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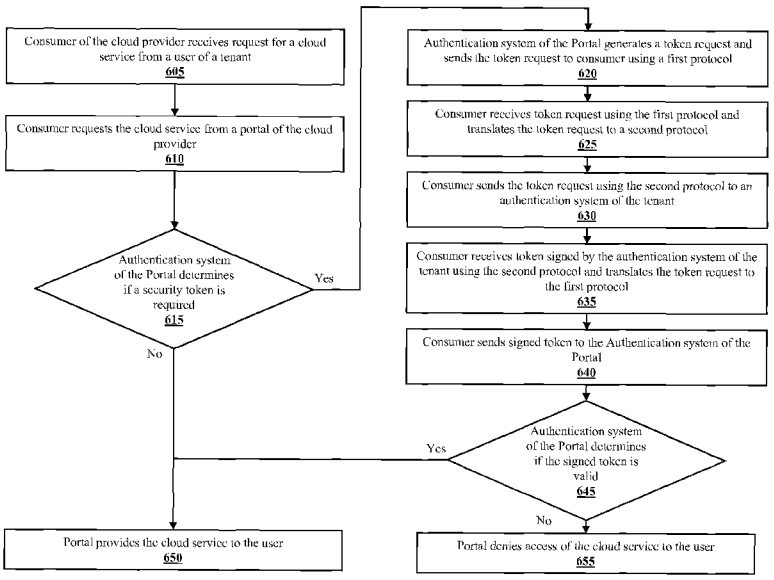

600

FIG. 6

(57) Abstract: Systems and methods for single sign on to a cloud. The system includes a cloud service provider and a tenant. The cloud service provider has a consumer unit and a portal. The consumer unit provides an interface for a user to connect to the cloud service provider. The portal providing a cloud service to the user, the portal has a first authentication system that issues a security token request and that is connected to the consumer unit. The tenant includes the user and a second authentication system. The second authentication system signs the security token request. The consumer unit is adapted to communicate with the first authentication system using a first protocol and adapted to communicate with the second authentication system using a second protocol.

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SINGLE SIGN ON FOR CLOUD

TECHNICAL FIELD

[0001] The present invention relates generally to a system for management of information technology systems.

BACKGROUND

[0002] Cloud computing enables convenient, on-demand network access to a shared pool of configurable computing resources, for example, networks, servers, storage, applications, and services that can be rapidly provisioned and released with minimal management effort or service provider interaction. For one or more end-users that are attached to the shared pool of configurable computing resources that comprise a cloud, cloud computing provides computation, applications, data access, and storage services for the end-user. The end-user does not require knowledge of the physical location and configuration of the system that delivers the services. Further, the end-user is able to pay for the computation, applications, data access, and storage services based on the amount of usage rather than having to purchase and manage dedicated computation, applications, data access, and storage resources.

[0003] Clouds are developed as stand-alone platforms and include hardware and applications necessary to perform required services for the end-users. In some contexts, clouds are known as platforms. The term "cloud" for the purpose of this application also encompasses the term “platform.” The term “off-site cloud” is used to refer to a public cloud, which is a cloud that is accessible on the Internet. The term “in-house cloud” is used to refer to a private cloud, which is not generally accessible on the Internet.

[0004] Examples of the services include software as a service ("SAAS"), platform as a service ("PAAS"), and infrastructure as a service ("IAAS"). In SAAS, users pay a fee on a recurring basis to access and use specific applications. In PAAS, the user leases access to an entire platform, for example, a customer resource management platform. In IAAS, the user leases access to certain infrastructure, for example, a physical or virtual server with particular computational and/or storage capabilities.

[0005] In recent times, as IT systems proliferate to support business processes, users and system administrators are faced with an increasingly complicated interface to accomplish their job functions. Users typically have to sign-on to multiple systems, necessitating an equivalent

number of sign-on dialogues, each of which may involve different usernames and authentication information. System administrators are faced with managing user accounts within each of the multiple systems to be accessed in a coordinated manner in order to maintain the integrity of security policy enforcement.

[0006] Clouds employ virtualization to perform tasks. The virtualization creates virtual machines running on the hardware, the virtual machines running applications. Each virtual machine has security features of some kind to give some users access to portions of the virtual machine but deny access to other users. Further, each application running on a virtual machine has additional security to give some users access to portions of the application but deny access to other users. Some systems may have thousands of virtual machines, applications, and users. Further, one user may require access to thousands of virtual machines. This can make standard authentication impractical because of the large number of devices that users have to authenticate with. Further, differing operating systems and domains used by the user, the cloud infrastructure, and the virtual machines in the cloud, complicate the authorization and authentication process.

[0007] In one conventional configuration, tenants subscribe to services provided by a cloud provider. The tenants can be other organizations with their own identity management system. The tenants may want the cloud provider to use their own existing identity management system to authenticate their users instead of registering each of the tenant's users in the cloud provider's identity management system.

SUMMARY

[0008] The systems and methods described herein attempt to overcome the drawbacks discussed above.

[0009] In one embodiment, a system for single sign on to a cloud comprises a cloud service provider and a tenant. The cloud service provider comprises a consumer unit and a portal. The consumer unit provides an interface for a user to connect to the cloud service provider. The portal provides a cloud service to the user, the portal comprising a first authentication system that issues a security token request and that is connected to the consumer unit. The tenant comprises the user and a second authentication system. The second authentication system signs the security token request. The consumer unit is adapted to communicate with the first authentication system

using a first protocol and adapted to communicate with the second authentication system using a second protocol.

[0010] In another embodiment, a system for single sign on to a cloud comprises a cloud service provider and a tenant. The cloud service provider comprises a consumer unit, a portal, and a first authentication system. The consumer unit provides an interface for a user to connect to the cloud service provider. The portal provides a cloud service to the user, the portal comprising a second authentication system connected to the consumer unit. The first authentication system connected to the consumer unit. The tenant comprises the user and a third authentication. The third authentication system connected to the user. The consumer unit is adapted to communicate with the first authentication system using a first protocol and adapted to communicate with the second authentication system using a second protocol. The first authentication system is federated with the third authentication system.

[0011] In yet another embodiment, a method for single sign on to a cloud system is disclosed. A consumer unit of a cloud provider receiving a request from a user for a cloud service. The consumer unit requesting a portal to provide access to the cloud service based on the request from the user. A first authentication system of the portal requesting a security token from the consumer unit using a first protocol, the request by the first authentication system based on the request by the consumer unit. The consumer unit translating the security token request from the first protocol to a second protocol. The consumer unit requesting a second authentication system to sign the requested security token using the second protocol. The consumer unit receiving the signed security token. The consumer unit translating the signed security token from the second protocol to the first protocol. The consumer unit sending the signed security token to the portal using the first protocol. The portal, providing the cloud service to the user based on the signed security token.

[0012] In still yet another embodiment, a machine-readable tangible and non-transitory medium with information recorded thereon, wherein the information, when read by a machine, causes the machine to perform the following steps. A consumer unit of a cloud provider receiving a request from a user for a cloud service. The consumer unit requesting a portal to provide access to the cloud service based on the request from the user. A first authentication system of the portal, requesting a security token from the consumer unit using a first protocol. The request by the authentication system based on the request from the consumer unit. The consumer unit, translating the security token request from the first protocol to a second protocol.

The consumer unit requesting a second authentication system to sign the requested security token using the second protocol. The consumer unit translating the signed security token from the second protocol to the first protocol. The consumer unit sending the signed security token to the portal using the first protocol. The portal providing the cloud service to the user based on the signed security token.

[0013]

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The accompanying drawings constitute a part of this specification and illustrate an embodiment of the invention, and together with the specification, explain the invention.

[0015] **FIG. 1** illustrates a cloud system according to an embodiment.

[0016] **FIG. 2** illustrates another cloud system according to an embodiment.

[0017] **FIG. 3** illustrates yet another cloud system according to an embodiment.

[0018] **FIG. 4A-B** illustrate how WS-Trust and WS-Policy are used along with different WS-* specifications implemented in the areas of Security, Reliability, and Transactions, according to an exemplary embodiment.

[0019] **FIG. 5** illustrates the programming model with WSIT according to an exemplary embodiment.

[0020] **FIG. 6** illustrates a method for the cloud portion of single sign on to a cloud provider according to an exemplary embodiment.

[0021] **FIG. 7** illustrates a method for the tenant portion of single sign on to a cloud provider according to an exemplary embodiment..

[0022] **FIG. 8** illustrates a general computer architecture according to an exemplary embodiment.

DETAILED DESCRIPTION

[0023] **FIG. 1** illustrates a cloud system **100.** The cloud system **100** comprises a cloud service provider **102** and first and second tenants **120** that subscribe to the cloud service. The cloud service provider **102** comprises a portal **105** that comprises one or more portlets **110,** a cloud service engine **115** that provides cloud services, and an authentication system **135.** The tenants comprise users **125** that use the cloud and an authentication system **130.** The tenants **120** may be, for example, companies, or departments in a company, and the users may be the employees of the company. There may be any number of tenants connected to the cloud service

provider **102**. The cloud service provider **102** and the tenants **120** may be on the same network or intranet. Alternatively, the tenants **120** may be connected to the cloud service provider **102** via the Internet.

[0024] The authentication mechanisms of the tenant include, for example, Lightweight Directory Access Protocol (LDAP) and Active Directory Federation Services (ADFS). The first and second tenants **120** and the portal **105** may be on different domains, therefore, the tenant authentication methods cannot be used to authenticate a user in another tenant or at the portal **105.**

[0025] To use the services provided by the tenant **120,** including the services provided by the cloud service provider **102**, a user **125** authenticates with the authentication system **130** of the tenant. To use a cloud service, a user **125** also authenticates with the authentication system **135** of the portal. In some embodiments, a separate authentication is further required for each portlet **110.** Thus, the user **125** may provide numerous user names and passwords before using the cloud service.

[0026] In a federated authentication system a common set of policies, practices, and protocols are put in place to manage the identity and trust among users and devices across organizations and domains. Identity federation enables users of one domain to access securely data or systems of another domain seamlessly, and without the need for completely redundant user administration. This process is known as Single sign on. Federation is enabled using open industry standards and/or openly published specifications, such that multiple parties can achieve interoperability for common use cases. Typical use-cases involve things such as cross-domain; web-based single sign-on, cross-domain user account provisioning, cross-domain entitlement management, and cross-domain user attribute exchange. ADFS provides such federated services using claims based authentication.

[0027] In claims based authentication, a trusted authority (Issuer) issues a signed security token containing a set of claims (credentials) which is given to an application, for example the cloud service provider **102** for validation. The application will authenticate the user if the security token is valid and signed by a trusted issuer, for example, authentication system **130** of the tenant **120.** Claims-based identity simplifies application development because applications using this type of authentication do not have to verify all the credentials presented by the user. Instead letting the issuer to deal with all security issues involved eases the process of integration, migration, merger, federation, or building cloud applications.

[0028] Single sign on has many benefits. Single sign on reduces the time taken by users in sign-on operations to individual domains and reduces the possibility of such sign on operations failing. Single sign on improves security through the reduced need for a user to handle and remember multiple sets of authentication information. Single sign on reduces the time taken, and improves the response, by system administrators to add and remove users to the system or modify the rights of the users. Single sign on improves security through the enhanced ability of system administrators to maintain the integrity of the user account configuration including the ability to inhibit or remove an individual user from having access to all system resources in a coordinated and consistent manner.

[0029] If the authentication system **135** of the portal **105** and portlets **110** are a federated authentication system, for example, ADFS, and the authentication system of the tenant **120** is a compatible federated authentication system, for example, ADFS, then authentication at the portal can be performed by using tokens **150** provided by the authentication system **130.**

[0030] In, for example, ADFS, the tokens **150** are gathered from the authentication system **130** by the authentication system **135** without the need for the user **125** to provide additional user names or passwords. The authentication system **130** will only provide the tokens if the user **125** has previously authenticated with the authentication system **130.** For example, a federated, claims based architecture based on an ADFS system with the authentication system **135** acting as a federate Security Token Service (STS) and authentication system **130** acting as a federated Identity Provider would enable single sign on. However, in general, the authentication systems **130** and **135** are not compatible, and, thus, it is difficult to implement a single sign on.

[0031] **FIGS. 2** and **3** illustrate cloud systems **200** and **300** that overcome the compatibility issues of the authentication systems **130** and **135.** Both systems **200, 300** include a consumer unit **245, 345** that provides an interface between different authentication systems. In the system **200,** the consumer communicates directly with an authentication system of tenants **220.** In the system **300,** the consumer communicates with a cloud authentication system **355** within the cloud that is compatible with and federated to an authentication system of the tenants **320.** Both the systems **200** and **300** provide single-sign-on for the users **225, 325** of the tenants **220, 320** using federated identity management.

[0032] The cloud system **200** comprises cloud service provider **202** and first and second tenants **220** that subscribe to the cloud service. The cloud service provider **202** comprises a cloud portal **205** that further comprises many portlets **210,** a cloud service engine **215** that

provides cloud services, and an authentication system **235.** The tenants comprise users **225** that use the cloud, and an authentication system **230.**

[0033] The cloud system **200** further comprises the consumer unit **245.** The consumer unit **245** forms a mediator between the authentication system **230** and the authentication system **235.** A user **225** needing to use the cloud service engine **215** contacts the consumer unit **245.** The consumer unit **245** in turn contacts the authentication system **235** of the portal **205.**

[0034] To use the tenant services, including gaining access to the cloud services, a user **225** authenticates with the authentication system **230** of the tenant. The user **225** may provide a user name and password, provide biometric data, or use any other means compatible with embodiments of the disclosure to authenticate with the authentication system **230.** When the user **225** is authenticated with the authentication system **230,** the user **225** contacts the consumer unit **245** with an access request **260** for a cloud service. The consumer unit **245** contacts the authentication system **235** of the portal **205** and requests access to one of the portlets **210.** The authentication system **235,** responds by requesting a specific form of token for the user **225.** The consumer unit **245** identifies the tenant to which the user **225** belongs, and contacts the authentication system **230** of that tenant. The consumer unit **245** issues a token request **249** to request the specific form of token **250** from the authentication system **230.** The authentication system **230** checks that the user is authenticated for the services of the corresponding tenant. If the user **225** is authenticated, the authentication system **230** completes and signs the token **250** and sends the token back to the consumer unit **245.** The consumer unit **245** forwards the completed and signed token to the authentication system **235.** The authentication system **235** provides access to the portlets **210** for the user **225** to access the cloud service engine **215.** Thus, by using the system of **FIG. 2**, the user **225** only needs to authenticate with the corresponding authentication system **230** before using the cloud service engine **215.**

[0035] Before the system **200** can be accessed by the users **225,** a trust structure has to be established between the authentication system **230,** the authentication system **235,** and the consumer unit **245.** In some embodiments, the trust can be established using predefined secure communications such as a Transport Layer Security (TLS), a Secure Sockets Layer (SSL), or a virtual private network (VPN). Trust can be established by using various cryptographic means to sign the tokens that are passed from the authentication system **230** to the authentication system **235.** For example, a decryption key may be required by the authentication system **230** to validate signatures on the signed tokens. The authentication system **230** may store the keys in a

key store. The authentication system **230** may also encrypt the token requests, and provide a public key so that only the authentication system **235** is capable of signing the requested token **250.**

[0036] Trust can be established by the authentication system **235** by requesting specific information known to the authentication system **230,** for example, a user name, a code issued to the user, a title for the user *etc.* Each specific piece of information is a claim in the claim based authentication system. The above claim information is provided to the authentication system **235** before the user **225** attempts to use the cloud service engine **215,** so that the authentication system **235** can verify the claim.

[0037] In the above embodiment, the authentication system **230** acts as an identity provider. Identity providers are adapted to validate various user credentials, such as user names and passwords, and certificates, and are adapted to issue tokens.

[0038] In some embodiments, the authentication system **230** is, for example, an ADFS component provided by Microsoft Corporation, a Shibboleth® identity provider provided by the Internet2™ advanced networking consortium, or any other service adapted to act as an Identity provider.

[0039] The authentication system **235** has to request the tokens and verify the tokens when the tokens are received. In some embodiments, the authentication system **235** is, for example, an ADFS component, a Shibboleth® service provider, or any other service adapted to act as a requester and verifier of tokens.

[0040] In some embodiments, the portal is a Liferay™ Portal. Liferay™ is a free and open source enterprise portal written in Java and distributed under the GNU Lesser General Public License. In some embodiments, the Liferay™ Portal is adapted to provide the authentication system **235** and request and verify the tokens.

[0041] The consumer unit **245** is adapted to communicate with the authentication system **230** using a first security protocol, for example, the protocols for Shibboleth®, an ADFS component, or any other protocol compatible with embodiments of the disclosure. The consumer **245** is also adapted to communicate with the authentication system **235** using a second security protocol for example, the protocols for Shibboleth®, an ADFS component, or any other protocol compatible with embodiments of the disclosure. In some embodiments, the consumer unit **245** translates the token requests by the authentication system **235** from the protocol of the authentication system **235** to the protocol of the authentication system **230,** and translates the

tokens from the authentication system **230** from the protocol of the authentication system **230** to the protocol of the authentication system **235** if the protocols are different. In some embodiments, the consumer unit **245** automatically detects the types of the authentication systems **230, 235,** and, therefore, the protocols used so that the protocol translation can be performed when forwarding token requests and tokens. Thus, the authentication system **230** and the authentication system **235** can use different protocols.

[0042] In some embodiments, the user **225** accesses the consumer **245** using a web browser and internet protocol. For example, the user **225** enters a web address corresponding to the internet address of the consumer **245** into the web browser. Alternatively, the user clicks on an internet link corresponding to the consumer **245** by using the web browser. In some embodiments, in response to the request by the user **225** the consumer **245** provides a web page to the user indicating that authentication is in progress. In some embodiments, the consumer **245** does not provide a response to the request by the user **225** until authentication is complete.

[0043] The cloud system **300** comprises cloud service provider **302** and first and second tenants **320** that subscribe to the cloud service. The cloud service provider **302** comprises a cloud portal **305** that further comprises many portlets **310,** a cloud service engine **315** that provides cloud services, and an authentication system **335.** The tenants comprise users **325** that use the cloud and an authentication system **330.**

[0044] The cloud system **300** is similar to the cloud system **200** but further comprises a cloud authentication system **355.** The consumer unit **345** forms a mediator between the cloud authentication system **355** and the authentication system **335.** A user **325** needing to use the cloud service engine **315** contacts the consumer unit **345** with an access request **360.** The consumer unit **345** contacts the authentication system **330** for access to the cloud service requested by the user **325.** If a security token is required for the user **325** to access the cloud service engine **315,** the authentication system **330** sends a token request **349** to the consumer unit **345.** The consumer unit **345** contacts the authentication system **355** for access to the cloud services provided by cloud service engine **315.** The authentication system **355** in-turn contacts the appropriate authentication system **330** of the tenants. The authentication system **355** is selected to use the same protocols as the authentication system **330.** Therefore, there is no compatibility issue between the authentication system **330** and the authentication system **355**

[0045] To use the tenant services, including gaining access to the cloud services, the user **325** authenticates with the authentication system **330** at the tenant. The user **325** may provide a u

ser name and password, provide biometric data, or use any other means compatible with embodiments of the disclosure to authenticate with the authentication system **330.** When the user **325** is authenticated with the authentication system **330,** the user **325** contacts the consumer unit **345.** The consumer unit **345** contacts the authentication system **335** of the portal **305** and requests access to the portlets **310.** The authentication system **335,** responds by requesting a specific form of token for the user **325.** The consumer unit **345,** contacts the authentication system **355** of the cloud provider. The consumer unit **345** requests the specific form of token from the authentication system **355.** The authentication system **355** identifies the tenant **320** for the user **325** and contacts the respective authentication system **330** to request a token **350** for the user **325,** based on the token **350** requested by the consumer unit **345.** The authentication system **330** checks to see that the user is authenticated for the services of the corresponding tenant **320.** If the user **325** is authenticated, the authentication system **330** completes and signs the token and sends the token **350** back to the authentication system **355.** The authentication system **355** completes the token requested by the consumer unit **345** based on the token issued by the authentication system **330** and issues the token **350** to the consumer unit **345.** The consumer unit **345** forwards the completed and signed token **350** to the authentication system **335.** The authentication system **335** provides access to the portlets **310** for the user **325** to access the cloud service engine **315.** Thus, by using the system of **FIG. 3**, the user **325** only needs to authenticate with the corresponding authentication system **330** before using the cloud service engine **315.**

[0046] Before the system **300** can be accessed by the users **325,** a trust structure has to be established between the authentication system **330,** the authentication system **335,** authentication system **355,** and the consumer unit **345.** In some embodiments, the trust can be established using predefined secure communications such as a Transport Layer Security (TLS), a Secure Sockets Layer (SSL), or a virtual private network (VPN). In some embodiments, the trust can be established by using various cryptographic means to sign the tokens **350** that are passed from the authentication system **330** to the authentication system **335,** and the tokens **350** passed from the authentication system **335** to the authentication system **335.** For example, decryption keys may be required to validate signatures on the issued tokens. The authentication system **330** may store the keys in a key store. The authentication system **330** may also encrypt the token requests, and provide a public key so that only the authentication system **355** and/or the authentication system **335** is capable of signing the requested token.

[0047] The consumer unit **345** is adapted to communicate with the authentication system **330** using a first security protocol, for example, the protocols for Shibboleth®, an ADFS component, or any other protocol compatible with embodiments of the disclosure. The consumer **345** is also adapted to communicate with the authentication system **355** using a second security protocol for example, the protocols for Shibboleth®, an ADFS component, or any other protocol compatible with embodiments of the disclosure. In some embodiments, the consumer unit **345** translates the token requests by the authentication system **335** from the protocol of the authentication system **335** to the protocol of the authentication system **355** and translates the tokens from the authentication system **355** from the protocol of the authentication system **355** to the protocol of the authentication system **335** if the protocols are different. In some embodiments, the consumer unit **345** automatically detects the types of the authentication systems **335, 355** and, therefore, the protocols used so that the protocol translation can be performed when forwarding token requests and tokens. Thus, the authentication system **335** and the authentication system **355** can use different protocols.

[0048] In some embodiments, the user **325** accesses the consumer **345** using a web browser and internet protocol. For example, the user **325** enters a web address corresponding to the internet address of the consumer **345** into the web browser. Alternatively, the user clicks on an internet link corresponding to the consumer **345** using the web browser. In some embodiments, in response to the request by the user **325** the consumer **345** provides a web page to the user indicating that authentication is in progress. In some embodiments, the consumer **345** does not provide a response to the request by the user **325** until authentication is complete.

[0049] In some embodiments, the consumer units **245, 345** can be implemented, for example, using the Java based WS-trust protocol and the Web service Interoperability technologies (WSIT). In one embodiment, a WSIT implementation of metro web services is used. WSIT is an open-source project for the next-generation of Web service technologies. WSIT provides interoperability between Java Web Services and Microsoft's Windows Communication Foundation. WSIT consists of Java programming language APIs that enable advanced WS-* features to be used in a way that is compatible with, for example, Microsoft's Windows Communication Foundation (WCF) as used by Microsoft .NET®. The interoperability between different products is accomplished by implementing a number of Web Services specifications, like JAX-WS that provides interoperability between Java Web Services and

Microsoft Windows Communication Foundation. WSIT implements the following WS-* protocols

WS-MetadataExchange
WS-Transfer
WS-Policy
WS-Security
WS-SecureConversation
WS-Trust
WS-SecurityPolicy
WS-ReliableMessaging
WS-RMPolicy
WS-Coordination
WS-AtomicTransaction

[0050] **FIG. 4A** illustrates WS-Trust, WS-Policy that are used. The major components are the JAX-WS RI – the core Web services platform **405** and an implementation of Reliability **415,** Security **410,** and Transactions **420** for WS-* specifications and interoperability with .NET 3.0/3.5

[0051] The Java API for XML Web Services JAX-WS RI provides the Core Web services platform **405.** This includes all the SOAP message functionality, including WS-Addressing and MTOM. The JAX-WS RI is an implementation of the JAX-WS specification.

[0052] WSIT implements support for Security **410,** Reliability **415,** and Transactions **420,** using the protocols and mechanisms defined by several WS-* specifications, on this Core layer **405.** This allows a Java client to communicate with a Java endpoint using these protocols. In addition these protocols also enable interoperability with the Windows Communication Foundation component of .NET 3.0/3.5 frameworks, and therefore, provide access to the ADFS APIs.

[0053] **FIG. 4B** illustrates the different WS-* specifications implemented in the areas of Security **410,** Reliability **415,** and Transactions **420.**

[0054] In Security **410,** WS-Security **425** provides a basic framework for SOAP message level security in Web services. WS-Trust **430** defines a framework for issuing, renewing, and validating security tokens, and brokering trust relationships within different trust domains. WS-Secure Conversation **435** increases the overall performance and security by defining semantics

for secure message exchange for multiple message exchanges. WS-Security Policy **440** enables Web service endpoints to specify their security requirements to potential clients in an interoperable manner.

[0055] In Reliability, WS-Reliable Messaging **445** defines a messaging protocol to identify, track, and manage the reliable message delivery between two parties, a source and a destination. WS-Reliable Messaging Policy **450** enables a Web service endpoint to indicate that a reliable message delivery is required.

[0056] In Transactions, WS-Coordination **455** provides an extensible framework for defining coordination context and types for protocols that coordinate distributed actions. WS-Atomic Transactions **460** provides the definition of transaction context and atomic transaction coordination type that is to be used with the framework defined by WS-Coordination. This enables transactions flowing over Web services.

[0057] Metadata section **465** identifies the mechanisms that allow the Security, Reliability, and Transactional capabilities of an endpoint to be published and consumed by a client in an interoperable manner. WSPolicy **470** defines a general-purpose framework to express the capabilities of an endpoint.

[0058] The above extensible framework is then used to define the domain-specific policy assertions. WS-Metadata Exchange and WS-Transfer are used by the client to retrieve the information about the endpoint.

[0059] **FIG. 5**: illustrates the programming model with WSIT. The programming model leverages the existing JAX-WS and EJB programming models and allows us to define Security, Reliability, and Transactional capability on the endpoints by bundling an additional configuration file with the application.

[0060] The configuration file can be easily generated using the NetBeans integrated development environment **505** or can be written by hand **510,** or using any other integrated development environment **510** that has inbuilt WSIT or with WSIT plug-in added. On the client side, an optional WSIT configuration file **520** may be used to specify certain client-side parameters such the locations of trust and keystores.

[0061] Most Servlet Containers that can be used with Liferay™ including Apache Tomcat™, Glassfish™ are supported by metro web services. Thus, if the portal **205, 305** is implemented using Liferay™, the portal can communicate with the consumer **245, 345** using metro web services and with ADFS authentication systems using WIST.

[0062] **FIG. 6** illustrates a method **600** for single sign on to a cloud provider. The method begins at step **605.** At step **605,** the consumer of the cloud provider receives a request for a cloud service from an user of a tenant. The consumer may be, for example, consumer unit **245** or **345.** The consumer may be a web page portal, and the request may be in the form of a web page request. When the request has been received the method proceeds to step **610.**

[0063] At step **610,** the consumer requests the cloud service from a portal of the cloud provider, for example, portal **205, 305.** When the request has been sent the method proceeds to step **615.**

[0064] At step **615,** the authentication system of the portal, for example, authentication system **235, 335** determines if a security token is required. If a security token is required, the method proceeds to step **620.** If a security token is not required, the method proceeds to step **650.**

[0065] At step **620,** the authentication system of the portal generates a token request and sends the token request to consumer using a first protocol. The first protocol may be, for example, the Java WSIT based protocol as discussed above or protocols for ADFS. The token request contains a list of the information that the authentication system of the portal expects to see in the returned signed token. The token request may be generated from a policy file. When the request has been sent, the method proceeds to step **625**

[0066] At step **625,** the consumer receives the token request using the first protocol and translates the token request to a second protocol. The second protocol is the protocol expected by the authentication system of the tenant. The second protocol may be, for example, the Java WSIT based protocol as discussed above or protocols for ADFS. The information contained in the token request in the second protocol is the same as the information contained in the request in the first protocol. When the translation is complete, the method proceeds to step **630.**

[0067] At step **630,** the consumer sends the token request using the second protocol to an authentication system of the tenant of the user. The authentication system of the tenant of the user performs steps **715-725**, as discussed below. When the token request has been sent, the method proceeds to step **635.**

[0068] In some embodiments, for example, the cloud system **300** the consumer does not send the token request to an authentication system of the tenant of the user. The consumer sends the token request to an authentication system of the cloud service provider, for example, authentication system **355** that is federated with the authentication system of the tenant of the

user. The authentication system of the cloud service provider signs the token based on communication with the authentication system of the tenant of the user. The authentication system of the cloud service provider then returns the signed token to the consumer and the method proceeds to step **635.**

[0069] At step **635,** the consumer receives the token signed by the authentication system of the tenant using the second protocol and translates the token request to the first protocol. When the translation of the token is complete, the method proceeds to step **640.** At step **640,** the consumer sends the signed token to the authentication system of the Portal using the first protocol. When the signed token has been sent, the method proceeds to step **645.** At step **645,** the authentication system of the Portal determines if the signed token is valid. If the signed token is valid, the method proceeds to step **650.** If the token is not valid, the method proceeds to step **655.**

[0070] At step **650,** the portal provides the cloud service to the user and the method terminates. At step **655,** the portal denies access of the cloud service to the user and the method terminates.

[0071] **FIG. 7** illustrates a method **700** for single sign on to a cloud provider. The method begins at step **705.** At step **705,** the user authenticates at the tenant authentication system. When the authentication is complete, the method proceeds to step **710.**

[0072] At step **710,** the user sends request to the consumer of the cloud provider to request a cloud service. When the request has been sent, the method proceeds to step **715.**

[0073] At step **715,** the tenant authentication system receives a request for a security token from the cloud service provider. When the request for the security token has been received, the method proceeds to step **720.**

[0074] At step **720,** the tenant authentication system checks that the user is authenticated, and signs the token request. When the request for the security token has been signed, the method proceeds to step **725.**

[0075] At step **725,** the tenant authentication system sends the signed request to cloud service authentication system. When the signed security token has been sent, the method proceeds to step **730.** At step **730,** the user receives access to the cloud service from the cloud provider.

[0076] **FIG. 8** depicts a general computer architecture on which the present embodiments can be implemented and has a functional block diagram illustration of a computer hardware

platform that includes user interface elements. The computer may be a general purpose computer or a special purpose computer. The computer **800** can be used to implement any components of the systems **100, 200** and **300.** For example, authentication systems **130, 135, 230, 235, 330, 335** the consumer units **245, 335,** can all be implemented on a computer such as computer **800,** by using the hardware, software program, firmware, or a combination of these components of the computer **800**. Although only one computer **800** is shown, for convenience, the computer functions relating to single sign on may be implemented in a distributed fashion on a number of similar platforms, to distribute the processing load.

[0077] The computer **800,** for example, includes COM ports **850** connected to and from a network to facilitate data communications. The computer **800** also includes a central processing unit (CPU) **820,** in the form of one or more processors, for executing program instructions. The exemplary computer platform includes an internal communication bus **810,** program storage and data storage of different forms, for example, disk **870,** read only memory (ROM) **830,** or random access memory (RAM) **840,** for various data files to be processed and/or communicated by the computer, as well as possibly program instructions to be executed by the CPU. The computer **800** also includes an I/O component **860,** supporting input/output flows between the computer and other components such as user interface elements **880.** The computer **800** may also receive programming and data via network communications.

[0078] Hence, aspects of the methods and systems for single sign on according to an embodiment, as discussed above, may be embodied in program elements. Program aspects of the embodiments may be thought of as "products" or "articles of manufacture" typically in the form of executable code and/or associated data that is carried on or embodied in a type of machine-readable medium. Tangible non-transitory "storage" type media include any or all of the memory or other storage for the computers, processors or the like, or associated modules thereof, such as various semiconductor memories, tape drives, disk drives and the like, which may provide storage at any time for the program elements.

[0079] All or portions of the program elements may at times be communicated through a network such as the Internet or various other telecommunication networks. Such communications, for example, may enable loading of the software from one computer or processor into another, for example, from a management server or host computer into the hardware platform(s) of a computing environment or other system. Other types of media that may carry the program elements include optical, electrical and electromagnetic waves, such as

used across physical interfaces between local devices, through wired, and optical networks and over various wireless links. The physical elements that carry such waves, such as wired or wireless links, optical links, or the like, also may be considered as media carrying the software. As used herein, unless restricted to tangible "storage" media, terms such as computer or machine "readable medium" refer to any medium that participates in providing instructions to a processor for execution.

[0080] Hence, a machine-readable medium may take many forms, including but not limited to, a tangible storage medium, a carrier wave medium, or physical transmission medium. Non-volatile storage media include, for example, optical or magnetic disks, such as any of the storage devices in any computer(s) or the like, which may be used to implement the single sign on system or any of the components of the single sign on systems as shown in the drawings. Volatile storage media include dynamic memory, such as a main memory of such a computer platform. Tangible transmission media include coaxial cables, copper wire and fiber optics, including the wires that form a bus within a computer system. Carrier-wave transmission media can take the form of electric or electromagnetic signals, or acoustic or light waves such as those generated during radio frequency (RF) and infrared (IR) data communications. Common forms of computer-readable media, therefore, include, for example, a floppy disk, a flexible disk, hard disk, solid state disk magnetic tape, any other magnetic medium, a CD-ROM, DVD, Blue-Ray™ or DVD-ROM, any other optical medium, punch cards paper tape, any other physical storage medium with patterns of holes, a RAM, a PROM and EPROM, a FLASH-EPROM, any other memory chip or cartridge, a carrier wave transporting data or instructions, cables or links transporting such a carrier wave, or any other medium from which a computer can read programming code and/or data. Many of these forms of computer readable media may be involved in carrying one or more sequences of one or more instructions to a processor for execution.

[0081] The embodiments described above are intended to be exemplary. One skilled in the art recognizes that numerous alternative components and embodiments that may be substituted for the particular examples described herein and still fall within the scope of the invention.

CLAIMS

What is claimed is:

1. A system for single sign on to a cloud, the system comprising:

a cloud service provider comprising:

a consumer unit that provides an interface for a user to connect to the cloud service provider; and

a portal that provides a cloud service to the user, the portal comprising a first authentication system that issues a security token request, and the first authentication system is connected to the consumer unit; and

a tenant comprising:

the user; and

a second authentication system that signs the security token request, wherein

the consumer unit is adapted to communicate with the first authentication system using a first protocol and adapted to communicate with the second authentication system using a second protocol.

2. The system according to claim 1, wherein the consumer unit is adapted to request the cloud service from the portal based on a request for the cloud service from the user.

3. The system according to claim 1, wherein

the consumer unit is adapted to translate a security token request in the first protocol to a security token request in the second protocol; and

the consumer unit is adapted to translate a signed security token in the second protocol to a signed security token in the first protocol.

4. The system according to claim 3, wherein

the consumer unit is adapted to receive the security token request in the first protocol from the first authentication system based on a request for the cloud service from the user; and

the consumer unit is adapted to send the security token request in the second protocol to the second authentication system.

5. The system according to claim 1, the portal comprising a plurality of portlets, and the portal adapted to assign the user to a one of the plurality of portlets to provide the cloud service.

6. The system according to claim 1, wherein the second authentication system is adapted to authenticate the user.

7. A system for single sign on to a cloud, the system comprising:

a cloud service provider comprising:

a consumer unit that provides an interface for a user to connect to the cloud service provider;

a portal that provides a cloud service to the user, the portal comprising a first authentication system connected to the consumer unit; and

a second authentication system connected to the consumer unit; and

a tenant comprising:

the user; and

a third authentication system connected to the user,

wherein the consumer unit is adapted to communicate with the first authentication system using a first protocol and adapted to communicate with the second authentication system using a second protocol; and

wherein the second authentication system is federated with the third authentication system.

8. The system according to claim 7, wherein the consumer unit is adapted to request the cloud service from the portal based on a request for the cloud service from the user.

9. The system according to claim 7, wherein

the consumer unit is adapted to translate a security token request in the first protocol to a security token request in the second protocol; and

the consumer unit is adapted to translate a signed security token in the second protocol to a signed security token in the first protocol.

10. The system according to claim 9, wherein

the consumer unit is adapted to receive the security token request in the first protocol from the first authentication system based on a request for the cloud service from the user; and

the consumer unit is adapted to send the security token request in the second protocol to the second authentication system.

11. The system according to claim 7, the portal comprising a plurality of portlets, and the portal adapted to assign the user to a one of the portlets to provide the cloud service.

12. The system according to claim 7, wherein the third authentication system is adapted to authenticate the user.

13. A method for single sign on to a cloud system, the method comprising:

receiving, by a consumer unit of a cloud provider, a request from a user for a cloud service;

requesting, by the consumer unit, a portal to provide access to the cloud service based on the request from the user;

requesting, by a first authentication system of the portal, a security token from the consumer unit using a first protocol, the request by the first authentication system based on the request by the consumer unit;

translating, by the consumer unit, the security token request from the first protocol to a second protocol;

requesting, by the consumer unit, a second authentication system to sign the requested security token using the second protocol;

receiving, by the consumer unit, the signed security token;

translating, by the consumer unit, the signed security token from the second protocol to the first protocol;

sending, by the consumer unit, the signed security token to the portal using the first protocol; and

providing, by the portal, the cloud service to the user based on the signed security token.

14. The method of claim 13, wherein the second authentication system is an authentication system of a tenant of the user that authenticated the user.

15. The method of claim 13, wherein the second authentication system is an authentication system of the cloud provider and the second authentication system is federated with an authentication system of a tenant of the user that authenticated the user.

16. The method of claim 13, wherein if the signed security token is not valid then the user is denied access to the cloud service.

17. A machine-readable tangible and non-transitory medium with information recorded thereon, wherein the information, when read by a machine, causes the machine to perform the following steps:

receive, by a consumer unit of a cloud provider, a request from a user for a cloud service;

request, by the consumer unit of the cloud provider, a portal to provide access to the cloud service based on the request by the user;

request, by a first authentication system of the portal, a security token from the consumer unit using a first protocol based on the request from the consumer unit;

translate, by the consumer unit, the security token request from the first protocol to a second protocol;

request, by the consumer unit, a second authentication system to sign the requested security token using the second protocol;

translate, by the consumer unit, the signed security token from the second protocol to the first protocol;

send, by the consumer unit, the signed security token to the portal using the first protocol; and

provide, by the portal, the cloud service to the user based on the signed security token.

18. The machine-readable medium of claim 17, wherein the second authentication system is an authentication system of a tenant of the user that authenticated the user.

19. The machine-readable medium of claim 17, wherein the second authentication system is an authentication system of the cloud provider and the second authentication system is federated with an authentication system of a tenant of the user that authenticated the user.

20. The machine-readable medium of claim 17, wherein if the signed security token is not valid then the user is denied access to the cloud service.

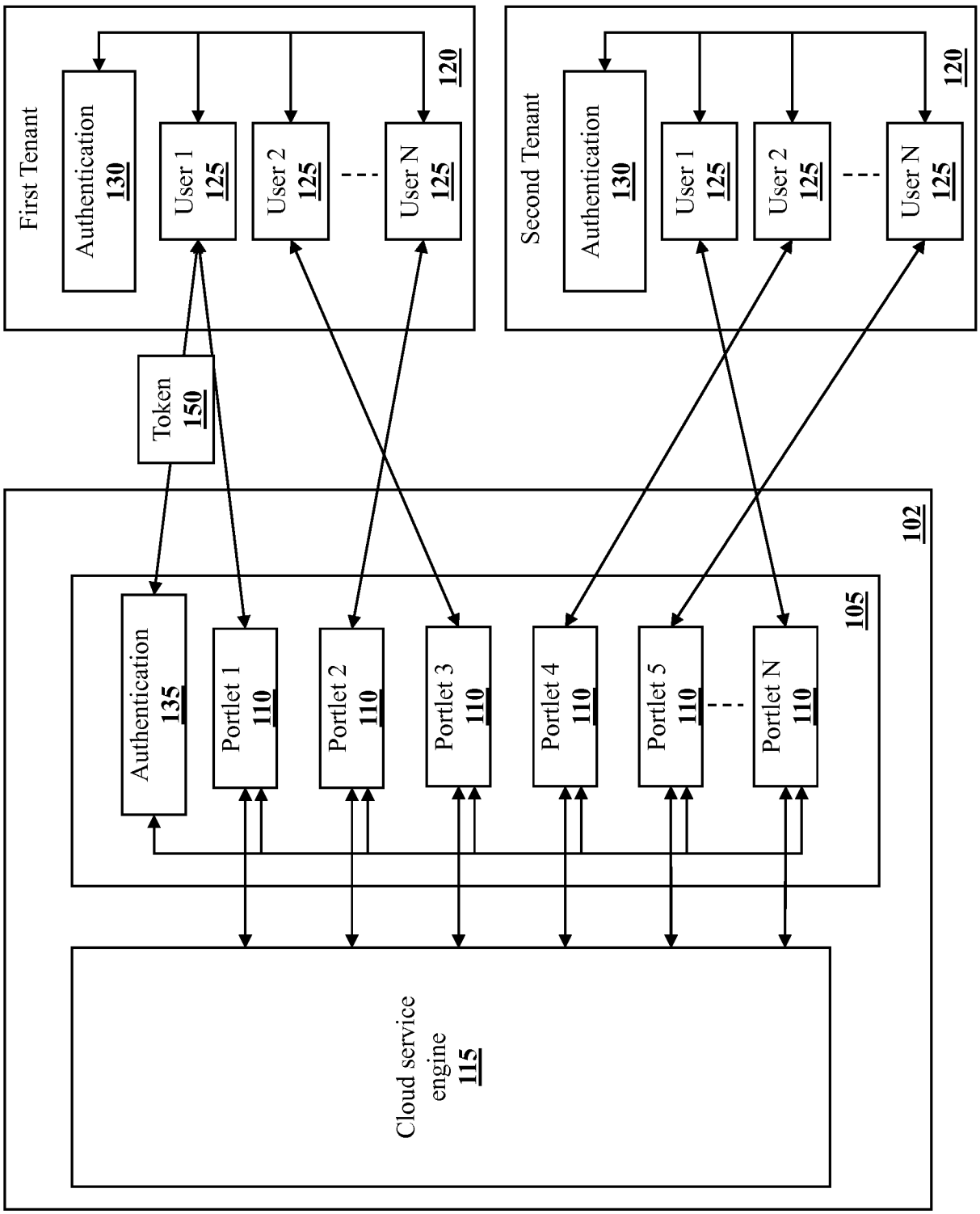
100
First Tenant
Authentication 130
User 1 125
User 2 125
User N 125
120
Second Tenant
Authentication 130
User 1 125
User 2 125
User N 125
120
Token 150
102
105
Authentication 135
Portlet 1 110
Portlet 2 110
Portlet 3 110
Portlet 4 110
Portlet 5 110
Portlet N 110
Cloud service engine 115

FIG. 1

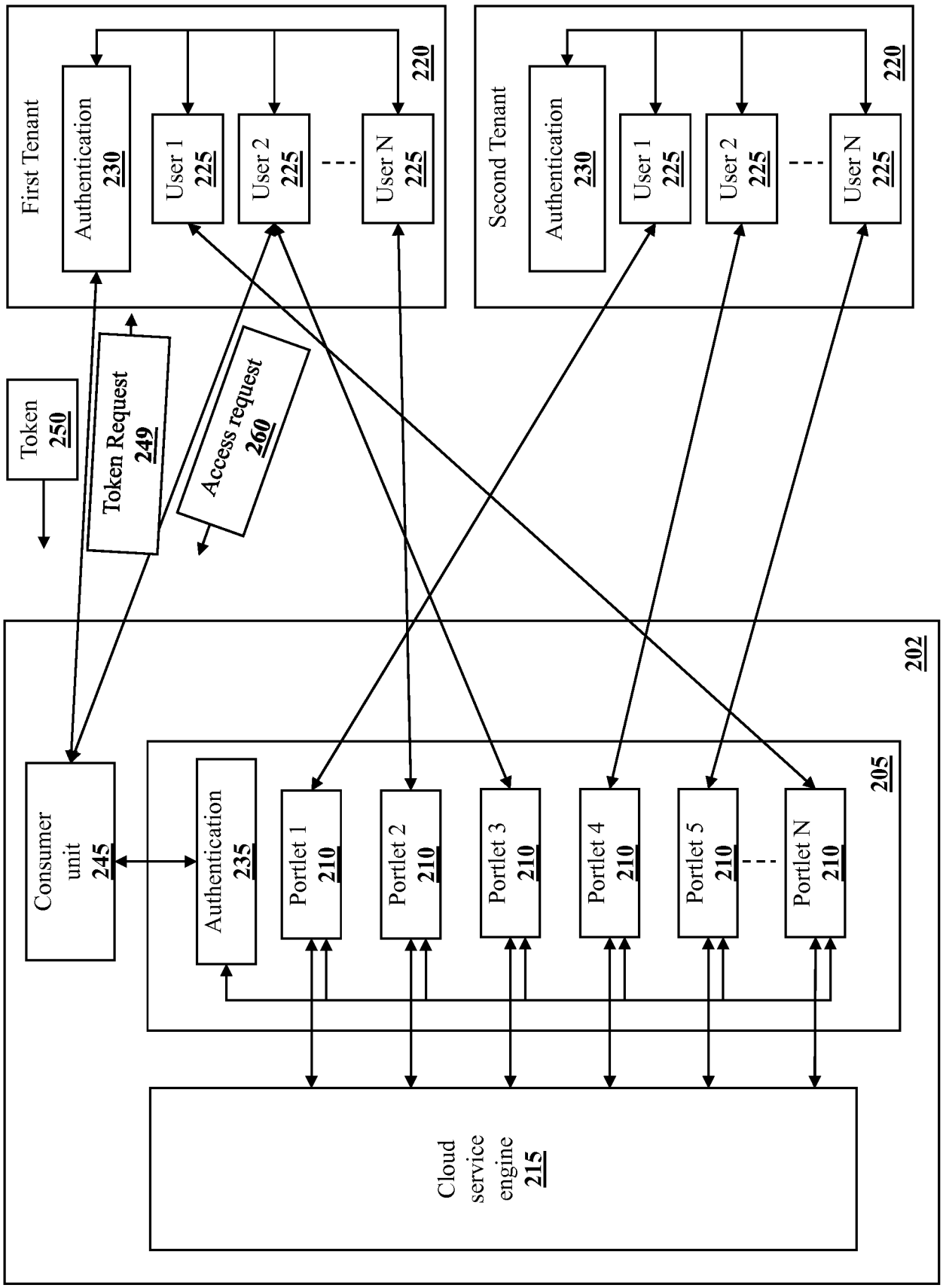
First Tenant
Authentication 230
User 1 225
User 2 225
User N 225
220
Second Tenant
Authentication 230
User 1 225
User 2 225
User N 225
220
Token 250
Token Request 249
Access request 260
202
Consumer unit 245
Authentication 235
205
Portlet 1 210
Portlet 2 210
Portlet 3 210
Portlet 4 210
Portlet 5 210
Portlet N 210
Cloud service engine 215

FIG. 2

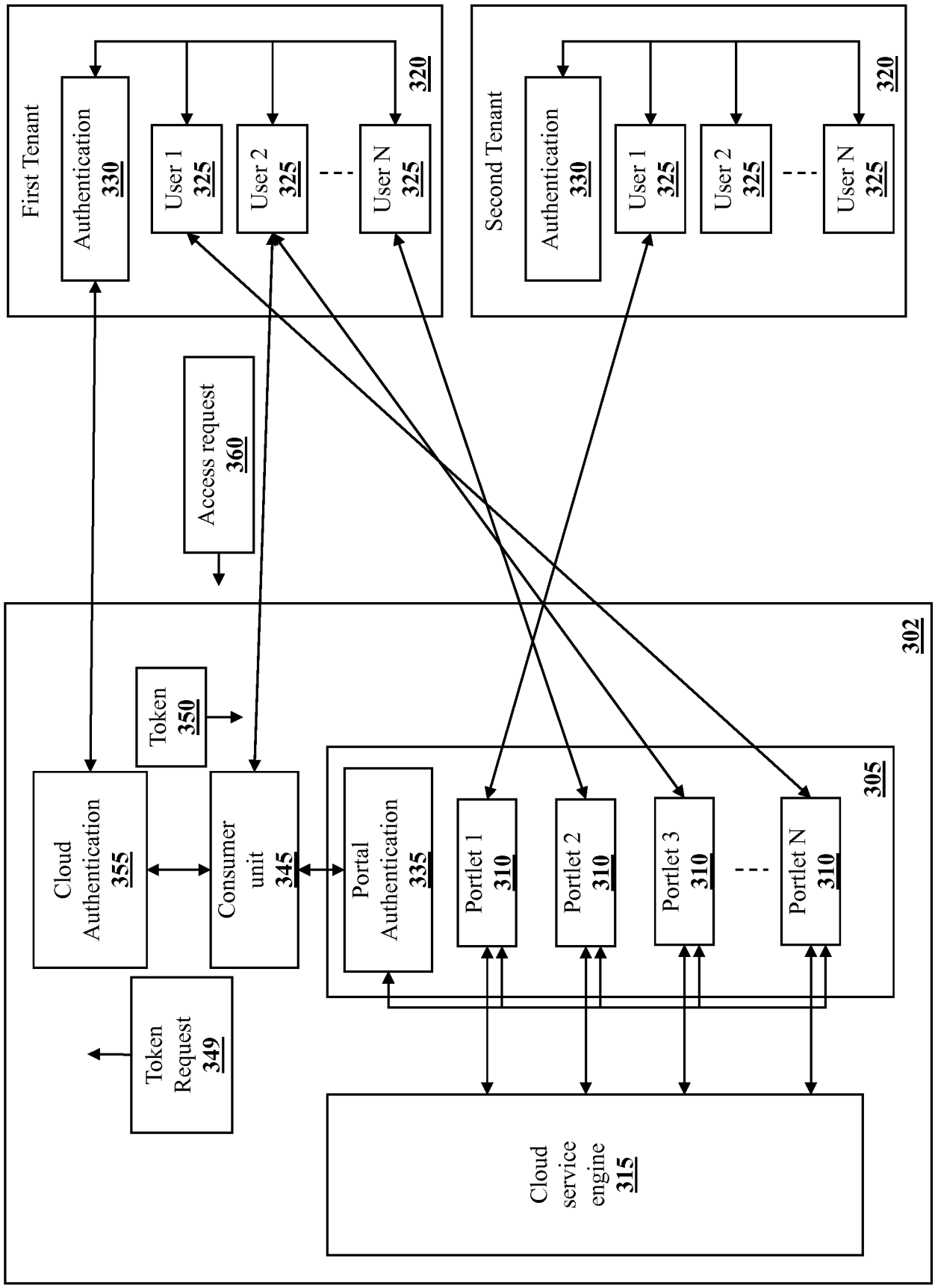
First Tenant
Authentication 330
User 1 325
User 2 325
User N 325
320
Second Tenant
Authentication 330
User 1 325
User 2 325
User N 325
320
Access request 360
302
Token 350
Cloud Authentication 355
Consumer unit 345
Portal Authentication 335
305
Portlet 1 310
Portlet 2 310
Portlet 3 310
Portlet N 310
Token Request 349
Cloud service engine 315

FIG. 3

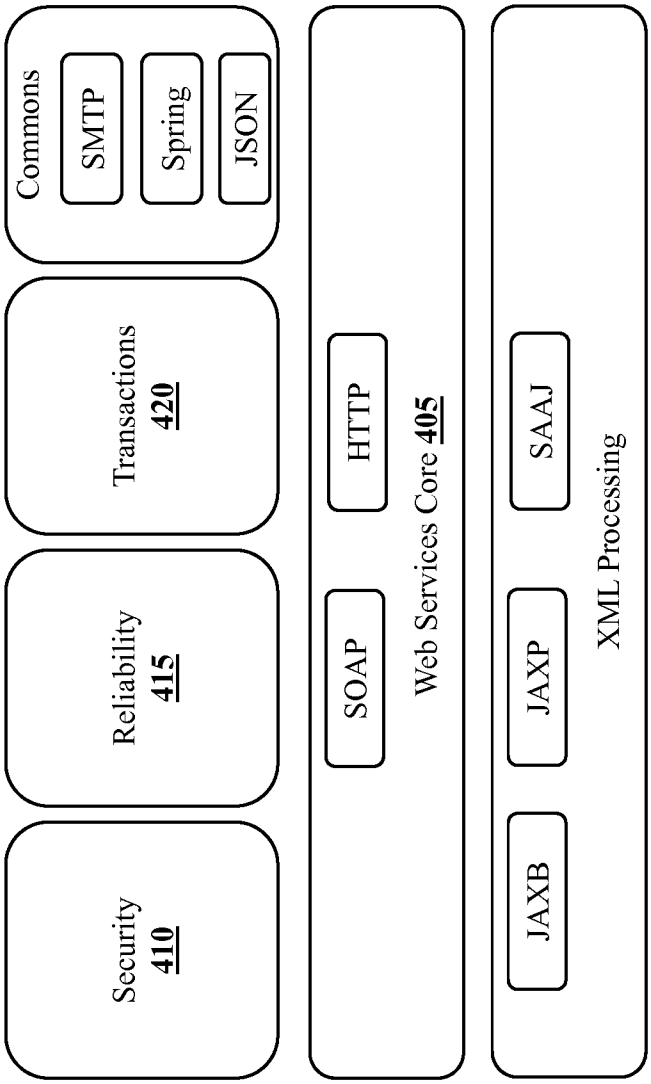
Security
410
Reliability
415
Transactions
420
Commons
SMTP
Spring
JSON
SOAP
HTTP
Web Services Core 405
JAXB
JAXP
SAAJ
XML Processing
400

FIG. 4A

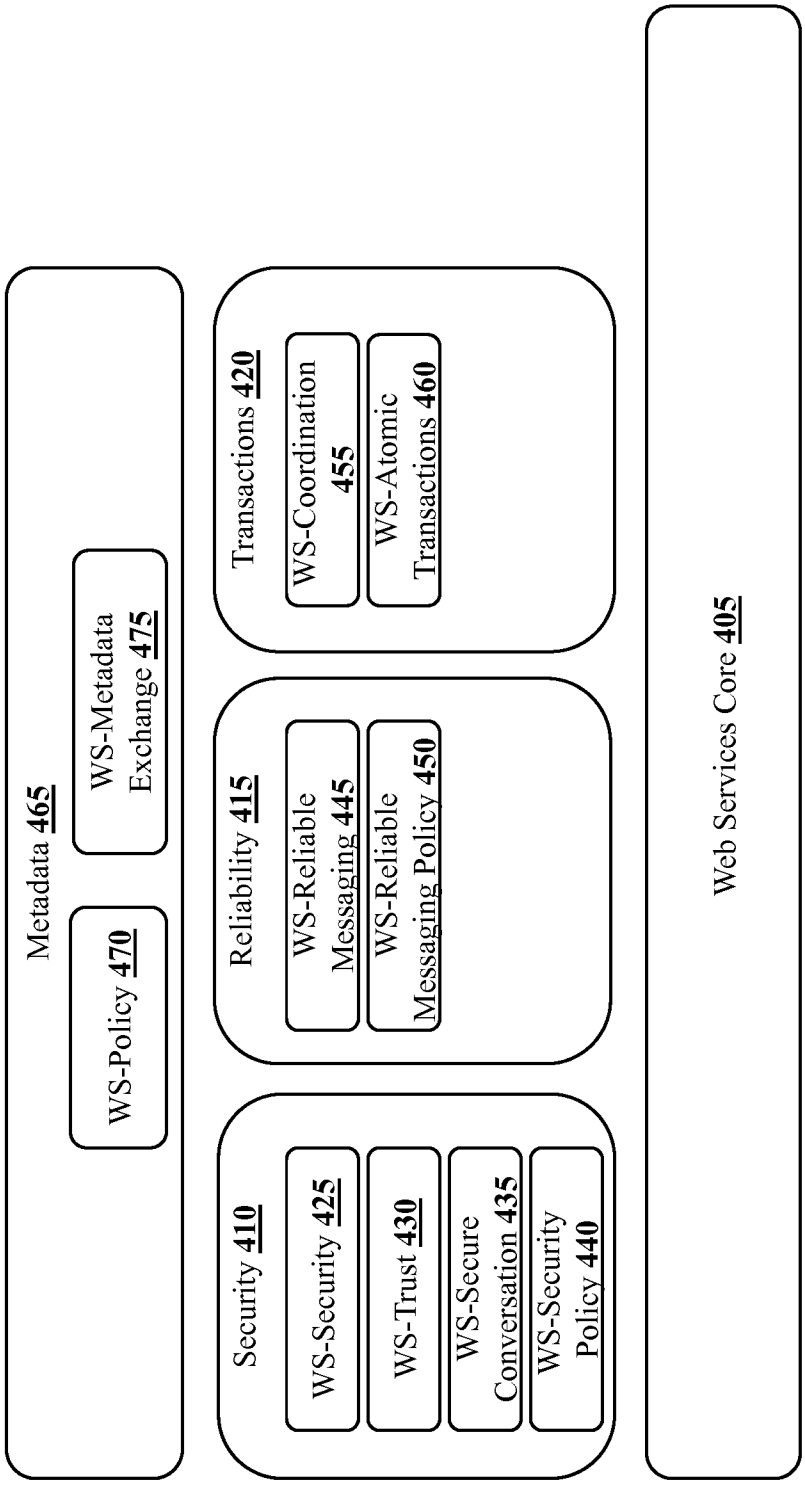
Metadata 465
WS-Policy 470
WS-Metadata Exchange 475
Security 410
WS-Security 425
WS-Trust 430
WS-Secure Conversation 435
WS-Security Policy 440
Reliability 415
WS-Reliable Messaging 445
WS-Reliable Messaging Policy 450
Transactions 420
WS-Coordination 455
WS-Atomic Transactions 460
Web Services Core 405

FIG. 4B

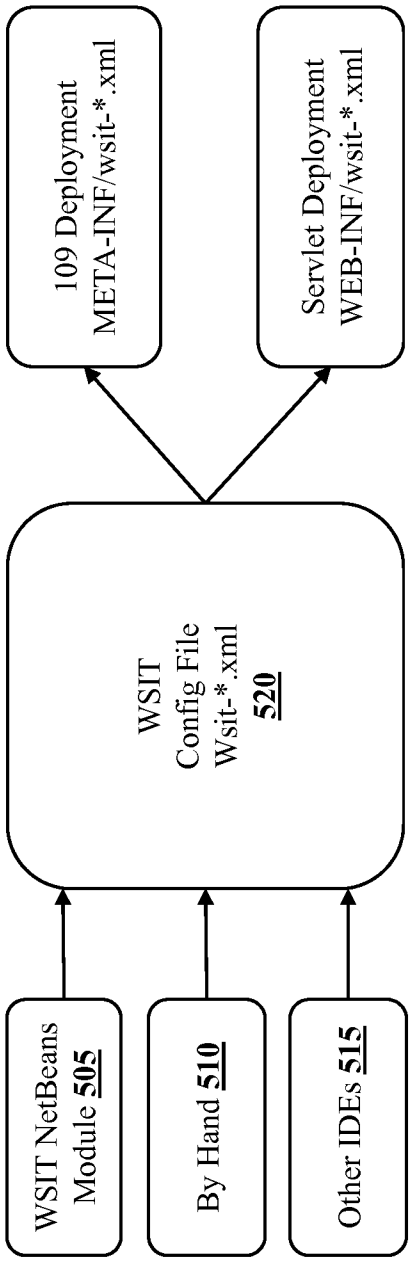
109 Deployment
META-INF/wsit-*.xml
Servlet Deployment
WEB-INF/wsit-*.xml
WSIT
Config File
Wsit-*.xml
520
WSIT NetBeans
Module 505
By Hand 510
Other IDEs 515
500

FIG. 5

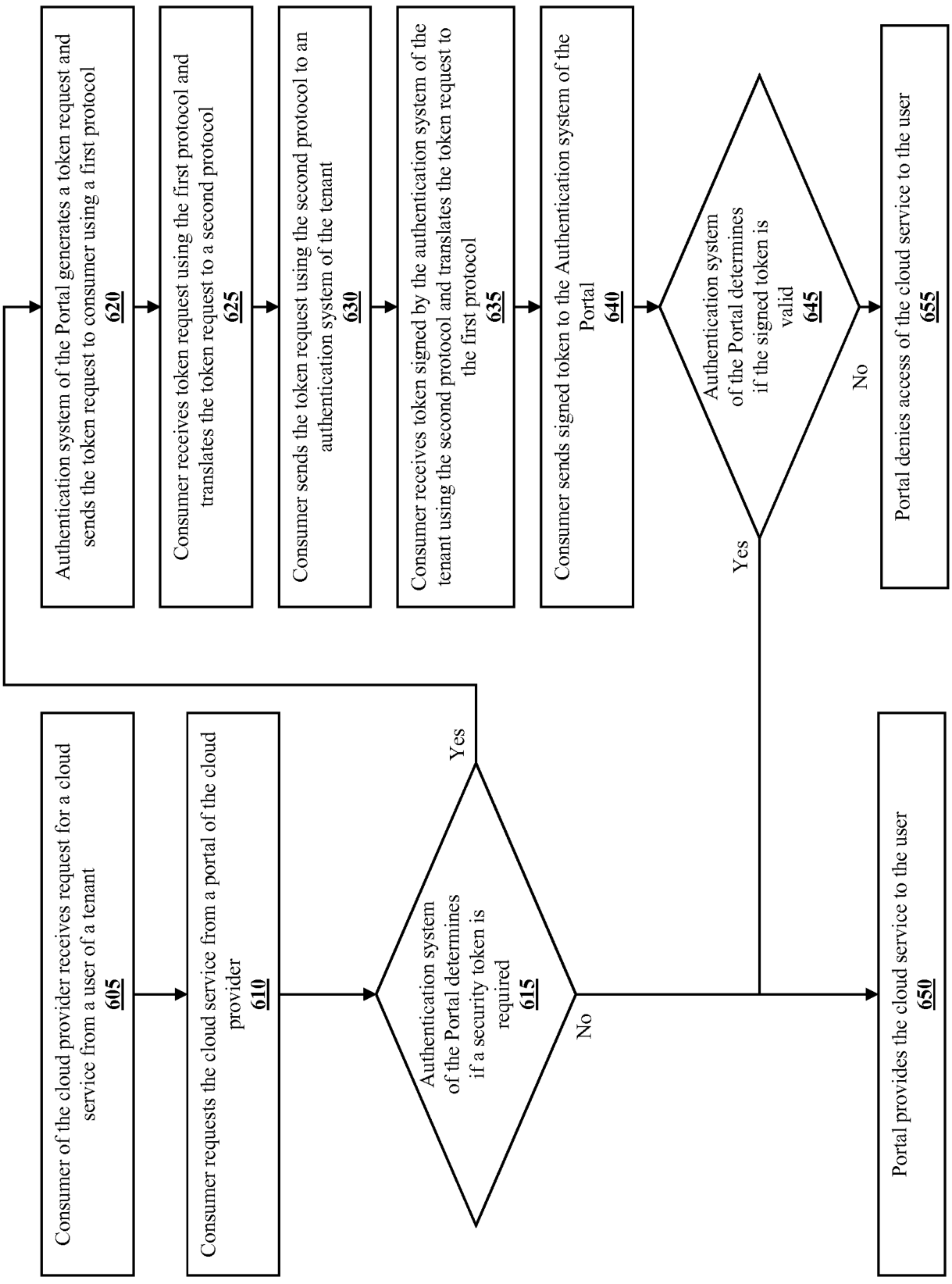
Consumer of the cloud provider receives request for a cloud service from a user of a tenant
605
Consumer requests the cloud service from a portal of the cloud provider
610
Authentication system of the Portal determines if a security token is required
615
Yes
No
Authentication system of the Portal generates a token request and sends the token request to consumer using a first protocol
620
Consumer receives token request using the first protocol and translates the token request to a second protocol
625
Consumer sends the token request using the second protocol to an authentication system of the tenant
630
Consumer receives token signed by the authentication system of the tenant using the second protocol and translates the token request to the first protocol
635
Consumer sends signed token to the Authentication system of the Portal
640
Authentication system of the Portal determines if the signed token is valid
645
Yes
No
Portal provides the cloud service to the user
650
Portal denies access of the cloud service to the user
655
600

FIG. 6

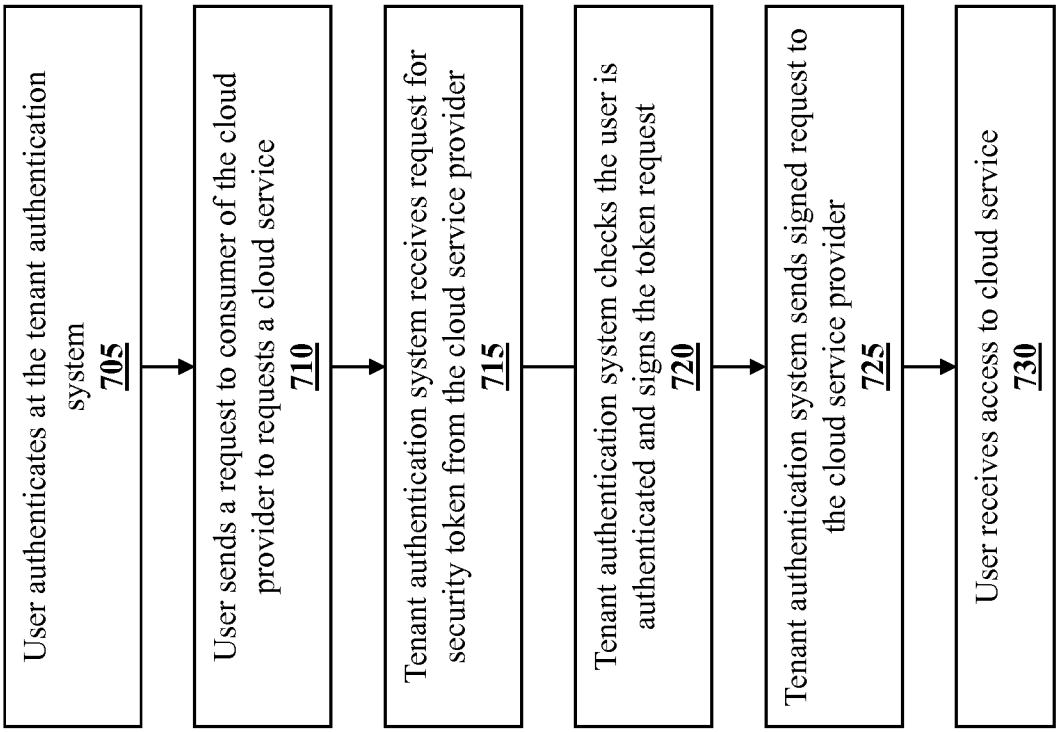
User authenticates at the tenant authentication system
705
User sends a request to consumer of the cloud provider to requests a cloud service
710
Tenant authentication system receives request for security token from the cloud service provider
715
Tenant authentication system checks the user is authenticated and signs the token request
720
Tenant authentication system sends signed request to the cloud service provider
725
User receives access to cloud service
730
700

FIG. 7

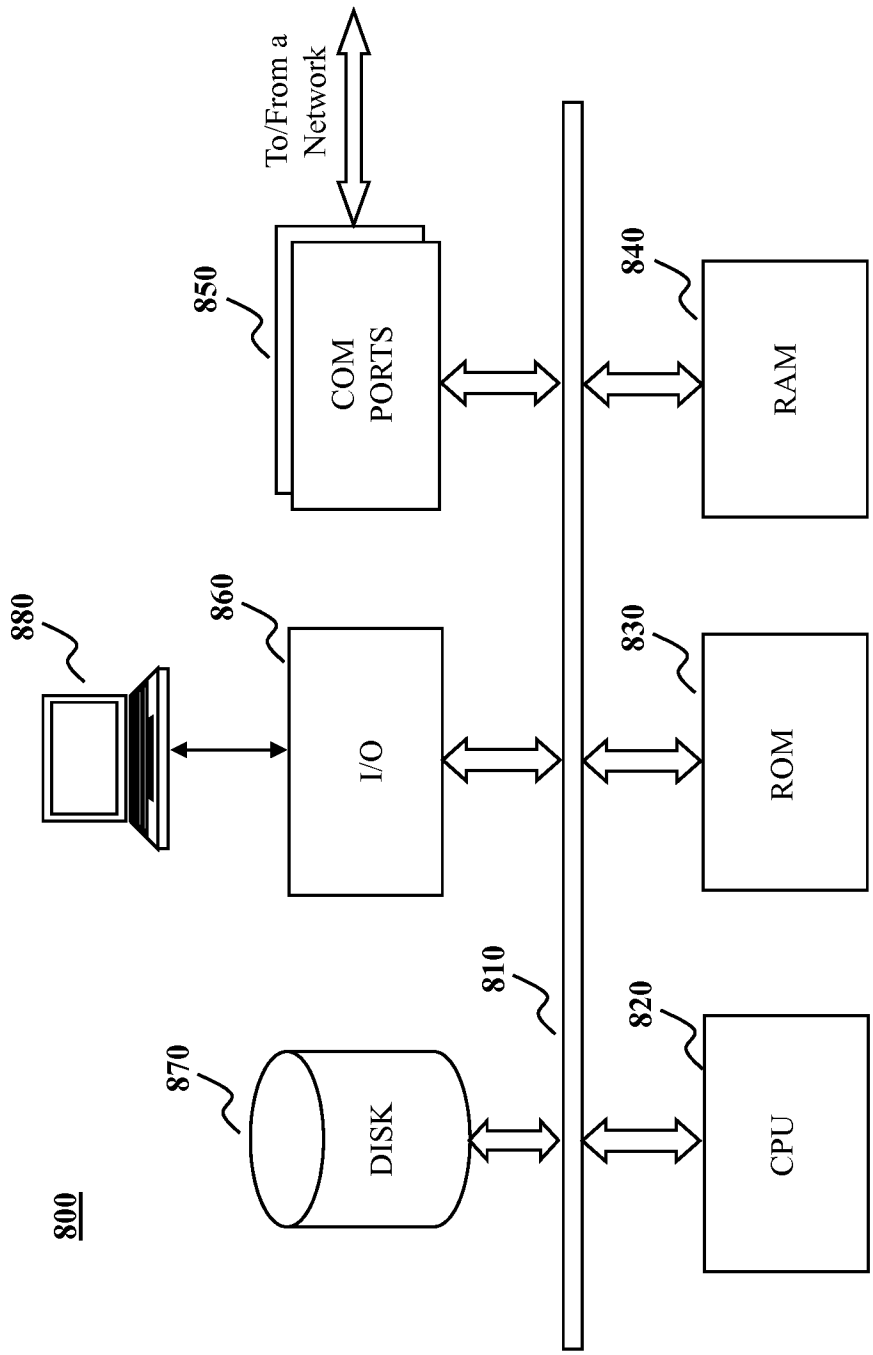
800
DISK
870
CPU
820
ROM
830
I/O
860
880
COM PORTS
850
RAM
840
To/From a Network
810

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/064425

A. CLASSIFICATION OF SUBJECT MATTER

G06Q 50/10(2012.01)i, G06F 21/20(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06Q 50/10; G06F 15/16; G06F 21/20; G06F 17/30; H04L 9/32

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: single sign on, cloud system, authentication

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011-0138453 A1 (VERMA, S. et al.) 9 June 2011 See page 1, paragraph [0005]-page 5, paragraph [0054], claims 1-20 and figures 1-8.	1-20
A	US 2007-0044143 A1 (ZHU, B. et al.) 22 February 2007 See page 2, paragraph [0023]-page 7, paragraph [0071] and figures 1-8.	1-20
A	US 2011-0153727 A1 (LI, H.) 23 June 2011 See page 2, paragraph [0023]-page 6, paragraph [0057] and figures 1-6.	1-20
A	KR 10-2010-0034321 A (ELECTRONICS AND TELECOMMUNICATIONS RESEARCH INSTITUTE) 1 April 2010 See page 6, paragraph [0020]-page 9, paragraph [0049] and figures 1-7.	1-20

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 March 2013 (26.03.2013)	**29 March 2013 (29.03.2013)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer KWON, Min Jeong Telephone No. 82-42-481-8678

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/064425

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2011-0138453 A1	09.06.2011	None	
US 2007-0044143 A1	22.02.2007	AU 2006-283634 A1	01.03.2007
		CA 2619420 A1	01.03.2007
		CN 100580657 C	13.01.2010
		CN 101243438 A	13.08.2008
		EP 1917603 A1	07.05.2008
		IL 189131A	31.10.2011
		IL 189131D0	07.08.2008
		JP 2009-505308 A	05.02.2009
		JP 5009294 B2	08.06.2012
		KR 10-2008-0041220 A	09.05.2008
		MX 2008002504 A	07.04.2008
		RU 2008106779 A	27.08.2009
		RU 2417422 C2	27.04.2011
		US 7690026 B2	30.03.2010
		WO 2007-024626 A1	01.03.2007
		ZA 200801179A	24.06.2009
US 2011-0153727 A1	23.06.2011	CN 102118430 A	06.07.2011
		EP 2336886 A2	22.06.2011
		EP 2336886 A3	06.06.2012
		JP 2011-129117 A	30.06.2011
		KR 10-1227267 B1	28.01.2013
KR 10-2010-0034321 A	01.04.2010	KR 10-1001555 B1	17.12.2010
		US 2011-0173689 A1	14.07.2011
		WO 2010-035949 A2	01.04.2010