US006993658B1

(12) **United States Patent**
Engberg et al.

(10) **Patent No.: US 6,993,658 B1**
(45) **Date of Patent: Jan. 31, 2006**

(54) **USE OF PERSONAL COMMUNICATION DEVICES FOR USER AUTHENTICATION**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/519,829**

(22) Filed: **Mar. 6, 2000**

(51) **Int. Cl.**
G07F 7/10 (2006.01)
H04L 9/32 (2006.01)
H04L 12/14 (2006.01)
H04M 15/00 (2006.01)

(52) **U.S. Cl.** **713/185**; 379/114.2; 709/219; 713/183; 713/201; 713/202

(58) **Field of Classification Search** 380/247, 380/249; 455/411; 713/202, 182, 183, 185; 705/74; 235/382.5; 379/114.2; 709/219
See application file for complete search history.

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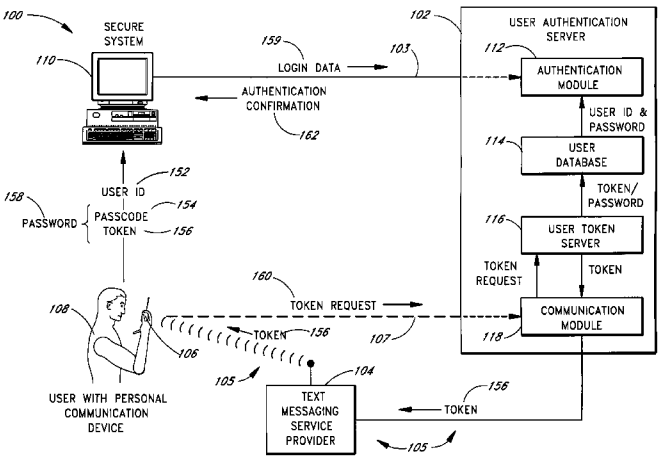
(57) **ABSTRACT**

A password setting system for a secure system includes a user token server and a communication module. The user token server generates a random token in response to a request for a new password from a user. The server creates a new password by concatenating a secret passcode that is known to the user with the token. The server sets the password associated with the user's user ID to be the new password. The communication module transmits the token to a personal communication device, such as a mobile phone or a pager carried by the user. The user concatenates the secret passcode with the received token in order to form a valid password, which the user submits to gain access to the secure system. Accordingly, access to the system is based upon: nonsecret information known to the user, such as the user ID; secret information known to the user, such as the passcode; and information provided to the user through an object possessed by the user, such as the token.

7 Claims, 11 Drawing Sheets



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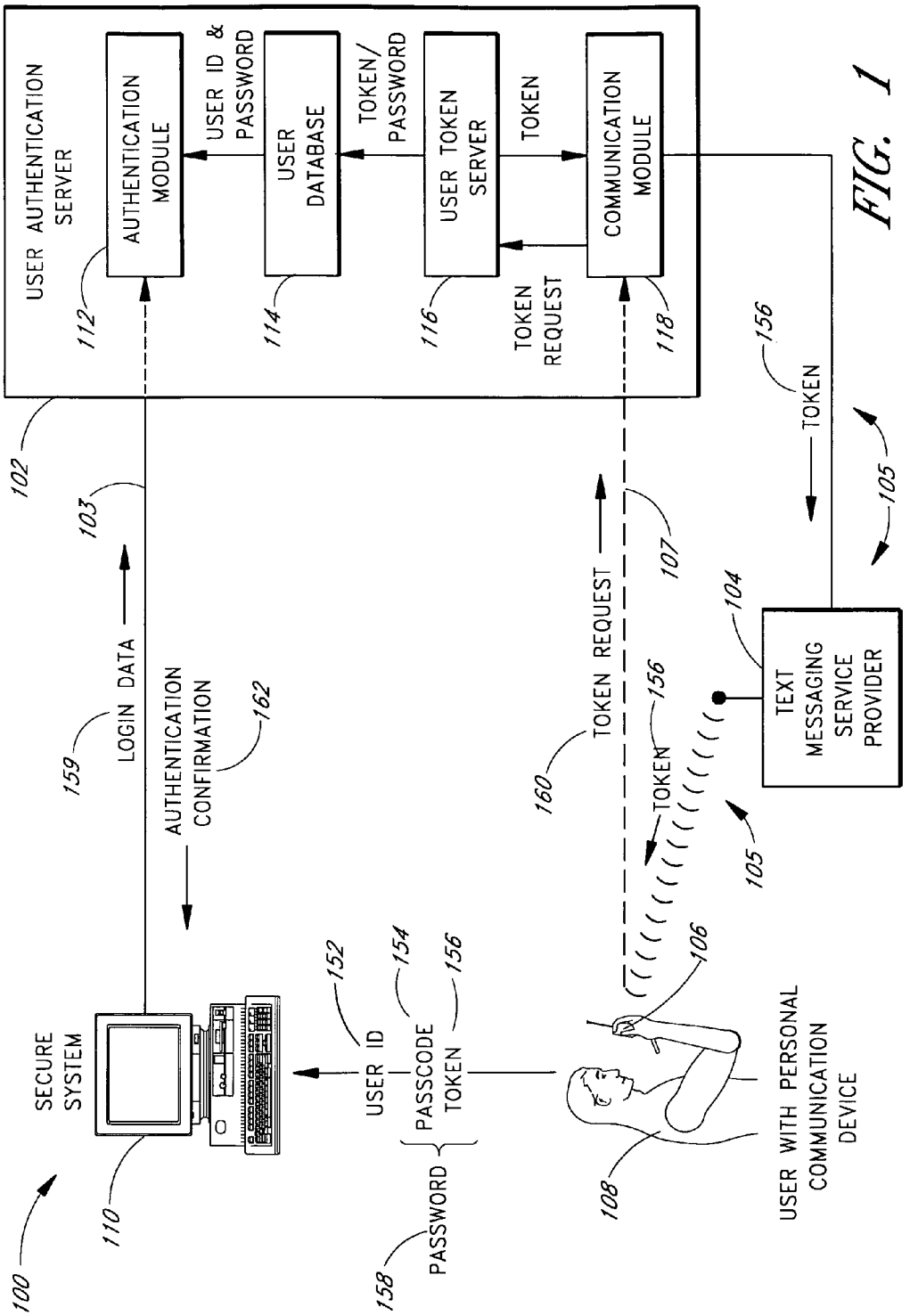

USER AUTHENTICATION SERVER
AUTHENTICATION MODULE
USER ID & PASSWORD
USER DATABASE
TOKEN/ PASSWORD
USER TOKEN SERVER
TOKEN
COMMUNICATION MODULE
TOKEN REQUEST
112
114
116
118
102
103
107
156
TOKEN
105
LOGIN DATA
159
AUTHENTICATION CONFIRMATION
162
TOKEN REQUEST
160
TOKEN
156
104
TEXT MESSAGING SERVICE PROVIDER
105
106
SECURE SYSTEM
110
100
152
USER ID
154
PASSCODE
156
TOKEN
PASSWORD
158
108
USER WITH PERSONAL COMMUNICATION DEVICE

FIG. 1

Logon To Network:

USER ID

PASSWORD

Note: Your password is your passcode followed by a valid token

FIG. 2A

Logon To Network:

USER ID

PASSCODE

TOKEN

FIG. 2B

Please enter a user ID to request a Token
Token will be instantly transmitted to your registered Personal Communication Device and will be valid for one minute

USER ID

FIG. 2C

Logon To Network:

PASSCODE

TOKEN

FIG. 2D

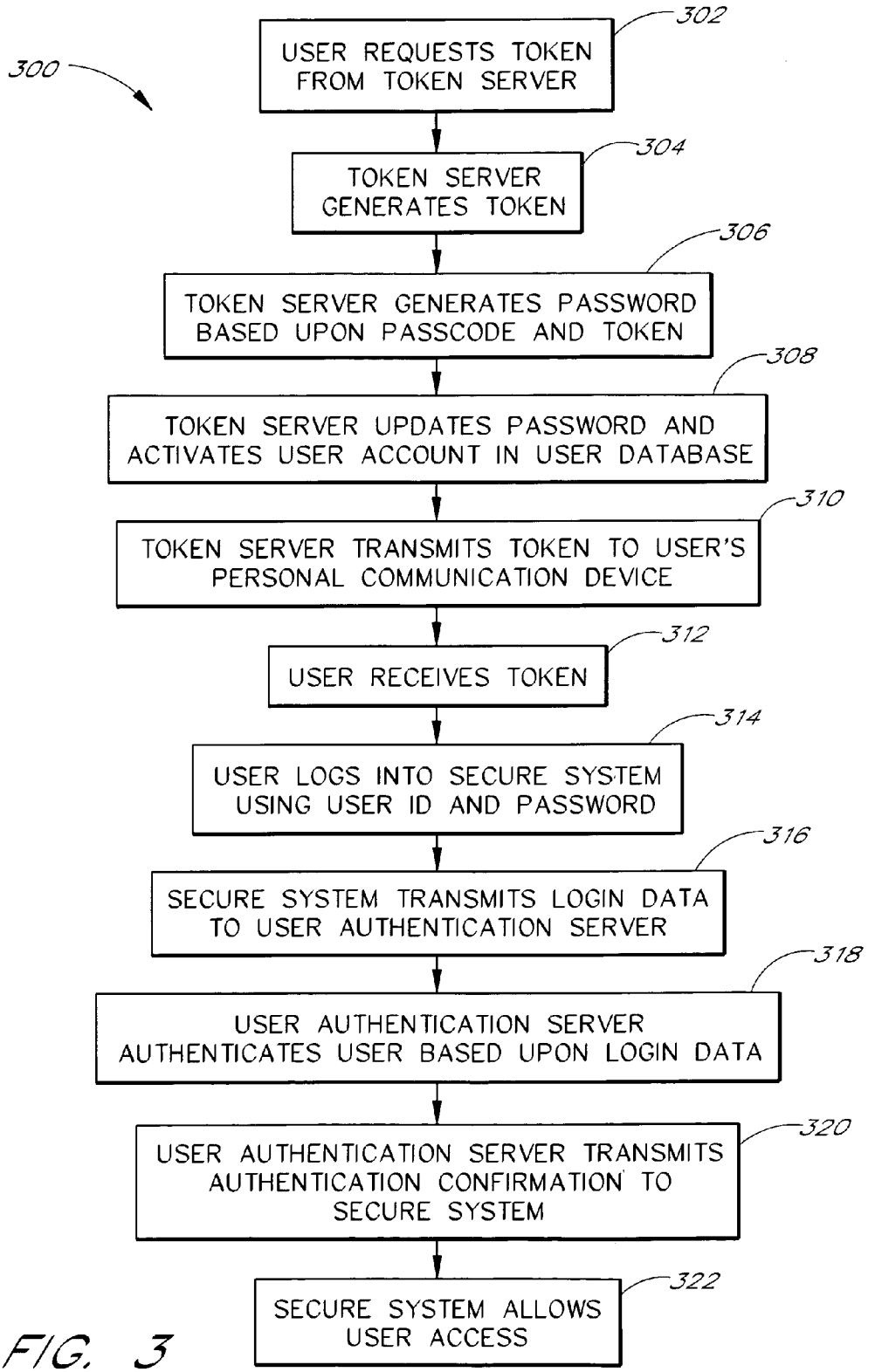

300
302
USER REQUESTS TOKEN FROM TOKEN SERVER
304
TOKEN SERVER GENERATES TOKEN
306
TOKEN SERVER GENERATES PASSWORD BASED UPON PASSCODE AND TOKEN
308
TOKEN SERVER UPDATES PASSWORD AND ACTIVATES USER ACCOUNT IN USER DATABASE
310
TOKEN SERVER TRANSMITS TOKEN TO USER'S PERSONAL COMMUNICATION DEVICE
312
USER RECEIVES TOKEN
314
USER LOGS INTO SECURE SYSTEM USING USER ID AND PASSWORD
316
SECURE SYSTEM TRANSMITS LOGIN DATA TO USER AUTHENTICATION SERVER
318
USER AUTHENTICATION SERVER AUTHENTICATES USER BASED UPON LOGIN DATA
320
USER AUTHENTICATION SERVER TRANSMITS AUTHENTICATION CONFIRMATION TO SECURE SYSTEM
322
SECURE SYSTEM ALLOWS USER ACCESS

FIG. 3

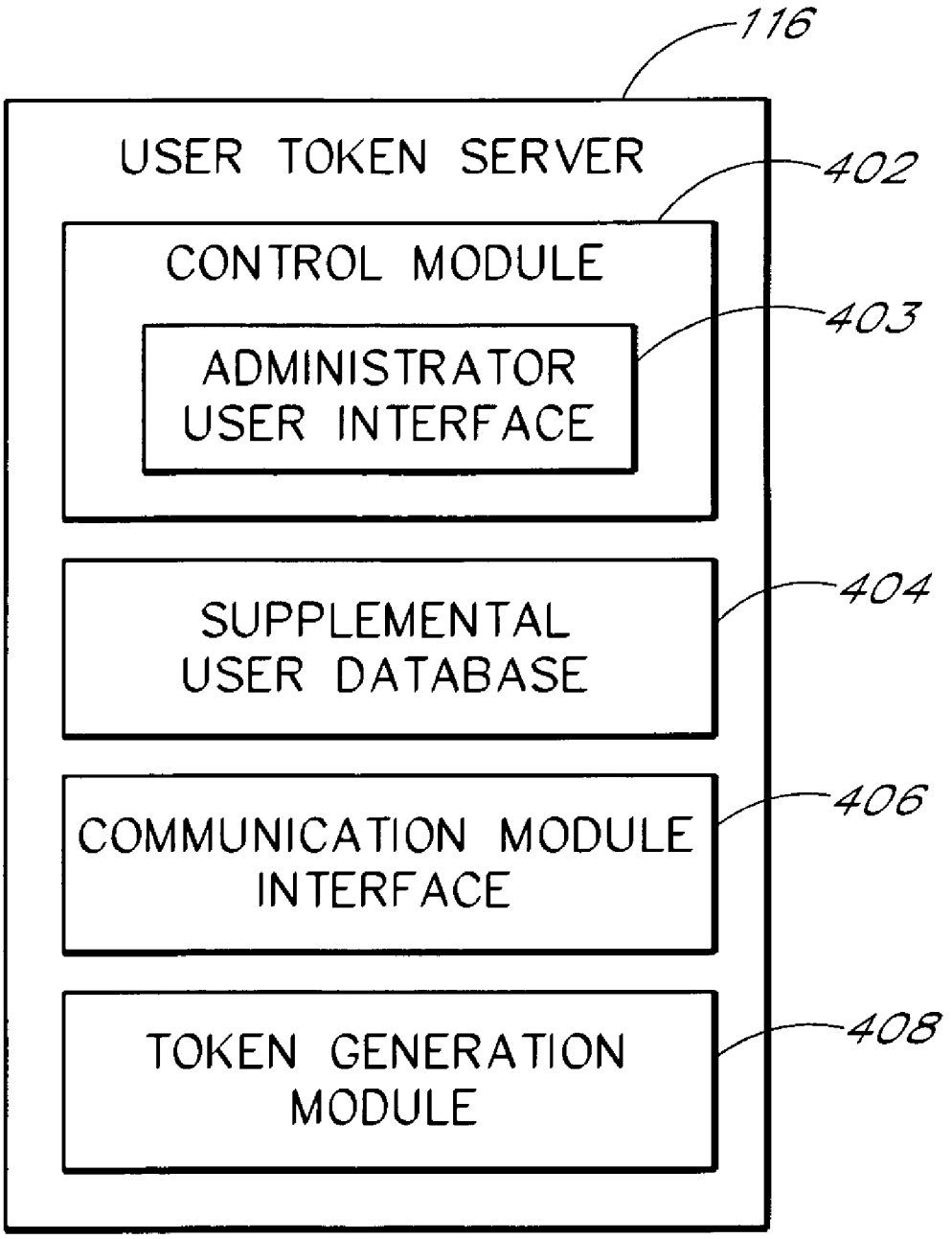

116
USER TOKEN SERVER
402
CONTROL MODULE
403
ADMINISTRATOR USER INTERFACE
404
SUPPLEMENTAL USER DATABASE
406
COMMUNICATION MODULE INTERFACE
408
TOKEN GENERATION MODULE

FIG. 4

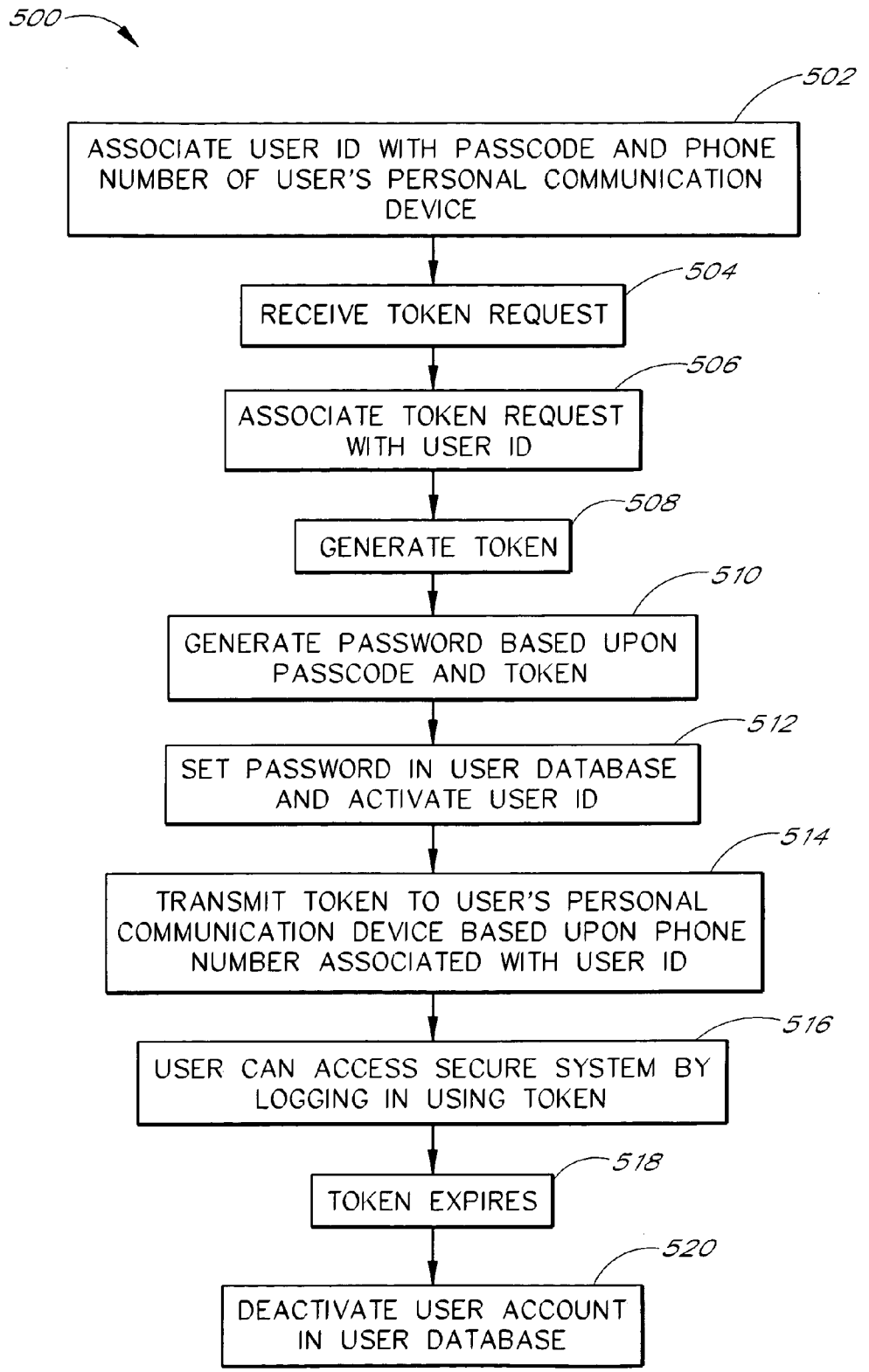

500
502
ASSOCIATE USER ID WITH PASSCODE AND PHONE NUMBER OF USER'S PERSONAL COMMUNICATION DEVICE
504
RECEIVE TOKEN REQUEST
506
ASSOCIATE TOKEN REQUEST WITH USER ID
508
GENERATE TOKEN
510
GENERATE PASSWORD BASED UPON PASSCODE AND TOKEN
512
SET PASSWORD IN USER DATABASE AND ACTIVATE USER ID
514
TRANSMIT TOKEN TO USER'S PERSONAL COMMUNICATION DEVICE BASED UPON PHONE NUMBER ASSOCIATED WITH USER ID
516
USER CAN ACCESS SECURE SYSTEM BY LOGGING IN USING TOKEN
518
TOKEN EXPIRES
520
DEACTIVATE USER ACCOUNT IN USER DATABASE

FIG. 5

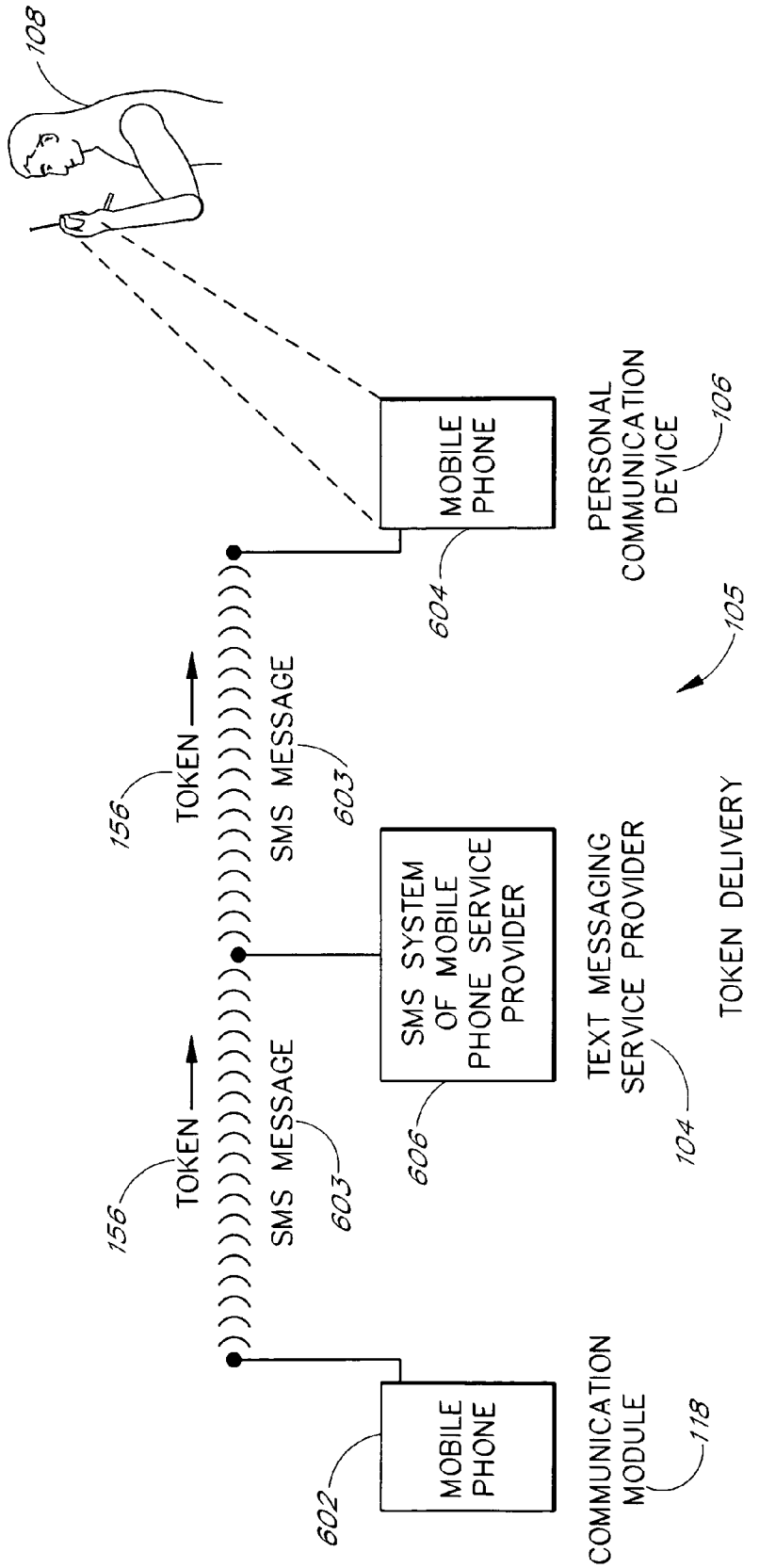

108
MOBILE PHONE
604
PERSONAL COMMUNICATION DEVICE
106
105
TOKEN
156
SMS MESSAGE
603
SMS SYSTEM OF MOBILE PHONE SERVICE PROVIDER
606
TEXT MESSAGING SERVICE PROVIDER
104
TOKEN DELIVERY
TOKEN
156
SMS MESSAGE
603
MOBILE PHONE
602
COMMUNICATION MODULE
118

FIG. 6A

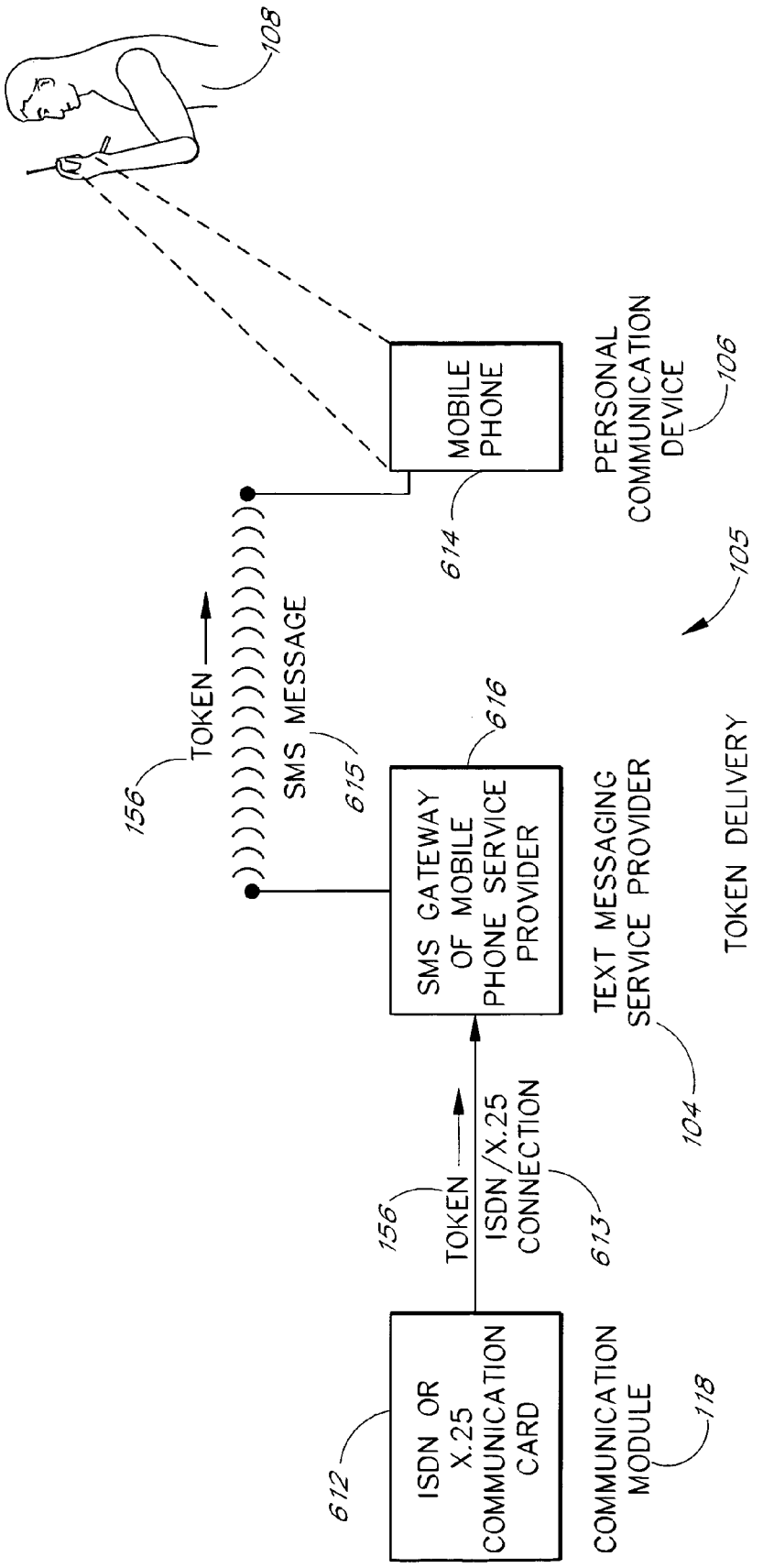

108
MOBILE PHONE
614
PERSONAL COMMUNICATION DEVICE
106
105
TOKEN
156
SMS MESSAGE
615
SMS GATEWAY OF MOBILE PHONE SERVICE PROVIDER
616
TEXT MESSAGING SERVICE PROVIDER
104
TOKEN DELIVERY
TOKEN
156
ISDN/X.25 CONNECTION
613
ISDN OR X.25 COMMUNICATION CARD
612
COMMUNICATION MODULE
118

FIG. 6B

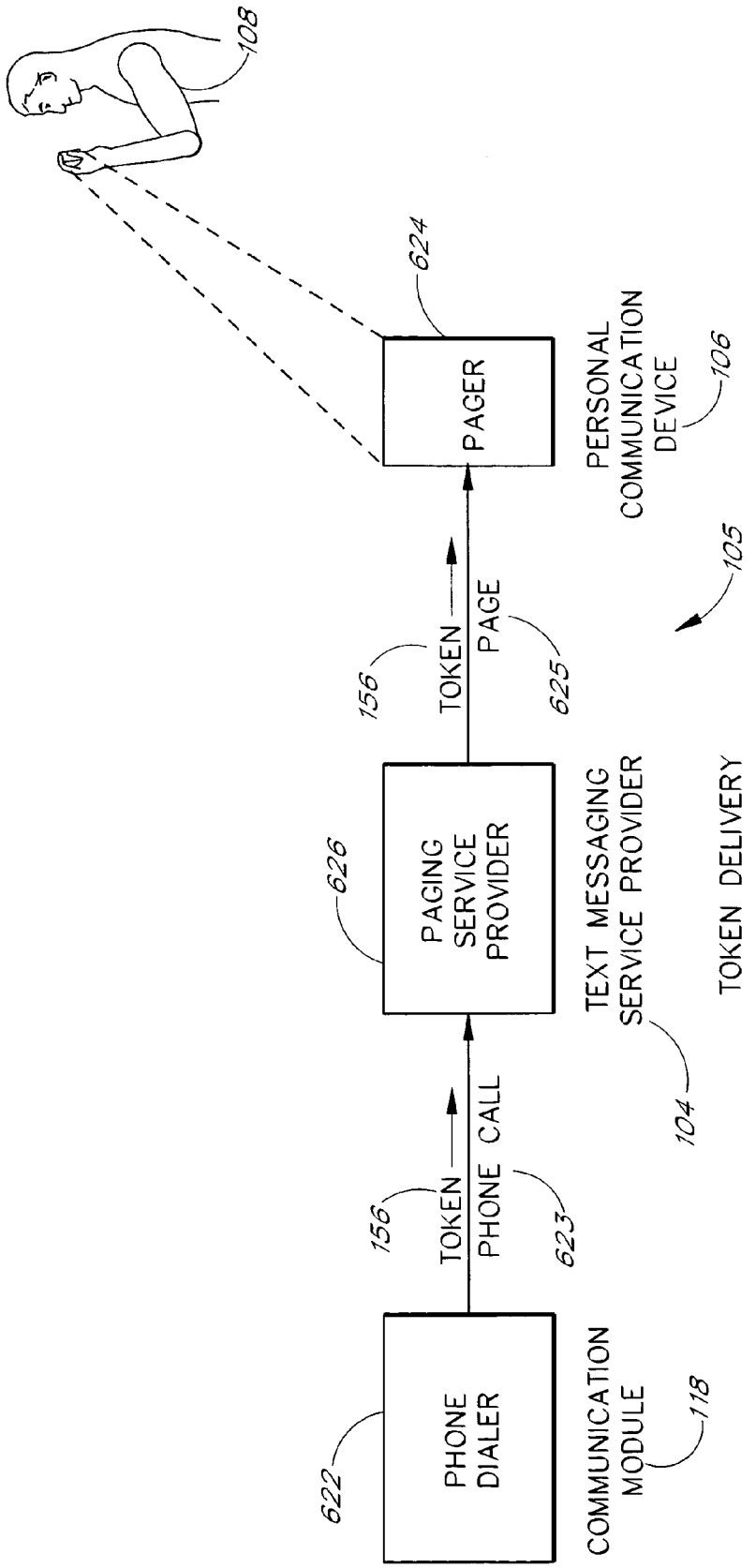

108
624
PAGER
PERSONAL COMMUNICATION DEVICE
106
105
156
TOKEN
PAGE
625
626
PAGING SERVICE PROVIDER
TEXT MESSAGING SERVICE PROVIDER
TOKEN DELIVERY
104
156
TOKEN
PHONE CALL
623
622
PHONE DIALER
COMMUNICATION MODULE
118

FIG. 6C

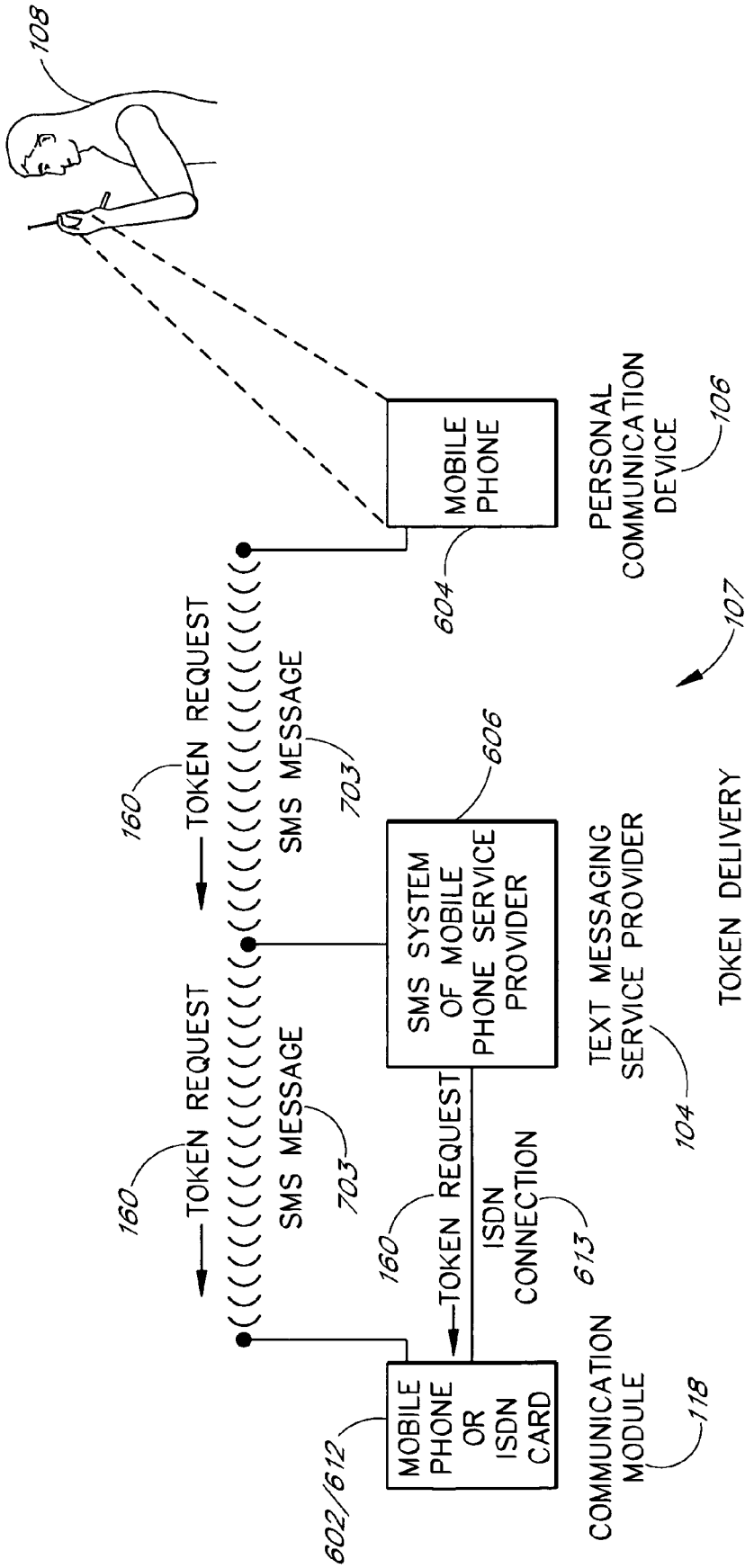

108
MOBILE PHONE
604
PERSONAL COMMUNICATION DEVICE
106
107
TOKEN REQUEST
160
SMS MESSAGE
703
606
SMS SYSTEM OF MOBILE PHONE SERVICE PROVIDER
TEXT MESSAGING SERVICE PROVIDER
104
TOKEN DELIVERY
TOKEN REQUEST
160
SMS MESSAGE
703
TOKEN REQUEST
160
ISDN CONNECTION
613
MOBILE PHONE OR ISDN CARD
602/612
COMMUNICATION MODULE
118

FIG. 7A

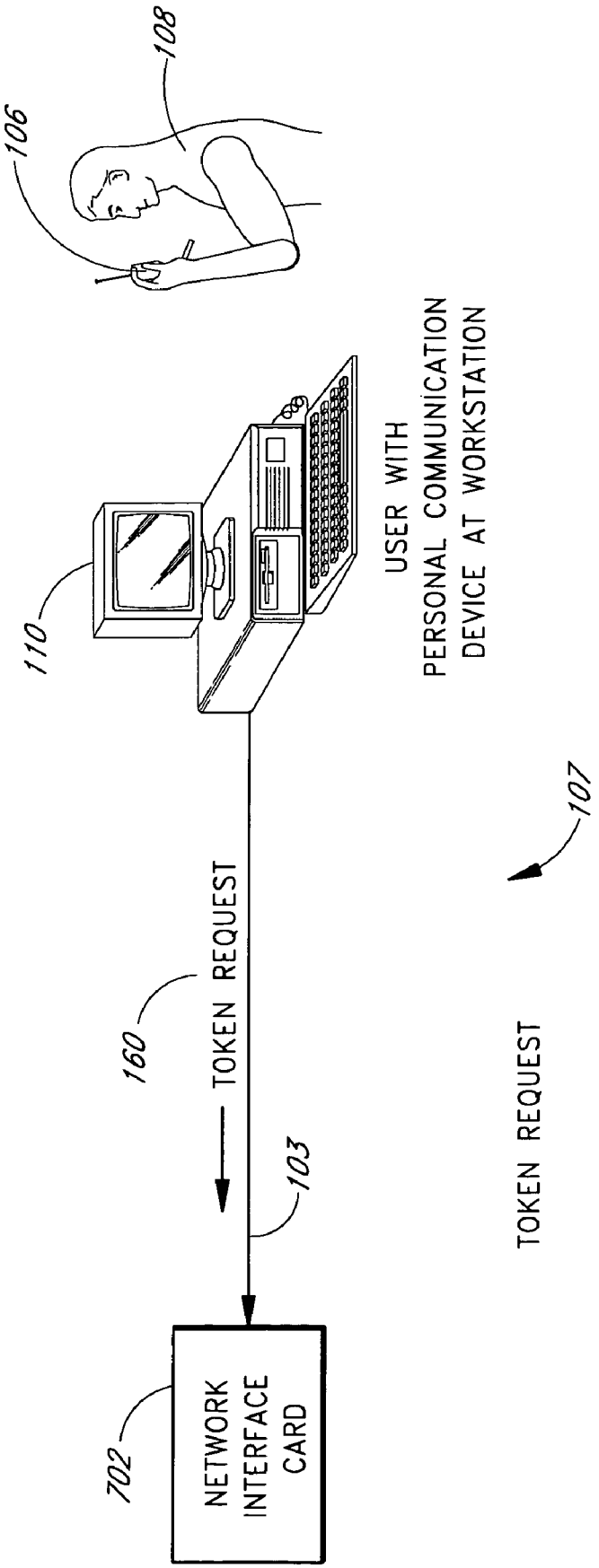

108
106
110
USER WITH
PERSONAL COMMUNICATION
DEVICE AT WORKSTATION
107
160
TOKEN REQUEST
103
TOKEN REQUEST
702
NETWORK
INTERFACE
CARD

FIG. 7B

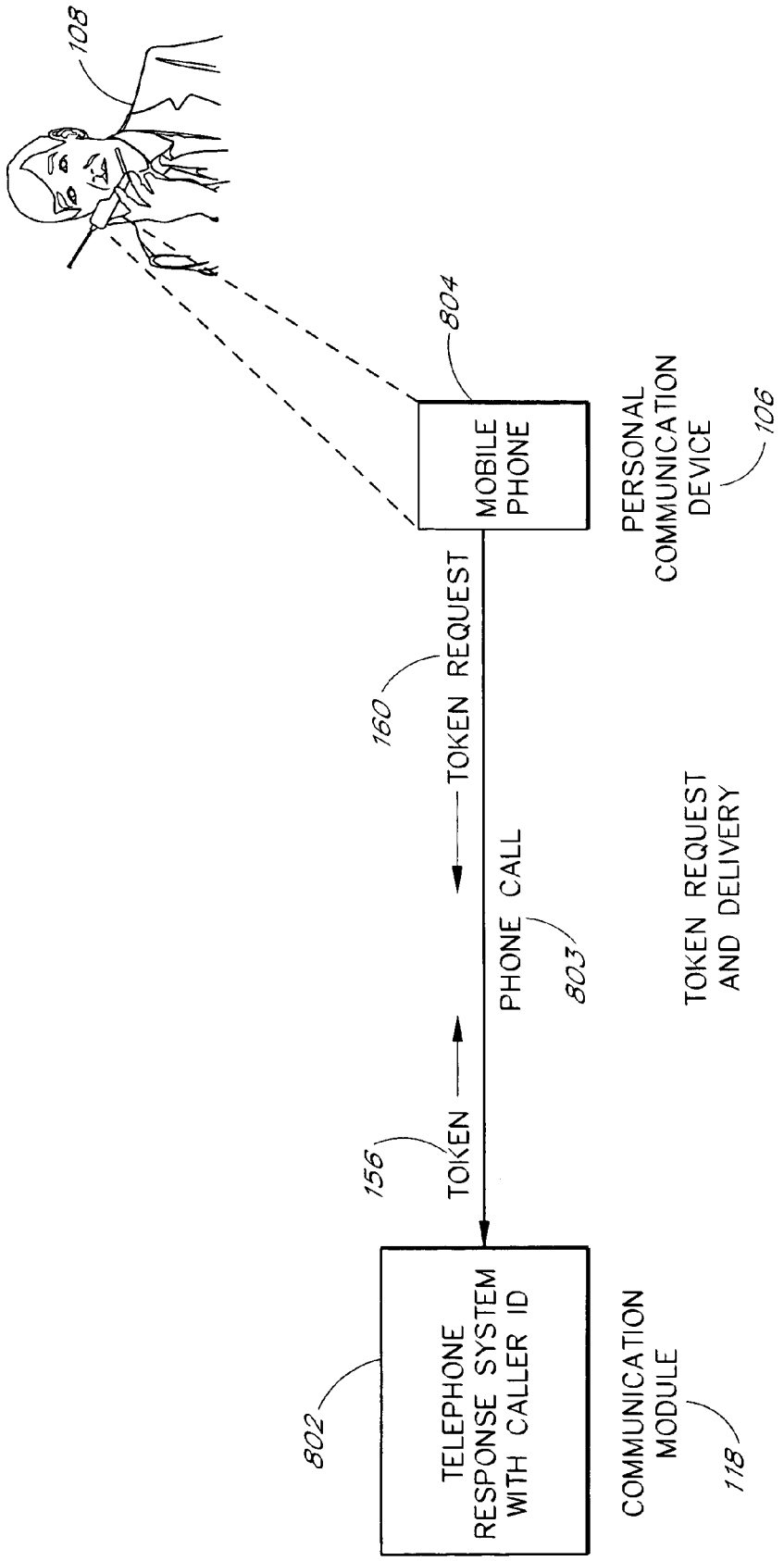

108
804
MOBILE PHONE
PERSONAL COMMUNICATION DEVICE
106
160
TOKEN REQUEST
PHONE CALL
803
TOKEN REQUEST AND DELIVERY
156
TOKEN
802
TELEPHONE RESPONSE SYSTEM WITH CALLER ID
COMMUNICATION MODULE
118

FIG. 8

USE OF PERSONAL COMMUNICATION DEVICES FOR USER AUTHENTICATION

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to the authentication of users of secure systems and, more particularly, the invention relates to a system through which user tokens required for user authentication are supplied through personal communication devices such as mobile telephones and pagers.

2. Description of the Related Art

Secure systems have traditionally utilized a user ID and password pair to identify and authenticate system users. Operating systems that control local area networks of workstations within a business or institution such as Novell NetWare, Microsoft NT, Windows 2000, and UNIX/Linux typically require submission of a user ID and password combination before allowing access to a workstation.

The incorporation of remote connectivity to secure systems over the Internet has weakened traditional controls imposed by a user's required physical presence within a company's premises and has exposed systems to additional security threats. External users accessing by dial-in or over the Internet, complicated by frequent personnel turnover, require frequent changes in password lists.

Passwords created by users are often combinations of words and names, which are easy to remember but also easily guessed. Guessing passwords is a frequent technique used by "hackers" to break into systems. Therefore, many systems impose regulations on password formats that require mixtures of letters of different cases and symbols and that no part of a password be a word in the dictionary. A user's inability to remember complex combinations of letters, numbers, and symbols often results in the password being written down, sometimes on a note stuck to the side of a workstation.

Present systems face several problems: users dread frequent password changes, frequent password changes with hard-to-remember passwords inevitably result in users surreptitiously writing down passwords, and security is compromised when users write down their passwords.

The SecurID product, which is distributed by RSA Security Inc., solves many of the aforementioned problems by requiring a two-factor authentication process. The first factor is a user passcode or personal identification number. The second factor is a SecurID card that is possessed by the user. The SecurID card generates and displays unpredictable, one-time-only access codes that automatically change every 60 seconds. The user supplies the displayed code upon logging into a system. The system has a corresponding code generator that allows verification of possession of the card.

The SecurID product, however, requires users to carry an additional item on their person in order to access a secure system. It would be advantageous if the benefits of the SecurID system could be achieved using a device that many users already carry—a personal communication device such as a mobile phone or a pager.

SUMMARY OF THE INVENTION

A preferred embodiment of the present invention is a password setting system for setting user passwords for a secure system, such as a computer system or a secure area of a building. The password setting system preferably includes a user token server and a communication module.

The user token server generates a random token in response to a request for a new password from a user. The server creates a new password by concatenating a secret passcode that is known to the user with the token. The server sets the password associated with the user's user ID to be the new password. The communication module transmits the token to a personal communication device, such as a mobile phone or a pager carried by the user. The user concatenates the secret passcode with the received token in order to form a valid password, which the user submits to gain access to the secure system. Accordingly, access to the system is based upon: nonsecret information known to the user, such as the user ID; secret information known to the user, such as the passcode; and information provided to the user through an object possessed by the user, such as the token.

One aspect of the invention is a method for setting passwords. The method includes associating a user ID with a phone number of a personal communication device. The method also includes generating a new password based at least upon a token. The method also includes setting a password associated with the user ID to be the new password. The method also includes transmitting the token to the personal communication device using the phone number associated with the user ID. In another aspect, the method also includes associating the user ID with a passcode. In another aspect, the new password is generated based additionally upon the passcode. In another aspect, the method also includes receiving a request for the user token. In another aspect, the personal communication device is a mobile phone. In another aspect, the personal communication device is a pager.

An additional aspect of the invention is a password setting system. The system includes a first user database configured to associate a user ID with a phone number of a personal communication device. The system also includes a control module configured to create a password based at least upon a token. The control module is further configured to cause a second user database to associate the password with the user ID. The system also includes a communication module interface configured to cause a communication module to transmit the token to the personal communication device using the phone number associated with the user ID. In another aspect, the first user database and the second user database are the same database. In another aspect, the first user database is further configured to associate the user ID with a passcode, and the control module is further configured to create the password based additionally upon the passcode.

An additional aspect of the invention is a method of regulating access to a secure system. The method includes transmitting a user token to a personal communication device. The method also includes receiving login data in response to a request for authentication information, wherein the login data is based at least upon the user token. The method also includes granting access to the secure system based upon the received login data. In another aspect, the login data is additionally based upon a user ID. In another aspect, the login data comprises a user ID. In another aspect, the login data is additionally based upon a passcode. In another aspect, the login data comprises a user ID and a password. In another aspect, the password comprises a passcode and the token. In another aspect, the password is a concatenation of the passcode and the token. In another aspect, the password is a hashed concatenation of the passcode and the token. In another aspect the method also includes generating the user token. In another aspect the method also includes receiving a request for the user token.

In another aspect, the personal communication device is a mobile phone. In another aspect, the personal communication device is a pager.

An additional aspect of the invention is an access control system. The system includes a user token server configured to transmit a token to a personal communication device. The user token server is further configured to generate a valid password based at least upon the token. The system also includes an authentication module configured to receive at least a submitted password in response to a request for authentication of a user. The authentication module is further configured to grant access to the user if at least the submitted password is based at least upon the token and matches the valid password. In another aspect, the user token server is further configured to generate the valid password based additionally upon a valid passcode that is known to the user. In another aspect, the user token server is further configured to transmit the token in response to a request by the user. In another aspect, the user token server is further configured to associate the valid password with a valid user ID, the authentication module is further configured to receive a submitted user ID in response to the request for authentication, and the authentication module is further configured to grant access to the user if, in addition, the submitted user ID matches the valid user ID.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described below in connection with the attached drawings in which:

FIG. **1** illustrates an overview, including system components, of a user authentication system according to a preferred embodiment of the present invention;

FIGS. **2**A–D illustrate login screens that can be used in conjunction with various embodiments of the invention;

FIG. **3** illustrates a preferred process performed by the system to authenticate users;

FIG. **4** illustrates a preferred embodiment of a user token server;

FIG. **5** illustrates a preferred process by which the user token server provides tokens and administrates user accounts;

FIGS. **6**A–C illustrate three embodiments of a token delivery communication link;

FIGS. **7**A–B illustrate two embodiments of a token request communication link; and

FIG. **8** illustrates an embodiment of a combined token request and delivery communication link.

DETAILED DESCRIPTION OF THE EMBODIMENTS

In the following description, reference is made to the accompanying drawings, which form a part hereof, and which show, by way of illustration, specific embodiments or processes in which the invention may be practiced. Where possible, the same reference numbers are used throughout the drawings to refer to the same or like components. In some instances, numerous specific details are set forth in order to provide a thorough understanding of the present invention. The present invention, however, may be practiced without the specific details or with certain alternative equivalent devices and methods to those described herein. In other instances, well-known methods and devices have not been described in detail so as not to unnecessarily obscure aspects of the present invention.

I. Overview and System Components

FIG. **1** illustrates an overview, including system components, of a user authentication system **100** according to a preferred embodiment of the present invention. FIG. **2**A illustrates a login screen that can be used in accordance with the preferred embodiment. FIGS. **2**B–D illustrate login screens that can be used in accordance with alternative embodiments.

The user authentication system **100** includes an authentication server **102**, a text messaging service provider **104**, a personal communication device **106** carried by a user **108**, and a secure system **110** to which the authentication system **100** regulates access. The personal communication device **106** is preferably a pager or a mobile phone having SMS (short message service) receive capability. SMS is a secure text messaging capability that is incorporated into most digital mobile phones. The secure system **110** is preferably a Windows NT computer workstation, but may be any system, device, account, or area to which it is desired to limit access to authenticated users. The secure system **110** may be, for example, a user account on a network of computer workstations, a user account on a web site, or a secure area of a building. The secure system **110** is preferably connected to the user authentication server **102** by a computer network **103**. In one embodiment, the user authentication server **102** is integrated into the secure system **110**.

The user authentication server **102** preferably includes a program or a suite of programs running on a computer system to perform user authentication services. The user authentication server **102** may also include the computer system and hardware upon which the programs run. The user authentication server **102** is preferably configured to require that the user **108** supply authentication information through the secure system **110** in order to gain access to the secure system **110**.

The authentication information preferably includes a user ID **152**, a passcode **154** and a user token **156**. The user **108** preferably commits to memory the user ID **152** and passcode **154**. The user ID **152** may be publicly known and used to identify the user **108**. The passcode **154** is preferably secret and only known to the user **108**. The token **156** is preferably provided only to the user **108** by the user authentication server **102** through the user's personal communication device **106** on an as needed basis. The token **156** preferably has a limited lifespan, such as 1 minute or 1 day. Accordingly, the user **108** needs to be in possession of his personal communication device **106** in order to gain access to the secure system **110**. Therefore, if the user's user ID **152** and passcode **154** are compromised, a malicious party still cannot access the secure system without possession of the personal communication device **106**.

In the preferred embodiment, the user **108** combines the token **156** with the passcode **154** to form a password **158**. For example, the user **108** can combine a valid, memorized passcode of "abcd" with a valid token of "1234" to form a valid password of "abcd1234." In this manner, a login screen such as is illustrated in FIG. **2**A, which is similar or identical to standard login screens that require a user ID **152** and a password **158**, can be used. In an alternative embodiment, the passcode **154** and the token **156** are submitted separately, as is illustrated in FIG. **2**B. In another embodiment, the passcode **154** is null in which case the token **156** alone is used as the password **158**. In still another embodiment, the token **156** can be requested through the secure system **110** as is illustrated in FIGS. **2**C–D.

The user authentication server **102** is preferably a secure system itself and may be a part or component of the secure

system **110**. The user authentication server **102** preferably includes an authentication module **112** and a user database **114**. The authentication module **112** is preferably identical to the code or software provided with operating systems such as Windows NT that authenticates users upon login. In alternative embodiments, the authentication module **112** may be any code, device, or module capable of authenticating a user based upon a supplied user ID **152** supplemented by a supplied password **158** or a passcode **154** and a token **156** combination. The authentication module **112** preferably responds to an authentication request transmitted over the computer network **103** by supplying an authentication confirmation **162** over the network **103**. If the user **108** has been authenticated, the confirmation **162** instructs the secure system **110** to allow access to the user **108**. The user database **114** is preferably similar or identical to the database accessed by the authentication module **112** that stores user ID and password data (or passcode and token data) in operating systems such as Windows NT. In alternative embodiments, the user database **114** can be any database capable of storing user ID and password data.

The user authentication server **102** preferably also includes a user token server **116** that responds to requests for tokens **160** by generating a token **156** and transmitting the token **156** to the user's personal communication device **106**. The user authentication server **102** preferably also resets passwords in the user database **114** based upon generated tokens and passcode data. The user authentication server **102** preferably transmits the tokens **156** over a token delivery communication link **105** to the user's personal communication device **106**.

The user authentication server **102** preferably also includes a communication module **118**, which is also part of the token delivery communication link **105**. The communication module **118** forwards tokens **156** to a text messaging service provider **104**, which may be a pager or mobile phone service provider. The text messaging service provider **104** then forwards the token **156** preferably in the form of a secure text message to the personal communication device **106**.

In the preferred embodiment, the communication module **118** is a mobile phone with SMS text messaging send capability. One applicable mobile phone is the presently available Ericsson T-**28**. The mobile phone **118** is preferably connected to the user authentication server **102** via a presently available serial port cable that makes the phone accessible in a manner similar to a computer modem. Accordingly, the user authentication server **102** can send tokens **156** via the server's mobile phone **118** to the user's mobile phone **106** using SMS. In this case, the server's mobile phone **118** transmits a message including the token **156** to the user's personal communication device **106** using the phone number of the user's personal communication device **106**. During the transmission, the message is relayed by the mobile phone service provider **104** to its final destination.

Preferably, the communication module **118** is also configured to receive requests for tokens **160**. The user preferably transmits a request for tokens **160** over a request communication link **107**. The request communication link **107** may be the same communication link as the delivery communication link **105** or it may be a different link. Various embodiments of the token delivery communication link **105** and the token request communication link **107** will be discussed in Section III below.

In the preferred embodiment, the communication module **118** is a mobile phone that also has SMS text messaging receive capability. The communication module **118** receives an SMS message from the user's mobile SMS send enabled mobile phone **106**, and the token server **116** preferably processes the message as a token request **160**. The incoming SMS message is tagged with the sending phone's phone number, which the user token server **116** can use to identify the requesting user and respond with a new token **156**. The token request **160** may also be in the form of a phone call, in which case the user token server **116** may use a caller ID feature to identify the calling phone number as a valid user's personal communication device **106**. The user token server **116** can then respond with a new token **156**. Alternatively, the user token server **116** may allow a calling user **108** to enter the phone number of his personal communication device **106** using the mobile phone keypad once a connection has been established.

In an alternative embodiment, the communication module **118** is an ISDN card that is connected to the text messaging service provider **104** preferably via an X.25 connection. The ISDN card **118** preferably transmits new tokens directly to the text messaging service provider **104** for forwarding to the user's personal communication device **106**. The ISDN card **118** may also be configured to be accessible at a phone number to receive calls for requests for tokens **160**.

FIG. **3** illustrates a preferred process **300** performed by the system **100** to authenticate users. At a step **302**, the user **108** requests a token from the user token server **116** through the token request communication link **107**. In the preferred embodiment, the user's mobile phone **106** has SMS send capability and the user sends an SMS message to the communication module **118** requesting a new token **156**. The SMS message need not contain any data in its body since the phone number of the sending mobile phone is automatically sent along with the message. The user token server **116** preferably identifies the user's mobile phone **106** based upon the phone number with which the SMS message is tagged. In an alternative embodiment, the user **108** makes a phone call with his personal communication device **106** to the communication module **118**. The user token server **116** identifies the user's personal communication device **106** preferably based upon a caller ID feature. Alternatively, the user **108** may call from any phone and enter in the phone number of his personal communication device **106**. As another alternative, the user **108** may request the token **156** through the secure system **110** itself as illustrated in FIGS. **2**C–D. As another alternative, the step **302** may be omitted altogether. In this case, the user token server **116** can automatically send tokens **156** to the user **108** at predetermined intervals, such as once per day where the tokens have a lifespan of one day.

At a step **304** the user token server **116** generates a token **156**. The token **156** may be generated by any of a number of methods that preferably produces a random or pseudo-random sequence of numbers and/or digits. The token **156** is preferably long enough such that it cannot be guessed, but short enough such that it is relatively easy to enter, such as six to eight characters.

At a step **306**, the token server **116** generates a new password **158**. The token server **116** preferably creates the new password **158** by combining the user's passcode **154**, which is stored by the user token server **116**, with the newly generated token **156**. At a step **308**, the token server updates the user database **114** with the new password **158**. In the case that the user's account in the user database **114** is inactive or deactivated, the token server **116** activates the user's account.

In the preferred embodiment, the token server creates a hash of the password **158** and stores the hash of the password **158** in the user database **114** rather than storing the password **158** itself. The hash is typically performed using a one-way hashing algorithm where the same password always produces the same hash, but where the password cannot be determined from the hash. In typical systems, passwords **158** are stored as hashes rather than as plain text in order to prevent system administrators and others from being able to determine users' passwords by examining the user database **114**. Also, when a user **108** submits a password **158** upon login to a secure system **110**, the submitted password **158** is immediately hashed using the same one-way hashing algorithm before transmission to the authentication module **112**. The authentication module **112** then compares hashes of passwords rather than the passwords themselves to authenticate the user **108**. In this manner, passwords **158** need not be transmitted over any communication links or computer networks as clear text. It will be apparent to one skilled in the art that the present invention can be implemented with or without the hashing of passwords and that incorporating hashing of passwords does not substantively affect the scope or spirit of the invention. So as not to unnecessarily obscure aspects of the present invention, a password as referred to herein may be an unhashed or a hashed password. For example, a receipt of a password may be a receipt of an unhashed or hashed password, and a comparison of passwords may be a comparison of unhashed or hashed passwords.

At a step **310**, the token server **116** transmits the token **156** to the user's personal communication device **106** via the token delivery communication link **105**. In the preferred embodiment, the communication module **118** is a mobile phone, and the user token server **116** uses the SMS send capability of the phone **118** to send an SMS message including the token **156** to the user's personal communication module **106**. At a step **312**, the user **108** receives the token through his personal communication device **106**.

At a step **314**, the user **108** logs into the secure system **110** using the user ID **152** and the password **158**. In the preferred embodiment, the user **108** combines the passcode **154** and the token **156** by concatenation to form the password **158**. In an alternative embodiment, the passcode **154** and the token **156** are submitted separately.

At a step **316**, the secure system **110** transmits login data **159** to the user authentication server **102** over the computer network **103** for authentication of the user **108**. The login data **159** preferably includes the user ID **152** and a hash of the password **158** that the secure system **110** creates in order to avoid sending the password **158** over the computer network **103** in clear text. Alternatively, the login data **159** may include a hash of the passcode **154** and the token **156**. As another alternative, the password **158**, or the passcode **154** and token **156** are not hashed.

At a step **318**, the user authentication server **102** authenticates the user **108** based upon the login data **159**. In order to authenticate the user **108**, the authentication server **102** preferably compares the login data to the password **158** (hashed or unhashed) or the passcode **154** and token **156** (hashed or unhashed) corresponding to the user ID **152** stored in the user database **114**.

At a step **320**, the user authentication server **102** transmits an authentication confirmation **162** to the secure system **110**. At a step **322**, the secure system **110** allows the user **108** access based upon the authentication confirmation **162**.

II. The User Token Server

FIG. **4** illustrates a preferred embodiment of the user token server **116**. The user token server **116** preferably includes a process or program running on or in conjunction with the user authentication server **102**. The user token server **116** may, however, include a computer upon which the process or program executes. The user token server **116** preferably includes a control module **402**, a supplemental user database **404**, a communication module interface **406**, and a token generation module **408**. The various modules and components of the user token server **116** are described herein from a functional perspective. The various functional components may, however, be seamlessly integrated into one or more executable programs, data structures, and/or physical components.

The control module **402** preferably serves as the top level component of the user token server **116**. The control module **402** preferably handles any tasks or functions not handled by the other modules of the token server **116**, in addition to controlling the other modules. The control module **402** preferably maintains a supplemental user database **404**, which preferably stores associations of user IDs with passcodes, phone numbers of users' personal communication devices, and any other supplemental user data. The other supplemental user data may include one or more of: whether an account is active, the expiration time of passwords, and the frequency with which tokens may be automatically distributed. The supplemental user database **404** is preferably accessed and modified through an administrator user interface **403** provided by the control module **402**. The administrator user interface **403** allows administration of user privileges by adding, modifying and removing user IDs, passcodes, and phone numbers from the supplemental user database **404**.

In the preferred embodiment, the supplemental user database **404** is maintained separately from the user database **114** of the user authentication server **102**. In this configuration, the user database **114** supplied with an OEM system need not be modified or reconfigured. The user token server **116** can be added to existing secure systems in order to provide additional security functionality. In an alternative embodiment, the supplemental user database **404** may be integrated into the user database **114**. In this case, user authentication module **102** is preferably configured and supplied as a single integrated component.

FIG. **5** illustrates a preferred process **500** by which the user token server **116** provides tokens **156** and administers user accounts. The process **500** is described below in conjunction with the description of the functionality of the various modules and components of the user token server **116**.

At a step **502**, the control module **402** associates a user ID with a passcode **154** and a phone number of a user's personal communication device **106**. Upon initially setting up an account, the association can be performed manually by a system administrator through the administrator user interface **403**. The administrator user interface **403** preferably solicits a desired user ID **152**, passcode **154**, and phone number from a system administrator. The control module **402** then preferably creates a deactivated user account with a user ID **152** for the secure system **110** on the user database **114** of the user authentication server **102**. The control module **402** preferably accesses the user database **114** using an application program interface (API) (not illustrated), which is typically provided with OEM systems. The control module **402** also preferably creates an entry in the supple-

mental user database **404** including the user ID **152**, the passcode **154**, and the phone number.

At a step **504**, the user token server **116** receives a token request **160** from the user **108**, possibly in order to activate his deactivated account. The token request **160** is preferably received through the communication module **118**, which the control module **402** preferably controls through a communication module interface **406**. The communication module interface **406** is preferably a device driver tailored for the specific implementation of the communication module **118**. In alternative embodiments, the user may request the token **156** through the secure system **110** itself, as illustrated in FIGS. **2**C–D. In this case, the request **160** may be received through the computer network **103**.

At a step **506**, the control module **402** associates the token request **160** with a valid user ID **152**. The control module **402** may make this association based upon a supplied phone number by querying the supplemental user database **404**. In one embodiment, if the user ID **152** is supplied in conjunction with the request **160**, the step **506** is not performed.

At a step **508**, the token generation module **408** generates a token by a method that produces a random or pseudo-random sequence of numbers or digits or both numbers and digits. Many methods are presently known for producing such random sequences. The token generation module **408** preferably passes the newly generated token **156** to the control module **402**.

At a step **510**, the control module **402** generates a new password **158** based upon the generated token **156** and the passcode **154** associated with the user ID **152** as listed in the supplemental user database **404**. The new password **158** is preferably generated by concatenating the passcode **154** and the token **156**.

At a step **512**, the control module **402** sets or resets the password associated with the user ID **152** in the user database **114**. In the preferred embodiment, the control module **402** sets the password to be a one-way hash of the newly generated password **158**. In alternative embodiments, the password **158** need not be hashed. In the case the user's account has been deactivated, the control module **402** activates the user ID **152** in the user database **114**. The control module **402** preferably accesses the user database **114** through the database API (not illustrated).

At a step **514**, the control module **402** transmits the token **156** to the user's personal communication device **106** preferably based upon the phone number associated with the user ID **152** in the supplemental user database **404**. In the preferred embodiment, the control module **402** causes the communication module **118** to generate and send an SMS message containing the token **156** to the user's mobile phone. In an alternative embodiment, the communication module **118** may call the phone number of the user's pager and transmit the token **156** as the page data.

At a step **516**, the user **108** is able to access the secure system **110** by logging in using the supplied token **156**. The user **108** preferably concatenates his memorized secret passcode **154** with the valid token **156** to create the password **158**. The user then logs in using his user ID **152** and the password **158**.

At a step **518**, if the token has an expiry time, the token **156** expires. At a step **520**, upon expiration of the token **156**, the control module **402** deactivates the user account in the user database **114**.

Finally, the process **500** repetitively continues either from the step **502**, if a new user **108** is to be added, or from the step **504** if an existing user **108** requests a token **156**.

III. Token Delivery and Request Communication Links

FIGS. **6**A–C illustrate three embodiments of the token delivery communication link **105**. FIGS. **7**A–B illustrate two embodiments of the token request communication link **107**. In some embodiments, the same communication link may be used as the token delivery communication link **105** and the token request communication link **107**. FIG. **8** illustrates an embodiment of a combined token request and delivery communication link that can function in conjunction with a mobile phone without text messaging capability. Additionally, communication technologies other than those illustrated here by example may be used to implement the communication links **105** and **107**.

FIG. **6**A illustrates a preferred embodiment of the token delivery communication link **105**. The communication module **118** is a mobile phone **602** with SMS send capability. The mobile phone **602** sends an SMS message **603** including the token **156** to the user's mobile phone **604**. While in transit, the message **603** is received and retransmitted by the SMS system **606** of a mobile phone service provider.

FIG. **6**B illustrates a first alternative embodiment of the token delivery communication link **105**. In this case, the communication module **118** is an ISDN card or an X.25 connection card **612** that connects to an SMS gateway **616** of a mobile phone service provider via an ISDN or X.25 connection **613**. The card **612** transmits the token **156** to the SMS gateway **616**, which then creates an SMS message **615** and transmits the message **615** to the user's mobile phone **614**.

FIG. **6**C illustrates a second alternative embodiment of the token delivery communication link **105**. In this case, the communication module **118** is a phone dialer **622**, the personal communication device **106** is a pager **624**, and the text messaging service provider is a paging service **626**. In order to transmit a token **156**, the phone dialer **622** places a phone call **623** to the phone number of the user's pager **624**. The paging service provider **626** answers and the phone dialer **622** enters a numeric token **156** to be transmitted to the pager **624**. The paging service provider **626**, in turn, sends a page **625** containing the token **156** to the user's pager **624**.

FIG. **7**A illustrates a preferred embodiment of the token request communication link **107**. The personal communication device **106** is preferably the mobile phone **604**, the communication module **118** is preferably the mobile phone **602**, and the text messaging service provider **104** is preferably the SMS system **606** of the preferred embodiment of the token delivery communication link **105** (FIG. **6**A). Alternatively, the communication module **118** may be the ISDN card or X.25 connection card **612** connected through the ISDN or X.25 connection **613** as in the first alternative embodiment of the token delivery communication link **105** (FIG. **6**B). The mobile phone **604** preferably sends an SMS message **703** as a token request **160** to the mobile phone **602** or the ISDN card **612**. The SMS message **703** may have a blank message body but the message preferably includes the sending phone's phone number in a tag or header field. While in transit, the message **603** is received and retransmitted by the SMS system **606**. The user token server **116** preferably identifies the sending phone's phone number, and if the phone number matches a valid user ID **152**, the token server **116** processes the message **703** as a token request **160**.

FIG. **7**B illustrates a first alternative embodiment of the token request communication link **107** in accordance with the token request and login screens of FIGS. **2**C–D. The user **108** makes the token request **160** through a first login screen (FIG. **2**C) on the secure system **110**. The token request **160**

in this case preferably includes the user's user ID **152** and is preferably transmitted through the computer network **103** to the user token server **116** through a network interface card **702**. In this case, the token request **160** need not be communicated through the communication module **118**. Also, the personal communication device **106** need not be used in requesting the token **156** but is preferably used in delivering the token **156**.

FIG. **8** illustrates a combined token request and delivery link in which the personal communication device **106** is preferably a mobile phone. The communication module **118** is preferably an automated telephone response system **802** with a caller ID capability. The user **108** places a phone call **803** to the telephone response system **802**, which identifies the calling phone **804** using caller ID. The telephone response system **802** interprets the call as a token request **160** and responds by generating a voice synthesized recitation of the token **156** that the user hears through the mobile phone **804**. The mobile phone **804**, in this case, need not have any text messaging or SMS capability.

In still other embodiments, various other technologies and combinations of technologies, which will be apparent to one skilled in the art, can be used to implement the token delivery **105** and token request **107** communication links. For example, a token request may be made through a land line phone, and in response, a token may be delivered to a mobile phone.

IV. Conclusion

Although the invention has been described in terms of certain preferred embodiments, other embodiments that are apparent to those of ordinary skill in the art, including embodiments which do not provide all of the features and advantages set forth herein, are also within the scope of this invention. Accordingly, the scope of the invention is defined by the claims that follow. In the claims, a portion shall include greater than none and up to the whole of a thing; encryption of a thing shall include encryption of a portion of the thing; a password may be an unhashed or a hashed password. In the method claims, reference characters are used for convenience of description only, and do not indicate a particular order for performing the method.

What is claimed is:

1. A method of authenticating a user on a first secure computer network, the user having a user account on said first secure computer network, the method comprising:

associating the user with a personal communication device possessed by the user, said personal communication device in communication over a second network, wherein said second network is a cell phone network different from the first secure computer network;

receiving a request from the user for a token via the personal communication device, over the second network;

generating a new password for said first secure computer network based at least upon the token and a passcode, wherein the token is not known to the user and wherein the passcode is known to the user;

setting a password associated with the user to be the new password;

activating access the user account on the first secure computer network;

transmitting the token to the personal communication device;

receiving the password from the user via the first secure computer network; and

deactivating access to the user account on the first secure computer network within a predetermined amount of time after said activating, such that said user account is not accessible through any password, via said first secure computer network.

2. The method of claim **1**, wherein the new password is generated by concatenating the token and the passcode.

3. The method of claim **1**, wherein the personal communication device is a mobile phone.

4. The method of claim **1**, wherein the personal communication device is a pager.

5. A user authentication system comprising:

a computer processor;

a user database configured to associate a user with a personal communication device possessed by the user, said personal communication device configured to communicate over a cell phone network with the user authentication system;

a control module executed on the computer processor configured to create a new password based at least upon a token and a passcode, wherein the token is not known to the user and wherein the passcode is known to the user, the control module further configured to set a password associated with the user to be the new password;

a communication module configured to transmit the token to the personal communication device through the cell phone network; and

an authentication module configured to receive the password from the user through a secure computer network, said secure computer network being different from the cell phone network, wherein the user has an account on the secure computer network, wherein the authentication module activates access to the account in response to the password and deactivates the account within a predetermined amount of time after activating the account, such that said account is not accessible through any password via the secure computer network.

6. The system of claim **5**, wherein the communication module is further configured to receive a request from the user for the token, and wherein the control module is further configured to create the new password in response to the request.

7. The system of claim **6**, wherein the request is transmitted by the user through the personal communication device.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 6,993,658 B1
APPLICATION NO. : 09/519829
DATED : January 31, 2006
INVENTOR(S) : Engberg et al.

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

On Title Page

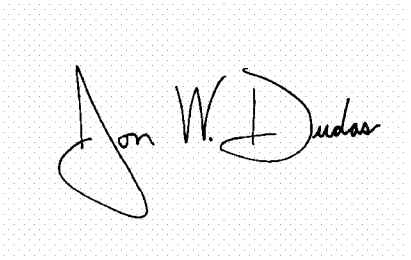
Item 56 Sheet 1 of 1 List of References cited by applicant and considered by examiner, Entry 1, line 1 (Other Documents), Page 2, Column 1 (Other Publications), delete "computerterps" and insert -- computerps --.

Item 56 Sheet 1 of List of References cited by applicant and considered by examiner, Entry 1, line 1 (Other Documents), Page 2, Column 1 (Other Publications), delete "html," and insert -- html.--

Item 56 Sheet 1 of List of References cited by applicant and considered by examiner, Entry 3, line 1 (Other Documents), Page 2, Column 2 (Other Publications), delete "Authenication" and insert -- Authentication --.

Signed and Sealed this

Third Day of April, 2007



JON W. DUDAS
Director of the United States Patent and Trademark Office