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(54) **AUTHENTICATION MANAGER**

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

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*Primary Examiner* — Darren B Schwartz

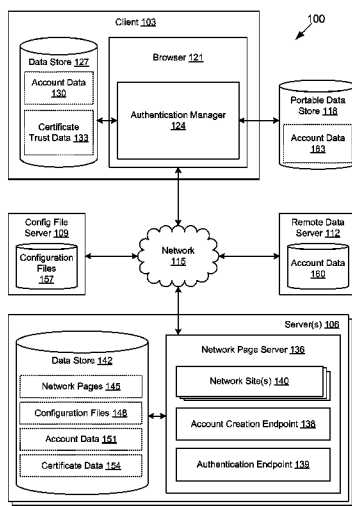
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(57) **ABSTRACT**

Disclosed are various embodiments for an authentication manager. A security credential is generated based at least in part on a security credential specification associated with a network site. The security credential and a domain name associated with the network site are stored. The security credential is provided to the network site when a domain name associated with a trusted certificate provided by the network site matches the stored domain name.

**22 Claims, 7 Drawing Sheets**



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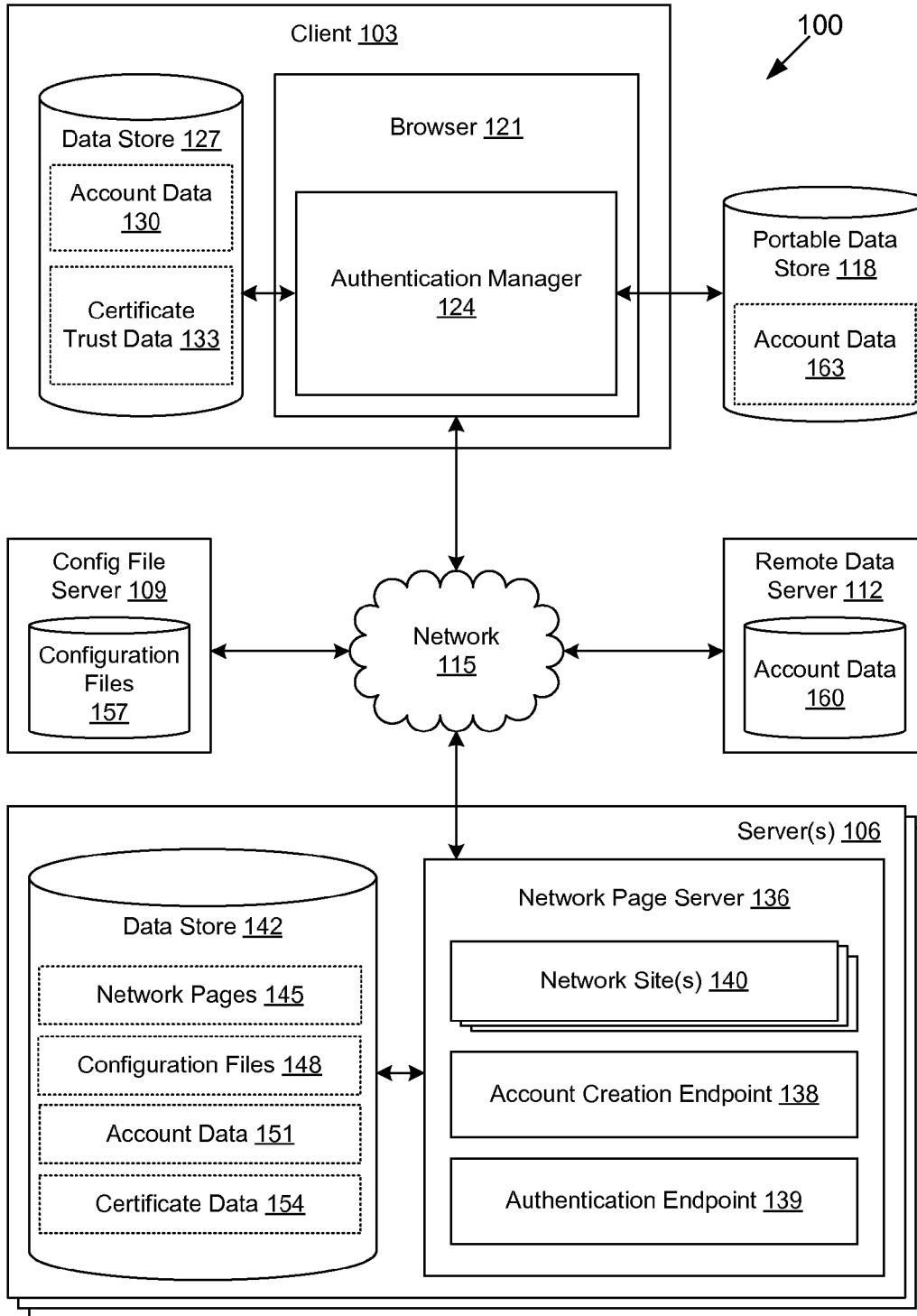


FIG. 1

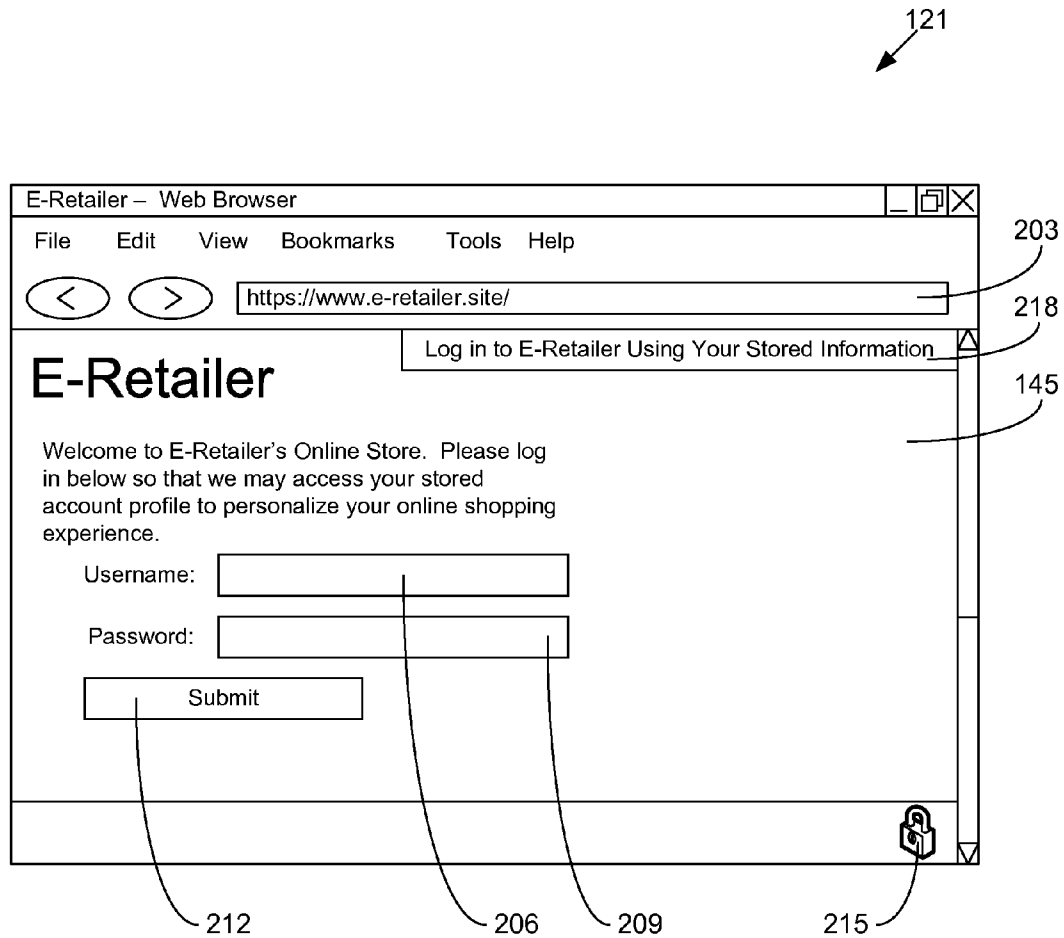


FIG. 2

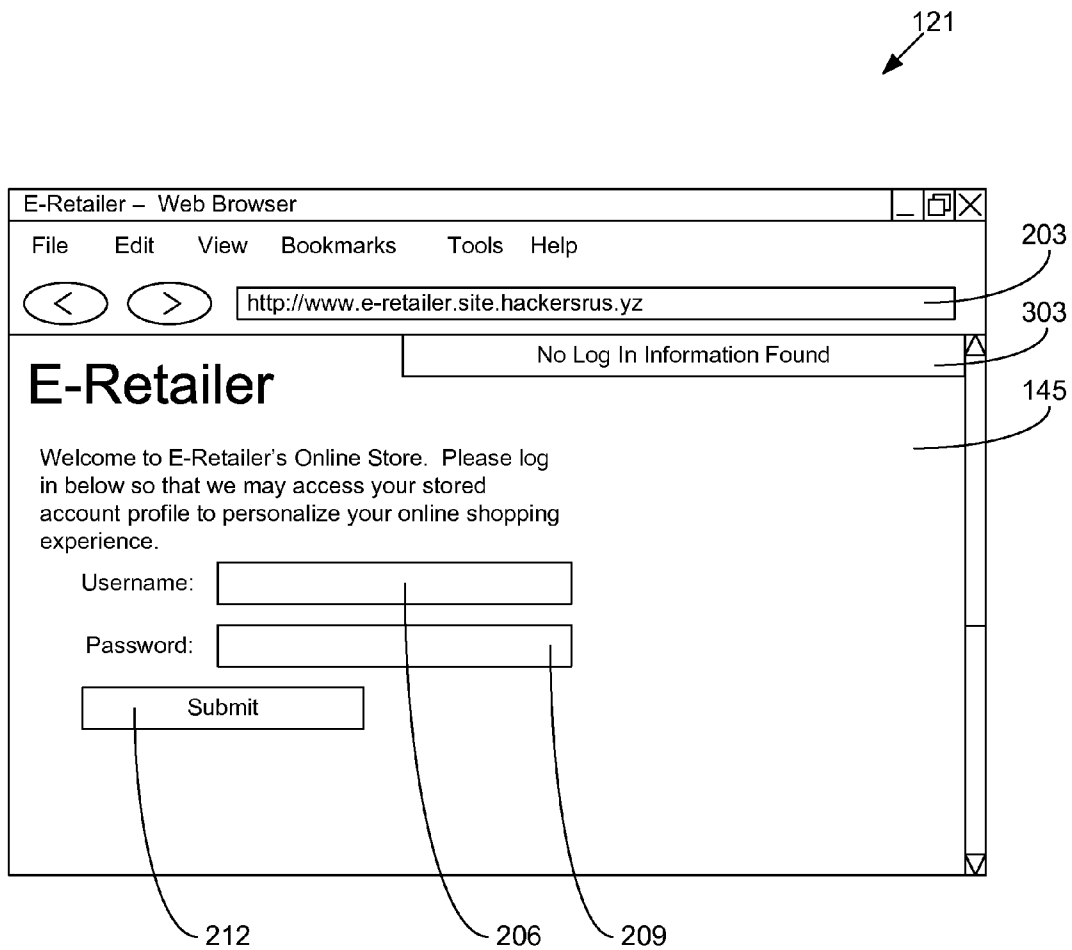
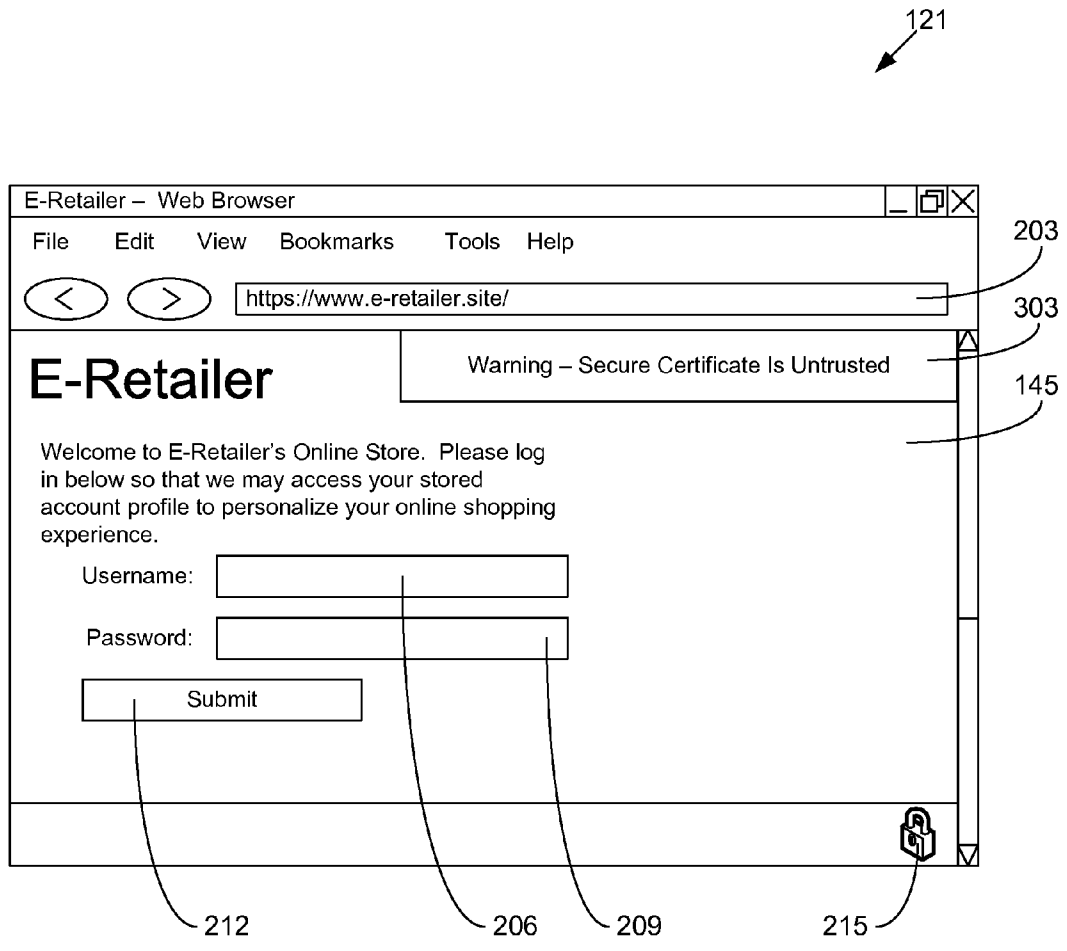
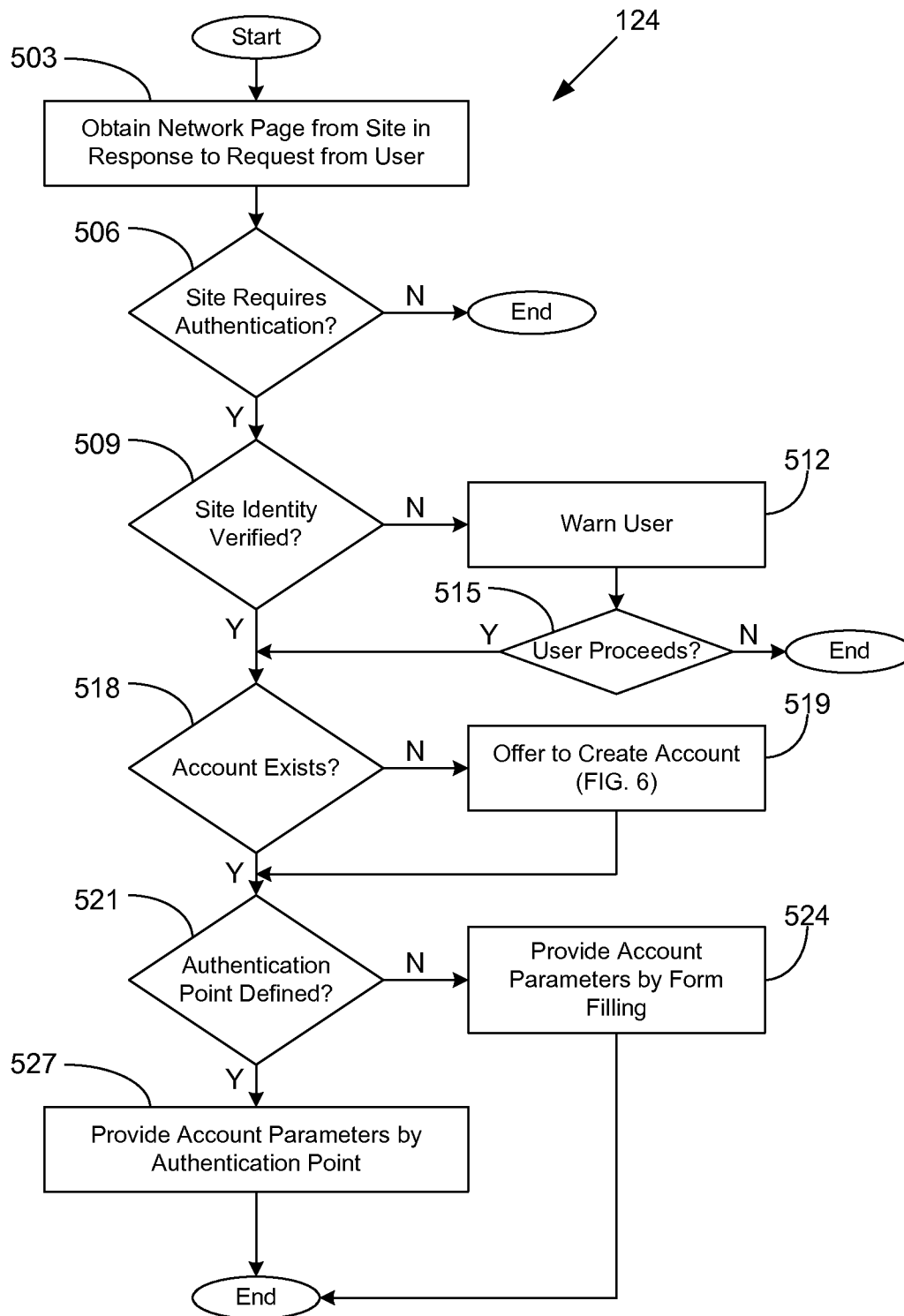


FIG. 3



**FIG. 4**



**FIG. 5**

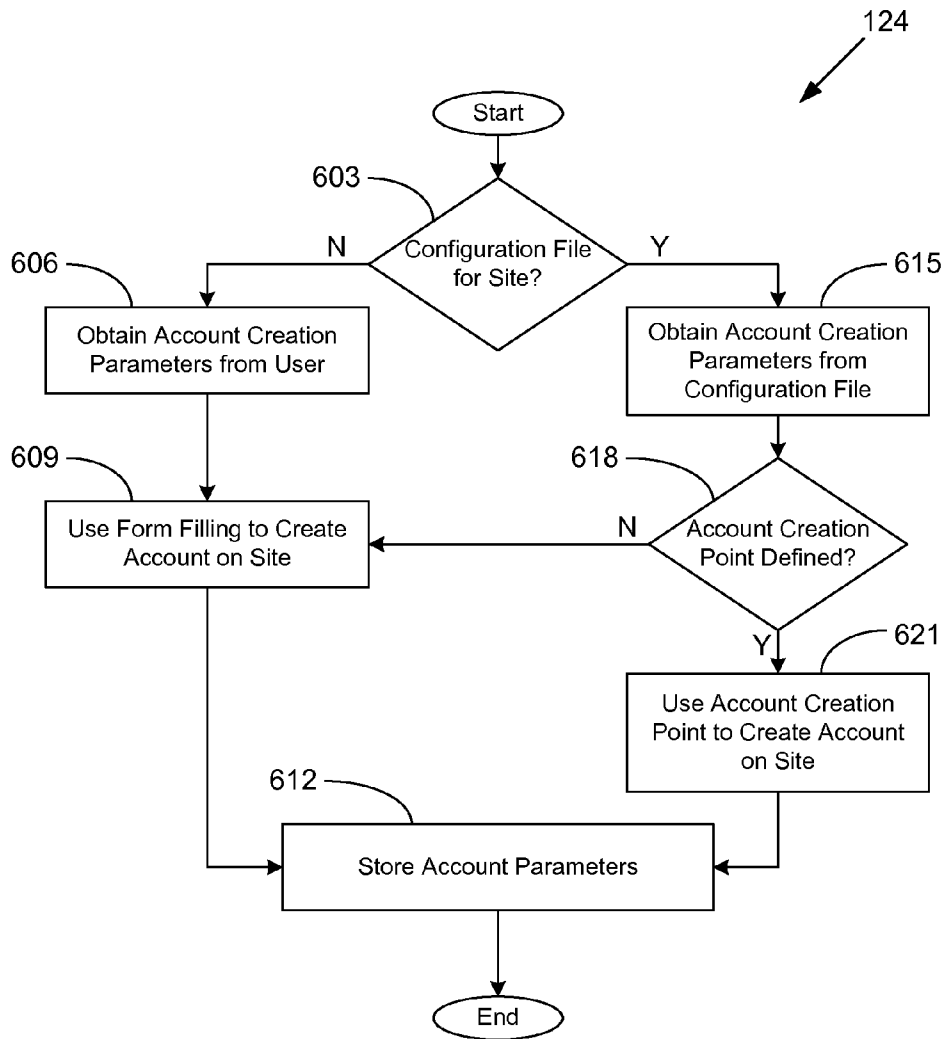


FIG. 6



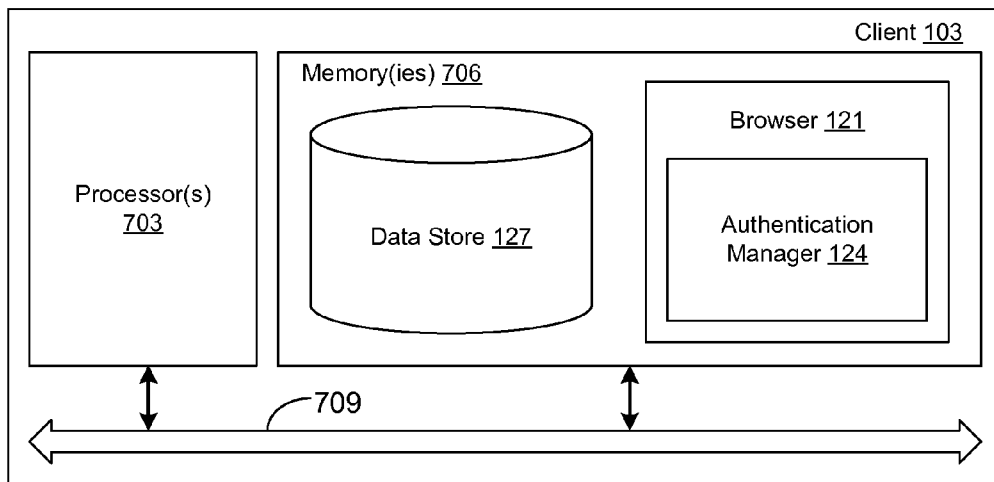


FIG. 7

## AUTHENTICATION MANAGER

## BACKGROUND

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 and/or specify 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.

## BRIEF DESCRIPTION OF THE DRAWINGS

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.

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

FIGS. 2-4 depict examples of network pages rendered by a browser executed in a client in the networked environment of FIG. 1 according to various embodiments of the present disclosure.

FIGS. 5 and 6 are flowcharts illustrating examples of functionality implemented as portions of an authentication manager executed in a server in the networked environment of FIG. 1 according to various embodiments of the present disclosure.

FIG. 7 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

Many network sites, such as web sites, use passwords and/or usernames and passwords in order to authenticate user accounts. 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. Moreover, through a practice known as "phishing," a user may inadvertently provide a password to a fraudulent network site that resembles a legitimate network site.

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. Good passwords are often random and 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. In ordinary use, the user may not need to know the password for the network site. Further, the system may be configured to verify the identity of a network site before

providing a password to the network site, thereby thwarting most phishing schemes. 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.

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 servers **106**, configuration file server **109**, and remote data server **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**.

The client **103** may comprise, for example, a computer system such as a desktop, laptop, or other computer system. The client **103** may also comprise personal digital assistants, cellular telephones, set-top boxes, or other systems with like capability. Further, the client **103** may also comprise any device that is network capable that may communicate with the servers **106**, **109**, **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.

The client **103** may be configured to execute various applications such as a browser **121**, an authentication manager **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, or other network content served up by the server **106** and/or other servers. The authentication manager **124** may be executed to manage usernames, passwords, private and public keys, certificates, and/or other security credentials. In some embodiments, the authentication manager **124** runs as a plug-in application to the browser **121**. In other embodiments, the authentication manager **124** may be a standalone application that interfaces with the browser **121** and/or other applications requiring management of authentication. The client **103** may be configured to execute applications beyond browser **121** and authentication manager **124** such as, for example, e-mail applications, instant message applications, and other applications.

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 account data **130**, certificate trust data **133**, and/or potentially other data. 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, account data **130** may be stored in an encrypted format. 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.

The server **106** may comprise, for example, a server computer or like system. The server **106** may represent multiple servers arranged, for example, in one or more server banks or other arrangements. Such servers **106** may be located in a single installation or may be dispersed among many different geographical locations. For purposes of convenience, the server **106** is referred to herein in the singular. However, in

one embodiment, the server **106** represents a plurality of servers arranged as described above.

The server **106** is configured to execute various applications such as, for example, a network page server **136**, an account creation endpoint **138**, 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 files from the server **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 method. Non-limiting examples of network page servers **136** include Apache™ HTTP Server, Microsoft® Internet Information Services, and other server applications.

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**.

The account creation endpoint **138** may comprise a network page and/or software configured to facilitate creation of one or more accounts for one or more users at a client **103** for one or more network sites **140**. In various embodiments, the authentication manager **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 server **106** as the network page server **136**.

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 manager **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 server **106** as the network page server **136**.

The server **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**, 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**. 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 server **106** to identify a network site and/or encrypt data.

The configuration file server **109** may comprise, for example, a server computer or like system. The configuration file server **109** may represent multiple servers arranged, for example, in one or more server banks or other arrangements. Such configuration file servers **109** may be located in a single installation or may be dispersed among many different geographical locations. For purposes of convenience, the configuration file server **109** is referred to herein in the singular. However, in one embodiment, the configuration file server **109** represents a plurality of servers arranged as described above.

The configuration file server **109** includes a data store used to store configuration files **157** and potentially other data. The configuration files **157** 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**. The configuration file server **109** may be, for example, a system configured to provide configuration files **157** corresponding to a plurality of servers **106**. The configuration file server **109** may be operated, in some cases, by a third party. In some embodiments, configuration files **157** may correspond to configuration files **148** stored on a server **106**.

The remote data server **112** may comprise, for example, a server computer or like system. The remote data server **112** may represent multiple servers arranged, for example, in one or more server banks or other arrangements. Such remote data servers **112** may be located in a single installation or may be dispersed among many different geographical locations. For purposes of convenience, the remote data server **112** is referred to herein in the singular. However, in one embodiment, the remote data server **112** represents a plurality of servers arranged as described above.

The remote data server **112** includes a data store used to store account data **160** and potentially other data. The account data **160** may include, for example, security credentials used to access various network sites **140** or network pages **145**, or to track user context across such network sites **140** or network pages **145**; information regarding authentication endpoints; and/or other information. In various embodiments, account data **160** may be stored in an encrypted format. The account data **160** may be, for example, a mirror of account data **130** for one or more users.

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 storage medium. The portable data store **118** may be removably attached to the client **103** in some embodiments.

The portable data store **118** may be configured to store account data **163**. The account data **163** may include, for example, security credentials used to access various network sites **140** or network pages **145**, information regarding authentication endpoints **139**, and/or other information. In various embodiments, the account data **163** may be a mirror of the account data **130**. In other embodiments, the account data **163** may take the place of account data **130**. The account data **163** may be stored in an encrypted format. 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 account data **163**; 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 manager **124** may be stored 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**.

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 manager **124** onto the client **103** and preconfigure the operation of the authentication manager **124** for existing accounts associated with network sites **140**. For example, the user may provide to the authentication manager **124** 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 user may also configure a security credential such as, for example, a username, password, biometric identification, etc. for the authentication manager **124** so that the security credentials may be encrypted or otherwise protected from use or view on client **103** without the authorization of the user.

The account information may be stored by the authentication manager **124** in account data **130** on the client **103** and/or at some other location. For example, the authentication manager **124** may back up the account information to account data **160** located on the remote data server **106**, account data **163** located on in the portable data store **118**, and/or another location. In some embodiments, the authentication manager **124** may not store the account information on the client **103** at all and may only use other locations. When the portable data store **118** or the remote data server **112** are used to store account information, a user may be able to use the authentication manager **124** and the account information on another client **103**. To this end, the authentication manager **124** may be, for example, downloaded, configured, and loaded automatically on another client **103**.

Security credentials may be shared among multiple users of the authentication manager **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 manager **124**. 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 account data **130**, **160**, it is secured such that only the authorized users can access it. When the second user next uses the authentication manager **124**, the second user may be given the opportunity to synchronize the new account with account data **163** located in the portable data store **118** belonging to the second user or in some other location.

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

When a user accesses a network site **140** with the browser **121** or another application, the authentication manager **124** determines whether the network site **140** is associated with

stored account information. If the network site **140** is not associated with stored account information, then the authentication manager **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 manager **124** in one or more of account data **130**, **160**, **167**.

Alternatively, or additionally, the authentication manager **124** 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 manager **124** 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.

As a non-limiting example, the authentication manager **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 manager **124** may also examine the URL for relevant keywords. As another non-limiting example, the authentication manager **124** may identify an account creation form when a challenge response test (e.g., a "Captcha") is present. The authentication manager **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 manager **124** may have the user identify the account creation form and/or tag input elements of the form so that the authentication manager **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 **157** which may then be uploaded to a configuration file server **109**. There, the configuration file **157** can be accessed by other users using the authentication manager **124** and used by them to simplify account creation on the network site **140** described by the configuration file **157**.

In various embodiments, the authentication manager **124** may create the account in an automated way through methods other than form filling. For example, the authentication manager **124** 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 configuration file server **109** that may provide a configuration file **157** associated with the network site **140**. The configuration file **148**, **157** may define one or more account creation endpoints **138** for the network site **140** where the authentication manager **124** may authenticate and/or create an account other than by filling out a form. For example, the configuration file **148**, **157** 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**.

The configuration file **148**, **157** 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. The authentication manager **124** may generate one or more security credentials based on the security credential specification.

When the authentication manager 124 is creating an account by form filling, the authentication manager 124 may prompt the user to supply a security credential specification so that the authentication manager 124 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 manager 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. As a non-limiting example, the authentication manager 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.

In various embodiments, when the authentication manager 124 is creating an account by form filling, the authentication manager 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 manager 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 manager 124 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 manager 124 may instead be configured to prompt the user for that information. In various embodiments, the authentication manager 124 may leave unrecognized form fields blank for the user to complete.

Accordingly, the authentication manager 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 manager 124 or may be left for additional user input to the authentication manager 124.

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 manager 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 manager 124 in an analogous way. In one embodiment, the authentication manager 124 may simply assume that the account was created.

Responsive to account creation, the authentication manager 124 stores 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 account data 130, 160, 163. 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. 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 account data 130, 160, 163 may be manually or automatically copied by the authentication manager 124 to any other account data 130, 160, 163 so that the account information may be mirrored across any two or more of account data 130, 160, 163.

For purposes of backup, the authentication manager 124 may be capable of rendering a list of the stored account information in account data 130, 160, 163 for viewing or printing. To facilitate viewing or printing, the authentication manager 124 may be configured to generate human readable or printable security credentials using an appropriate character set. Alternatively, the authentication manager 124 may encode security credentials in a printable form using an encoding approach such as, for example, UUencoding, Bin-Hex, Multipurpose Internet Mail Extensions (MIME) encodings, Base64, and other encoding approaches.

When a stored account exists for a network site 140, the authentication manager 124 determines whether to provide the security credentials to the network site 140. As a preliminary matter, the authentication manager 124 may require that the user be authenticated to the authentication manager 124 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 manager 124 may decrypt the stored account data 130, 160, 163. In some embodiments, the authentication manager 124 may be given access to the stored account data 130, 160, 163 responsive to providing a master security credential. The authentication manager 124 then verifies the identity of the network site 140.

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 manager 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.

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 manager 124 may display a warning to the user. In some cases, the user may accept the warning and continue. In some embodiments, the authentication manager 124 may remember such characteristics and use them to aid in future identity verification of the network site 140. In other cases, the authentication manager 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 manager 124, and/or take other precautions. Additionally, by integrating the authentication manager 124 with a site pro-

viding reputation data for network sites **140** the authentication manager **124** can warn the user that a network site **140** is hostile.

The authentication manager **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**.

Once the identity of a network site **140** is verified, the authentication manager **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 manager **124** is configured to obtain user input, the authentication manager **124** may render a button or other user interface feature in or on top of the browser **121** to obtain confirmation.

When no authentication endpoint **139** is defined for a network site **140**, the authentication manager **124** may be configured to detect whether an authentication form is presented. The authentication manager **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 manager **124** may also examine the URL for relevant keywords. In some embodiments, the authentication manager **124** may store a URL associated with the network site **140** in account data **130**, **160**, **163** which may be used for authentication. The authentication manager **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.

Turning now to FIG. 2, 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**.

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 server **106** (FIG. 1) is being encrypted. In FIG. 2, the authentication manager **124** (FIG. 1) has verified the identity of the network site **140** and is presenting an authentication button **218**. The authentication button **218** indicates that account information associated with the network site **140** is stored in account data **130**, **160**, **163**.

Once a user selects the authentication button **218**, the authentication manager **124** may fill in the username field **206** and the password field **209**. The authentication manager **124** may also automatically submit the logon request by program-

matically 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. Alternatively, if, for example, an authentication endpoint **139** (FIG. 1) is defined, the authentication manager **124** may authenticate in the background. In such a case, the authentication manager **124** may give an indication of success or failure and may provide another authentication button **218** in order to log out of the network site **140**. If multiple user accounts are present for the network site **140**, the authentication manager **124** may provide a drop-down box or other user interface element allowing the user to select one of the accounts for authentication.

Referring next to FIG. 3, 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 this example, the user may have entered, or may have been automatically redirected to, a different URL such as “https://www.e-retailer.site.hackersrus.yz/,” which is displayed in the address bar **203** (FIG. 2) 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** (FIG. 2), a password field **209** (FIG. 2), and a submit button **212** (FIG. 2).

FIG. 3 represents an example of a common phishing scheme, where a network page **145** is presented by a fraudulent network site **140** having a look-and-feel that is identical or nearly identical to the network page **145** presented by the legitimate network site **140**. See FIG. 2. Although the URL in this example includes the domain name of the legitimate network site **140**, the URL is not identical and is in fact a subdomain of “hackersrus.yz.” In this case, the authentication manager **124** (FIG. 1) cannot verify the identity of the network site **140** by way of the URL presented in the address bar **203** because the domain name in the URL is not a subdomain of, or identical to, the stored domain name “e-retailer.site” or “www.e-retailer.site.”

The network site **140** in FIG. 3 cannot be identified additionally because the network site **140** has not presented a trusted certificate as the security indication **215** (FIG. 2) is absent. Various phishing attacks may involve presenting a trusted certificate associated with the name of some other network site **140** or a real certificate for the fraudulent network site **140**. Other phishing attacks may involve substituting a security indication **215** that is faked. The authentication manager **124** may avoid such attacks because it is not deceived by graphical appearances but instead may examine the network page **145** and certificate data received behind the scenes by the browser **121**. The authentication manager **124** determines that this network site **140** in FIG. 3 has no stored security credentials. Thus, in this non-limiting example, the authentication manager **124** presents an information button **303** in place of an authentication button **218** (FIG. 2) that states “No Log In Information Found.”

In some embodiments, the authentication manager **124** may employ a heuristic analysis of the network page **145** and/or reputation data to identify fraudulent sites proactively. For example, the authentication manager **124** may perform a heuristic analysis to determine whether a network page includes a logon form that is a fraudulent copy of a logon form associated with a stored domain name. In such cases, the authentication manager **124** may provide a warning to the user. Additionally, if the user were to request that the authentication manager **124** provide the security credentials used for

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a legitimate network site **140** to a fraudulent network site **140** (e.g., if the domain name of a trusted certificate of the fraudulent network site **140** does not match the stored domain name associated with the legitimate network site **140**), the authentication manager **124** may generate a warning.

Moving on to FIG. 4, 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 browser **121** appears identical to that depicted in FIG. 2, except that the authentication manager **124** (FIG. 1) has provided an information button **303** (FIG. 3) in place of an authentication button **218** (FIG. 2). The address bar **203** (FIG. 2) appears to depict the URL of the legitimate network site **140** (FIG. 1). However, the secure certificate was issued by an untrusted certificate authority.

The inconsistency may be explained by spoofing attacks according to various methods such as, for example, a man-in-the-middle attack and other attacks. As a non-limiting example, the client **103** may have been provided misbehaving and/or compromised DNS servers through the dynamic host configuration protocol (DHCP). The misbehaving DNS servers may be configured to give inaccurate domain name information. By contrast, malicious users are less likely to be able to compromise a trusted certificate authority because public key infrastructure is used. Here, the authentication manager **124** has determined that a network site **140** is not verified and has not provided the security credentials. An ordinary user, however, may have been misled and supplied the security credentials to the fraudulent network site **140**.

In some cases, the inconsistency may result from a legitimate network site **140** changing its certificate provider. The authentication manager **124** may include a configuration setting to enable a warning when the certificate authority signing the secure certificate for a network site **140** changes from the certificate authority that issued the secure certificate that the authentication manager **124** received when the security credential was previously created or stored for the network site **140**.

With reference to FIG. 5, shown is a flowchart that provides one example of the operation of a portion of the authentication manager **124** (FIG. 1) according to various embodiments. 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 manager **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.

Beginning with box **503**, the authentication manager **124** obtains a network page **145** (FIG. 1) from a network site **140** (FIG. 1) in response to a request by a user. In various embodiments, the network page **145** may be obtained through operation of the browser **121** (FIG. 1). Next, in box **506**, the authentication manager **124** determines whether the network site **140** requires authentication. This determination may be based, for example, on the presence of an authentication form on the network page **145** or some other network page **145** on the network site **140**, the presence of a configuration file **148**, **157** (FIG. 1), on user input, or on other factors. If authentication is not required by the network site **140**, the control flow of the authentication manager **124** stops.

After determining that a network site **140** requires authentication, the authentication manager **124** proceeds to box **509**. In box **509**, the authentication manager **124** determines

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whether the identity of the network site **140** can be verified. This verification may involve, for example, examination of a domain name associated with a trusted certificate received in connection with the network page **145**.

5 If the authentication manager **124** cannot verify the identity of the network site **140**, the authentication manager **124** moves to box **512** and warns the user that the identity of the site cannot be verified and/or notifies the user that no stored account information can be found. Next, the authentication manager **124** determines in box **515** whether the user has indicated to proceed with authentication nonetheless using other stored account information. In some embodiments, the authentication manager **124** may preclude the user from proceeding with authentication. If the user has not indicated to proceed, the control flow of the authentication manager **124** stops. If the user has indicated to proceed in box **515**, the authentication manager **124** moves to box **518**. If in box **509** the identity of the network site **140** has been verified, the authentication manager **124** moves also to box **518**.

10 In box **518**, the authentication manager **124** determines whether an account exists in account data **130**, **160**, **163** (FIG. 1) for the network site **140**. This determination may be made by comparing the domain name associated with the request with stored domain names in account data **130**, **160**, **163**. Additionally, the user may provide a domain name to the authentication manager **124** which the user believes to correspond to the network site **140** in order to locate a stored account. If the authentication manager **124** determines that an account does not exist, the authentication manager **124** proceeds to box **519** and offers to create an account for the user. Account creation is covered in more detail by the flowchart of FIG. 6. Moreover, additional accounts for a same network site **140** may be created by the authentication manager **124** in response to user input.

15 Next, in box **521**, the authentication manager **124** determines whether an authentication endpoint **139** (FIG. 1) has been defined for the network page **145** or network site **140**. This may involve examining, if they exist, configuration files **148**, **157** (FIG. 1). If an authentication endpoint **139** has not been defined, the authentication manager **124** moves to box **524** and provides the account parameters, including security credentials, by form filling. The authentication manager **124** may send the account parameters to the network site **140** or may merely allow the user to submit the form. The control flow of the authentication manager **124** then stops.

20 If in box **521** the authentication manager **124** determines that an authentication endpoint **139** has been defined, the authentication manager **124** proceeds to box **527** and provides the account parameters by way of the authentication endpoint **139**. The authentication manager **124** may send the account parameters to the network site **140** or wait for user input for approval. The control flow of the authentication manager **124** then stops.

25 Turning now to FIG. 6, shown is a flowchart that provides one example of the operation of another portion of the authentication manager **124** (FIG. 1) according to various embodiments. It is understood that the flowchart of FIG. 6 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 manager **124** as described herein. As an alternative, the flowchart of FIG. 6 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.

30 Beginning with box **603**, the authentication manager **124** determines whether there is a configuration file **148**, **157** (FIG. 1) for the network site **140** (FIG. 1). If there is not, the

authentication manager 124 moves to box 606 and obtains account creation parameters from the user. The parameters may relate, for example, to length of a password, permissible characters, required characters, etc.

Then, in box 609, the authentication manager 124 uses form filling to create the account on the network site 140. User input may be necessary to submit the form in some embodiments, or the account creation request may be submitted automatically. If the account creation request results in failure, the authentication manager 124 may return to box 606 or leave the account creation up to the user. Next, in box 612, the authentication manager 124 stores account parameters in one or more of account data 130, 160, 163 (FIG. 1). The control flow of the authentication manager 124 then stops.

If the authentication manager 124 determines in box 603 that a configuration file 148, 157 exists for the network site 140, the authentication manager 124 moves to box 615 and obtains account creation parameters from a configuration file 148, 157. Then, in box 618, the authentication manager 124 determines whether an account creation endpoint 138 (FIG. 1) is defined. If no account creation endpoint 138 is defined, the authentication manager 124 moves to box 609.

Then, in box 609, the authentication manager 124 uses form filling to create the account on the network site 140. User input may be necessary to submit the form in some embodiments, or the account creation request may be submitted automatically. If the account creation request results in failure, the authentication manager 124 may return to box 606 or leave the account creation up to the user. Next, in box 612, the authentication manager 124 stores account parameters in one or more of account data 130, 160, 163. The control flow of the authentication manager 124 then stops.

If in box 618, the authentication manager 124 determines that an account creation endpoint 138 has been defined, the authentication manager 124 proceeds to box 621 and uses the account creation endpoint 138 to create an account on the site. Next, in box 612, the authentication manager 124 stores account parameters in one or more of account data 130, 160, 163. The authentication manager 124 then ends.

Referring next to FIG. 7, shown is a schematic block diagram of the client 103 (FIG. 1) according to one embodiment of the present disclosure. The client 103 includes a processor circuit, for example, having a processor 703 and a memory 706, both of which are coupled to a local interface 709. The local interface 709 may comprise, for example, a data bus with an accompanying address/control bus or other bus structure as can be appreciated.

Stored in the memory 706 are both data and several components that are executable by the processor 703. In particular, stored in the memory 706 and executable by the processor 703 are a browser 121 (FIG. 1), authentication manager 124 (FIG. 1), and potentially other applications. Also stored in the memory 706 may be a data store 127 (FIG. 1) and other data. In addition, an operating system may be stored in the memory 706 and executable by the processor 703.

It is understood that there may be other applications that are stored in the memory 706 and are executable by the processors 703 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, Python, Ruby, Flash, or other programming languages.

A number of software components are stored in the memory 706 and are executable by the processor 703. In this respect, the term "executable" means a program file that is in a form that can ultimately be run by the processor 703.

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 706 and run by the processor 703, 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 706 and executed by the processor 703, or source code that may be interpreted by another executable program to generate instructions in a random access portion of the memory 706 to be executed by the processor 703, etc. An executable program may be stored in any portion or component of the memory 706 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.

The memory 706 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 706 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.

Also, the processor 703 may represent multiple processors and the memory 706 may represent multiple memories that operate in parallel processing circuits, respectively. In such a case, the local interface 709 may be an appropriate network that facilitates communication between any two of the multiple processors 703, between any processor 703 and any of the memories 706, or between any two of the memories 706, etc. The local interface 709 may comprise additional systems designed to coordinate this communication, including, for example, performing load balancing. The processor 703 may be of electrical or of some other available construction.

Although the browser 121, authentication manager 124, 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.



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The flowcharts of FIGS. 5 and 6 show the functionality and operation of an implementation of portions of the authentication manager 124. 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 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).

Although the flowcharts of FIGS. 5 and 6 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. 5 and 6 may be executed concurrently or with partial concurrence. 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.

Also, any logic or application described herein, including the browser 121 and the authentication manager 124, that comprises software or code can be embodied in any computer-readable medium for use by or in connection with an instruction execution system such as, for example, a processor 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. The computer readable medium can comprise any one of many physical media such as, for example, electronic, magnetic, optical, electromagnetic, infrared, 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.

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.

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Therefore, the following is claimed:

1. A method, comprising:

receiving, via an authentication manager executed by a client, data encoding a security credential specification from a first at least one network site;  
 generating, via the authentication manager executed by the client, a first security credential based at least in part on the data encoding the security credential specification;  
 generating, via the authentication manager executed by the client, a second security credential based at least in part on data encoding a security credential specification that is associated with a second at least one network site and supplied by a user;  
 sending, via the authentication manager executed by the client, a request to create an account associated with the first security credential from the client to the first at least one network site;  
 sending, via the authentication manager executed by the client, a request to create an account associated with the second security credential from the client to the second at least one network site;  
 storing, via the authentication manager executed by the client, the first security credential, the second security credential, a first trusted certificate associated with the first at least one network site, and a second trusted certificate associated with the second at least one network site;  
 refraining from providing, via the authentication manager executed by the client, the first security credential to the first at least one network site at an authentication endpoint in response to determining that a third trusted certificate provided by the first at least one network site does not match the first trusted certificate associated with the first at least one network site; and  
 refraining from providing, via the authentication manager executed by the client, the second security credential to the second at least one network site by form filling in response to determining that a fourth trusted certificate provided by the second at least one network site does not match the second trusted certificate associated with the second at least one network site.

2. A method, comprising:

receiving, via an authentication manager executed by a client, data encoding a security credential specification from at least one network site;  
 generating, via the authentication manager executed by the client, at least one security credential based at least in part on the data encoding the security credential specification;  
 receiving, via the authentication manager executed by the client, a first trusted certificate associated with the at least one network site;  
 storing, via the authentication manager executed by the client, the at least one security credential and the first trusted certificate;  
 receiving, via the authentication manager executed by the client, a second trusted certificate provided by the at least one network site;  
 determining, via the authentication manager executed by the client, whether the first trusted certificate matches the second trusted certificate; and  
 refraining from providing, via the authentication manager executed by the client, the at least one security credential to the at least one network site in response to determining that the first trusted certificate does not match the second trusted certificate.

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3. The method of claim 2, further comprising sending a request to create an account associated with the at least one security credential from the client to the at least one network site.

4. The method of claim 2, wherein the security credential specification defines at least a character set and a length for a password.

5. The method of claim 2, wherein the at least one security credential is stored in an encrypted format, with the providing further comprising decrypting, by the client, the encrypted format of the at least one security credential, wherein access to the at least one security credential is dependent at least in part on at least one master security credential supplied by a user.

6. The method of claim 2, wherein the receiving further comprising receiving, via the authentication manager executed by the client, the data encoding the security credential specification from at least one server.

7. The method of claim 2, further comprising receiving, via the authentication manager executed by the client, a plurality of input parameters from a user, the input parameters meeting a set of requirements of the security credential specification.

8. The method of claim 2, wherein the providing further comprises:

receiving, via the authentication manager executed by the client, data encoding a specification for an authentication endpoint from the at least one network site, the authentication endpoint providing an interface for automatic authentication to the at least one network site; and sending the at least one security credential from the client to the at least one network site at the authentication endpoint.

9. The method of claim 2, wherein the providing further comprises:

filling a form rendered in a network page by the client with the at least one security credential; and

sending the at least one security credential from the client to the at least one network site responsive to a user submitting the form.

10. The method of claim 2, further comprising generating, via the authentication manager executed by the client, a warning in response to determining that a domain name associated with the second trusted certificate does not match a domain name stored from the first trusted certificate.

11. The method of claim 2, further comprising generating, via the authentication manager executed by the client, a warning in response to determining that the at least one network site does not provide the second trusted certificate.

12. The method of claim 2, further comprising identifying, via the authentication manager executed by the client, the at least one network site based at least in part on a domain name stored from the first trusted certificate and a domain name rendered in an address bar of a browser rendering a network page received from the at least one network site.

13. The method of claim 2, wherein the storing further comprises storing the at least one security credential and the first trusted certificate on a portable storage device removably attached to the client.

14. The method of claim 2, wherein the storing further comprises storing the at least one security credential and the first trusted certificate on at least one server.

15. The method of claim 2, further comprising performing, via the authentication manager executed by the client, a heuristic analysis to determine whether at least one network page includes a logon form that is a fraudulent copy of a logon form associated with another stored trusted certificate.

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16. The method of claim 2, further comprising:

determining, via the authentication manager executed by the client, whether a portion of the first trusted certificate matches a corresponding portion of the second trusted certificate; and

refraining from providing, via the authentication manager executed by the client, the at least one security credential to the at least one network site in response to determining that the portion of the first trusted certificate does not match the corresponding portion of the second trusted certificate.

17. The method of claim 2, further comprising providing, via the authentication manager executed by the client, the at least one security credential to the at least one network site in response to determining that the first trusted certificate matches the second trusted certificate.

18. A system, comprising:

a client; and

an authentication manager executable by the client, the authentication manager comprising:

logic that, responsive to receiving data encoding a security credential specification from at least one network site, generates at least one security credential based at least in part on the data encoding the security credential specification;

logic that, responsive to receiving a first trusted certificate associated with the at least one network site, stores the at least one security credential and the first trusted certificate;

logic that, responsive to receiving a second trusted certificate provided by the at least one network site, determines whether the first trusted certificate matches the second trusted certificate; and

logic that refrains from providing the at least one security credential to the at least one network site in response to determining that the first trusted certificate does not match the second trusted certificate.

19. The system of claim 18, wherein the authentication manager further comprises logic that sends a request to create an account associated with the at least one security credential to the at least one network site.

20. The system of claim 18, wherein the authentication manager further comprises:

logic that receives a specification for an authentication endpoint from the at least one network site, the authentication endpoint providing an interface for automatic authentication to the at least one network site; and

logic that sends the at least one security credential to the at least one network site at the authentication endpoint.

21. The system of claim 18, wherein the authentication manager further comprises logic that compares a domain name associated with the second trusted certificate with another domain name provided by a user.

22. The system of claim 18, wherein the authentication manager further comprises logic that compares a domain name associated with the second trusted certificate with another domain name inferred by heuristic analysis.

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