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(54) SYSTEM, DESIGN AND PROCESS FOR STRONG AUTHENTICATION USING BIDIRECTIONAL OTP AND OUT-OF-BAND MULTICHANNEL AUTHENTICATION

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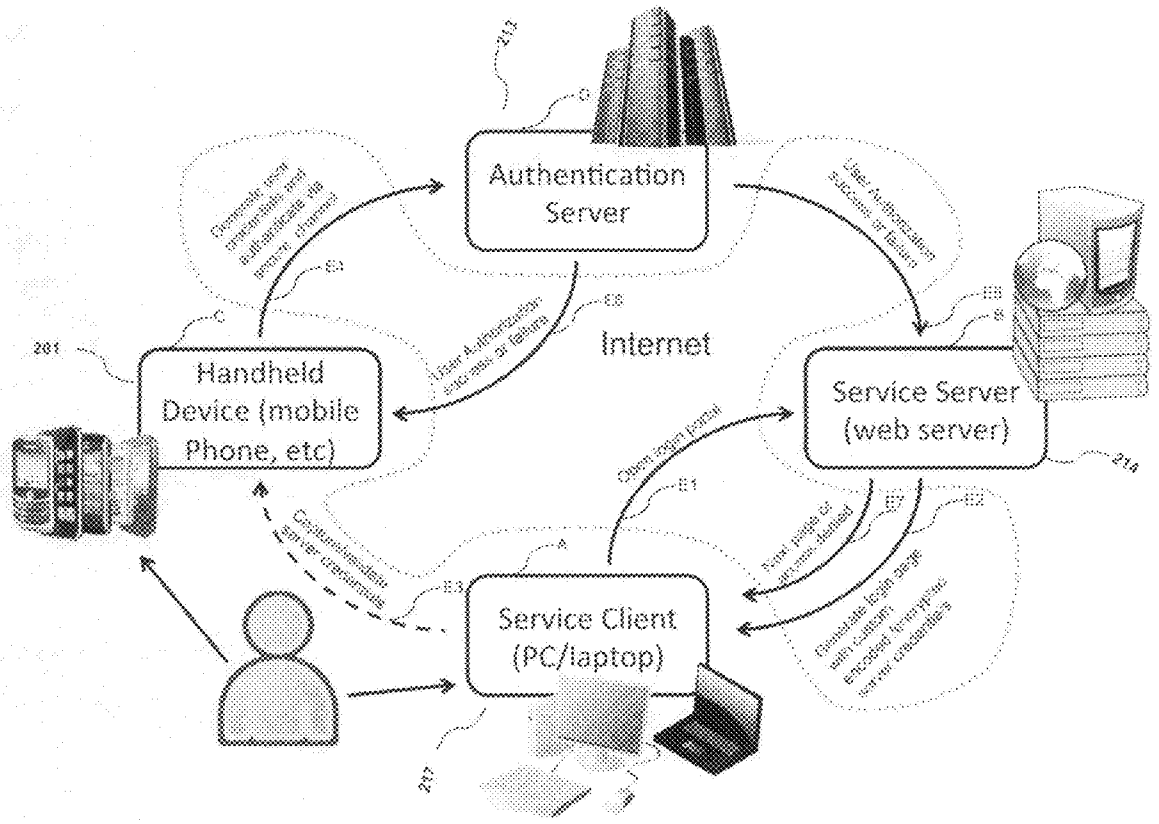
(57) **ABSTRACT**

Systems and methods of authentication according to the invention are provided comprising a user, a service client, a service server, a portable communications device and an authentication server, wherein the method comprises use of one time passwords and out-of-band outbound communication channels. This system gives access to authentication seekers based on OTP out of band outbound authentication mechanism. The authentication seeker or system user scans a multi-dimensional barcode or another like encoding mechanism and validates the client and triggers the out of band outbound mechanism. The portable mobile device invokes the client server to request authentication. The client server authenticates the user based on a shared secret key and the user is automatically traversed to the next page.



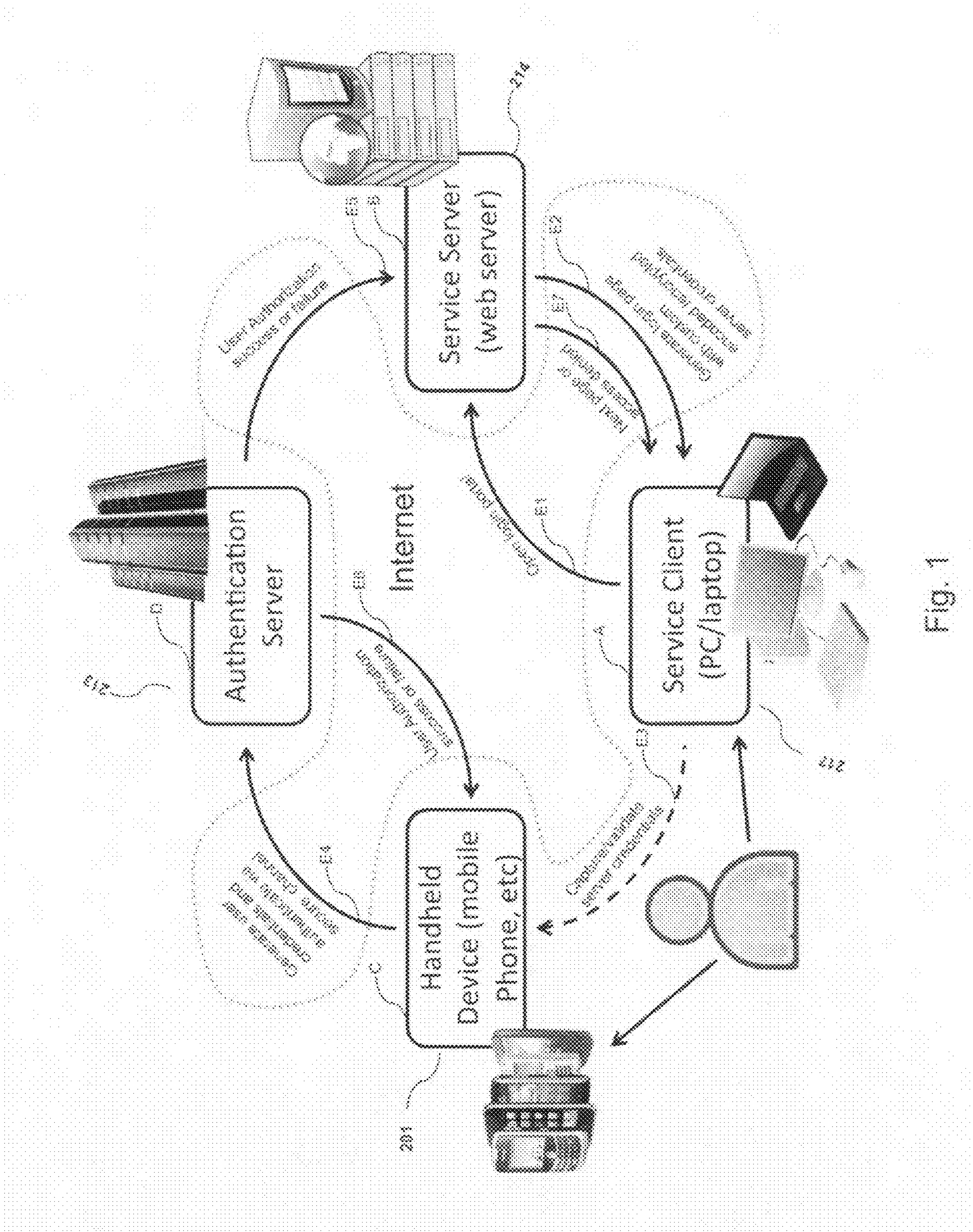

Authentication Server
Service Server (web server)
Service Client (PC/laptop)
Handheld Device (mobile Phone, etc)
Internet
User Authentication success or failure
Open login portal
Next page or access denied
Capture variable server credentials
213
214
212
201

Fig. 1

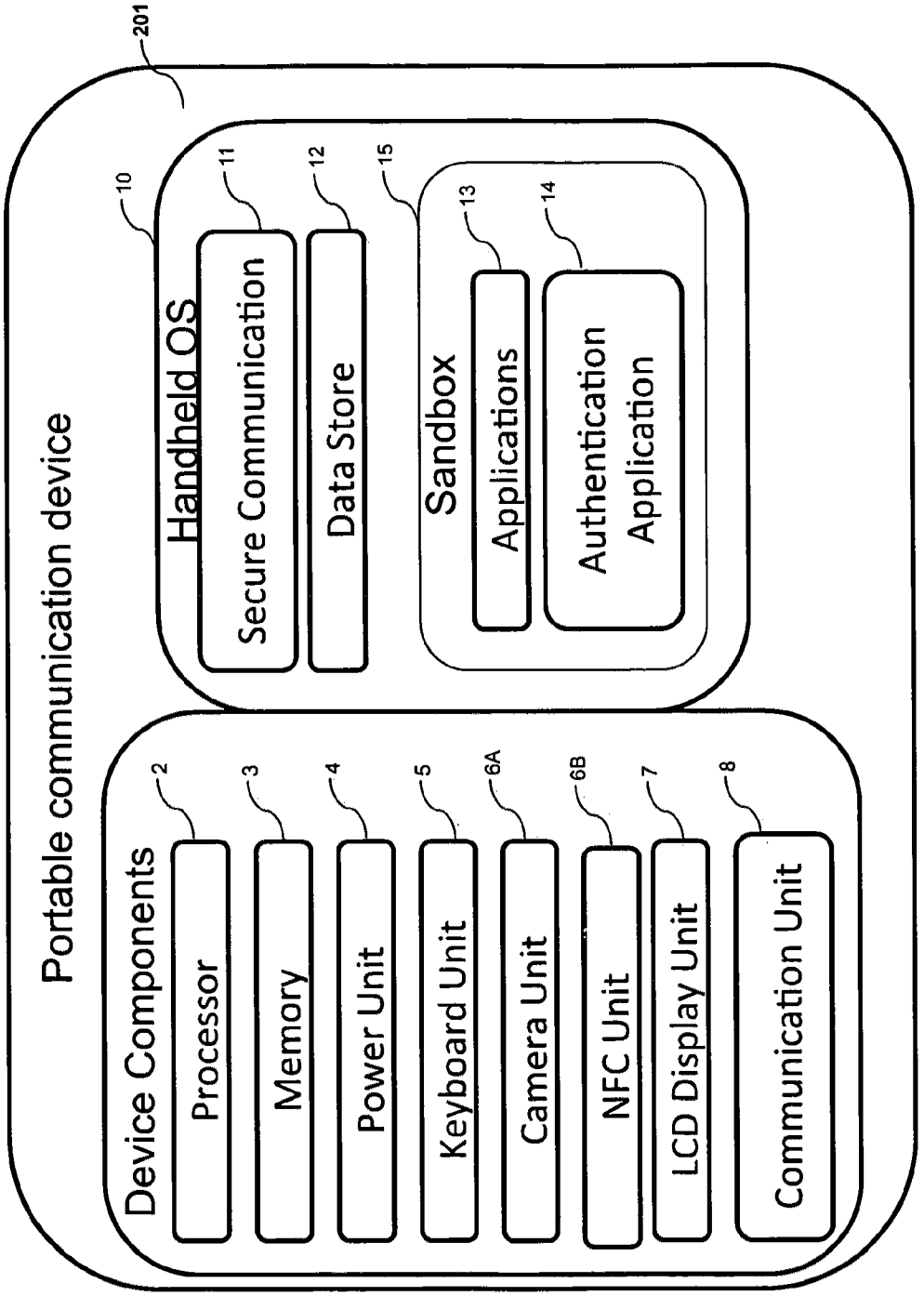

201
Portable communication device
10
Handheld OS
11
Secure Communication
12
Data Store
15
Sandbox
13
Applications
14
Authentication Application
Device Components
2
Processor
3
Memory
4
Power Unit
5
Keyboard Unit
6A
Camera Unit
6B
NFC Unit
7
LCD Display Unit
8
Communication Unit

Fig. 2

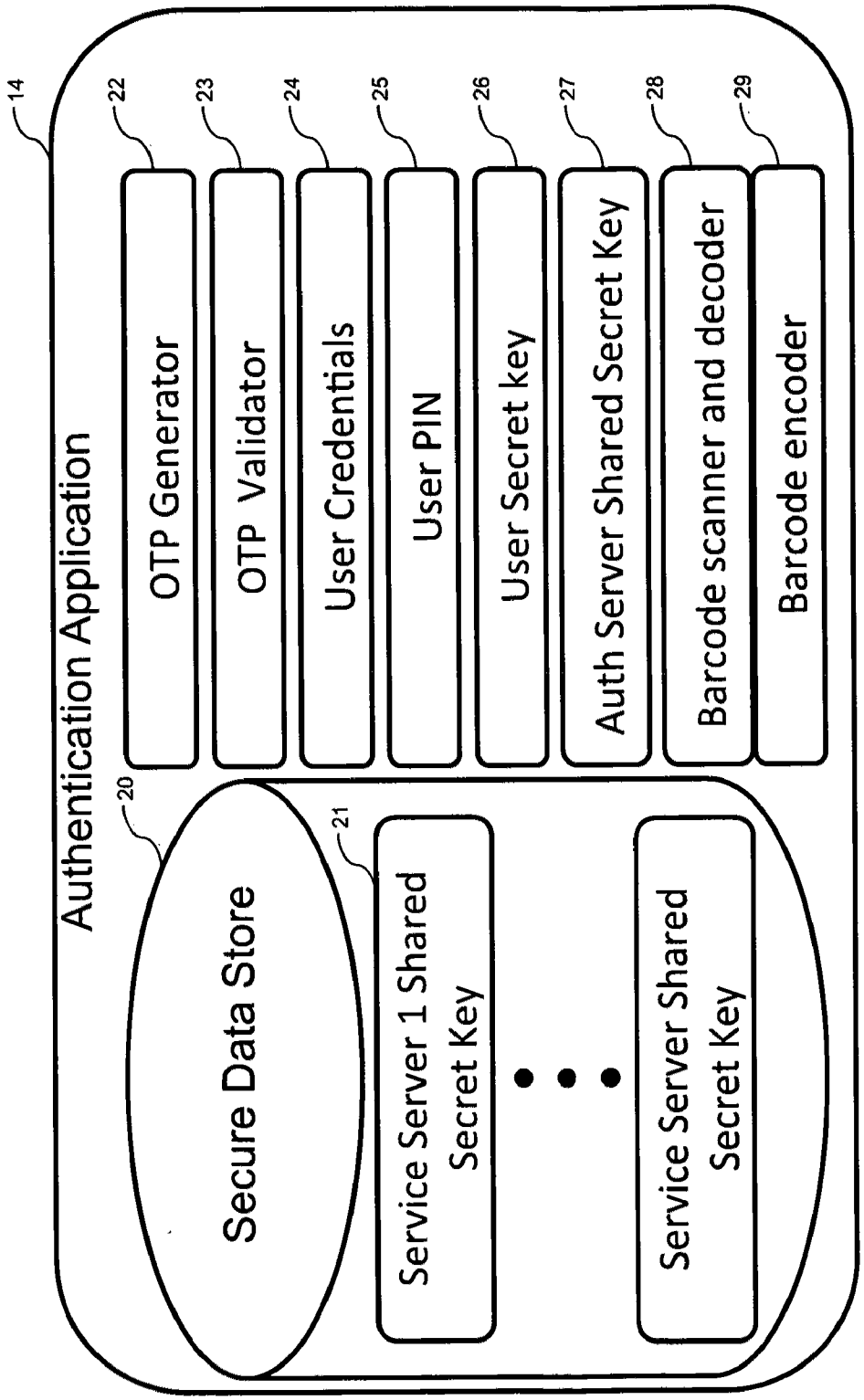

14
Authentication Application
22
OTP Generator
23
OTP Validator
24
User Credentials
25
User PIN
26
User Secret key
27
Auth Server Shared Secret Key
28
Barcode scanner and decoder
29
Barcode encoder
20
Secure Data Store
21
Service Server 1 Shared Secret Key
Service Server Shared Secret Key

Fig. 3

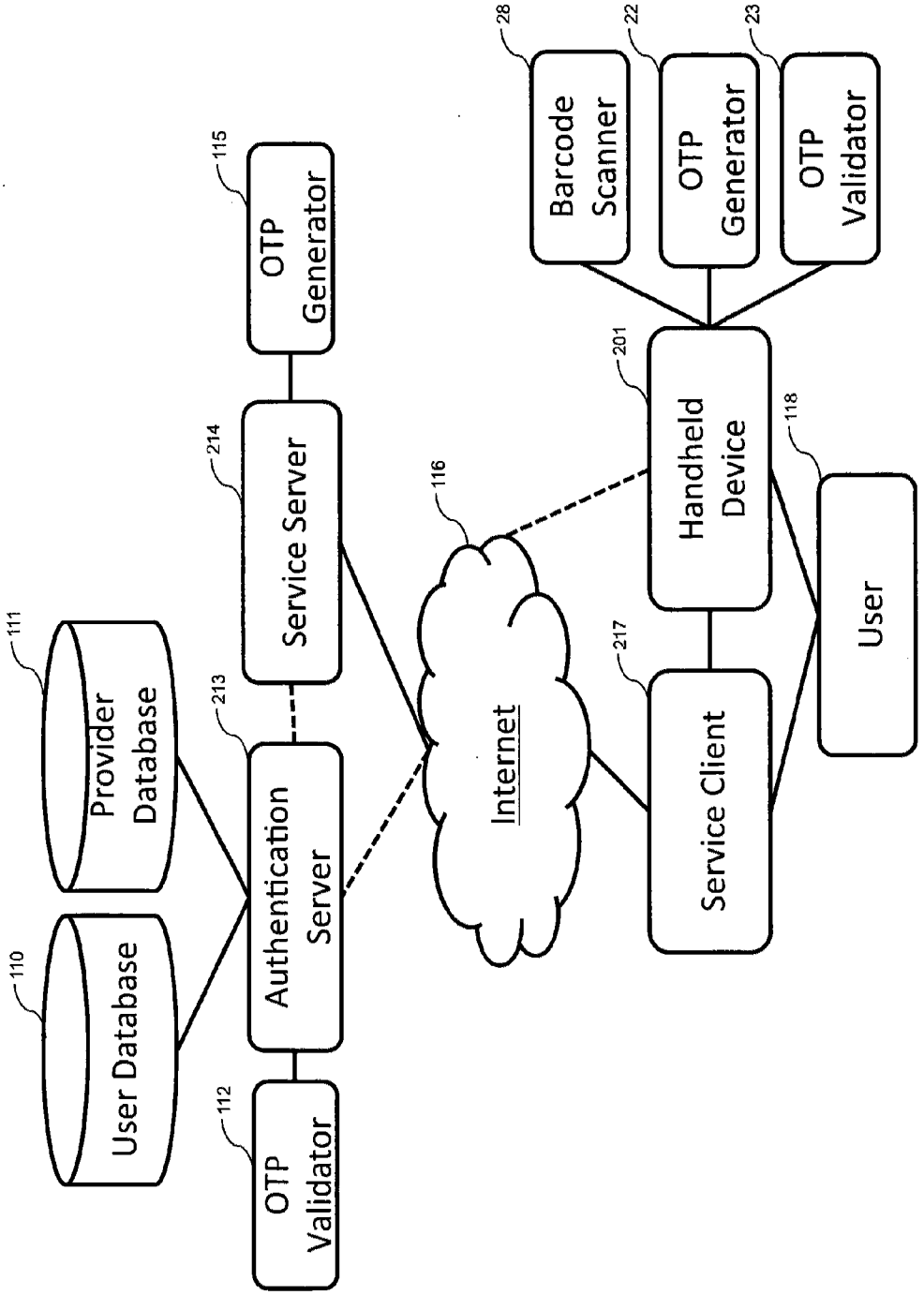

110
User Database
111
Provider Database
112
OTP Validator
213
Authentication Server
214
Service Server
115
OTP Generator
116
Internet
217
Service Client
201
Handheld Device
118
User
28
Barcode Scanner
22
OTP Generator
23
OTP Validator

Fig. 4

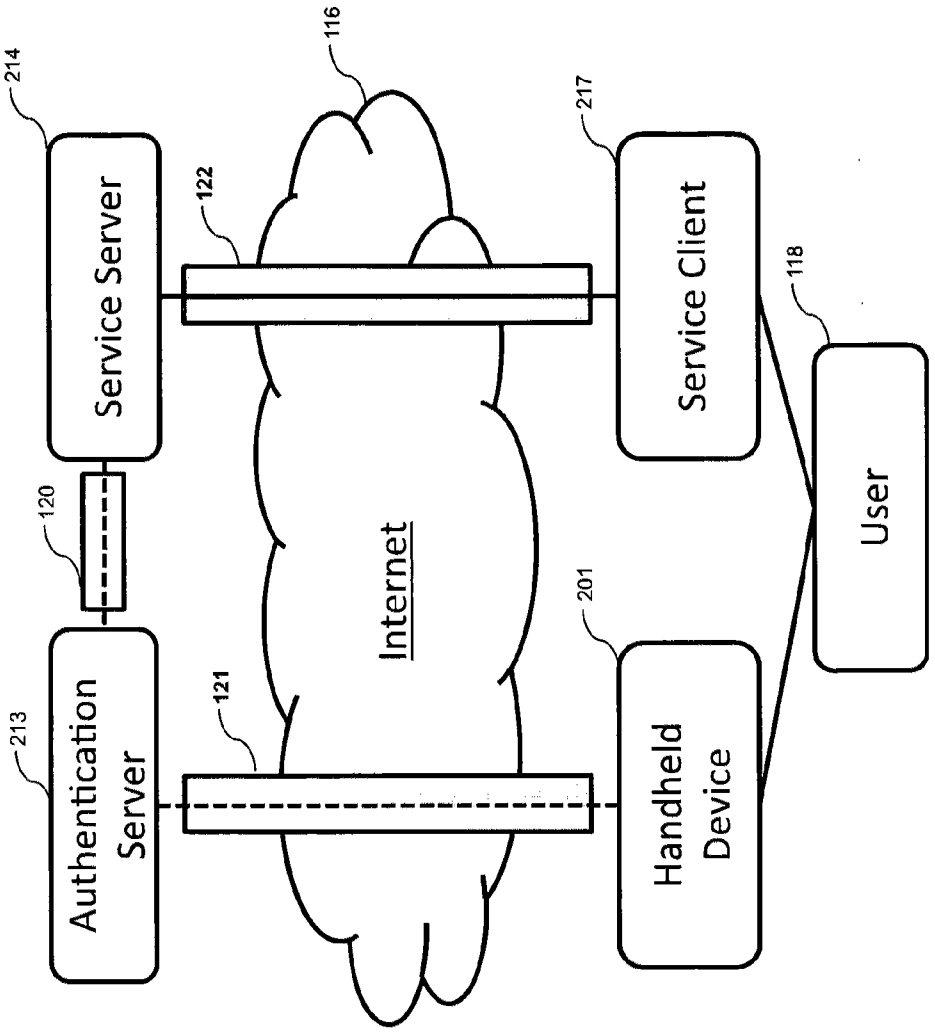

214
Service Server
120
213
Authentication Server
122
121
116
Internet
217
Service Client
201
Handheld Device
118
User

Fig. 5

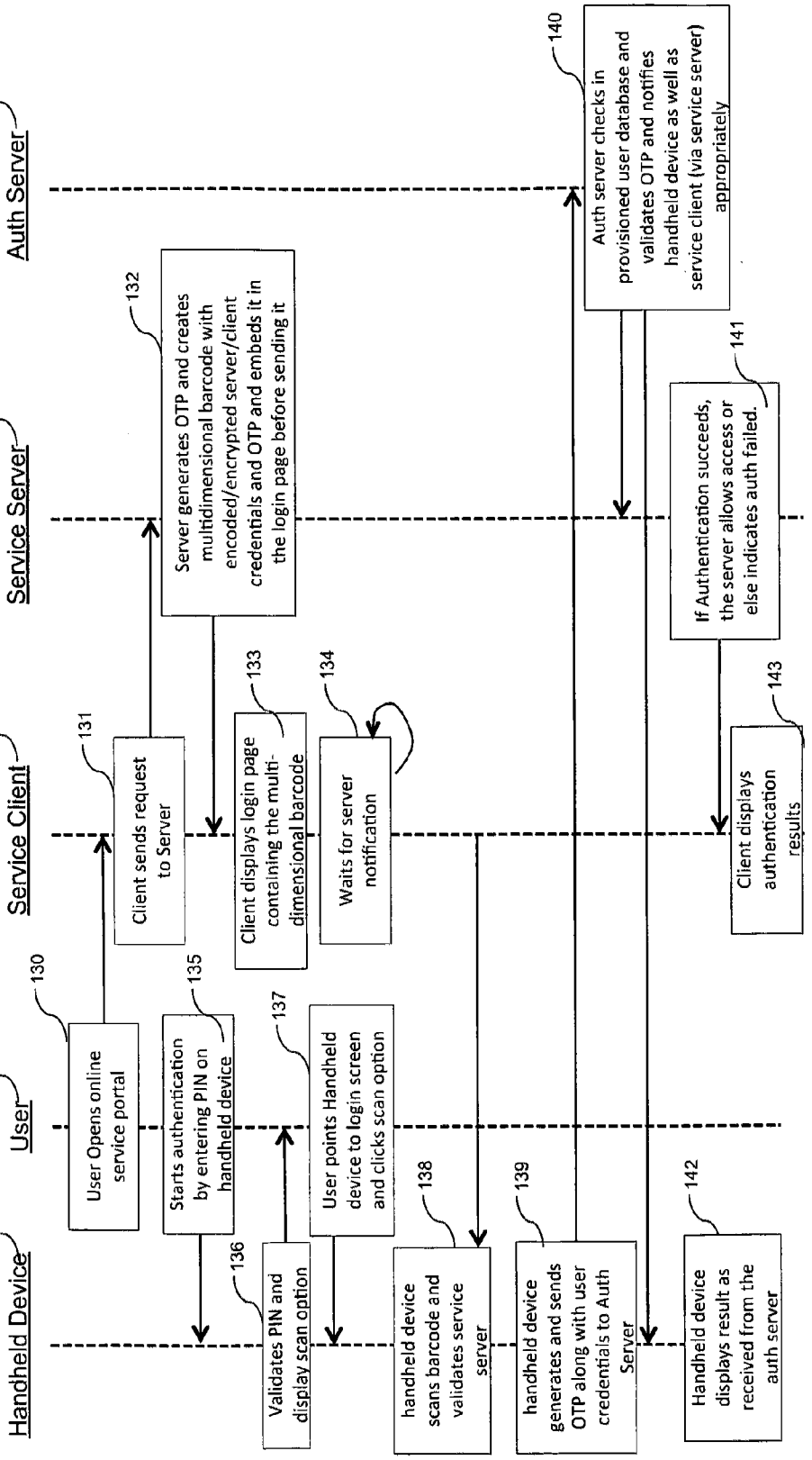

Handheld Device
201
User
118
Service Client
217
Service Server
214
Auth Server
213
User Opens online service portal
130
Client sends request to Server
131
Server generates OTP and creates multidimensional barcode with encoded/encrypted server/client credentials and OTP and embeds it in the login page before sending it
132
Client displays login page containing the multi-dimensional barcode
133
Waits for server notification
134
Starts authentication by entering PIN on handheld device
135
Validates PIN and display scan option
136
User points Handheld device to login screen and clicks scan option
137
handheld device scans barcode and validates service server
138
handheld device generates and sends OTP along with user credentials to Auth Server
139
Auth server checks in provisioned user database and validates OTP and notifies handheld device as well as service client (via service server) appropriately
140
If Authentication succeeds, the server allows access or else indicates auth failed.
141
Handheld device displays result as received from the auth server
142
Client displays authentication results
143

Fig. 6

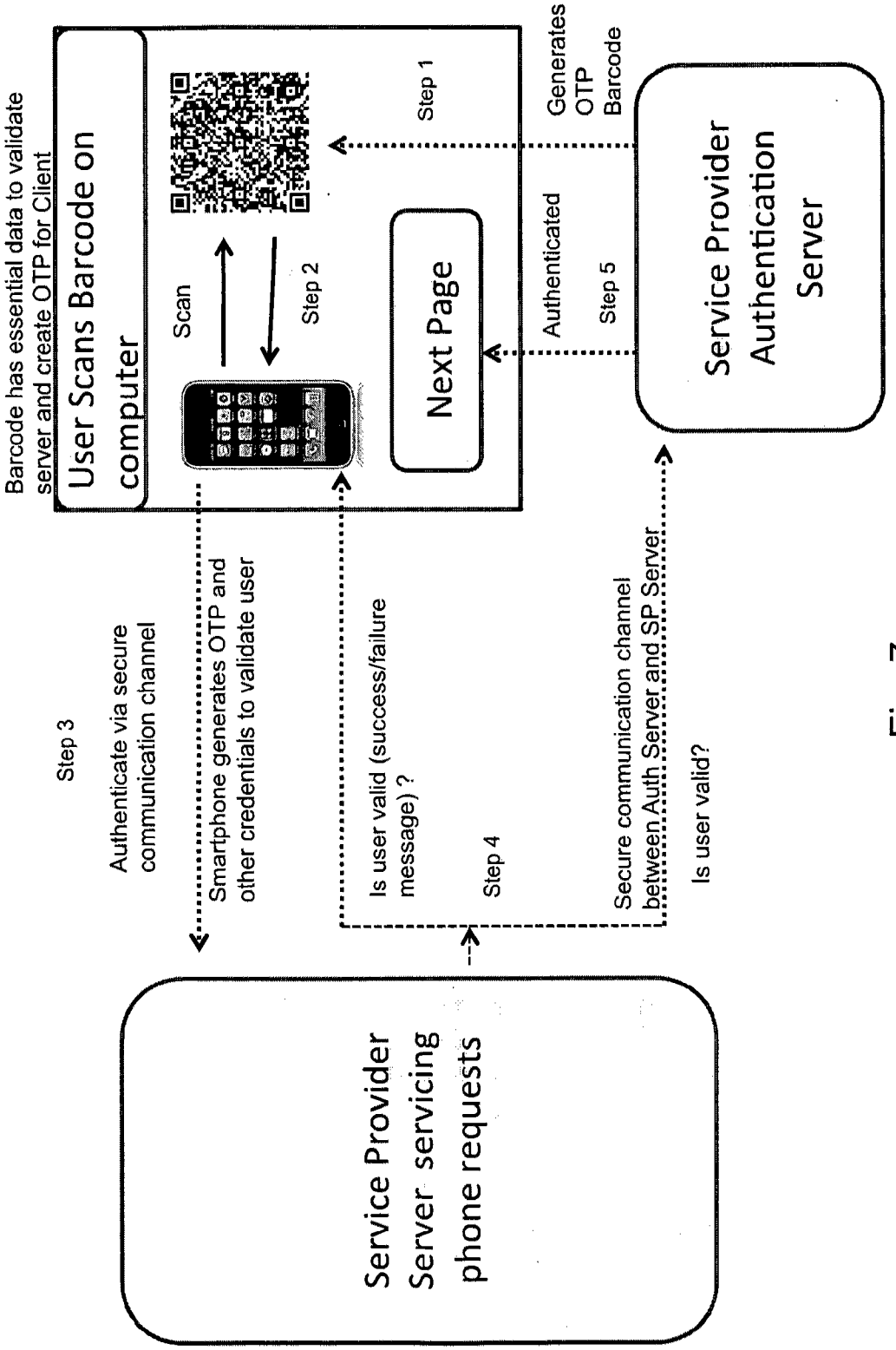

Barcode has essential data to validate server and create OTP for Client
User Scans Barcode on computer
Scan
Step 2
Step 1
Next Page
Generates OTP Barcode
Authenticated
Step 5
Service Provider Authentication Server
Step 3
Authenticate via secure communication channel
Smartphone generates OTP and other credentials to validate user
Is user valid (success/failure message) ?
Step 4
Secure communication channel between Auth Server and SP Server
Is user valid?
Service Provider Server servicing phone requests

Fig. 7

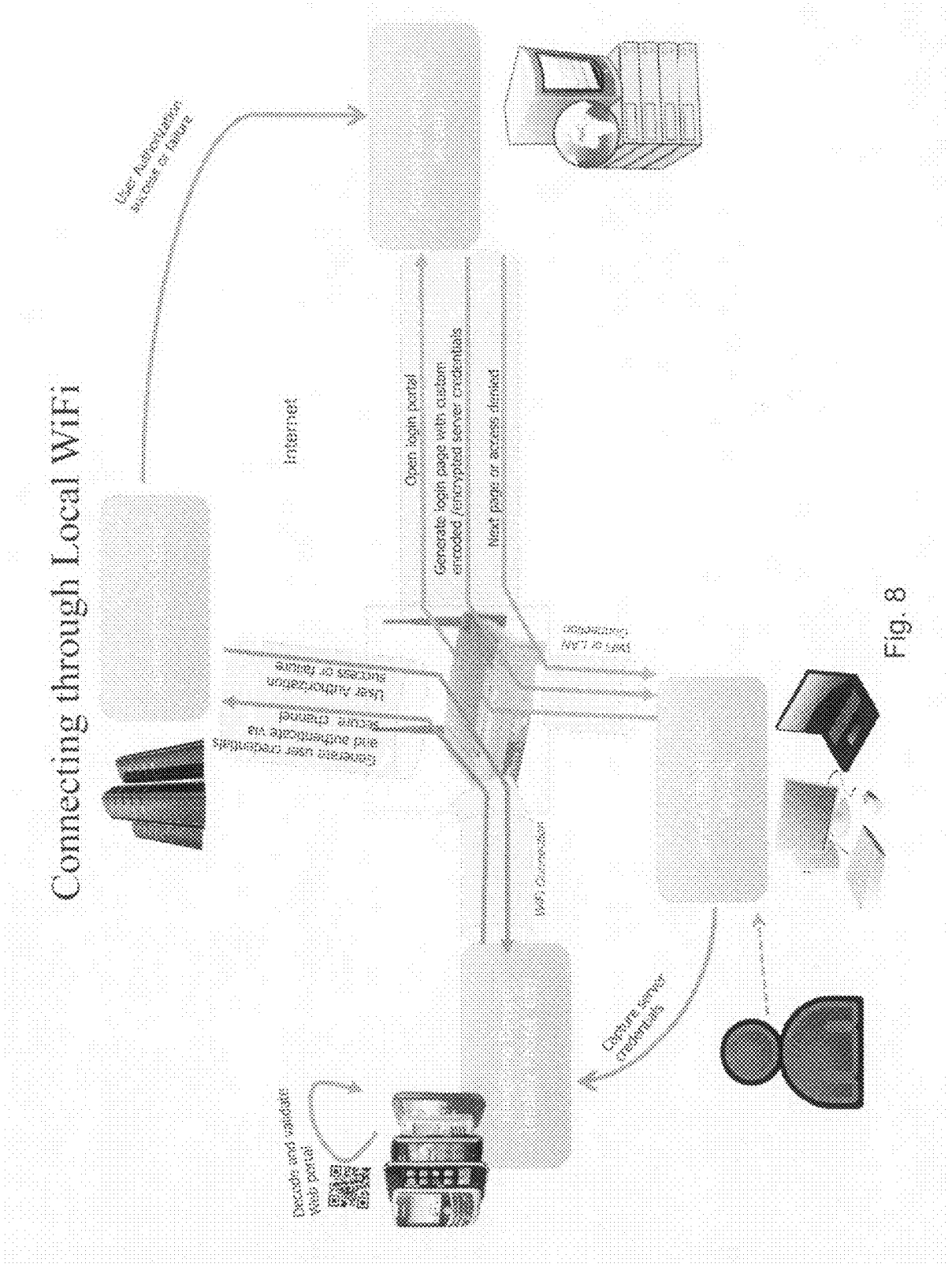

Connecting through Local WiFi
Internet
User Authorization success or failure
Open login portal
Generate login page with custom encoded /encrypted server credentials
Next page or access denied
WiFi or LAN Connection
User Authorization success or failure
Generate user credentials and authenticate via secure channel
WiFi Connection
Capture server credentials
Decode and validate Web portal

Fig. 8

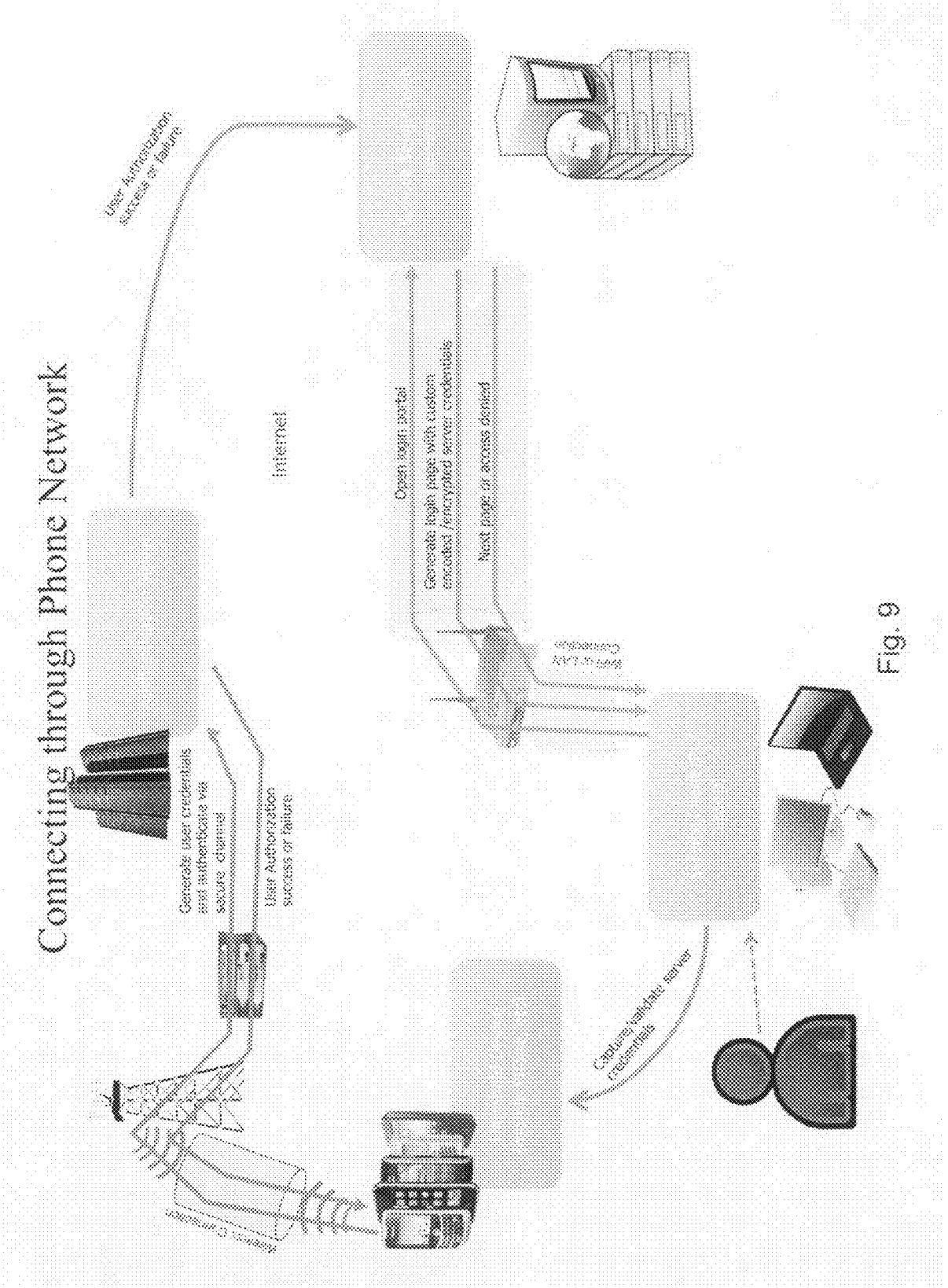

Connecting through Phone Network
Generate user credentials and authenticate via secure channel
User Authorization success or failure
Internet
Open login portal
Generate login page with custom encoded / encrypted server credentials
Next page or access denied
User Authorization success or failure
Capture validate server credentials

Fig. 9

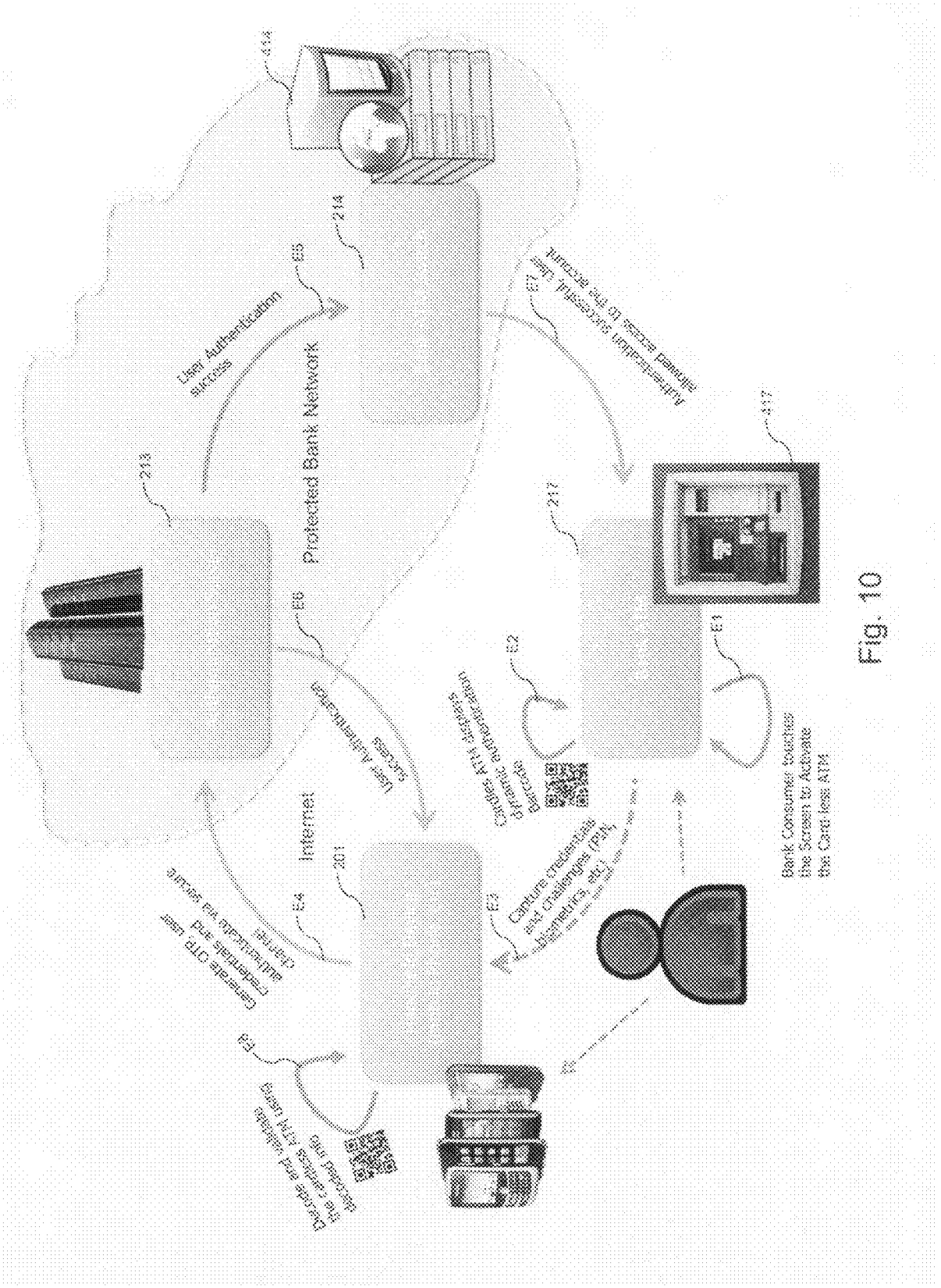

414
214
E5
User Authentication success
Protected Bank Network
213
E6
User Authentication success
Internet
201
E4
Generate OTP, user credentials and authenticate via secure channel
E3
Capture credentials and challenges (PIN, biometrics, etc)
E2
Cardless ATM displays dynamic authentication barcode
E1
Bank Consumer touches the Screen to Activate the Card-less ATM
217
417
E7
Authentication successful, User allowed access to the account
E8
Decode and validate the cardless ATM using decoded info

Fig. 10

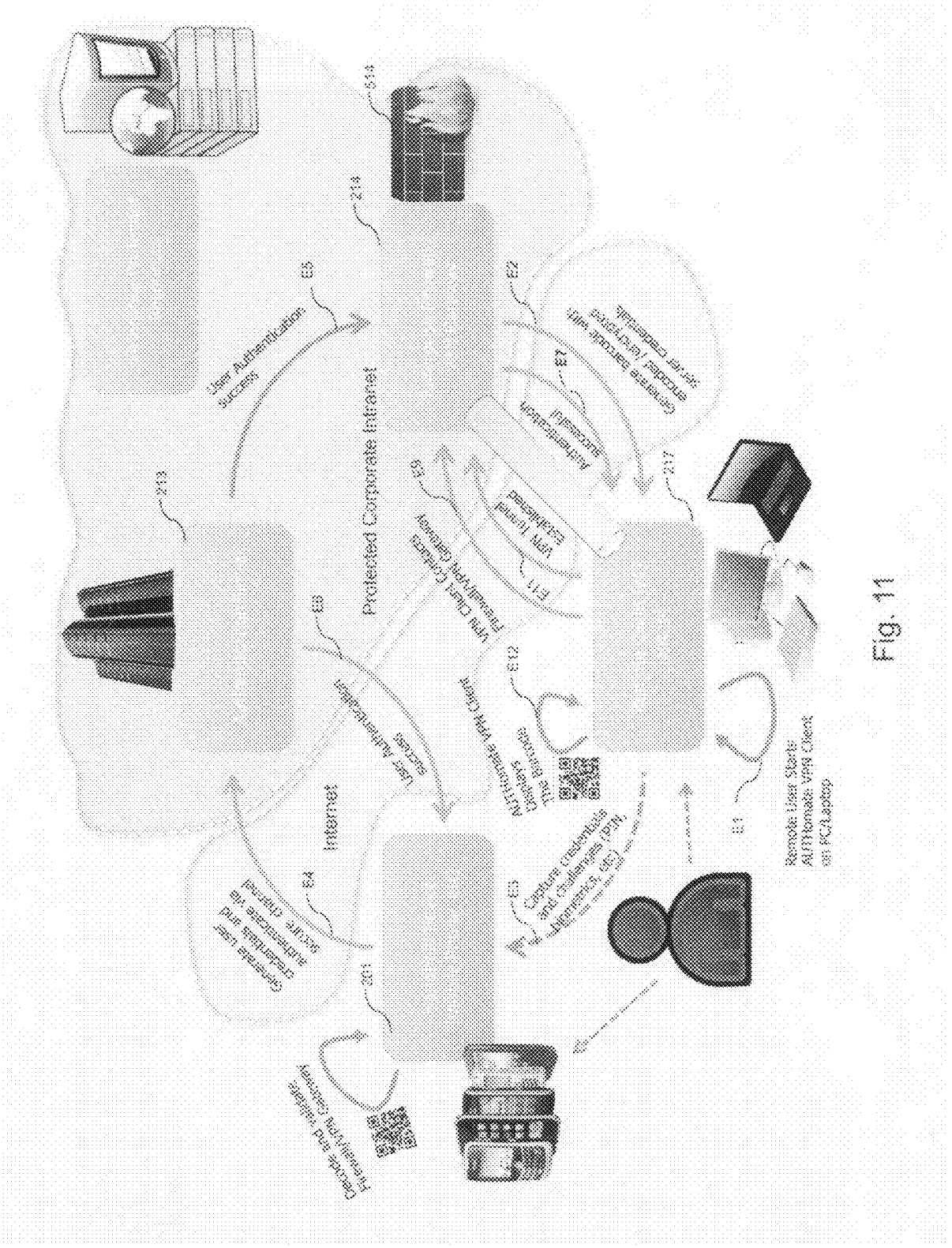

Protected Corporate Intranet
Internet
User Authentication Success
Authentication successful
VPN Tunnel Established
VPN Client Contacts Firewall/VPN Gateway
Remote User Starts AUTHomate VPN Client on PC/Laptop
Capture credentials and challenges (PIN, biometrics, etc)
Generate user credentials and authenticate via secure channel
Decode and validate Firewall/VPN Gateway
E1
E2
E3
E4
E5
E6
E7
E9
E11
E12
201
213
214
217
514

Fig. 11

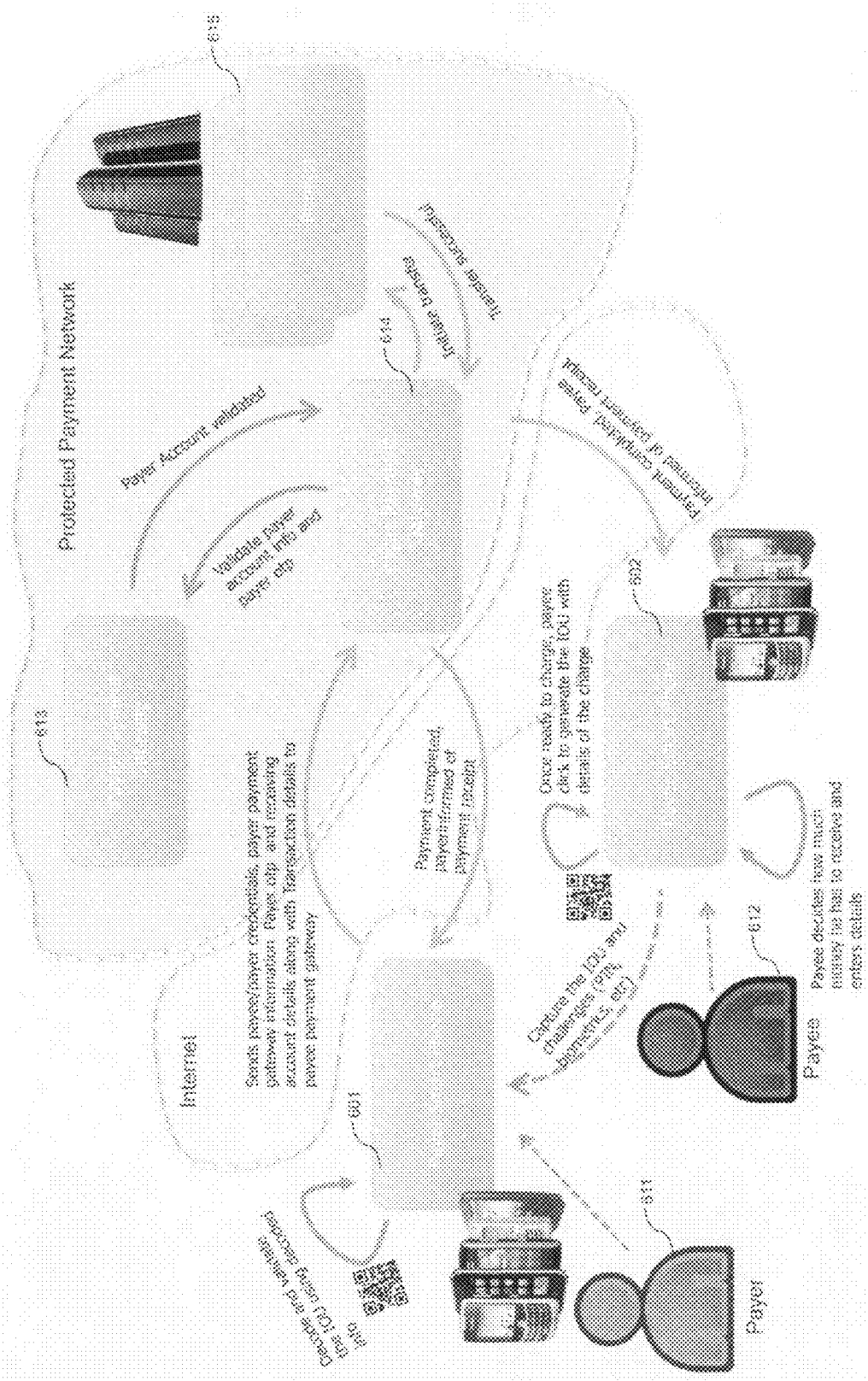

Protected Payment Network
615
Payer Account validated
Validate payer account info and payer otp
614
Initiate transfer
Transfer successful
Payment completed, Payee informed of payment receipt
613
Internet
Sends payee/payer credentials, payer payment gateway information, Payer otp and receiving account details along with Transaction details to payee payment gateway
Payment completed, payer informed of payment receipt
Once ready to charge, payee click to generate the IOU with details of the charge
602
Payee decides how much money he has to receive and enters details
612
Payee
Capture the IOU and challenges (PIN, biometrics, etc)
601
Decode and validate the IOU using decoded info
611
Payer

Fig. 12

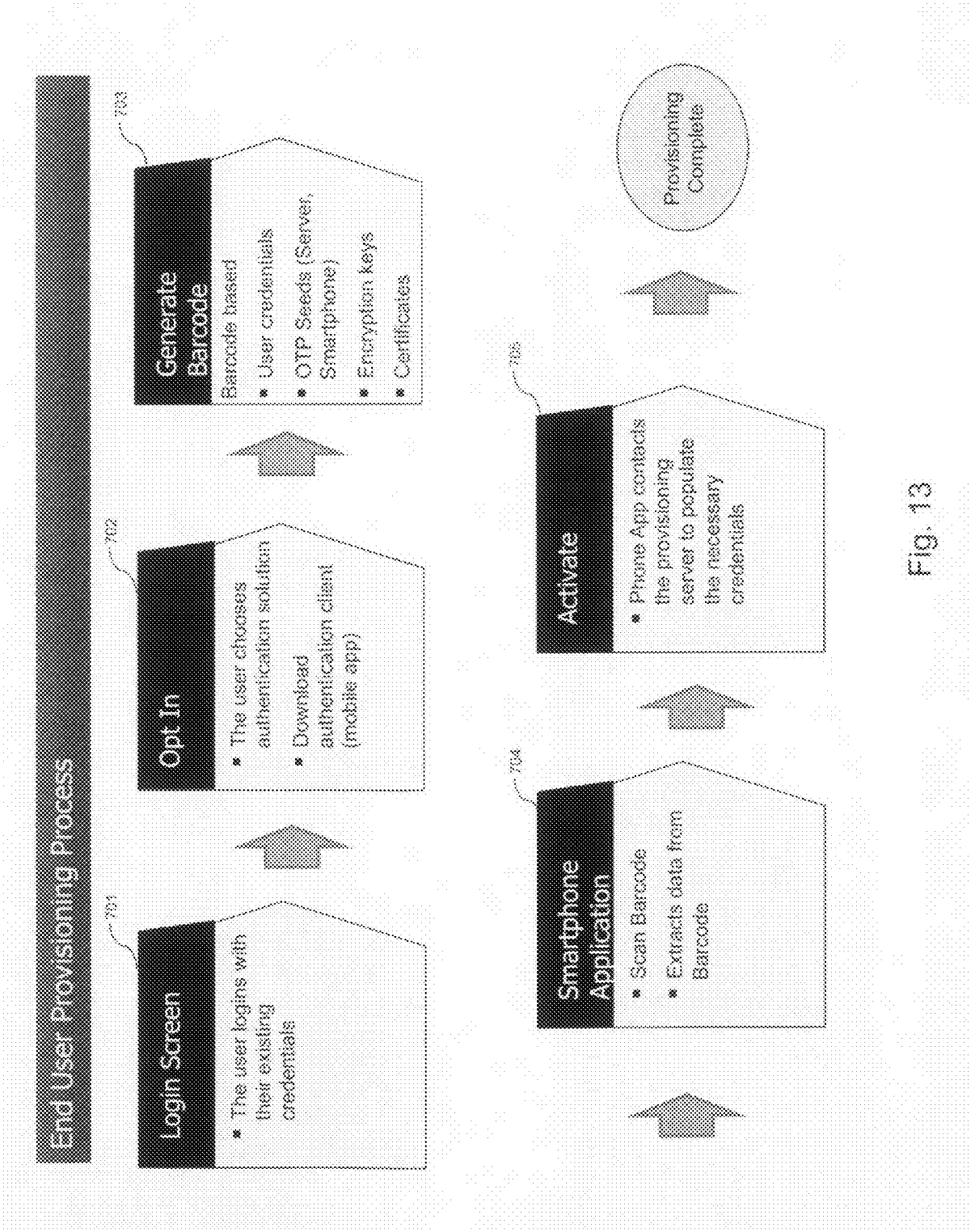

End User Provisioning Process
701
Login Screen
* The user logins with their existing credentials
702
Opt In
* The user chooses authentication solution
* Download authentication client (mobile app)
703
Generate Barcode
Barcode based
* User credentials
* OTP Seeds (Server, Smartphone)
* Encryption keys
* Certificates
704
Smartphone Application
* Scan Barcode
* Extracts data from Barcode
705
Activate
* Phone App contacts the provisioning server to populate the necessary credentials
Provisioning Complete

Fig. 13

SYSTEM, DESIGN AND PROCESS FOR STRONG AUTHENTICATION USING BIDIRECTIONAL OTP AND OUT-OF-BAND MULTICHANNEL AUTHENTICATION

BACKGROUND OF THE INVENTION

[0001] The growth of the interne has spurred demand for secure, convenient and private access to networks and the web for consumers and companies. Users transmit confidential information when accessing email servers or financial accounts, making purchases online or even logging into personalized news sites. Unfortunately, the increased transmission of confidential information leads to increased risk of identity theft. Millions of Americans have become the victims of identity theft, leading to billions in losses.

[0002] Although there are various techniques designed to provide authentication to protect critical data and prevent identity theft, these techniques are subject to vulnerabilities or are difficult to use, thereby deterring wide spread implementation.

[0003] For example, a common form of authentication is the static password authentication method. In this method, a user enters a static user identification and password on a client site. A request is sent to an authentication server to validate the credentials of the user. If the credentials are valid, the user is traversed to the next page. If the user credentials are not valid, access to the next page is denied and the client site may again ask the user to enter proper credentials. However, this form of authentication is vulnerable to threats such as phishing, key logging, shoulder surfing, snooping, social engineering, brute force attack, replay, dictionary, browser cache, man in the middle (MITM) attacks and replay attacks.

[0004] To overcome some of the vulnerabilities of static passwords, random password authentication mechanisms and systems have been developed that rely upon passwords or codes that are valid for only a certain period of time. For example, a one-time password (OTP) is only valid for one login session or transaction. An example of this is RSA Secure ID, which utilizes an OTP authentication server and an OTP Client that share a secret key and a common OTP generation algorithm, to generate the one time password for each use. The one time password cannot be predicted based on knowledge of prior one time passwords. Some OTP algorithms are based on time-synchronization between the OTP authentication server and the OTP client, event based hash chain algorithms that generate a one-time password based on the previous password, or on a challenge and/or a counter.

[0005] OTP based authentication often use hard tokens (FOB keys) or soft tokens (software generated) as OTP clients. In both cases, the user enters a login identification and a combination of a fixed pin along with a token generated OTP. The use of token based OTP is prevalent in enterprises and corporate environment. Although more effective against tampering and spoofing, OTP tokens can be difficult to carry around, can get lost or broken, and are still subject to phishing, MITM or other types of attacks. OTP systems that are in-band, meaning that all information that is requested on the same node or network, are subject to a hacker being in the same environment as the authentication mechanism. Other mechanisms, such as Authenticate as a Service, use cloud computing or other web methods to deliver OTP tokens.

[0006] Multifactor authentication systems are more secure than static user identifications and passwords. However, they can be difficult and expensive to adopt and use.

[0007] Accordingly, an authentication system that mitigates some of the vulnerabilities of prior art systems is desired. Furthermore, an authentication system that provides a strong multi-factor authentication and transaction mechanism for service providers, including banks or large enterprises, to protect user identities and accounts and provide seamless usability for end users and is easy to implement is generally desired.

SUMMARY OF THE INVENTION

[0008] In one embodiment, the present disclosure is directed to methods and systems for out-of-band outbound multichannel authentication. The method may include using a service client, a service server, a portable communications device, and an authentication server. The method may include generating a barcode at the service server and transmitting the barcode to the service client through a first communications channel. The method may also include capturing the barcode with a portable communications device, decoding the barcode and decrypting the third party server credentials to obtain user information and third party server credentials and transmitting the user information and third party server credentials to an authentication server via an outbound, out-of-band communications channel by the handheld communications device. The method may also include an authentication server comparing the user information and third party server credentials to a database of user information and a database of third party server credentials, and the authentication server authenticating the user information and third party server credentials to obtain authentication results.

[0009] Accordingly, a method and system according to the invention is provided for authentication in a system comprising a user, a service client, a service server, a portable communications device, and an authentication server. The method includes providing a login portal for access by a user, wherein the login portal is in communication with the service server via a communication channel. Transmitting of user identification information is provided from the login portal to the service server. In addition, generation of a barcode at the service server is provided using the identification information and encrypting third party credentials of the service server. The barcode is transmitted by the service server to the service client through a first communications channel. The barcode is displayed or presented by the service client to a user of the portable device so that the barcode can be captured or scanned by a portable communications device. The barcode is decoded and decrypted to obtain the third party server credentials and to obtain user information and third party server credentials. The user information and third party server credentials are transmitted to an authentication server via a outbound out-of-band communications channel from the handheld communications device. The authentication server compares the user information and third party server credentials to a database of user information and a database of third party server credentials, and the authentication server authenticating the user information and third party server credentials to obtain authentication results. The authentication server transmits the authentication results to the service server and thereafter the service server can transmit the authentication results to the service client. If the authentication results are positive, the service client and the service server can establish a secure communication channel.

[0010] In addition or in the alternative, the invention can also provide that the login portal is disposed at the service

client for receiving information for the user, and that the service client has a VPN client program with a preconfigured user identifier.

[0011] In addition or in the alternative, the invention can also provide for generating a barcode by generating a multi-dimensional dynamic barcode based on a preconfigured user identifier.

[0012] In addition or in the alternative, the invention can also provide that the service server is a VPN server and said VPN server includes VPN server credentials, and that the generating of a barcode includes generating a multi-dimensional dynamic barcode based on a VPN server credentials and a first OTP thereby uniquely identifying the service server.

[0013] In addition or in the alternative, the invention can also provide that the portable communications device combines the barcode with stored user credentials stored on the portable communications device.

[0014] In addition or in the alternative, the invention can also provide that the portable communications device generates a second one time access challenge.

[0015] In addition or in the alternative, the invention can also provide that the portable communications device sends user credentials and the second one time access challenge to the authentication server via a secure out-of-band communications channel.

[0016] In addition or in the alternative, the invention can also provide for transmitting the user information and third party server credentials to an authentication server via an out-of-band communications channel, and includes establishing an independent secure connection between the mobile communications device and the authentication server using pre-specified asymmetric keys or shared secrets.

[0017] In addition or in the alternative, the invention can also provide that the authentication server validates the mobile communications device based on one or more security measures, such as a second one time access challenge, shared secrets and user credentials, among other things, and that the authentication server can transmit validation information to the service server, wherein the validation information can be selected from various test information such as successful and failed validation results.

[0018] In addition or in the alternative, the invention can also provide that the generating of the barcode is performed by the service server. In addition or in the alternative, the invention can also provide that the capturing or scanning of the barcode includes using a portable communications device having an online authentication client such as a service client and a camera.

[0019] In addition or in the alternative, the invention can also provide that the step of decrypting the barcode and the combining of data extracted from the barcode is performed by the online authentication client or service client. In addition or in the alternative, the invention can also provide a login portal for access by a user at either the service client or the login portal or the service server. In addition or in the alternative, the invention can also provide that the login portal includes receiving identification information from the user at the login portal. In addition or in the alternative, the invention can also provide that the login portal is maintained by service server. Furthermore, the invention can also provide that the login portal is programmed to receive the user identification information.

[0020] In addition or in the alternative, the invention can also provide that the use of third party credentials include using third party identification information, service server IP address, authentication server IP address, one-time password, or randomly generated one-time key, among other things for additional security.

[0021] In addition or in the alternative, a method and system according to the invention can also provide for displaying the barcode by the service client or by the login portal or by service server. Similarly, the decoding of the barcode can be performed by the portable communications device. In addition or in the alternative, the portable communications device can be programmed to decode and/or decrypt the barcode and/or third party credentials.

[0022] In addition or in the alternative, a method and system according to the invention can also provide that transmitting of the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device is out-of-band with respect to the communications channel between the authentication server and service server and/or between the service server and the service client. In addition, or in the alternative, a system and method according to the invention can provide that the outbound out-of-band communications channel between the handheld communications device and the authentication server requires at least a portion of the outbound out-of-band communications channel to be is physically separate from the transmissions medium than that used between the authentication server and service server and/or between the service server and the service client.

[0023] It can be appreciated that several variations of systems can be employed to effect the above-described processes. For example, an authentication system according to the invention can be provided for use in a communications network with a third party service server, wherein the authentication system includes a mobile communication device and an authentication server. The authentication server includes a communications unit, including a transmitter and a receiver; a processor; and a storage unit; and programming. The programming can provide several of the above processes, including storing user credentials and associated mobile communication device information; accepting a secure connection from the mobile communications device using security measures selected from the group of shared secrets, digital certificates and encryption mechanisms; accepting an authentication request from a service server and associating the authentication requests with the associated mobile communication device information. In addition, the mobile communication device includes a communications unit, including a transmitter and a receiver; a processor; and a storage unit and programming. The programming can provide several of the above described processes including communicating with the authentication server using an out-of-band communications channel, encrypting and decrypting of information selected from the group comprising shared secrets, digital certificates, user credentials and OTP generation keys; generating a multi-dimensional dynamic barcode based on service server credentials and a first one time access challenge so as to uniquely identify the service server, presenting said multi-dimensional dynamic barcode to a user, scanning said multi-dimensional dynamic barcode, extracting data from said barcode, and combining said barcode with user credentials stored on a mobile communications device and generating a second one time access challenge.

[0024] It is to be understood that both the foregoing description and the following description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] FIG. **1** is a block diagram describing the various components of an embodiment invention and depicting an example of an out-of-band outbound multichannel authentication.

[0026] FIG. **2** is a schematic block diagram of an embodiment of a handheld portable communication device.

[0027] FIG. **3** is a schematic block diagram of embodiment of an authentication application that may reside in the handheld portable communication device described in FIG. **2**.

[0028] FIG. **4** is a block diagram showing the authentication process based on an embodiment of the present invention.

[0029] FIG. **5** is a block diagram illustrating one example of two separate communication channels in present invention.

[0030] FIG. **6** is a sequence diagram describing the authentication flow based on invention as depicted in FIG. **8**.

[0031] FIG. **7** is a block diagram showing the flow and authentication process based on an embodiment of the present invention.

[0032] FIG. **8** is a diagram depicting one embodiment of the invention wherein the communication channels involve connection through a Wi-Fi.

[0033] FIG. **9** is a diagram depicting one embodiment of the invention wherein the communication channels involves connection through a phone network.

[0034] FIG. **10** is a diagram depicting an embodiment of authentication process of the present invention involving cardless Bank ATM.

[0035] FIG. **11** is a diagram depicting an embodiment of an authentication process of the present invention involving a protected corporate intranet.

[0036] FIG. **12** is a diagram depicting an authentication process of the present invention involving P2P Payments.

[0037] FIG. **13** is a flow chart depicting an end user provisioning process.

DETAILED DESCRIPTION OF THE ILLUSTRATIVE EMBODIMENTS

[0038] FIG. **1** is a first illustrative embodiment of a system and process according to the invention. In particular, FIG. **1** shows an embodiment of an authentication system that utilizes out-of-band outbound multichannel authentication. In this particular embodiment, a user can access or open a login portal on a service client **217**, also known as an online service client or a remote client, for example a PC or a laptop. ATM machines, iPads and Tablets are other examples of devices that could function as service clients. As used herein, "online service portal" may also be referred to as a "login portal." Accordingly, the Service Client **217** can transmit E**1** a request to the Service Server **214** to open the login portal. User identification information is transmitted from the login portal to a third party server **214**. Examples of third party servers that may be used in the present invention include service servers or web servers, and other desired target machines or services that the user is trying to authenticate to. Examples of user identification information can include user's name, user id, ISP address, credit card number, account number, and phone number.

[0039] A login page or a barcode is generated. In one embodiment of the invention, web based access is provided wherein the login page can be provided with a barcode which is dynamically generated. In another embodiment of the invention, a VPN client is provided which is residing on the Service client, and just the barcode may be generated by the VPN client. In a further embodiment, the step of generating the bar code E**2** is performed by the service server along with the login page.

[0040] The step of generating the barcode or login page includes generating a barcode using the user identification information and encrypting third party credentials of the service server **214**. Examples of third party credentials include third party identification information, service server IP address, authentication server IP address and a one-time password, or randomly generated one-time key.

[0041] The barcode can have many forms. For example, it can be a multi-dimensional dynamic barcode, such as a QR code. In a preferred embodiment, the step of generating a barcode includes generating a multidimensional dynamic barcode based on a preconfigured user identifier.

[0042] The barcode is transmitted E**2** from the service server **214** through a communications channel to the Service Client **217**. Examples of communications channels can include Wi-Fi networks, LAN connections, wireless phone networks (GRM, 3G, 4G, etc), Internet connections, or telephone line connections, or combinations thereof. The barcode or login page is then displayed by the service client **217**.

[0043] A portable communication device **201**, such as a mobile phone, iPad, tablet, portable scanner, or other handheld device, captures E**3** the barcode. A schematic block diagram of an exemplary portable communication device or hand held device is shown in FIG. **2**.

[0044] The barcode is decoded and the third party credentials are decrypted to obtain user information and third party server credentials. In one embodiment, the barcode is decoded by the portable communication device **201**. Decoding including programming to decoding of the barcode, for example extracting information from a two-dimensional barcode. Decryption processes include programming for taking that decoded data which is encrypted and extracting any encrypted information from it.

[0045] The user information and the third party credentials are transmitted E**4** by the portable communication device **201** to an authentication server **213** through a secure channel. In one embodiment, the secure channel is an outbound, out-of-band communications channel. Out-of-band refers to utilizing a separate channel, being different from the primary channel, simultaneously used to communicate between devices or end points for the purpose of critical data transfer or exchange without the involvement of the primary channel. In one embodiment, a first communication channel is out-of-band using logically a separate communications channel than that of a second communications channel such as can be provided using CDMA. In a further embodiment, the first communication channel is out-of-band using a physically separate communications channel from that of the second communications channel such as providing the channel on a separate frequency, such as FDMA, or over a physically separate transmissions media. In a further embodiment, the out-of-band channel has an origination point that is different than that of

the original request, data, or information transfer. In another embodiment, the communications channels need not be physically separate along all portions of the communication channel to constitute out-of-band so long as the communication channels are separate and independent. In addition, or in an alternative embodiment, only a portion of the communications channels need to be separate and independent of the communications channel used to transmit the barcode or login page. Examples of different out-of-band communication channels are shown throughout the drawings, for example by elements **121** and **122**, wherein a first communication channel **121** is out-of-band with respect to a second communication channel **122**. In addition, or in an alternative embodiment, the out-of-band communication channels are separate from the connection point of view (i.e. do not have knowledge of each other). In an alternative embodiment, the out-of-band outbound system is out of network from the original stream and it is a push from the portable device to the server. For purpose of this invention in band refers to using the same communication channel or loop

[0046] The authentication server **213** compares the user information and the third party server credentials to a database of user information and a database of third party server credentials. The authentication server **213** authenticates the user information and the third party server credentials to obtain authentication results. The authentication server **213** transmits E**5** the authentication results to the service server **214** and can also transmit E**6** the authentication results to the portable communications device **201**. The service server **214** also transmits E**7** the authentication results to the service client **217**. If the authentication results are positive, a secure communication may be established between the service client **217** and the service server **214**, and the service client **217** may be granted access by the service server **214**. Alternatively, if the authentication results are negative, the service client **217** is denied further access to the service server **214**.

[0047] In one embodiment, the service client **217** has a Virtual Private Network (VPN) client program with a preconfigured user identifier. In another embodiment the service server **214** is a Virtual Private Network (VPN) server. It may include VPN server credentials. In one embodiment, the service server **214** can generate a multi-dimensional dynamic barcode based on a VPN server credentials and a first one time access challenge thereby uniquely identifying the online server. It can be appreciated by those of ordinary skill in the art that an access challenge can include a request for additional information from the user such as a secondary password, PIN, or token.

[0048] FIG. **2** illustrates the components of an embodiment of a portable communication device **201** according to the invention, such as a hand held device like a mobile phone or an iPad. The portable communications device can include various components, including a processor **2**, memory **3**, power unit **4**, keyboard **5**, camera **6**A, a near field communication ("NFC") unit **6**B, LCD Display **7** and a communications unit **8**. The device also has an operating system **10** which includes programming for the processes utilize by the device, including programming for secure communication **11**, a data storage **12** as well as a sandbox **15**, containing an authentication application **14** and other applications **13** to supplement the processes of the authentication application **14**. The sandbox provides a security mechanism for separating running programs and thereby enhances the security of a device according to the invention. Incorporation of an NFC unit **6**B in a device according to the invention facilitates use of a device according to the invention by a user in a manner which can make the underlying processes appear seamless. It can be appreciated by a person of ordinary skill in the art to use known processes for the device including processes for providing secure communication **11** by the device **201** to provide for secure receipt and transmission of information. Containing applications **13** include software (and may be hardware capabilities/applications/libraries on the phone) that provide capabilities like picture taking and touch sensitive activity detection.

[0049] FIG. **3** illustrates an embodiment of an authentication application having processes that may reside in the handheld portable communication device described in FIG. **2**. It can be appreciated by a person of ordinary skill in the art that various programming can be provided to effect the processes of an device **201** according to the invention. The processes can be programmed into one or more separately discrete units. Among other things, a secure data storage **20** process can be provided to effect secure storage and retrieval of information from memory **3** on the device **201**. Among other things, the secure data storage **20** can include one or more shared secret keys associated with one or more service servers **214**. In addition, a one time password ("OTP") generator **22** can be provided which generates one or more one time passwords for use with the processes performed by the device **201**. Additionally, a OTP validator **23** can be provided which validates the OTP passwords used by the processes performed by the device **201**. The authentication application **14** can also include separate processes for managing and storing other information, such as user credentials **24**, a user pin **25**, user secret key **26**, and an authentication server shared secret key **27** which can be stored in the secure data storage **20** or in other portions of the memory **20**. Furthermore, the device **201** includes processes for a barcode scanner and decoder **28** and a barcode encoder **29**, which processes can be provided separately or as part of the authentication application **14** process software. The components and arrangements of FIGS. **2** and **3** may be varied within the principles of the present application.

[0050] FIG. **4** and FIG. **5** illustrate how an embodiment of an authentication system and process according to the present invention communicates. The authentication server **213** communicates with a provider database **111** and can also communicate with a user database **110**. The provider database **111** includes information related to each service provider server **214**, such as identification information of the service client **217**, third party server credential information and security information such as shared keys. The user database **110** includes information related to each user and/or user device **201** such as identification information of the user or device **201** and security information such as shared keys. The authentication server **213** can also include a OTP validator **112** which validates the OTP passwords used by the processes performed by the authentication server **213**. The authentication server **213** can be provided to communicate to the service client **217**, handheld device **201** and service server **214** over communication channels including the Internet **116**. In addition, or in the alternative, the authentication server **213** can be provided to communicate to the service server **214** directly. As discussed above, the handheld device **201** can include a barcode scanner, OTP generator and an OTP validator and in an alternative embodiment, the barcode scanner **28**, the OTP

generator **22**, and/or the OTP validator **23** can be provided separately from the handheld device **201**.

[0051] FIG. **5** illustrates one example of the two separate communication channels in present invention that are used for authentication process. The handheld device **201** communicates with the authentication server **213** over a communications channel **121** which is separate from the communications channel **122** over which the service client **217** and service server **214** communicate. In one embodiment of a system and process according to the invention, at least the out-bound portions of communications from the handheld device to the authentication server are provided in a separate communications channel and are out-of-band from the communication channel **122** over which the service server **214** and service client **217** communicate.

[0052] FIGS. **6** and **7** illustrate an authentication process according to the present invention. A user opens an online service portal **130** by interacting with a service client **217**. The service client **217** sends a request **131** to the service server **214**. The service server **214** generates **132** a OTP and creates a multi dimensional barcode or other barcode. The barcode is encoded and/or encrypted with server and/or client credentials and a OTP. The barcode can be embedded in the login page between the service server **214** and the service client **217**. Alternatively, the service provider server **214** can transmit a barcode to the service client computer **217** to be utilized at a screen page supporter by the service client **217**.

[0053] During the process, the user can begin authentication **135** by providing authentication information, such as by entering a PIN on the handheld device **201**. The handheld device **201** can validate the PIN and display to the user an option to scan a barcode **136**. The user, using a portable communications device **201**, such as a smart phone, scans the barcode **137** provided by the service client. The barcode has essential data to validate the server and create the OTP for the service client **217**. The smart phone generates a OTP and other credentials to validate **138** the user and transmits the information to the authentication server **213**. Authentication occurs via a secure communications channel with an authentication server **213**. The Service Provider Authentication Server **213** then authenticates **140** the user credentials by matching the credentials and other information with corresponding information in the user database and also validates the OTP. Thereafter, the authentication server **213** transmits **140** a message via a secure outbound channel to the handheld device which is out-of-band with the communication channel connecting the authentication server **213** and the service server **214** indicating if the authentication was successful or not. The authentication server **213** can transmit whether not the authentication was successful to both the service server **214** and to the handheld device **201**, which can display the results to the user. If the authentication was successful and the user is valid, a secure communication channel between the service provider **214** and the client **217** is established and the user is granted access to the desired next page.

[0054] FIGS. **8** and **9** illustrate additional embodiments of a system and process according to the invention utilizing different out-of-band communication channels. For example, here the communication channels are out-of-band even though they share the same Wife transmission medium and connection because at least a portion of the connection is separate and independent. The actual point to point connection is independent of the physical devices that it uses to create the connection.

[0055] FIG. **10** illustrates an alternative embodiment of the invention involving a cardless ATM machine. A bank consumer can interact with the screen of a service client **217**. For example, a user touches a bank ATM **417** screen to activate the cardless ATM E**1**. The cardless ATM displays a dynamic authentication barcode E**2**. The user scans the barcode E**3** with a portable communications device **201** which captures credentials and challenges (PIN, biometrics, among other things). The portable communications device **201** decodes and validates the cardless ATM using the decoded information E**8**. Once the validity of the ATM is ensured, the handheld device generates a OTP E**4**. The handheld device **201** then establishes an independent secure out-of-band outbound channel to the authentication server **213** which is out-of-band with the communication channel between the authentication server **213** and the service server **214**. The handheld device then sends user credentials and the OTP E**4** to the authentication server **213** directly using the secure out-of-band channel. The authentication server validates the user based on the OTP. If the authentication server finds the user credentials valid, it contacts the service server **214**, such as a Bank ATM Switch **414**, and indicates that user authentication was successful E**5**. If the user authentication was successful, a secure connection is established with the Bank ATM Switch **414** and the user is allowed access to the account.

[0056] FIG. **11** is an embodiment of an authentication process of the present invention with an enterprise solution, such as a virtual private network ("VPN"). In this embodiment, the user starts the VPN client on the user's computer E**1**. The VPN client contacts E**9** the service server **214**, such as enterprise firewall or VPN gateway **514**. W VPN Gateway **514** generates the barcode with encoded and/or encrypted server credentials E**2**. The VPN client then displays the barcode to the user E**12** which can then capture the credentials and challenges (PIN, biometrics, etc) E**3**. In the event that authentication is successful E**7**, the VPN gateway **514** can open a VPN tunnel E**11** and establish a secure communication with the VPN client **217**.

[0057] FIG. **12** is a diagram depicting an embodiment of an authentication system and process of the present invention involving Person to Person payments using smart phones. Here, the process of out-of-band authentication is used by one user to make payments to another user who is also using the same software of the smart phone. In this example a first user, such as a payer **611** desires to pay second user, such as a payee **612**. The payee decides how much money he desires to receive for the transaction and enters the information into the payee's handheld device **602**. Once the payee is ready to generate the charge, the payee may direct the smart phone **602** to generate an invoice with details of the charge. The payee handheld device **602** can capture the invoice as well as challenges (PIN, biometrics, among other things). A user, such as a payer **611** utilizes their handheld communications device **601** to initiate a payment. The handheld communications device **601**, such as a smart phone, since the payee credentials and payer credentials as well as payer payment gateway information to a service server **214**, such as a payee payment Gateway server **614**. The payee payment gateway **614** sends payer account information and payer OTP to the payer payment gateway **613** in order to validate the information. The payer payment gateway **613** validates the information and sends notification of whether or not the payer account has been validated to the payee payment gateway **614**. If the information has been validated the payee payment gateway

614 can direct a third-party, such as a payer bank **615**, to a second third-party, such as a payee bank **615**. Once the payment is completed, the payee payment Gateway **614** can inform the payer smart phone **601** of transfer of payment.

[0058] FIG. **13** is a flow chart depicting the process of provisioning the portable communications device **201**, such as a smartphone, with the right credentials. At a login screen, the user can login to the device **201** using their existing credentials **701**. The portable device **201** can provide the user with the opportunity to choose to use an authentication solution according to the system **702**. If the user chooses the authentication solution, the device **201** can download authentication client software. Once the software has been downloaded by the device **201**, the software prompts the device **703** to generate a barcode based on user credentials, OTP seeds such as server and smartphone information, encryption keys and certificates, among other things. In addition once the software has been downloaded to the device **201**, a smartphone application can be loaded onto the device **201** which can permit the user to scan a barcode and extract the information from the barcode **704**. The smartphone application can then contact the provisioning server to populate the necessary credentials **705**.

[0059] In an alternative embodiment, the invention involves a client/server system that comprises an authentication server, online service server, an online service client and a user hand held mobile device equipped with a camera with online authentication client, all of which are connected via a network. The authentication server has a system to generate OTP based on a pre-provisioned shared secret key. The online service server and the authentication server achieve mutual secure connection based on asymmetric keys. The online service client and the online service server are also connected via a network and achieve mutual secure connection using asymmetric keys or using SSL or any other means of securing the communication. The handheld device may also be connected to the network and can connect to the authentication server in a secure manner using pre-specified asymmetric keys or shared secret. The handheld device and the authentication server share common secret. Shared secret is used is also called the symmetric key. This is a method used by the invention for securing the communication.

[0060] In an alternative embodiment of the present invention, a user who wants to login to the service provider online service server, opens the login portal on the online server and provides just the user name. In other embodiments, the login portal may be provided or maintained by service client, the login portal or by the service server. The login portal is opened on the service client to access the service server. In one embodiment of a system according to the invention, when a user uses a browser and enter in address of a portal on the service client in the browser to access the server facilities. The online server generates a multi-dimensional dynamic barcode based on online service client/server credentials and OTP so as to uniquely identify the online server and presents it on the login page, either as an alternative or as a replacement of login/password. In addition, or in the alternative embodiment, other methods can be used instead of OTP, such as one-time authentication & certification (OTAC). The user scans the multi-dimensional barcode using the hand-held device that includes an online authentication client or authentication application and a camera. The online authentication client on the hand held device decrypts/decodes the barcode to ensure the validity of the online server. This unique client validation mechanism helps ensure there are no phishing attacks. Once the validity of the server is ensured, the online authentication client takes the extracted data from the barcode, combines it with the user credentials stored on the hand held device and generates a new OTAC. The handheld device then establishes an independent secure connection over carrier network wireless connection or Wi-Fi connection to the authentication server using pre-specified asymmetric keys or shared secret. The hand held device then sends user credentials and the OTAC to the authentication server directly using this secure out-of-band channel. The authentication server validates the user based on the OTAC, shared secret and user credentials. If the authentication server finds the user credentials valid, it contacts the online service server and passes the user credentials as well as user roles/privileges. Based on the user roles/privileges the online service server can automatically provide access to the allowed service components for which the user has been authorization.

[0061] In this embodiment, the user only needs to scan the barcode presented on the login screen with the handheld device in order to login and be authorized to proceed to the next screen based on the user rights.

[0062] In alternative embodiments, the invention can be used for re-authentication, such as during long sessions or when additional security may be warranted. For example, the user may scan the barcode to validate a transaction and/or keep the current session going.

[0063] In an alternative embodiment of the present invention, the inventive methods and systems may work with existing service provider SSL infrastructure. In another alternative embodiment, the present invention can be utilized in place of SSL infrastructure.

[0064] In an alternative embodiment of the invention, the user never enters any credentials on the browser, thereby making a Trojan that infects the internet browser software and is capable of drastically modifying transaction contents from within the browser ineffective.

[0065] In an alternative embodiment of the invention, the out-of-band outbound mechanism provides an additional level of security due to the original request being different than the outgoing push from the portable device to the service provider server.

[0066] Other embodiments of the invention will be apparent to those skilled in the art from consideration of the specification or learned by practice of the invention disclosed herein. It is understood that intended that the specification and examples are exemplary and explanatory only and are not intended to restrict limit the invention as claimed.

1. A method for authentication in a system comprising a user, a service client, a service server, a portable communications device, and an authentication server, wherein the method comprises:

providing a login portal for access by a user, said login portal being in communication with said service server;

transmitting user identification information from the login portal to the service server;

generating a barcode at the service server, wherein the step of generating the barcode includes generating a barcode using the identification information and encrypting third party credentials of the service server,

transmitting the barcode by the service server to the service client through at least a first communications channel;

displaying the barcode by the service client;

capturing the barcode with a portable communications device;

decoding the barcode and decrypting the third party server credentials to obtain user information and third party server credentials;

transmitting the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device;

the authentication server comparing the user information and third party server credentials to a database of user information and a database of third party server credentials, and the authentication server authenticating the user information and third party server credentials to obtain authentication results;

the authentication server transmitting the authentication results to the service server;

the service server transmitting the authentication results to the service client; and

the service client and the service server establishing a secure communication if the authentication results are positive.

2. A method according to claim **1** wherein the login portal is provided at the service client for receiving information for the user, and wherein the service client has a VPN client program with a preconfigured user identifier.

3. A method according to claim **2** wherein the step of generating a barcode includes generating a multi-dimensional dynamic barcode based on said preconfigured user identifier.

4. A method according to claim **2** wherein the service server is a VPN server and said VPN server includes VPN server credentials, and wherein the step of generating a barcode includes generating a multi-dimensional dynamic barcode based on a VPN server credentials and a first OTP thereby uniquely identifying the service server.

5. A method according to claim **4** further comprising the steps of the portable communications device combining said barcode with stored user credentials stored on the portable communications device;

the portable communications device generating a second one time access challenge; and

the portable communications device sending user credentials and the second one time access challenge to the authentication server via a secure out-of-band communications channel.

6. A method according to claim **5**, wherein the step of transmitting the user information and third party server credentials to an authentication server via an out-of-band communications channel, includes establishing an independent secure connection between said mobile communications device and said authentication server using pre-specified asymmetric keys or shared secrets.

7. A method according to claim **5**, further comprising the steps of the authentication server validating the mobile communications device based on a selection of the group consisting of the second one time access challenge, shared secrets and user credentials; and the authentication server transmitting validation information to the service server, said validation information selected from the group comprising successful and failed validation.

8. A method according to claim **1** wherein the step of generating said barcode is performed by the service server.

9. A method according to claim **1** wherein the step of capturing the barcode includes using a portable communications device having an online authentication client and a camera.

10. A method according to claim **9** wherein the step of decrypting said barcode and combining of data extracted from said barcode is performed by said online authentication client.

11. A method according to claim **1** wherein the step of providing a login portal for access by a user is performed either by the service client or by the login portal or by service server.

12. A method according to claim **1** wherein the step of providing a login portal includes receiving identification information from the user by the login portal.

13. A method according to claim **1** wherein said login portal is maintained by service server.

14. A method according to claim **1** wherein said login portal is programmed to receive the user identification information.

15. A method according to claim **1** wherein the third party credentials include third party identification information, service server IP address, authentication server IP address, one-time password, or randomly generated one-time key.

16. A method according to claim **1** wherein the step of displaying the barcode is performed by the service client or by the login portal or by service server.

17. A method according to claim **1** wherein the step of decoding the barcode is performed by the portable communications device.

18. A method according to claim **1** wherein said portable communications device is programmed to decode and/or decrypt the barcode and/or third party credentials.

19. A method according to claim **1** wherein the step of the authentication server transmitting the authentication results to the service server includes transmitting the authentication results via a second communications channel, and wherein the step of transmitting the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device is out-of-band with respect to the second communications channel.

20. A method according to claim **1** wherein the step of the service server transmitting the authentication results to the service client includes transmitting the authentication results via a third communications channel, and wherein the step of transmitting the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device is out-of-band with respect to the third communications channel.

21. A method according to claim **19** wherein the step of transmitting the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device requires communication though at least a portion of the outbound out-of-band communications channel that is logically separate from a logical connection over a multiplexed medium used by the second communications channel.

22. A method according to claim **19** wherein the step of transmitting the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device requires communication though at least a portion

of the outbound out-of-band communications channel that is physically separate transmissions medium than that used by the second communications channel.

23. A method according to claim **20** wherein the step of transmitting the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device requires communication though at least a portion of the outbound out-of-band communications channel that is logically separate from a logical connection over a multiplexed medium used by the second communications channel.

24. A method according to claim **20** wherein the step of transmitting the user information and third party server credentials to an authentication server via a outbound out-of-band communications channel by the handheld communications device requires communication though at least a portion of the outbound out-of-band communications channel that is physically separate transmissions medium than that used by the second communications channel.

25. An authentication system for use in a communications network with a third party service server, said authentication system comprising a mobile communication device and an authentication server,

wherein the authentication server comprises a communications unit, including a transmitter and a receiver; a processor; and a storage unit; and programming for

storing user credentials and associated mobile communication device information;

accepting a secure connection from the mobile communications device using security measures selected from the group of shared secrets, digital certificates and encryption mechanisms;

accepting an authentication request from a service server and associating the authentication requests with the associated mobile communication device information; and

wherein the mobile communication device comprises a communications unit, including a transmitter and a receiver; a processor; and a storage unit; and programming for:

communicating with the authentication server using an out-of-band communications channel,

encrypting and decrypting of information selected from the group comprising shared secrets, digital certificates, user credentials and OTP generation keys;

generating a multi-dimensional dynamic barcode based on service server credentials and a first one time access challenge so as to uniquely identify the service server,

presenting said multi-dimensional dynamic barcode to a user,

scanning said multi-dimensional dynamic barcode,

extracting data from said barcode, and

combining said barcode with user credentials stored on a mobile communications device and generating a second one time access challenge.

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