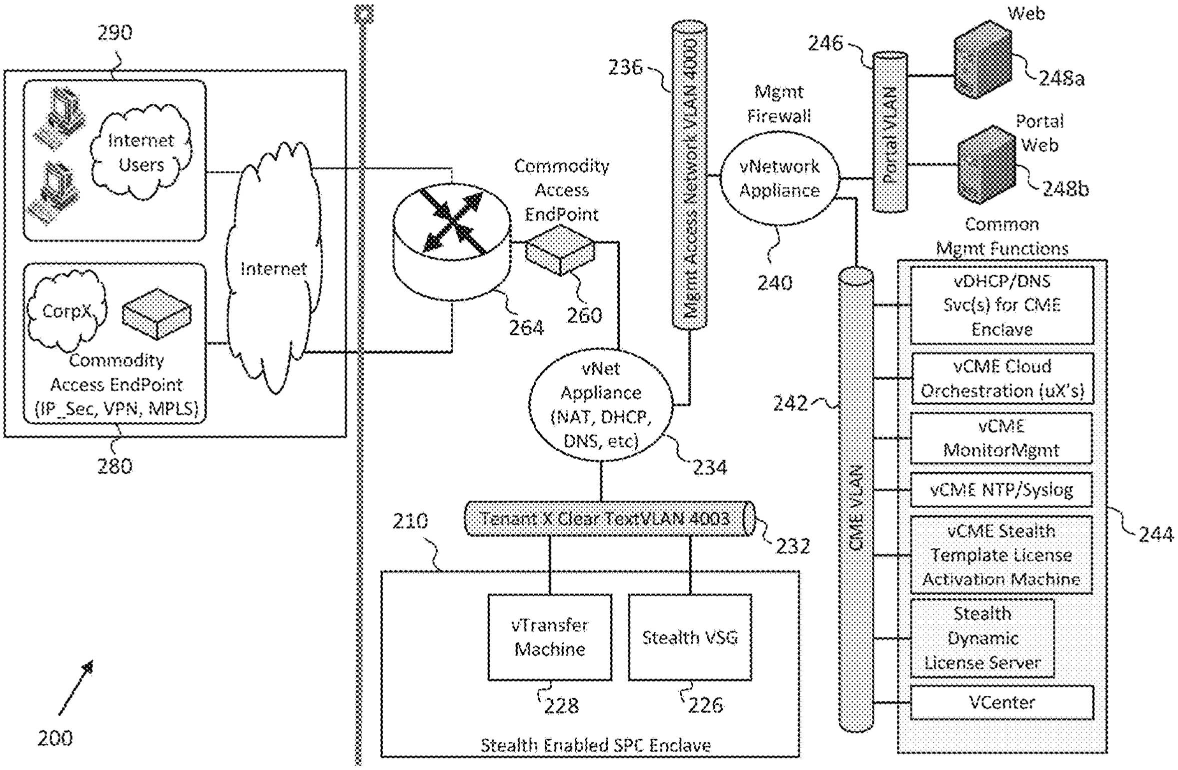

290
Internet Users
CorpX
Commodity Access EndPoint (IP_Sec, VPN, MPLS)
Internet
280
264
Commodity Access EndPoint
260
236
Mgmt Access Network VLAN 4000
Mgmt Firewall
vNetwork Appliance
240
246
Portal VLAN
Web
248a
Portal Web
248b
Common Mgmt Functions
vDHCP/DNS Svc(s) for CME Enclave
vCME Cloud Orchestration (uX's)
vCME MonitorMgmt
vCME NTP/Syslog
vCME Stealth Template License Activation Machine
Stealth Dynamic License Server
VCenter
244
242
CME VLAN
vNet Appliance (NAT, DHCP, DNS, etc)
234
Tenant X Clear TextVLAN 4003
232
210
vTransfer Machine
Stealth VSG
228
226
Stealth Enabled SPC Enclave
200

Figure 2

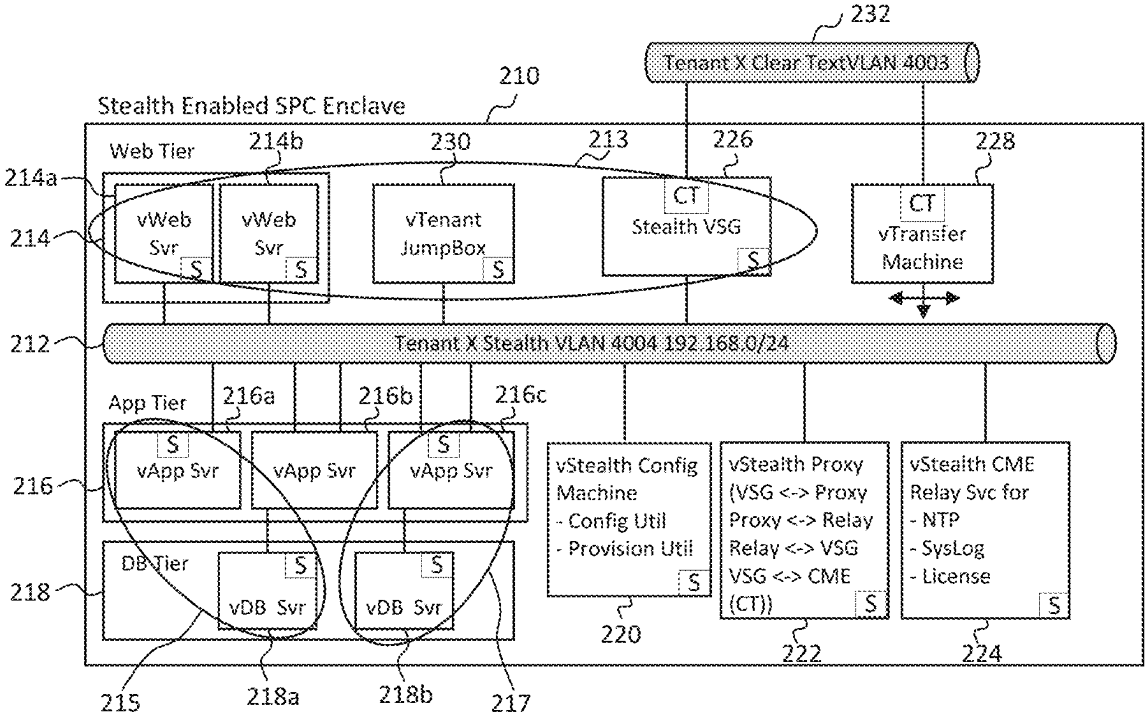

232
Tenant X Clear TextVLAN 4003
Stealth Enabled SPC Enclave
210
Web Tier
214a
214b
230
213
226
228
214
vWeb Svr
S
vWeb Svr
S
vTenant JumpBox
S
CT
Stealth VSG
S
CT
vTransfer Machine
212
Tenant X Stealth VLAN 4004 192.168.0/24
App Tier
216a
216b
216c
216
S
vApp Svr
vApp Svr
S
vApp Svr
vStealth Config Machine
- Config Util
- Provision Util
S
vStealth Proxy (VSG <-> Proxy Proxy <-> Relay Relay <-> VSG VSG <-> CME (CT))
S
vStealth CME Relay Svc for
- NTP
- SysLog
- License
S
218
DB Tier
S
vDB Svr
S
vDB Svr
220
222
224
215
218a
218b
217

Figure 3

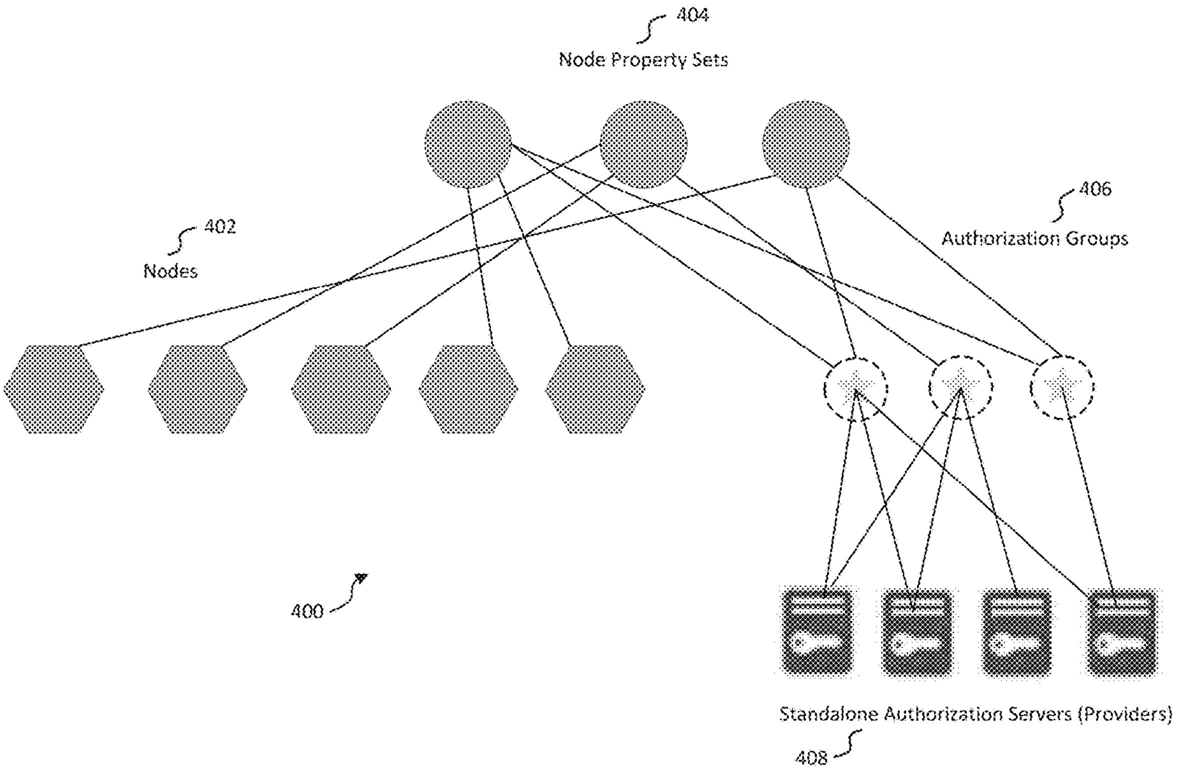

404
Node Property Sets
402
Nodes
406
Authorization Groups
400
Standalone Authorization Servers (Providers)
408

Figure 4

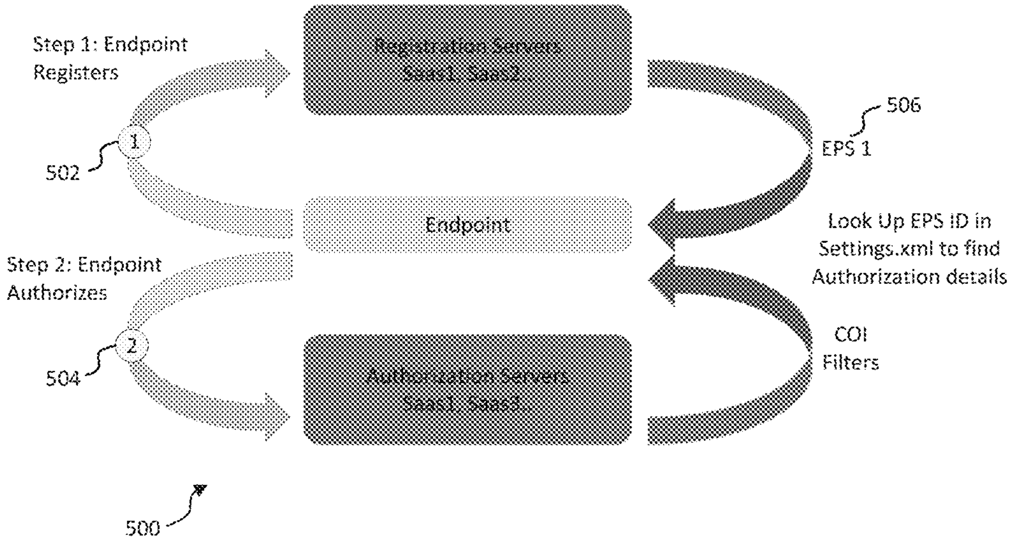

Step 1: Endpoint Registers
Registration Servers
Saas1, Saas2...
506
EPS 1
1
502
Endpoint
Look Up EPS ID in Settings.xml to find Authorization details
Step 2: Endpoint Authorizes
2
504
COI
Filters
Authorization Servers
Saas1, Saas3...
500

Figure 5

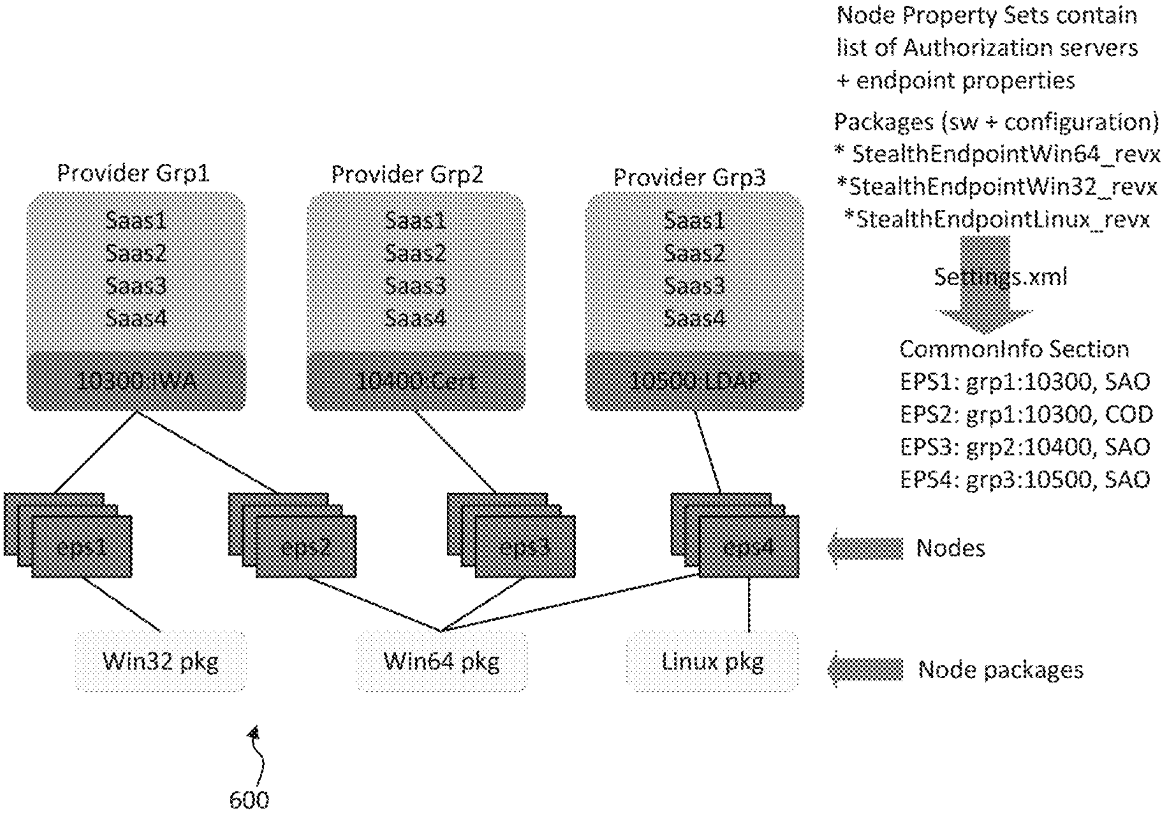
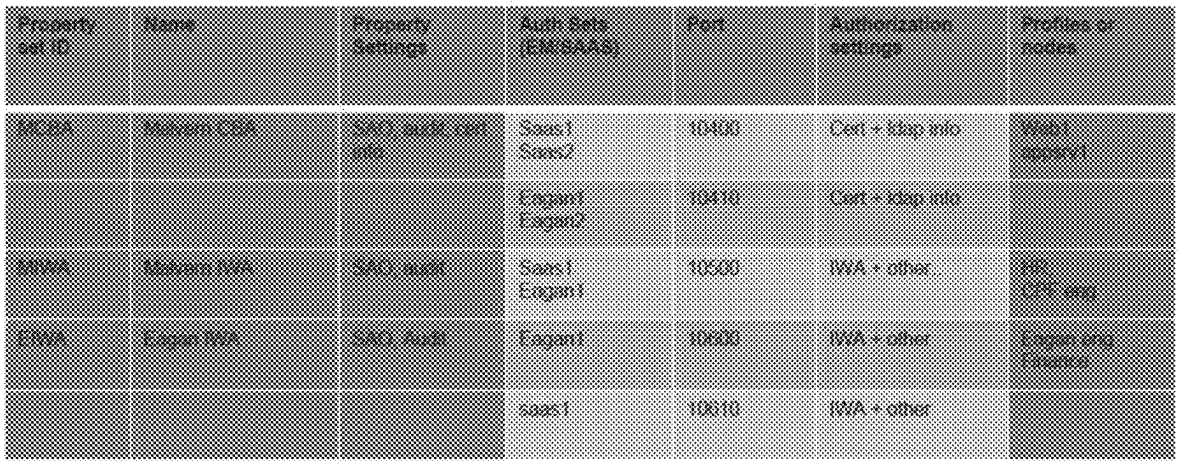

Node Property Sets contain
list of Authorization servers
+ endpoint properties
Packages (sw + configuration)
* StealthEndpointWin64_revx
*StealthEndpointWin32_revx
*StealthEndpointLinux_revx
Settings.xml
CommonInfo Section
EPS1: grp1:10300, SAO
EPS2: grp1:10300, COD
EPS3: grp2:10400, SAO
EPS4: grp3:10500, SAO
Provider Grp1
Saas1
Saas2
Saas3
Saas4
10300:IWA
Provider Grp2
Saas1
Saas2
Saas3
Saas4
10400:Cert
Provider Grp3
Saas1
Saas2
Saas3
Saas4
10500:LDAP
eps1
eps2
eps3
eps4
Nodes
Win32 pkg
Win64 pkg
Linux pkg
Node packages
600

Figure 6



Property set ID	Name	Property Settings	Auth Sets (EM/SAAS)	Port	Authorization settings	Profiles or nodes
MCBA	Malvern CBA	SAO, audit, cert info	Saas1 Saas2	10400	Cert + ldap info	Web1 apsvr1
			Eagan1 Eagan2	10410	Cert + ldap info	
MIWA	Malvern IWA	SAO, audit	Saas1 Eagan1	10500	IWA + other	HR, CFP eng
EIWA	Eagan IWA	SAO, Audit	Eagan1	10600	IWA + other	Eagan eng Finance
			saas1	10610	IWA + other	

Property settings include: audit, type (sao, cod, etc), tunnel priority, cert name and type
Authorization settings include: auth method + other settings, authservice config info as needed

700

Figure 7

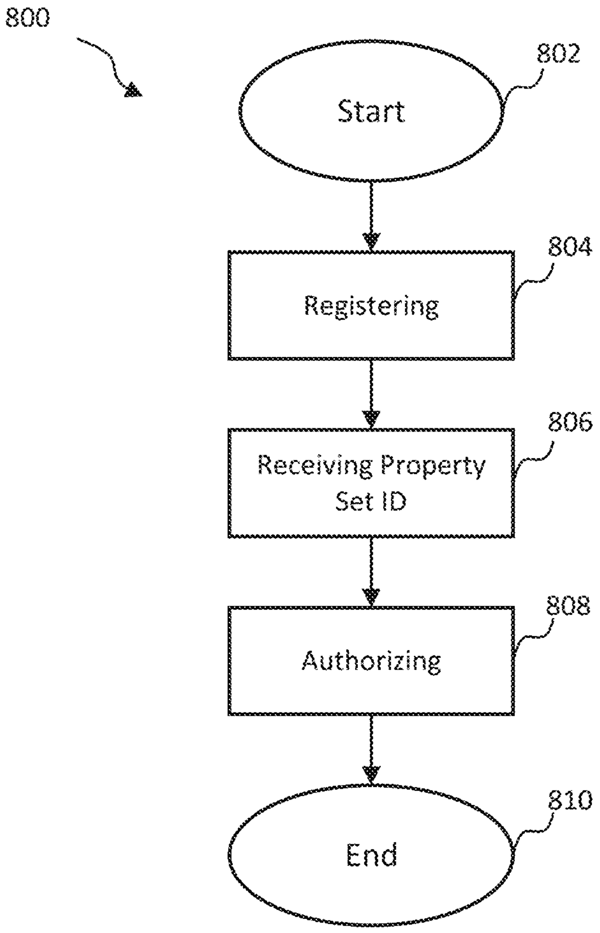

800
802
Start
804
Registering
806
Receiving Property Set ID
808
Authorizing
810
End

Figure 8

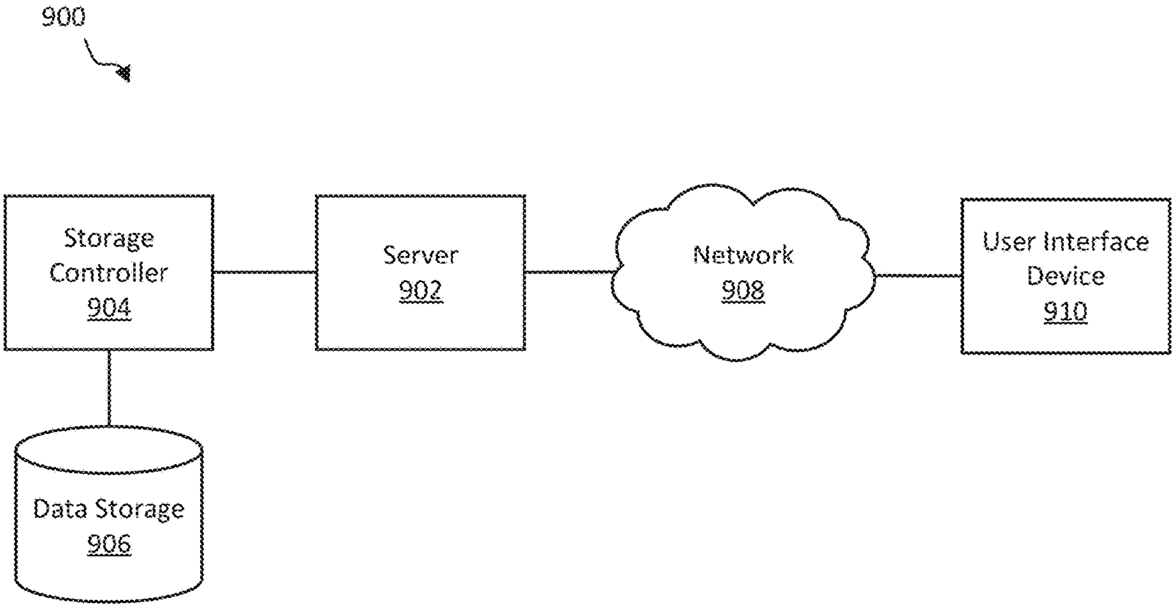

900
Storage Controller 904
Server 902
Network 908
User Interface Device 910
Data Storage 906

Figure 9

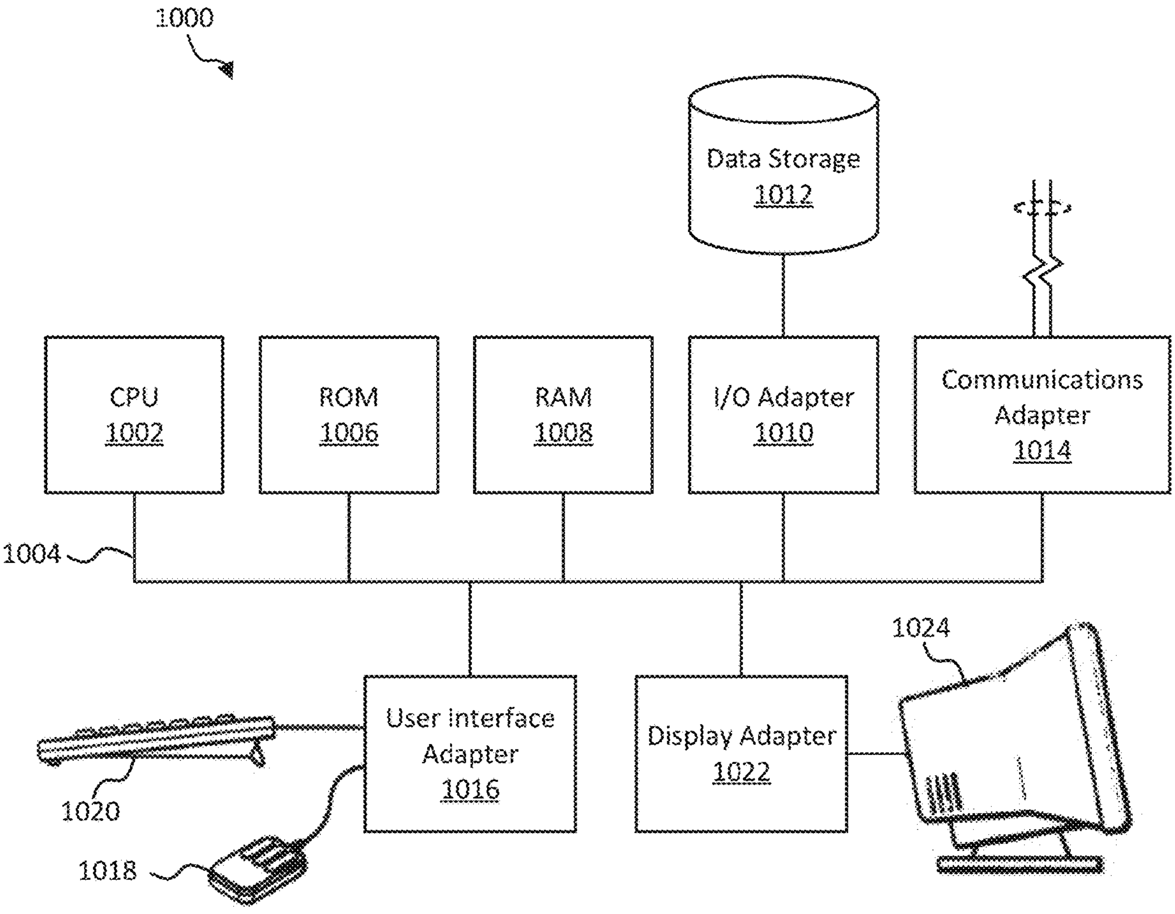

1000
Data Storage
1012
CPU
1002
ROM
1006
RAM
1008
I/O Adapter
1010
Communications
Adapter
1014
1004
1024
User interface
Adapter
1016
Display Adapter
1022
1020
1018

Figure 10

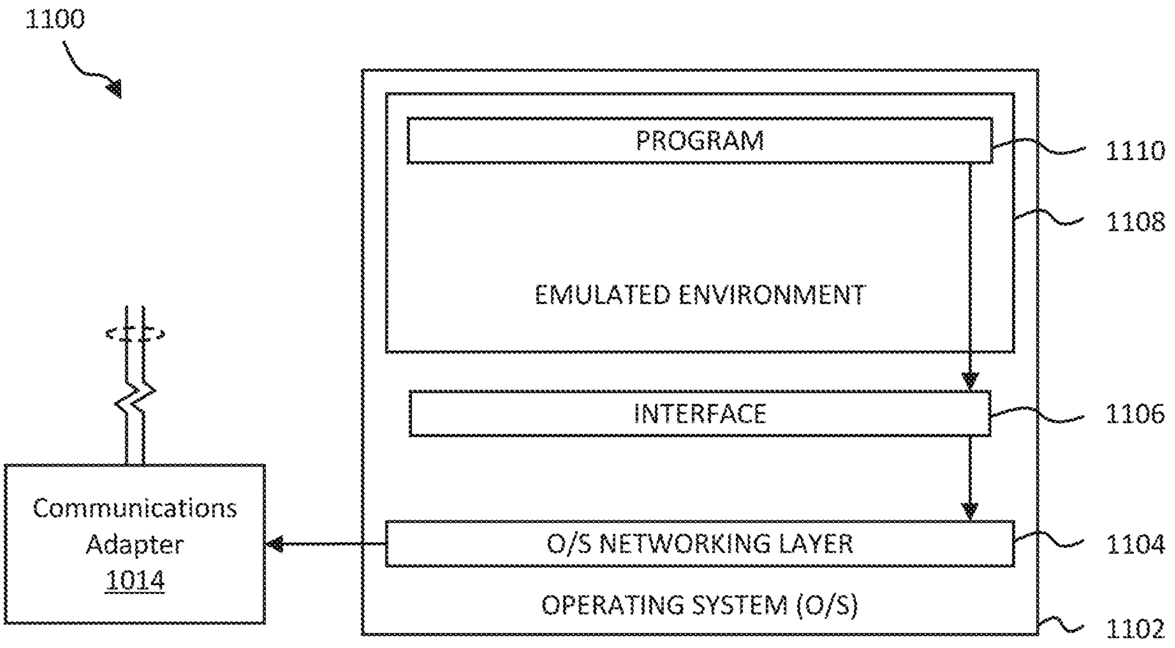


Figure 11A

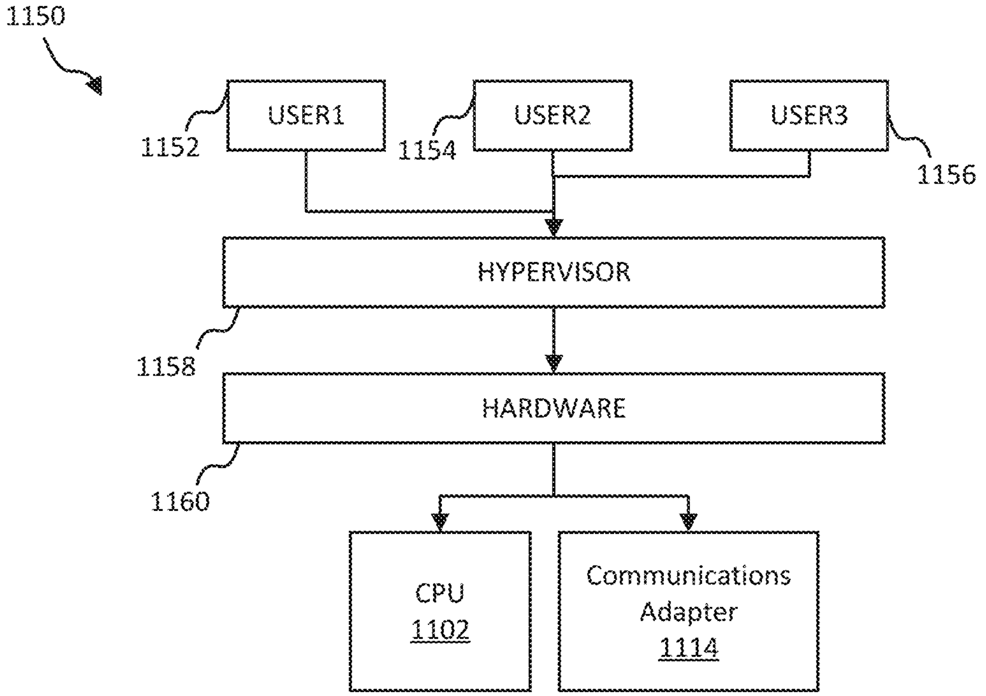


Figure 11B

NETWORK MODEL UTILIZING PROPERTY SETS

FIELD OF THE DISCLOSURE

The present application relates generally to creating secure endpoints on a network. The present application also relates to property sets for endpoints and generic endpoint packages.

BACKGROUND

Robust enterprise security software is complex. The complexity of enterprise security software increases with the level of security required. For example, in enterprise networks in which data must be secured during intra-network storage and/or transmission, detailed definitions regarding a level of security for each user, types of encryption, permissions, and other policies must be set. Because there are often a large number of computing systems within such an enterprise network, provisioning each system can become so complex as to be time- and cost-prohibitive to install such enterprise security software, or at the very least to exploit its full capabilities. Network visualization products enable an administrator, or user, to more easily configure and deploy network security policies in order to protect a network. A user can easily discover endpoints and communications on the network using a live discovery or existing packet capture files to automatically develop network models. Alternatively, a user can create network models from scratch utilizing network visualization products to design new segments or entire networks.

The administrator of a secure network has to describe authorization parameters and the associated authorization servers. Information to guide the endpoint during the period prior to authorization was also described. The packages, which contain both configuration information and software, are manually maintained and mapped to individual servers in the secure network. This results in an administrative burden of manually tracking which server needed which version and ensuring endpoints were running the desired levels of software and configuration. Another drawback to the current implementation is that there are many different packages adding to the administrative burden. Therefore, improvements in the area of change management and deployment are desirable.

SUMMARY

In a first aspect, a network model includes nodes, node property sets, authorization groups and authorization servers. The node property sets define how the nodes operate and authenticate. The nodes are member of the node property sets. The authorization groups are associated with the node property set. And, authorization servers are member of the authorization groups.

In a second aspect, a network model in a secure network environment has at least one community of interest. The network model includes at least one node being a member of a node property set that defines how the node operates and authenticates.

The foregoing has outlined rather broadly the features, technical advantages, and process of the present invention in an order that the detailed description of this invention may be better understood. Additional features and advantages of the invention described hereinafter form the subject of the claims for the invention. It should be appreciated by those skilled in the art that the conception and specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes and intentions of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims. The novel features that are believed to be characteristic of the invention, both as to its organization and method of operation, together with further objects and advantages will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures are provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present invention.

BRIEF DESCRIPTION OF THE FIGURES

For a more complete understanding of the disclosed system and methods, reference is now made to the following descriptions taken in conjunction with the accompanying drawings.

FIG. **1** is a block diagram illustrating an encrypted enclave of virtual machines organized into communities-of-interest, according to one embodiment of the present invention;

FIG. **2** is a is a block diagram illustrating a network implementing communities-of-interest, according to one embodiment of the present invention;

FIG. **3** is a block diagram illustrating an enclave included in the network of FIG. **2**;

FIG. **4** is an illustration of a property set, according to one example embodiment of the present invention;

FIG. **5** is an illustration of registration and authorization, according to one example embodiment of the present invention.

FIG. **6** is an illustration of generic endpoint packages, according to one example embodiment of the present invention;

FIG. **7** is an illustration of an endpoint property set configuration information, according to one example embodiment of the present invention;

FIG. **8** is a flow diagram of a method, according to one example embodiment of the present invention.

FIG. **9** is a block diagram illustrating a computer network, according to one example embodiment of the present invention;

FIG. **10** is a block diagram illustrating a computer system, according to one example embodiment of the present invention;

FIG. **11**A is a block diagram illustrating a server hosting an emulated software environment for virtualization, according to one example embodiment of the present invention; and

FIG. **11**B is a block diagram illustrating a server hosting an emulated hardware environment, according to one example embodiment of the present invention.

DETAILED DESCRIPTION

Stealth enterprise security solution from Unisys Corporation of Blue Bell, Pennsylvania can be used to implement features of the present disclosure. Unisys's Stealth Suite includes both Stealth(core) ("Stealth") and Stealth(aware). Stealth reduces attack surfaces in a network environment by creating dynamic, identity-driven microsegments called communities-of-interest. Micro segmentation is a security strategy that segments a network into smaller elements and manages them with IT security policies. By establishing secure community-of-interest, Stealth separates trusted devices, users and data from unknown or untrusted devices. It can further reduce attack surfaces by encrypting all communication between Stealth protected devices and cloaking the devices from unauthorized or unknown users. Micro segmentation divides a physical network into multiple logical micro-segments. Only the resources within the micro segment can see and communicate with one another.

For example, virtual or physical machines executing on one or more servers may each be assigned to one or more communities-of-interest. The communities-of-interest may allow an administrator to create logical organizations of virtual machines. A community-of-interest may be defined by a role performed by the virtual machines in the application stack.

Messages or communications within a community-of-interest are encrypted with a key corresponding to the community-of-interest. In this fashion, messages or communications are cryptographically isolated. FIG. **1** is a block diagram illustrating an encrypted enclave of virtual machines organized into communities-of-interest according to one example embodiment of the present disclosure. A network **100** may include a network bus **130** serving an enclave **104**. The bus **130** may couple virtual machines **108***a-e* within the enclave **104**. Each of the virtual machines **108***a-e* may communicate through encrypted communications carried on the bus **130**. A virtual gateway **106** may be coupled to the bus **130** to provide communications from the enclave **104** to external devices, such as a client **110** and/or other public networks, such as the Internet. The client **110** may be a remote device, such as a personal computer or mobile device. The client **110** may be connected to the virtual gateway **106** through a secured tunnel, such that the communications between the client **110** and the virtual gateway **106** are encrypted similar to the encrypted communications on the bus **130**.

The virtual machines **108***a-e* may be assigned to one or more communities-of-interest. For example, the virtual machines **108***a*, **108***c*, and **108***e* may be assigned to community-of-interest **124**. Virtual machines **108***d* and **108***e* may be assigned to community-of-interest **114**. And, virtual machine **108***b* may be assigned to community-of-interest **122**. And, the virtual machine **108***a* and the client **110** may be assigned community-of-interest **116**.

A virtual machine **108***e* may be instructed to transmit a message, or data, to the virtual machine **108***a*. For example, software executing on the virtual machine **108***e* may request data from a database server hosted on the virtual machine **108***d*. When the virtual machine **108***e* receives the message destined for the virtual machine **108***a*, the virtual machine **108***e* may identify a community-of-interest in common between virtual machine **108***e* and virtual machine **108***a*. The community-of-interest **124** may be identified and a key associated with community-of-interest **124** may be used to encrypt the message.

The community-of-interest organization of virtual machines may be implemented in a computer network to provide cryptographic isolation of virtual machines. FIGS. **2** and **3** are block diagrams illustrating a network implementing communities-of-interest according to one embodiment of the disclosure. A network **200** may include an enclave **210**. According to one embodiment, the enclave **210** may belong to a single tenant of the network **200**. In other embodiments, the enclave **210** may be shared between tenants.

Communities-of-interest may be configured for a web tier **214**, an application tier **216**, and a database tier **218**. The web tier **214** may include a number of web servers **214***a-b*, the application tier **216** may include a number of application servers **216***a-c*, and the database tier **218** may include a number of database servers **218***a-b*. Each of the servers **214***a-b*, **216***a-c*, and **218***a-b* may be a virtual server executing within a virtual machine. Additional communities-of-interest may be defined for infrastructure functions, such as administrative, proxy, application tier management, database tier management, or a jumpbox management. The enclave **210** may also include a jumpbox **230**, a transfer machine **228**, a virtual gateway **226**, a relay **224**, a proxy **222**, and a configuration device **220**, which may also be executing in virtual machines.

Membership of the virtual machines in individual communities-of-interest are shown as numbered circles **213**, **215**, **217**. For example, a community-of-interest **213** may include the servers **214***a-b*, the jumpbox **230** and virtual gateway **226**. According to one embodiment, only virtual machines that share a common community-of-interest may communicate. When the first virtual machine initiates communication with the second virtual machine, the first virtual machine may search for a common community-of-interest between the first and the second virtual machine. If found, a cryptographic session key may be created that is encrypted with a key associated to the common community-of-interest. Thus, only a virtual machine that shares the community-of-interest key may decrypt the session key. All communication between the two virtual machines may be encrypted and decrypted with the session key. Messages within the enclave **210** may be isolated from the rest of the network **200**, because the messages are encrypted with keys that are not available to the rest of the network **200**.

For example, a web server virtual machine **214***a* may be able to communicate with another web server virtual machine **214***b*, because the virtual machines **214***a-b* have the community-of-interest **213** in common. They cannot communicate with the DB tier since the machines **218***a-b* do not have a community-of-interest in common with the virtual machines **214***a-b*.

Each of the devices within the enclave **210** may be coupled to a bus **212**. When a device within the enclave **210** communicates with devices outside the enclave **210**, then messages may be handled by the virtual gateway **226**, which may be coupled to an unencrypted network **232**. According to one embodiment, the virtual gateway **226**, such as a Stealth Gateway, may encrypt and/or decrypt messages between the enclave **210** and the unencrypted network **232**. The network **232** may couple the enclave **210** to other network appliances **234**, such as network address translation (NAT) devices, dynamic host control protocol (DHCP) devices, domain name service (DNS) devices, and the like. The other network appliances **234** may also be executing in virtual machines.

Access to the enclave **210** may be controlled by the virtual gateway **226**. Messages passing through the gateway **226** from the unencrypted, or clear-text, network **232** to the enclave **210** may be encrypted and messages in the other direction may be decrypted by the gateway **226**. According to one embodiment, messages within the enclave **210** may only be transmitted to a virtual machine that has a community-of-interest in common with the gateway **226**. Furthermore, the gateway **226** may be configured to filter messages for a community-of-interest. The filter may allow an administrator to restrict access based on a message's source and/or destination address and/or port. The enclave **210** may also be isolated from other enclaves (not shown) in the network **200**, because only a virtual machine having a common community-of-interest with the gateway **226** may communicate outside of the enclave **210**.

For example, the web servers **214***a-b* may be able to communicate through the gateway **226**, because the web servers **214***a-b* share the community-of-interest **213** with the gateway **226**. In another example, the application servers **216***a-c* and the database servers **218***a-b* may have restricted access through the gateway **226**, because the gateway **226** may filter messages transmitted in the application community-of-interest and the database community-of-interest to only provide access from management devices **244**.

Productivity and innovation require access to IT services on-premises and in the cloud, from any device, in any location globally. Traditional security perimeters are dissolving, increasing the network complexity and making it difficult to keep track of all the activity, especially in regards to security. Stealth(aware) is a network visualization product that enables a user to easily configure and deploy network security policies in order to protect the network. Stealth (aware) allows a user to visually discover endpoints and traffic on the network, as well as communications, using live discovery or existing packet capture files. Additionally, Stealth(aware) enables a user to create new network models from scratch to visualize new environments.

To simplify network complexity, Stealth(aware) automatically groups devices, or Nodes, into Profiles that have similar traffic patterns. Granularity levels are adjusted to balance simplicity and details. With a single click, a network model can be transformed into a model of micro segmentation policies. Stealth(aware) keeps the network view current by refreshing network model to identify policy violations or unwanted and suspicious communications between Nodes. It then allows the network administrator to quickly create and update network security polices to isolate the Node or block the suspicious communication.

In Stealth(aware), when a Project is initially created, a set of predefined Solutions, Profiles, Channels and Flows are automatically created for the user to help with the initial set up of a Stealth Environment. As part of creating these pre-defined objects, a Stealth recommended configuration is provided for the user in order to have a functioning Stealth environment as quickly as possible. Secure endpoint or nodes must also be created.

Stealth(aware) has Property Sets, which is an object associated with nodes that defines who the node authenticates to and how that node operates. Referring to FIG. **4**, the concept of Property Sets **400** is illustrated. Property Sets **400** includes nodes **402** (also referred to as endpoints), node property sets **404**, authorization groups **406** and authorization servers **408**. Nodes **402** are members of a node property set **404**; node property sets **404** are associated with one or more authorization groups **406**; and authorization groups **406** contain one or more standalone authorization servers **408**. An authorization group **406** can be associated with one or more node property sets **404**, and authorization servers **408** can be members of one or more authorization groups **406**.

Referring to FIG. **5**, a node **402** must perform registration **502** before authorization **504**. The node **402** applies a random selection algorithm to choose which authorization server **408** to register to. Once registered, the node **402** receives an endpoint property set ID **506** to get authorized. The endpoint property set ID **506** allows the node **402** to look up its authorization details in a setting file such that it can authorize **504**.

A user can set the Property Set **400** at a Project level (automatically done when the Project is created), at a Solution level (where are member nodes of that Solution are associated with the selected Property Set), at a Profile level (where all member Nodes of that Profile are associated with the selected Property Set) and at a Node level. Property Sets can includes a registration server, Stealth Management Server, Standalone Authorization Server or Default IWA Property Set. Property Set membership uses an inheritance/hierarchy concept. The Project level value is set to a default IWA Property Set. Solutions inherit from the Project level; Profiles inherit from the Solution level; and Nodes inherit from the Profile level. A user can then change the parameters of any given Property Set **400**.

Property Sets **400** abstract the actual Authorization Servers from the network administrator. This enables the Property Sets **400** to be created based on a functional, location or other basis as determined by the network administrator. The user can create, edit, display and delete node property sets **404** and their related fields. The user also creates node property sets **404** for both registration **502** and authorization **504**.

Previously, a user would describe the authorization parameters and the associated authorization servers. Information to guide the node during the authorization was also described. The packages, which contain both configuration information and software were manually maintained and mapped to individual servers.

In this disclosure, the configuration information is consolidated into a single standard configuration, referred to as generic node configuration, which can be used by all nodes **402**. Regardless of Operating System type, the configuration is the same and automatically managed by the software. This greatly reduces the burden of management and distribution of endpoint packages. Referring to FIG. **6**, a generic endpoint package **600** is illustrated. This generic endpoint package **600** is a consolidation of configuration information into a single standard configuration, which can be used by all endpoints. The configuration is applied to each supported software, such as Linux, Windows 32 bit systems and Windows 64 bit systems. Regardless of the OS type, the configuration is the same and automatically managed by the Stealth software. The node configuration is divided into three main sections: node property sets **402**, common-information and registration. The node property sets **402** contain all the authorization information that is used by a particular node **402**. The administrator may define one or more property sets depending on network complexity and needs of the enterprise.

A random hunting algorithm is used such that various nodes **402** start the attempt to authorize at a different place in the list. This provides load balancing of the authorization of nodes **402** between multiple authorization servers **408** without having to define multiple ordered lists to accomplish this. The randomization of this list makes the consolidation of the node package even more generic. A mapping table is maintained by the software where each node is mapped to a node property set **404** as defined by the user.

The common-info section contains the rules to apply to nodes **402** while in service mode and prior to authorization. These rules govern the communication to other Stealth enabled nodes. The registration section includes information to direct the node **402** to pre-defined registration servers as defined by the user. In order for a node to successfully authorize and join the secure network, it must first contact the registration server where its identity is mapped to a property set. Once the property set is known by the node, it can attempt authorization as defined by the generic endpoint configuration.

Updates are sent by node property sets **404** to the nodes **402** that are mapped to them automatically. As the user makes changes, a new version of the node package is generated and distributed as directed by the user. This greatly reduces the burden of managing and creating node packages by the user.

FIG. **7** illustrates a node property set's information **700**. Referring to FIG. **8**, a method **800** of creating secure endpoint on a network is illustrated. The method begins at **802**. At **804**, a node registers using a random selection algorithm to choose which server to register to. At **806**, the node receives a property set ID. At **808**, the node authorizes using the property set ID to look up it authorization information. The method ends at **810**.

FIG. **9** illustrates one embodiment of a system **900** for an information system, which may host virtual machines. The system **900** may include a server **902**, a data storage device **906**, a network **908**, and a user interface device **910**. The server **902** may be a dedicated server or one server in a cloud computing system. The server **902** may also be a hypervisor-based system executing one or more guest partitions. The user interface device **910** may be, for example, a mobile device operated by a tenant administrator. In a further embodiment, the system **900** may include a storage controller **904**, or storage server configured to manage data communications between the data storage device **906** and the server **902** or other components in communication with the network **908**. In an alternative embodiment, the storage controller **904** may be coupled to the network **908**.

In one embodiment, the user interface device **910** is referred to broadly and is intended to encompass a suitable processor-based device such as a desktop computer, a laptop computer, a personal digital assistant (PDA) or tablet computer, a smartphone or other a mobile communication device having access to the network **908**. The user interface device **910** may be used to access a web service executing on the server **902**. When the device **910** is a mobile device, sensors (not shown), such as a camera or accelerometer, may be embedded in the device **910**. When the device **910** is a desktop computer the sensors may be embedded in an attachment (not shown) to the device **910**. In a further embodiment, the user interface device **910** may access the Internet or other wide area or local area network to access a web application or web service hosted by the server **902** and provide a user interface for enabling a user to enter or receive information.

The network **908** may facilitate communications of data, such as dynamic license request messages, between the server **902** and the user interface device **910**. The network **908** may include any type of communications network including, but not limited to, a direct PC-to-PC connection, a local area network (LAN), a wide area network (WAN), a modem-to-modem connection, the Internet, a combination of the above, or any other communications network now known or later developed within the networking arts which permits two or more computers to communicate.

In one embodiment, the user interface device **910** accesses the server **902** through an intermediate sever (not shown). For example, in a cloud application the user interface device **910** may access an application server. The application server may fulfill requests from the user interface device **910** by accessing a database management system (DBMS). In this embodiment, the user interface device **910** may be a computer or phone executing a Java application making requests to a JBOSS server executing on a Linux server, which fulfills the requests by accessing a relational database management system (RDMS) on a mainframe server.

FIG. **10** illustrates a computer system **1000** adapted according to certain embodiments of the server **902** and/or the user interface device **910**. The central processing unit ("CPU") **1002** is coupled to the system bus **1004**. The CPU **1002** may be a general purpose CPU or microprocessor, graphics processing unit ("GPU"), and/or microcontroller. The present embodiments are not restricted by the architecture of the CPU **1002** so long as the CPU **1002**, whether directly or indirectly, supports the operations as described herein. The CPU **1002** may execute the various logical instructions according to the present embodiments.

The computer system **1000** also may include random access memory (RAM) **1008**, which may be synchronous RAM (SRAM), dynamic RAM (DRAM), synchronous dynamic RAM (SDRAM), or the like. The computer system **1000** may utilize RAM **1008** to store the various data structures used by a software application. The computer system **1000** may also include read only memory (ROM) **1006** which may be PROM, EPROM, EEPROM, optical storage, or the like. The ROM may store configuration information for booting the computer system **1000**. The RAM **1008** and the ROM **1006** hold user and system data, and both the RAM **1008** and the ROM **1006** may be randomly accessed.

The computer system **1000** may also include an input/output (I/O) adapter **1010**, a communications adapter **1014**, a user interface adapter **1016**, and a display adapter **1022**. The I/O adapter **1010** and/or the user interface adapter **1016** may, in certain embodiments, enable a user to interact with the computer system **1000**. In a further embodiment, the display adapter **1022** may display a graphical user interface (GUI) associated with a software or web-based application on a display device **1024**, such as a monitor or touch screen.

The I/O adapter **1010** may couple one or more storage devices **1012**, such as one or more of a hard drive, a solid state storage device, a flash drive, a compact disc (CD) drive, a floppy disk drive, and a tape drive, to the computer system **1000**. According to one embodiment, the data storage **1012** may be a separate server coupled to the computer system **1000** through a network connection to the I/O adapter **1010**. The communications adapter **1014** may be adapted to couple the computer system **1000** to the network **908**, which may be one or more of a LAN, WAN, and/or the Internet. The communications adapter **1014** may also be adapted to couple the computer system **1000** to other networks such as a global positioning system (GPS) or a Bluetooth network. The user interface adapter **1016** couples user input devices, such as a keyboard **1020**, a pointing device **1018**, and/or a touch screen (not shown) to the computer system **1000**. The keyboard **1020** may be an on-screen keyboard displayed on a touch panel. Additional devices (not shown) such as a camera, microphone, video camera, accelerometer, compass, and or gyroscope may be coupled to the user interface adapter **1016**. The display adapter **1022** may be driven by the CPU **1002** to control the display on the display device **1024**. Any of the devices **1002-1022** may be physical and/or logical.

The applications of the present disclosure are not limited to the architecture of computer system **1000**. Rather the computer system **1000** is provided as an example of one type of computing device that may be adapted to perform the functions of a server **902** and/or the user interface device

910. For example, any suitable processor-based device may be utilized including, without limitation, personal data assistants (PDAs), tablet computers, smartphones, computer game consoles, and multi-processor servers. Moreover, the systems and methods of the present disclosure may be implemented on application specific integrated circuits (ASIC), very large scale integrated (VLSI) circuits, or other circuitry. In fact, persons of ordinary skill in the art may utilize any number of suitable structures capable of executing logical operations according to the described embodiments. For example, the computer system **1000** may be virtualized for access by multiple users and/or applications.

FIG. **11**A is a block diagram illustrating a server hosting an emulated software environment for virtualization according to one embodiment of the disclosure. An operating system **1102** executing on a server includes drivers for accessing hardware components, such as a networking layer **1104** for accessing the communications adapter **1014**. The operating system **1102** may be, for example, Linux. An emulated environment **1108** in the operating system **1102** executes a program **1110**, such as CPCommOS. The program **1110** accesses the networking layer **1104** of the operating system **1102** through a non-emulated interface **1106**, such as XNIOP. The non-emulated interface **1106** translates requests from the program **1110** executing in the emulated environment **1108** for the networking layer **1104** of the operating system **1102**.

In another example, hardware in a computer system may be virtualized through a hypervisor. FIG. **11**B is a block diagram illustrating a server hosting an emulated hardware environment according to one embodiment of the disclosure. Users **1152**, **1154**, **1156** may access the hardware **1160** through a hypervisor **1158**. The hypervisor **1158** may be integrated with the hardware **1160** to provide virtualization of the hardware **1160** without an operating system, such as in the configuration illustrated in FIG. **11**A. The hypervisor **1158** may provide access to the hardware **1160**, including the CPU **1002** and the communications adaptor **1014**.

If implemented in firmware and/or software, the functions described above may be stored as one or more instructions or code on a computer-readable medium. Examples include non-transitory computer-readable media encoded with a data structure and computer-readable media encoded with a computer program. Computer-readable media includes physical computer storage media. A storage medium may be any available medium that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can comprise RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to store desired program code in the form of instructions or data structures and that can be accessed by a computer. Disk and disc includes compact discs (CD), laser discs, optical discs, digital versatile discs (DVD), floppy disks and blu-ray discs. Generally, disks reproduce data magnetically, and discs reproduce data optically. Combinations of the above should also be included within the scope of computer-readable media.

In addition to storage on computer readable medium, instructions and/or data may be provided as signals on transmission media included in a communication apparatus. For example, a communication apparatus may include a transceiver having signals indicative of instructions and data. The instructions and data are configured to cause one or more processors to implement the functions outlined in the claims.

Although the present disclosure and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the spirit and scope of the disclosure as defined by the appended claims. Moreover, the scope of the present application is not intended to be limited to the particular embodiments of the process, machine, manufacture, composition of matter, means, methods and steps described in the specification. As one of ordinary skill in the art will readily appreciate from the present invention, disclosure, machines, manufacture, compositions of matter, means, methods, or steps, presently existing or later to be developed that perform substantially the same function or achieve substantially the same result as the corresponding embodiments described herein may be utilized according to the present disclosure. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, or steps.

We claim:

1. A network model comprising:

node property sets that include nodes and define how nodes operate and authenticate, wherein the node property sets contain a list of authorization servers and node properties;

authorization groups that contain authentication servers associated with the node property sets;

authorization servers that is a combination of hardware and software, which are members of the authorization groups;

nodes, which are devices including endpoints and are members of the node property sets, authorize as secure nodes in the network by registering to a registration server and receiving a node property set ID, performing a random selection algorithm based on a node configuration of the nodes to choose an authorization server from the list of authorization servers contained in the node property set that includes the nodes and define how the nodes operate and authenticate to provide-authorization of the node, using the node property set ID to access authorization information from the node property set associated with the node property set ID and authorize using the authorization information associated with the node property set ID, wherein the random selection algorithm causes each node to authorize at a randomly selected authorization server based on the random selection algorithm performed by the node.

2. The model according to claim **1**, wherein updates are provided to the node property sets, which are mapped to the nodes automatically.

3. The model according to claim **1**, wherein authorization groups can be associated with more than one property set.

4. The model according to claim **3**, wherein authorization servers can be member of more than one authorization group.

5. The model according to claim **1**, wherein a node's membership in a property set uses an inheritance or hierarchy concept.

6. The model according to claim **1**, wherein the node properties include audit, type, tunnel priority, cert name and type.

7. The model according to claim **1**, wherein the nodes are members of at least one community of interest in a secure network environment.

8. A network model in a secure network environment having at least one community of interest, the network model comprising:

at least one node that is a device including an endpoint being a member of a node property set that includes nodes and defines how the at least one node operates and authenticates; and the node registering to a registration server and receiving a node property set ID, applying a random selection algorithm based on a node configuration of the nodes to choose which authentication server that is a combination of hardware and software from a list of authorization servers contained in the node property set that includes the nodes and define how the nodes operate and authenticate to provide authorization of the node, use the node property set ID to access authorization information from the node property set associated with the node property set ID and authorize using the authorization information associated with the node property set ID, wherein the random selection algorithm causes each node to authorize at a randomly selected authorization server based on the random selection algorithm performed by the node, and wherein the node property sets contain the list of authorization servers and node properties.

9. The network model of claim **8**, wherein the node inherits rules on how the node operates from the property set and instructions on how to authenticate.

10. The network model of claim **9**, wherein updates to the property set automatically promulgate to the node.

11. The network model of claim **10**, further comprising:

at least one authorization group associated with the node property set; and

at least one authorization server, which is a member of the authorization group.

12. The network model of claim **11**, wherein the at least one authorization group can be associated with more than one property set.

13. The network model of claim **12**, wherein the at least one authorization server can be associated with more than one authorization group.

14. The network model of claim **13**, wherein the at least one node is a member of the at least one community of interest.

15. The network model of claim **14**, wherein the at least one node is a member of more than one community of interest.

16. The network model of claim **15**, wherein the at least one authentication server is a member of the at least one community of interest.

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