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(54) SYSTEM AND METHOD FOR HIGHLY RELIABLE MULTI-FACTOR AUTHENTICATION

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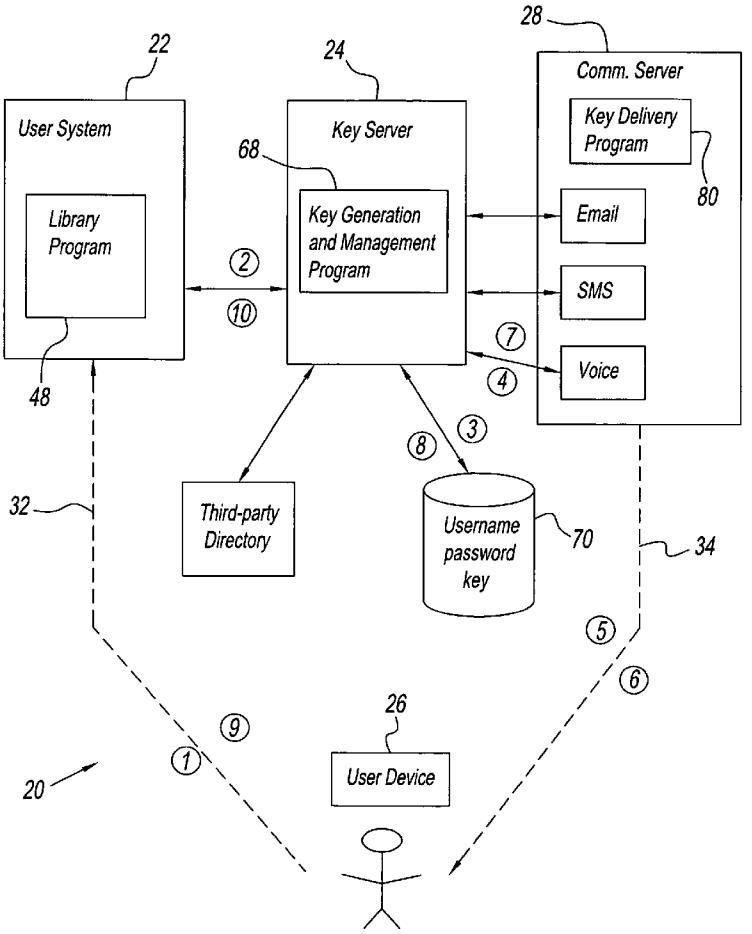
(57) **ABSTRACT**

A system and method for authenticating an online user by using different and independent communication services to enhance security. A key server validates the factors of authentication, namely a first factor (username/password) and a second factor (key). The key server generates and sends the key to the user with a different and independent communication service, e.g., telephone, SMS or email. The user then submits the key using the online communication service. A third factor, e.g., a second password or a biometric symbol of the user, can also be used. Validation of the biometric symbol can be a prerequisite to delivery of the key to the user. A plurality of the independent services can be daisy-chained.



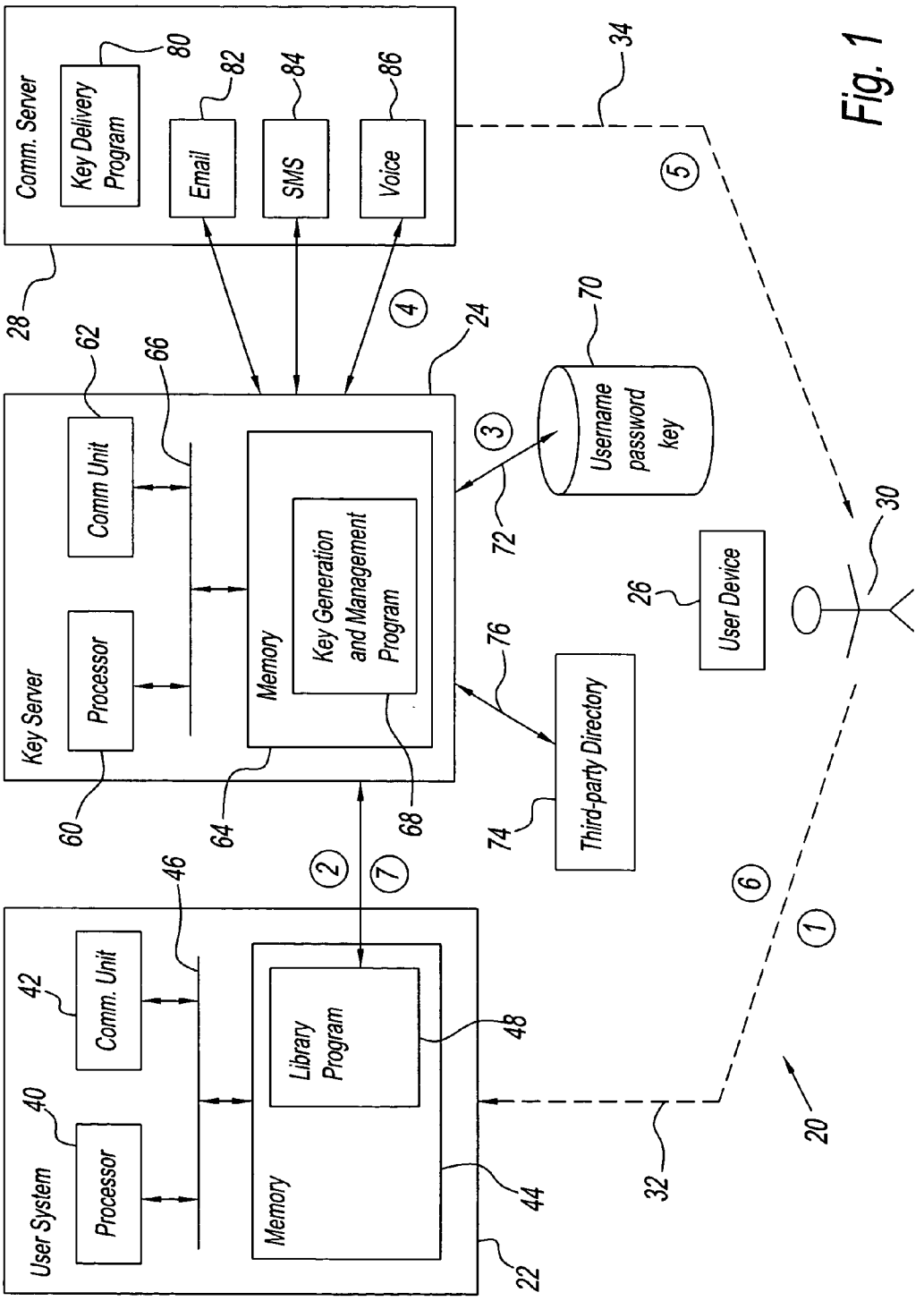

Comm. Server
Key Delivery Program
80
Email
82
SMS
84
Voice
86
34
28
62
66
24
70
Comm Unit
Key Server
Processor
Memory
Key Generation and Management Program
Username password key
72
60
64
68
74
Third-party Directory
76
26
User Device
30
User System
Comm. Unit
42
46
Processor
40
Library Program
48
Memory
44
22
32
20
1
2
3
4
5
6
7

Fig. 1

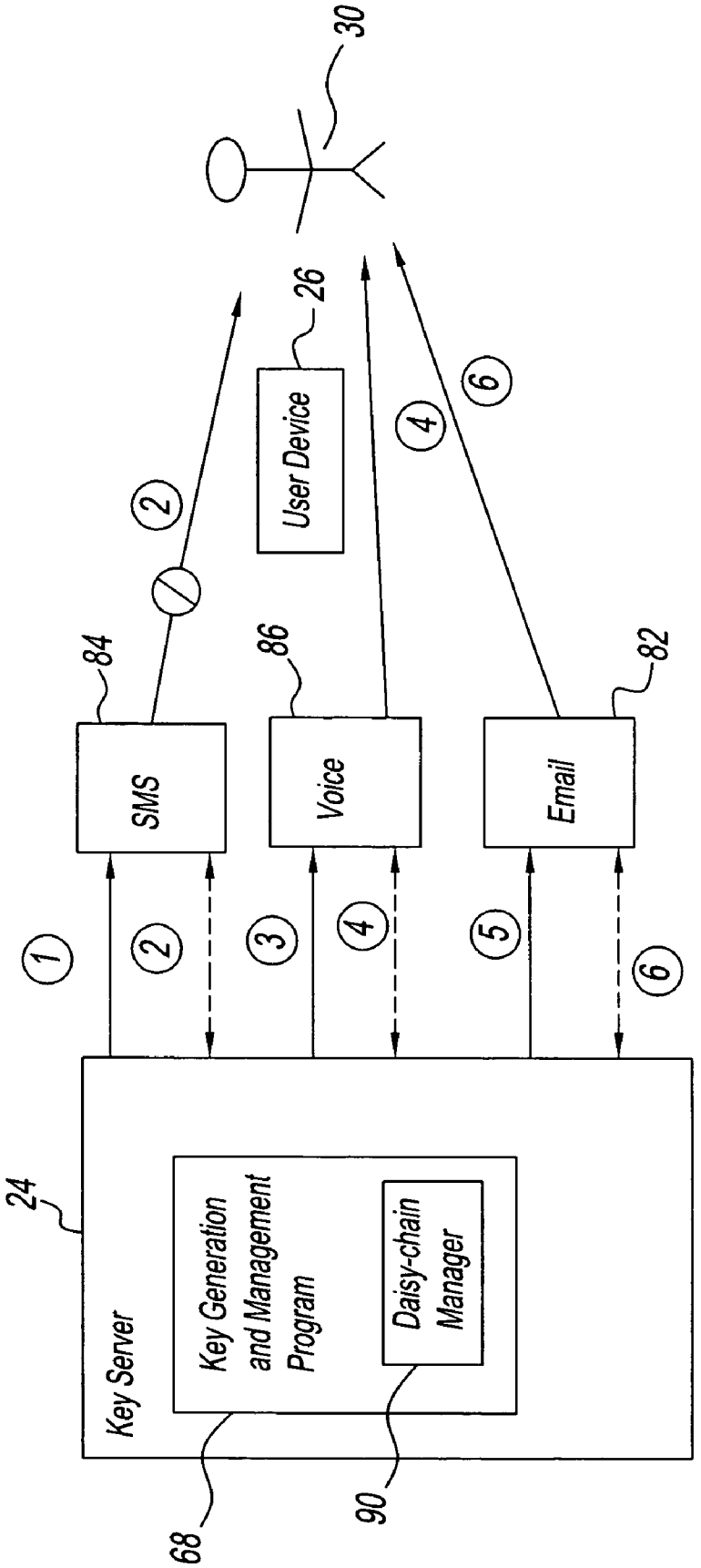

30
26
User Device
2
4
6
84
86
82
SMS
Voice
Email
1
2
3
4
5
6
24
Key Server
Key Generation and Management Program
Daisy-chain Manager
68
90

Fig. 2

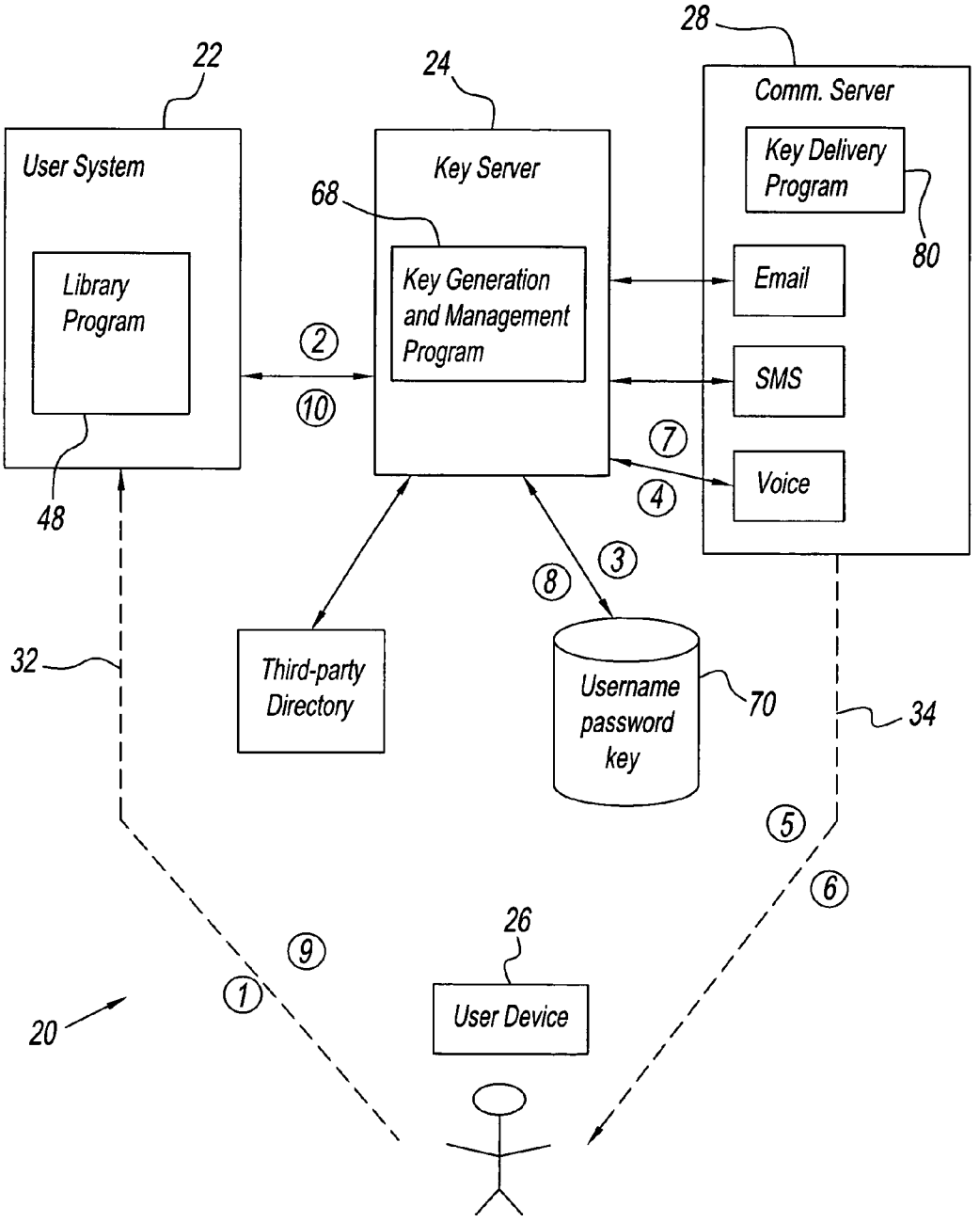

28
22
24
Comm. Server
User System
Key Server
Key Delivery Program
68
80
Library Program
Key Generation and Management Program
Email
2
10
SMS
7
Voice
4
48
3
8
32
Third-party Directory
Username password key
70
34
5
6
26
9
1
User Device
20

Fig. 3

SYSTEM AND METHOD FOR HIGHLY RELIABLE MULTI-FACTOR AUTHENTICATION

RELATED APPLICATION

[0001] This application claims the benefit of U.S. Provisional Patent Application, Ser. No. 60/700,506, filed Jul. 19, 2005, the entire contents of which are hereby incorporated by reference.

FIELD OF THE INVENTION

[0002] The present disclosure generally relates to multi-factor authentication of an on-line user and, in particular, to a system and method that employs two or more different and independent communication services.

BACKGROUND OF THE INVENTION

[0003] Multi-factor authentication is used to ensure that a person accessing a computer system is the person they claim to be by presenting multiple credentials of different types. Single-factor authentication requires the presentation of a datum known by the individual (e.g., a password, a user name or both). Two-factor authentication requires the additional presentation of something the user possesses (e.g., a key generated by a device).

[0004] For the sake of the present description, the term "fob" will mean any physical device capable of generating a one-time, expiring key. The fob could be a classic key-chain, a card or software designed to execute on a particular mobile phone, etc. Two-factor authentication with fob-based keys for the second factor was initially used by only very secure computing facilities. Today it is used to protect many corporate networks against phishing, identity theft and other intrusive activities. In classic two-factor authentication, the first factor is something the user knows, e.g., a password or pass phrase. The second factor is something the user has, the fob-based key that generates and displays information synchronized with a central server, usually an alpha-numeric key that changes periodically. An IP provider has recently adopted two-factor authentication that gives users the option of using fobs to protect their accounts.

[0005] As the price of implementing multi-factor authentication decreases, it will be adopted by more and more of the institutions with which we interact on a daily basis. How long will it be before the average professional has to carry around a dozen fobs?

[0006] There is a need for authentication with high level security.

[0007] There is also a need to eliminate the use of fobs used to provide the second authentication factor.

SUMMARY OF THE INVENTION

[0008] A system of the present disclosure authenticates a user with a computer that receives a first factor and a third factor that are sent by the user using a first communication service and a second communication service, respectively. The computer comprises a program that generates a second factor, validates the first and third factors, then causes the second factor to be sent to the user using the second communication service and after receipt of the second factor sent by the user using the first communication service authenticates the user by validating the second factor.

[0009] In one embodiment of the system of the present disclosure, the first and third factors are different from one another.

[0010] In another embodiment of the system of the present disclosure, the first and third factors are selected from the group consisting of: password, pass phrase, username and any combination thereof.

[0011] In another embodiment of the system of the present disclosure, the third factor is a biometric symbol of the user. Preferably, the biometric symbol is selected from the group consisting of: a voiceprint, an iris scan, a fingerprint, a photograph or other symbol of a physical part of the user.

[0012] In another embodiment of the system of the present disclosure, the first communication service is an online service.

[0013] In another embodiment of the system of the present disclosure, the second communication service is selected from the group consisting of: SMS, telephone (land line or cellular) and page.

[0014] In another embodiment of the system of the present disclosure, the second factor comprises one or more series of alphabetic characters, numeric characters or both.

[0015] In another embodiment of the system of the present disclosure, the program validates the first and third factors by comparison with a repository of personal data of the user.

[0016] The method of the present disclosure authenticates a user by using a computer to perform the steps of:

[0017] receiving a first factor and a third factor that are sent by the user using a first communication service and a second communication service, respectively;

[0018] generating a second factor;

[0019] validating the first and third factors;

[0020] then causing the second factor to be sent to the user using the second communication service; and

[0021] after receipt of the second factor sent by the user using the first communication service, authenticating the user by validating the second factor.

[0022] In one embodiment of the method of the present disclosure the first and third factors are different from one another.

[0023] In another embodiment of the method of the present disclosure, the first and third factors are selected from the group consisting of: password, pass phrase, username and any combination thereof.

[0024] In another embodiment of the method of the present disclosure, the third factor is a biometric symbol of the user. Preferably, the biometric symbol is selected from the group consisting of: a voiceprint, an iris scan, a fingerprint, a photograph and other symbol of a physical part of the user.

[0025] In another embodiment of the method of the present disclosure, the first communication service is an online service.

[0026] In another embodiment of the method of the present disclosure, the second communication service is selected from the group consisting of: SMS, telephone (land line or cellular) and page.

[0027] In another embodiment of the method of the present disclosure, the second factor comprises one or more series of alphabetic characters, numeric characters or both.

[0028] In another embodiment of the method of the present disclosure, the program validates the first and third factors by comparison with a repository of personal data of the user.

[0029] In another embodiment of the system of the present disclosure, a computer validates a user of an online service using a first factor and a second factor. The computer sends the second factor to the user using an order of communication services other than the online service for delivery of the second factor to the user. If there is a failure of delivery in a first communication service used in the order, the computer sends the second factor to the user using one of the communication services that is second in the order.

[0030] In another embodiment of the system of the present disclosure, the first and second communication services are different than and independent of one another and the online service.

[0031] In another embodiment of the system of the present disclosure, the computer automatically uses the second communication service without any input from the user.

[0032] In another embodiment of the system of the present disclosure, the communication service is a member of the group consisting of: SMS, email and telephone.

[0033] In another embodiment of the system of the present disclosure, the computer authenticates the user using the first factor, the second factor and a third factor. The first factor is a first password and/or username, the second factor is a key and the third factor is a second password.

[0034] In another embodiment of the method of the present disclosure, a user of an online service is authenticated by using a computer to perform steps comprising:

[0035] validating the user using a first factor and a second factor,

[0036] sending the second factor to the user using an order of communication services other than the online service for delivery of the second factor to the user; and

[0037] if there is a failure of delivery in a first communication service used in the order, sending the key to the user using one of the communication services that is second in the order.

[0038] In another embodiment of the method of the present disclosure, the first and second communication services are different than and independent of one another and the online service.

[0039] In another embodiment of the method of the present disclosure, the second communication service automatically sends the second factor without any input from the user.

[0040] In another embodiment of the method of the present disclosure, the communication service is a member of the group consisting of: SMS, email and telephone.

[0041] In another embodiment of the method of the present disclosure, the user is further validated using a third factor. The first factor is a first password and/or username. The second factor is a key and the third factor is a second password.

BRIEF DESCRIPTION OF THE DRAWINGS

[0042] Other and further objects, advantages and features of the present disclosure will be understood by reference to the following specification in conjunction with the accompanying drawings, in which like reference characters denote like elements of structure and:

[0043] FIG. **1** is a schematic representation of a two-factor authentication with two or more communication services according to the present disclosure;

[0044] FIG. **2** is a schematic representation of chained key delivery in the face of delivery failure of the system of FIG. **1**; and

[0045] FIG. **3** is a schematic representation of a three-factor authentication using two or more communication services according to the present disclosure.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0046] The system and method of the present disclosure provides multi-factor authentication to ensure that a person accessing a computer system is the person they claim to be by presenting multiple credentials of different types. Single-factor authentication requires the presentation of a datum known by the individual (e.g., a password, a user name or both). Two-factor authentication requires the additional presentation of something the user possesses (e.g., a key generated by a device). Three-factor authentication, in one embodiment, requires the user to present some physical part of themselves (e.g., a voiceprint, an iris scan, a fingerprint, a photograph or other biometric symbol).

[0047] The system and method of the present disclosure provides authentication with security for an online transaction in which a user enters a username and password using an online service. The security is enhanced by using two or more communication services the user already has available, e.g., an email account, an SMS account or a telephone to deliver a key to the user. This key comprises a computer recognizable expression, e.g., one or more series of alphanumeric characters. This key has an expiration date. This key is the second factor is sent to one of the user's devices. This key eliminates the fob.

[0048] In some embodiments, a third factor is also used to identify the user. For example, a voiceprint can be required before a key is delivered over the telephone. In the absence of voiceprint software, a challenge-response dialogue can be used. Another approach is also supported with the introduction of a fingerprint reader or iris scanner. These devices require additional support for the system on the user's device.

[0049] In some embodiments, the system and method of the present disclosure monitors the delivery of keys. In case of failure of delivery (e.g., because of an unreliable SMS network), another key delivery service associated with the user is used. These communication services have a predetermined order of delivery. If, for example, the first device in the chain or order is an SMS service, the system waits a

defined period of time for delivery to the user to be confirmed. If this confirmation is not received, the key may be automatically sent to the same telephone, via a standard voice call.

[0050] Referring to FIG. **1**, an authentication system **20** of the present disclosure comprises a facility computer **22** (e.g., a web site), a key server **24**, a communication server **28** and a user device **26** (e.g., a computer, a telephone, a pager). A user **30** uses user device **26** (e.g., a computer) to communicate with facility computer **22** via a first communication service **32** (e.g., IP network). Communication server **28** uses one of its sub-systems (**82**, **84**, **86**, etc.) to deliver a key to user device **26**.

[0051] First communication service **32** may be a typical online dialog between user **30** and facility computer **22** using a web page with prompts for user **30** to enter information. Second communication service **34** can be any one of a plurality of services that are different and independent of one another and of first communication service **32**. For example, second communication service **34** may be email, SMS, telephone (land line or cellular), page or other service. All of these services can be offered over a multiple user network, such as an Internet, an Intranet or other network. Alternatively, the telephone service may be offered over the telephone and/or cellular network.

[0052] Facility computer **22**, e.g., has possession of information concerning user **30**, which is to be protected from access by unauthorized persons or entities. For example, facility computer **22** may be used in the conduct of a service business with which user **30** has an account. The provided service might be financial, utility, travel, maintenance or repair or any service that needs to protect private information of user **30**.

[0053] User **30** can access a user account with the facility by using user device **26** and first communication service **32** to communicate with facility computer **22**. Both user device **26** and facility computer **22** are provided with a communication module (not shown) for the purpose of using first communication service **32**.

[0054] Facility computer **22** comprises a processor **40**, a communication module **42** and a memory **44** that are interconnected with a bus **46**. Facility computer **22** also comprises an input/output unit (not shown) to communicate with various input/output devices, such as a keyboard, display, a printer and other input/output devices. Facility computer **22** may comprise one or more computers or servers to perform the authentication role of the facility.

[0055] A library program **48** is stored in memory **44**. Library program **48** is used by application developers to request the generation and authentication of keys. Library program **48** allows facility application developers to integrate the authentication method of the present disclosure into the software of facility computer **22**. Library program **48** includes a function to request a key and a function to request the checking of the validity of a key entered by the user. Both functions require valid username and password tokens.

[0056] Key server **24** comprises a processor **40**, a communication module **42** and a memory **44** that are interconnected with a bus **46**. Key server **24** also comprises an input/output unit (not shown) to communicate with various input/output devices, such as a keyboard, display, a printer and other input/output devices. Key server **24** may comprise one or more computers or servers to perform its role in the authentication method of the present disclosure.

[0057] A key generation and management program **68** uses a database **70** of user profile information that includes usernames and passwords. The usernames and passwords can be managed internally or externally by a separate server **74**, e.g., a Microsoft Active Directory server. If managed internally, key server **24** accesses the user authentication data via a communication link **72**. If server **24** and database **70** are located near one another, communication link **72** may simply be a wired link or a short-range wireless link. In other embodiments, communication link **72** could be the Internet or an Intranet. In still other embodiments, the user profile can be stored in memory **64** of key server **24**.

[0058] If managed externally, key generation and management program **68** can access that data in server **74** using plug-in authentication bridges (not shown) via a communication link **76**, which may be the Internet or an Intranet.

[0059] Key generation and management program **68** generates random keys. By default, the system uses a series of randomly generated numbers to create a key. The system allows the use of third party key generation software.

[0060] Communication server **28** comprises a key delivery program **80** that manages the delivery of keys provided by key server **24** to user **30** via second communication service **34**. Communication server **28** can deliver keys via email, SMS or by automated voice application. To this end, a plug-in email communication bridge program **82** is instantiated to deliver keys via email. A plug-in SMS communication bridge program **84** is instantiated to deliver keys via SMS message. An automated voice bridge program **86** is instantiated to deliver keys via a telephone voice message.

[0061] In one embodiment of the present disclosure, system **20** performs the following procedure in which the numbered procedural steps correspond to the encircled numbers in FIG. **1**:

[0062] 1. User **30** uses user device **26** and first communication service **32** to enter and send a username and a password to facility computer **22**.

[0063] 2. Library program **48** receives the username and password and requests key server **24** to send a key to user **30**.

[0064] 3. Key generation and management program **68** validates the username and password using the user profile information.

[0065] 4. If validated, key generation and management program **68** generates the key, stores it in the user profile and hands the key to communication server **28**.

[0066] 5. Communication server **28** uses a predetermined one of communication bridges **82**, **84** or **86** and second communication service **34** to deliver the key to user **30**.

[0067] 6. User **30** receives and uses user device **26** and first communication service **32** to enter and send the key to key server **24**.

[0068] 7. Key generation and management program **68** authenticates user **30**, using the username, password and key.

[0069] In the above example, the key (password or phrase) is delivered to the user using a second communication service (email, SMS or telephone) to which user **30** already subscribes. This is implemented by allowing user **30** of the service (email, SMS or telephone) to return the key by using user device **26** and communication service **32** to system **20**. The key is processed by key generation and management program **68** and authenticated in the same way that the first factor (password) is authenticated. The use of second communication service **34** makes the overall process far more secure than a classic two-factor authentication system using only first communication service **32**. In this embodiment, key generation and management program **68** comprises code for steps 3, 4 and 7 and key delivery program **80** comprises code for step 5.

[0070] Library program **48**, key generation and management program **68**, key delivery program **80**, email bridge communication program **82**, SMS bridge communication program **84** and voice bridge program **86** can be written in any suitable language. In one embodiment of key server **24**, key generation and management program **68** is written in Java and library program **48** is written in Java and PHP.

[0071] Referring to FIG. **2**, key generation and management program **68** comprises a daisy-chain manager **90**. Daisy chain manager **90** enables for the purpose of contacting user **30** a predetermined ordering of SMS, voice and email. For example, should the ordering be SMS, telephone and email, user **30** would first be contacted by SMS. Should the SMS contact fail, user **30** would then automatically be contacted by telephone. Should the telephone contact fail, user **30** would then automatically be contacted by email.

[0072] Daisy-chain manager **90** has a first activity that gathers a preferred order of contact from user **30**. The user's preferred order of contact can be obtained either by online, email, voice or SMS communication service. The preferred order, once gathered is entered into user profile **70**.

[0073] Daisy-chain manager **90** has a second activity to effect delivery of the key without any input from user **30** in the following manner. When a new key has been generated for user **30**, daisy chain manager **90** uses the preferred order to send the key to user **30**. Using the above preferred order example, daisy chain manager **90** first instructs key delivery program **80** to select SMS bridge communication program **84** to send the key using SMS service. Second, daisy-chain manager **90** monitors delivery of the key. Third, should delivery fail daisy-chain manager **90** instructs key delivery program **80** to select voice bridge program **86** to send the key using telephone service. Fourth, daisy-chain manager **90** monitors delivery of the key. Fifth, should delivery fail daisy-chain manager **90** instructs key delivery program **80** to select email bridge program **82** to send the key using email service. Sixth, daisy-chain manager **90** monitors delivery of the key. If the delivery fails, daisy-chain manager **90** generates an error message. If any delivery succeeds, the delivery activity ends.

[0074] Referring to FIG. **3**, in another embodiment of the present disclosure, system **20** performs the following procedure in which the numbered procedural steps correspond to the encircled numbers in FIG. **3**:

[0075] 1. User **30** uses user device **26** and first communication service **32** to enter and send a username and a password to facility computer **22**.

[0076] 2. Library program **48** receives the username and password and requests key server **24** to send a key to user **30**.

[0077] 3. Key generation and management program **68** validates the username and password using the user profile information.

[0078] 4. If validated, key generation and management program **68** generates the key, stores it in the user profile and hands the key to communication server **28**.

[0079] 5. Communication server **28** uses a predetermined one of communication bridges **82**, **84** or **86** and second communication service **34** to deliver the key to user **30**.

[0080] 6. User **30** enters a second password [or biometric token] using user device **26** and second communication service **34**.

[0081] 7. Communication server **28** receives and delivers the second password to key server **24**.

[0082] 8. Key generation and management program **68** stores the second pass word in user profile **70**.

[0083] 9. User **30** enters key using user device **26** and first communication service **32**.

[0084] 10. Facility computer **22** sends the key to key server **24** and key generation and management program **68** authenticates user **30** using username, first password, second password and key.

[0085] In the above embodiment, user **30** enters a username and first password into system **20**. Library program **48** requests that a key be sent to the user **30**. Key server **24** validates the username and first password using user profile **70** or external authentication source **74**. If valid to date, key server **24** generates the key, stores it in user profile (with expiry time), and hands it to communication server **28** with the identity of the appropriate communication bridge (defined in user profile). Communication server **28** using the second communication service **34** then notifies user **30** that a key is ready and requests a second password. User **30** enters the second password (or biometric token) using user device **26** and second communication service **34**. Communication server **28** delivers the second password to key server **24**. Key server **24** validates that token before instructing communication server **28** to send the key using communication service **34**. User **30** uses user device **26** and communication service **32** to enter the key into system **22**. Facility server **22** sends the key to key server **24**. Key server **24** further authenticates user **30** using the key. In this embodiment, key generation and management program **68** comprises code for steps 3, 4, 8 and 10. Key delivery program **80** comprises code for steps 5 and 7. Library program **48** comprises code for steps 2 and 9.

[0086] The second password can be any word, phrase, biometric token, or any combination thereof. In one preferred embodiment, the second password is a biometric symbol of user **30**. The biometric symbol, for example may be a voiceprint, an iris scan, a fingerprint, a photograph or other biometric symbol of user **30**.

[0087] The present disclosure defines the components required for the process to operate within set norms of security, but does not place any limitations on implementation. The norms defined are: (a) two-factor, with the key from the second factor (the virtual fob) being sent over the same service as the password; (b) two-factor, over two services, with a second key (something the user knows) being sent over the second service; and (c) three-factor over two services; and (d) device chaining in order to ensure delivery of requested keys.

[0088] The present disclosure having been thus described with particular reference to the preferred forms thereof, it will be obvious that various changes and modifications may be made therein without departing from the spirit and scope of the present disclosure as defined in the appended claims.

What is claimed is:

1. A system that authenticates a user comprising a computer that receives a first factor and a third factor that are sent by said user using a first communication service and a second communication service, respectively, wherein said computer comprises a program that (a) generates a second factor, (b) validates said first and third factors, (c) then causes said second factor to be sent to said user using said second communication service and (d) after receipt of said second factor sent by said user, using said first communication service authenticates said user by validating said second factor.

2. The system of claim 1, wherein said first and third factors are different from one another.

3. The system of claim 2, wherein said first and third factors are selected from the group consisting of: password, pass phrase, username and any combination thereof.

4. The system of claim 2, wherein said third factor is a biometric symbol of said user.

5. The system of claim 4, wherein said biometric symbol is selected from the group consisting of: a voiceprint, an iris scan, a fingerprint, a photograph or other symbol of a physical part of said user.

6. The system of claim 1, wherein said first communication service is an online service.

7. The system of claim 1, wherein said second communication service is selected from the group consisting of: SMS, email, telephone and page.

8. The system of claim 1, wherein said second factor comprises one or more series of alphabetic characters, numeric characters or both.

9. The system of claim 1, wherein said program validates said first and third factors by comparison with a repository of personal data of said user.

10. A method that authenticates a user comprising:

using a computer to perform the steps of:

receiving a first factor and a third factor that are sent by said user using a first communication service and a second communication service, respectively;

generating a second factor;

validating said first and third factors;

then causing said second factor to be sent to said user using said second communication service; and

after receipt of said second factor sent by said user using said first communication service, authenticating said user by validating said second factor.

11. The method of claim 10, wherein said first and third factors are different from one another.

12. The method of claim 11, wherein said first and third factors are selected from the group consisting of: password, pass phrase, username and any combination thereof.

13. The method of claim 11, wherein said third factor is a biometric symbol of said user.

14. The method of claim 13, wherein said biometric symbol is selected from the group consisting of: a voiceprint, an iris scan, a fingerprint, a photograph and other symbol of a physical part of said user.

15. The method of claim 10, wherein said first communication service is an online service.

16. The method of claim 10, wherein said second communication service is selected from the group consisting of: SMS, email, telephone and page.

17. The method of claim 10, wherein said second factor comprises one or more series of alphabetic characters, numeric characters or both.

18. The method of claim 10, wherein said program validates said first and third factors by comparison with a repository of personal data of said user.

19. A system comprising a computer that validates a user of an online service using a first factor and a second factor, wherein said computer sends said second factor to said user using an order of communication services other than said online service for delivery of said second factor to said user, wherein if there is a failure of delivery in a first communication service used in said order, said computer sends said second factor to said user using one of said communication services that is second in said order.

20. The system of claim 19, wherein said first and second communication services are different than and independent of one another and said online service.

21. The system of claim 19, wherein said computer automatically uses said second communication service without any input from said user.

22. The system of claim 19, wherein said communication service is a member of the group consisting of: SMS, email, telephone and page.

23. The system of claim 19, wherein said computer authenticates said user using said first factor, said second factor and a third factor, wherein said first factor is a first password and/or username, wherein said second factor is a key and wherein said third factor is a second password.

24. A method of authenticating a user of an online service by using a computer to perform steps comprising:

validating said user using a first factor and a second factor,

sending said second factor to said user using an order of communication services other than said online service for delivery of said second factor to said user; and

if there is a failure of delivery in a first communication service used in said order, sending said key to said user using one of said communication services that is second in said order.

25. The method of claim 24, wherein said first and second communication services are different than and independent of one another and said online service.

26. The method of claim 24, wherein said second communication service automatically sends said second factor without any input from said user.

27. The method of claim 24, wherein said communication service is a member of the group consisting of: SMS, email, telephone and page.

28. The method of claim 24, wherein said user is further validated using a third factor, wherein said first factor is a first password and/or username, wherein said second factor is a key and wherein said third factor is a second password.

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