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(54) **CLIENT-CLIENT-SERVER AUTHENTICATION**

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H04L 9/32 (2006.01)

(52) **U.S. Cl.**
CPC ***H04L 9/3268*** (2013.01)

(58) **Field of Classification Search**
USPC 726/10
See application file for complete search history.

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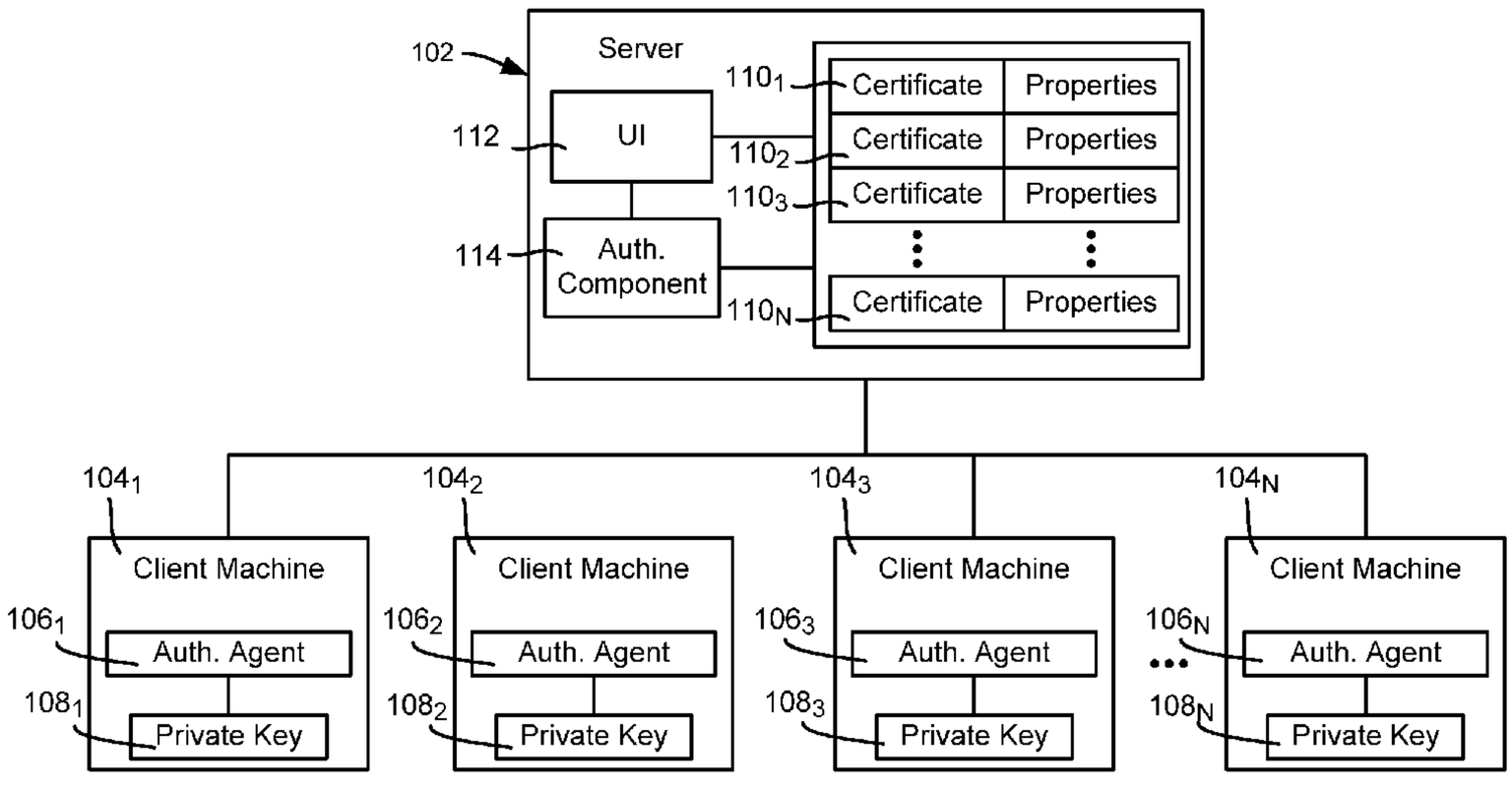
(57) **ABSTRACT**

Described is a technology by which machines of a (typically small) network have associated public key-based certificates for use in authentication with a server and validation of other machines in the network. This provides an inexpensive and straightforward mechanism to control, manage and maintain client machines, as well as to allow valid client machines to securely communicate with one another and recognize machines that are not valid on the network. Certificates are maintained on the server and checked for validity as needed.

19 Claims, 4 Drawing Sheets



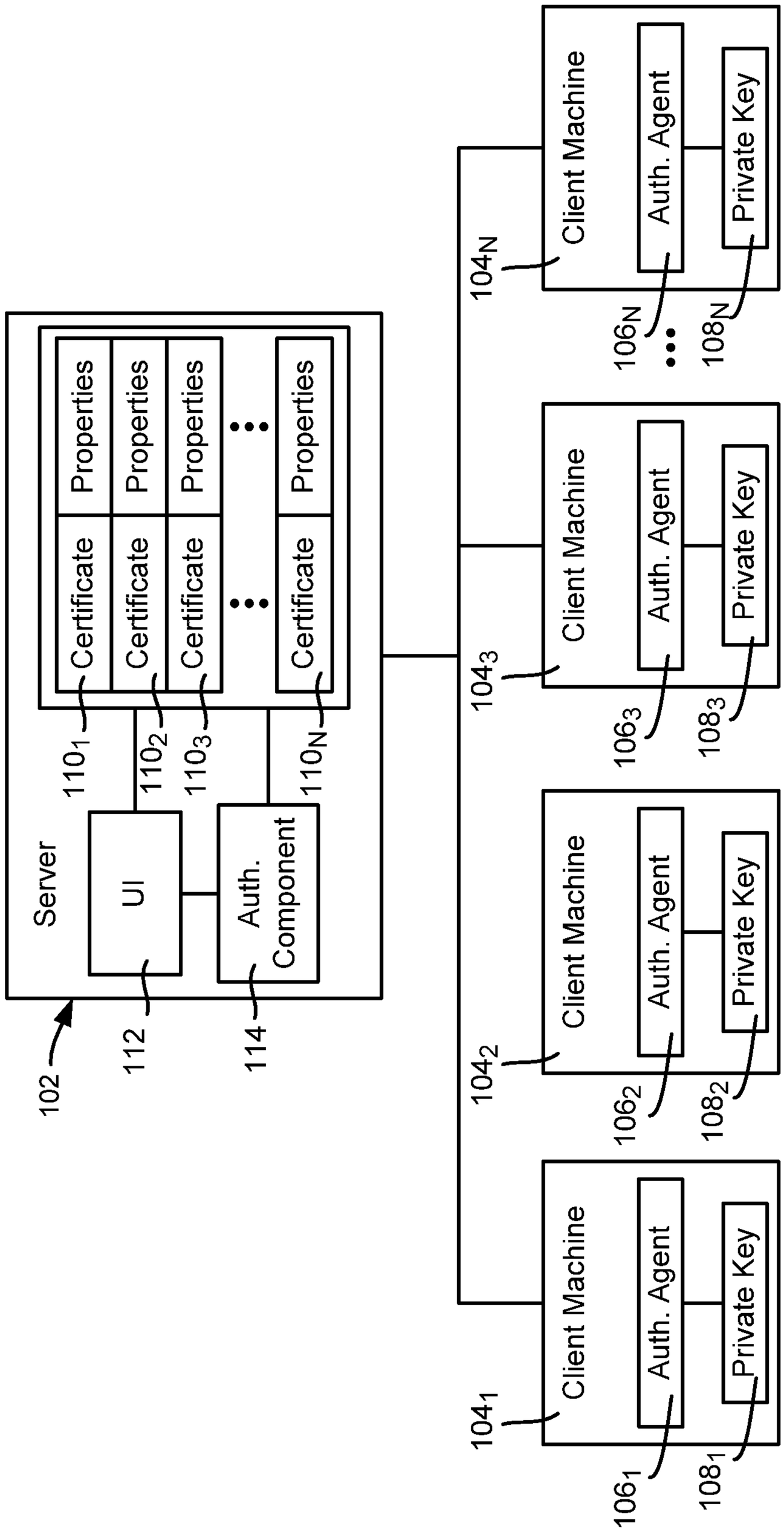

Server
Certificate
Properties
110_1
110_2
110_3
110_N
UI
Auth. Component
102
112
114
Client Machine
Auth. Agent
Private Key
104_1
104_2
104_3
104_N
106_1
106_2
106_3
106_N
108_1
108_2
108_3
108_N

FIG. 1

FIG. 2

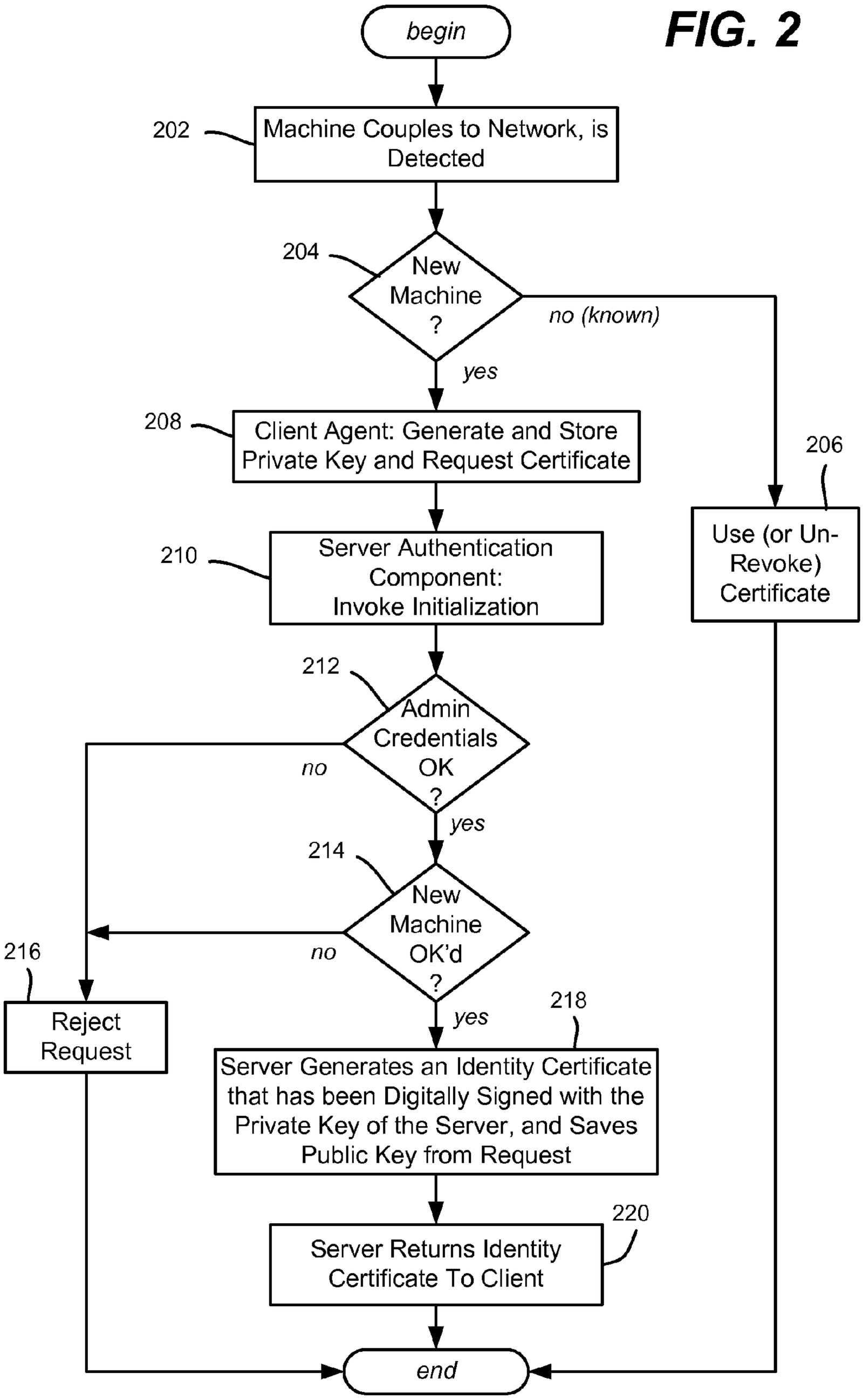
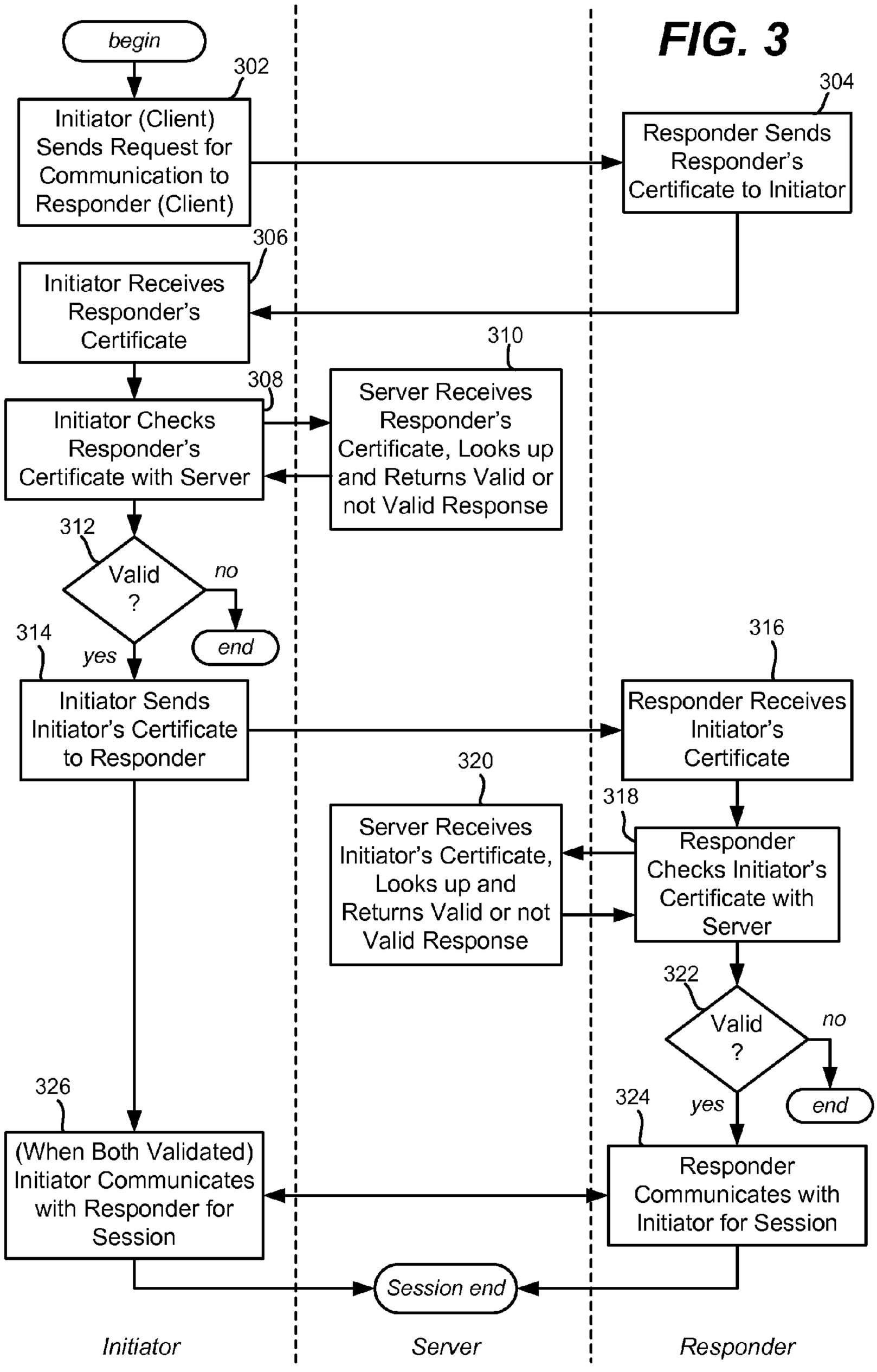

begin
202
Machine Couples to Network, is Detected
204
New Machine ?
no (known)
yes
206
Use (or Un-Revoke) Certificate
208
Client Agent: Generate and Store Private Key and Request Certificate
210
Server Authentication Component: Invoke Initialization
212
Admin Credentials OK ?
no
yes
214
New Machine OK'd ?
no
yes
216
Reject Request
218
Server Generates an Identity Certificate that has been Digitally Signed with the Private Key of the Server, and Saves Public Key from Request
220
Server Returns Identity Certificate To Client
end

FIG. 3


begin
302
Initiator (Client) Sends Request for Communication to Responder (Client)
304
Responder Sends Responder's Certificate to Initiator
306
Initiator Receives Responder's Certificate
310
Server Receives Responder's Certificate, Looks up and Returns Valid or not Valid Response
308
Initiator Checks Responder's Certificate with Server
312
Valid ?
no
end
314
yes
Initiator Sends Initiator's Certificate to Responder
316
Responder Receives Initiator's Certificate
320
Server Receives Initiator's Certificate, Looks up and Returns Valid or not Valid Response
318
Responder Checks Initiator's Certificate with Server
322
Valid ?
no
end
324
yes
Responder Communicates with Initiator for Session
326
(When Both Validated) Initiator Communicates with Responder for Session
Session end
Initiator
Server
Responder

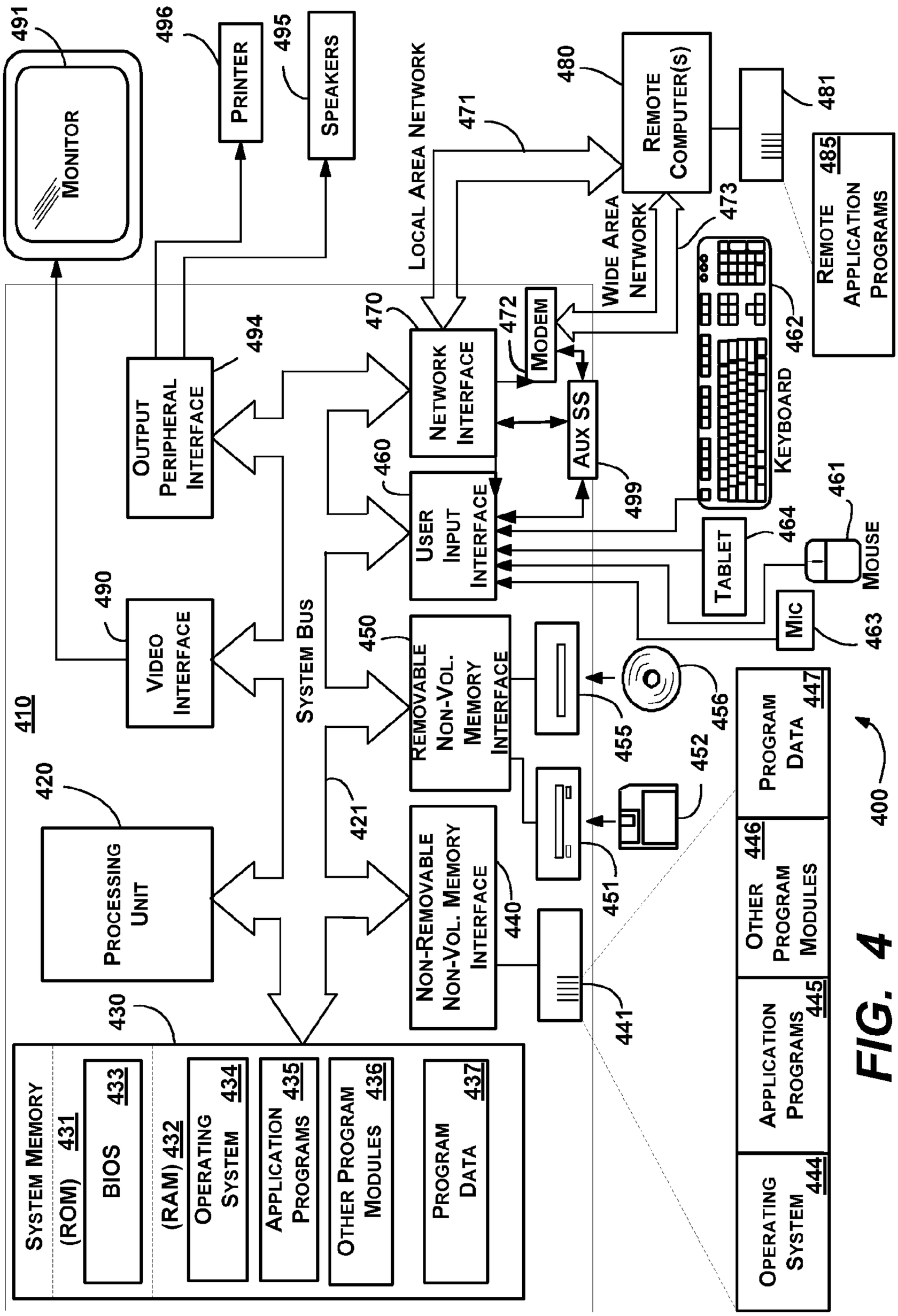

400
410
420
PROCESSING UNIT
421
SYSTEM BUS
430
SYSTEM MEMORY
(ROM) 431
BIOS 433
(RAM) 432
OPERATING SYSTEM 434
APPLICATION PROGRAMS 435
OTHER PROGRAM MODULES 436
PROGRAM DATA 437
VIDEO INTERFACE 490
OUTPUT PERIPHERAL INTERFACE 494
NETWORK INTERFACE 470
USER INPUT INTERFACE 460
REMOVABLE NON-VOL. MEMORY INTERFACE 450
NON-REMOVABLE NON-VOL. MEMORY INTERFACE 440
MODEM 472
AUX SS 499
MONITOR 491
PRINTER 496
SPEAKERS 495
LOCAL AREA NETWORK 471
WIDE AREA NETWORK 473
REMOTE COMPUTER(S) 480
MEMORY 481
REMOTE APPLICATION PROGRAMS 485
KEYBOARD 462
TABLET 464
MOUSE 461
MIC 463
455
456
452
451
441
PROGRAM DATA 447
OTHER PROGRAM MODULES 446
APPLICATION PROGRAMS 445
OPERATING SYSTEM 444

FIG. 4

CLIENT-CLIENT-SERVER AUTHENTICATION

BACKGROUND

Small computer networks such as found in small businesses or homes typically do not have the facilities of larger networks, e.g., based upon technology such as domains, Active Directory® and so forth. Further, the machines in small networks may run on various platforms, including operating systems from different vendors and/or having different versions, and may be of different types (e.g., laptops, personal computers, smartphones and other devices).

As a result, concepts such as authentication that facilitate control, management, maintenance and the like of the network's machines are not straightforward to implement in a small network. What is desirable is a solution for providing a unified way to authenticate machines as valid and trusted, such as to control, manage and maintain a machine of basically any platform in the local network or Internet, and to facilitate trusted communication between machines.

SUMMARY

This Summary is provided to introduce a selection of representative concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used in any way that would limit the scope of the claimed subject matter.

Briefly, various aspects of the subject matter described herein are directed towards a technology by which certificate technology is used to authenticate client machines on a network, including to allow client machines to securely communicate with one another. In one aspect, an "initiator" client machine that wants to communicate with another "responder" client machine needs to validate the responder client machine, and vice-versa, to provide secure communication. The initiator client and responder client each provide (e.g., separately) each provide each other's certificate to a server. The server determines (e.g., by a lookup) whether each certificate is valid and returns a response to each. If the initiator knows that the responder's certificate is valid, and vice-versa, they may establish a secure communication session.

In one implementation, the server maintains an instance of the initiator certificate and an instance of the responder certificate, (along with any other client certificates). Each certificate associated with a client machine includes a public key that corresponds to a private key maintained at that client device. The server also maintains property data associated with each certificate, e.g., located by using the public key as a search key to the index.

In one aspect, the private key is generated when a machine initially couples to the network, with the certificate including the public key created based upon instructions of an administrator with appropriate credentials. In this way, only a machine that the administrator desires to add to the network has a valid certificate in the network. An administrator may revoke and un-revoke a certificate as desired.

Other advantages may become apparent from the following detailed description when taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is illustrated by way of example and not limited in the accompanying figures in which like reference numerals indicate similar elements and in which:

FIG. **1** is a block diagram showing example components of a network in which certificates are used for authentication of the network machines.

FIG. **2** is a flow diagram representing example steps that may be taken when coupling a new machine to a network to facilitate authentication.

FIG. **3** is a flow diagram representing example steps that may be taken to validate machines for client-to-client communication, including using server-based authentication.

FIG. **4** is a block diagram representing an exemplary computing environment into which aspects of the subject matter described herein may be incorporated.

DETAILED DESCRIPTION

Various aspects of the technology described herein are generally directed towards an authentication/validation technology useful in a small network, in which a server maintains certificate data and property information for each valid client machine. The client machines each use private-public key technology to authenticate with the server, and to communicate with the server, including checking received certificate data so that each client device knows whether another client device is valid. As will be understood, the technology described herein thus provides a platform-independent way to facilitate control, management and maintenance of network machine, as well as authenticated (secure/trusted) communication between any client machines.

Using certificate authentication, a unique certificate (e.g., including a GUID) is deployed to a client machine on a local network or the Internet. When one client machine communicates with any other client machine, the certificate is used to identify the clients to each other, creating mutual security between the machines. As can be readily appreciated, with this technology, centralization for viewing, patching, controlling, backup, file restore and bare metal restore the client cross the network and operating system platform may be securely employed. Using certificate authentication, communication for management or general communication between clients or server to client or client to server may be maintained independent of which operating system is running on a given client, and/or regardless where the client is based (e.g., local network or Internet). The server on the network offers a root certificate to the clients to which the server connects, which are available for connection both locally and on the Internet to validate the authenticity of the certificate for mutual authentication.

It should be understood that any of the examples herein are non-limiting. As such, the present invention is not limited to any particular embodiments, aspects, concepts, structures, functionalities or examples described herein. Rather, any of the embodiments, aspects, concepts, structures, functionalities or examples described herein are non-limiting, and the present invention may be used various ways that provide benefits and advantages in data communications in general.

FIG. **1** shows a block diagram in which a server **102** is coupled to a plurality of client machines $\mathbf{104}_1$-$\mathbf{104}_n$. The client machines $\mathbf{104}_1$-$\mathbf{104}_n$ may be connected through a local area network connection or an internet connection. The client machines $\mathbf{104}_1$-$\mathbf{104}_n$ may be individually based upon any suitable platform including the same and/or different operating system vendors and/or versions, and may be different types of machines, such as personal computers, smartphones, game consoles and the like.

The server **102** may comprise one or more machines (physical or virtual), and a single physical machine may be configured to contain the server (or part thereof) as well as

one more client machines, e.g., via virtual machine technology. The server **102** or any part thereof may be implemented remotely, e.g., as a "cloud" server or part of a "cloud" service.

As generally represented in the example steps of FIG. **2**, when each client machine is attached to the network, at steps **202** and **204** the machine is detected by a service or the like, e.g., running on the server. Any machine is detected, including one that is determined to be a new machine that is not valid on the network. Note that if recognized as an existing machine via a valid certificate, at step **206** its certificate may be used for authentication if valid, or if revoked (as described below), may be un-revoked as decided by an administrator.

As represented via step **208**, a client agent running on the new machine (e.g., authentication agent $\mathbf{106}_1$) generates and stores a private key $\mathbf{108}_1$ (e.g., comprising a GUID), and requests a certificate from the network server **102** based upon the client's corresponding public key provided in association with the request. At generally the same time, in response to detection of a new machine, at step **210** the service provides an administrator with a user interface **112** that allows the administrator to provide administrator credentials and specify that the machine is valid on the network (or reject it as not valid as decided by the administrator). For example, the service may use an authentication component **114** that includes the user interface **112**. The administrator thus may be interacting with the server **102** directly, (or possibly through a valid client machine's remote server connection or the like), e.g., via a console or pop-up user interface included in the authentication component **114**, which indicates that a new machine has been attached and is requesting validation. The administrator alternatively may be operating on the new client machine (e.g., $\mathbf{104}_1$), in which event an initialization program (e.g., part of the authentication agent $\mathbf{106}_1$) may be used in conjunction with the server authentication component **114** to verify the administrator's credentials with the server.

As represented via step **212**, administrator credentials are checked such that rogue users are rejected, thus preventing a malicious user or the like from joining a machine to the network simply by wirelessly (or even via wired) coupling a machine to the network. At step **214**, the administrator may also reject (step **216**) a request to join; (typically in a small network the administrator will be adding the new machine personally or by close personal communication with the person doing so, and will know when a proper machine is being added).

As described above with respect to step **208**, as part of initialization, the client machine generates a private key (e.g., a GUID) and maintains it locally. A corresponding public key (e.g., a GUID) is maintained on the server **102**, where in one implementation the server **102** includes the public key within an instance of a certificate (e.g., $\mathbf{110}_1$, FIG. **1**) associated with that client machine $\mathbf{104}_1$ (steps **218** and **220**). The private and public keys may thereafter be used in a standard transport layer security (TLS) handshake operation for authentication of that client machine.

In one implementation, the certificate comprises the public key along with a user-friendly machine name (e.g., in human-readable text), which provides a number of benefits. As one benefit, if a client machine is replaced with another (e.g., to upgrade it), the previous user-friendly machine name may be reused, which other users and other components may then recognize without necessarily even noticing the replacement. Alternatively, if a machine is simply renamed, the private and public keys remain the same, and authentication may proceed as normal. The public key GUID may be used as the index key to find the certificates and other associated properties.

In one aspect, when a machine is no longer valid, the certificate may be revoked by marking the certificate as invalid (rather than deleting the certificate). For example, if a Smartphone or laptop is lost, the administrator may mark the certificate as invalid (e.g., in a property that the server checks before taking further action). If the Smartphone or laptop is later found, when re-coupled to the network the administrator may mark the certificate as valid (un-revoke the certificate marked as revoked), whereby the Smartphone or laptop operates as before.

Once the server has established a certificate for the client, the client and server may authenticate via known certificate (public key, private key) technology. For example, a standard challenge-response protocol may be used. This allows the server to control, manage and maintain the client.

Further, the clients may now validate one another for client-client communication, as described below. More particularly, turning to client-client authentication aspects, FIG. **3** shows general operations when one client wants to communicate with another client. As used herein for clarity, the client that wants to start communication is referred to herein as an "initiator client" (or more simply the "initiator"), with the other communicating client referred to as a "responder client" (or more simply the "responder"). In FIG. **3**, example operations of the initiator client are shown to the left, example operations of the server in the center, and example operations of the responder client to the right of the flow diagram. For purposes of simplicity, it is assumed that the initiator, server and responder are all are properly connected and running their respective authentication component/agents, and thus capable of communication with one another.

In one implementation, the initiator sends a request for communication to the responder, as represented by step **302**. Note that in an alternative implementation, the request for communication may include the initiator's certificate, however in the example of FIG. **3** the initiator's certificate is not sent at this time.

At step **304**, the responder returns the responder's certificate in response to the request. Receipt of the responder's certificate is represented at step **306**.

As represented via steps **308** and **310**, the initiator and server communicate to check the validity of the responder's certificate; note that the initiator may need to first authenticate with the server to start an initiator-server session. If the certificate is validated (step **312**), the process continues as described below, otherwise the process ends.

If the responder's certificate was valid, step **314** starts what is basically a counterpart validation process for the initiator's certificate, by having the initiator send the initiator's certificate to the responder. Step **316** represents receiving the initiator's certificate, with steps **318** and **320** validating the initiator's certificate with the server (after server authentication of the responder if needed). Note that in the above-described alternative implementation in which the initiator sends the initiator's certificate to the responder as part of the initial request to communicate, these steps may be performed prior to the initial response back providing the requestor's certificate (assuming the initiator is validated).

If valid (step **322**), the responder and initiator know that each machine is valid on the network, may then securely communicate with one another as represented via steps **324** and **326**. Note that in one implementation, validation/communication is per session, e.g., corresponding to a TCP connection.

As can be seen there is provided a certificate-based technology for client to server authentication and client-to-client authentication via the server. While suitable for small net-

works, the technology remains compatible with large network technology. For example, the certificate-based authentication technology may work outside of Active Directory® or inside of Active Directory®.

Exemplary Operating Environment

FIG. **4** illustrates an example of a suitable computing and networking environment **400** into which the examples and implementations of any of FIGS. **1-3** may be implemented. The computing system environment **400** is only one example of a suitable computing environment and is not intended to suggest any limitation as to the scope of use or functionality of the invention. Neither should the computing environment **400** be interpreted as having any dependency or requirement relating to any one or combination of components illustrated in the exemplary operating environment **400**.

The invention is operational with numerous other general purpose or special purpose computing system environments or configurations. Examples of well known computing systems, environments, and/or configurations that may be suitable for use with the invention include, but are not limited to: personal computers, server computers, hand-held or laptop devices, tablet devices, multiprocessor systems, microprocessor-based systems, set top boxes, programmable consumer electronics, network PCs, minicomputers, mainframe computers, distributed computing environments that include any of the above systems or devices, and the like.

The invention may be described in the general context of computer-executable instructions, such as program modules, being executed by a computer. Generally, program modules include routines, programs, objects, components, data structures, and so forth, which perform particular tasks or implement particular abstract data types. The invention may also be practiced in distributed computing environments where tasks are performed by remote processing devices that are linked through a communications network. In a distributed computing environment, program modules may be located in local and/or remote computer storage media including memory storage devices.

With reference to FIG. **4**, an exemplary system for implementing various aspects of the invention may include a general purpose computing device in the form of a computer **410**. Components of the computer **410** may include, but are not limited to, a processing unit **420**, a system memory **430**, and a system bus **421** that couples various system components including the system memory to the processing unit **420**. The system bus **421** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus also known as Mezzanine bus.

The computer **410** typically includes a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by the computer **410** and includes both volatile and nonvolatile media, and removable and non-removable media. By way of example, and not limitation, computer-readable media may comprise computer storage media and communication media. Computer storage media includes volatile and nonvolatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can accessed by the computer **410**. Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of the any of the above may also be included within the scope of computer-readable media.

The system memory **430** includes computer storage media in the form of volatile and/or nonvolatile memory such as read only memory (ROM) **431** and random access memory (RAM) **432**. A basic input/output system **433** (BIOS), containing the basic routines that help to transfer information between elements within computer **410**, such as during start-up, is typically stored in ROM **431**. RAM **432** typically contains data and/or program modules that are immediately accessible to and/or presently being operated on by processing unit **420**. By way of example, and not limitation, FIG. **4** illustrates operating system **434**, application programs **435**, other program modules **436** and program data **437**.

The computer **410** may also include other removable/non-removable, volatile/nonvolatile computer storage media. By way of example only, FIG. **4** illustrates a hard disk drive **441** that reads from or writes to non-removable, nonvolatile magnetic media, a magnetic disk drive **451** that reads from or writes to a removable, nonvolatile magnetic disk **452**, and an optical disk drive **455** that reads from or writes to a removable, nonvolatile optical disk **456** such as a CD ROM or other optical media. Other removable/non-removable, volatile/nonvolatile computer storage media that can be used in the exemplary operating environment include, but are not limited to, magnetic tape cassettes, flash memory cards, digital versatile disks, digital video tape, solid state RAM, solid state ROM, and the like. The hard disk drive **441** is typically connected to the system bus **421** through a non-removable memory interface such as interface **440**, and magnetic disk drive **451** and optical disk drive **455** are typically connected to the system bus **421** by a removable memory interface, such as interface **450**.

The drives and their associated computer storage media, described above and illustrated in FIG. **4**, provide storage of computer-readable instructions, data structures, program modules and other data for the computer **410**. In FIG. **4**, for example, hard disk drive **441** is illustrated as storing operating system **444**, application programs **445**, other program modules **446** and program data **447**. Note that these components can either be the same as or different from operating system **434**, application programs **435**, other program modules **436**, and program data **437**. Operating system **444**, application programs **445**, other program modules **446**, and program data **447** are given different numbers herein to illustrate that, at a minimum, they are different copies. A user may enter commands and information into the computer **410** through input devices such as a tablet, or electronic digitizer, **464**, a microphone **463**, a keyboard **462** and pointing device **461**, commonly referred to as mouse, trackball or touch pad. Other

input devices not shown in FIG. **4** may include a joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **420** through a user input interface **460** that is coupled to the system bus, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB). A monitor **491** or other type of display device is also connected to the system bus **421** via an interface, such as a video interface **490**. The monitor **491** may also be integrated with a touch-screen panel or the like. Note that the monitor and/or touch screen panel can be physically coupled to a housing in which the computing device **410** is incorporated, such as in a tablet-type personal computer. In addition, computers such as the computing device **410** may also include other peripheral output devices such as speakers **495** and printer **496**, which may be connected through an output peripheral interface **494** or the like.

The computer **410** may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer **480**. The remote computer **480** may be a personal computer, a server, a router, a network PC, a peer device or other common network node, and typically includes many or all of the elements described above relative to the computer **410**, although only a memory storage device **481** has been illustrated in FIG. **4**. The logical connections depicted in FIG. **4** include one or more local area networks (LAN) **471** and one or more wide area networks (WAN) **473**, but may also include other networks. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When used in a LAN networking environment, the computer **410** is connected to the LAN **471** through a network interface or adapter **470**. When used in a WAN networking environment, the computer **410** typically includes a modem **472** or other means for establishing communications over the WAN **473**, such as the Internet. The modem **472**, which may be internal or external, may be connected to the system bus **421** via the user input interface **460** or other appropriate mechanism. A wireless networking component **474** such as comprising an interface and antenna may be coupled through a suitable device such as an access point or peer computer to a WAN or LAN. In a networked environment, program modules depicted relative to the computer **410**, or portions thereof, may be stored in the remote memory storage device. By way of example, and not limitation, FIG. **4** illustrates remote application programs **485** as residing on memory device **481**. It may be appreciated that the network connections shown are exemplary and other means of establishing a communications link between the computers may be used.

An auxiliary subsystem **499** (e.g., for auxiliary display of content) may be connected via the user interface **460** to allow data such as program content, system status and event notifications to be provided to the user, even if the main portions of the computer system are in a low power state. The auxiliary subsystem **499** may be connected to the modem **472** and/or network interface **470** to allow communication between these systems while the main processing unit **420** is in a low power state.

Conclusion

While the invention is susceptible to various modifications and alternative constructions, certain illustrated embodiments thereof are shown in the drawings and have been described above in detail. It should be understood, however, that there is no intention to limit the invention to the specific forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention.

What is claimed is:

1. In a computing environment, a method performed at least in part on at least one processor comprising, validating a responder client machine at an initiator client machine coupled to the responder client machine via a network connection, including communicating to receive a responder certificate from the responder client machine, maintaining an instance of an initiator certificate at a server, generating a private key at the initiator client machine that corresponds to a public key included in the initiator certificate, using the public key of the initiator certificate as an index key to locate property data associated with the instance of the initiator certificate, and communicating with the server to determine, based upon the public key in the initiator certificate, whether the responder certificate is valid on a network comprising the initiator client machine and the responder client machine.

2. The method of claim **1** further comprising, at the responder client machine, validating the initiator client machine, including communicating to receive an initiator certificate from the initiator client machine, and communicating with the server to determine whether the initiator certificate is valid.

3. The method of claim **2** further comprising, securely communicating between the initiator client machine and the responder client machine using the initiator certificate and the responder certificate.

4. The method of claim **1** further comprising, maintaining an instance of the responder certificate at the server, maintaining an initiator private key at the initiator client machine that corresponds to a public key included in the initiator certificate maintained at the server, and maintaining a responder private key at the responder client machine that corresponds to a public key included in the responder certificate maintained at the server.

5. The method of claim **4** further comprising, maintaining initiator property data associated with the instance of the initiator certificate, and maintaining responder property data associated with the instance of the responder certificate.

6. The method of claim **4** further comprising, detecting an initial coupling of the initiator machine to the network, and creating the initiator certificate at the server.

7. The method of claim **6** further comprising, revoking the initiator certificate by marking the initiator certificate as invalid.

8. The method of claim **7** further comprising, un-revoking the revoked initiator certificate by marking the initiator certificate as valid.

9. In a networked machine environment, a system comprising, at least one processor, a memory communicatively coupled to the at least one processor and including components comprising, a server configured on a network to maintain certificate data for a plurality of client machines that are valid in the network, the server configured to access the certificate data to determine whether a certificate associated with a request is valid in the network, wherein the request is from a first client machine in the network and the certificate in the request corresponds to a second client machine, wherein a public key that corresponds to a certificate for the first client machine is stored in the request and a private key that corresponds to the certificate for the first machine is generated at the first client machine, wherein the server is further configured to maintain property data associated with the certificate for the first client machine and use the public key in the request as an index key to locate the property data.

10. The system of claim **9** wherein the server is configured to access the certificate data to respond to the request from the first client machine in the network as to whether the certificate, which corresponds to the second client machine, is valid.

11. The system of claim **10** wherein the first client machine and second client machine have different platforms.

12. The system of claim **10** wherein the first client machine comprises a personal computer and the second client machine comprises a Smartphone.

13. The system of claim **10** wherein the server validates a first certificate provided by a second client machine and validates a second certificate provided by a first client machine to facilitate secure communication between the first client machine and the second client machine.

14. The system of claim **9** wherein the certificate data associated with a client machine includes public key data corresponding to private key data of the client machine, and name data of the client machine.

15. The system of claim **9** wherein the server is configured to access the certificate data to control, manage or maintain, or any combination of control, manage or maintain, at least one of the plurality of client machines.

16. A computer-readable storage device having computer-executable instructions, which when executed perform steps, comprising: detecting an initial coupling of an initiator client machine to a network, generating a private key at the initiator client machine, receiving a responder certificate as part of a request from the initiator client machine, the request comprising a public key that corresponds to an initiator certificate; using the public key of the initiator certificate as an index key to locate property data associated with the initiator certificate; determining whether the responder certificate is valid, and returning a response to the request from the initiator client machine that indicates whether the responder certificate is valid; receiving an instance of the initiator certificate as part of a request from a responder client machine of the network; and determining whether the initiator certificate is valid, and returning a response to the request from the responder client machine that indicates whether the initiator certificate is valid.

17. The computer-readable device of claim **16** having further computer-executable instructions comprising, detecting a new machine coupled to the network, receiving instructions from an administrator to add the new machine as a valid machine to the network, and creating a certificate for the new machine by which the new machine is able to authenticate with a server of the network.

18. The computer-readable storage device of claim **16** having further computer-executable instructions comprising, receiving instructions from an administrator to revoke a certificate for a specified machine on the network, and revoking the certificate for the specified machine by associating information with the certificate that marks the certificate as invalid.

19. The computer-readable storage device of claim **16** having further computer-executable instructions comprising using the initiator certificate or the responder certificate, or both, for viewing, patching, controlling, backing up, file restoring and bare metal restoring of at least one client on the network.

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