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**DeSoto et al.**

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(54) **LOGIN USING QR CODE**

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(51) **Int. Cl.**

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**H04L 29/06** (2006.01)

**H04W 12/06** (2009.01)

**G06F 7/04** (2006.01)

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

CPC ..... **H04L 63/08** (2013.01); **H04W 12/06** (2013.01)

USPC ..... **726/18; 726/5**

(58) **Field of Classification Search**

None

See application file for complete search history.

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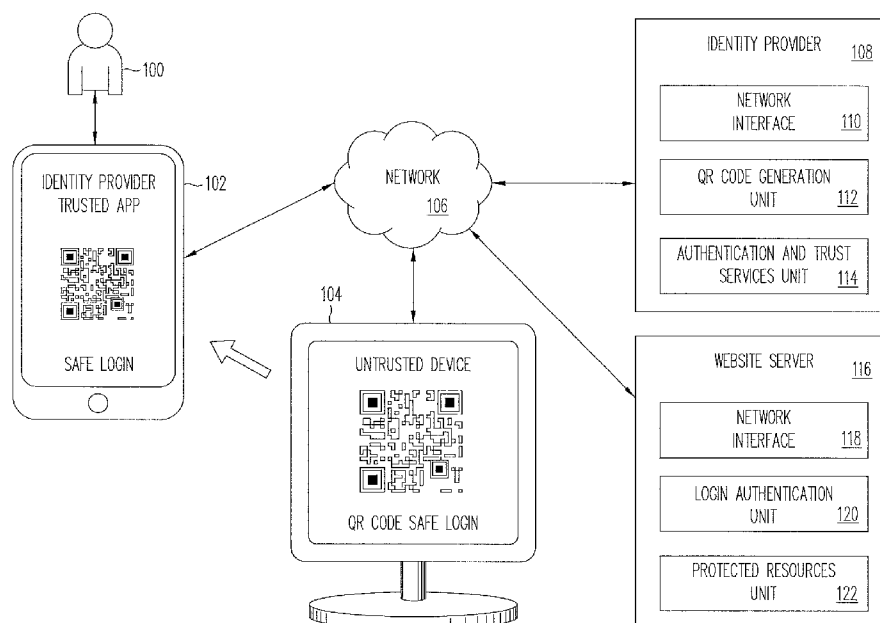
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(57) **ABSTRACT**

Systems and methods are disclosed herein for a user to use a trusted device to provide sensitive information to an identity provider via QR (Quick Response) code for the identity provider to broker a website login or to collect information for the website. A user may securely transact with the website from unsecured devices by entering sensitive information into the trusted device. The identity provider may generate the QR code for display by the website on an unsecured device. A user running an application from the identity provider on the trusted device may scan the QR code to transmit the QR code to the identity provider. The identity provider may validate the QR code and may receive credential information to authenticate the user or may collect information for the website. Advantageously, the user may perform a safe login to the website from untrusted devices using the trusted device.

**15 Claims, 7 Drawing Sheets**



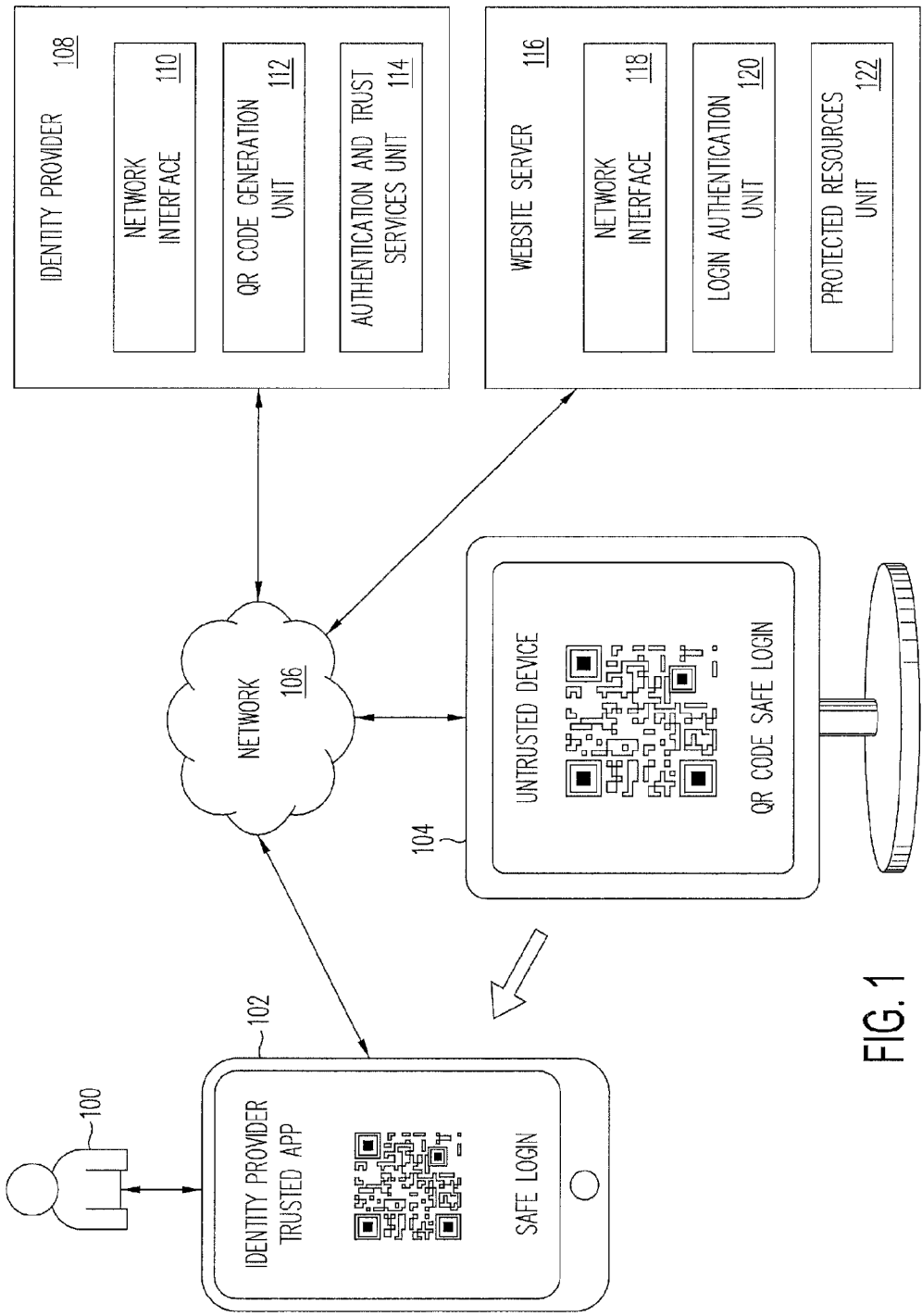


FIG. 1

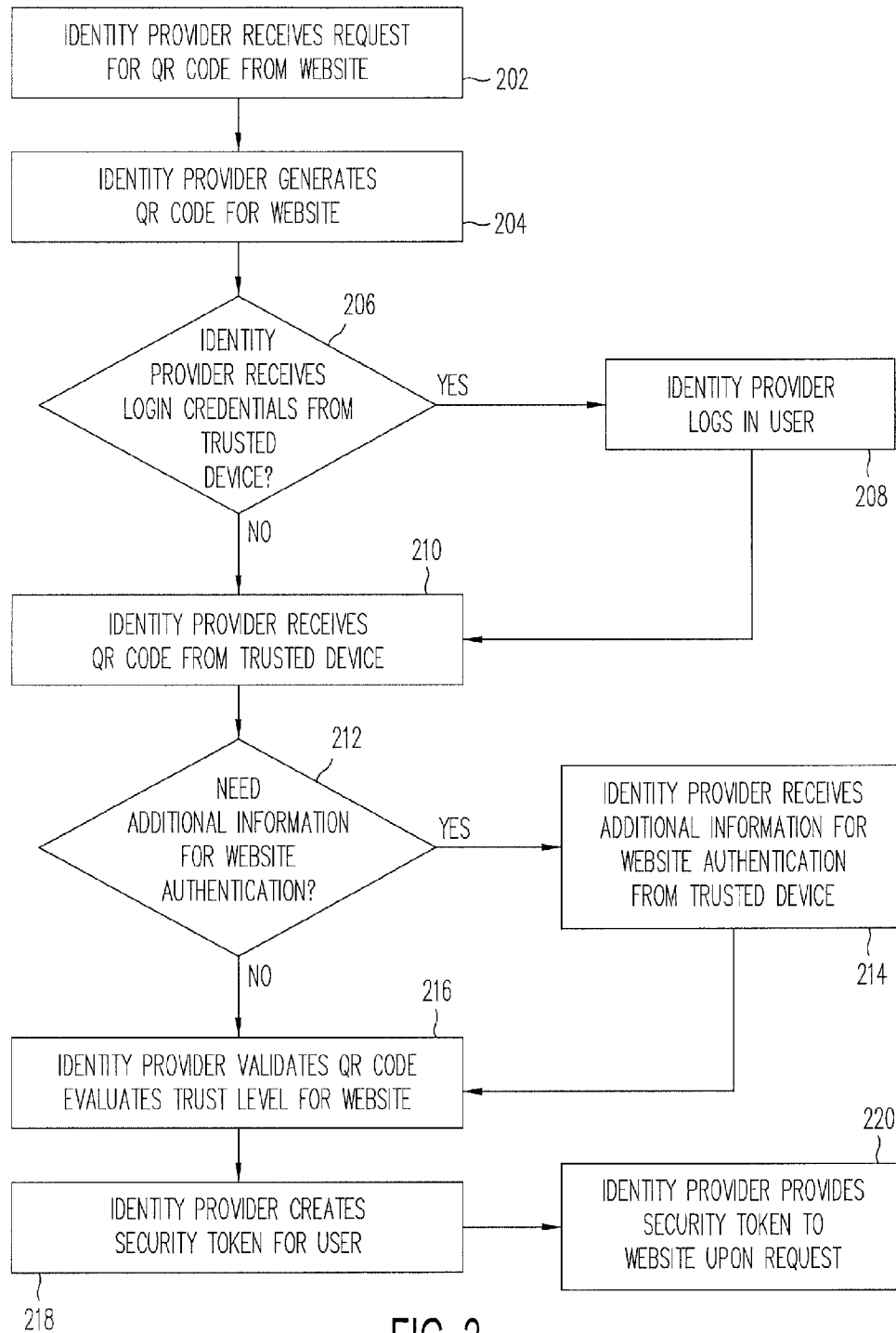


FIG. 2

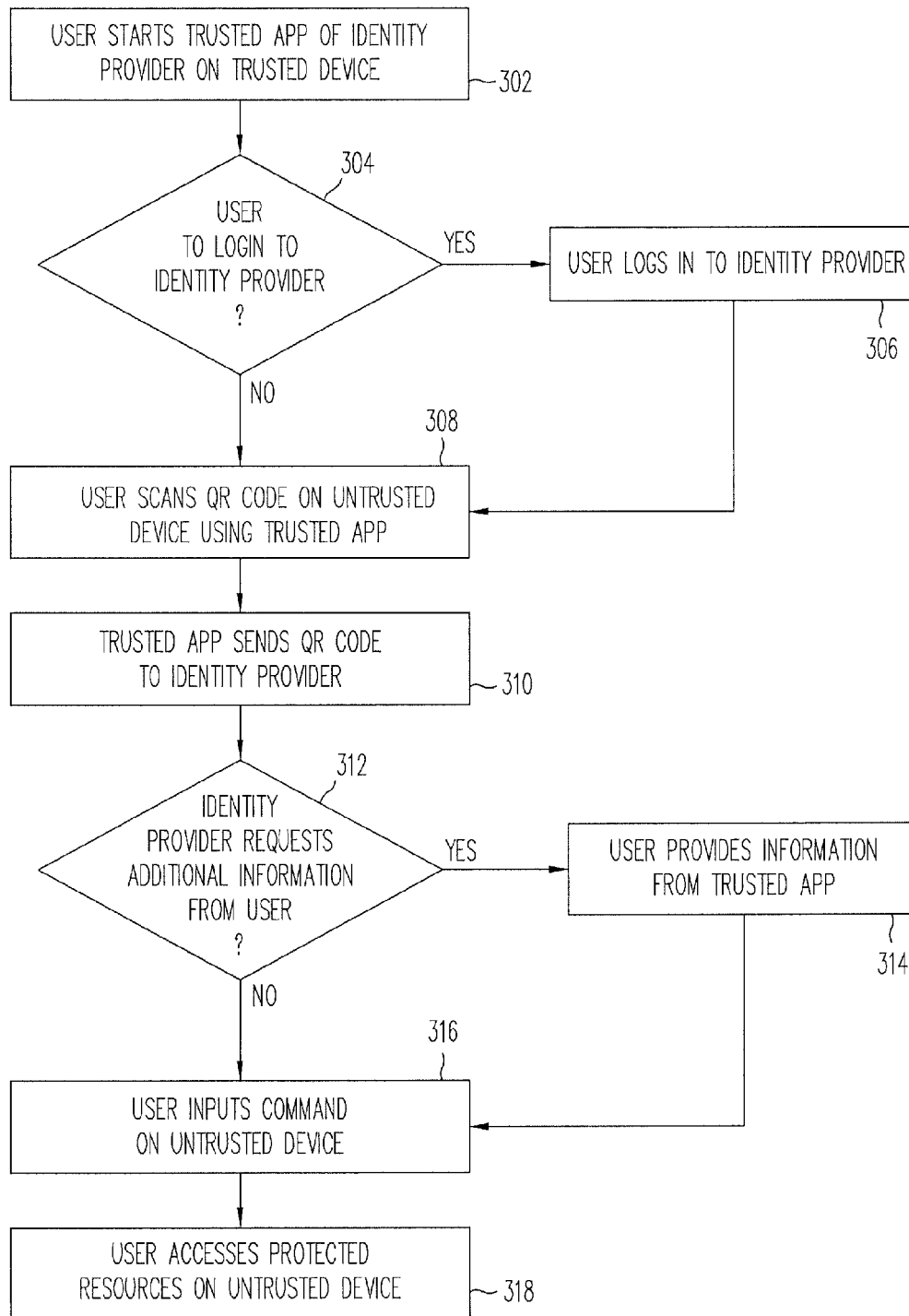


FIG. 3

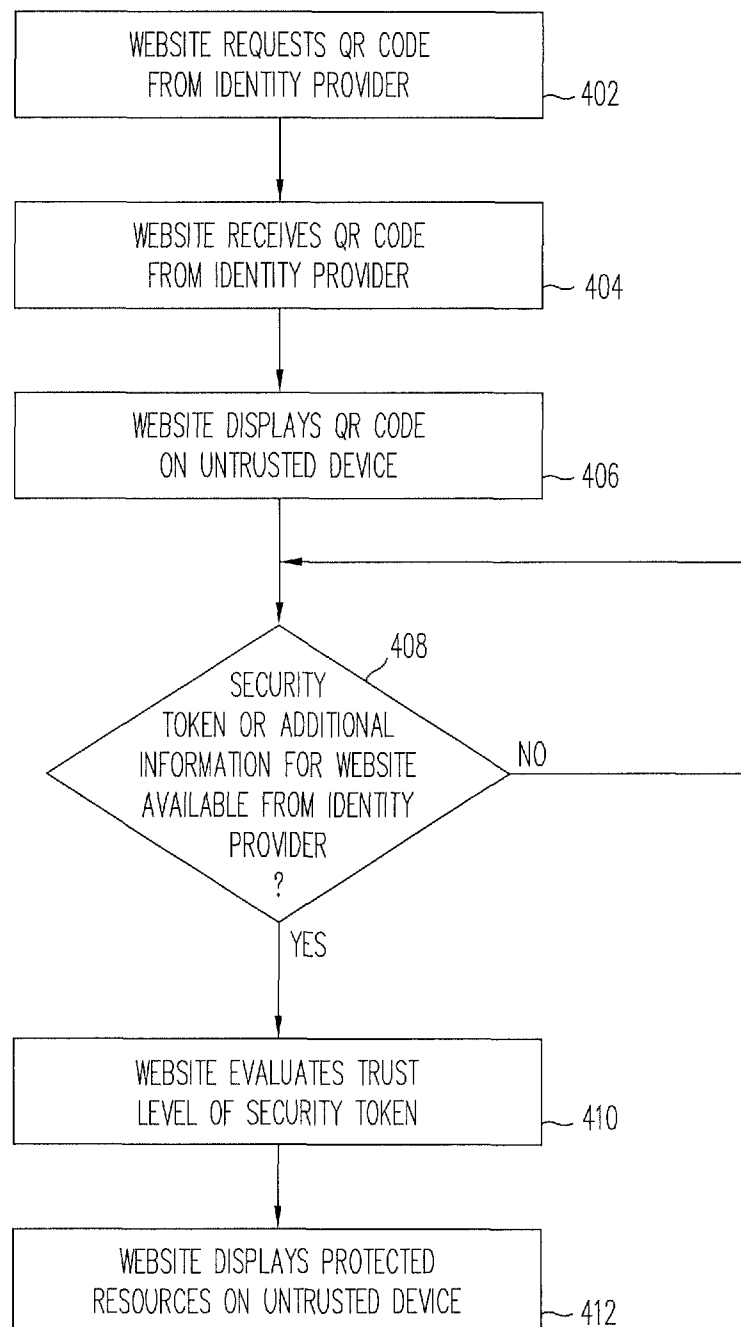


FIG. 4

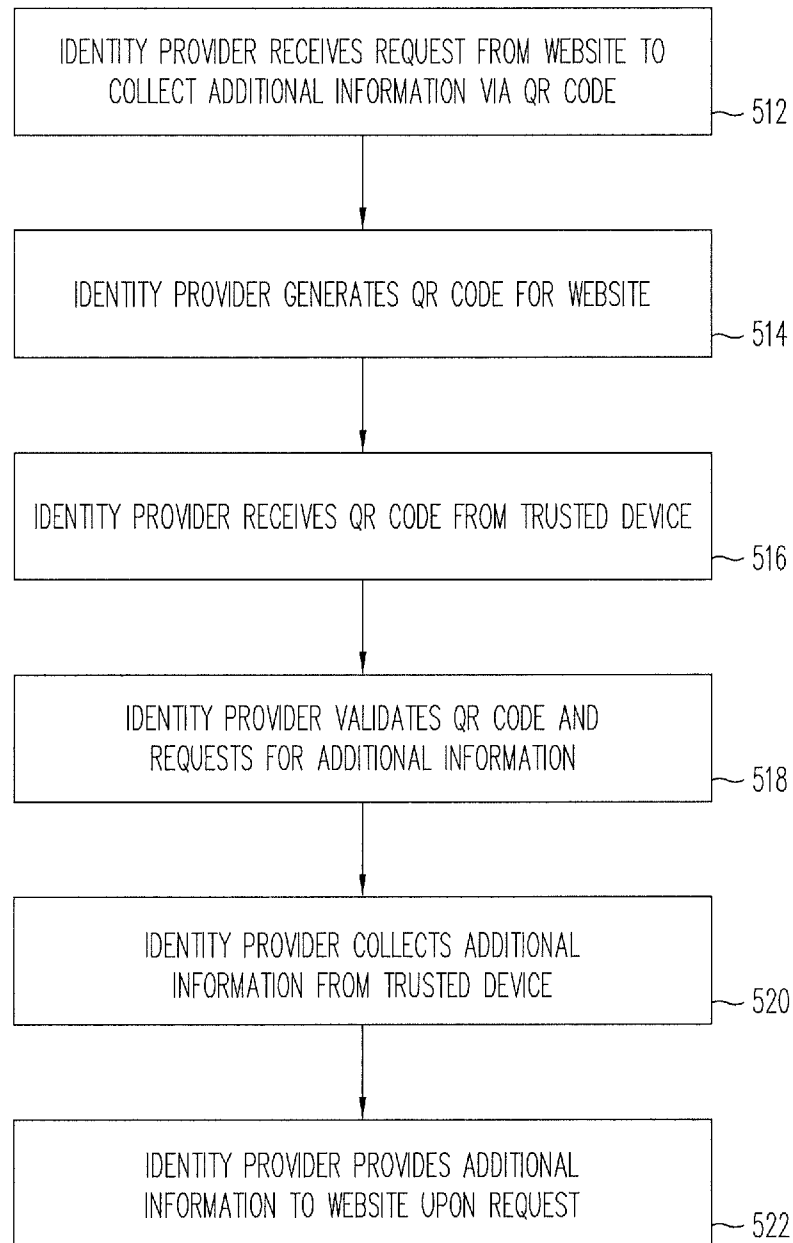


FIG. 5

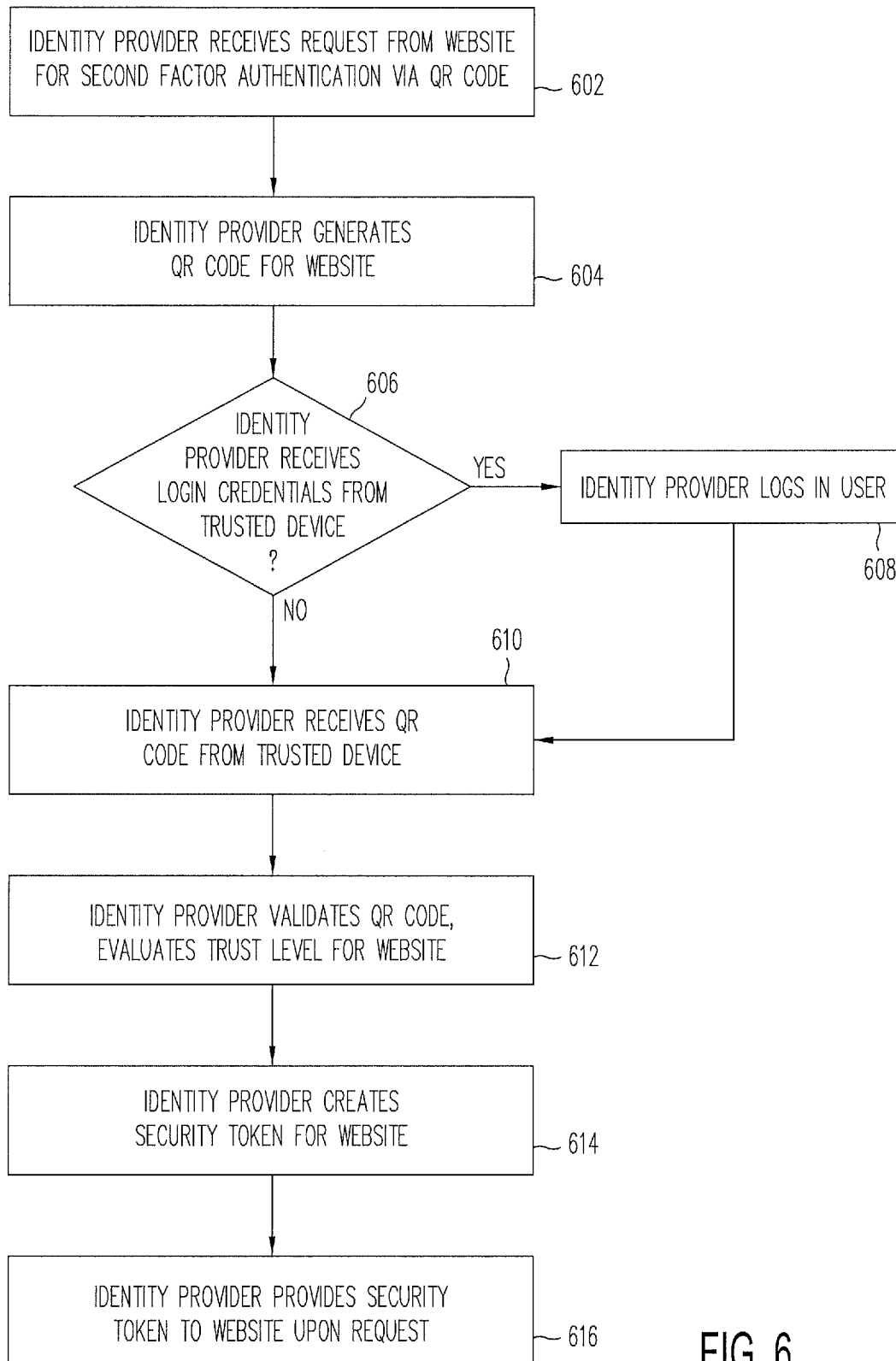


FIG. 6

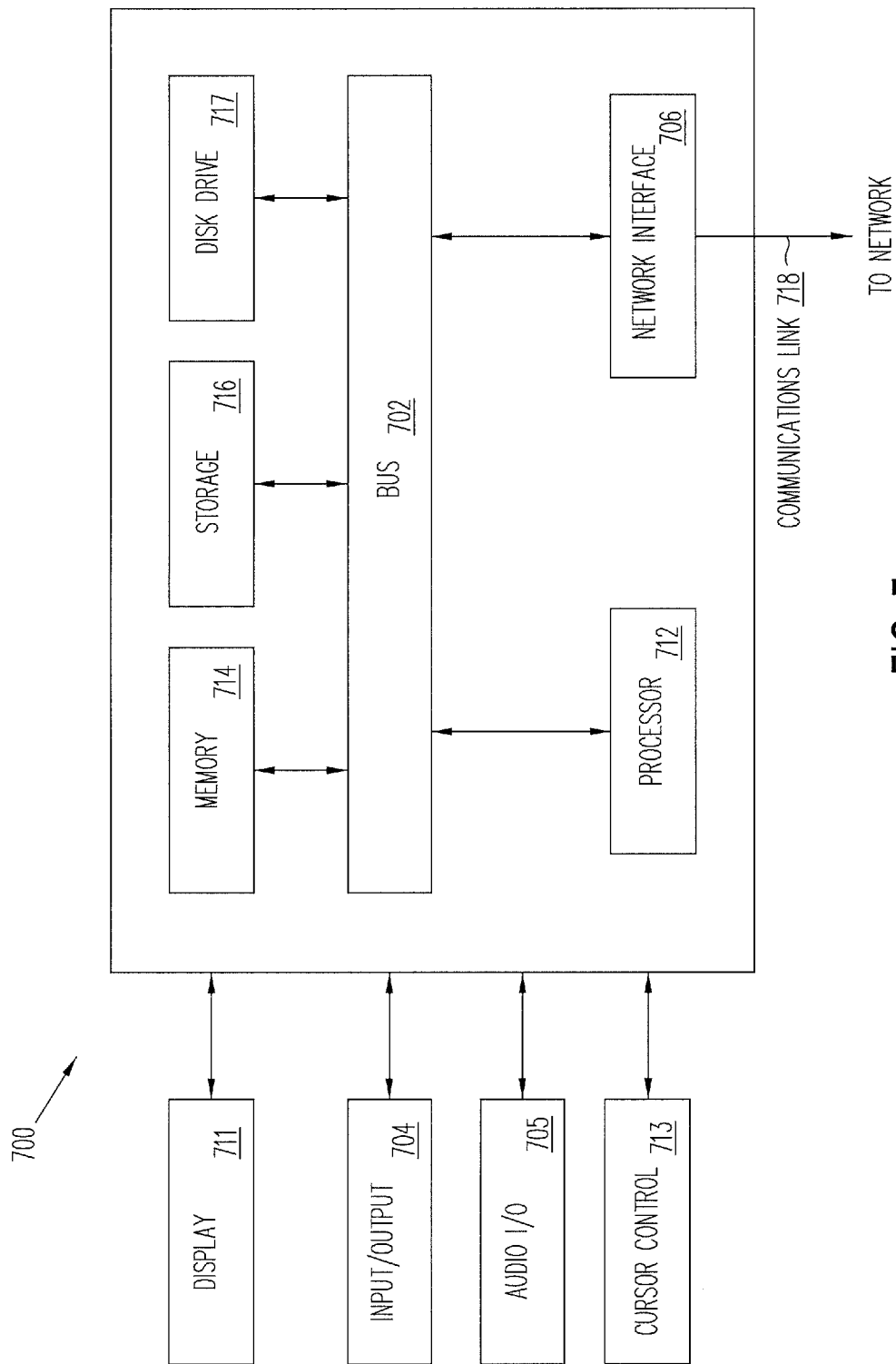


FIG. 7



# 1

## LOGIN USING QR CODE

### CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims priority to and benefit of U.S. Provisional Patent Application Ser. No. 61/600,444, filed on Feb. 17, 2012, and of U.S. Provisional Patent Application Ser. No. 61/621,823, filed on Apr. 9, 2012. The contents of the provisional applications are hereby incorporated by reference in their entirety.

### TECHNICAL FIELD

The present disclosure relates generally to systems and methods for authenticating users over a computer network. In particular, the present disclosure relates to methods and systems for using trusted devices to broker secure logins into websites from devices that may be insecure.

### BACKGROUND

Internet users are frequently asked to login to websites from publicly shared devices. These devices may be inherently insecure as they may be infected with malware, or otherwise compromised by key-logger spyware, etc. Users entering their login credentials into insecure devices face the risk of exposing their login credentials to unauthorized parties. Thus, there is a need for users to login to websites without entering sensitive information on insecure devices. Even when the devices are secure, there are situations where it may be difficult for users to manually enter credentials into the devices, such as on devices with limited input capabilities. While systems have been proposed to more securely authenticate users, these systems may require special hardware such as biometrics readers or near field communication (NFC) devices. In addition, even NFC devices may be compromised to expose sensitive information. To increase security, some websites may implement secondary authentication mechanism such as requiring users to use fobs or other second factor devices. However, these devices are inconvenient for users to carry. Accordingly, it is desirable to provide ways to users to login to websites securely, conveniently, and efficiently.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a system for a user to use a trusted device to scan QR code displayed on a display of an untrusted device to supply sensitive information to an identity provider for the identity provider to broker a login to a website according to one or more embodiments of the present disclosure;

FIG. 2 shows a flow chart of the steps for an identity provider to generate QR code for a website and to validate the QR code received from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure;

FIG. 3 shows a flow chart of the steps for a user to use a trusted device to scan QR code displayed on an untrusted device to provide sensitive information to an identity provider for the identity provider to broker a login to a website or for the website to request additional information from the user according to one or more embodiments of the present disclosure;

FIG. 4 shows a flow chart of the steps for a website server to request QR code and to receive security token from an identity provider for the website server to login a user or

2

display protected resources to the user according to one or more embodiments of the present disclosure;

FIG. 5 shows a flow chart of the steps for an identity provider to generate QR code for a website to request additional information from a user and to receive the QR code from a trusted device to provide the requested additional information to the website according to one or more embodiments of the present disclosure;

FIG. 6 shows a flow chart of the steps for an identity provider to generate QR code for a website for second factor authentication of a user and to receive the QR code from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure; and

FIG. 7 is a block diagram of a computer system suitable for implementing one or more components discussed herein according to one embodiment of the present disclosure.

Embodiments of the present disclosure and their advantages are best understood by referring to the detailed description that follows. It should be appreciated that like reference numerals are used to identify like elements illustrated in one or more of the figures.

### DETAILED DESCRIPTION

Systems and methods are disclosed herein for a user to use a trusted device to provide sensitive information to an identity provider via QR (Quick Response) code for the identity provider to broker a login to a website or to assist in the authentication of the user by the website. The identity provider may be a service provider that facilitates transactions between the user and the website. Users may securely transact with the website from unsecured devices without the risk of exposing sensitive information to unauthorized parties running malware or key logger spyware on the unsecured devices. The QR code may be generated by the identity provider when the website desires to obtain sensitive information from users. The website may display the QR code on the unsecured devices. A user running a trusted application from the identity provider on the trusted device may scan the QR code to transmit the QR code to the identity provider. The identity provider may validate the QR code and prompt the user for the sensitive information. The identity provider may validate the QR code and may evaluate a trust level of the user to generate a security token based on the type of sensitive information received and/or the level of authentication performed on the user. The identity provider may provide the security token to the website for the website to display protected resources corresponding to the security token on the unsecured devices. Advantageously, the user may perform a safe login to the website from untrusted devices such as publicly shared devices.

The systems and methods disclosed may be used as a second factor authentication even after the user has entered login information directly into the unsecured devices. For example, the website may, through the identity provider, perform additional authentication of the user via QR code to increase the trust level of the user so as to prevent logins by fraudsters. The website may request the identity provider to generate QR code to prompt the user to provide information for the second factor authentication. The website may display the QR code on the unsecured devices. A user running a trusted application from the identity provider on the trusted device may scan the QR code for transmission to the identity provider. The identity provider may validate the QR code and may prompt the user for the information. The identity provider may evaluate the trust level of the user based on the

3

credentials entered into the trusted device when the user logs into the identity provider, on the characteristics of the trusted device, and/or on other information entered by the user. The identity provider may generate a security token based on the level of trust of the user. The website may use the security token to guard against unauthorized logins. Advantageously, the user may avoid the need to carry second factor devices such as fobs for websites that implement second factor authentication mechanism when logging in from untrusted devices.

The systems and methods disclosed may also be used to securely collect additional sensitive information or credentials from the user even after the user has logged into the website on the unsecured device. For example, the website may request the identity provider to generate additional QR code when the website desires to collect additional sensitive information from the user when the user is already logged in. The website may request the identity provider to generate QR code to prompt the user to provide the additional information. The website may display the QR code on the unsecured devices. A user running a trusted application from the identity provider on the trusted device may scan the QR code for transmission to the identity provider. The identity provider may validate the QR code and may prompt the user for the information. The user may enter the requested information through the trusted application on the trusted device. The identity provider may collect and provide the information to the website. In one or more embodiments, if the user is connected to the identity provider through the trusted app, the website may request the identity provider to directly prompt the user for the additional information without going through the QR code. Advantageously, the user may securely enter sensitive information to the website anytime during a login session when conducting transactions with the website from untrusted devices.

Advantageously, the user may securely access websites from devices that may be unsecure, or have no or limited input capabilities. Security is enhanced because the user is not required to enter login credentials or other sensitive information into the unsecured devices that may be stolen, seen, or copied. The QR code itself does not need to contain an URL of the website, but may be encrypted to contain just enough information to uniquely identify the website and to tie the transactions together. The trusted application from the identity provider running on the trusted device and the identity provider provide a bridge through which the user may provide sensitive information to the website securely, conveniently, and efficiently.

In accordance with one or more embodiments of the present disclosure, a method is disclosed. The method includes generating by an identity provider a code for display by a website on an untrusted device. The identity provider uses the code to broker a transaction with the website. The method also includes receiving by the identity provider from a trusted device credential information to identify a user. The method further includes authenticating the user using the credential information. The method further includes receiving by the identity provider the code from the trusted device. The method further includes validating the received code. The method further includes generating by the identity provider information to enable the website to perform the transaction with the user on the untrusted device. The method further includes providing the information from the identity provider to the website.

In accordance with one or more embodiments of the present disclosure, a method is disclosed. The method includes requesting by a website a code from an identity

4

provider, where the code is used by the identity provider to broker a transaction of a user with the website. The method also includes receiving by the website the code from the identity provider. The method further includes displaying the code on an untrusted device. The method further includes receiving by the website transactional information from the identity provider. The transactional information is generated by the identity provider based on information received from a trusted device. The method further includes performing by the website the transaction using the transactional information.

In accordance with one or more embodiments of the present disclosure, an apparatus is disclosed. The apparatus includes a network interface. The network interface is used to communicate with a website server and other devices over a network. The apparatus also includes a code generation unit. The code generation unit is used to generate a code for display by the website server on an untrusted device. The code is used to by the apparatus to broker a transaction with the website. The apparatus further includes an authentication and trust services unit. The authentication and trust services unit is used to receive credential information to identify a user from a trusted device. The authentication and trust services unit is also used to authenticate the user from the credential information. The authentication and trust services unit is further used to receive the code from the trusted device. The authentication and trust services unit is further used to validate the code. The authentication and trust services unit is further used to generate information for the website server to enable the website server to perform the transaction with the user on the untrusted device.

Refer now to the figures wherein the drawings are for purposes of illustrating embodiments of the present disclosure only, and not for purposes of limiting the same. FIG. 1 shows a system for a user to use a trusted device to scan QR code displayed on a display of an untrusted device to supply sensitive information to an identity provider for the identity provider to broker a login to a website according to one or more embodiments of the present disclosure.

A user **100** carries a trusted device **102**. Trusted device **102** may be a smart phone (e.g., iPhone, Google phone, or other phones running Android, Window Mobile, or other operating systems), a tablet computer (e.g., iPad, Galaxy), personal digital assistant (PDA), a notebook computer, or various other types of wireless or wired computing devices. It should be appreciated that trusted device **102** may be referred to as a mobile device without departing from the scope of the present disclosure. Trusted device **102** may have a camera. Trusted device **102** may communicate over a network **106** with an identity provider **108**. A website server **116** hosts a website and may also communicate with identity provider **108** over network **106**. The website may be operated by a financial institution, a merchant, or other entities providing secured access to authorized users. In one embodiment, identity provider **108** may broker a login session to website server **116** by user **100**.

Network **106** may be implemented as a single network or a combination of multiple networks. For example, in various embodiments, network **106** may include the Internet and/or one or more intranets, wireless networks (e.g., cellular, wide area network (WAN), WiFi hot spot, WiMax, personal area network (PAN), Bluetooth, etc.), landline networks and/or other appropriate types of communication networks. As such, in various embodiments, trusted device **102** may be associated with a particular link (e.g., a link, such as a URL (Uniform Resource Locator) to an IP (Internet Protocol) address).

5

In one or more embodiments, user **100** is at an untrusted device **104** and wishes to access the website on website server **116**. Untrusted device **104** may be a publicly shared device whose security is unknown. To eliminate the risk of exposing sensitive information when such information is entered directly onto untrusted device **104**, trusted device **102** and identity provider **108** may be used to broker access to website server **116**.

To broker access to website server **116** by user **100**, identity provider **108** may have a network interface **110** that interfaces with network **106** to communicate with trusted device **102** and website server **116**. A QR code generation unit **112** of identity provider **108** may generate QR code when requested by website server **116**. The QR code may not contain an URL of website server **116**, but may encrypt information to allow identity provider **108** to uniquely identify website server **116** and to enable identity provider **108** to associate user **100**/trusted device **102** with a login session or a transaction on website server **116**. For example, QR code may encode information to prompt user **100** to initiate a safe login session to website server **116**, or to prompt user **100** to provide information required to complete a transaction by website server **116**. The QR code generated by identity provider **108** is not readable by standard QR code readers and the encrypted information may only be decrypted by identity provider **108**. Website server **116** may display the QR code on untrusted device **104**. While the exemplary embodiments described herein use QR code, identity provider **108** may generate other types of symbol or data encoding schemes, such as UPC code. Website server **116** may similarly display these data encoding schemes on untrusted device **104** for capture or scan by trusted device **102**.

To scan the QR code, user **100** may run a trusted app (application) from identity provider **108** on trusted device **102**. The trusted app identifies trusted device **102** to identity provider **108** through network **106**. The trusted app and trusted device **102** have previously been registered with identity provider **108** by user **100**. As such, when the trusted app communicates with identity provider **108**, a security level is established for user **100**. To increase the security level, in one or more embodiments, user **100** may login to user's account with identity provider **108**. User **100** may enter a user name and password such as an e-mail address and a PIN for the login credentials. User **100** may enter the information on trusted device **102** through a keyboard, keypad, touchscreen, or using voice command. User **100** may scan the QR code displayed on untrusted device **104**. The trusted application decodes the scanned QR code and transmits the information to identity provider **108**. In one or more embodiments, the trusted application may transmit the QR code image to identity provider **108** for decoding.

An authentication and trust services unit **114** of identity provider **108** validates the QR code received from trusted device **102**. Identity provider **108** may verify that the QR code identifies a website that has requested identity provider **108** to broker an access, such as from website server **116**. Identity provider **108** may also verify that the QR code is associated with a safe login session or with a request by website server **116** to request additional information from user **100** to further authenticate user **100** or to complete a transaction. If website server **116** is requesting additional information, identity provider **108** may transmit a request to trusted device **102** to prompt user **100** to enter the information on trusted device **102**. For example, identity provider **108** may request user **100** to provide login credentials to website server **116** for second factor authentication. In one embodiment, trusted device **102** may store the login credentials entered by user **100** so that the

6

login credentials are automatically sent to identity provider **108** for second factor authentication the next time user **100** accesses website server **116**. Alternatively, identity provider **108** may request user **100** to provide sensitive information to complete a transaction on website server **116**. User **100** may enter the requested information into trusted app for trusted device to transmit the information to identity provider **108**.

After validating the QR code, authentication and trust services unit **114** evaluates the security level for user **100**/trusted device **102**, any additional login credentials received from user **100**, and past history of trusted device **102** to determine a level of trust for user **100**/trusted device **102**. Authentication and trust services unit **114** may create a security token for user **100** corresponding to the level of trust determined. For example, if user **100** has not logged into identity provider **108** or website server **116**, the security token may have a low level of trust for user **100**. On the other hand, if user **100** has logged into identity provider **108** and has passed second factor authentication, the security token may have a high level of trust for user **100**. Identity provider **108** may store the security token for retrieval by website server **116**.

Website server **116** may use a network interface **118** to poll identity provider **108** to detect if a security token has been generated. In one or more embodiments, identity provider **108** may inform website server **116** that a security token is available for retrieval. In one or more embodiments, identity provider **108** may issue an instruction to trusted device **102** directing user **100** how to proceed. For example, when establishing a safe login session, identity provider **108** may direct user **100** to click on the QR code or a "safe login" button on untrusted device **104** to proceed with the login session. When user **100** does as directed, website server **116** may retrieve the security token and may inform user **100** on untrusted device **104** that a login session has been established. A login authentication unit **120** of website server **116** may evaluate the security token to determine the protected resources, if any, that may be accessed by user **100**. Website server **116** may access a protected resources unit **122** to display the protected resources on untrusted device **104** for user **100** to access. When the QR code was generated for website server **116** to request additional information from user **100**, identity provider **108** may direct user **100** to click on the QR code on untrusted device **104** for website server **116** to retrieve the requested information from identity provider **108**. When user **100** does as directed, website server **116** may retrieve the requested information to complete the transaction.

FIG. 2 shows a flow chart of the steps for an identity provider of FIG. 1 to generate QR code for a website and to validate the QR code received from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure. In **202**, identity provider **108** receives a request for a QR code for a login session from website server **116**. The QR code may encrypt information to allow identity provider **108** to uniquely identify website server **116** and to enable identity provider **108** to associate user **100**/trusted device **102** with a login session on website server **116**. For example, the QR code may contain a key for retrieval of the security token associated with user **100**/trusted device **102** for the login session, an identifier for website server **116**, and a time stamp. The time stamp may indicate a period of validity of the QR code.

In **204**, QR code generation unit **112** of identity provider **108** generates the QR code. QR code generation unit **112** may encrypt an amount of data and size the QR code such that the QR code may be scanned and decoded from a reasonable distance by trusted device **102**. To prevent a rogue site from

putting up QR code masquerading as QR code generated by identity provider 108 to steal login credentials from user 100, the QR code may be generated to be read only by trusted app from identity provider 108 running on trusted device 102, and not by standard QR code readers. In one or more embodiments, the encoded data may only be decrypted by identity provider 108. In one or more embodiments, the encoded data may be decrypted by the trusted app from identity provider 108. In addition, to mitigate DDOD (Distributed Denial-of-Service) concerns and to ensure that QR code generation does not become a risk to identity provider 108, rate limiting may be implemented on the QR code generation. QR code generation unit 112 may also generate the QR code on a “best effort” basis. If the QR code is generated by a service, there may be a dedicated pool of QR code that is considered best effort.

Identity provider 108 provides the QR code to website server 116 for website server 116 to display the QR code on a login page on untrusted device 104. Website server 116 may also display a “QR code safe login” button on untrusted device 104 to inform users that the QR code is for initiating a safe login. The button may also be clicked by users after identity provider 108 has generated the security token for website server 116 to retrieve the security token from identity provider 108. To scan the QR code, user 100 runs a trusted app from identity provider 108 on trusted device 102. Trusted device 102 has previously been registered with identity provider 108 as belonging to user 100 so that a security level is established for user 100 when trusted app communicates with identity provider 108. The security level is one factor identity provider 108 evaluates when generating the security token for the safe login session. The higher the security level of user 100, the higher the level of trust in the security token generated for user 100, and the more of the protected resources of website server 116 may be accessible by user 100. To increase the security level, user 100 may enter login credentials for identity provider 118 into the trusted app.

In 206, identity provider 108 determines if user 100 has provided login credentials from trusted device 102. If login credentials are received, in 208, identity provider 108 logs in user 100 and increases the security level for user 100. Otherwise, the security level remains unchanged. The trusted app may display a “safe login” icon. User 100 may click on the “safe login” icon to enable the camera on trusted device 102 to scan the QR code displayed on untrusted device 104. The trusted app decodes the scanned QR code and transmits the data to identity provider 108.

In 210, identity provider 210 receives the decoded QR code from trusted device 102. In one or more embodiments, identity provider 210 may receive the un-decoded QR code from trusted device 102. Authentication and trust services unit 114 of identity provider 108 may, if necessary, decode the QR code and may decrypt the decoded data. In 212, identity provider 108 determines if additional information is needed from user 100 for authentication by website server 116. The additional information may include login credentials to website server 116 or may include other sensitive information of user 100. If additional information is needed, identity provider 108 may prompt user 100 for the information on trusted device 102. In 214, identity provider 108 receives the additional information from trusted device 102.

In 216, authentication and trust services unit 114 validates the QR code. Authentication and trust services unit 114 may verify that the time stamp for the QR code has not expired, that the QR code identifies website server 116, and that the key for retrieval of the security token is associated with a safe login session. Authentication and trust services unit 114 also

evaluates the security level for user 100, any additional information received from user 102, and history of trusted device 102 to determine a level of trust for user 100. For example, if there is increased security level because user 100 has logged into identity provider 108, user 100 has provided additional information such as login credentials for website server 116, and there is no history of fraudulent use associated with trusted device 102, a high level of trust may be determined for user 100. On the other hand, if there is just a regular security level because user 100 has not logged into identity provider 108, and user 100 has not provided additional information for website server 116, a lower level of trust may be determined for user 100.

In step 218, authentication and trust services unit 114 generates a security token corresponding to the level of trust determined for user 100. Identity provider 108 may inform website server 116 that a security token for a safe login session is available. In one or more embodiments, identity provider 108 may transmit a message to trusted device 102 instructing user 100 to request website server 116 to retrieve the security token. For example, user 100 may be instructed to click on the QR code or the “QR code safe login” button displayed on untrusted device 104. When user 100 clicks on the QR code or the button, website server 116 requests the security token from identity provider 108. In 220, identity provider 108 provides the security token for user 100 to website server 116. Website server 116 may evaluate the security token to establish a login session for user 100 and may present protected resources corresponding to the level of trust of the security token on untrusted device 104 for user 100 to access. In one or more embodiments, identity provider 108 may provide to website server 116 the additional information received from trusted device 102, such as the login credentials to website server 116. Website server 116 may use the additional information to further authenticate user 100 or to determine the protected resources presented to user 100.

FIG. 3 shows a flow chart of the steps for a user to use a trusted device to scan QR code displayed on an untrusted device of FIG. 1 to provide sensitive information to an identity provider for the identity provider to broker a login to a website or for the website to request additional information from the user according to one or more embodiments of the present disclosure. User 100 may execute the steps of FIG. 3 when user 100 wishes to login to website server 116 at untrusted device 104. User 100 may also execute the steps of FIG. 3 when user 100 is already logged in to website server 116 at untrusted device 104 but website server needs additional information from user 100 to complete a transaction.

In 302, user 100 starts a trusted app from identity provider 108 on trusted device 102. The trusted app may transmit identification information of trusted device 102 to identity provider 108. Trusted device 102 has previously been registered by user 100 with identity provider 108. Therefore, identity provider 108 may associate the transmission from trusted device 102 with user 100 to establish a security level for user 100. To increase the security level, user 100 may login to identity provider 108. In 304, user 100 decides whether to login to user’s account with identity provider 108. If the answer is yes, user 100 enters user’s login credentials into trusted device in 306. Identity provider 108 may authenticate user 100 to increase the security level.

In 308, user 100 scans the QR code displayed on untrusted device 104 using the trusted app. The QR code may encode information to allow user 100 to request a safe login session with website server 116 or to allow website server 116 to request additional information from user 100 after user 100 is already logged in. User 100 may scan the QR code using the

trusted app regardless of whether user **100** has logged in with identity provider **108**. The trusted app may decode the QR code or may rely on identity provider **108** to decode the QR code. In **310**, trusted app transmits the decoded or un-decoded QR code to identity provider **108**. Identity provider **108** may decode and/or decrypt the QR code. Identity provider **108** may validate the QR code to determine whether the QR code is used for a safe login or to obtain additional information from user **100**. If the QR code is used for a safe login, additional information may be needed from user **100** for authentication by identity provider **108** or website server **116**. For example, the additional information may include login credentials to website server **116**. If the QR code is used to obtain additional information from user **100** to complete a transaction, identity provider **108** may determine the type of information needed.

In **312**, identity provider **108** determines if it needs additional information from user **100**. If it does, identity provider **108** transmits a message to trusted device **102** on the information needed. Trusted device **102** may prompt user **100** to enter the requested information. In **314**, user enters the information into trusted app for trusted device **102** to transmit the information to identity provider **108**. In one or more embodiments, trusted device **102** may store the entered information so that the information may be provided to identity provider **108** without user input. If trusted device **102** is used to broker a safe login, identity provider **108** may evaluate the security level for user **100**, any authentication information received, and history of trusted device **102** to determine the level of trust. Identity provider **108** may generate a security token corresponding to the level of trust. If trusted device **102** is used to provide additional information to website server **116** to complete a transaction after user **100** has already logged in, identity provider **108** may store the additional information.

In **316**, trusted device **102** receives a message from identity provider **108** that a security token has been generated or that the requested information has been received. The message may contain instructions directing user **100** how to activate website server **116** to retrieve the security token or the additional information. For example, user **100** may be directed to input a command to website server **116** such as to click on the QR code displayed on untrusted device **104**. User **100** inputs the command as directed. Website server **116** retrieves the security token or the additional information from identity provider **108**. Website server **116** may establish a safe login session and may display protected resources on untrusted device **104** based on the security token. In **318**, user accesses the protected resources through untrusted device **104**. In the case where website server **116** obtains additional information for user **100** who is already logged in, website server **116** may use the additional information to complete a transaction. User **100** may proceed to carry out transactions with website server **116** on untrusted device and may close the trusted app on trusted device **102**.

FIG. 4 shows a flow chart of the steps for a website server of FIG. 1 to request QR code and to receive security token from an identity provider for the website server to login a user or display protected resources to the user according to one or more embodiments of the present disclosure. Website server **116** may use the QR code when website server **116** requests sensitive information from user **100**. For example, website server **116** may use the QR code to allow user **100** to initiate a safe login session using trusted device **102**. In one or more embodiments, website server **116** may use the QR code to request credentials for second factor authentication when user **100** has entered login information directly into unsecured device **104**. In one or more embodiments, website

server **116** may use the QR code to securely collect additional sensitive information when user **100** is already logged into website server **116** to complete a transaction.

In **402**, website server **116** requests identity provider **108** to generate a QR code. Website server **116** may provide information that identifies website server **116** and untrusted device **104** to identity provider **108**. In addition, website server **116** may provide metadata that identifies the type of information requested by website server **116**. Identity provider **108** may generate a QR code that uniquely identifies website server **116** and that ties a transaction for a login session on untrusted device **104** to website server **116**.

In **404**, website server **116** receives the QR code from identity provider **108**. In **406**, website server **116** displays the QR code on untrusted device **104**. For example, for a safe login session, website server **116** may display the QR code and a “QR code safe login” button on untrusted device **104** to inform users that the QR code may be scanned to initiate a safe login using trusted device **102**. In one or more embodiments, website server **116** may display the QR code and a message on untrusted device **104** that user **100** is requested to provide additional information using trusted device **102**. If the QR code is used for a safe login session, when user **100** scans the QR code with trusted device **102** using the trusted app from identity provider **108**, identity provider **108** may generate a security token for user **100** corresponding to a level of trust. If the QR is used to collect additional information from user **100**, when user **100** scans the QR code, identity provider **108** may transact with user **100** to collect the additional information via trusted device **102**.

In **408**, website server **116** determines if the security token or the additional information is available from identity provider **108**. In one or more embodiments, website server **116** may poll identity provider **108**. In one or more embodiments, website server **116** may receive a activation command from user **100** that the security token or the additional information is available when user **100** clicks on the QR code displayed on untrusted device **104** as directed by identity provider **108**. Website server **116** may retrieve the security token or the additional information. Website server **116** may use the additional information to authenticate user **100** using login authentication unit **120**. In one or more embodiments, website server **116** may use the additional information to complete the transaction requiring the information. Website server **116** may proceed to carry out transactions with user **100** on untrusted device **104**.

In **410**, if the security token was retrieved by website server **116** for a safe login session, login authentication unit **120** may evaluate the security token to determine the protected resources, if any, that may be accessed by user **100**. Website server **116** may access protected resource unit **122** to access the protected resources. In **412**, website server **116** establishes the safe login session and presents the protected resource on untrusted device **104** for user **100** to access.

FIG. 5 shows a flow chart of the steps for an identity provider of FIG. 1 to generate QR code for a website to request additional information from a user and to receive the QR code from a trusted device to provide the requested additional information to the website according to one or more embodiments of the present disclosure. Website server **116** may request the additional information after user **100** is already logged into website server **116**.

In **512**, identity provider **108** receives a request from website server **116** to generate a QR code to collect additional information from user **100**. Identity provider **108** may receive from website server **116** metadata that identifies the type of requested information, in addition to information that identi-

11

fies website server 116 and untrusted device 104. In 514, identity provider 108 generates a QR code that associates the requested information for a login session on untrusted device 104 with website server 116. Identity provider 108 may transmit the QR code to website server 116. Website server 116 may display the QR code on untrusted device 104 with a notification that user 100 is requested to scan the QR code to provide the information. User 100 may start the trusted app from identity provider 108 on trusted device 102 to scan the QR code.

In 516, identity provider 108 receives the QR code from trusted device 102. Identity provider 108 may decode and/or decrypt the QR code the decoded data. In 518, identity provider 108 validates the QR code to verify that the QR code is associated with a request for information for a login session on untrusted device 104 with website server 116. Identity provider 108 may identify from the metadata the requested information and may transmit a message to trusted device 102 prompting user 100 for the requested information.

In 520, identity provider 108 receives the requested information from trusted device 102. Identity provider 108 may transmit a message to trusted device 102 directing user 100 to instruct website server 116 to retrieve the collected information from identity provider 108, such as by directing user 100 to click on the QR code displayed on untrusted device 104. Upon receiving the command from user 100, website server 116 may request the collected information from identity provider 108. In 522, identity provider 108 provides the requested information to website server 116. Website server 116 may use the information to complete a transaction. User 100 may transact with website server 116 on untrusted device 104 until additional information is required, at which point identity provider 108 may repeat the steps of FIG. 5 to collect the information for website server 116.

FIG. 6 shows a flow chart of the steps for an identity provider of FIG. 1 to generate QR code for a website for second factor authentication of a user and to receive the QR code from a trusted device to generate a security token to broker a login to the website according to one or more embodiments of the present disclosure. Website server 116 may perform second factor authentication after user 100 has entered login information directly into untrusted device 104 so as to increase the trust level of user 100.

In 602, identity provider 108 receives a request from website server 116 to generate a QR code to collect credential information from user 100/trusted device 102 for second factor authentication. Identity provider 108 may receive from website server 116 information identifying website server 116 and untrusted device 104. In 604, identity provider 108 generates a QR code that associates the requested credentials with website server 116. Identity provider 108 may transmit the QR code to website server 116. Website server 116 may display the QR code on untrusted device 104 with a notification that user 100 is requested to scan the QR code to provide the credentials. User 100 may start the trusted app from identity provider 108 on trusted device 102 to scan the QR code. When the trusted app communicates with identity provider 108, a security level is established for user 100 associated with trusted device 102. To increase the security level, user 100 may be prompted to enter login credentials with identity provider 108.

In 606, identity provider 108 determines if user 100 has provided the login credentials from trusted device. If user 100 has provided the login credentials, identity provider 108 authenticates user 100 in 608. Identity provider 108 may increase the security level for user 100 if user 100 is successfully authenticated. In 610, identity provider 108 receives the

12

QR code from trusted device 102. Identity provider 108 may decode and/or decrypt the QR code the decoded data. In 612, identity provider 108 validates the QR code to verify that the QR code is associated with a request for second factor authentication with website server 116. Identity provider 108 may evaluate a level of trust for user 100 based on the characteristics and history of trusted device 102, and the security level of user 100.

In 614, identity provider 108 generates a security token based on the level of trust determined for user 100. Identity provider 108 may transmit a message to trusted device 102 directing user 100 to instruct website server 116 to retrieve the security token from identity provider 108, such as by directing user 100 to click on the QR code displayed on untrusted device 104. Upon receiving the command from user 100, website server 116 may request the security token from identity provider 108. In 616, identity provider 108 provides the security token to website server 116. Website server 116 may evaluate the security token to determine the protected resources, if any, that may be accessed by user 100. Website server 116 establishes the safe login session and presents the protected resource on untrusted device 104 for user 100 to access. Thus, website server 116 may perform second factor authentication for user 100 without requiring user 100 to carry second factor devices such as fobs or other second factor devices.

FIG. 7 is a block diagram of a computer system 700 suitable for implementing one or more embodiments of the present disclosure. In various implementations, the trusted device of the user may comprise a personal computing device (e.g., smart phone, a computing tablet, a personal computer, laptop, PDA, Bluetooth device, key FOB, badge, etc.) capable of communicating with the network. The website server or the identity provider may utilize a network computing device (e.g., a network server) capable of communicating with the network. It should also be appreciated that the trusted app from the identity provider may be implemented as applications running on computer system 700.

Network computing device may comprise or implement a plurality of servers and/or software components that operate to perform various methodologies in accordance with the described embodiments. Exemplary servers may include, for example, stand-alone and enterprise-class servers operating a server OS such as a MICROSOFT® OS, a UNIX® OS, a LINUX® OS, or other suitable server-based OS. It can be appreciated that the servers illustrated in FIG. 7 may be deployed in other ways and that the operations performed and/or the services provided by such servers may be combined or separated for a given implementation and may be performed by a greater number or fewer number of servers. One or more servers may be operated and/or maintained by the same or different entities.

Computer system 700 includes a bus 702 or other communication mechanism for communicating information data, signals, and information between various components of computer system 700. Components include an input/output (I/O) component 704 that processes a user action, such as selecting keys from a keypad/keyboard, selecting one or more buttons or links, etc., and sends a corresponding signal to bus 702. I/O component 704 may also include an output component such as a display 711, and an input control such as a cursor control 713 (such as a keyboard, keypad, mouse, etc.). An optional audio input/output component 705 may also be included to allow a user to use voice for inputting information by converting audio signals into information signals. Audio I/O component 705 may allow the user to hear audio. A transceiver or network interface 706 transmits and receives

13

signals between computer system 700 and other devices, such as another user device, or another network computing device via a communication link 718 to a network. In one embodiment, the transmission is wireless, although other transmission mediums and methods may also be suitable. A processor 712, which can be a micro-controller, digital signal processor (DSP), or other processing component, processes these various signals, such as for display on computer system 700 or transmission to other devices via communication link 718. Processor 712 may also control transmission of information, such as cookies or IP addresses, to other devices.

Components of computer system 700 also include a system memory component 714 (e.g., RAM), a static storage component 716 (e.g., ROM), and/or a disk drive 717. Computer system 700 performs specific operations by processor 712 and other components by executing one or more sequences of instructions contained in system memory component 714. Logic may be encoded in a computer readable medium, which may refer to any medium that participates in providing instructions to processor 712 for execution. Such a medium may take many forms, including but not limited to, non-volatile media, volatile media, and transmission media. In various implementations, non-volatile media includes optical, or magnetic disks, or solid-state drives, volatile media includes dynamic memory, such as system memory component 714, and transmission media includes coaxial cables, copper wire, and fiber optics, including wires that comprise bus 702. In one embodiment, the logic is encoded in non-transitory computer readable medium. In one example, transmission media may take the form of acoustic or light waves, such as those generated during radio wave, optical, and infrared data communications.

Some common forms of computer readable media includes, for example, floppy disk, flexible disk, hard disk, magnetic tape, any other magnetic medium, CD-ROM, any other optical medium, punch cards, paper tape, any other physical medium with patterns of holes, RAM, PROM, EEPROM, FLASH-EEPROM, any other memory chip or cartridge, or any other medium from which a computer is adapted to read.

In various embodiments of the present disclosure, execution of instruction sequences to practice the present disclosure may be performed by computer system 700. In various other embodiments of the present disclosure, a plurality of computer systems 700 coupled by communication link 718 to the network (e.g., such as a LAN, WLAN, PTSN, and/or various other wired or wireless networks, including telecommunications, mobile, and cellular phone networks) may perform instruction sequences to practice the present disclosure in coordination with one another.

Where applicable, various embodiments provided by the present disclosure may be implemented using hardware, software, firmware, or combinations thereof. Also where applicable, the various hardware components, software components, and/or firmware components set forth herein may be combined into composite components comprising software, firmware, hardware, and/or all without departing from the spirit of the present disclosure. Where applicable, the various hardware components, software components, and/or firmware components set forth herein may be separated into sub-components comprising software, firmware, hardware, or all without departing from the spirit of the present disclosure. In addition, where applicable, it is contemplated that software components may be implemented as hardware components, and vice-versa.

Application software in accordance with the present disclosure, such as computer programs executed by a processor

14

of the identity provider to generate/validate QR code and to generate the security token, by a processor of the website server to evaluate the security token to display the protected resources, or by the trusted app to scan the QR code, may be stored on one or more computer readable mediums. It is also contemplated that the application software identified herein may be implemented using one or more general purpose or specific purpose computers and/or computer systems, networked and/or otherwise. Where applicable, the ordering of various steps described herein may be changed, combined into composite steps, and/or separated into sub-steps to provide features described herein.

Although embodiments of the present disclosure have been described, these embodiments illustrate but do not limit the disclosure. For example, even though QR code is a mature technology with large information storage capacity, other code, symbols, text, or objects that may be recognized quickly and accurately by trusted devices may be used for the safe login or for the information request. For example, UPC code can be generated by the identity provider, which then can be scanned by the trusted device to accomplish the safe login process or the information request by the website server as discussed herein. It should also be understood that embodiments of the present disclosure should not be limited to these embodiments but that numerous modifications and variations may be made by one of ordinary skill in the art in accordance with the principles of the present disclosure and be included within the spirit and scope of the present disclosure as hereinafter claimed.

We claim:

1. A system comprising:

a non-transitory memory storing user account information, wherein the user account information comprises authentication information for user accounts; and

one or more hardware processors coupled to the memory and operable to read instructions from the memory to perform the steps of:

generating by a service provider a QR code for display by a website on a first device, wherein the QR code is used for a transaction between a user and the website; receiving by the service provider from a second device credential information to identify the user, wherein the second device comprises a smart phone; authenticating the user from the credential information; receiving by the service provider the QR code from the second device; validating the QR code received; determining a trust level for the second device using the credential information and a past history for the second device; generating by the service provider a security token using at least the trust level to enable the website to perform the transaction with the user on the first device; and providing the security token from the service provider to the website.

2. The system of claim 1, wherein the transaction is a safe login session of the user with the website on the first device.

3. The system of claim 1, wherein the credential information comprises information identifying the second device, and wherein said authenticating the user from the credential information comprises identifying the user from the information identifying the second device.

4. The system of claim 1, wherein the credential information comprises login information of the user to the service provider, and wherein said authenticating the user from the credential information comprises authenticating the user using the login information.

## 15

5. The system of claim 1, wherein the one or more hardware processors are operable to read instructions from the memory to further perform the steps of receiving by the service provider from the second device authentication information of the user with the website.

6. The system of claim 1, wherein the transaction is a second factor authentication of the user after the user has entered login information into the first device.

7. The system of claim 1, wherein the transaction is for the website to obtain additional information from the user after the user has logged into the website, and wherein said generating by the service provider the security token to enable the website to perform the transaction comprises collecting by the service provider the additional information from the second device.

8. A system comprising:

a non-transitory memory storing protected resources for a website; and

one or more hardware processors coupled to the memory and operable to read instructions from the memory to perform the steps of:

requesting by the website a QR code from a service provider, wherein the QR code is used for a transaction between a user and the website through the service provider;

receiving by the website the QR code from the service provider;

displaying the QR code on a first device;

receiving by the website a security token from the service provider based on information received by the service provider from a second device, wherein the service provider determines a trust level for the second device using the credential information and a past history for the second device to generate the security token, and wherein the second device comprises a smart phone;

performing by the website the transaction using the security token.

9. The system of claim 8, wherein the transaction is a safe login session of the user with the website on the first device.

## 16

10. The system of claim 8, wherein said performing by the website the transaction using the security token comprises evaluating the security token to display the protected resources on the first device for access by the user.

11. The system of claim 8, wherein the one or more hardware processors are operable to read instructions from the memory to further perform the steps of receiving by the website from the service provider authentication information of the user with the website.

12. The system of claim 8, where the transaction is a second factor authentication of the user after the user has entered login information into the first device.

13. The system of claim 8, wherein the transaction is for the website to obtain additional information from the user after the user has logged into the website, and wherein the transactional information received by the website from the service provider comprises the additional information.

14. A method comprising:

generating by a service provider a QR code for display for a website on a first device; wherein the QR code is used for a transaction between a user and the website;

receiving by the service provider from a second device credential information to identify the user, wherein the second device comprises a smart phone;

authenticating the user from the credential information;

receiving by the service provider the QR code from the second device;

validating the QR code received;

determining, using one or more hardware processors of the service provider, a trust level for the second device using the credential information and a past history for the second device;

generating by the service provider a security token using at least the trust level to enable the website to perform the transaction with the user on the first device; and

providing the security token from the service provider to the website.

15. The method of claim 14, wherein the transaction is a safe login session of the user with the website on the first device.

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