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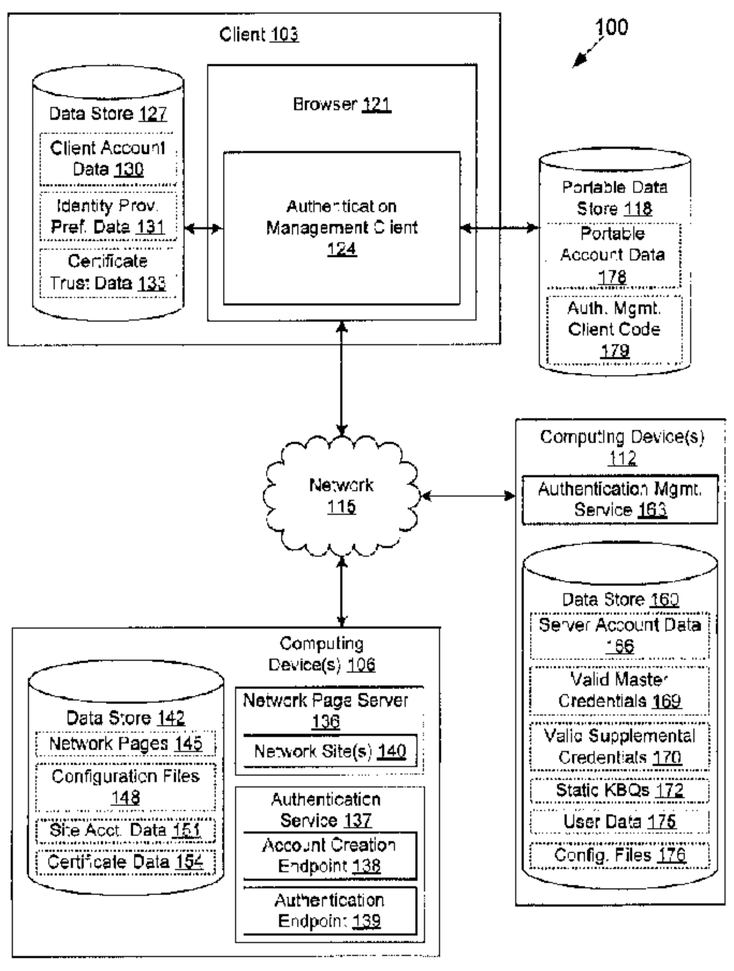

(57) Abrégé/Abstract:
An authentication service obtains first and second authentication requests that specify first and second security credentials associated with first and second user accounts using authentication protocols from a first authentication management client application executed in a first client computing device and a second authentication management client application executed in a second client computing device, respectively. The authentication service authenticates the first user account at the first client computing device for access to at least one secured resource of a network site hosted by at least one other computing device in response to the first authentication request and authenticates the second user account at the second client computing device for access to the at least one secured resource of the network site in response to the second authentication request. The first and second authentication management client applications are different and are deployed by different providers of authentication management services.

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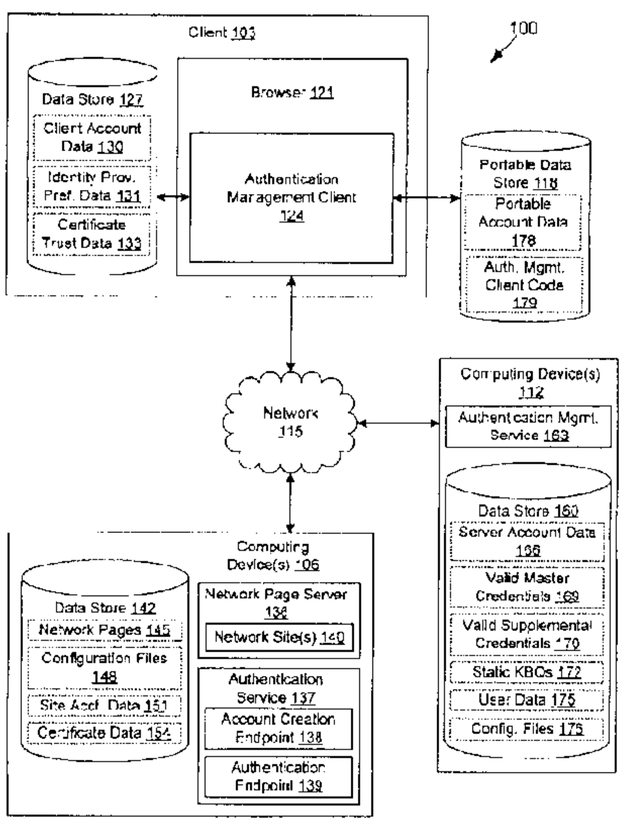

FIG. 1

(57) Abstract: Disclosed are various embodiments for account management for multiple network sites. Multiple accounts of a user are maintained for multiple network sites in a computing device. A secured resource of a network site is to be accessed by the computing device. A new account is created, or an existing account is upgraded, in response to determining that the accounts are not capable of accessing the secured resource. A set of information about the user is provided to the network site to create, or upgrade, the account.

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AUTHENTICATION MANAGEMENT SERVICES

BACKGROUND

[0001] Many web sites require users to log in with a username and password so that the users may be securely identified. Users, however, often forget their username and/or password that are required to log in to a web site. It is also common for users to use the same username and/or password for multiple web sites. Managing tens or even hundreds of usernames and passwords is a major cause of pain for users and results in excessive abandonment rates where users simply fail to sign up for a new service if it requires a new account.

[0002] In one embodiment, there is provided a system. The system includes at least one computing device, and an authentication service executable in the at least one computing device. The authentication service includes logic that obtains a first authentication request by way of an authentication protocol from a first authentication management client application executed in a first client computing device, the first authentication request specifying a first security credential associated with a first user account, and logic that authenticates the first user account at the first client computing device for access to at least one secured resource of a network site hosted by at least one other computing device in response to the first authentication request. The authentication service further includes logic that obtains a second authentication request by way of the authentication protocol from a second authentication management client application executed in a second client computing device, the second authentication request specifying a second security credential associated with a second user account, and logic that authenticates the second user account at the second client computing device for access to the at least one secured resource of the network site in response to the second authentication request. The first authentication management client application and the second authentication management client application are different authentication management client applications deployed by different providers of authentication management services.

[0002a] In another embodiment, there is provided a non-transitory computer-readable medium embodying at least one program executable in a client computing device. The at least one program includes code that decrypts a security credential associated with a user account stored by a first authentication management client in response to receiving a master security credential from an input device of the client computing device. The security credential is stored in the client computing device in an encrypted form. The at least one program further includes code that sends a first authentication request using the first authentication management client by way of an authentication protocol to an authentication service associated with a first secured resource of a network site, the first authentication request specifying the security credential associated with the user account, and code that accesses the first secured resource after being authenticated by the authentication service in response to the first authentication request. The at least one program further includes code that imports the user account and the decrypted security credential associated with the user account from the first authentication management client into a second authentication management client configured to interact with a second secured resource. The at least one program further includes code that sends a second authentication request using the second authentication management client by way of the authentication protocol to the authentication service, the second authentication request specifying the decrypted security credential, and code that accesses the second secured resource after being authenticated by the authentication service in response to the second authentication request. The at least one program further includes code that, in response to receiving a denial of an access request to another secured resource, sends an account upgrade request for the user account using the second authentication management client to the authentication service, wherein the account upgrade request seeks a permission for the user account associated with the user to access the another secured resource and specifies a set of information about the user, and code that accesses the another secured resource of the network site after the user account receives the permission to access the another secured resource.

[0002b] In another embodiment, there is provided a method. The method involves obtaining, in at least one computing device, a first authentication request by way of an authentication protocol from a first authentication management client application executed in a first client computing device, the first authentication request specifying a first security credential associated with a first user account. The method further involves authenticating, in the at least one computing device, the first user account submitted by the first client computing device for access to at least one secured resource of a network site hosted by at least one other computing device in response to the first authentication request. The method further involves obtaining, in the at least one computing device, a second authentication request by way of the authentication protocol from a second authentication management client application executed in a second client computing device, the second authentication request specifying a second security credential associated with a second user account, and authenticating, in the at least one computing device, the second user account submitted by the second client computing device for access to the at least one secured resource of the network site in response to the second authentication request. The first authentication management client application and the second authentication management client application are different authentication management client applications deployed by different providers of authentication management services.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] Many aspects of the present disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the disclosure. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0004] FIG. **1** is a drawing of a networked environment according to various embodiments of the present disclosure.

[0005] FIGS. **2**A-**2**C are drawings of examples of user interfaces rendered by a client in the networked environment of FIG. **1** according to various embodiments of the present disclosure.

[0006] FIGS. **3**-**6**B are flowcharts illustrating examples of functionality implemented as portions of an authentication management client executed in a client in the networked environment of FIG. **1** according to various embodiments of the present disclosure.

[0007] FIG. **7** is a flowchart illustrating one example of functionality implemented as portions of an authentication endpoint executed in a computing device in the networked environment of FIG. **1** according to various embodiments of the present disclosure.

[0008] FIG. **8** is a flowchart illustrating one example of functionality implemented as portions of an authentication management service executed in a computing device in the networked environment of FIG. **1** according to various embodiments of the present disclosure.

[0009] FIG. **9** is a schematic block diagram that provides one example illustration of a client employed in the networked environment of FIG. **1** according to various embodiments of the present disclosure.

DETAILED DESCRIPTION

[0010] The present disclosure relates to managing security credentials such as usernames, passwords, security keys, and/or other security credentials. Although passwords may be a strong security credential when used properly, they are often misused. For example, a user may set a relatively weak password, such as a word from a dictionary or a password that is otherwise easy to guess. A user may also set the same password for multiple accounts across multiple network sites and with different security requirements. Thus, if one account is compromised, all other accounts using the same password are also vulnerable.

[0011] Thus, many problems associated with using passwords as a security credential are caused by humans being unable to process the type of data that passwords represent. Strong passwords often contain random characters and are long, which makes them hard to remember. Passwords are often not a single chunk of information and can stretch the limits of human working memory. The system disclosed herein largely separates the user from the password, thereby resolving many of the issues. For example, the system may automatically generate a unique, strong password for each network site, using characters selected from the entire set of characters acceptable by the network site. This can provide excellent resilience to brute force, rainbow table, and/or other attacks. In ordinary use, the user may not need to know the password for the network site. Further, the system may store the password on a server and make the password available to the user across multiple client devices, even on public-use client devices such as kiosks, *etc.* Access to the centrally stored passwords may be protected by knowledge-based questions, master passwords, and/or other approaches.

[0012] In various embodiments, accounts may be created automatically by an authentication management client providing a base set of information about a user to an account creation endpoint of a network site or identity provider. Accounts may be upgraded as necessary by providing additional information to access certain secured resources. Multiple users may be able to login to the authentication management client, which may allow the users to create respective accounts and to access

secured resources of network sites by authenticating using the authentication management client. In some embodiments, multiple authentication management services may be available, and may be offered potentially by competing entities. Some network sites or identity providers may support some of the authentication management services but not others. Users may migrate from one authentication management service to another.

[0013] In various embodiments, an authentication management client presents security credentials to network sites (or identity providers) according to a domain name of the network site using domain name matching or other groupings. Some network sites may support authentication using multiple identity providers. Users may store preferences for preferred identity providers to be used by an authentication management client where multiple identity providers are available. In some situations, accounts and security credentials managed by an authentication management service may be recovered and used only by preauthorized clients. Also, credentials may be changed or exported to facilitate use outside of the authentication client. In some embodiments, where the authentication client facilitates logging into multiple network sites using multiple accounts, the authentication client may be configured to provide automatic logout functionality for the multiple network sites. In the following discussion, a general description of the system and its components is provided, followed by a discussion of the operation of the same.

[0014] With reference to FIG. **1**, shown is a networked environment **100** according to various embodiments of the present disclosure. The networked environment **100** includes a client **103** that may be in data communication with computing devices **106**, and computing devices **112** by way of a network **115**. The network **115** includes, for example, the Internet, intranets, extranets, wide area networks (WANs), local area networks (LANs), wired networks, wireless networks, or other suitable networks, *etc.*, or any combination of two or more such networks. The client **103** may also be in data connection with a portable data store **118** by way of, for example, a local interface, data bus, or another network **115**.

[0015] The client **103** may comprise, for example, a computer system such as a desktop computer, a laptop computer, personal digital assistants, cellular telephones, smartphones, set-top boxes, music players, web pads, tablet computer systems, game consoles, electronic book readers, kiosks, or other devices with like capability. Further, the client **103** may also comprise any device that is network capable that may communicate with the computing devices **106**, **112** over the network **115** to perform various functions. Such clients **103** may comprise, for example, processor-based devices having processor circuits comprising a processor and a memory.

[0016] The client **103** may be configured to execute various applications such as a browser **121**, an authentication management client **124**, and/or other applications. The browser **121** may be executed in a client **103**, for example, to access and render network pages, such as web pages, gopher pages, mobile application content, or other forms of network content served up by the computing devices **106** and/or other servers. The authentication management client **124** may be executed to manage user accounts for network sites and identity providers, including usernames, passwords, private and public keys, certificates, and/or other security credentials.

[0017] In some embodiments, the authentication management client **124** runs as a plug-in application to the browser **121**. For example, the authentication management client **124** may be implemented as a toolbar for the browser **121**. Authentication management clients **124** may be implemented in hypertext markup language (HTML) version **5**, or another language. In other embodiments, the authentication management client **124** may be a standalone application that interfaces with the browser **121**, mobile applications, and/or other applications requiring management of authentication. The client **103** may be configured to execute applications beyond the browser **121** and the authentication management client **124** such as, for example, e-mail applications, instant message applications, and other applications.

[0018] The client **103** includes a data store **127**, and potentially other data stores, which may comprise data and applications configured to provide access to

the data. The data store **127** may be used to store client account data **130**, identity provider preference data **131**, certificate trust data **133**, and/or potentially other data. The client account data **130** may include, for example, security credentials used to access various network sites or network pages, information regarding authentication endpoints, and/or other information. In various embodiments, client account data **130** may be stored in an encrypted format. In various embodiments, client account data **130** may be stored ephemerally such that the security credentials are erased upon expiration of a session of the authentication management client **124**. In one embodiment, the data store **127** may store an encrypted key that may be decrypted in response to a master security credential obtained from the user. The decrypted key may then be used to decrypt the client account data **130**.

[0019] The client account data **130** may also include a set of information about the user that may be employed by the authentication management client **124** in automatically creating or upgrading an account. Such information may include, for example, first name, last name, middle initial or middle name, email address, phone number, physical address, date of birth, and/or other information. The stored user information may be divided into more sensitive sets and less sensitive sets, which may be highlighted when a user provides consent to share the information. In one embodiment, information deemed less sensitive may be shared by default to create or upgrade accounts. If user information is requested for account creation or upgrade but is not stored in the client account data **130**, a form may be rendered for the user to provide the missing information. In one embodiment, a "base" set of information may be defined by a standard.

[0020] The identity provider preference data **131** may indicate user preferences for identity providers to be used by the authentication management client **124** where multiple identity providers are available for a network site. Certificate trust data **133** may describe trusted certificate authorities that issue digital certificates used by network sites. Certificate trust data **133** may comprise, for example, public keys associated with the trusted certificate authorities. The public keys may be used to validate the digital signature of a trusted certificate authority on a digital certificate.

[0021] The computing device **106** may comprise, for example, a server computer or any other system providing computing capability. Alternatively, a plurality of computing devices **106** may be employed that are arranged, for example, in one or more server banks or computer banks or other arrangements. For example, a plurality of computing devices **106** together may comprise a cloud computing resource, a grid computing resource, and/or any other distributed computing arrangement. Such computing devices **106** may be located in a single installation or may be distributed among many different geographical locations. For purposes of convenience, the computing device **106** is referred to herein in the singular. Even though the computing device **106** is referred to in the singular, it is understood that a plurality of computing devices **106** may be employed in the various arrangements as described above.

[0022] The computing device **106** is configured to execute various applications such as, for example, a network page server **136**, an authentication service **137** having an account creation endpoint **138** and an authentication endpoint **139**, and other applications. The network page server **136** is configured to serve up network pages, such as web pages, and other data from the computing device **106** to various clients **103**. The network page server **136** may be configured to send network pages by hypertext transfer protocol (HTTP), hypertext transfer protocol secure (HTTPS), or some other protocol. The network page server **136** may employ encryption using, for example, secure sockets layer (SSL), transport layer security (TLS), and/or some other approach. Non-limiting examples of network page servers **136** include Apache® HTTP Server, Apache® Tomcat, Microsoft® Internet Information Services (IIS), and other server applications.

[0023] The network page server **136** may be configured to serve up one or more network sites **140**. Such a network site **140** is said to be hosted by the network page server **136**. A network site **140** may include a set of network pages and/or files associated with a domain name, such as a canonical name, and a directory, such as a root directory (*i.e.*, "/") or some other directory. Each network site **140** may be

associated with distinct configuration settings in the network page server **136**, while other default configuration settings may be shared across network sites **140**.

[0024] The authentication service **137** is executed to facilitate account creation and authentication. The authentication service **137** may be operated by the network site **140** or may be employed by multiple network sites **140**. Where the authentication service **137** is employed by multiple network sites **140**, the authentication service **137** may be referred to as an identity provider. As an identity provider, the authentication service **137** may be used by many different network sites **140** operated by many different entities. In some cases, a network site **140** may support multiple authentication services **137** or identity providers. In various embodiments, the network sites **140** and the authentication services **137** may be executed in the same computing device **106** or in different computing devices **106**.

[0025] The account creation endpoint **138** may comprise a network page and/or software configured to facilitate creation of one or more accounts and/or the establishment of security credentials for existing accounts for one or more users at a client **103** for one or more network sites **140** using an account creation protocol. In various embodiments, the authentication management client **124** communicates with the account creation endpoint **138** through the network page server **136**. To this end, the account creation endpoint **138** may be a plug-in or other module of the network page server **136**, a script or other software embedded within a network page or otherwise within a network site **140** and executed by way of an interpreter or a common gateway interface, or accessed in some other way through the network page server **136**. In other embodiments, the account creation endpoint **138** may be a server application executing on the same or a different computing device **106** as the network page server **136**.

[0026] The authentication endpoint **139** may comprise a network page and/or software configured to facilitate authentication of a user at a client **103** for one or more network sites **140**. In various embodiments, the authentication management client **124** communicates with the authentication endpoint **139** through the network page server **136**. To this end, the authentication endpoint **139** may be a plug-in or

other module of the network page server **136**, a script or other software embedded within a network page or otherwise within a network site **140** and executed by way of an interpreter or a common gateway interface, or accessed in some other way through the network page server **136**. In other embodiments, the authentication endpoint **139** may be a server application executing on the same or a different computing device **106** as the network page server **136**.

[0027] The computing device **106** includes a data store **142** and potentially other data stores, which may comprise data and applications configured to provide access to the data. The data store **142** may be used to store network pages **145**, configuration files **148**, site account data **151**, certificate data **154**, and/or potentially other data. Network pages **145** may include the network pages and/or files served up for the network sites **140** hosted by the network page server **136**. Configuration files **148** may include one or more security credential specifications and/or describe an interface of one or more account creation endpoints **138** and/or authentication endpoints **139**. Site account data **151** comprises security credentials and/or other data associated with users of one or more network sites **140**. Certificate data **154** comprises digital certificates that may be used by the network page server **136**, the authentication endpoint **139**, and/or other applications on the computing device **106** to identify a network site and/or encrypt data.

[0028] The computing device **112** may comprise, for example, a server computer or any other system providing computing capability. Alternatively, a plurality of computing devices **112** may be employed that are arranged, for example, in one or more server banks or computer banks or other arrangements. For example, a plurality of computing devices **112** together may comprise a cloud computing resource, a grid computing resource, and/or any other distributed computing arrangement. Such computing devices **112** may be located in a single installation or may be distributed among many different geographical locations. For purposes of convenience, the computing device **112** is referred to herein in the singular. Even though the computing device **112** is referred to in the singular, it is understood that a

plurality of computing devices **112** may be employed in the various arrangements as described above.

[0029] Various applications and/or other functionality may be executed in the computing device **112** according to various embodiments. Also, various data is stored in a data store **160** that is accessible to the computing device **112**. The data store **160** may be representative of a plurality of data stores **160** as can be appreciated. The data stored in the data store **160**, for example, is associated with the operation of the various applications and/or functional entities described below.

[0030] The components executed on the computing device **112**, for example, include an authentication management service **163** and other applications, services, processes, systems, engines, or functionality not discussed in detail herein. The authentication management service **163** is executed to provide access to security credentials stored by the computing device **112** in association with a user account with a network site **140**. In various embodiments, the authentication management service **163** may be configured to generate user accounts and/or establish security credentials with the network site **140** on behalf of a user at a client **103**. In various embodiments, the authentication management service **163** may authenticate clients **103** using a master security credential and/or knowledge-based questions.

[0031] In one embodiment, the authentication management services **163** are registered in a directory of such services. Such a directory may be maintained by an impartial third party. The authentication management services **163** may be differentiated with respect to one another. Some authentication management services **163** may, for example, offer a privacy-friendly service that ensures users that their browsing habits are not being profiled by the authentication management service **163**. Other authentication management services **163** may choose to track logins performed by the authentication management client **124**. Users may be able to migrate their account data from one authentication management service **163** to another authentication management service **163** by way of a migration protocol.

[0032] The data stored in the data store **160** includes, for example, server account data **166**, valid master credentials **169**, valid supplemental credentials **170**,

static knowledge-based questions **172**, user data **175**, configuration files **176**, and potentially other data. The data stored in the data store **160** may be partitioned into user-specific data and global data. The server account data **166** includes security credentials for users for authentication to network sites **140**. Such security credentials may be stored in an encrypted form or a non-encrypted form. The server account data **166** may also include information regarding account creation endpoints **138**, authentication endpoints **139** and/or other information. The authentication management clients **124** may be configured to update and synchronize the server account data **166** with the client account data **130** frequently to ensure freshness when the user logs in via multiple clients **103**.

[0033] The valid master credentials **169** are employed to authenticate users for the authentication management service **163**. In one example, the valid master credentials **169** may correspond to hashed versions of a master security credential established by users. The valid supplemental credentials **170** correspond to supplemental credentials that may also be employed to authenticate users for the authentication management service **163**. Unlike the master security credential, a combination of one or more valid supplemental credentials **170** along with correct answers to one or more knowledge-based questions may be needed for a user to be authenticated. Respective weights may be applied to each component of a score used to determine authentication.

[0034] The static knowledge-based questions **172** correspond to knowledge-based questions for which the user has preconfigured an answer. Such questions may be selected by the user or may be preselected. The user data **175** corresponds to various data associated with users. Such user data **175** may relate to purchase transactions of a user with an online retailer, browsing history, order history, search history, profile information, and/or other data. The user data **175** may be employed to generate dynamic knowledge-based questions as will be described. The user data **175** may correspond to data describing the interactions of a user with a network site **140** in some embodiments.

[0035] The configuration files **176** may include one or more security credential specifications and/or describe an interface of one or more account creation endpoints **138** and/or authentication endpoints **139**. While the data in the data store **160** that has been previously discussed has been of a user-specific nature, the configuration files **176** may be non-user specific and thus may be considered global data.

[0036] The portable data store **118** may comprise, for example, a universal serial bus (USB) flash storage device, a solid-state storage device, a portable hard disk, a floppy disk, an optical disc, and/or other portable storage devices. In various embodiments, the portable data store **118** may include a processor circuit comprising a processor and a memory. In other embodiments, the portable data store **118** may merely consist of a non-transitory computer-readable storage medium. The portable data store **118** may be removably attached to the client **103** in some embodiments.

[0037] The portable data store **118** may be configured to store portable account data **178**, authentication management client code **179**, and/or other data. The portable account data **178** may include, for example, security credentials used to access various network sites **140** or network pages **145**, information regarding authentication endpoints **139**, master security credentials to decrypt the client account data **130**, and/or other information. In various embodiments, the portable account data **178** may be a mirror of the client account data **130** or the server account data **166**. In other embodiments, the portable account data **178** may take the place of client account data **130** or the server account data **166**. The portable account data **178** may be stored in an encrypted format.

[0038] To this end, the portable data store **118** may include a device (*e.g.*, a fingerprint scanner or other biometric recognition device, a pin pad, *etc.*) used to authenticate a user in order to provide access to the data on the portable data store **118**, such as portable account data **178**; or it may include hardware and/or software to permit a user to enter a password and/or decryption key in order to provide access to the data on the portable data store **118**. Additionally, in some

embodiments, the authentication management client **124** may be stored as authentication management client code **179** on the portable data store **118** and executed in the client **103**, for example, when the portable data store **118** is attached to the client **103**.

[0039] Next, a general description of the operation of the various components of the networked environment **100** is provided. To begin, a user may install authentication management client **124** onto the client **103** and preconfigure the operation of the authentication management client **124** for existing accounts associated with network sites **140**. For example, the user may provide to the authentication management client **124** and/or the authentication management service **163** existing security credentials such as, for example, usernames, passwords, security keys, certificates, and/or other security credentials along with identifying information for the network sites **140** and/or uniform resource locators (URLs) associated with the security credentials. The authentication management client **124** may be associated with one or more of multiple authentication management services **163**. The authentication management clients **124** may or may not interact with the authentication management services **163** by way of a standard authentication management protocol. In some cases, the authentication management client **124** may show some logo or other branding associated with a corresponding authentication management service **163**.

[0040] The user may also configure a master security credential such as, for example, a username, password, biometric identification, *etc.* for the authentication management client **124** so that the security credentials may be encrypted or otherwise protected from use or view on the client **103** without the authorization of the user. In one embodiment, upon installation of the authentication management client **124**, the authentication management client **124** encrypts the client account data **130** using a randomly-generated, high-entropy master key. This master key may, in turn, be encrypted to a user-specified master key, which may be stored along with the client account data **130** to allow for local decryption. In some embodiments, access to the operating system user session in the client **103** may

provide access to the client account data **130** without a separate user login. In one embodiment where the client **103** executes the Windows® operating system, the master security credential may be stored in "Credential Manager."

[0041] Where the security credentials are stored in the server account data **166** of the computing devices **112**, the user may establish a valid master credential **169** with the authentication management service **163**. In one embodiment, the server account data **166** for the user may be stored in an encrypted form. In one embodiment, the server account data **166** for the user is encrypted using a security credential generated as the result of an SSL/TLS session between the client **103** and the computing device **112**, e.g., a Rivest Cipher **4** (RC**4**) symmetric key or some other security credential. The encryption may be performed in the authentication management client **124** so that security credential details are not given in the clear to the authentication management service **163**. In some cases, the user may configure answers to static knowledge-based questions **172** with the authentication management service **163**.

[0042] The account information may be stored by the authentication management client **124** in client account data **130** on the client **103** and/or at some other location. For example, the authentication management client **124** may back up the account information to the site account data **151** located on the computing device **106**, portable account data **178** located on in the portable data store **118**, and/or another location. Various techniques relating to storage of the account information on the client **103** are described by U.S. Patent Number **8,776,214** entitled "AUTHENTICATION MANAGER".

[0043] In some embodiments, the account information may be centrally hosted in the server account data **166** of the computing devices **112**. When the computing devices **112**, the portable data store **118**, or other storage locations are used to store account information, a user may be able to use the authentication management client **124** and the account information on another client **103**. To this end, the authentication management client **124** may be, for example, downloaded, configured, and loaded automatically on another client **103**. Additionally, various

functions that are described as being performed by the authentication management client **124** may instead be performed by the authentication management service **163**. For example, the authentication management service **163** may be configured to create accounts, regenerate security credentials, *etc.* in place of the authentication management client **124**. The authentication management client **124** in some cases may be characterized as a client application of the authentication management service **163**.

[0044] Security credentials may be shared among multiple users of the authentication management client **124**. As a non-limiting example, several users in an organization may share an online banking account. A first user may create a username and password for the account using the authentication management client **124** and/or the authentication management service **163**. The first user may mark the account as shared and provide a list of users that are authorized to access the account, including a second user. When the account is distributed to client account data **130**, server account data **166**, portable account data **178**, it may be secured such that only the authorized users can access it. When the second user next uses the authentication management client **124**, the second user may be given the opportunity to synchronize the new account with portable account data **178** located in the portable data store **118** belonging to the second user or in some other location.

[0045] During the installation process, in one embodiment, the user may specify whether the authentication management client **124** is to operate as a browser **121** plug-in or as a standalone application. The authentication management client **124** may be installed and configured for a plurality of browsers **121** such as Firefox®, Internet Explorer®, Safari®, Chrome®, and/or other browsers **121**. The authentication management client **124** may also be configured for a plurality of users on the client **103**.

[0046] When a user accesses a network site **140** with the browser **121** or another application, the authentication management client **124** determines whether the network site **140** is associated with stored account information, which may be

stored, for example, centrally in the server account data **166** or locally in the client account data **130**. The authentication management client **124** may communicate with an authentication service **137** of the network site **140** or of a separate identity provider.

[0047] The authentication management client **124** may refer to the domain name of the network site **140** in order to correlate a stored account with the network site **140**. In some cases, multiple network sites **140** having different domain names may use the same stored account. Sometimes, this determination may be based on a portion of the domain name, such as the second-level domain portion. As a non-limiting example, a company may have several network sites **140** with different domain names for various geographic locales or generic top-level domains, *e.g.*, "e-retailer.com," "e-retailer.net," "e-retailer.co.uk," "e-retailer.eu," "e-retailer.co.jp," and so on. The authentication management client **124** may identify the user account according to the string "e-retailer" being in the domain name, rather than an exact match of the domain name. However, the matching may not be dispositive, and the network sites **140** may in fact be unrelated. Accordingly, the identification of the account may be presented to the user for explicit confirmation before any secured information from a stored account is exchanged with the network site **140**.

[0048] If the network site **140** is not associated with stored account information, then the authentication management client **124** may notify the user and may prompt the user to provide security credentials if the user has an existing account. The user-provided security credentials may then be stored by the authentication management client **124** in one or more of client account data **130**, server account data **166**, or portable account data **178**.

[0049] Alternatively, or additionally, the authentication management client **124** and/or the authentication management service **163** may assist the user in creating an account for the network site **140**. The account may be a one-time account, a first account for the user, or a second or subsequent account for the user. The authentication management client **124** and/or the authentication management service **163** may determine how to create an account for a network site **140** based,

for example, on the structure of a form embedded within a network page **145**. Such a form may be defined in hypertext markup language (HTML), extensible markup language (XML), or some other language.

[0050] As a non-limiting example, the authentication management client **124** may identify an account creation form when a submit input element on a network page **145** is associated with text such as "Create Account." The authentication management client **124** may also examine the URL for relevant keywords. As another non-limiting example, the authentication management client **124** may identify an account creation form when a challenge response test (*e.g.*, a "Captcha") is present. The authentication management client **124** may automatically identify required fields for security credentials using, for example, input elements on a network page **145** named "username," "password," or other identifiable names. In various embodiments, the authentication management client **124** may have the user identify the account creation form and/or tag input elements of the form so that the authentication management client **124** may accurately identify how the account may be created with form filling. Such a list of tags can be stored in a configuration file **176** which may then be uploaded to a computing device **112**. There, the configuration file **176** can be accessed by other users using the authentication management client **124** and used by them to simplify account creation on the network site **140** described by the configuration file **176**. Alternatively, or additionally, configuration files **176** may be stored by the computing device **112** to be accessed by the authentication management client **124**, the authentication management service **163**, and/or other applications.

[0051] In various embodiments, the authentication management client **124** and/or the authentication management service **163** may create the account in an automated way through methods other than form filling. For example, the authentication management client **124** and/or the authentication management service **163** may obtain a configuration file **148** associated with the network site **140** from either the network page server **136** for the network site **140** or a computing device **112** that may provide a configuration file **176** associated with the network site

140. The configuration file **148**, **176** may define one or more account creation endpoints **138** for the network site **140** where the authentication management client **124** and/or the authentication management service **163** may authenticate and/or create an account other than by filling out a form. For example, the configuration file **148**, **176** may define the URL, parameters, encoding, and/or other information required to create an account in an automated way through an account creation endpoint **138**. In some embodiments, one account creation endpoint **138** may be shared by multiple network sites **140** and/or network page servers **136**. To prevent unauthorized automatic creation of accounts, the authentication management client **124** and/or the authentication endpoint **139** may include "Captchas," limit velocity of account creation, and/or take other measures.

[0052] The configuration file **148**, **176** may also include a security credential specification associated with the network site **140**. The security credential specification may specify a character set, minimum length, maximum length, and/or other parameters for usernames and/or passwords. The security credential specification may also specify minimum key length, acceptable algorithms and formats, and/or other parameters applicable to public key infrastructure or other types of security credentials.

[0053] The authentication management client **124** and/or the authentication management service **163** may generate one or more security credentials based on the security credential specification. In one embodiment, the authentication management service **163** may be configured to obtain the security credential specifications according to a subscription-based push model. In another embodiment, the authentication management service **163** may be configured to pull the security credential specifications from the computing device **106** at regular intervals.

[0054] When the authentication management client **124** and/or the authentication management service **163** is creating an account by form filling, the authentication management client **124** may prompt the user to supply a security credential specification so that the authentication management client **124** and/or the

authentication management service **163** may generate one or more security credentials to be filled in on the form. The user may see information regarding required attributes for security credentials displayed on the network page **145** near the account creation form. The authentication management client **124** may provide options including, but not limited to, length of the security credential, directions to use a certain character set, directions to use at least one number, directions to use at least one non-alphanumeric character, and other options.

[0055] As a non-limiting example, the authentication management client **124** may present a graphical interface to the user listing various attributes that may be used in generating the security credentials. Such a graphical interface may include, for example, checkboxes, radio buttons, drop-down boxes, text fields, text areas, *etc.* The graphical interface may be preconfigured with default selections. Where the security credentials are generated by the authentication management service **163**, the authentication management service **163** may perform the form filling, or the security credentials may be transferred to the authentication management client **124** for the authentication management client **124** to perform the form filling.

[0056] In various embodiments, when the authentication management client **124** is creating an account by form filling, the authentication management client **124** may replace, for example, the normal user interaction in filling out the form with a wizard interface. The wizard interface may omit tasks or fields that may be done automatically by the authentication management client **124**. However, the wizard interface may obtain input from the user in order to fill out fields such as "Captchas" and other challenge response tests. Although the authentication management client **124** and/or the authentication management service **163** may be configured to fill out fields pertaining to other personal information (*e.g.*, name, date of birth, social security number, phone number, address, *etc.*), the authentication management client **124** may instead be configured to prompt the user for that information. In various embodiments, the authentication management client **124** may leave unrecognized form fields blank for the user to complete.

[0057] Accordingly, the authentication management client **124** and/or browser **121** sends an account creation request associated with the generated security credential to the network site **140**. After the account creation request is submitted, the account will either be created or not created for the network site **140**. The network site **140** typically provides a response page indicating whether the account creation was successful. Such a network page **145** may be parsed automatically by the authentication management client **124** or may be left for additional user input to the authentication management client **124**.

[0058] In some cases, the response page will include another form with an indication that there was a problem. As a non-limiting example, a username field may be highlighted with an explanation that the specified username was already taken. The authentication management client **124** may be configured to respond automatically to such requests and/or to seek user input. Account creation responses through an authentication endpoint **139** may be handled by the authentication management client **124** in an analogous way. In one embodiment, the authentication management client **124** may simply assume that the account was created.

[0059] Responsive to account creation, the authentication management client **124** and/or the authentication management service **163** store the account information including, but not limited to, security credentials, URLs, and domain names associated with the account and network site **140**, in one or more of client account data **130**, server account data **166**, or portable account data **178**. In particular, the network site **140** or authentication endpoint **139** may present a trusted certificate from certificate data **154** during the account creation process. Information relating to this trusted certificate, including domain name, certificate authority, and other information from the certificate, may be stored with the account information.

[0060] The account information may consequently be marked as usable on a network site **140** corresponding to the domain name provided in the trusted certificate, or only for a network site **140** able to present that specific certificate in higher assurance environments. Account information stored in any of client account

data **130**, server account data **166**, or portable account data **178** may be manually or automatically copied by the authentication management client **124** and/or the authentication management service **163** to any other client account data **130**, server account data **166**, or portable account data **178** so that the account information may be mirrored across any two or more of client account data **130**, server account data **166**, or portable account data **178**.

[0061] For purposes of backup, the authentication management client **124** and/or the authentication management service **163** may be capable of rendering a list of the stored account information in client account data **130**, server account data **166**, or portable account data **178** for viewing or printing. To facilitate viewing or printing, the authentication management client **124** and/or the authentication management service **163** may be configured to generate human readable or printable security credentials using an appropriate character set. Alternatively, the authentication management client **124** and/or the authentication management service **163** may encode security credentials in a printable form using an encoding approach such as, for example, UUencoding, BinHex, Multipurpose Internet Mail Extensions (MIME) encodings, Base**64**, and other encoding approaches.

[0062] Additionally, for purposes of recovery, the master security credential may be written to removable media such as a Universal Serial Bus (USB) key. To improve security in recovery cases, the master security credential may be encrypted to a secret stored in the client **103**. This ensures that a lost USB key or other removable media cannot be used to access the server account data **166**. In some embodiments, recovery could be something implemented at least in part by the operating system by tying the master security credential to the user account in the operating system.

[0063] To enable roaming and recovery, a set of one-time passwords may be generated by the authentication management client **124**. Each of these may be used to generate additional encrypted versions of the master security credential, each of which may be appended to the server account data **166**. The one-time password may be enforced by the authentication management client **124** removing

each entry from the server account data **166** as it is used. The user may be responsible for keeping these one-time passwords somewhere outside of the system (*e.g.*, on a print out, wallet card, *etc.*)

[0064] In some embodiments, recovery and reset capabilities may be managed on a per-machine basis by the authentication management service **163**. In one embodiment, only the first client **103** for a given authentication management account may be capable of recovery. The authentication management service **163** could provide a user interface to manage clients **103**, including the ability to allow recovery/reset at additional clients **103**. Further, different types of account data recovery mechanisms may be supported (*e.g.*, one-time passwords, operating system recovery, credential stored on removable media, *etc.*), and a subset of these account data recovery mechanisms may be enabled or disabled on a per-client basis. For example, the authentication management client **124** may be configured to request permission to use a particular one of the account data recovery mechanisms. Such a request may include a client-identifying token.

[0065] The authentication management service **163** may enable or disable the requested account data recovery mechanism according to whether authorization has been granted to the particular client **103**. As a non-limiting example, a first registered client **103** (*e.g.*, a home machine) may be able to use all recovery mechanisms, but by default, none of the recovery mechanisms may be available for use on other clients **103** (*e.g.*, a friend's machine). This may be used to preempt the possibility of security attacks through such recovery mechanisms. An interface with the authentication management service **163** may be provided for a user to selectively enable or disable particular recovery mechanisms for particular clients **103**.

[0066] To facilitate recovery of a lost master security credential, the master security credential may be written to a portable data store **118** or other removable media. To improve security in such a situation, the master security credential may be encrypted to a key that is stored in the client **103** so that the master security credential may be decrypted only at the client **103**, even if the portable data store

118 or removable media is stolen. In some embodiments, the master security credential may correspond to an operating system credential that is managed by the operating system.

[0067] In some embodiments, a set of one-time passwords may be generated by the authentication management client **124**, and each of these may be used to generate additional encrypted versions of the master security credential, each of which may be appended to the client account data **130** and server account data **166**. To enforce the one-time passwords, each entry is removed by the authentication management client **124** from the client account data **130** as it is used. The user may be responsible for keeping these one-time passwords secure outside the system (*e.g.*, on a print out, on a wallet card, *etc.*).

[0068] When a stored account exists for a network site **140**, the authentication management client **124** and/or the authentication management service **163** determines whether to provide the security credentials to the network site **140**. As a preliminary matter, the authentication management client **124** and/or the authentication management service **163** may require that the user be authenticated to the authentication management client **124** and the authentication management service **163** by way of a master security credential such as a password, presence of the portable data store **118** at the client **103**, biometric identification, native operating system identification, or some other authentication. Responsive to authentication, the authentication management client **124** may decrypt the stored client account data **130**, server account data **166**, or portable account data **178**. In some embodiments, the authentication management client **124** may be given access to the stored client account data **130**, server account data **166**, or portable account data **178** responsive to providing a master security credential. The authentication management client **124** then verifies the identity of the network site **140**.

[0069] Verifying the identity of the network site **140** may be performed, for example, by comparing a domain name associated with a trusted certificate provided by a network site **140** at the time of logon with the domain name associated with the network site **140** in the stored account information. The authentication management

client **124** may compare the domain name associated with the trusted certificate provided by the network site **140**, for example, with a domain name provided by a user, a domain name inferred by heuristic analysis, or some other domain name, in order to identify which stored account the network site **140** appears to resemble. Verifying the identity of the network site **140** through the use of trusted certificates may be less susceptible to spoofing attacks than by verifying the identity merely through domain name service (DNS) name resolution, for example, or comparing a stored domain name to what is displayed in the address bar of the browser **121**.

[0070] If the network site **140** provides no certificate (*e.g.*, authentication under HTTP) or if the certificate is not trusted (*e.g.*, self-signed or issued by a certificate authority not considered to be trusted in the certificate trust data **133**), the authentication management client **124** may display a warning to the user. In some cases, the user may accept the warning and continue. In some embodiments, the authentication management client **124** may remember such characteristics and use them to aid in future identity verification of the network site **140**. In other cases, the authentication management client **124** may identify a clear use of a spoofing attack or other phishing attempt and provide additional warnings, disable authentication at the particular network site **140**, require reauthentication by the user to the authentication management client **124**, and/or take other precautions. Additionally, by integrating the authentication management client **124** with a site providing reputation data for network sites **140**, the authentication management client **124** can warn the user that a network site **140** is hostile.

[0071] The authentication management client **124** may additionally verify the identity of the network site **140** by other methods. One verification method may comprise comparing the contents of the address bar in the browser **121** with a stored URL or domain name. A second verification method may comprise comparing contents of the HTTP headers sent by the accessed network site **140** with a stored URL or domain name. A third verification method may comprise performing a reverse DNS look-up on an Internet Protocol (IP) address associated with the accessed network site **140** and comparing that domain name with a stored URL or

domain name. Other verification methods may also be employed. More secure methods may be employed prior to downgrading to less secure methods, and the user may specify acceptable methods of proving the identity of network sites **140**.

[0072] Once the identity of a network site **140** is verified, the authentication management client **124** may provide the security credentials to the network site **140** automatically through an authentication endpoint **139** or may obtain user confirmation. If the authentication management client **124** is configured to obtain user input, the authentication management client **124** may render a button or other user interface feature in or on top of the browser **121** to obtain confirmation.

[0073] When no authentication endpoint **139** is defined for a network site **140**, the authentication management client **124** may be configured to detect whether an authentication form is presented. The authentication management client **124** may examine the network page **145** for elements such as a submit input element associated with text such as "Log In," input fields matching "username" and/or "password," fields using the password type, and other identifying elements. The authentication management client **124** may also examine the URL for relevant keywords. In some embodiments, the authentication management client **124** and/or the authentication management service **163** may store a URL associated with the network site **140** in client account data **130**, server account data **166**, or portable account data **178**, which may be used for authentication. The authentication management client **124** may provide the security credentials to the network site **140** by form filling. The submission of such a form may be automatic or may be subject to user input such as selection of a "Submit" or "Log In" button or other user interface element.

[0074] In some cases, the user may forget the master security credential or may not have access to the master security credential on another client **103**. The user may then be able to either reset the master security credential, or gain at least temporary access to stored security credentials, through a procedure implemented by the authentication management service **163**. Upon a user selecting a master security credential or reset option, the authentication management service **163** may

generate a user interface providing one or more knowledge-based questions. For example, the user interface may correspond to a network page for rendering in the browser **121**. Alternatively, data may be sent to the authentication management client **124** in order for a user interface to be rendered by the authentication management client **124**.

[0075] The user interface may present static knowledge-based questions **172** that are preconfigured by the user. For example, the user interface may present a question of "What is your mother's maiden name?," "In what city were you born?," "What was the mascot of your high school?," and so on. The user interface may present true questions or false questions. True questions correspond to questions that can be validated by both the user and the authentication management service **163** that are unique to the user. False questions are those designed to catch an attacker who is attempting gain unauthorized access to the security credentials. For example, a false question may be: "What was the last payment amount for the truck you lease?" where the correct answer should be: "I do not have a truck."

[0076] Furthermore, the user interface may present knowledge-based questions that are dynamically generated by the authentication management service **163**. With dynamically generated questions, the user may have no foreknowledge as to what type of questions will be asked. Dynamically generated questions may employ user data **175** including unique customer information such as purchase transaction history and/or other data. One example of a dynamically generated question may be: "I see that you purchased an item from E-Retailer yesterday, can you tell me the bill amount?"

[0077] Multiple knowledge-based questions may be presented in a user interface. The answers to the knowledge-based questions may be used by the authentication management service **163** to generate a score. When the score meets a predefined threshold (*e.g.*, one question answered correctly, three questions answered correctly, one dynamically generated question based on recent data answered correctly, *etc.*), the user may be granted access to the stored security credentials of the server account data **166** and/or access to establish a new valid

master credential **169**. It is noted that different weighting may be applied to different types of questions in generating a score. For example, dynamic questions based on a recent event may be given a greater weight than a static question based on information obtained during account creation. In the case of new or infrequent users for whom insufficient user data **175** is present for dynamically generated questions, the authentication management service **163** may fall back to employ the static knowledge-based questions **172**.

[0078] Once a user is authenticated by the authentication management service **163** through the use of knowledge-based questions, or through a valid master security credential, security credentials of the user from the server account data **166** may be downloaded to the client account data **130** for use by the authentication management client **124**. In one example, the client **103** corresponds to a kiosk or another public-use client **103**. In such an example, the security credentials may be maintained ephemerally in the memory of the client **103** such that they are erased from memory when the user logs out, exits the browser **121**, or otherwise ends the session of the authentication management client **124**. Alternatively, the security credentials may be saved to the client account data **130** for future use through the client **103**.

[0079] Moreover, once a user is authenticated by the authentication management service **163**, the user may be presented with an opportunity to set a new security credential. For example, the user may supply the new security credential with or without the previous security credential. The valid master credentials **169** are updated by the authentication management service **163** to store the new valid master credential **169**. It is noted that the valid master credential **169** may be hashed or otherwise encoded.

[0080] The authentication management service **163** may also be employed to generate or regenerate security credentials according to security credential specifications in the configuration files **176**. In addition to initial account creation and configuration, the authentication management service **163** may be configured to regenerate security credentials periodically or when triggered by a user or

administrator. For example, an administrator may trigger an automatic regeneration of security credentials for many users with accounts for a certain network site **140** in response to a potential security compromise. Upon regeneration of the security credentials, the authentication management service **163** may establish the newly generated security credentials with the various network sites **140** using the appropriate account creation endpoint **138**. The authentication management service **163** may supply a previous security credential to facilitate establishing the newly generated security credential. The security credentials may be generated or regenerated to have a maximum security strength allowed by the security credential specification.

[0081] Where multiple authentication management services **163** are available, authentication management clients **124** may be configured to import/export the client account data **130** for use with different authentication management services **163**. Authentication management clients **124** may be deployed by different providers of authentication management services **163** or by other parties. In some embodiments, a particular authentication management client **124** may function only with a corresponding authentication management service **163**. Thus, the authentication management client **124** may be configured to allow import and export of client account data **130** to different authentication management clients **124** for use with different authentication management services **163**.

[0082] In one embodiment, the authentication management service **163** may provide a revocation user interface in order to revoke security credentials associated with the server account data **166**. To facilitate this central revocation, the security credentials in the server account data **166** may be token based, and not based on literal storage of user credentials. Revocation and reset may be performed by the authentication management client **124** in some embodiments. For example, the authentication management client **124** may include a "reset all credentials" function that would automatically reset each credential to a newly generated credential. Knowledge-based questions may be asked of the user to provide an additional check on the identity of the user before performing the automatic credential resets.

[0083] In addition to credential resets, the authentication management client **124** may support credential changes to user-specified passwords, *etc.* Such support may be useful in the case of a user going on vacation without access to the authentication management client **124**. The user may want to change the automatically generated security credentials to a single temporary password that may be easy to remember. After returning from vacation, the user may reset the temporary password to new automatically generated security credentials. In one embodiment, the single temporary password may have an expiration period, to be enforced by the authentication management service **163**.

[0084] Turning now to FIG. **2**A, shown is an example of a network page **145** (FIG. **1**) rendered by a browser **121** (FIG. **1**) executed in a client **103** (FIG. **1**) in the networked environment **100** (FIG. **1**) according to various embodiments of the present disclosure. In this example, the user may have entered, or may have been automatically redirected to, the URL "https://www.e-retailer.site/," which is displayed in the address bar **203** of the browser **121**. The network page **145** provided by the network site **140** (FIG. **1**) in response to the URL includes an authentication form having a username field **206**, a password field **209**, and a submit button **212**.

[0085] The browser **121** includes a security indication **215** that indicates that the network site **140** has presented a trusted certificate and the communication between the client **103** and the computing device **106** (FIG. **1**) is being encrypted. In FIG. **2**A, the authentication management client **124** (FIG. **1**) has verified the identity of the network site **140** and is presenting an authentication system selection **218**. The authentication system selection **218** indicates that the user has installed the authentication management client **124** and that account information associated with the network site **140** is available. In particular, the authentication system selection **218** allows for selection of account data from among multiple authentication services **137** (FIG. **1**). It may be assumed in FIG. **2**A that the user has previously authenticated with the authentication management client **124** or that an opportunity to authenticate will be presented if a supported authentication service **137** is

selected. If account data did not exist, the authentication system selection **218** may allow for account creation with a selected authentication service **137**.

[0086] Once a user selects the authentication service **137**, the authentication management client **124** may fill in the username field **206** and the password field **209**. The authentication management client **124** may also automatically submit the logon request by programmatically pressing the submit button **212**. In some embodiments, the username field **206** and password field **209** may be prefilled automatically with the security credential upon verification of the identity of the network site **140**. The security credentials may be shown as place holding characters or as plain text.

[0087] Alternatively, if, for example, an authentication endpoint **139** (FIG. **1**) is defined, the authentication management client **124** or the authentication management service **163** (FIG. **1**) may authenticate with the authentication endpoint **139** in the background. The authentication management client **124** may give an indication of success or failure and may provide another user interface element in order to log out of the network site **140**.

[0088] Moving on to FIG. **2**B, shown is another example of a network page **145** (FIG. **1**) rendered by a browser **121** (FIG. **1**) executed in a client **103** (FIG. **1**) in the networked environment **100** (FIG. **1**) according to various embodiments of the present disclosure. In the example of FIG. **2**B, an authentication management client **124** (FIG. **1**) is configured in the client **103**, but no account is found for the current network site **140** (FIG. **1**). Thus, the user is presented with the username field **206** and the password field **209** and a notification **221** that no account is found. A checkbox or other user interface component may be provided in association with the notification **221** for the user to consent to add the provided legacy account information to the authentication management client **124**. Further, a link, button, or other user interface component may be provided for the user to consent to account creation.

[0089] With reference to FIG. **2**C, shown is yet another example of a network page **145** (FIG. **1**) rendered by a browser **121** (FIG. **1**) executed in a client **103** (FIG.

1) in the networked environment **100** (FIG. **1**) according to various embodiments of the present disclosure. In the example of FIG. **2**C, the network site **140** (FIG. **1**) supports authentication by way of an authentication management client **124** (FIG. **1**), but no authentication management client **124** is detected. In this case, a notification **224** may be presented to that effect. The notification **224** may be presented in association with a user interface component **227** such as a button, link, *etc*. to allow the user to view more information about the authentication management client **124**, to create an account with an authentication management service **163** (FIG. **1**), to download and/or install an authentication management client **124**, and/or perform other actions. Alternatively, the user may log on to the network site **140** with a legacy username and password using the username field **206** and the password field **209**.

[0090] Referring next to FIG. **3**, shown is a flowchart that provides one example of the operation of a portion of the authentication management client **124** according to various embodiments. It is understood that the flowchart of FIG. **3** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the authentication management client **124** as described herein. As an alternative, the flowchart of FIG. **3** may be viewed as depicting an example of steps of a method implemented in the client **103** (FIG. **1**) according to one or more embodiments.

[0091] Beginning with box **303**, the authentication management client **124** authenticates a user to an authentication management service **163** (FIG. **1**). For example, a user may log in to an operating system session which is tied to a session of the authentication management client **124**. Alternatively, the user may log in to the authentication management client **124** directly. In box **306**, the authentication management client **124** obtains encrypted account data from the authentication management service **163**. In some cases, this encrypted account data may already be stored in the client **103** as client account data **130** (FIG. **1**) or in a portable data store **118** (FIG. **1**) as portable account data **178** (FIG. **1**). In box **309**, the authentication management client **124** decrypts the encrypted account data based at

least in part on a master security credential supplied by the user. The decrypted account data may be stored, at least ephemerally, as the client account data **130** for use during a user session of the authentication management client **124**.

[0092] In box **312**, the authentication management client **124** determines that a secured resource of a network site **140** (FIG. **1**) is to be accessed. For example, the user may employ the browser **121** (FIG. **1**) to navigate to a secured network page **145** (FIG. **1**) or other secured network resource. In box **315**, the authentication management client **124** determines whether the client account data **130** includes an account for the network site **140** (or an identity provider used by the network site **140**). To this end, the authentication management client **124** may determine one or more authentication services **137** (FIG. **1**) associated with the network site **140** having an authentication endpoint **139** (FIG. **1**) and an account creation endpoint **138** (FIG. **1**). The authentication services **137** may correspond to third-party authentication providers in some cases. The authentication management client **124** may send a query to the network site **140** to determine the supported authentication services **137** and/or may determine the supported authentication services **137** based at least in part on the content of a network resource already obtained by the browser **121**.

[0093] The authentication management client **124** may determine the existence of an account in the client account data **130** according to the domain name of the network site **140** or through other identifying data available from the network site **140**. In one embodiment, the authentication management client **124** may query the authentication management service **163** to obtain information to map the domain name of the network site **140** to a stored account. In another embodiment, the authentication management client **124** may perform a matching on at least a portion of the domain name, such as the second-level domain name, *e.g.*, "e-retailer" within "e-retailer.com" and "e-retailer.co.uk." Thus, the different first-level domain names may be ignored when determining which account may be used.

[0094] Where a matching is performed across different domain names, an explicit user confirmation may be solicited before an identified existing account is

actually utilized. Where multiple accounts are configured for the same base domain name, the account having the longest match may be employed. As a non-limiting example, an account for "us.e-retailer.com" may be preferred to log into "www.e-retailer.com" instead of an account for "e-retailer.com."

[0095] If an existing account is identified, the authentication management client **124** authenticates to the authentication service **137** of the network site **140** using the security credentials of the pre-existing account in box **318**. Subsequently, the secured resources of the network site **140** may be accessed. In most cases, this authentication may happen automatically without user intervention. However, in some cases (*e.g.*, with high-value transactions), the authentication service **137** may set a flag in the authentication protocol to require explicit consent, thereby forcing the user to consent to the log in using the authentication management client **124**. Also, where multiple accounts are identified, the authentication management client **124** may be configured to render a user interface to obtain a user selection of one of the accounts. Thereafter, the portion of the authentication management client **124** ends.

[0096] If an existing account is not identified, the authentication management client **124** moves from box **315** to box **321** and determines whether the user has a legacy account, *i.e.*, an existing account not available in the client account data **130**. To this end, the authentication management client **124** may render a user interface that is configured to prompt the user to enter legacy account information and security credentials, if the user has a legacy account. If the user has a legacy account, in box **324**, the authentication management client **124** obtains the legacy account information from the user.

[0097] In box **327**, the authentication management client **124** stores the legacy account information in the client account data **130**. In some cases, the authentication management client **124** may transition the provided security credentials to stronger credentials as defined in a security credential specification. The user may be prompted to consent to such a credential change. In box **330**, the authentication management client **124** authenticates with the network site **140** using

the respective authentication service **137** and the legacy account information. Thereafter, the portion of the authentication management client **124** ends.

[0098] If the user does not provide legacy account information, or if the user provides a confirmation that the user does not have an existing account capable of accessing the secured resource, the authentication management client **124** moves from box **321** to box **333**. In box **333**, the authentication management client **124** determines whether a new account is to be created for the network site **140**. For example, the user may have specified a set of information (*e.g.*, name, email address, age, *etc.*) that may be shared with account creation endpoints **138** in order to create an account. The user may have established rules to automatically consent to the sharing of some information but not other information. If an account is not to be created, *e.g.*, the user does not give consent or stored preferences disallow sharing of the information, the portion of the authentication management client **124** ends. Otherwise, if a new account is to be created for the user, the authentication management client **124** transitions from box **333** to box **336**.

[0099] In box **336**, the authentication management client **124** obtains consent from the user to share the information needed to create an account capable of accessing the secured resource. Such a consent may correspond to an explicit confirmation in a user interface, a stored consent preference, and/or other forms of consent. The authentication management client **124** may determine which set of information (out of a superset of information) is needed by obtaining an indication of the particular set from the account creation endpoint **138**. The authentication management client **124** may obtain additional information from the user in some cases. The additional information may include freeform data, multiple choice selections, yes or no answers, and/or other data.

[0100] In box **339**, the authentication management client **124** automatically creates the account using the set of information about the user by communicating with the account creation endpoint **138**. In some cases, the account may be with an operator of the network site **140**. In other cases, the account may be with a third-

party identity provider, which may enable the account to access multiple secured resources across multiple network sites **140** associated with multiple operators.

[0101] In box **342**, if the account was created successfully, the authentication management client **124** stores the resulting account information, including, for example, automatically generated security credentials, in the client account data **130**. In box **345**, the authentication management client **124** authenticates with the authentication endpoint **139** of the network site **140** using the new account to facilitate access to the secured resource. Thereafter, the portion of the authentication management client **124** ends.

[0102] Turning now to FIG. **4**, shown is a flowchart that provides one example of the operation of another portion of the authentication management client **124** according to various embodiments. Specifically, FIG. **4** relates to an account creation workflow that may include upgrading an existing account. Upgrading may be performed to access secured resources of a network site that are otherwise not accessible by the existing account. For example, a user may create an account with an online merchant to browse without providing a shipping address, but a shipping address may be necessary to place an order. The user may be able to upgrade the account to place the order by providing the shipping address. It is understood that the flowchart of FIG. **4** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the authentication management client **124** as described herein. As an alternative, the flowchart of FIG. **4** may be viewed as depicting an example of steps of a method implemented in the client **103** (FIG. **1**) according to one or more embodiments.

[0103] Beginning with box **403**, the authentication management client **124** determines that an account is to be created with an authentication service **137** (FIG. **1**) in order to access one or more secured resources of a network site **140** (FIG. **1**). If an existing account is present, access to the specific secured resources may be denied through the particular existing account. In box **406**, the authentication management client **124** determines whether the client account data **130** (FIG. **1**)

includes an existing account for the network site **140**. If the client account data **130** does not include an existing account for the network site **140**, the authentication management client **124** moves to box **409**.

[0104] If the client account data **130** does include an existing account, the authentication management client **124** moves from box **406** to box **412** and determines whether the existing account is upgradeable in order to access the requested secured resource. If the existing account is not upgradeable, the authentication management client **124** moves from box **412** to box **409**. It is noted that in some embodiments all or nearly all accounts may be capable of being upgraded and enriched with additional information when necessary. That is to say, it may be rare situation where a user already has an account with a network site **140** but has to create another account.

[0105] In box **409**, the authentication management client **124** obtains consent from the user to share the information needed to create an account capable of accessing the secured resource. Such a consent may correspond to an explicit confirmation in a user interface, a stored consent preference, and/or other forms of consent. The user may also provide additional information. In box **415**, the authentication management client **124** automatically creates an entirely new account using the set of information about the user, and potentially the newly provided information, by communicating with the account creation endpoint **138** (FIG. **1**). In box **418**, if the account was created successfully, the authentication management client **124** stores the resulting account information, including, for example, automatically generated security credentials, in the client account data **130**. Thereafter, the portion of the authentication management client **124** ends.

[0106] If, instead, the authentication management client **124** determines that an existing account is upgradeable to access the secured resource, the authentication management client **124** proceeds from box **412** to box **421**. In box **421**, the authentication management client **124** determines a subset of the set of user information that is needed to upgrade the existing account to access the secured resource. In box **424**, the authentication management client **124** obtains consent

from the user to share the subset of user information. The authentication management client **124** may also or instead obtain further information from the user that is not already available in the set of user information. In box **427**, the authentication management client **124** upgrades the existing account by providing the additional user information, including the subset of the set of user information and/or the newly provided user information, to the account creation endpoint **138** of the network site **140**. Thereafter, the portion of the authentication management client **124** ends.

[0107] Moving on to FIG. **5**, shown is a flowchart that provides one example of the operation of yet another portion of the authentication management client **124** according to various embodiments. In particular, FIG. **5** relates to multi-user use of the authentication management client **124** and logout from multiple network sites **140** (FIG. **1**). It is understood that the flowchart of FIG. **5** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the authentication management client **124** as described herein. As an alternative, the flowchart of FIG. **5** may be viewed as depicting an example of steps of a method implemented in the client **103** (FIG. **1**) according to one or more embodiments.

[0108] Beginning with box **503**, the authentication management client **124** authenticates a user with the authentication management service **163** (FIG. **1**) in response to the user providing some security credential. In box **506**, the authentication management client **124** obtains encrypted account data from the authentication management service **163**. In box **509**, the authentication management client **124** decrypts the account data based at least in part on a master security credential provided by the user. In box **512**, the authentication management client **124** logs into a network site **140** by communicating with an authentication endpoint **139** (FIG. **1**) of an authentication service **137** (FIG. **1**).

[0109] The authentication management client **124** provides stored security credentials from the client account data **130** (FIG. **1**). Where multiple authentication services **137** are available for a given network site **140**, the user may explicitly select

one of the authentication services **137**, or one might be selected automatically according to a stored preference in the identity provider preference data **131** (FIG. **1**). Where an account does not already exist, it may be created or upgraded automatically as previously described in connection with the flowcharts of FIGS. **3** and **4**.

[0110] In box **515**, the authentication management client **124** determines whether another network site **140** is accessed. Alternatively, another secured resource of the same network site **140** which requires a separate login may be accessed. If another network site **140** is accessed, the authentication management client **124** returns to box **512** and logs into the other network site **140** using stored security credentials. Thus, the authentication management client **124** may automatically authenticate with multiple authentication services **137** corresponding to multiple network sites **140**. A respective session may be established for each network site **140**, which may include session data such as session cookies stored by the browser **121** (FIG. **1**), cached network resources, and so on. If another network site **140** is not accessed, the authentication management client **124** instead proceeds from box **515** to box **518**.

[0111] In box **518**, the authentication management client **124** obtains a universal logout request from the user. Such a logout request may be explicit, such as with the user selecting a single logout button on a user interface of the authentication management client **124**, or implicit, such as with the user exiting the authentication management client **124**. The user session of the authentication management client **124** may be ended upon a switch user request being made by the user, or when the user logs out of an operating system account. In some cases, a user session with the authentication management client **124** may be ended automatically after a predefined period of inactivity. In some embodiments, the user may provide a logout request for a specific network site **140** or a set of network sites **140**.

[0112] In response to the logout request, in box **521**, the authentication management client **124** logs out from each network site **140**. To this end, the authentication management client **124** may automatically send a respective logout

indication to each of the authentication services **137**. In box **524**, the authentication management client **124** may automatically flush any session data and client account data **130**. Specifically, the decrypted account data may be removed from the client **103**. Where the logout request is a specific logout request instead of a universal logout request, the logout may be performed only for the specified network sites **140**. Thus, in the case of a specific logout, the user may continue to utilize sessions that were not indicated in the specific logout request.

[0113] In box **527**, the authentication management client **124** determines whether another user is to use the authentication management client **124**. For example, the authentication management client **124** may be configured to accommodate multiple users within a single operating system user session. If another user is to be authenticated, the authentication management client **124** returns to box **503**. Otherwise, the portion of the authentication management client **124** ends.

[0114] Continuing now to FIG. **6**A, shown is a flowchart that provides one example of the operation of yet another portion of the authentication management client **124** according to various embodiments. In particular, FIG. **6**A relates to resetting security credentials. It is understood that the flowchart of FIG. **6**A provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the authentication management client **124** as described herein. As an alternative, the flowchart of FIG. **6**A may be viewed as depicting an example of steps of a method implemented in the client **103** (FIG. **1**) according to one or more embodiments.

[0115] Beginning with box **603**, the authentication management client **124** authenticates a user to the authentication management service **163** (FIG. **1**) in response to the user providing some security credential. In box **606**, the authentication management client **124** obtains encrypted account data from the authentication management service **163**. In box **609**, the authentication management client **124** decrypts the account data based at least in part on a master security credential provided by the user. In box **612**, the authentication management

client **124** obtains a request to reset the security credentials in the client account data **130** (FIG. **1**). Such a request may encompass a reset request, a change request, and/or a temporary change request.

[0116] In box **615**, the authentication management client **124** determines whether the operation is permitted. For example, the authentication management service **163** may configure the authentication management client **124** such that only the first client **103** registered for a particular authentication management account with the authentication management service **163** is permitted to perform certain operations, such as resetting the credentials and/or other operations. Other clients **103** may be preauthorized by the user as well. In some cases, the user may provide a one-time password to effect the reset or change, and the authentication management service **163** may enforce the one-time password. Also, in some cases, the authentication management client **124** may present one or more static knowledge-based questions **172** (FIG. **1**) to the user to verify the identity of the user. The determination as to whether the operation is permitted may be made by the authentication management service **163**.

[0117] If the operation is not permitted, the authentication management client **124** moves to box **618** and generates an error. Thereafter, the portion of the authentication management client **124** ends. Otherwise, the authentication management client **124** proceeds to box **621** and resets or changes each one of the security credentials for the accounts of the user in the client account data **130**.

[0118] In some cases, the authentication management client **124** may establish a single temporary password in place of the automatically generated credentials. The authentication management client **124** may configure an expiration for the temporary password, where the security credentials are regenerated and reset for each of the accounts of the user after the expiration. In box **624**, the authentication management client **124** synchronizes the client account data **130** with the server account data **166** (FIG. **1**). Thereafter, the portion of the authentication management client **124** ends.

[0119] Transitioning to FIG. **6**B, shown is a flowchart that provides one example of the operation of yet another portion of the authentication management client **124** according to various embodiments. In particular, FIG. **6**B relates to resetting security credentials in response to a server-originated request. It is understood that the flowchart of FIG. **6**B provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the authentication management client **124** as described herein. As an alternative, the flowchart of FIG. **6**B may be viewed as depicting an example of steps of a method implemented in the client **103** (FIG. **1**) according to one or more embodiments.

[0120] Beginning with box **633**, the authentication management client **124** authenticates a user to the authentication management service **163** (FIG. **1**) in response to the user providing some security credential. In box **636**, the authentication management client **124** obtains encrypted account data from the authentication management service **163**. In box **639**, the authentication management client **124** decrypts the account data based at least in part on a master security credential provided by the user. In box **642**, the authentication management client **124** obtains a request to reset the security credentials from the authentication management service **163**. Such a request may be one-time or periodic in nature.

[0121] The authentication management client **124** proceeds to box **651** and resets or changes each one of the security credentials for the accounts of the user in the client account data **130**. In some cases, the authentication management client **124** may establish a single temporary password in place of the automatically generated credentials. The authentication management client **124** may configure an expiration for the temporary password, where the security credentials are regenerated and reset for each of the accounts of the user after the expiration. In box **654**, the authentication management client **124** synchronizes the client account data **130** with the server account data **166** (FIG. **1**). Thereafter, the portion of the authentication management client **124** ends.

[0122] Referring next to FIG. **7**, shown is a flowchart that provides one example of the operation of a portion of the authentication endpoint **139** according to various embodiments. It is understood that the flowchart of FIG. **7** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the authentication endpoint **139** as described herein. As an alternative, the flowchart of FIG. **7** may be viewed as depicting an example of steps of a method implemented in the computing device **106** (FIG. **1**) according to one or more embodiments.

[0123] Beginning with box **703**, the authentication endpoint **139** obtains an authentication request from an authentication management client **124** (FIG. **1**). The authentication request may be obtained by way of an authentication protocol supported by multiple authentication management clients **124** having different affinities for authentication management services **163** (FIG. **1**). For example, an authentication management client **124** may be distributed by a provider of an authentication management service **163**, and the authentication management client **124** may have an affinity for the particular authentication management service **163**. As another example, the authentication management client **124** may be distributed by a third party but may still have an affinity for a particular authentication management service **163** or a set of a plurality of authentication management services **163**.

[0124] In box **706**, the authentication endpoint **139** determines the affinity of authentication management client **124** from the request. For example, the authentication endpoint **139** may determine the affinity of the authentication management client **124** according to an identifier in a user agent string. It may be the case that the authentication endpoint **139** supports some authentication management clients **124** but not others. Similarly, the account creation endpoint **138** (FIG. **1**) may support some authentication management clients **124** but not others.

[0125] In box **709**, the authentication endpoint **139** determines whether the particular authentication management client **124** is supported. If the authentication management client **124** is not supported, the authentication endpoint **139** moves to

box **712** and denies the authentication request. Thereafter, the portion of the authentication endpoint **139** ends. If the authentication management client **124** is supported, the authentication endpoint **139** moves from box **709** to box **715**.

[0126] In box **715**, the authentication endpoint **139** obtains a security credential from the authentication management client **124**. In box **718**, the authentication endpoint **139** determines whether the credential is valid. If the credential is not valid, the authentication endpoint **139** moves to box **712** and denies authentication request. Thereafter, the portion of the authentication endpoint **139** ends.

[0127] In box **721**, the authentication endpoint **139** creates a session for the user in response to the successful authentication. To this end, the authentication endpoint **139** may set one or more session cookies with a session token and/or perform other actions. In addition, the authentication endpoint **139** may send branded experience data (such as, for example, logos, graphics, text, *etc.*) to the authentication management client **124**. The authentication management client **124** may be configured to customize a user interface in the client **103** (FIG. **1**) for an identity provider associated with the authentication endpoint **139** based at least in part on the branded experience data. The branded experience data may include, for example, a logo for a network site **140** or identity provider, a link to a privacy policy, a link for terms of use, and/or other information.

[0128] In box **724**, the authentication endpoint **139** determines whether the security credential employed by the authentication management client **124** is to be changed. Such a change may be prompted by a manual change request from the user or by expiration of a predefined change interval in the authentication endpoint **139** or in the authentication management client **124**. If the security credential is to be changed, the authentication endpoint **139** moves from box **724** to box **727** and establishes the new security credential. Such a credential may be generated by the authentication endpoint **139** and sent to the authentication management client **124**, or it may be generated by the authentication management client **124** and then sent to the authentication endpoint **139**. Thereafter, the portion of the authentication

endpoint **139** ends. If the security credential is not to be changed, the portion of the authentication endpoint **139** also ends.

[0129] Moving on to FIG. **8**, shown is a flowchart that provides one example of the operation of a portion of the authentication management service **163** according to various embodiments. It is understood that the flowchart of FIG. **8** provides merely an example of the many different types of functional arrangements that may be employed to implement the operation of the portion of the authentication management service **163** as described herein. As an alternative, the flowchart of FIG. **8** may be viewed as depicting an example of steps of a method implemented in the computing device **112** (FIG. **1**) according to one or more embodiments.

[0130] Beginning with box **803**, the authentication management service **163** obtains a request for account data from an authentication management client **124** (FIG. **1**) at a client **103** (FIG. **1**). In box **806**, authentication management service **163** determines whether the request includes a valid master credential **169** (FIG. **1**). If the request does not include the valid master credential **169** for the user associated with the account data, the authentication management service **163** transitions to box **809** and denies the request for the account data. Thereafter, the portion of the authentication management service **163** ends.

[0131] If the request does specify a valid master credential **169**, the authentication management service **163** continues from box **806** to box **812** and determines whether the client **103** corresponds to a preauthorized client **103**. For example, the authentication management service **163** may evaluate a source network address of the request, a client-identifying token presented in the request, and/or other data. If the authentication management service **163** determines that the client **103** does not correspond to a preauthorized client **103**, the authentication management service **163** moves to box **813** and prompts the client **103** for a valid supplemental credential **170** (FIG. **1**), such as a one-time password, an answer to a knowledge-based question, *etc.* If a valid supplemental credential **170** is not provided, the authentication management service **163** moves to box **809** and denies

the request for the account data. Thereafter, the portion of the authentication management service **163** ends.

[0132] If a valid supplemental credential **170** is provided, the authentication management service **163** continues from box **813** to box **815**. If the client **103** is instead preauthorized, the authentication management service **163** moves from box **812** to box **815**. In box **815**, the authentication management service **163** sends some or all of the encrypted account data from the server account data **166** (FIG. **1**) to the authentication management client **124**. In box **818**, the authentication management service **163** may obtain updates to the encrypted account data from the authentication management client **124**. If the authentication management service **163** obtains such updates, the authentication management service **163** synchronizes the server account data **166** in box **821**. Thereafter, the portion of the authentication management service **163** ends.

[0133] With reference to FIG. **9**, shown is a schematic block diagram of the client **103** according to an embodiment of the present disclosure. The client **103** includes at least one processor circuit, for example, having a processor **903** and a memory **906**, both of which are coupled to a local interface **909**. To this end, the client **103** may comprise, for example, at least one client computer or like device. The local interface **909** may comprise, for example, a data bus with an accompanying address/control bus or other bus structure as can be appreciated. The computing devices **106** and **112** may be illustrated similarly to the client **103**, and the following discussion also pertains to computing devices **106** and **112**.

[0134] Stored in the memory **906** are both data and several components that are executable by the processor **903**. In particular, stored in the memory **906** and executable by the processor **903** are the browser **121**, the authentication management client **124**, and potentially other applications. Also stored in the memory **906** may be a data store **127** and other data. In addition, an operating system may be stored in the memory **906** and executable by the processor **903**.

[0135] It is understood that there may be other applications that are stored in the memory **906** and are executable by the processor **903** as can be appreciated.

Where any component discussed herein is implemented in the form of software, any one of a number of programming languages may be employed such as, for example, C, C++, C#, Objective C, Java®, JavaScript®, Perl, PHP, Visual Basic®, Python®, Ruby, Delphi®, Flash®, or other programming languages.

[0136] A number of software components are stored in the memory **906** and are executable by the processor **903**. In this respect, the term "executable" means a program file that is in a form that can ultimately be run by the processor **903**. Examples of executable programs may be, for example, a compiled program that can be translated into machine code in a format that can be loaded into a random access portion of the memory **906** and run by the processor **903**, source code that may be expressed in proper format such as object code that is capable of being loaded into a random access portion of the memory **906** and executed by the processor **903**, or source code that may be interpreted by another executable program to generate instructions in a random access portion of the memory **906** to be executed by the processor **903**, *etc.* An executable program may be stored in any portion or component of the memory **906** including, for example, random access memory (RAM), read-only memory (ROM), hard drive, solid-state drive, USB flash drive, memory card, optical disc such as compact disc (CD) or digital versatile disc (DVD), floppy disk, magnetic tape, or other memory components.

[0137] The memory **906** is defined herein as including both volatile and nonvolatile memory and data storage components. Volatile components are those that do not retain data values upon loss of power. Nonvolatile components are those that retain data upon a loss of power. Thus, the memory **906** may comprise, for example, random access memory (RAM), read-only memory (ROM), hard disk drives, solid-state drives, USB flash drives, memory cards accessed via a memory card reader, floppy disks accessed via an associated floppy disk drive, optical discs accessed via an optical disc drive, magnetic tapes accessed via an appropriate tape drive, and/or other memory components, or a combination of any two or more of these memory components. In addition, the RAM may comprise, for example, static random access memory (SRAM), dynamic random access memory (DRAM), or

magnetic random access memory (MRAM) and other such devices. The ROM may comprise, for example, a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), or other like memory device.

[0138] Also, the processor **903** may represent multiple processors **903** and the memory **906** may represent multiple memories **906** that operate in parallel processing circuits, respectively. In such a case, the local interface **909** may be an appropriate network that facilitates communication between any two of the multiple processors **903**, between any processor **903** and any of the memories **906**, or between any two of the memories **906**, *etc.* The local interface **909** may comprise additional systems designed to coordinate this communication, including, for example, performing load balancing. The processor **903** may be of electrical or of some other available construction.

[0139] Although the browser **121**, the authentication management client **124**, the network page server **136** (FIG. **1**), the authentication service **137** (FIG. **1**), the authentication management service **163** (FIG. **1**), and other various systems described herein may be embodied in software or code executed by general purpose hardware as discussed above, as an alternative the same may also be embodied in dedicated hardware or a combination of software/general purpose hardware and dedicated hardware. If embodied in dedicated hardware, each can be implemented as a circuit or state machine that employs any one of or a combination of a number of technologies. These technologies may include, but are not limited to, discrete logic circuits having logic gates for implementing various logic functions upon an application of one or more data signals, application specific integrated circuits having appropriate logic gates, or other components, *etc.* Such technologies are generally well known by those skilled in the art and, consequently, are not described in detail herein.

[0140] The flowcharts of FIGS. **3-8** show the functionality and operation of an implementation of portions of the authentication management client **124**, the authentication endpoint **139** (FIG. **1**), and the authentication management service

163. If embodied in software, each block may represent a module, segment, or portion of code that comprises program instructions to implement the specified logical function(s). The program instructions may be embodied in the form of source code that comprises human-readable statements written in a programming language or machine code that comprises numerical instructions recognizable by a suitable execution system such as a processor **903** in a computer system or other system. The machine code may be converted from the source code, *etc*. If embodied in hardware, each block may represent a circuit or a number of interconnected circuits to implement the specified logical function(s).

[0141] Although the flowcharts of FIGS. **3**-**8** show a specific order of execution, it is understood that the order of execution may differ from that which is depicted. For example, the order of execution of two or more blocks may be scrambled relative to the order shown. Also, two or more blocks shown in succession in FIGS. **3**-**8** may be executed concurrently or with partial concurrence. Further, in some embodiments, one or more of the blocks shown in FIGS. **3**-**8** may be skipped or omitted. In addition, any number of counters, state variables, warning semaphores, or messages might be added to the logical flow described herein, for purposes of enhanced utility, accounting, performance measurement, or providing troubleshooting aids, *etc*. It is understood that all such variations are within the scope of the present disclosure.

[0142] Also, any logic or application described herein, including the browser **121**, the authentication management client **124**, the network page server **136**, the authentication service **137**, and the authentication management service **163**, that comprises software or code can be embodied in any non-transitory computer-readable medium for use by or in connection with an instruction execution system such as, for example, a processor **903** in a computer system or other system. In this sense, the logic may comprise, for example, statements including instructions and declarations that can be fetched from the computer-readable medium and executed by the instruction execution system. In the context of the present disclosure, a "computer-readable medium" can be any medium that can contain, store, or

maintain the logic or application described herein for use by or in connection with the instruction execution system.

[0143] The computer-readable medium can comprise any one of many physical media such as, for example, magnetic, optical, or semiconductor media. More specific examples of a suitable computer-readable medium would include, but are not limited to, magnetic tapes, magnetic floppy diskettes, magnetic hard drives, memory cards, solid-state drives, USB flash drives, or optical discs. Also, the computer-readable medium may be a random access memory (RAM) including, for example, static random access memory (SRAM) and dynamic random access memory (DRAM), or magnetic random access memory (MRAM). In addition, the computer-readable medium may be a read-only memory (ROM), a programmable read-only memory (PROM), an erasable programmable read-only memory (EPROM), an electrically erasable programmable read-only memory (EEPROM), or other type of memory device.

[0144] It should be emphasized that the above-described embodiments of the present disclosure are merely possible examples of implementations set forth for a clear understanding of the principles of the disclosure. Many variations and modifications may be made to the above-described embodiment(s) without departing substantially from the spirit and principles of the disclosure. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the following claims.

[0145] Embodiments of the disclosure can be described in view of the following clauses:

Clause 1. A non-transitory computer-readable medium embodying a program executable in a computing device, the program comprising:

code that maintains, for each of a plurality of users, a plurality of accounts for a plurality of network sites;

code that authenticates one of the users;

code that decrypts data relating to the accounts for the one of the users using a master security credential, the data including a plurality of security

credentials relating to the accounts and a set of information about the one of the users;

code that determines that a first secured resource of one of the network sites is to be accessed by the computing device;

code that accesses the first secured resource using a first security credential in the data relating to the accounts;

code that determines that a second secured resource of another network site is to be accessed by the computing device;

code that creates a new account with the other network site in response to determining that the accounts are not capable of accessing the second secured resource and in response to obtaining a consent indication from the one of the users, wherein a subset of the set of information about the one of the users is automatically provided to the other network site to create the new account;

code that automatically generates a second security credential for the new account; and

code that accesses the second secured resource using the second security credential.

Clause **2**. The non-transitory computer-readable medium of clause **1**, wherein the program further comprises code that ends a session of the one of the users after a predefined period of inactivity, and the data that has been decrypted is removed from the computing device when the session is ended.

Clause **3**. The non-transitory computer-readable medium of any one of clauses **1** or **2**, wherein the program further comprises code that authenticates another one of the users after a session of the one of the users is ended.

Clause **4**. A system, comprising:

a computing device; and

an authentication management client application executable in the computing device, the authentication management client application comprising:

logic that maintains a plurality of accounts of a user for a plurality of network sites;

logic that determines that a secured resource of a network site is to be accessed by the computing device;

logic that determines whether the accounts are capable of accessing the secured resource; and

logic that creates a new account with the network site in response to determining that the accounts are not capable of accessing the secured resource, wherein a set of information about the user is automatically provided to the network site to create the new account.

Clause **5**. The system of clause **4**, wherein the authentication management client application further comprises:

logic that obtains a confirmation from the user that the user does not have an existing account capable of accessing the secured resource in response to determining that the accounts are not capable of accessing the secured resource; and

wherein the logic that creates the new account is configured to create the new account in response to the confirmation.

Clause **6**. The system of any one of clauses **4** or **5**, wherein the logic that creates the new account further comprises logic that determines whether the user has previously authorized automatic account creation using the set of information.

Clause **7**. The system of any one of clauses **4** to **6**, wherein the logic that creates the new account further comprises logic that automatically generates a security credential for the new account according to a security credential specification.

Clause **8**. The system of any one of clauses **4** to **7**, wherein the logic that creates the new account further comprises logic that automatically establishes a security credential for the new account according to a symmetric key generated in a transport layer security (TLS) session between the computing device and the network site.

Clause **9**. The system of any one of clauses **4** to **8**, wherein the logic that maintains the accounts is configured to maintain data related to the accounts in an encrypted state and to decrypt the data related to the accounts in response to a master security credential obtained from the user.

Clause **10**. The system of clause **9**, wherein the logic that maintains the accounts is configured to:

decrypt a key using the master security credential; and

decrypt the data related to the accounts using the key.

Clause **11**. The system of any one of clauses **4** to **10**, wherein the logic that creates the new account further comprises logic that obtains additional information from the user before creating the new account, the additional information being included in the set of information that is automatically provided to the network site to create the new account.

Clause **12**. The system of any one of clauses **4** to **11**, wherein the logic that creates the new account further comprises logic that obtains a consent indication from the user before creating the new account.

Clause **13**. The system of clause **12**, wherein the set of information corresponds to one of a plurality of subsets of a superset of information about the user, the logic that creates the new account is configured to obtain an identification

of the one of the subsets from the network site, and the logic that obtains the consent indication is configured to indicate the one of the subsets to the user.

Clause **14**. The system of any one of clauses **4** to **13**, wherein the set of information includes a name of the user.

Clause **15**. The system of any one of clauses **4** to **14**, wherein the set of information includes a physical address of the user.

Clause **16**. The system of any one of clauses **4** to **15**, wherein the set of information includes a date of birth of the user.

Clause **17**. The system of any one of clauses **4** to **16**, wherein the set of information includes contact information for the user.

Clause **18**. The system of any one of clauses **4** to **17**, wherein the new account is created with a third-party identity provider, and the new account is capable of accessing a plurality of secured resources across a plurality of network sites associated with a plurality of network site operators.

Clause **19**. A method, comprising the steps of:

maintaining, in a computing device, a plurality of accounts of a user for a plurality of network sites;

determining, in the computing device, that a secured resource of a network site is to be accessed by the computing device;

determining, in the computing device, whether the accounts are capable of accessing the secured resource; and

upgrading, in the computing device, one of the accounts in response to determining that the accounts are not capable of accessing the secured resource,

wherein a set of information about the user is provided to the network site to upgrade the one of the accounts.

Clause **20**. The method of clause **19**, wherein the set of information has not previously been provided to the network site in creating the one of the accounts.

Clause **21**. The method of clause **19** or **20**, further comprising the steps of:

determining, in the computing device, that another secured resource of the network site is to be accessed by the computing device;

determining, in the computing device, whether the accounts are capable of accessing the other secured resource;

automatically providing, in the computing device, a stored security credential associated with one of the accounts to the network site in response to determining that the accounts are capable of accessing the other secured resource; and

accessing, in the computing device, the other secured resource from the network site.

Clause **22**. The method of any one of clauses **19** to **21**, wherein the upgrading step further comprises the step of obtaining, in the computing device, at least one element in the set of information from the user.

Clause **23**. The method of any one of clauses **19** to **22**, wherein the upgrading step further comprises the step of obtaining, in the computing device, at least one element in the set of information from stored data.

Clause **24**. The method of any one of clauses **19** to **23**, wherein the upgrading step further comprises the step of obtaining, in the computing device, a consent indication from the user, and the set of information is automatically provided to the network site in response to obtaining the consent indication.

Clause **25**. The method of any one of clauses **19** to **24**, wherein the maintaining step further comprises the step of maintaining, in the computing device, data for the accounts in an encrypted state, and the method further comprises the steps of:

obtaining, in the computing device, a master security credential from the user; and

decrypting, in the computing device, the data for the accounts using the master security credential.

Clause **26**. The method of clause **25**, further comprising the step of obtaining, in the computing device, the data for the accounts from another computing device.

Clause **27**. A system, comprising:

a computing device; and

an authentication management client application executable in the computing device, the authentication management client application comprising:

logic that maintains a plurality of accounts of a user for a plurality of network sites, wherein encrypted security credentials for the accounts are synchronized with an authentication management service by way of a network;

logic that determines that a secured resource of a network site is to be accessed by the computing device;

logic that determines whether the accounts are capable of accessing the secured resource; and

logic that authenticates using a legacy account with the network site in response to determining that the accounts are not capable of accessing the secured resource, wherein at least one security credential for the legacy account is obtained from the user.

Clause **28**. The system of clause **27**, wherein the authentication management client application further comprises logic that adds the legacy account to the accounts maintained by the logic that maintains.

Clause **29**. The system of clause **28**, wherein the authentication management client application further comprises logic that transitions the at least one security credential to at least one replacement security credential that is automatically generated according to a security credential specification associated with the network site.

Clause **30**. The system of any one of clauses **27** to **29**, wherein the authentication management client application further comprises logic that obtains the encrypted security credentials from the authentication management service.

Clause **31**. A non-transitory computer-readable medium embodying at least one program executable in a computing device, the at least one program comprising:

code that decrypts a security credential associated with a user account stored by a first authentication management client in response to obtaining a master security credential from a user;

code that sends a first authentication request using the first authentication management client by way of an authentication protocol to an authentication service associated with a secured resource of a network site, the first authentication request specifying the security credential associated with the user account;

code that accesses the secured resource after being authenticated by the authentication service in response to the first authentication request;

code that imports the security credential from the first authentication management client into a second authentication management client;

code that sends a second authentication request using the second authentication management client by way of the authentication protocol to the authentication service, the second authentication request specifying the security credential; and

code that accesses the secured resource after being authenticated by the authentication service in response to the second authentication request.

Clause **32**. The non-transitory computer-readable medium of clause **31**, wherein the first authentication management client and the second authentication management client are deployed by different providers of authentication management services.

Clause **33**. The non-transitory computer-readable medium of clause **31** or **32**, wherein the program further comprises:

code that obtains an upgrade confirmation from the user in response to the user attempting to access another secured resource of the network site, the user account being denied access to the other secured resource;

code that sends an account upgrade request for the user account using the second authentication management client to the authentication service, the account upgrade request specifying a set of information about the user; and

code that accesses the other secured resource of the network site after upgrading the user account.

Clause **34**. A system, comprising:

at least one computing device; and

an authentication service executable in the at least one computing device, the authentication service comprising:

logic that obtains an authentication request by way of an authentication protocol from an authentication management client executed in

a client computing device, the authentication request specifying a security credential associated with a user account;

logic that determines whether the authentication management client is supported based at least in part on an affinity of the authentication management client; and

logic that authenticates the user account at the client computing device for access to at least one secured resource of a network site in response to the authentication request and in response to the authentication management client being supported.

Clause **35**. The system of clause **34**, wherein a plurality of authentication management clients having different affinities are configured to use the authentication protocol.

Clause **36**. The system of clause **34** or **35**, wherein at least one of the authentication management clients is supported, and at least one of the authentication management clients is unsupported.

Clause **37**. The system of any one of clauses **34** to **36**, wherein the authentication service is configured to identify the affinity of the authentication management client by way of a user agent string.

Clause **38**. The system of any one of clauses **34** to **37**, wherein the authentication service further comprises:

logic that obtains an account creation request from the authentication management client, the account creation request specifying a set of information about a user; and

logic that creates the user account according to the account creation request in response to determining that the authentication management client is supported.

Clause **39**. The system of any one of clauses **34** to **38**, wherein the user account is associated with a plurality of network sites operated by a plurality of entities.

Clause **40**. The system of any one of clauses **34** to **39**, wherein the authentication service is operated by an identity provider, the authentication service further comprises logic that sends branded experience data to the authentication management client, and the authentication management client is configured to customize a user interface in the client computing device for the identity provider based at least in part on the branded experience data.

Clause **41**. The system of any one of clauses **34** to **40**, wherein the authentication service further comprises:

logic that obtains a request to change the security credential for the user account after authentication; and

logic that establishes a new security credential for the user account in response to the request to change the security credential.

Clause **42**. The system of clause **41**, wherein the logic that establishes the new security credential further comprises:

logic that automatically generates the new security credential; and

logic that provides the new security credential to the authentication management client.

Clause **43**. The system of clause **41** or **42**, wherein the request to change the security credential originates automatically in the authentication management client.

Clause **44**. The system of clause **41** or **42**, wherein the request to change the security credential does not originate in the authentication management client.

Clause **45**. The system of any one of clauses **41** to **44**, wherein the authentication service further comprises:

logic that provides a security credential specification to the authentication management client; and

wherein the request to change the security credential specifies the new security credential, and the new security credential is automatically generated by the authentication management client according to the security credential specification.

Clause **46**. A method, comprising the steps of:

obtaining, in at least one computing device, a first authentication request by way of an authentication protocol from a first authentication management client executed in a first client computing device, the first authentication request specifying a first security credential associated with a first user account;

authenticating, in the at least one computing device, the first user account at the first client computing device for access to at least one secured resource of a network site in response to the first authentication request;

obtaining, in the at least one computing device, a second authentication request by way of the authentication protocol from a second authentication management client executed in a second client computing device, the second authentication request specifying a second security credential associated with a second user account;

authenticating, in the at least one computing device, the second user account at the second client computing device for access to the at least one secured resource of the network site in response to the second authentication request; and

wherein the first authentication management client and the second authentication management client are deployed by different providers of authentication management services.

Clause **47**. The method of clause **46**, further comprising the steps of:

sending, in the at least one computing device, branded experience data to the first authentication management client and the second authentication management client; and

wherein the first authentication management client is configured to customize a first user interface in the first client computing device based at least in part on the branded experience data, and the second authentication management client is configured to customize a second user interface in the second client computing device based at least in part on the branded experience data.

Clause **48**. The method of clause **46** or **47**, further comprising the steps of:

determining, in the at least one computing device, whether the first authentication management client is supported in response to the first authentication request; and

determining, in the at least one computing device, whether the second authentication management client is supported in response to the second authentication request.

Clause **49**. The method of any one of clauses **46** to **48**, further comprising the steps of:

obtaining, in the at least one computing device, a request to change the first security credential for the first user account after authentication, the request to change the first security credential originating automatically in the first authentication management client; and

establishing, in the at least one computing device, a new security credential for the first user account in response to the request to change the first security credential.

Clause **50**. The method of clause **49**, wherein the new security credential corresponds to a symmetric key employed by a transport layer security (TLS) session between the first client computing device and the at least one computing device.

Clause **51**. The method of any one of clauses **46** to **50**, further comprising the steps of:

obtaining, in the at least one computing device, an account upgrade request from the first authentication management client after authentication, the account upgrade request specifying a set of information about a user;

upgrading, in the at least one computing device, the first user account according to the account upgrade request; and

authenticating, in the at least one computing device, the first user account at the first client computing device for access to another secured resource of the network site after upgrading.

Clause **52**. The method of clause **51**, wherein the first authentication management client is configured to send the account upgrade request to the at least one computing device in response to the user attempting to access the other secured resource in the first client computing device and in response to obtaining a consent indication from the user.

Clause **53**. A non-transitory computer-readable medium embodying at least one program executable in a computing device, the at least one program comprising:

code that maintains a plurality of accounts of a user for a plurality of network sites;

code that determines that a secured resource of a network site is to be accessed by the computing device;

code that identifies a plurality of the accounts which are accepted by the network site for authentication to the secured resource based at least in part on a

domain name of the network site and a listing of supported third-party authentication providers obtained from the network site;

code that renders for display a user interface configured to obtain a user selection of one of the plurality of the accounts;

code that stores the user selection of the one of the plurality of the accounts in association with the domain name of the network site; and

code that automatically authenticates with the network site using a security credential associated with the one of the plurality of the accounts that is selected by the user selection.

Clause **54**. The non-transitory computer-readable medium of clause **53**, wherein at least one of the plurality of the accounts is associated with a plurality of the network sites.

Clause **55**. The non-transitory computer-readable medium of clause **53** or **54**, wherein the code that identifies the plurality of the accounts further comprises code that compares a second-level portion of the domain name with a second-level portion of a different stored domain name.

Clause **56**. A system, comprising:

a computing device; and

an authentication management client application executable in the computing device, the authentication management client application comprising:

logic that maintains a plurality of accounts of a user for a plurality of network sites;

logic that determines that a secured resource of a network site is to be accessed by the computing device;

logic that identifies one of the accounts according to a domain name of the network site, the one of the accounts being associated with a

different network site having a different domain name from the domain name; and

logic that automatically authenticates with the network site using a security credential associated with the one of the accounts.

Clause **57**. The system of clause **56**, wherein the logic that identifies the one of the accounts further comprises:

logic that sends an account identification request to an authentication management service, the account identification request including the domain name of the network site; and

logic that obtains an account identification from the authentication management service in response to the account identification request, the account identification specifying the one of the accounts.

Clause **58**. The system of clause **56** or **57**, wherein the different domain name of the different network site includes a portion in common with the domain name, and the portion in common excludes a first-level domain name.

Clause **59**. The system of any one of clauses **56** to **58**, wherein the network site is an affiliate of the different network site.

Clause **60**. The system of any one of clauses **56** to **59**, wherein the logic that automatically authenticates with the network site is further configured to obtain a consent indication from the user before automatically authenticating with the network site.

Clause **61**. The system of clause **60**, wherein the consent indication is previously stored by the user.

Clause **62**. The system of any one of clauses **56** to **61**, wherein the logic that identifies the one of the accounts is further configured to identify the one of the accounts according to a second-level domain name of the network site.

Clause **63**. The system of any one of clauses **56** to **62**, wherein the authentication management client application further comprises:

logic that determines that another secured resource of another network site is to be accessed by the computing device;

logic that identifies the one of the accounts according to another domain name of the other network site; and

logic that automatically authenticates with the other network site using the security credential associated with the one of the accounts.

Clause **64**. The system of clause **63**, wherein the domain name and the other domain name each have a same second-level domain name and a different first-level domain name.

Clause **65**. The system of any one of clauses **56** to **64**, wherein the logic that identifies the one of the accounts further comprises:

logic that identifies a plurality of the accounts according to the domain name of the network site;

logic that generates a user interface configured to obtain a user selection of one of the plurality of the accounts; and

logic that identifies the one of the accounts according to the user selection.

Clause **66**. The system of any one of clauses **56** to **65**, wherein the logic that identifies the one of the accounts further comprises:

logic that identifies a plurality of the accounts according to the domain name of the network site; and

logic that identifies the one of the accounts out of the plurality of the accounts according to a stored user preference.

Clause **67**. A method, comprising the steps of:

maintaining, in a computing device, a plurality of accounts of a user for a plurality of network sites;

determining, in the computing device, that a secured resource of a network site is to be accessed by the computing device;

determining, in the computing device, a plurality of the accounts which are accepted by the network site for authentication to the secured resource;

selecting, in the computing device, one of the plurality of the accounts for authentication to the secured resource; and

automatically authenticating, in the computing device, with the network site using a security credential associated with the one of the plurality of the accounts that is selected.

Clause **68**. The method of clause **67**, wherein the selecting step further comprises the steps of:

rendering for display, in the computing device, a user interface configured to obtain a user selection of the one of the plurality of the accounts; and

obtaining, in the computing device, the user selection.

Clause **69**. The method of clause **67** or **68**, wherein the selecting step further comprises the step of selecting, in the computing device, the one of the plurality of accounts according to a stored preference.

Clause **70**. The method of any one of clauses **67** to **69**, wherein at least one of the plurality of the accounts is with a third-party authentication provider.

Clause **71**. The method of any one of clauses **67** to **70**, wherein the step of determining, in the computing device, the plurality of the accounts which are accepted by the network site for authentication to the secured resource further comprises the step of identifying, in the computing device, the plurality of the accounts based at least in part on a domain name of the network site.

Clause **72**. The method of any one of clauses **67** to **71**, wherein the step of determining, in the computing device, the plurality of the accounts which are accepted by the network site for authentication to the secured resource further comprises the step of obtaining, in the computing device, a listing of a plurality of supported authentication providers from the network site.

Clause **73**. A non-transitory computer-readable medium embodying a program executable in a computing device, the program comprising:

code that sends a request for account data to an authentication management service, the request specifying a security credential for accessing the account data and a client-identifying token, the account data including a plurality of security credentials of a user for accessing a plurality of network sites, wherein the authentication management service is configured to maintain the account data in an encrypted form;

code that obtains the account data from the authentication management service in response to the request for the account data;

code that obtains a master security credential from the user;

code that decrypts the account data using the master security credential;

code that obtains a request from the user to reset the security credentials to a single temporary security credential specified by the user; and

code that automatically resets each of the security credentials to the single temporary security credential by:

authenticating with a respective authentication service using the respective security credential; and

sending a corresponding reset request specifying the single temporary security credential to the respective authentication service.

Clause **74**. The non-transitory computer-readable medium of clause **73**, wherein the program further comprises code that enforces an expiration of the single temporary security credential.

Clause **75**. The non-transitory computer-readable medium of clause **73** or **74**, wherein the program further comprises:

code that obtains a request from the user to reset the single temporary security credential to a plurality of new security credentials; and

code that automatically resets the single temporary security credential for each authentication service by:

authenticating with the respective authentication service using the single temporary security credential; and

resetting the single temporary security credential to a respective new security credential for the respective authentication service.

Clause **76**. A system, comprising:

at least one computing device; and

a service executable in the at least one computing device, the service comprising:

logic that stores account data including a plurality of security credentials associated with a plurality of network sites for a user, the account data being stored in an encrypted form;

logic that obtains a request for the account data from a client, the request specifying a security credential for accessing the account data; and

logic that sends the account data to the client in response to determining that the client corresponds to a preauthorized client and in response to determining that the security credential for accessing the account data is valid.

Clause **77**. The system of clause **76**, wherein the security credential is stored by a removable computer-readable medium of the client.

Clause **78**. The system of clause **76** or **77**, wherein the service further comprises logic that determines whether the client corresponds to a preauthorized client based at least in part on a source network address of the request.

Clause **79**. The system of any one of clauses **76** to **78**, wherein the service further comprises logic that determines whether the client corresponds to a preauthorized client based at least in part on a client-identifying token presented in the request.

Clause **80**. The system of any one of clauses **76** to **79**, wherein the account data is sent to the client undecrypted from the encrypted form.

Clause **81**. The system of any one of clauses **76** to **80**, wherein the service is operated by a third-party entity relative to the network sites.

Clause **82**. The system of any one of clauses **76** to **81**, wherein the service further comprises:

logic that obtains a request to use one of a plurality of account data recovery mechanisms from the client;

logic that enables use of the one of the account data recovery mechanisms in response to determining that the client is authorized to use the one of the plurality of account data recovery mechanisms; and

logic that disables use of the one of the account data recovery mechanisms in response to determining that the client is not authorized to use the one of the plurality of account data recovery mechanisms.

Clause **83**. The system of clause **82**, wherein authorization for use of a selected subset of the account data recovery mechanisms is specified on a per-client basis.

Clause **84**. A method, comprising the steps of:

sending, in a computing device, a request for account data to an authentication management service, the request specifying a security credential for accessing the account data, the account data including a plurality of security credentials of a user for accessing a plurality of network sites;

obtaining, in the computing device, the account data from the authentication management service in response to the request for the account data;

obtaining, in the computing device, a master security credential;

decrypting, in the computing device, the account data using the master security credential; and

automatically resetting, in the computing device, each of the security credentials to a respective new security credential.

Clause **85**. The method of clause **84**, wherein the step of obtaining, in the computing device, the master security credential further comprises the steps of:

obtaining, in the computing device, an encrypted version of the master security credential from a removable computer-readable medium; and

decrypting, in the computing device, the encrypted version of the master security credential based at least in part on another security credential stored in the computing device.

Clause **86**. The method of clause **84** or **85**, wherein the master security credential is associated with an operating system of the computing device.

Clause **87**. The method of any one of clauses **84** to **86**, further comprising the steps of:

generating, in the computing device, a plurality of one-time security credentials; and

storing, in the computing device, the one-time security credentials with the account data.

Clause **88**. The method of clause **87**, further comprising the steps of:

obtaining, in the computing device, one of the one-time security credentials from the user;

generating, in the computing device, the master security credential based at least in part on the one of the one-time security credentials; and

removing, in the computing device, the one of the one-time security credentials from the account data.

Clause **89**. The method of any one of clauses **84** to **88**, wherein the automatically resetting step is performed in response to a reset request initiated by the user.

Clause **90**. The method of clause **89**, further comprising the steps of:

presenting, in the computing device, at least one knowledge-based question to the user in response to the reset request;

obtaining, in the computing device, at least one answer to the at least one knowledge-based question from the user;

querying, in the computing device, the authentication management service to determine whether the at least one answer is valid; and

wherein the step of automatically resetting is performed in response to the at least one answer being valid.

Clause **91**. The method of any one of clauses **84** to **90**, wherein the automatically resetting step is performed in response to a predetermined reset time interval.

Clause **92**. The method of any one of clauses **84** to **91**, wherein the automatically resetting step further comprises the steps of:

for each of the security credentials:

authenticating, in the computing device, with a respective authentication service associated with at least one of the network sites using the respective security credential; and

sending, in the computing device, a corresponding reset request to the respective authentication service.

Clause **93**. The method of any one of clauses **84** to **92**, wherein one of the security credentials is associated with a plurality of the network sites.

Clause **94**. The method of any one of clauses **84** to **93**, wherein the request for the account data includes a client-identifying token stored by the computing device.

Clause **95**. The method of any one of clauses **84** to **94**, wherein the new security credentials correspond to a single new security credential obtained from the user.

Clause **96**. The method of any one of clauses **84** to **95**, further comprising the step of automatically generating, in the computing device, at least some of the

new security credentials according to at least one security credential specification associated with at least one of the corresponding network sites.

Clause **97**. The method of any one of clauses **84** to **96**, further comprising the steps of:

obtaining, in the computing device, a request to manually export the new security credentials; and

rendering, in the computing device, a listing of the security credentials in clear text.

Clause **98**. The method of any one of clauses **84** to **97**, further comprising the step of updating, in the computing device, the account data maintained by the authentication management service to store the new security credentials.

Clause **99**. The method of clause **98**, wherein the updating step further comprises the step of encrypting, in the computing device, the account data including the new security credentials using the master security credential before sending the account data to the authentication management service.

Clause **100**. A non-transitory computer-readable medium embodying a program executable in a computing device, the program comprising:

code that obtains account data for a plurality of accounts of a user for a plurality of network sites from an authentication management service over a network, the account data including a respective security credential for each of the accounts;

code that automatically authenticates with a plurality of authentication services corresponding to a plurality of the network sites using a respective plurality of the accounts in response to the user accessing each one of the plurality of the network sites, wherein a respective session is established for each of the network sites;

code that determines that a logout is to be performed based at least in part on at least one of a user logout indication and an expiration of a predetermined period of user inactivity; and

code that performs the logout by ending each one of the sessions, the code that performs the logout being further configured to:

automatically send a respective logout indication to each one of the authentication services;

automatically flush data relating to the sessions in the computing device; and

automatically flush the account data from the computing device.

Clause **101**. The non-transitory computer-readable medium of clause **100**, wherein the data relating to the sessions includes a plurality of session cookies stored by a browser application executed in the computing device.

Clause **102**. The non-transitory computer-readable medium of clause **100** or **101**, wherein the account data is decrypted using a master security credential obtained from the user.

Clause **103**. A system, comprising:

a computing device; and

an authentication client executable in the computing device, the authentication client comprising:

logic that maintains account data for a plurality of accounts of a user for a plurality of network sites, the account data including a respective security credential for each of the accounts;

logic that automatically authenticates with a plurality of authentication services corresponding to a plurality of the network sites using a respective plurality of the accounts in response to the user accessing each

one of the plurality of the network sites, wherein a respective session is established for each of the network sites;

logic that determines that a logout is to be performed; and

logic that performs the logout by ending each one of the sessions.

Clause **104**. The system of clause **103**, wherein the logic that performs the logout is configured to automatically send a respective logout indication to each one of the authentication services.

Clause **105**. The system of clause **103** or **104**, wherein the logic that performs the logout is configured to automatically flush data relating to the sessions in the computing device.

Clause **106**. The system of clause **105**, wherein the data relating to the sessions includes a plurality of session cookies.

Clause **107**. The system of any one of clauses **103** to **106**, wherein the user accesses each one of the plurality of the network sites by way of a browser application executed in the computing device.

Clause **108**. The system of any one of clauses **103** to **107**, wherein the logic that determines that the logout is to be performed is configured to obtain a single logout request from the user.

Clause **109**. The system of any one of clauses **103** to **108**, wherein the logic that determines that the logout is to be performed is configured to obtain a switch user request from the user.

Clause **110**. The system of any one of clauses **103** to **109**, wherein the logic that determines that the logout is to be performed is configured to determine whether a predetermined period of user inactivity has been met.

Clause **111**. The system of any one of clauses **103** to **110**, wherein the logic that determines that the logout is to be performed is configured to determine whether the user has logged out of an operating system account.

Clause **112**. The system of any one of clauses **103** to **111**, wherein the authentication client is configured to download the account data in an encrypted form from an authentication management service.

Clause **113**. The system of clause **112**, wherein the authentication client is configured to decrypt the account data using a master security credential obtained from the user.

Clause **114**. A method, comprising the steps of:

obtaining, in a computing device, account data for a plurality of accounts of a user for a plurality of network sites from an authentication management service over a network, the account data including a respective security credential for each of the accounts;

automatically authenticating, in the computing device, with a plurality of authentication services corresponding to a plurality of the network sites using a respective plurality of the accounts in response to the user accessing each one of the plurality of the network sites, wherein a respective session is established for each of the network sites;

determining, in the computing device, that a logout is to be performed; and

performing, in the computing device, the logout by ending each one of the sessions.

Clause **115**. The method of clause **114**, further comprising the step of decrypting, in the computing device, the account data using a master security credential obtained from the user.

Clause **116**. The method of clause **114** or **115**, further comprising the step of decrypting, in the computing device, the account data using a master security credential stored in a computer-readable medium in the computing device.

Clause **117**. The method of any one of clauses **114** to **116**, wherein the performing step further comprises the step of automatically sending, in the computing device, a respective logout indication to each one of the authentication services.

Clause **118**. The method of any one of clauses**114** to **117**, wherein the performing step further comprises the step of automatically flushing data relating to the sessions in the computing device.

Clause **119**. The method of any one of clauses **114** to **118**, wherein the performing step further comprises the step of automatically flushing the account data from the computing device.

EMBODIMENTS IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A system, comprising:

at least one computing device; and

an authentication service executable in the at least one computing device, the authentication service comprising:

logic that obtains a first authentication request by way of an authentication protocol from a first authentication management client application executed in a first client computing device, the first authentication request specifying a first security credential associated with a first user account;

logic that authenticates the first user account at the first client computing device for access to at least one secured resource of a network site hosted by at least one other computing device in response to the first authentication request;

logic that obtains a second authentication request by way of the authentication protocol from a second authentication management client application executed in a second client computing device, the second authentication request specifying a second security credential associated with a second user account; and

logic that authenticates the second user account at the second client computing device for access to the at least one secured resource of the network site in response to the second authentication request,

wherein the first authentication management client application and the second authentication management client application are different authentication management client applications deployed by different providers of authentication management services.

2. The system of claim **1**, wherein the authentication service further comprises:

logic that determines whether the first authentication management client application is supported based at least in part on an affinity of the first authentication management client application; and

logic that authenticates the first user account at the first client computing device for access to the at least one secured resource of the network site in response to the first authentication request and in response to the first authentication management client application being supported.

3. The system of claim **1**, wherein the first authentication management client application is configured to:

decrypt the first security credential associated with the first user account stored by the first authentication management client in response to obtaining a master security credential from a user;

send the first authentication request by way of the authentication protocol to the authentication service associated with the at least one secured resource of the network site, the first authentication request specifying the first security credential associated with the first user account;

access the at least one secured resource after being authenticated by the authentication service in response to the first authentication request; and

import the first security credential from the first authentication management client into a third authentication management client application executed in the first client computing device.

4. The system of claim **1**, wherein the authentication service further comprises:

logic that stores account data including a plurality of security credentials associated with a plurality of network sites for a user, the account data being stored in an encrypted form;

logic that obtains a request for the account data from a third client, the request specifying a third security credential for accessing the account data; and

logic that sends the account data to the third client in response to determining that the third client corresponds to a preauthorized client and in response to determining that the third security credential for accessing the account data is valid.

5. The system of claim **1**, wherein the authentication service further comprises:

logic that obtains a request to change the first security credential for the first user account after authentication, the request to change the first security credential originating automatically in the first authentication management client application; and

logic that establishes a new security credential for the first user account in response to the request to change the first security credential.

6. The system of claim **1**, wherein the authentication service further comprises:

logic that obtains an account upgrade request from the first authentication management client application after authentication, the account upgrade request specifying a set of information about a user;

logic that upgrades the first user account according to the account upgrade request; and

logic that authenticates the first user account at the first client computing device for access to another secured resource of the network site after upgrading.

7. A non-transitory computer-readable medium embodying at least one program executable in a client computing device, the at least one program comprising:

code that decrypts a security credential associated with a user account stored by a first authentication management client in response to receiving a master security credential from an input device of the client computing device, wherein the security credential is stored in the client computing device in an encrypted form;

code that sends a first authentication request using the first authentication management client by way of an authentication protocol to an authentication service associated with a first secured resource of a network site, the first authentication request specifying the security credential associated with the user account;

code that accesses the first secured resource after being authenticated by the authentication service in response to the first authentication request;

code that imports the user account and the decrypted security credential associated with the user account from the first authentication management client into a second authentication management client configured to interact with a second secured resource;

code that sends a second authentication request using the second authentication management client by way of the authentication protocol to the authentication service, the second authentication request specifying the decrypted security credential;

code that accesses the second secured resource after being authenticated by the authentication service in response to the second authentication request;

code that, in response to receiving a denial of an access request to another secured resource, sends an account upgrade request for the user account using the second authentication management client to the authentication service, wherein the account upgrade request seeks a permission for the user account associated with the user to access the another secured resource and specifies a set of information about the user; and

code that accesses the another secured resource of the network site after the user account receives the permission to access the another secured resource.

8. The non-transitory computer-readable medium of claim **7**, wherein the first authentication management client and the second authentication management client are deployed by different providers of authentication management services.

9. A method, comprising:

obtaining, in at least one computing device, a first authentication request by way of an authentication protocol from a first authentication management client application executed in a first client computing device, the first authentication request specifying a first security credential associated with a first user account;

authenticating, in the at least one computing device, the first user account submitted by the first client computing device for access to at least one secured resource of a network site hosted by at least one other computing device in response to the first authentication request;

obtaining, in the at least one computing device, a second authentication request by way of the authentication protocol from a second authentication management client application executed in a second client computing device, the second authentication request specifying a second security credential associated with a second user account;

authenticating, in the at least one computing device, the second user account submitted by the second client computing device for access to the at least one secured resource of the network site in response to the second authentication request; and

wherein the first authentication management client application and the second authentication management client application are different

authentication management client applications deployed by different providers of authentication management services.

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

sending, in the at least one computing device, branded experience data to the first authentication management client application and the second authentication management client application; and

wherein the first authentication management client application is configured to customize a first user interface in the first client computing device based at least in part on the branded experience data, and the second authentication management client application is configured to customize a second user interface in the second client computing device based at least in part on the branded experience data.

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

determining, in the at least one computing device, whether the first authentication management client application is supported in response to the first authentication request; and

determining, in the at least one computing device, whether the second authentication management client application is supported in response to the second authentication request.

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

obtaining, in the at least one computing device, a request to change the first security credential for the first user account after authentication, the

request to change the first security credential originating automatically in the first authentication management client application; and

establishing, in the at least one computing device, a new security credential for the first user account in response to the request to change the first security credential.

13. The method of claim **12**, wherein the new security credential corresponds to a symmetric key employed by a transport layer security (TLS) session between the first client computing device and the at least one computing device.

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

obtaining, in the at least one computing device, an account upgrade request from the first authentication management client after authentication, the account upgrade request specifying a set of information about a user;

upgrading, in the at least one computing device, the first user account according to the account upgrade request; and

authenticating, in the at least one computing device, the first user account at the first client computing device for access to another secured resource of the network site after upgrading.

15. The method of claim **14**, wherein the first authentication management client is configured to send the account upgrade request to the at least one computing device in response to the user attempting to access the another secured resource in the first client computing device and in response to obtaining a consent indication from the user.

16. The method of claim **14**, wherein the account upgrade request seeks a permission for the first user account associated with the user to access the another secure resource.

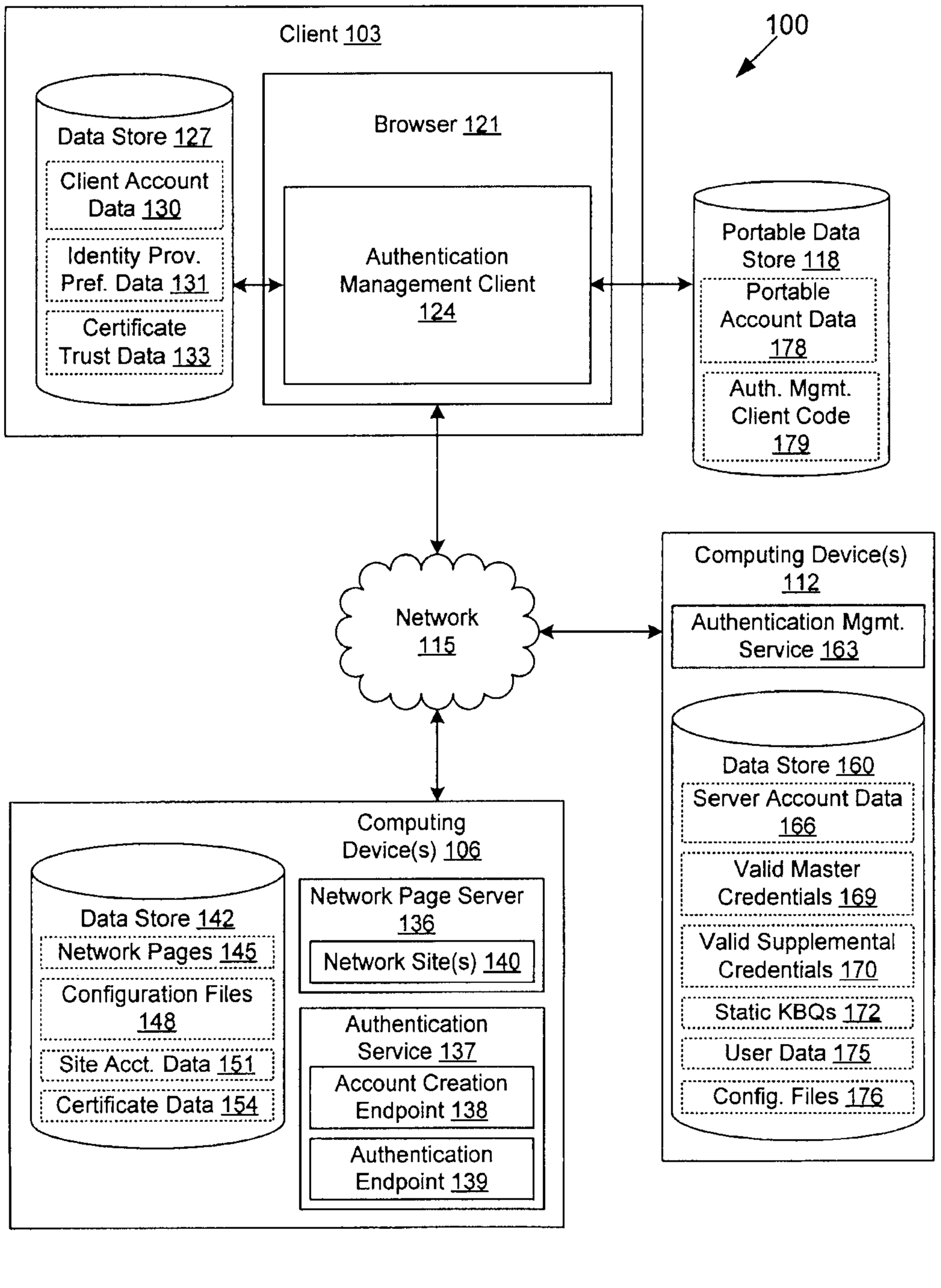

100
Client 103
Data Store 127
Client Account Data 130
Identity Prov. Pref. Data 131
Certificate Trust Data 133
Browser 121
Authentication Management Client 124
Portable Data Store 118
Portable Account Data 178
Auth. Mgmt. Client Code 179
Network 115
Computing Device(s) 112
Authentication Mgmt. Service 163
Data Store 160
Server Account Data 166
Valid Master Credentials 169
Valid Supplemental Credentials 170
Static KBQs 172
User Data 175
Config. Files 176
Computing Device(s) 106
Data Store 142
Network Pages 145
Configuration Files 148
Site Acct. Data 151
Certificate Data 154
Network Page Server 136
Network Site(s) 140
Authentication Service 137
Account Creation Endpoint 138
Authentication Endpoint 139

FIG. 1

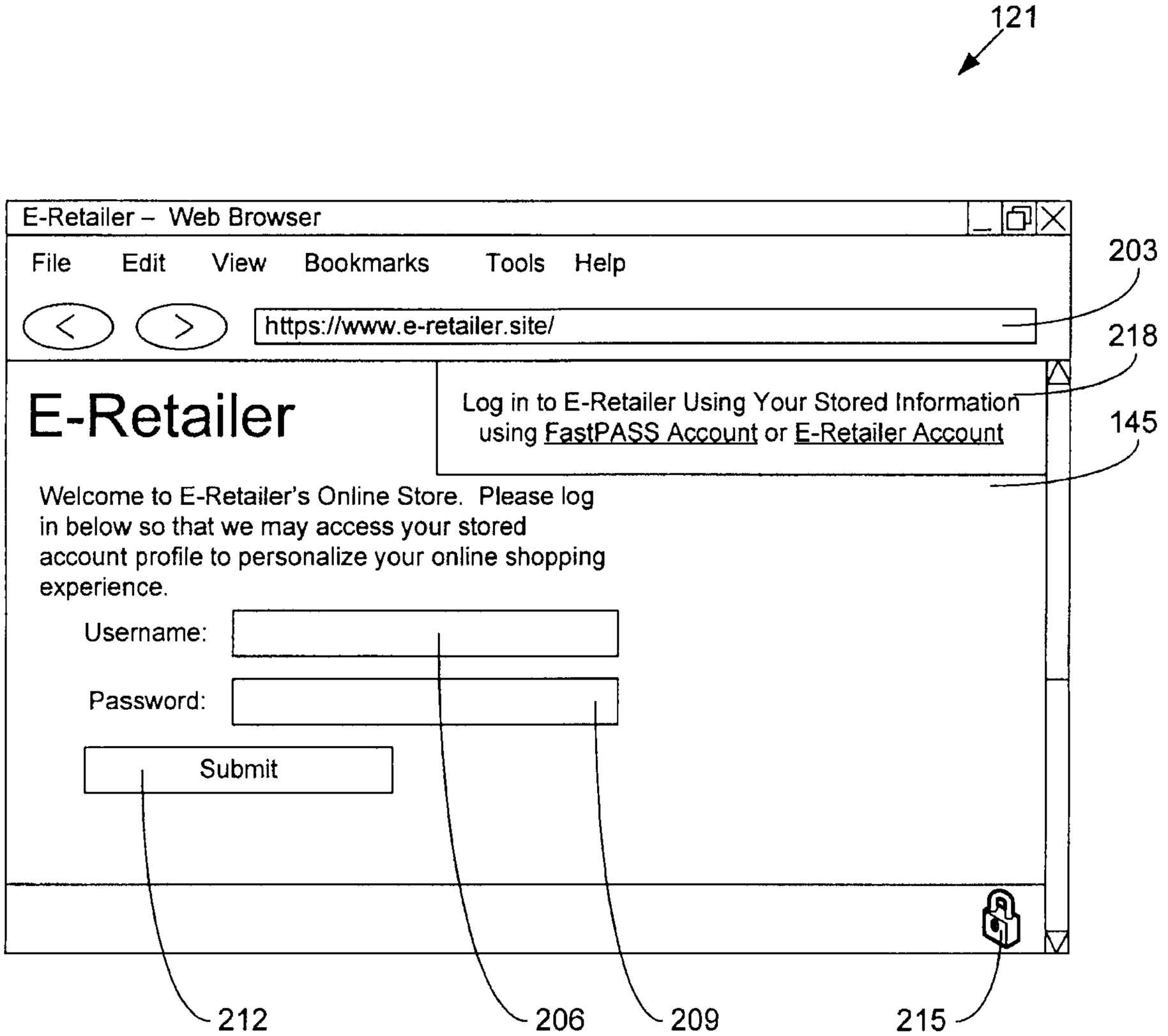

121
E-Retailer – Web Browser
File Edit View Bookmarks Tools Help
https://www.e-retailer.site/
203
218
145
E-Retailer
Log in to E-Retailer Using Your Stored Information using FastPASS Account or E-Retailer Account
Welcome to E-Retailer's Online Store. Please log in below so that we may access your stored account profile to personalize your online shopping experience.
Username:
Password:
Submit
212
206
209
215

FIG. 2A

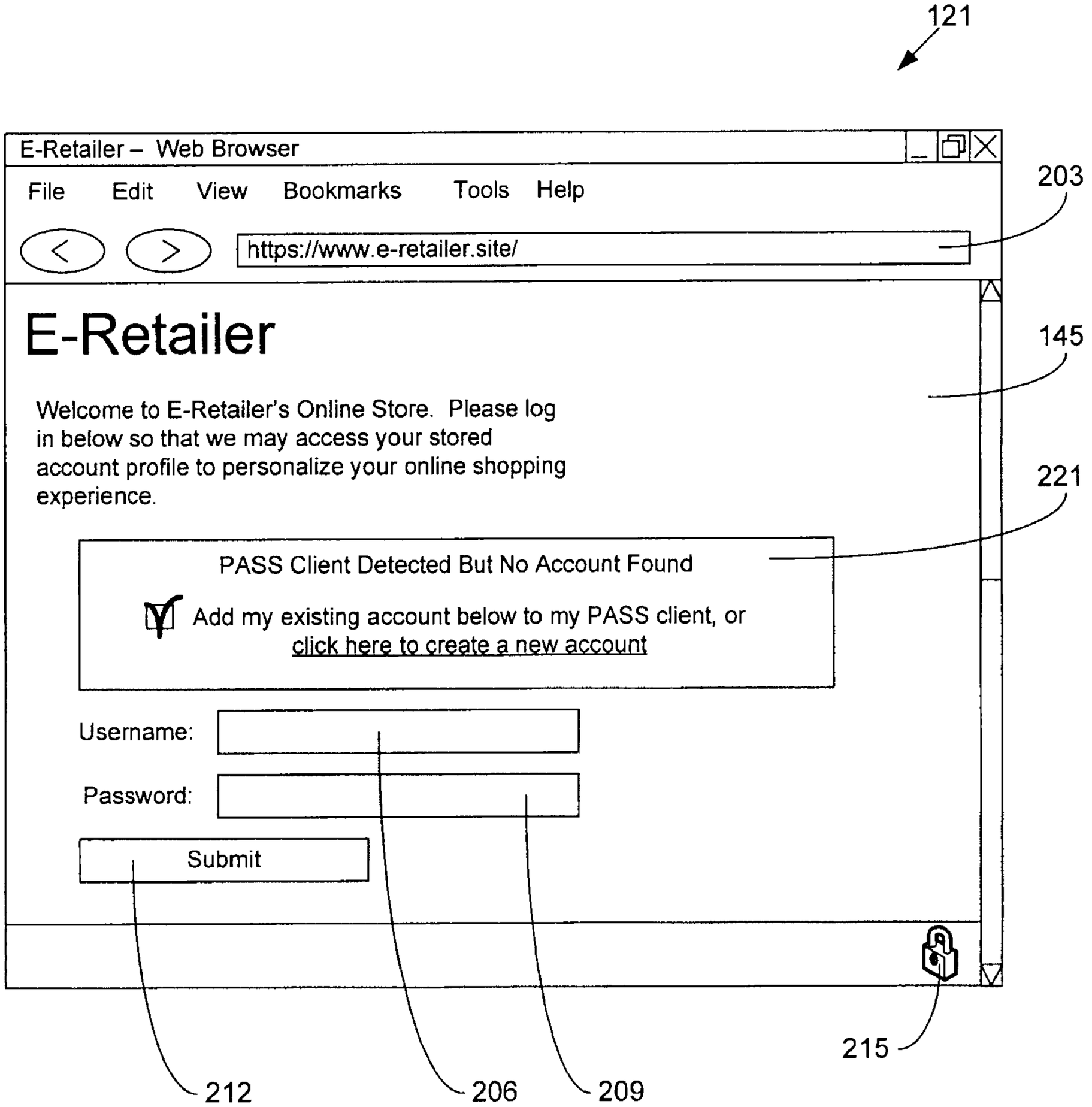

121
E-Retailer – Web Browser
File Edit View Bookmarks Tools Help
https://www.e-retailer.site/
203
E-Retailer
145
Welcome to E-Retailer's Online Store. Please log in below so that we may access your stored account profile to personalize your online shopping experience.
221
PASS Client Detected But No Account Found
Add my existing account below to my PASS client, or
click here to create a new account
Username:
Password:
Submit
215
212
206
209

FIG. 2B

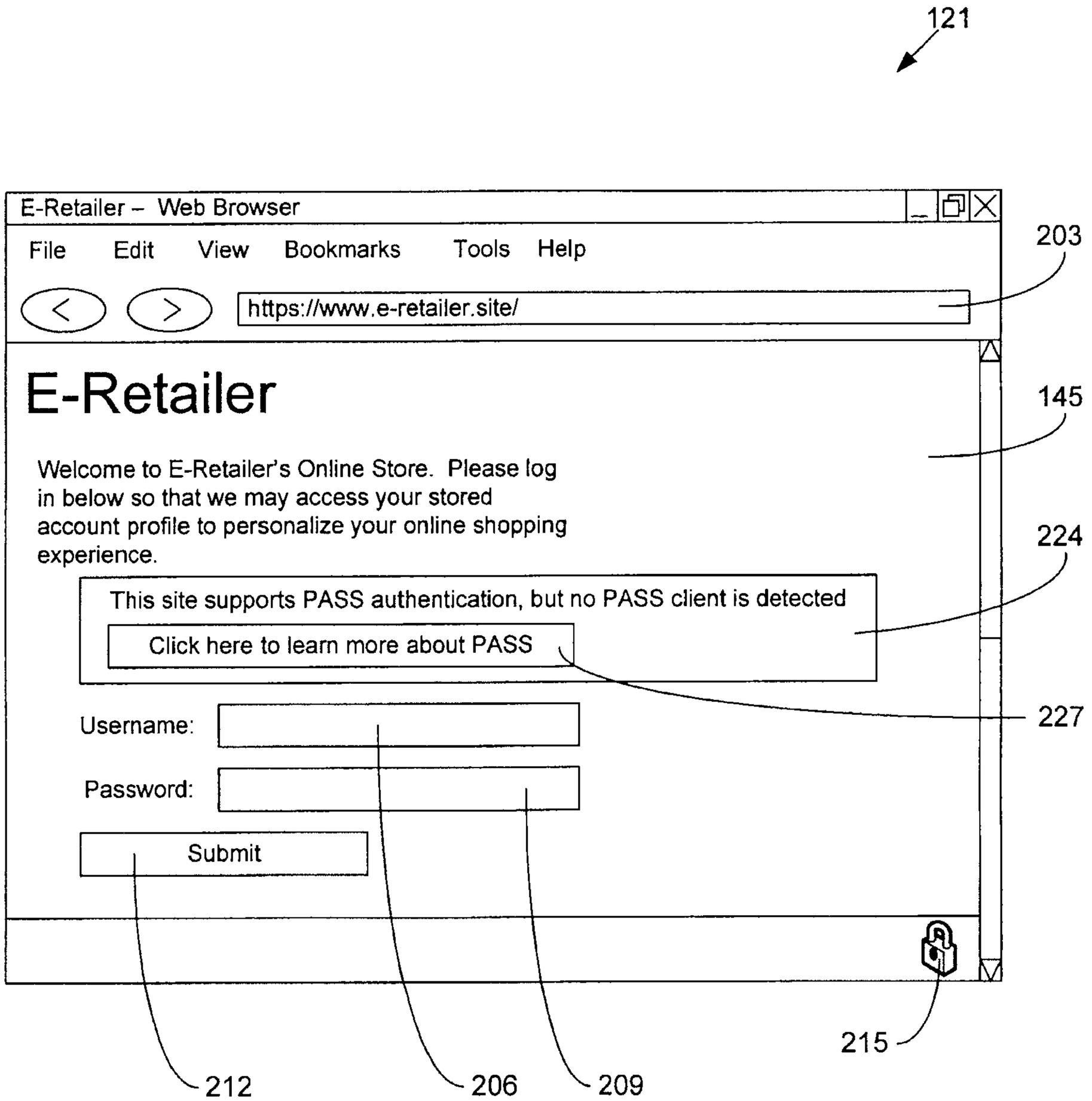

121
E-Retailer – Web Browser
File Edit View Bookmarks Tools Help
https://www.e-retailer.site/
203
E-Retailer
145
Welcome to E-Retailer's Online Store. Please log in below so that we may access your stored account profile to personalize your online shopping experience.
224
This site supports PASS authentication, but no PASS client is detected
Click here to learn more about PASS
227
Username:
Password:
Submit
215
212
206
209

FIG. 2C

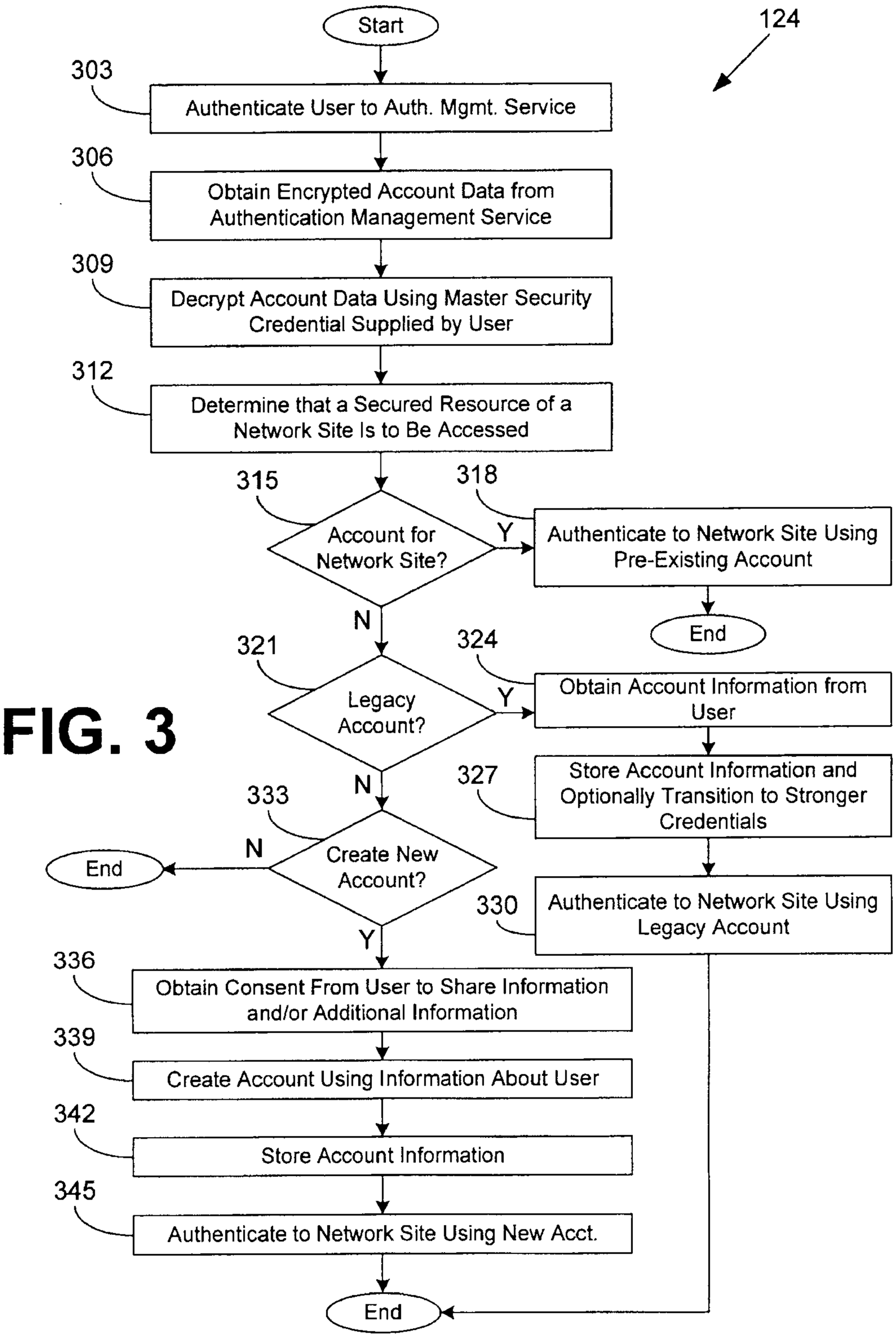

124
Start
303
Authenticate User to Auth. Mgmt. Service
306
Obtain Encrypted Account Data from Authentication Management Service
309
Decrypt Account Data Using Master Security Credential Supplied by User
312
Determine that a Secured Resource of a Network Site Is to Be Accessed
315
Account for Network Site?
Y
318
Authenticate to Network Site Using Pre-Existing Account
End
N
321
Legacy Account?
Y
324
Obtain Account Information from User
327
Store Account Information and Optionally Transition to Stronger Credentials
330
Authenticate to Network Site Using Legacy Account
N
333
Create New Account?
N
End
Y
336
Obtain Consent From User to Share Information and/or Additional Information
339
Create Account Using Information About User
342
Store Account Information
345
Authenticate to Network Site Using New Acct.
End

FIG. 3

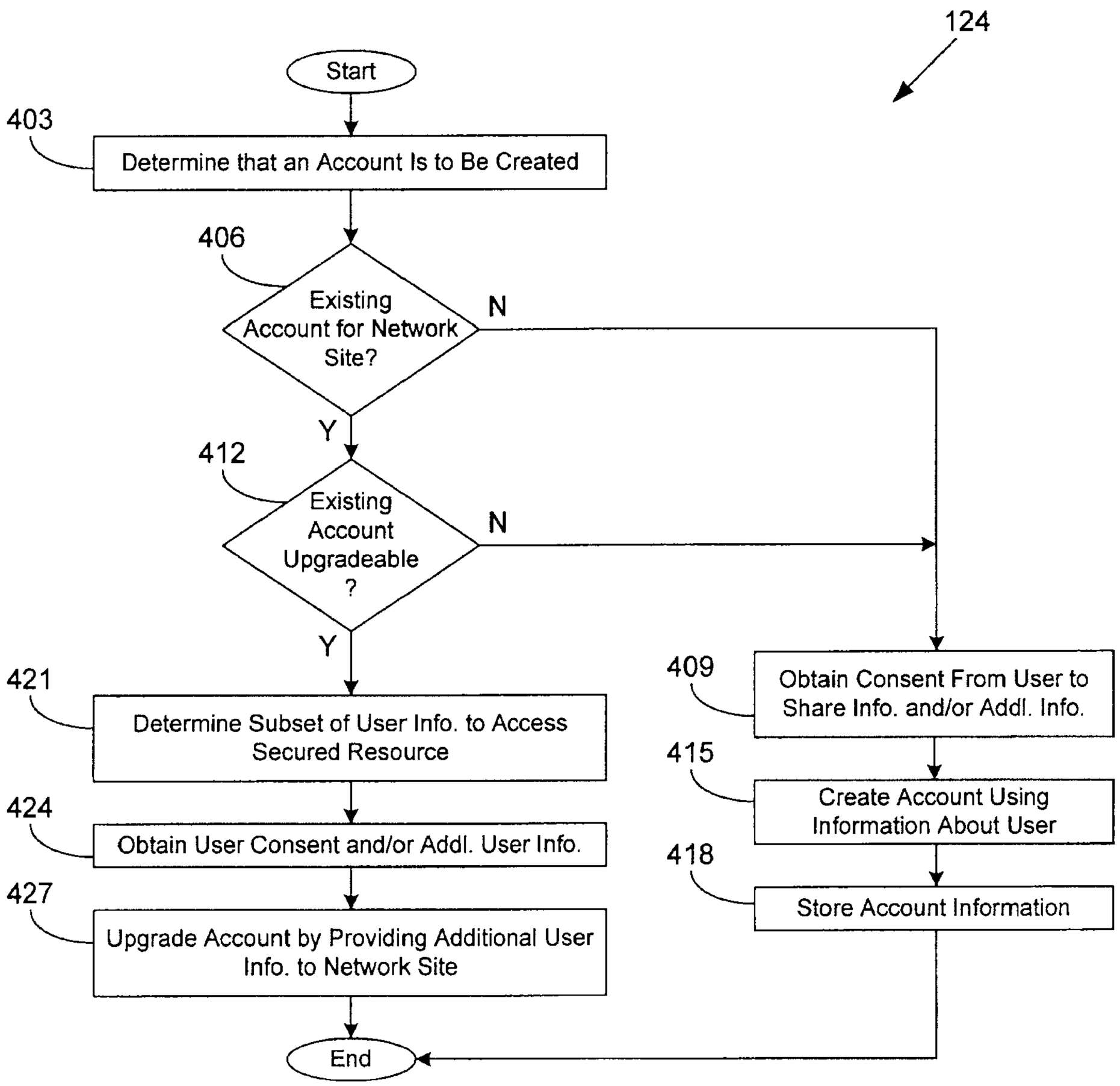

124
Start
403
Determine that an Account Is to Be Created
406
Existing Account for Network Site?
N
Y
412
Existing Account Upgradeable ?
N
Y
421
Determine Subset of User Info. to Access Secured Resource
424
Obtain User Consent and/or Addl. User Info.
427
Upgrade Account by Providing Additional User Info. to Network Site
409
Obtain Consent From User to Share Info. and/or Addl. Info.
415
Create Account Using Information About User
418
Store Account Information
End

FIG. 4

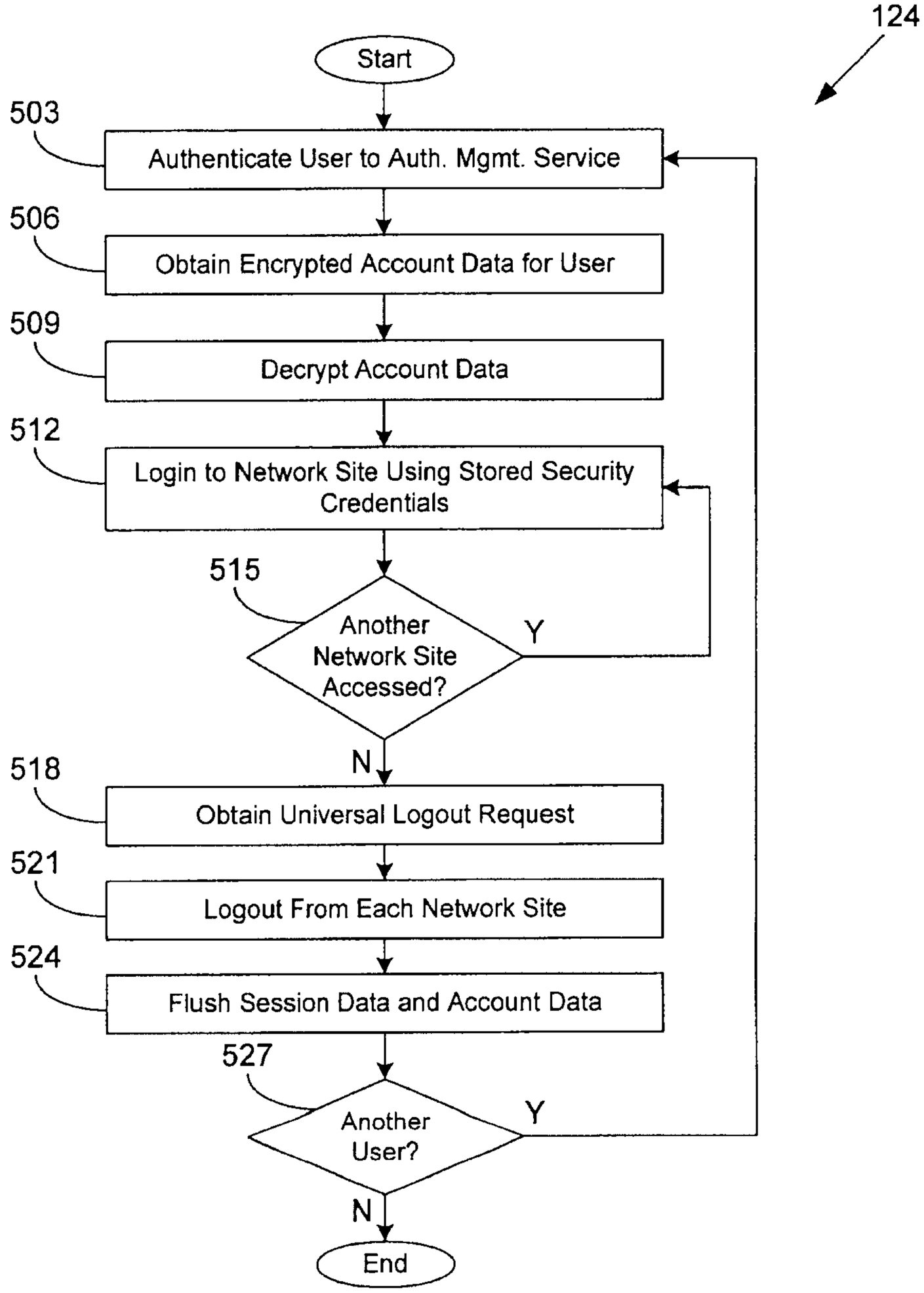

124
Start
503
Authenticate User to Auth. Mgmt. Service
506
Obtain Encrypted Account Data for User
509
Decrypt Account Data
512
Login to Network Site Using Stored Security Credentials
515
Another Network Site Accessed?
Y
N
518
Obtain Universal Logout Request
521
Logout From Each Network Site
524
Flush Session Data and Account Data
527
Another User?
Y
N
End

FIG. 5

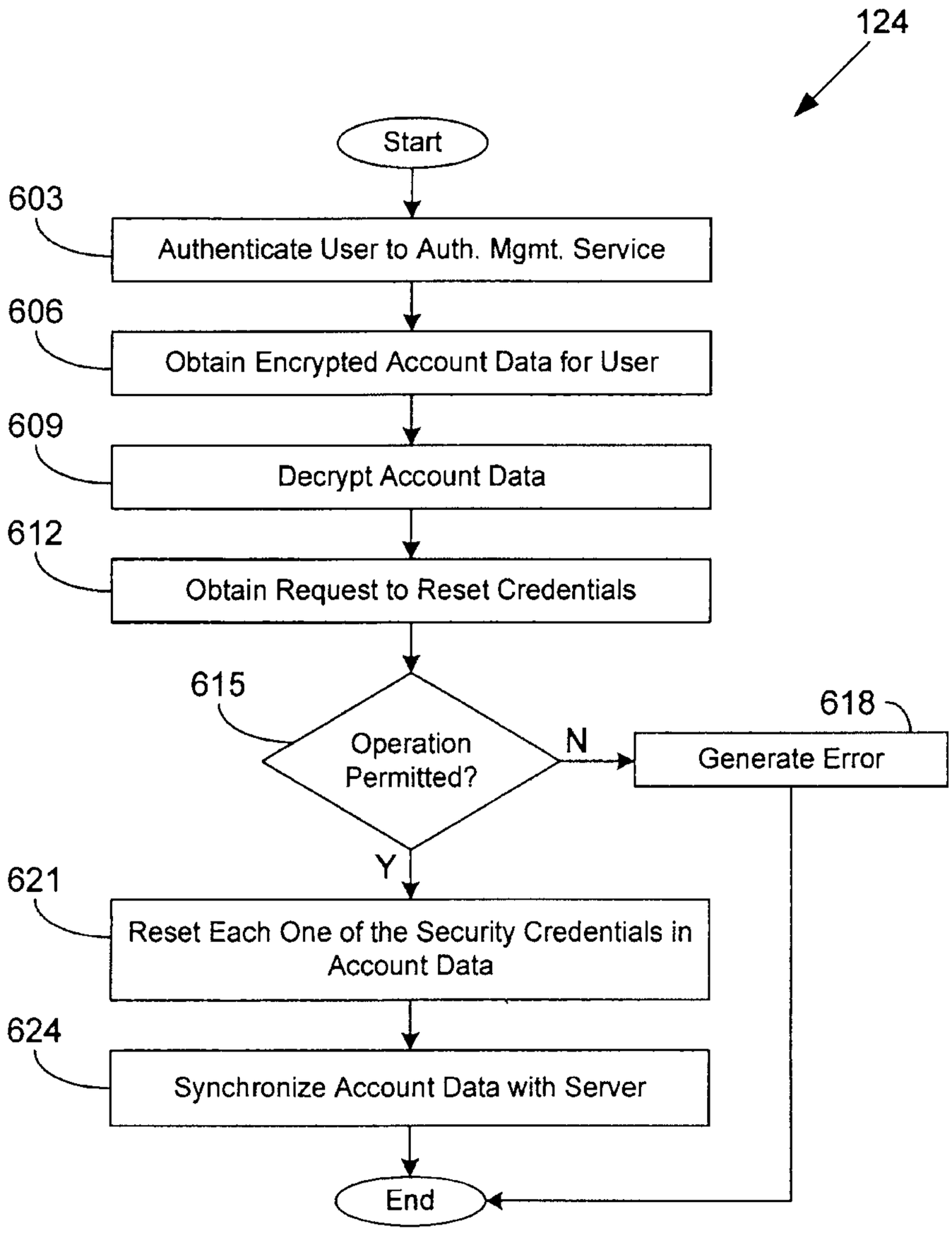

124
Start
603
Authenticate User to Auth. Mgmt. Service
606
Obtain Encrypted Account Data for User
609
Decrypt Account Data
612
Obtain Request to Reset Credentials
615
Operation Permitted?
N
618
Generate Error
Y
621
Reset Each One of the Security Credentials in Account Data
624
Synchronize Account Data with Server
End

FIG. 6A

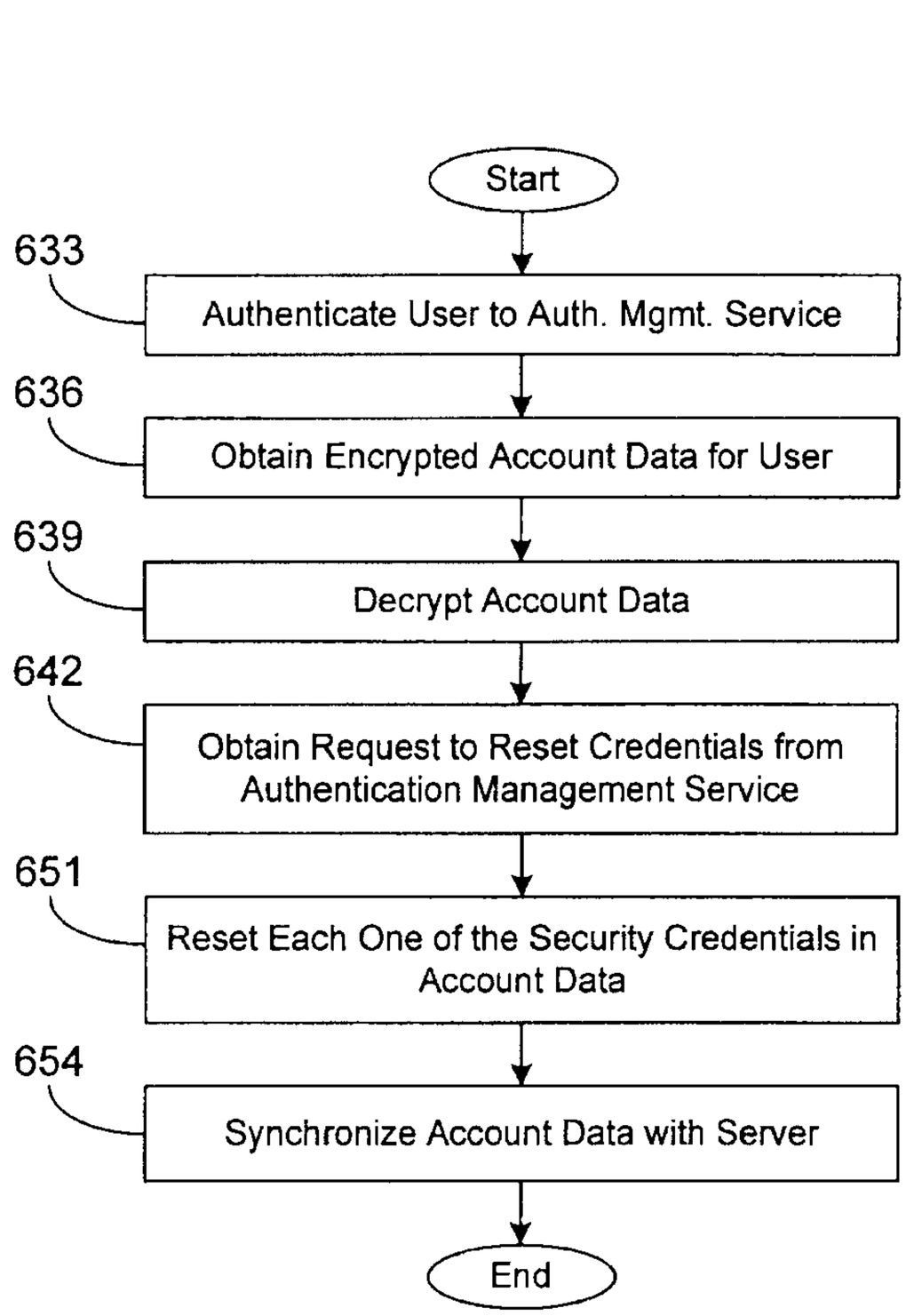

124
Start
633
Authenticate User to Auth. Mgmt. Service
636
Obtain Encrypted Account Data for User
639
Decrypt Account Data
642
Obtain Request to Reset Credentials from Authentication Management Service
651
Reset Each One of the Security Credentials in Account Data
654
Synchronize Account Data with Server
End

FIG. 6B

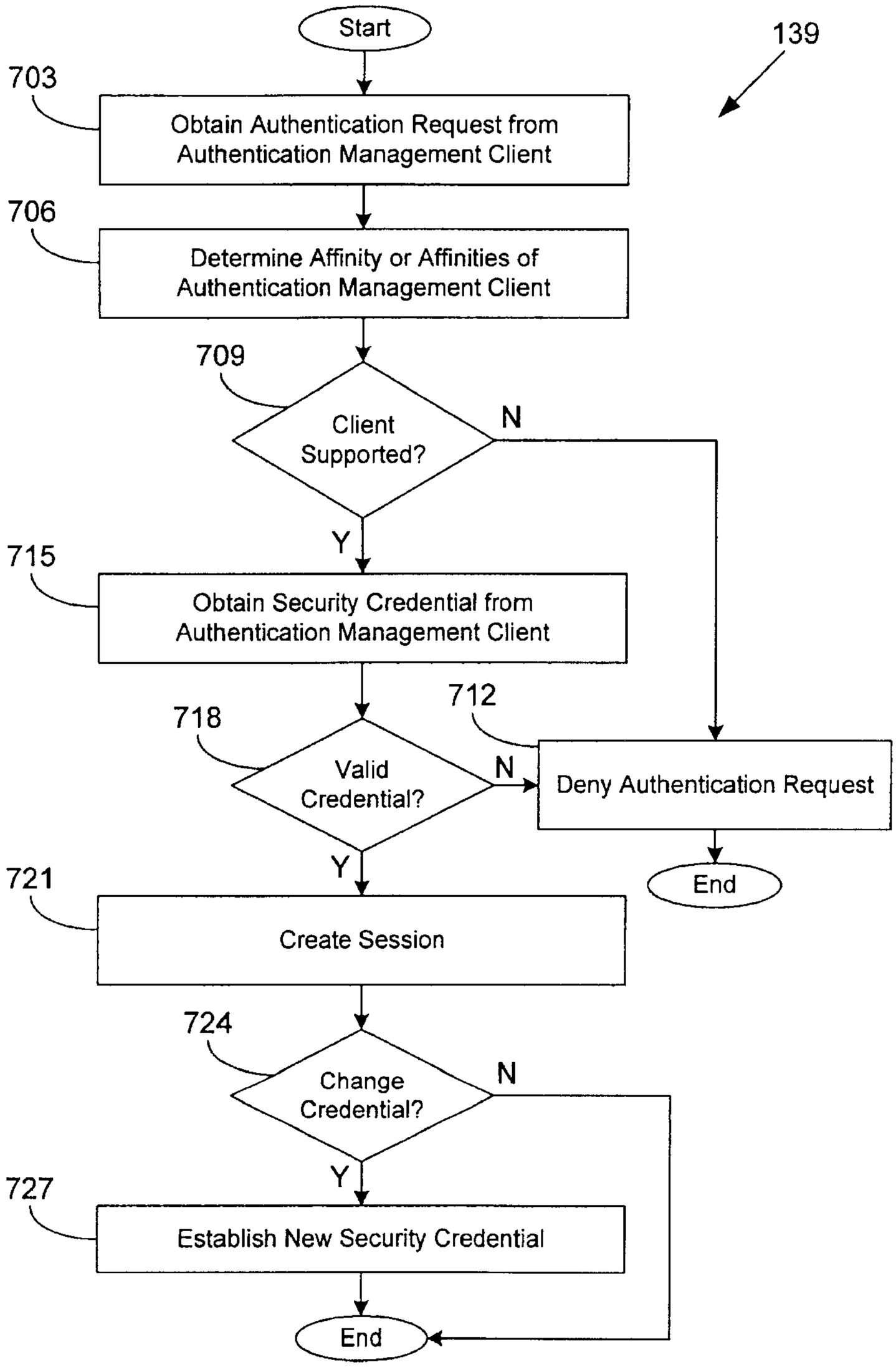

Start
139
703
Obtain Authentication Request from Authentication Management Client
706
Determine Affinity or Affinities of Authentication Management Client
709
Client Supported?
N
Y
715
Obtain Security Credential from Authentication Management Client
712
718
Valid Credential?
N
Deny Authentication Request
End
Y
721
Create Session
724
Change Credential?
N
Y
727
Establish New Security Credential
End

FIG. 7

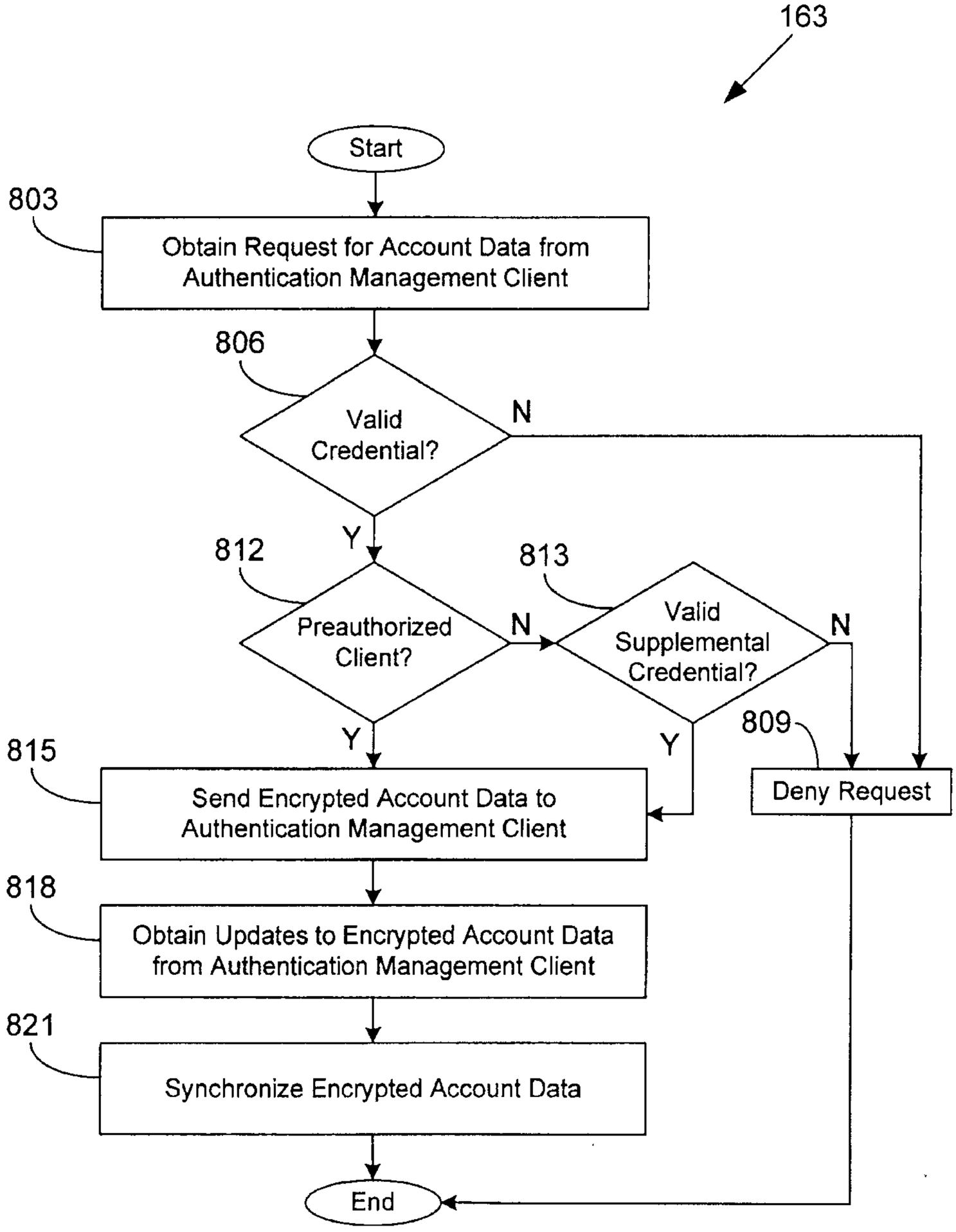

163
Start
803
Obtain Request for Account Data from Authentication Management Client
806
Valid Credential?
N
Y
812
Preauthorized Client?
N
813
Valid Supplemental Credential?
N
Y
Y
809
Deny Request
815
Send Encrypted Account Data to Authentication Management Client
818
Obtain Updates to Encrypted Account Data from Authentication Management Client
821
Synchronize Encrypted Account Data
End

FIG. 8

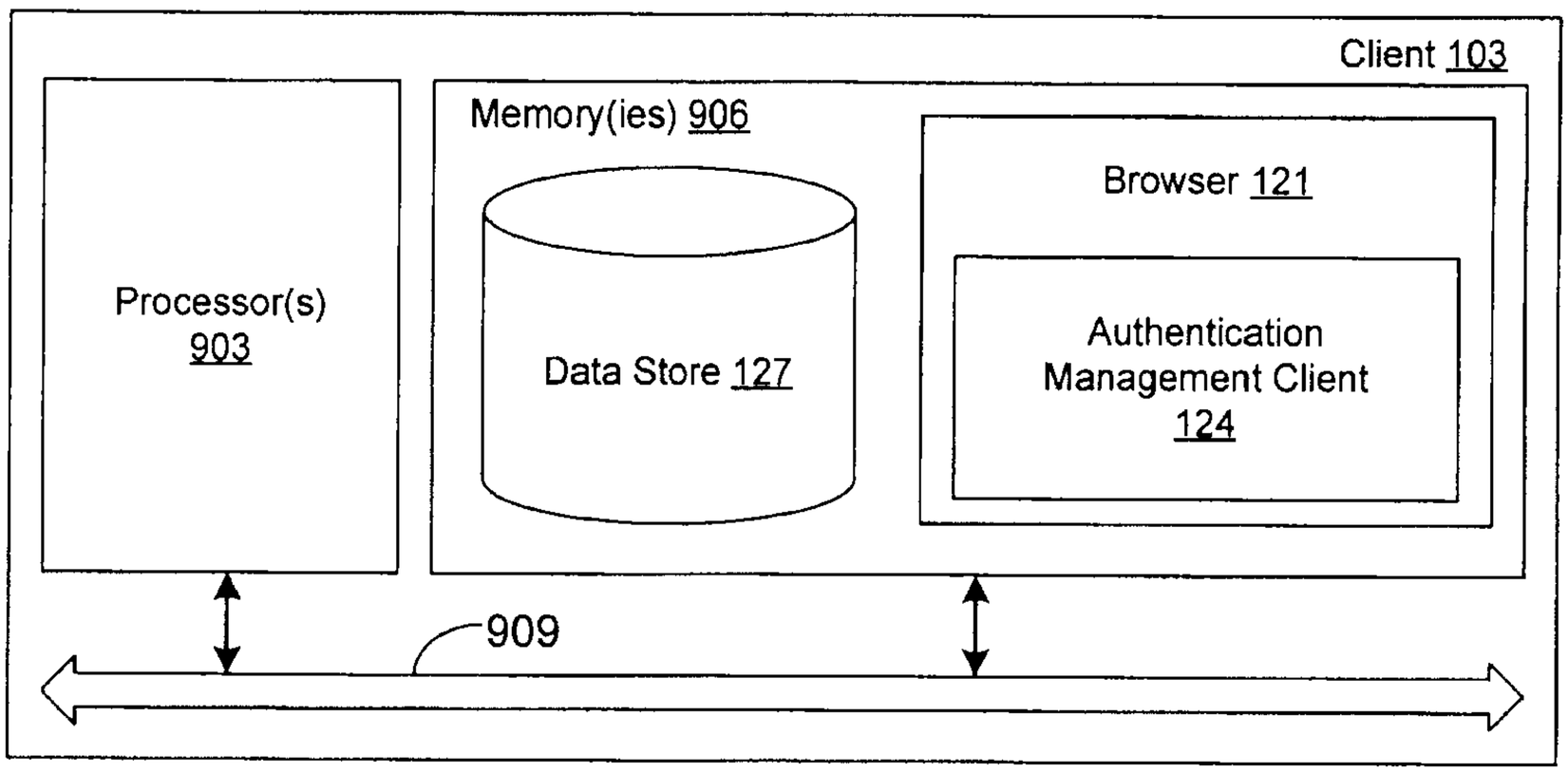
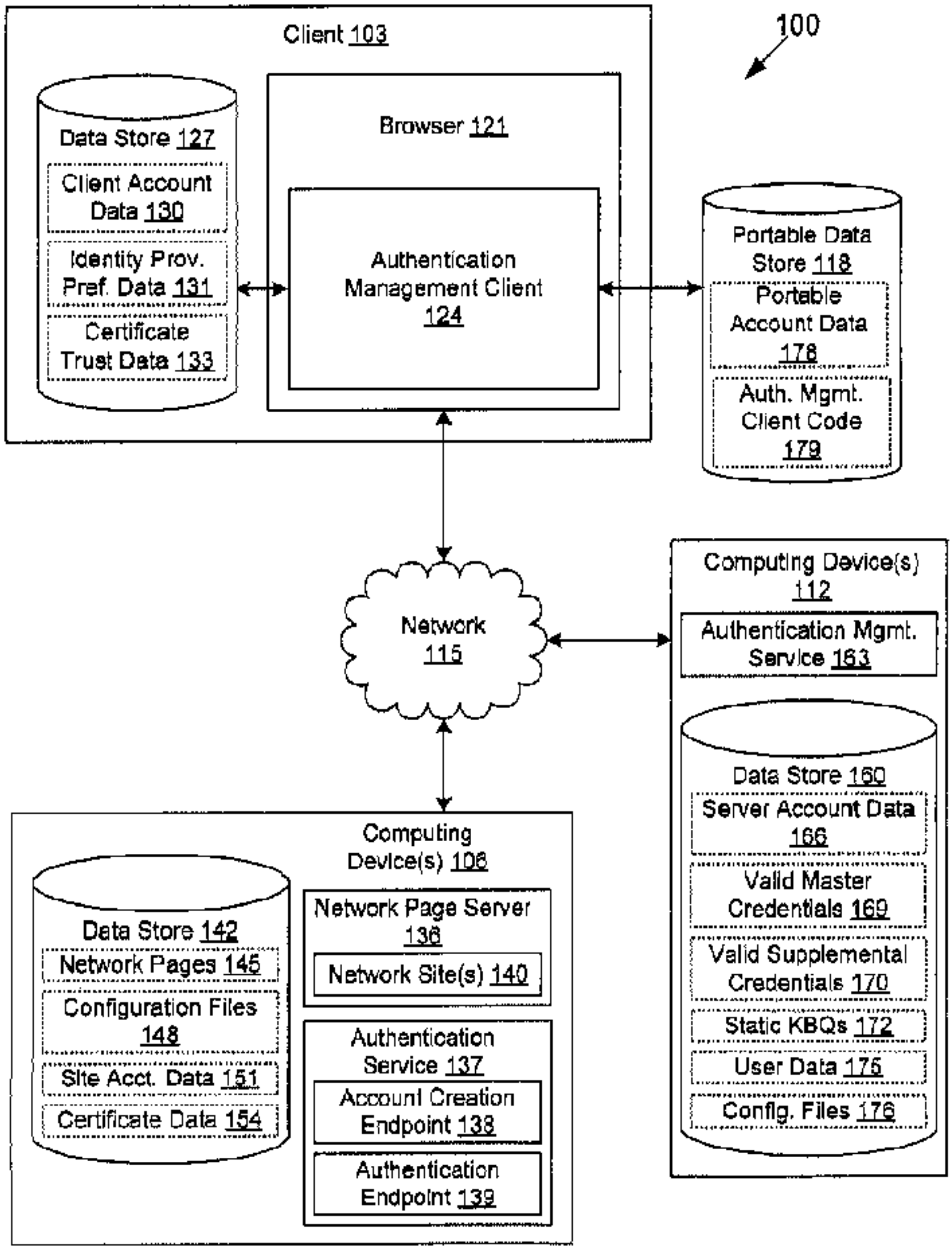

Client 103
Memory(ies) 906
Data Store 127
Browser 121
Authentication Management Client 124
Processor(s) 903
909

FIG. 9


100
Client 103
Data Store 127
Client Account Data 130
Identity Prov. Pref. Data 131
Certificate Trust Data 133
Browser 121
Authentication Management Client 124
Portable Data Store 118
Portable Account Data 178
Auth. Mgmt. Client Code 179
Network 115
Computing Device(s) 112
Authentication Mgmt. Service 163
Data Store 160
Server Account Data 166
Valid Master Credentials 169
Valid Supplemental Credentials 170
Static KBQs 172
User Data 175
Config. Files 176
Computing Device(s) 106
Data Store 142
Network Pages 145
Configuration Files 148
Site Acct. Data 151
Certificate Data 154
Network Page Server 136
Network Site(s) 140
Authentication Service 137
Account Creation Endpoint 138
Authentication Endpoint 139