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(54) **VIRTUAL DESKTOP IN A COMPUTER NETWORK**

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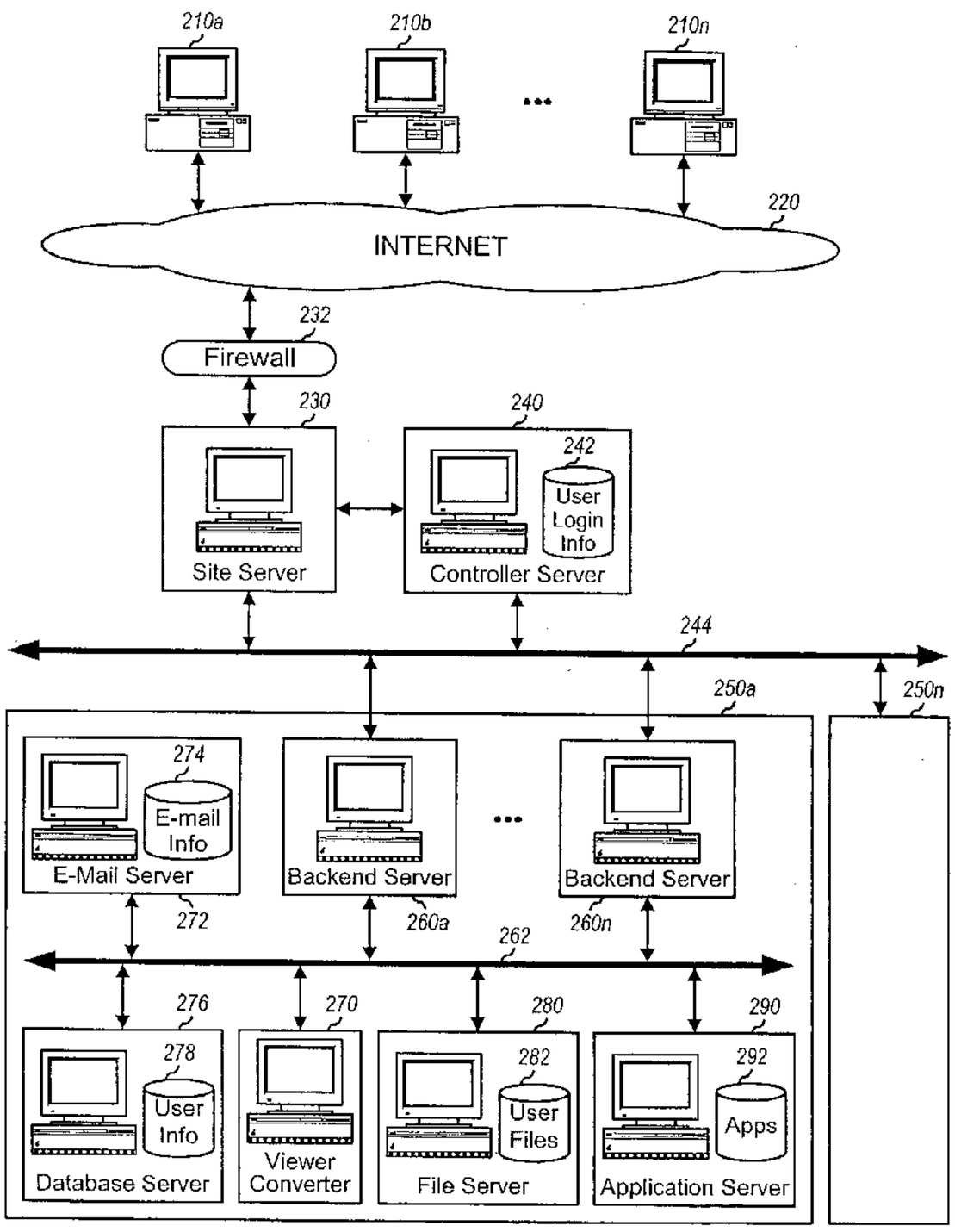
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(57) **ABSTRACT**

A network of servers coupled to the Internet provides a virtual desktop in a virtual computing environment. A user is able to access the virtual desktop from a variety of systems through various communications links. A site server initially receives a URL access from the user at a local system. After a successful login, a personal web page of the user is retrieved from a file server and returned to the local system. Through the personal web page, the user is able to send commands that are received and processed by one or more backend servers. The web page represents the virtual desktop of the user and includes links for applications available to the user, files and folders accessible by the user, and other personal information of the user. The network provides facilities to manipulate and manage files, and facilities to access and process data from web sites on the Internet.



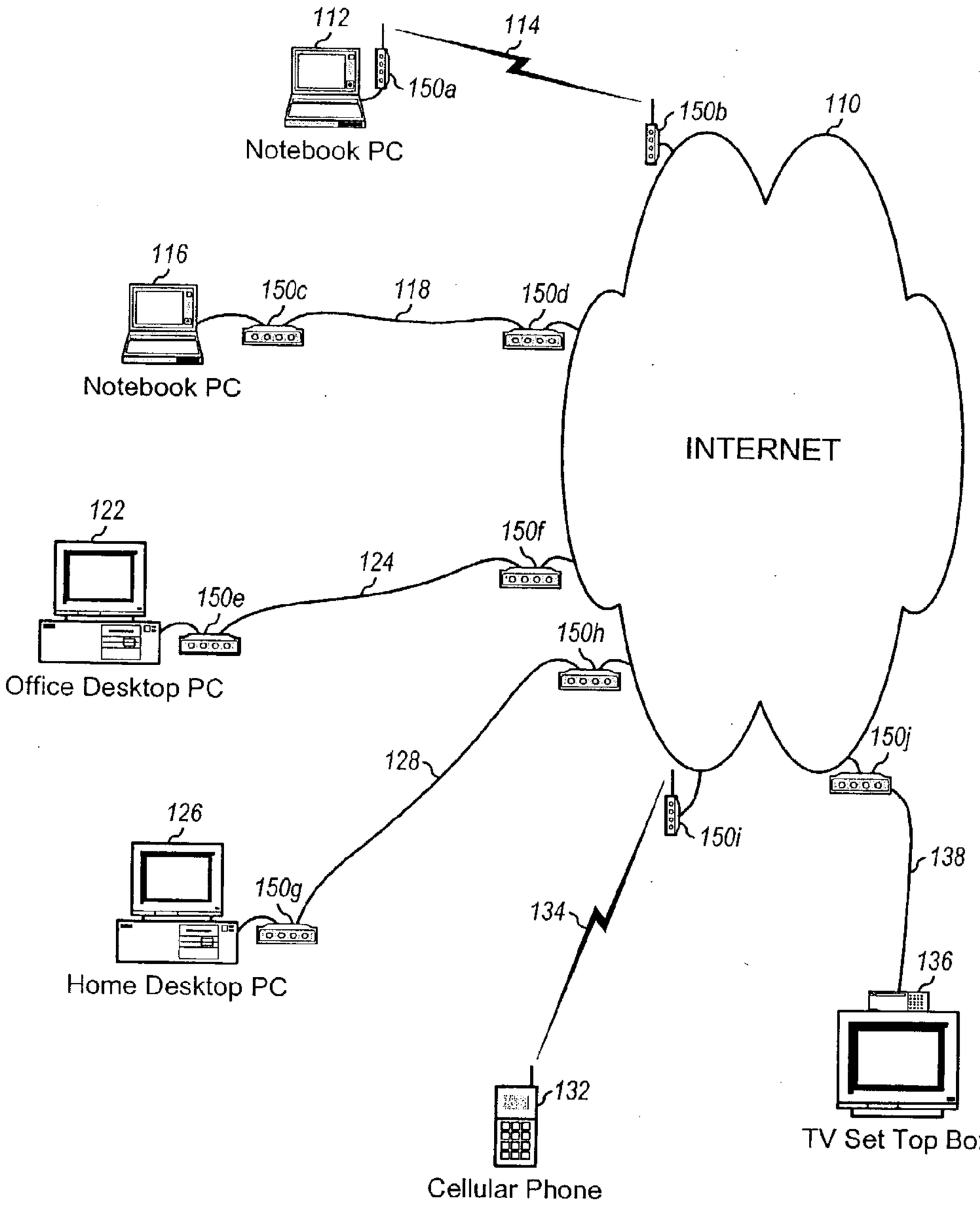

112
114
150a
Notebook PC
150b
110
116
150c
118
150d
Notebook PC
INTERNET
122
150f
124
150e
Office Desktop PC
150h
128
150j
126
150g
150i
138
134
136
Home Desktop PC
132
TV Set Top Box
Cellular Phone

FIG. 1

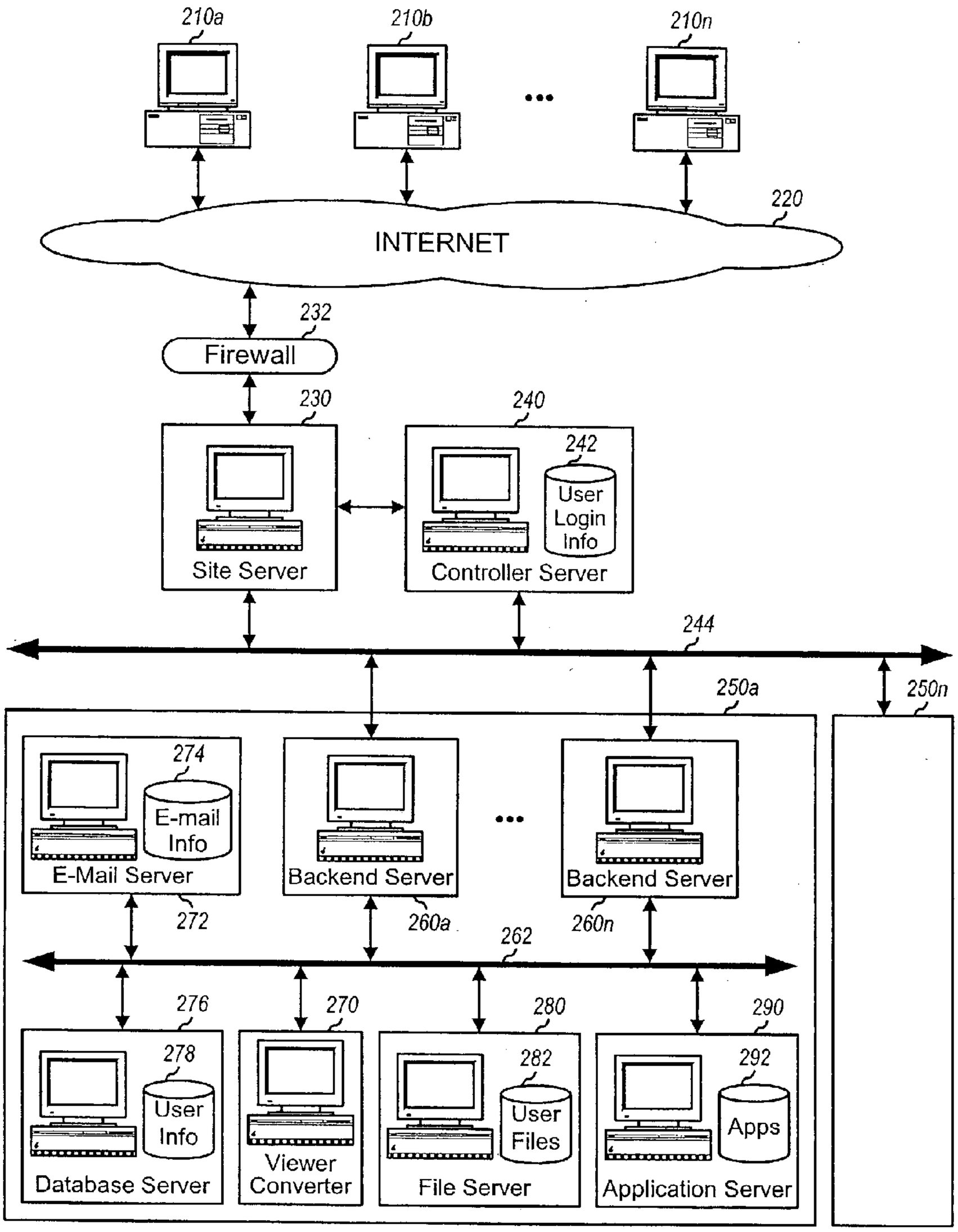

210a
210b
210n
220
INTERNET
232
Firewall
230
240
242
User Login Info
Site Server
Controller Server
244
250a
250n
274
E-mail Info
E-Mail Server
Backend Server
Backend Server
272
260a
260n
262
276
270
280
290
278
User Info
282
User Files
292
Apps
Viewer Converter
Database Server
File Server
Application Server

FIG. 2

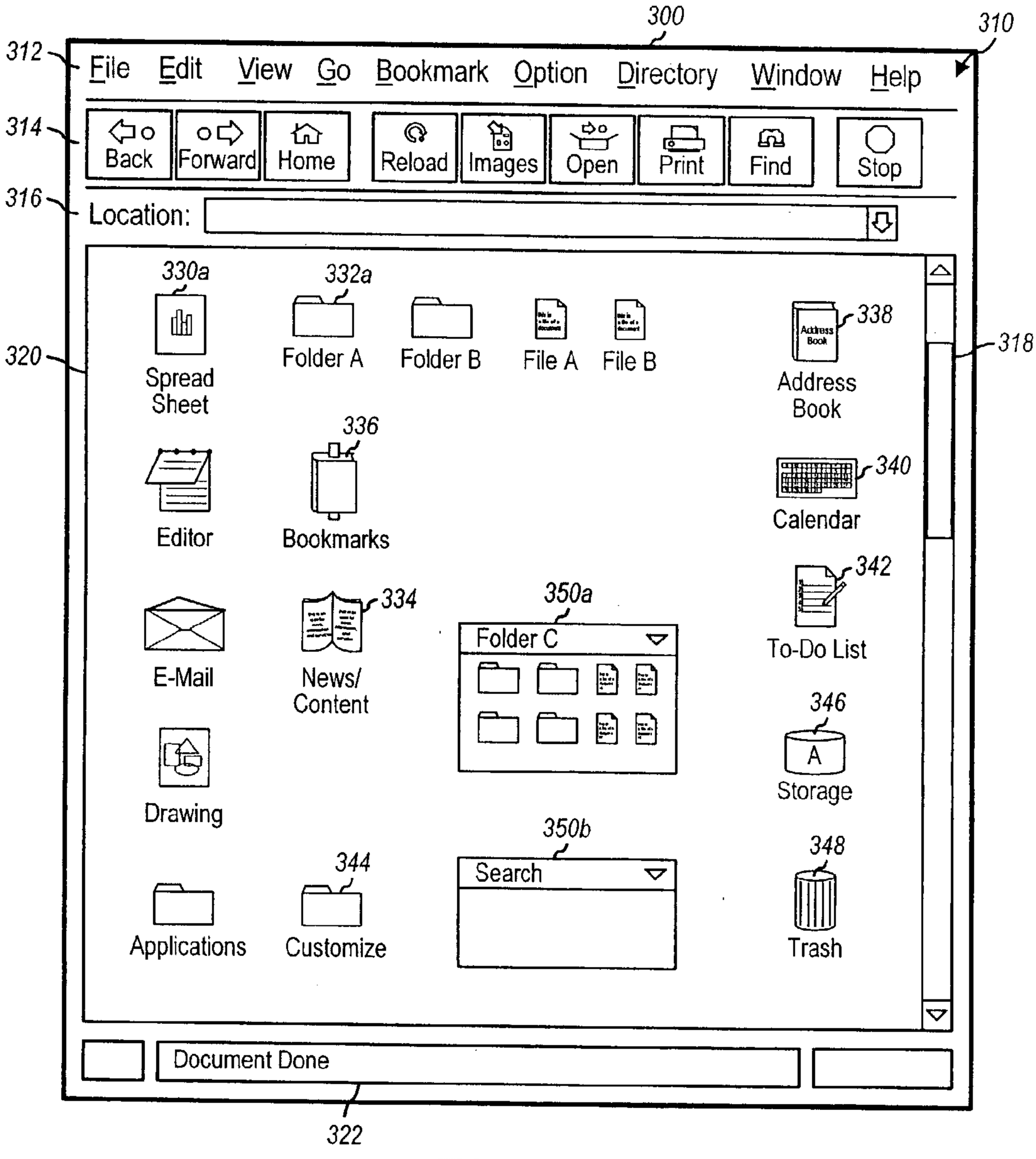

300
310
312
File Edit View Go Bookmark Option Directory Window Help
314
Back
Forward
Home
Reload
Images
Open
Print
Find
Stop
316
Location:
320
318
330a
Spread Sheet
332a
Folder A
Folder B
File A
File B
338
Address Book
336
Editor
Bookmarks
340
Calendar
342
To-Do List
334
E-Mail
News/ Content
350a
Folder C
346
A
Storage
Drawing
350b
Search
344
348
Applications
Customize
Trash
Document Done
322

FIG. 3

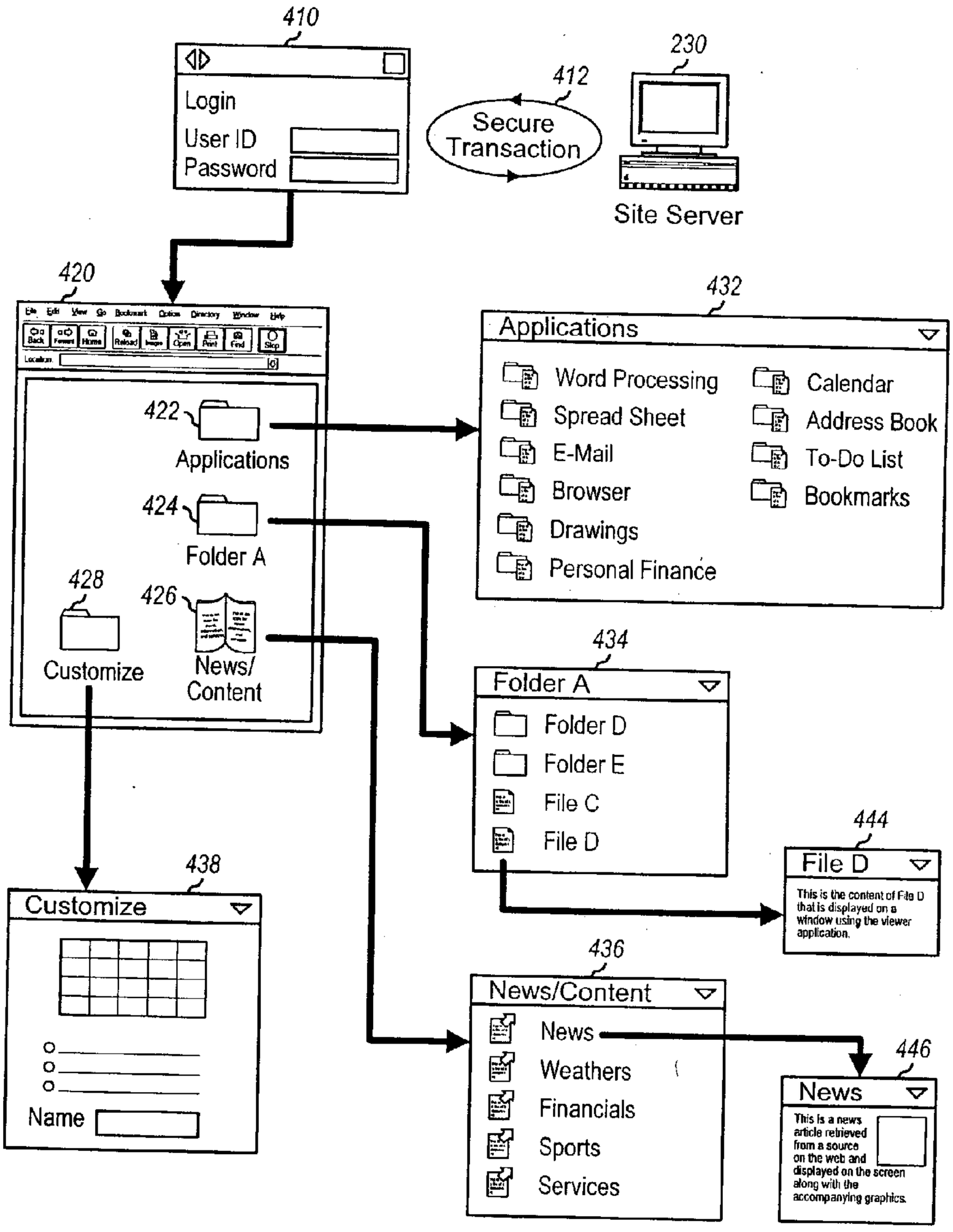

410
Login
User ID
Password
412
Secure Transaction
230
Site Server
420
422
Applications
424
Folder A
428
Customize
426
News/ Content
432
Applications
Word Processing
Spread Sheet
E-Mail
Browser
Drawings
Personal Finance
Calendar
Address Book
To-Do List
Bookmarks
434
Folder A
Folder D
Folder E
File C
File D
444
File D
This is the content of File D that is displayed on a window using the viewer application.
438
Customize
Name
436
News/Content
News
Weathers
Financials
Sports
Services
446
News
This is a news article retrieved from a source on the web and displayed on the screen along with the accompanying graphics.

FIG. 4

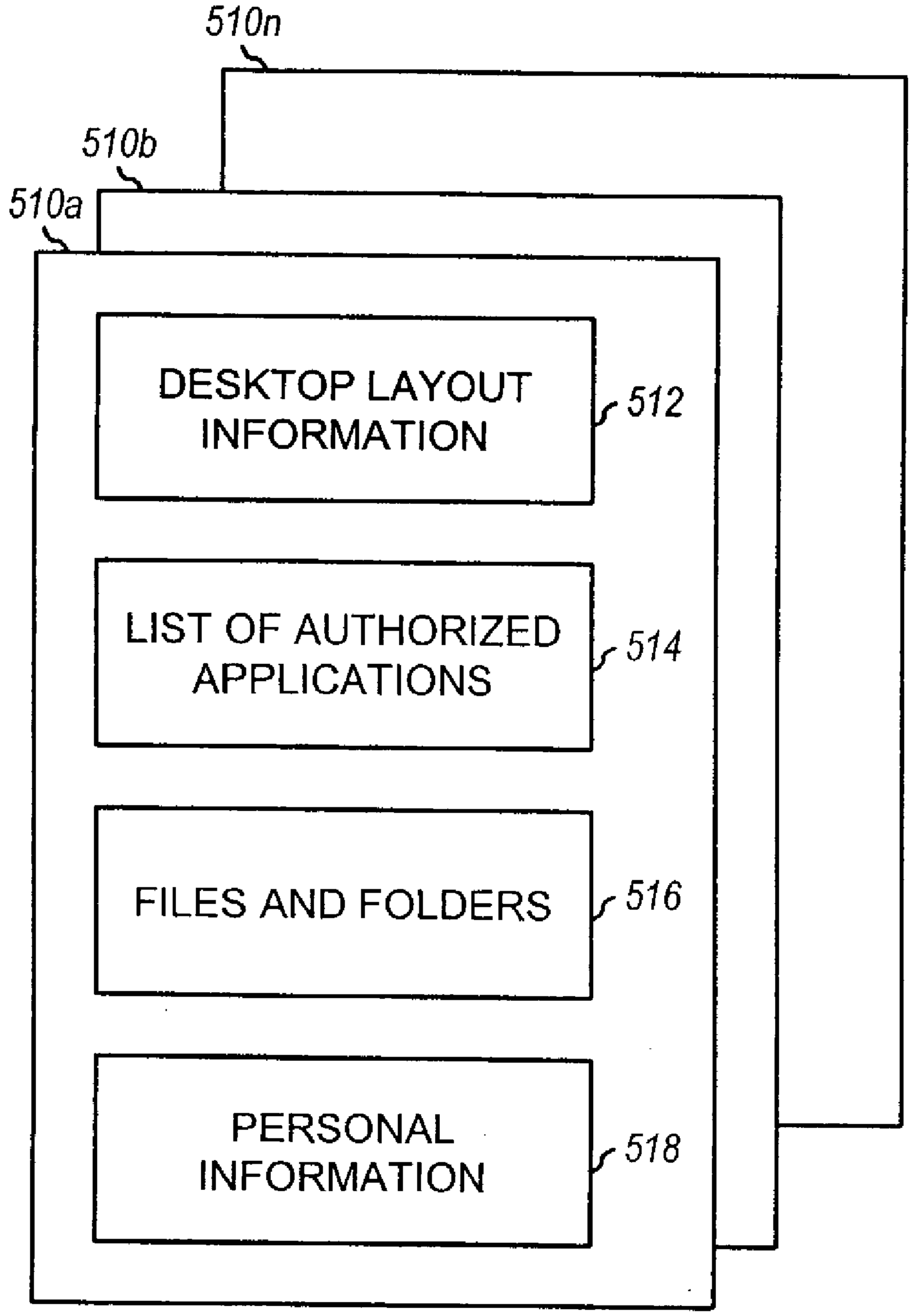

510n
510b
510a
DESKTOP LAYOUT INFORMATION
512
LIST OF AUTHORIZED APPLICATIONS
514
FILES AND FOLDERS
516
PERSONAL INFORMATION
518

FIG. 5

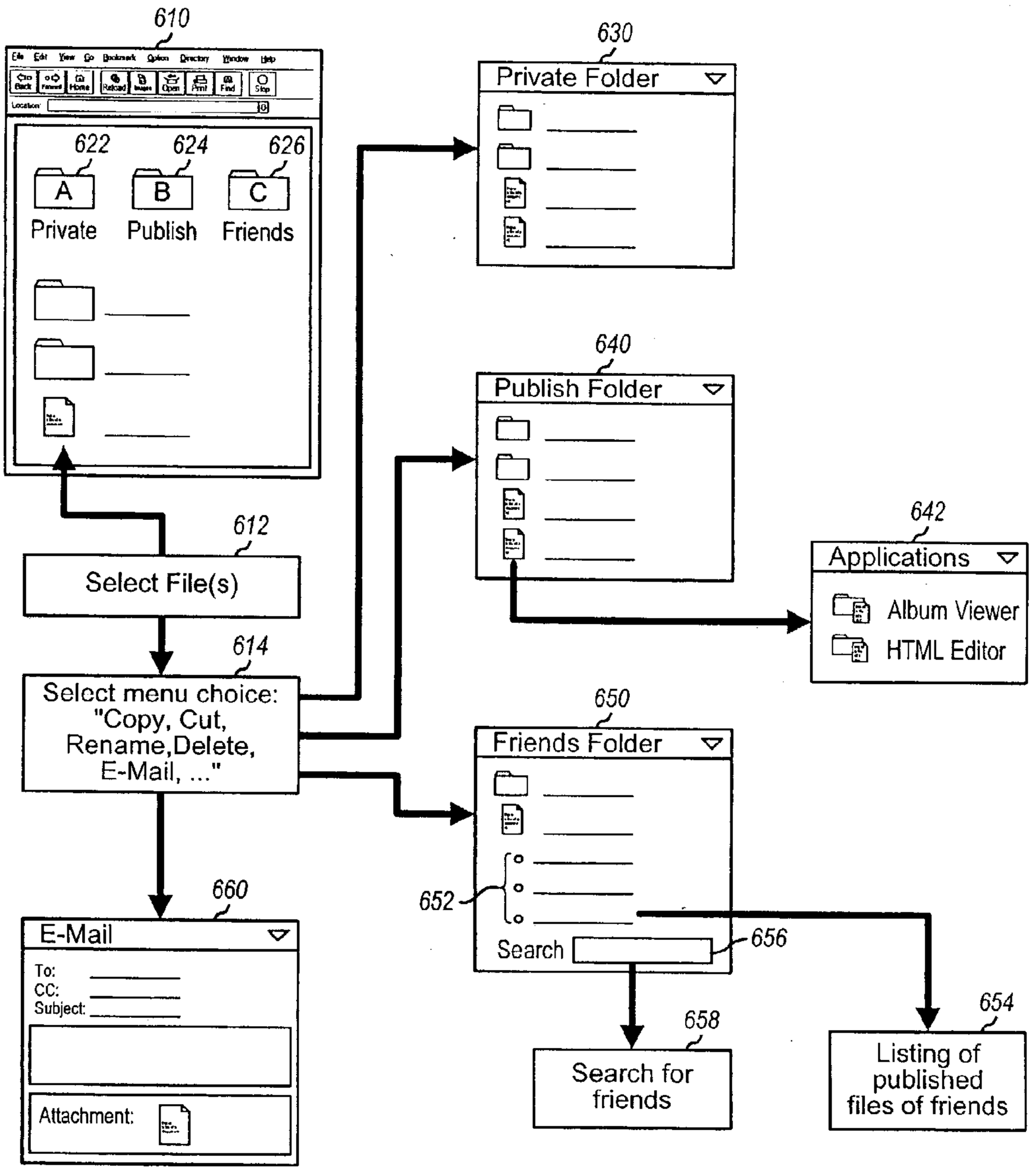

610
622
624
626
A
B
C
Private
Publish
Friends
612
Select File(s)
614
Select menu choice: "Copy, Cut, Rename,Delete, E-Mail, ..."
660
E-Mail
To:
CC:
Subject:
Attachment:
630
Private Folder
640
Publish Folder
642
Applications
Album Viewer
HTML Editor
650
Friends Folder
652
Search
656
658
Search for friends
654
Listing of published files of friends

FIG. 6

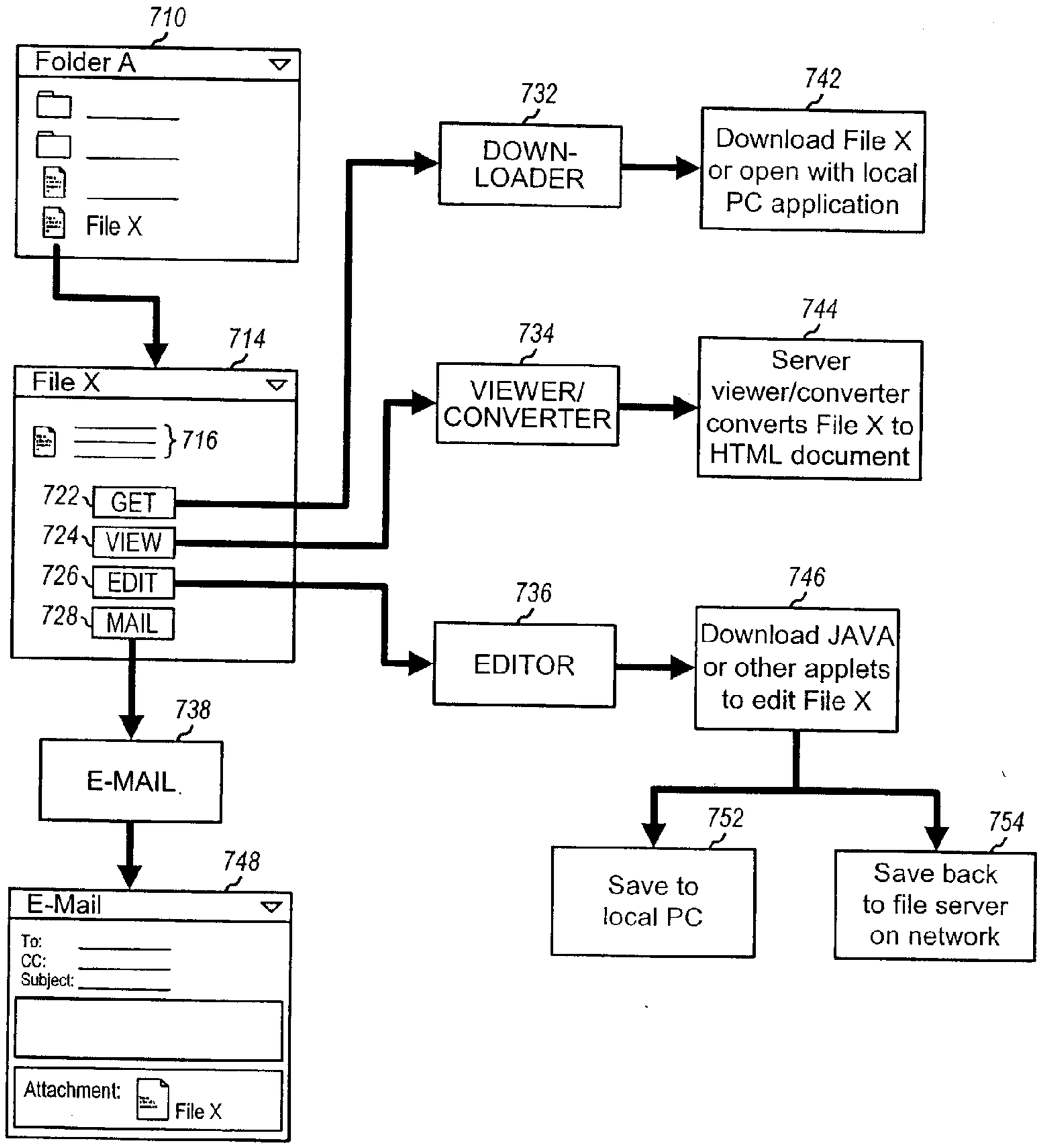

710
Folder A
File X
714
File X
716
722 GET
724 VIEW
726 EDIT
728 MAIL
732
DOWN-LOADER
Download File X or open with local PC application
742
734
VIEWER/ CONVERTER
Server viewer/converter converts File X to HTML document
744
736
EDITOR
Download JAVA or other applets to edit File X
746
738
E-MAIL
748
E-Mail
To:
CC:
Subject:
Attachment: File X
752
Save to local PC
754
Save back to file server on network

FIG. 7

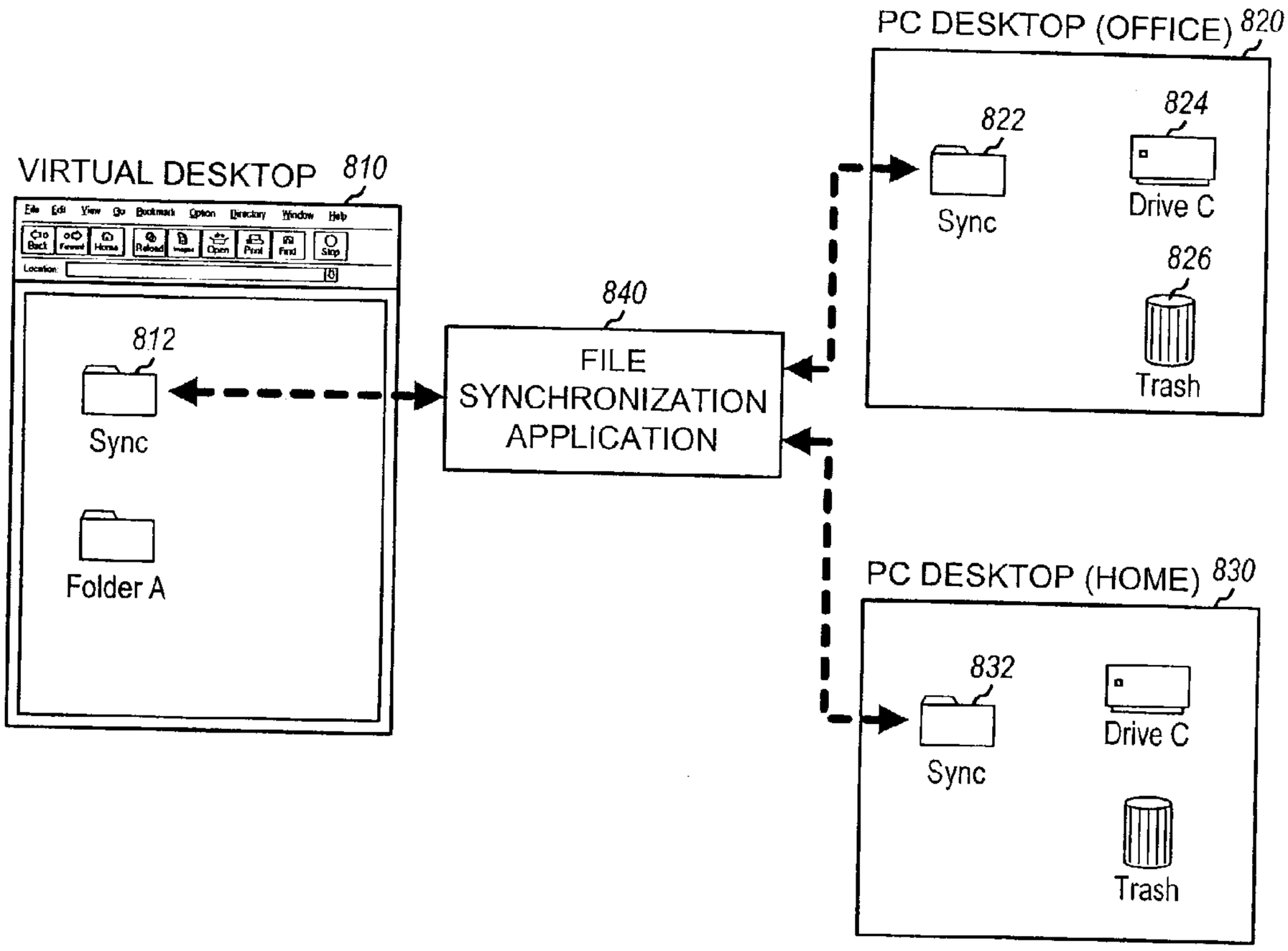

VIRTUAL DESKTOP
810
812
Sync
Folder A
840
FILE SYNCHRONIZATION APPLICATION
PC DESKTOP (OFFICE)
820
822
Sync
824
Drive C
826
Trash
PC DESKTOP (HOME)
830
832
Sync
Drive C
Trash

FIG. 8

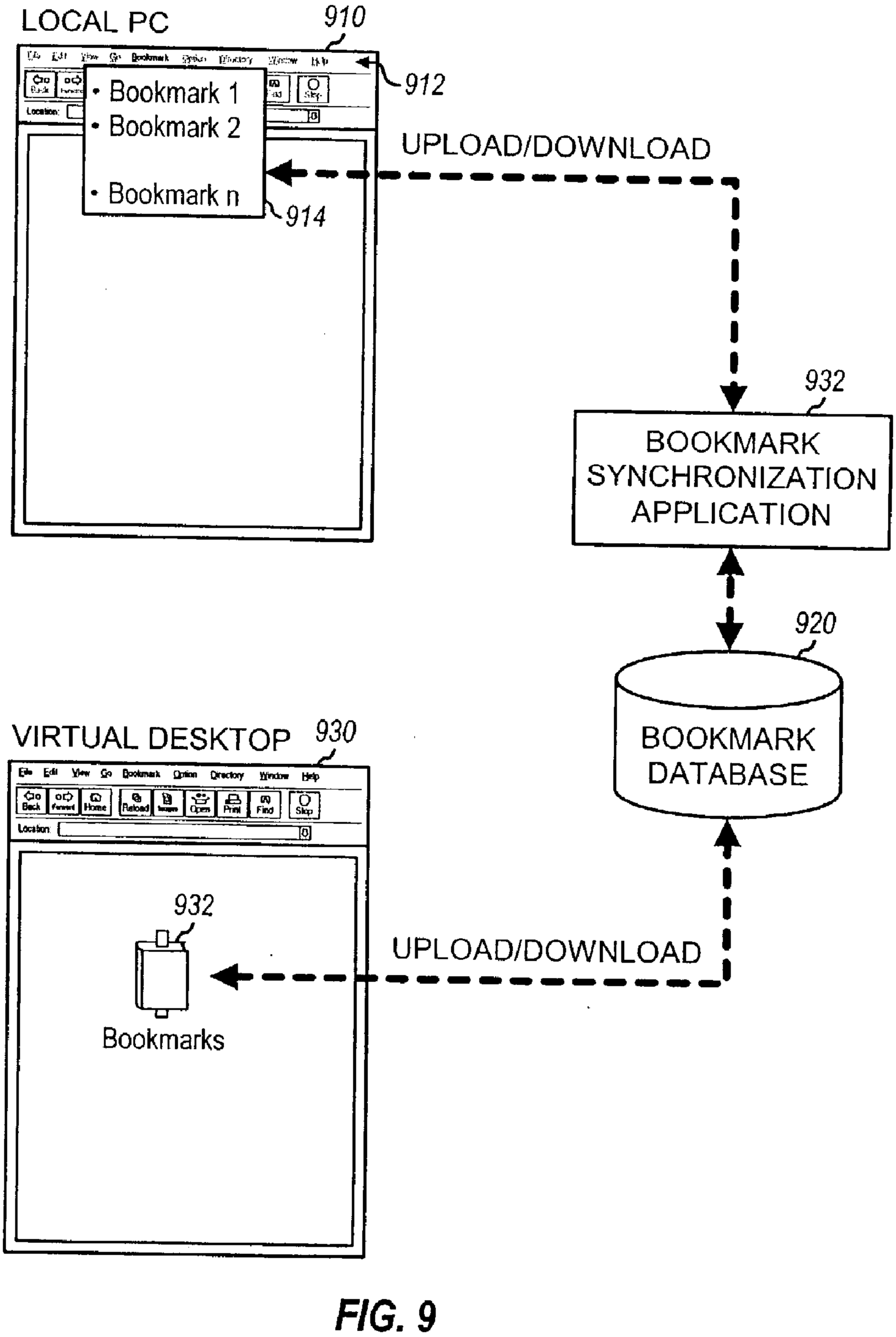

LOCAL PC
910
912
• Bookmark 1
• Bookmark 2
• Bookmark n
914
UPLOAD/DOWNLOAD
932
BOOKMARK SYNCHRONIZATION APPLICATION
920
BOOKMARK DATABASE
VIRTUAL DESKTOP
930
932
Bookmarks
UPLOAD/DOWNLOAD

FIG. 9

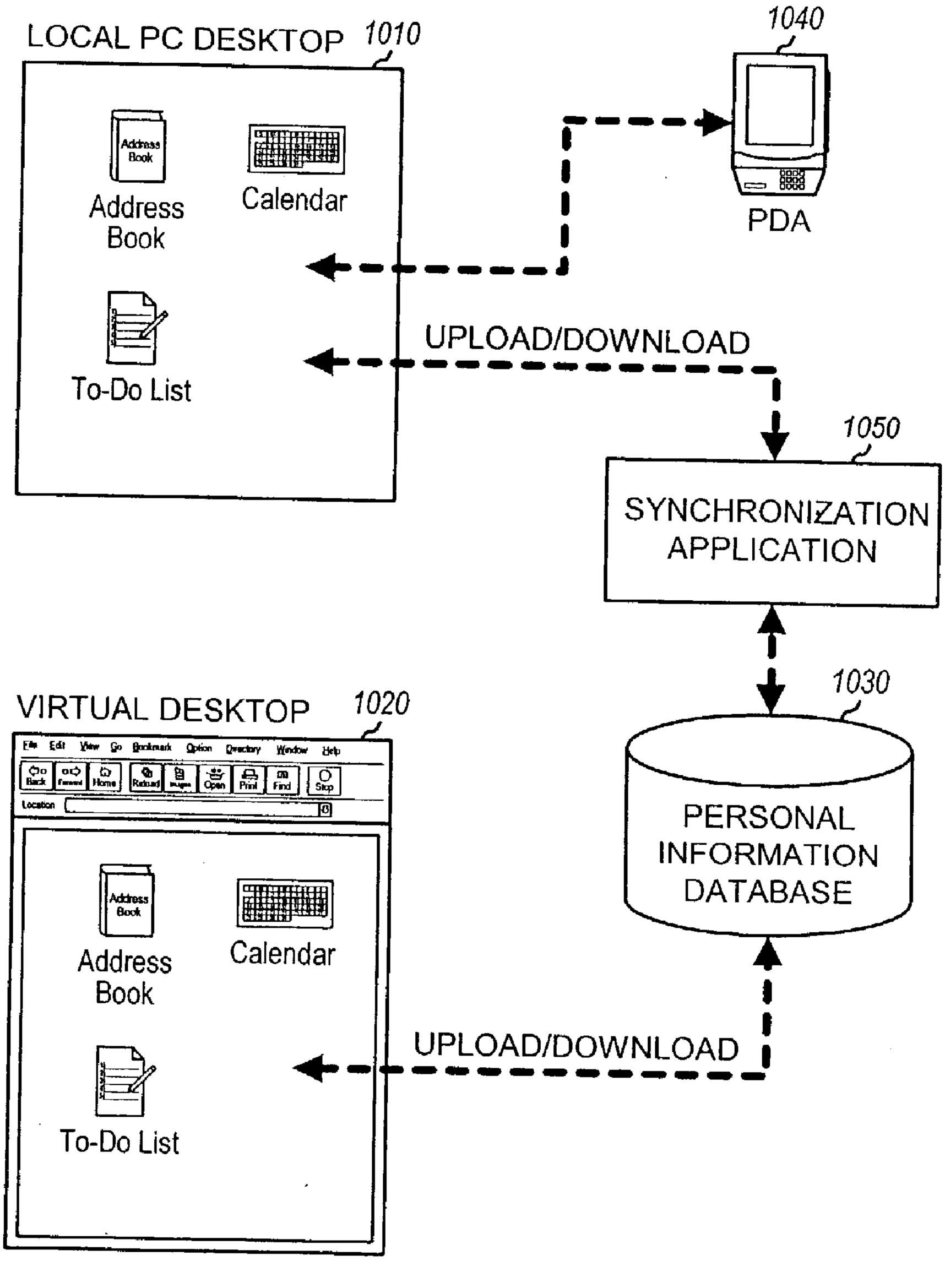

LOCAL PC DESKTOP
1010
Address Book
Calendar
Address Book
To-Do List
1040
PDA
UPLOAD/DOWNLOAD
1050
SYNCHRONIZATION APPLICATION
1030
PERSONAL INFORMATION DATABASE
VIRTUAL DESKTOP
1020
File Edit View Go Bookmark Option Directory Window Help
Back Forward Home Reload Images Open Print Find Stop
Location
Address Book
Calendar
Address Book
To-Do List
UPLOAD/DOWNLOAD

FIG. 10

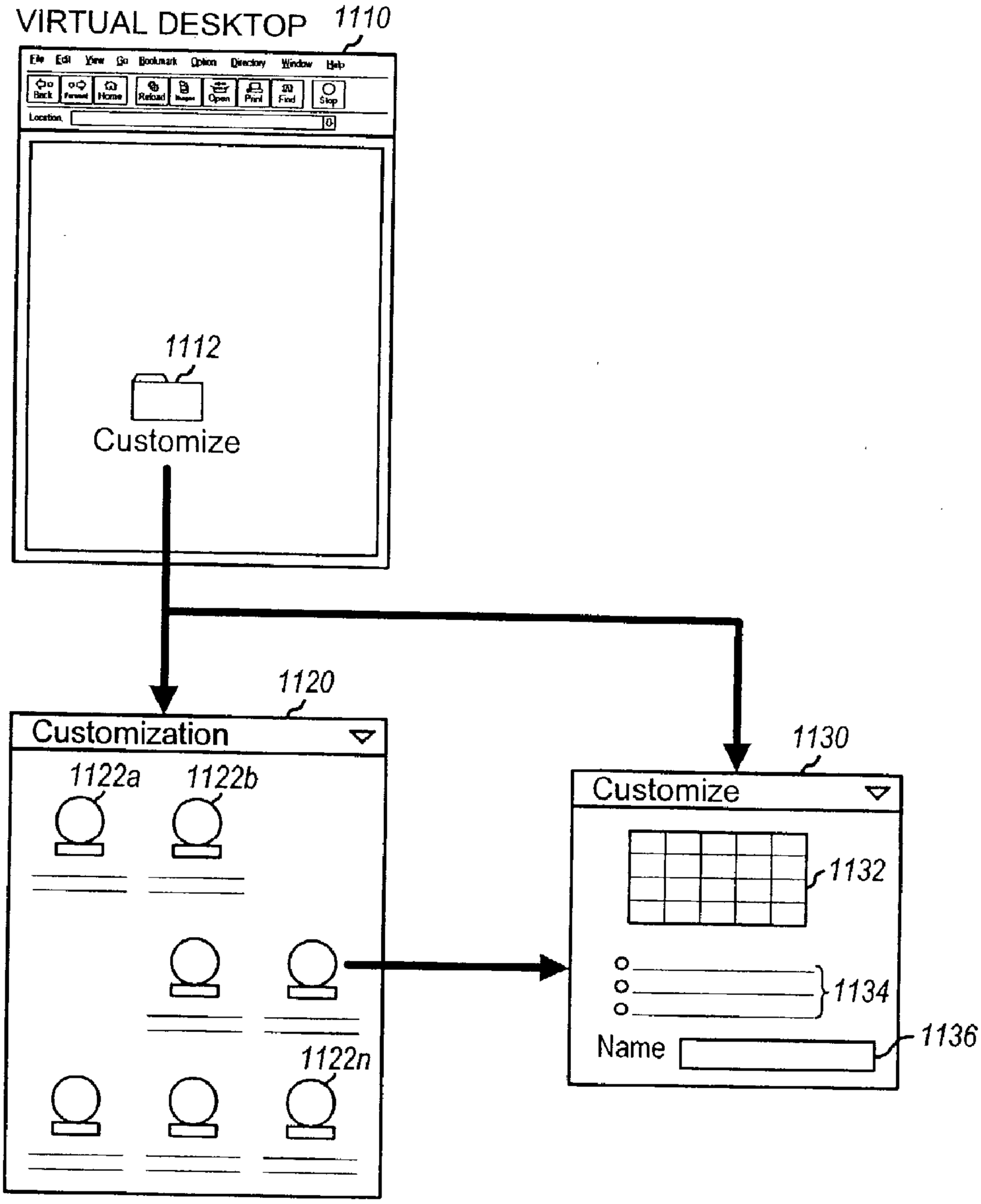

VIRTUAL DESKTOP
1110
File Edit View Go Bookmark Option Directory Window Help
Back Forward Home Reload Images Open Print Find Stop
Location
1112
Customize
1120
Customization
1122a
1122b
1122n
1130
Customize
1132
1134
Name
1136

FIG. 11

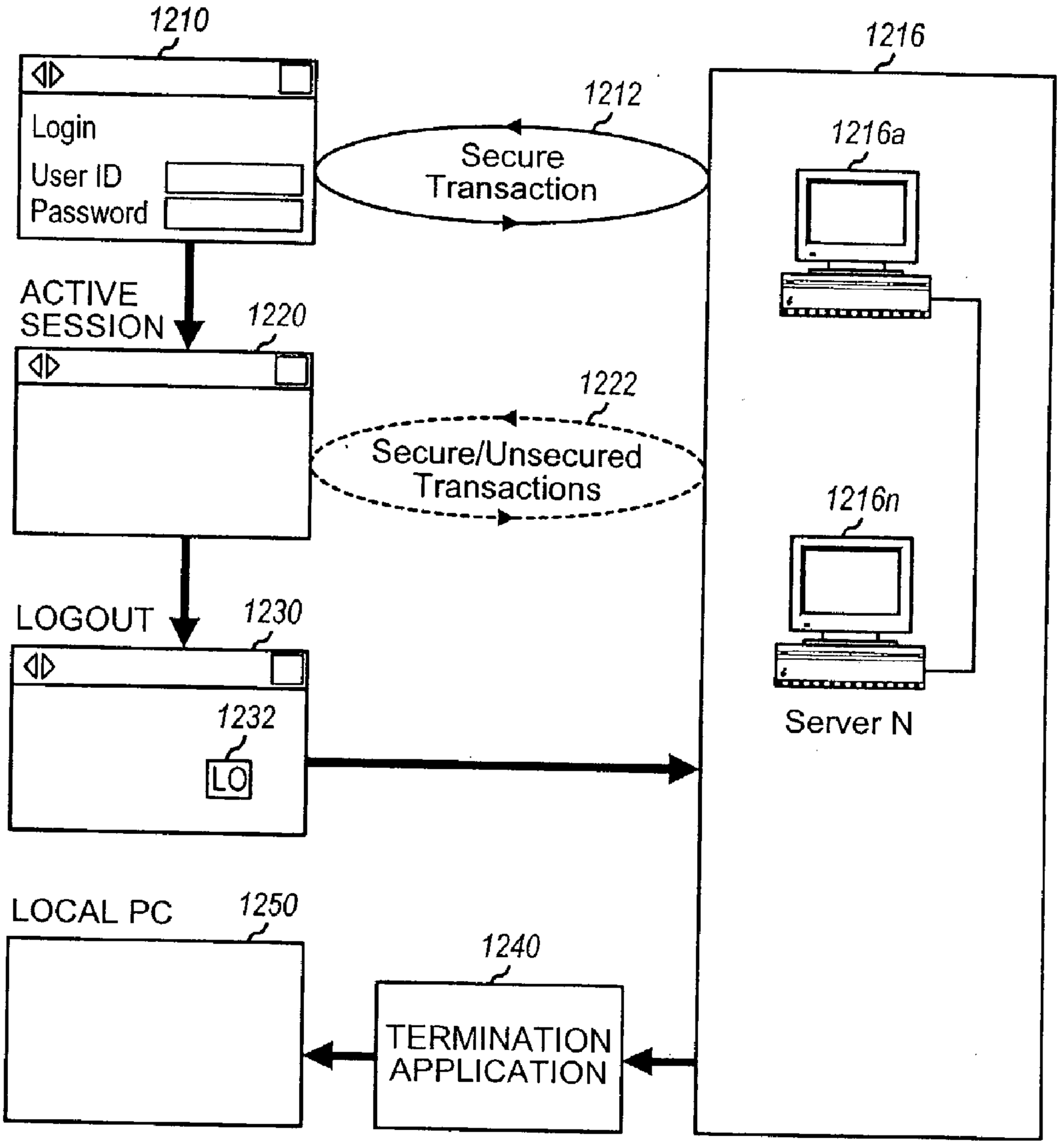

1210
Login
User ID
Password
ACTIVE SESSION
1220
LOGOUT
1230
1232
LO
1212
Secure Transaction
1222
Secure/Unsecured Transactions
1216
1216a
1216n
Server N
LOCAL PC
1250
1240
TERMINATION APPLICATION

FIG. 12

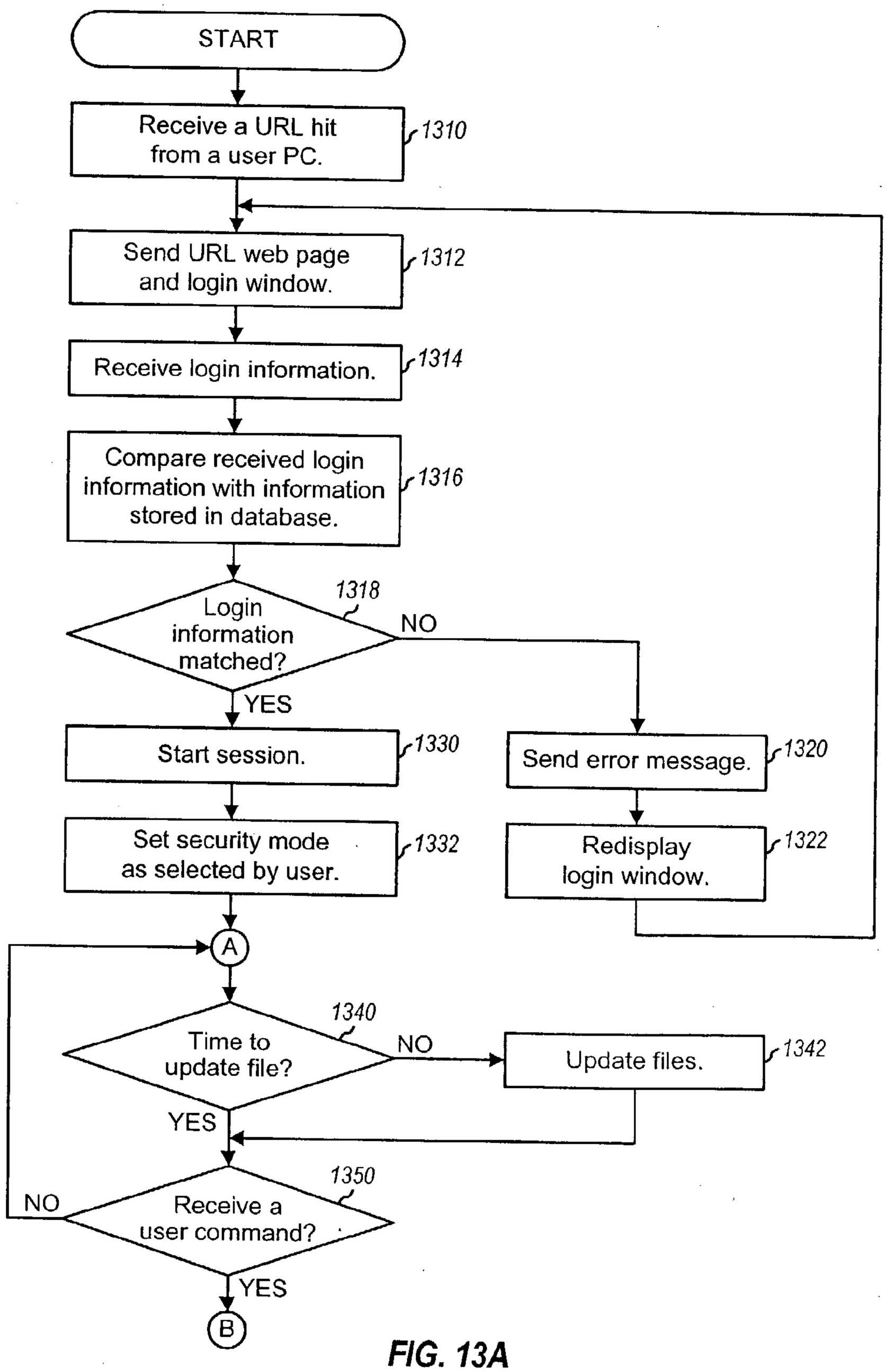

START
Receive a URL hit from a user PC.
1310
Send URL web page and login window.
1312
Receive login information.
1314
Compare received login information with information stored in database.
1316
Login information matched?
1318
NO
YES
Start session.
1330
Send error message.
1320
Redisplay login window.
1322
Set security mode as selected by user.
1332
A
Time to update file?
1340
NO
Update files.
1342
YES
Receive a user command?
1350
NO
YES
B

FIG. 13A

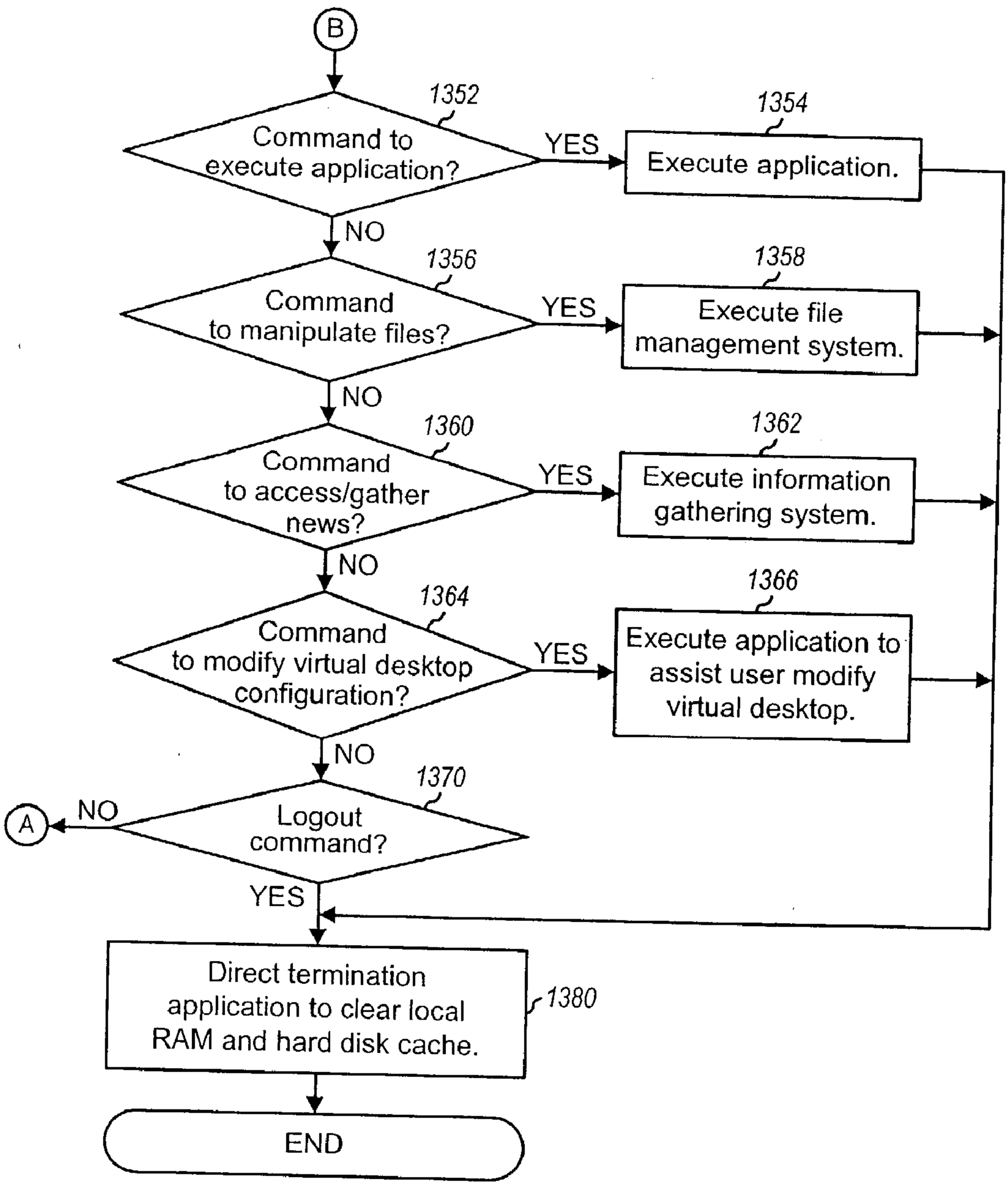

B
1352
Command to execute application?
YES
1354
Execute application.
NO
1356
Command to manipulate files?
YES
1358
Execute file management system.
NO
1360
Command to access/gather news?
YES
1362
Execute information gathering system.
NO
1364
Command to modify virtual desktop configuration?
YES
1366
Execute application to assist user modify virtual desktop.
NO
1370
Logout command?
NO
A
YES
Direct termination application to clear local RAM and hard disk cache.
1380
END

FIG. 13B

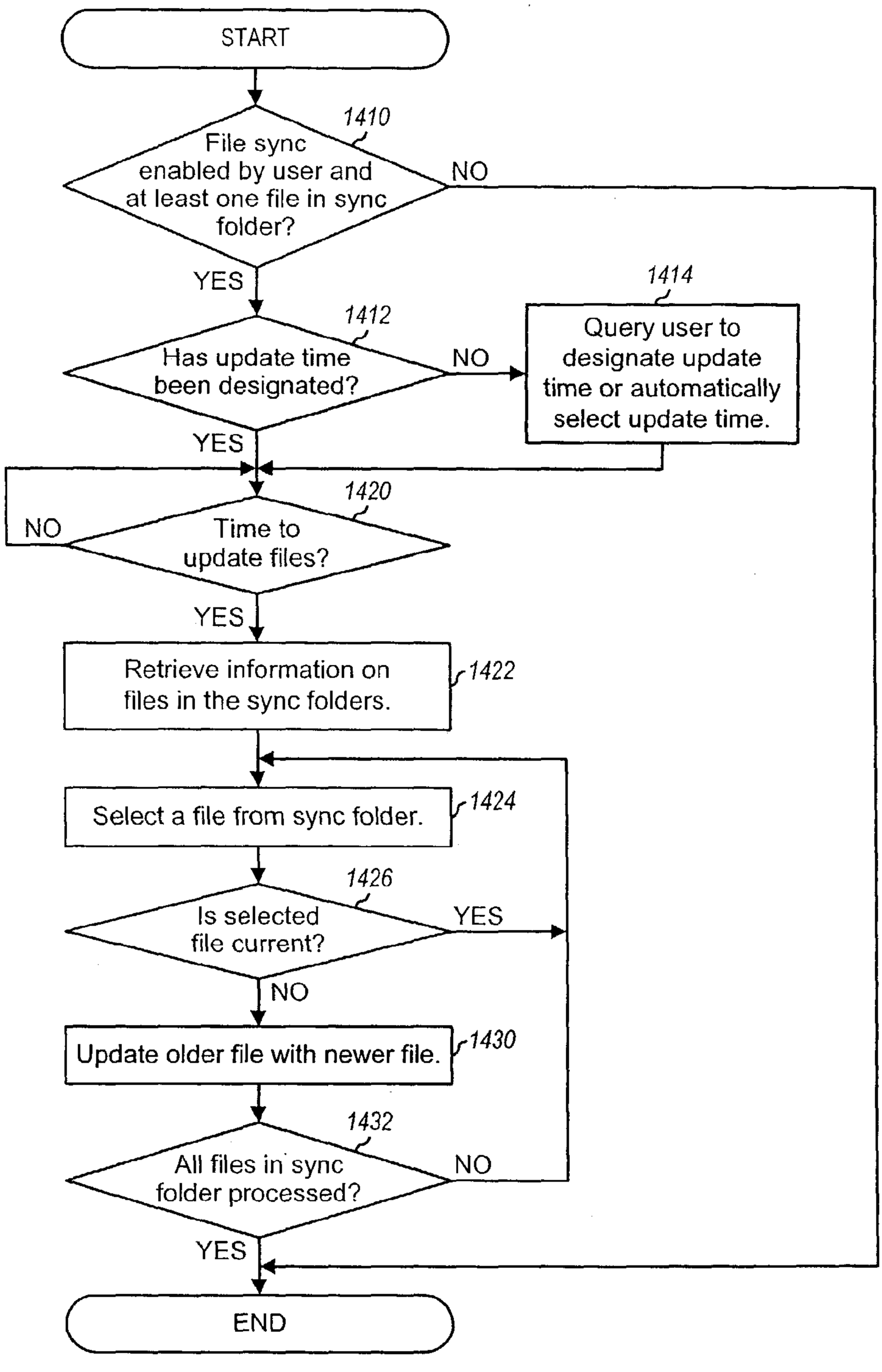

START
1410
File sync enabled by user and at least one file in sync folder?
NO
YES
1412
Has update time been designated?
NO
1414
Query user to designate update time or automatically select update time.
YES
1420
NO
Time to update files?
YES
Retrieve information on files in the sync folders.
1422
Select a file from sync folder.
1424
1426
Is selected file current?
YES
NO
Update older file with newer file.
1430
1432
All files in sync folder processed?
NO
YES
END

FIG. 14

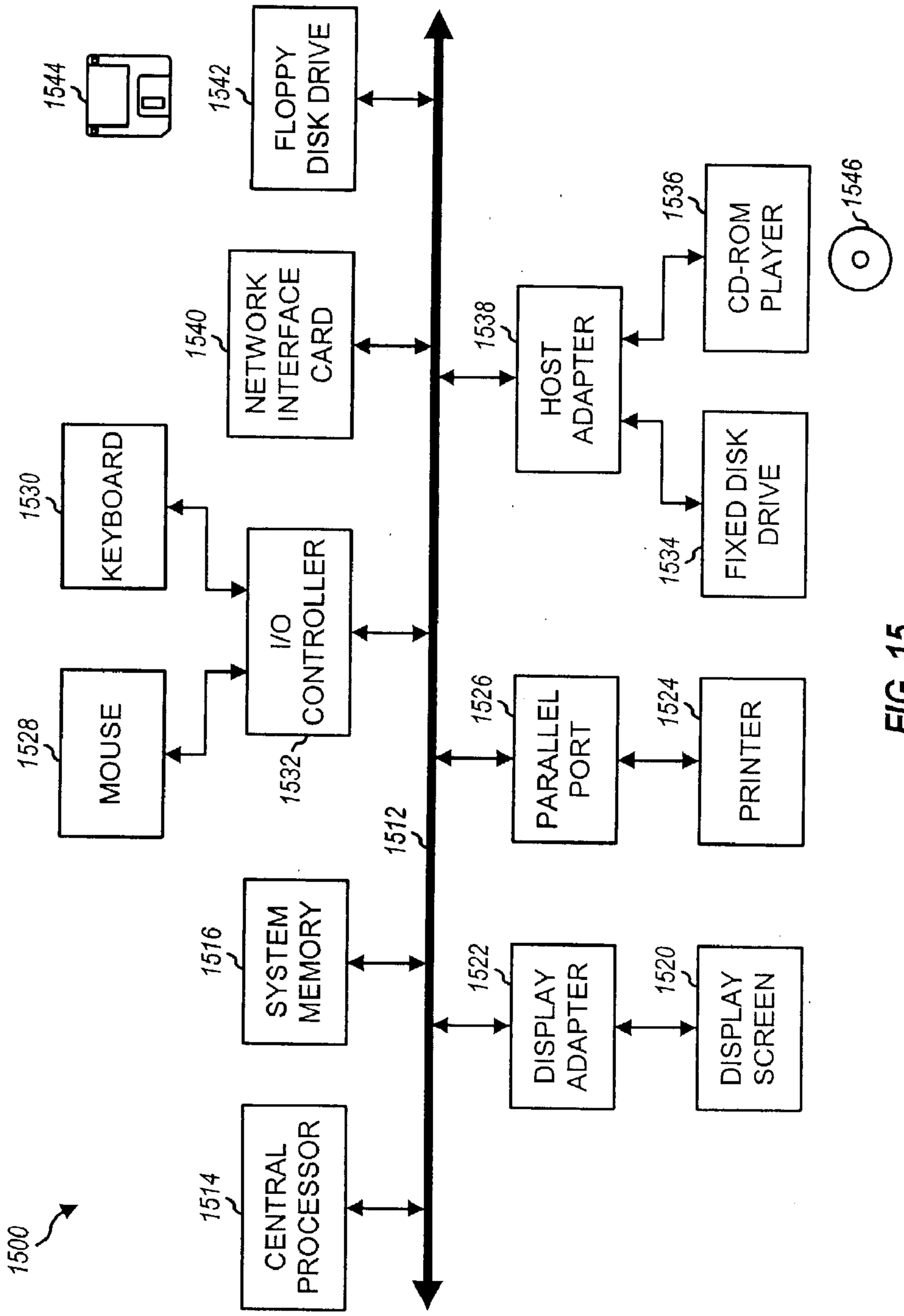

1500
CENTRAL PROCESSOR
1514
SYSTEM MEMORY
1516
MOUSE
1528
KEYBOARD
1530
I/O CONTROLLER
1532
SYSTEM BUS
1512
DISPLAY ADAPTER
1522
DISPLAY SCREEN
1520
PARALLEL PORT
1526
PRINTER
1524
HOST ADAPTER
1538
FIXED DISK DRIVE
1534
CD-ROM PLAYER
1536
1546
NETWORK INTERFACE CARD
1540
FLOPPY DISK DRIVE
1542
1544

FIG. 15

VIRTUAL DESKTOP IN A COMPUTER NETWORK

[0001] This application is a continuation of U.S. Ser. No. 09/239,412, filed Jan. 28, 1999, now U.S. Pat. No. 6,571,245, which claims the benefit of U.S. provisional Application Serial No. 60/111,341, also entitled "VIRTUAL DESKTOP IN A COMPUTER NETWORK," filed Dec. 7, 1998, all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention relates generally to computer systems, and more particularly to techniques for providing a virtual desktop in a computer network.

[0003] Many individuals extensively or periodically interface with a computer system for work or leisure. These individuals maintain desktop or portable computer systems and are typically able to customize the systems according the their specific needs and preferences. The customization can range from the set of application software installed on the system, the arrangement of the desktop icons, the organization of the file management system, the settings of the CRT display and mouse control, and so on.

[0004] For those who regularly interface with computers, many have access to multiple computer systems. For example, a user may be assigned a desktop computer system at work and may also maintain a personal computer system at home. The user may also have access to additional computer systems, such as a portable computer system assigned for business trips or other miscellaneous systems when on travel. These numerous systems are usually not maintained to be replicas of each other and have different customizations. As such, they are typically installed with different applications, contained different files that are organized in different arrangements, and have different desktop "feels."

[0005] In most situations, it is highly desirable and efficient to provide a "virtual" computing environment such that the user sees the same desktop with which the user is accustomed, has access to the same applications and files, and enjoys the same amenities regardless of the computer system on which the user gains access. The virtual computing environment is particularly advantageous for individuals who travel often, for telecommuters who alternate between working at home or remote sites and the office, for individuals who perform portions of their office work at home, for individuals who gain access to other computer systems outside their normal computing environment, and many others.

[0006] One way to achieve a virtual computing environment is for the user to maintain identical computer systems. However, this technique is impractical in most instances because of the enormous amount of time and effort necessary to keep track of changes and update all systems. As a compromise, the user typically maintains the various systems to be as nearly identical as practical. However, the applications and files on these systems are usually not maintained current. Often times, one system has a copy of the most current work file and the remaining systems contain old versions, if at all, of the same file. Consequently, the differences that exist between the various systems undermine the advantages to be gained by maintaining nearly identical computer systems.

[0007] Another way to achieve a virtual computing environment is to maintain a network of identical computer systems. In this technique, each computer on the network is set up with identical desktop, applications, and file management system such that the user sees the same interface and has access to the same resources from any one of the computer systems connected to the network. The work files can be stored in a central location that is accessible from the computer systems on the network. However, this rigid desktop requirement prevents the user from customizing the desktop to the user's particular needs and preferences. Additionally, the benefits are only realized from having access to the particular systems connected to the network. Often times, the home and portable computer systems are not connected to the network. Thus, the advantages provided by this technique are limited.

[0008] As can be seen from the above, a virtual computing environment that provides the user with a "virtual" desktop accessible from a wide range of computer systems is highly desirable.

SUMMARY OF THE INVENTION

[0009] The invention provides a virtual desktop in a virtual computing environment. In an embodiment, the virtual computing environment is supported by a network of servers coupled to the Internet. The user is able to access the servers from a variety of systems through various communications links available to connect to the Internet.

[0010] A specific embodiment of the invention provides a computer-implemented method for providing a virtual desktop. A site server initially receives a URL access from a user at a local system. After a successful login, a personal web page of the user is retrieved from a file server and returned to the local system. Through the personal web page, the user is able to send commands that are received and processed by one or more backend servers. The web page represents the virtual desktop of the user and includes links for applications available to the user and files accessible by the user. The web page can also include links to personal information of the user.

[0011] Various aspects of the invention support the many features of the virtual desktop. For file manipulation, the virtual desktop includes applications that facilitate file creation, editing, conversion, e-mail, and so on. For file management, the virtual desktop includes a synchronization folder that contains files and folders to be maintained current with similar items on a synchronization folder on the local system. At designated times, the items in these synchronization folders are compared and updated, if necessary. The virtual desktop also includes facilities that allow for convenient access to news, information, and services on the Internet, and easy manipulation of retrieved information.

[0012] Another specific embodiment of the invention provides a computer-implemented method for storing information representative of a virtual desktop for a user. A file server receives information indicative of: (a) a layout of the virtual desktop, (b) a list of applications available to the user, and (c) files and folders associated with the user. Personal information can also be provided to the file server. The user information is maintained in a data record that is stored in the file server. For efficient implementation, the record can

be partitioned and portions of the record can be stored in different databases on multiple file servers.

[0013] Yet another specific embodiment of the invention provides a computer network configured to provide a virtual computing environment. The network includes one or more servers. At least one of the servers includes a processor, an electronic storage medium (e.g., disk, tape, CD, and other storage media), and a memory. The servers are configured to receive a URL access from a user at a local system, retrieve a personal web page of the user from a file server, and transmit the personal web page to the local system. The servers are also configured to receive and process user commands that have been entered through the personal web. The web page represents the virtual desktop of the user and includes icons for applications available to the user and files accessible by the user.

[0014] The foregoing, together with other aspects of this invention, will become more apparent when referring to the following specification, claims, and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] **FIG. 1** is a diagram that illustrates the enormous interconnectivity provided by an Internet-based computer network of the invention;

[0016] **FIG. 2** shows a diagram of an embodiment of a computer network **200** that implements a virtual computing environment and supports the virtual desktop of the invention;

[0017] **FIG. 3** shows a diagram of a browser display of a representative virtual desktop for a particular user that has been retrieved from the URL web site;

[0018] **FIG. 4** shows, in summary form, some of the processes and features provided by the virtual desktop of the invention;

[0019] **FIG. 5** shows a diagram of an embodiment of the data stored for the users in the virtual computing environment;

[0020] **FIG. 6** shows a diagram of some of the processes of the file management system of the invention;

[0021] **FIG. 7** shows a diagram of additional processes of the file management system of the invention;

[0022] **FIG. 8** shows a simplified diagram of an embodiment of the file synchronization feature of the invention;

[0023] **FIG. 9** shows a diagram of an embodiment of the bookmark synchronization feature of the invention;

[0024] **FIG. 10** shows a diagram of an embodiment of some of the features provided by a personal information manager of the invention;

[0025] **FIG. 11** shows a simplified diagram of an embodiment of the customization process for the virtual desktop of the invention;

[0026] **FIG. 12** shows a diagram of an embodiment of the security provided for the virtual desktop of the invention;

[0027] **FIGS. 13A and 13B** show a flow diagram that describes an implementation of an embodiment of the virtual desktop of the invention;

[0028] **FIG. 14** shows a flow diagram that describes an implementation of an embodiment of the file synchronization of the invention; and

[0029] **FIG. 15** shows the basic subsystems of a server **1500** suitable for use with the invention.

DESCRIPTION OF THE SPECIFIC EMBODIMENTS

[0030] System Description

[0031] **FIG. 1** is a diagram that illustrates the enormous interconnectivity provided by an Internet-based computer network of the invention. As shown in **FIG. 1**, numerous systems can gain access to the Internet **110** through a wide range of communications channels. For example, access to the Internet **110** can be gained by a portable notebook personal computer (PC) **112** though a wireless link **114**, a notebook PC **116** through a wireline link **118**, an office desktop PC **122** through a high speed modem link **124** (e.g., T1, ISDN, or others), a home desktop PC **126** through a telephone link **128**, a mobile cellular phone **132** through a cellular link **134**, and a television set top box **136** through a cable link **138**. In **FIG. 1**, modems **150** facilitate communications between the respective systems and the Internet. Although all modems are similarly designated in **FIG. 1**, in actuality, they are specifically designed to support the particular link to which they are coupled. The connections are typically TCP/IP (Transmission Control Protocol/Internet Protocol) connections, but other connections and protocols are possible. For example, the connection may be a SLIP/PPP (Serial Link IP/Point-to-Point Protocol) connection.

[0032] Other communications links that may be used to connect to the Internet include, for example, a terrestrial link, a microwave link, a satellite link, and others. The communications link can be symmetric (i.e., having the same data bandwidth in both directions). Alternatively, the communications link can be unsymmetrical such that, for example, the downstream bandwidth from the Internet to the system is greater than the upstream bandwidth from the system to the Internet.

[0033] **FIG. 2** shows a diagram of an embodiment of a computer network **200** that implements a virtual computing environment and supports the virtual desktop of the invention. Within network **200**, a number of computer systems **210** couples to the Internet **220** through various communications links described above. Computer systems **210** can represent the various systems depicted in **FIG. 1**. The Internet **220** is a collection of networks that allows files and resources on computers interconnected to the networks to be shared. A site server **230** also couples to the Internet **220** through a firewall **232**. Firewall **232** provides a security wall between site server **230** and the Internet **220** and is discussed in further detail below.

[0034] Site server **230** is a Uniform Resource Locator (URL) site (e.g., MAGICALLY.COM) to which computer systems **210** connect. Site server **230** processes a user's login, which typically includes receiving the user's identification and password. Site server **230** couples to, and provides the login information to, a controller server **240**. Controller server **240** checks the login information against a database **242** of login information to determine whether the user is authorized for access to the network. If the user is

authorized, controller server **240** determines the appropriate Hypertext Transport Protocol (HTTP) server to which the user should be directed. In a large network that includes more than one backend server, controller server **240** directs the user computer system to the appropriate (i.e., the least congested) backend server. In an embodiment, site server **230** and controller server **240** are integrated into one server.

[**0035**] Site server **230** further couples to a bus **244** that interconnects one or more regional networks **250**. Each regional network **250** supports a particular geographic area. For example, regional network **250***a* can cover a geographic area such as the United States and regional network **250***n* can cover another geographic area such as Asia. Within each regional network **250**, a number of backend servers **260** services the assigned geographic area. Tasks can be received and forwarded for processing by any one of backend servers **260** then available. Backend servers **260** further couple to a bus **262** that also interconnects a viewer converter **270**, an e-mail server **272**, a database server **276**, a file server **280**, and an application server **290**. E-mail server **272** couples to an e-mail database **274**, database server **276** couples to a user information database **278**, file server **280** couples to a user file database **282**, and application server **290** couples to an application database **292**. Data in databases **274**, **278**, **282**, and **292** may be stored using, for example, an SQL format that is well known in the art. Also, in an embodiment, converter **270** and servers **272**, **276**, **280**, and **290** can be directly coupled to bus **244**.

[**0036**] In an embodiment, e-mail server **272** is implemented with a combination of a POP3 server and a SMTP server. The POP3 server processes the received e-mail messages, and the SMTP server processes the outgoing e-mail messages.

[**0037**] The functions performed by converter **270** and servers **272**, **276**, **280**, and **290** are described in detail below. Further, the functions of backend server **260**, viewer converter **270**, e-mail server **272**, database server **276**, file server **280**, and application server **290**, or a combination of these servers, can be integrated and provided by one or more servers.

[**0038**] The configuration of network **200** in **FIG. 2** provides many advantages, including interconnectivity (i.e., global Internet access) and scalability. For example, additional regional networks **250** can be added to bus **244** as appropriate. Also, the regional networks can be reconfigured to cover a smaller geographic area due, for example, to increased demands for the servers within regional networks. Also, additional backend servers **260** can be added to a particular regional network **250** as necessitated by traffic demands. Regional network **250** is also scalable by adding additional converters, file servers, and application servers as necessary.

[**0039**] Virtual Desktop

[**0040**] The invention provides a virtual desktop in a virtual computing environment such that a user sees the same desktop and has access to the same applications, files, and amenities independent of the particular computer system on which the access is gained. The user is also provided with tools that allow the user to customize the desktop to whatever configuration the user finds preferable. The virtual desktop is provided through a web browser, or similar applications, that interfaces the user with a backend server on a network such as the Internet.

[**0041**] Numerous advantages can be realized through a virtual computing environment wherein the network provides many of the functions and features of the computer. First, the user enjoys a 'virtual' desktop work environment regardless of the computer through which access is gained to the Internet. Familiarity with a particular desktop can enhance efficiency and improves productivity. Second, because of the ubiquitous nature of the Internet, the user is able to gain access to a familiar computing environment through numerous means and from almost anywhere. This effectively provides the user with global access from the home, office, while on travel, and so on. Third, the virtual work environment allows the user to have access to the same files and resources from anywhere. This allows the user to work on a particular document using a particular application from virtually any location with Internet access. Additional features are also provided by the invention by virtue of the integration of the resources. For example, the invention can provide an automatic file backup system, file synchronization, and so on, which are discussed below.

[**0042**] In illustrating the invention with respect to its implementation in conjunction with a web browser application (or browser), a few terms will now be defined. A Universal Resource Locator (URL) is a well-known element widely used in communications systems that make up the World Wide Web (or web). URL is used as an identifier to point to a specific site or location of a computer and its contents on the web. A given URL typically points to a Hyper Text Markup Language (HTML) encoded page of data, but it may also point to a text file, an image, or even a moving image stream. The URLs are specified by the user (i.e., through a user interface). The browser is an application program that requests, receives, processes, and presents data pointed to by the URLs. The browser normally selects the appropriate method to process each type of data that is received and then displays an HTML page of the data. The browser has the ability to move in response to the user's direction from one specified URL content to another. For example, if the user selects a link in an HTML page, the browser will access the new URL location pointed to by the link.

[**0043**] In the invention, the user initially activates a browser application program installed on computer system **210** in **FIG. 2**. Typical browser application programs such as Navigator™ from Netscape Corporation and Internet Explorer from Microsoft Corporation are well known and readily available. The browser is executed by (double) clicking on the browser icon or through other means (i.e., executing the browser from the desktop file management system).

[**0044**] When the browser's main screen comes up, the user enters into a user interface field the URL of the site server that supports the virtual desktop. For example, the user can enter the web site "HTTP//MAGICALLY.COM" and hit the carriage return <CR> key. The user can also activate the URL search by selecting a bookmark under the browser's pull down main menu (i.e., "BOOKMARKS" in the Navigator™ browser). The browser then searches for the web site and retrieves from the appropriate site server a web page corresponding to the entered URL.

[0045] The URL site server provides data contents, called a web page, that are processed by the browser and presented for display on the CRT of the user's computer system. The processing can be performed by either the browser's own facilities, facilities provided by the operating system under which the browser executes, other facilities provided by the applications concurrently executing along with the browser, or a combination of the above. The web page can contain any mixture of text, graphic imagery, pictures, sounds, and even motion picture information. The web page also includes a login window. Upon a successful login, the user's personal web page that displays the virtual desktop is provided to the user's computer system. The login process is described in further detail below.

[0046] **FIG. 3** shows a diagram of a browser display of a representative virtual desktop for a particular user that has been retrieved from the URL web site. A browser display **300** includes a user interface control area **310** and a display area **320**. Control area **310** can include pull down menus **312**, an array of functionally selectable buttons **314**, a typing field **316**, and a scroll bar **318** that enables the user to scroll through the page(s) in display area **320**. Additional information, icons, control functions, and the like can also be displayed in control area **310**. For example, a URL field **322** can be provided at the bottom of display **300** to indicate the URL associated with a link in display area **320** whenever the user passes the mouse pointer over the link. Control area **310** can be rearranged or reconfigured, to an extent as allowed by the particular browser application, based on the user's preference. However, changes made to control area **310** are generally localized to the particular computer system on which the browser is installed.

[0047] Display area **320** represents the virtual desktop of the user and can be customized according to the user's needs and preferences. As shown in **FIG. 3**, display area **320** includes icons **330** for applications available to the user, icons **332** for folders and files, an icon **334** for sources of news and information, an icon **336** for browser bookmarks, an icon **338** for an address book, an icon **340** for a calendar, an icon **342** for a to-do list, an icon **344** for customization tools, an icon **346** for storage, an icon **348** for trash, and windows **350** that pop up on display area **320** based on selections by the user. The various icons enumerated above can be replaced or supplemented with toolbars, lists, objects, or other indicators that identify the underlying items for which they represent. Application icons **330** can be provided for applications such as word processing (e.g., Word™ and WordPerfect™), spread sheet (e.g., Excel™ and Lotus123™), presentation (e.g., PowerPoint™), e-mail, and others. The various trademarked products are from Microsoft Corporation and Lotus Corporation. Display area **320** can also have a wallpaper background selected by the user based on personal preference.

[0048] **FIG. 4** shows, in summary form, some of the processes and features provided by the virtual desktop of the invention. As shown in **FIG. 4**, the web page from the site server initially includes a login window **410** that prompts the user for an identification and a password. The user then enters the requested information in the appropriate fields. Upon indicating that the information has been entered (i.e., by hitting the carriage return in the password field), a secured transaction **412** is initiated with URL site server **230**. The login information is securely transmitted to site server **230** using, for example, a Secured Socket Layer (SSL) based security technique. Site server **230** determines whether the user is registered and, if yes, transmits the user's personal web page. The login process is described in further detail below.

[0049] After a successful login, the user's personalized virtual desktop **420** is transmitted, received, and displayed. Desktop **420** corresponds generally to browser display **300** in **FIG. 3**. The user can then activate the features of the virtual computer by activating the appropriate icon from virtual desktop **420**. In general, through virtual desktop **420**, the user has access to applications, files, news and information, and additional features.

[0050] To execute a particular application, the user (double) clicks on the icon representing that application and, in response, the site server cooperates with the application server to allow execution of the selected application. Depending on the particular application, the application server can transmit applets of the application which are then executed by the browser. The application server can also transmit codes for the application which are then executed on the user's computer system. The application server can also execute the application at the server site and communicates the data and correspondences with the user's computer system. The user may also be given a choice to direct execution of the application on a particular computer or server. Once the selected application is executed, the user interacts with the application in similar manner as if the application is executing on the user's computer. The user is practically unaware of the difference in the computing environment.

[0051] The applications available to the user can also provide other features and amenities. For example, by clicking on an application icon **422**, a list of available applications is displayed on a window **432**. This list may include, for example, icons for a calendar, e-mail, to-do list, address book, bookmarks, browsers, and so on.

[0052] The user can manage files and folders through a file management system provided by the virtual computing environment. Because of the extensive interconnectivity associated with the Internet, the file management system provides additional advantages and features not normally associated with a stand-alone computer or a local area network. For example, separate folders can be provided for the user's private files, public files, and limited access files. These file types have different attributes. These and other features of the file management system are described in further detail below.

[0053] To activated a folder, the user simply (double) clicks on a folder icon **424**. A window **434** then appears which contains the files and folders associated with the selected folder. A folder within window **434** can then be selected and, in response, an additional window appears which contains the files and folders associated with that selected folder. Alternatively, window **434** can be refreshed with the contents of the selected folder each time a folder is selected. If the user selects a file, a viewing window **444** appears which displays. the data in the selected file.

[0054] An advantage provided by the Internet-based computer network is the ability to easily gather news and information from various web sites. As such, virtual desktop

420 can include icons corresponding to, or including, URL links to news and content sources. The user can access the sources by (double) clicking on a news icon **426** that then opens a window **436**. Window **436** can include URL links to other web sites. Each link is associated with the URL of another web page on the web. The URL links appear to the user as text that is highlighted in some manner, such as underlining and/or colored text. The URL links can be arranged by category, in alphabetical order, or by other arrangements based on user preference. By selecting the link with the mouse or other pointing device, the user can move to a web page corresponding to the selected link which is displayed in a window **446**. The operation of the news/content aspect of the invention is described in further detail below.

[**0055**] The virtual desktop layout and configuration can be tailored to the user's particular preference. Customization of virtual desktop **420** can be initiated by (double) clicking on a customize icon **428** that activates a customize window **438**. Customize window **438** includes the tools and features that allow the user to customize the virtual desktop. The operation of the customization feature of the invention is described in further detail below.

[**0056**] **FIG. 5** shows a diagram of an embodiment of the data stored for the users in the virtual computing environment. Referring back to **FIG. 2**, data associated with the users is stored in one or more databases, including user login information database **242**, e-mail database **274**, user information database **278**, and user file database **282**. The information associated with each user can be represented by a data record **510**. Data record **510** includes, for example, virtual desktop layout information **512**, a list of applications **514** that the user has been authorized for access, files and folders **516**, and personal information **518**. Additional types of data can be stored for each user. Also, the data size for each data type can vary from user to user based on, for example, a particular user's requirements. The number of files and the total storage area typically vary among users. The number of applications authorized and the amount of available storage space may further be dependent on, for example, payment of a service fee.

[**0057**] Although the data for each user is shown as being integrated to a single data record, the data within the record may, in actuality, be stored in separate databases. For example, the desktop layout information, the list of authorized applications, and the personal information for all users may be stored in user information database **278**, and the files and folders may be stored in user file database **282**. Alternatively, the entire record may be stored on one database at a central server.

[**0058**] File Management

[**0059**] The file management system allows the user to manipulate files and folders in similar manner as for a desktop PC, including create, save, rename, delete, copy, cut, paste, find, and so on. In addition, because the files are maintained in a network environment, the invention provides other file manipulation capabilities not available on the desktop PC, including file sharing, access control, and others. The invention also provides additional features through a high level of integration between the file management system and the applications, as explained below.

[**0060**] **FIG. 6** shows a diagram of some of the processes of the file management system of the invention. A virtual desktop **610** includes a number of files and folders created by the user and the system. Desktop **610** generally corresponds to window **300** in **FIG. 3** with the other icons not shown for clarity. The files and folders can be displayed using various formats including large icons, small icons, listings, or a combination of the above.

[**0061**] The user selects a particular file or folder in file window **610** by (double) clicking on the particular item (as indicated at **612**). Upon making the item selection, a window appears which enumerates the available menu choices for the selected item (as indicated at **614**). For example, the user can create a duplicate of the selected item, make a copy of the selected item into another folder, and so on.

[**0062**] Because of the interconnectivity provided the Internet-base computer network of the invention, additional file management features are available. For example, files and folders may be shared between users connected to the network. The invention provides techniques to control access to files. Access rights includes, for example, no access, read access, write access, and full access. Also, files may be accessed and manipulated by one or more authorized users, even concurrently, and techniques are provided to maintain the files. Some of the files, and their contents, can also be freely transferred through the web. URL links can also be generated to allow external access, through the Internet, to some of the files.

[**0063**] In an embodiment, for each user, the network maintain three separate folders labeled as secure (or "private"), open (or "publish"), and limited access (or "friends"), as shown in window **610** in **FIG. 6**. However, greater or fewer number of folders can be provided and is within the scope of the invention. An appropriately identified icon in window **610** represents each of these three folders. A private folder icon **622** represents the private folder, a publish folder icon **624** represents the published folder, and a friends folder icon **626** represents the limited access folder.

[**0064**] The private folder is accessed by clicking on private folder icon **622** to open a private folder window **630**. The private folder contains protected files that are accessible only by the authorized users. No URL links are provided to files in this folder. No access is possible to files in the private folder from the Internet, except from the virtual desktop of the authorized user. The private folder can include a multi-level listing (e.g., a file located within a folder that is located within another folder, and so on).

[**0065**] The public folder is similarly accessed by clicking on publish folder icon **624** to open a publish folder window **640**. The public folder contains unprotected files that are freely accessible by everyone (i.e., with full read access). A file in the publish folder can be associated with a URL link, and FTP access to the files is also available. Files in the publish folder are to be shared between all who have access to the network. The publish folder can also include a multi-level listing.

[**0066**] Files in the publish folder may be associated with additional features not available or appropriate for other file types, and additional menu choices can be provided to activate these features. By clicking on a file or folder in window **640**, a menu screen **642** appears which lists the possible application choices. The choices can include, for

example, an album viewer and a HTML editor that facilitate the creation of a public homepage for the selected file.

[**0067**] The limited access folder is accessed by clicking on friends folder icon **626** to open a friends folder window **650**. The limited access folder contains protected files that are accessible only by those specifically authorized by the user. The extent of the access is also limited to the rights granted by the user, which may include read only, read and write, and others. Each limited access file can be individually tailored with different rights granted to different "friends." For example, friend A may be granted read only access to file X, friend B may be granted full access to the same file, and so on.

[**0068**] Window **650** can also contain a list **652** of links to other friends (e.g., other users who are denoted as friend by this user). By clicking on a particular link in list **652**, a window **654** opens which lists the files available to this user from the friend associated with the link. The user clicks on a friends link listed in window **650** to see a list of publish files available from that friend, and also a list of the limited access files from that friend that are available for access by this user. Window **650** also contains a search and query box **656** that allows the user to search for other users who consider this users as their friend. A window **658** would then appear that lists the results of the search.

[**0069**] Because of the integration provided by the invention, additional file manipulation features are available. For example, in box **614**, a menu choice can be provided to e-mail the selected file or folder. By selecting this menu choice, the e-mail application is conveniently activated and a window **660** for a new e-mail message is generated. The e-mail message automatically includes the selected file or folder in the attachment section. The user then simply enters the recipient's address and sends off the message.

[**0070**] **FIG. 7** shows a diagram of additional processes of the file management system of the invention. A file window **710**, corresponding to window **434** in **FIG. 4**, appears on the user's virtual desktop by (double) clicking on a file icon on the virtual desktop. File window **710** includes a listing of the files and folders within the selected folder. By clicking on a particular file or folder, a window **714** appears that includes the available menu choices for the selected item. As shown in **FIG. 7, a** File X is selected.

[**0071**] File window **714** can include, for example, a listing **716** of information on the selected file such as the file version, the file type (e.g., a word processing, spreadsheet, or other document types), the size of the file, who created it and when, who last modified it and when, who has access rights to it, whether a payment must be made to use the file, and so on. File window **714** can also include buttons that indicate the menu choices available for the selected file, such as get, view, edit, mail, and so on.

[**0072**] By clicking on a get button **722**, a downloader **732** is activated which initiates a download of the selected file (i.e., to the user's computer system or the local PC), as indicated by at **742**. The downloader can also open the selected file with a local PC application as indicated by the file information. The downloaded file can be printed, copied, edited, or otherwise processed.

[**0073**] By clicking on a view button **724**, a viewer/converter **734** is activated. Viewer/converter **734** is typically resident on the application server and invoked when selected. Viewer/converter can, for example, convert the selected file into an HTML file, as indicated at **744**. Viewer **734** can also convert, for example, a PowerPoint™ presentation into a JPEG file, a WordPerfect™ document into a HTML file, and so on. Once the file is converted into the destination format (e.g., HTML or JPEG), it can be easily manipulated by standard applications designed to operate on these file formats. The converted files can also be printed, viewed, copied, and so on.

[**0074**] By clicking on an edit button **726**, an editor **736** is activated. The editor can be written with JAVA™ or other programming languages (i.e., using applets) that can be downloaded onto the local PC for execution, as indicated at **746**. Editor **736** can also download a selected file (if any) onto the local PC for manipulation by the user. An edited file can be saved to the local PC (as indicated at **752**) or back to the user's storage space on the network (as indicated at **754**), or both. In an embodiment, while a file is being edited, it is temporarily stored along with the application (i.e., on the local PC) to provide faster access speed. Periodically, the file can be copied back to the network where file backup can be performed.

[**0075**] Alternatively, editor **736** can (already) reside within the local PC and activated when the user clicks on edit button **726**. The selected file, if any, can be downloaded onto the local PC for editing. After the file is closed, a copy of the edited file can be uploaded back to the network for storage.

[**0076**] For some situations, it may be more advantageous to execute the editor at the application server. This may occur, for example, if the amount of data to be manipulated is small. In this case, a portion of the editor (i.e., the viewer) can be downloaded onto the local PC (if none already exits). As the file is edited, changes are downloaded onto the local PC for display. Commands from the user are received from the local PC and transmitted to the application server for processing.

[**0077**] By clicking on a mail button **728**, an e-mail application **738** is activated. E-mail application **738** can display an e-mail message window **748** that conveniently includes the selected file as an attachment. The user then simply fills in the appropriated fields (e.g., TO, CC, and SUBJECT fields) in window **748** and hits the send button. This feature is particularly convenient for the web-based computer network of the invention.

[**0078**] **FIG. 8** shows a simplified diagram of an embodiment of the file synchronization feature of the invention. As noted above, files and folders can be easily transferred and shared between the storage on the network and the local PCs (e.g., the office desktop PC, the home desktop PC, or a portable PC) used to access the virtual desktop. File sharing greatly enhances flexibility but requires the file management system to maintain up-to-date copies of the files.

[**0079**] As shown in **FIG. 8, a** virtual desktop window **810** includes a sync folder icon **812**. An office PC desktop window **820** includes a sync folder icon **822**, a hard disk icon **824**, and a trash icon **826**. Similarly, a home PC desktop window **830** includes a sync folder **832**. The communications between the PC desktops and the virtual desktop is coordinated by a file synchronization application **840**.

Although typically one desktop PC accesses the virtual desktop at any give moment, there may be situations when multiple desktop PCs concurrently access the virtual desktop (i.e., such as when files are being shared between two users at two desktop PCs). Windows **810**, **820**, and **830** typically include other icons that are not shown in **FIG. 8** for clarity. Also, more than one sync folder can be created on a particular desktop.

[**0080**] The sync folders on the desktop PCs contain files and folders to be maintained "in sync" with their duplicates on the network. The user is able to access and manipulate the items in the sync folder like any other folders. These items are functionally indistinguishable to the user except for the sync feature.

[**0081**] In an embodiment, if the user maintains a sync folder on the PC desktop and the sync folder has at least one item, the file synchronization application is launched and runs in the background of the desktop PC. At the designated update times, the file synchronization application exchanges with the file server information pertaining to the items in the sync folder. Files are then transferred and updated based on the exchanged information and in accordance with the instructions set by the user, as further described below.

[**0082**] The update times can be designated by the user or selected automatically by the file synchronization application. For example, the user can elect to update the files at the start of a session, at the end of the session, during the session, or a combination of the above. The user can also elect to have the files updated at specific times (e.g., at midnight everyday) or only when the user commands. If no times are designated by the user, the synchronization application can automatically select the update times. The user can also selectively enable and disable the file synchronization feature.

[**0083**] In performing the file synchronization at the designated time, the synchronization application first retrieves information for items in the sync folder. For each item in the folder, the application then compares the last edit time of the item in the PC desktop with its duplicate, if any, on the file server. If the times match, no additional work is performed. Otherwise, if the times do not match, the files are updated in accordance with a method selected by the user. For example, the newer item can be written over the older item, the newer item can be saved as a new version, and so on. The updated item is indicated accordingly (i.e., with a name change, an extension change, or a version change in the file attribute). If a file is recently created and a corresponding duplicate does not exist, the recently created file is duplicated on the other desktop.

[**0084**] The file synchronization feature ensures that the user has access to the most current files at any given moment, and from virtually anywhere web access is available.

[**0085**] Additional Features

[**0086**] **FIG. 9** shows a diagram of an embodiment of the bookmark synchronization feature of the invention. This feature allows the user to have access to the same bookmarks regardless of where and when the bookmarks are created. As shown in **FIG. 9**, on the local PC, a browser (e.g., Netscape™ or Internet Explorer™) is executed which opens a browser window **910**. Window **910** includes a pull down main menu **912** that lists, among other menu choices, the "Bookmark" or "Favorite" menu choice. By clicking on the Bookmark menu choice, a window **914** pops up that lists the bookmarks previously saved by the user. The user is then able to scroll through the bookmarks, click on a particular bookmark, and the URL corresponding to that bookmark is launched.

[**0087**] Conventionally, bookmarks are local to the PC, or more specifically, local to the browser that is installed on the PC. It is generally a time consuming process to search for a particular website. Also, the bookmarks corresponding to the URLs are typically named (i.e., by the user or the browser) with descriptive names for ease of recognition. Thus, it is advantageous to provide the user with access to the same set of up-to-date bookmarks regardless of the computer from which access to the virtual desktop is gained.

[**0088**] In an embodiment, a bookmark database **920** stores the bookmarks of the user. Bookmark database **920** can reside in file server **280** in **FIG. 2**. The bookmarks in database **920** are uploaded to, and downloaded from, a virtual desktop **930** at the designated times. This allows the user on the local PC to have access to a familiar set of bookmarks on the virtual desktop. On virtual desktop **930**, the bookmarks are contained in a bookmark folder **932**.

[**0089**] The bookmarks in database **920** can also be uploaded to, and downloaded from, the local PC. Upon activation by the user, a bookmark synchronization application **932** is executed and runs in the background on the local PC. At the designated times, application **932**"grabs" the bookmarks from database **920** and loads the local PC with the retrieved bookmark information. Thus, the bookmarks on the local PC are synchronized with the bookmarks on the virtual desktop. The browser loaded on the local PC, including Netscape™ and Internet Explorer™ can also have access to the bookmarks. The bookmarks are freely transferable between the local and virtual desktops, and also between the different browser applications.

[**0090**] **FIG. 10** shows a diagram of an embodiment of some of the features provided by a personal information manager of the invention. The personal information manager maintains a database of information personal to the user, including a calendar, an address and contact book, a to-do list, and other information. Similar to the files and bookmarks, it is advantageous to maintain up-to-date personal information in a central location that is accessible from virtually anywhere.

[**0091**] As shown in **FIG. 10, a** local PC desktop **1010** and a virtual desktop **1020** each includes a combination of icon, folder, or enumerated list of personal information of various types. For example, icons or folders can be generated that identify the user's address book, calendar, and to-do list. The user can access each type of information by clicking on the designated icon. A window is then opened that displays the selected information.

[**0092**] In an embodiment, a personal information database **1030** stores the personal information of the user. Personal information database **1030** can reside in file server **280** in **FIG. 2**. The personal information can be transferred between database **1030** and desktops **1010** and **1020**. The personal information can further be transferred between local PC desktop **1010** and a personal digital assistance (PDA) **1040** such as a PalmPilot™, a Windows CE™, or other (hand-held) units.

[0093] When enabled by the user, a synchronization application **1050** runs in the background on the local PC. At the designated times, application **1050** updates the personal information on the local PC with the information from database **1030**. In this manner, the personal information on the local PC is synchronized with that from the central database.

[0094] News, Information, and Services

[0095] The virtual desktop and virtual computing environment of the invention provide an integrated link to the vast amount of information on the Internet. Through the virtual desktop, the user is able to quickly and conveniently access other URL links on the Internet. The results gather from the URL links can be manipulated using the applications and tools available on the virtual desktop.

[0096] Referring back to **FIG. 4**, virtual desktop **420** includes icon **426** that represents links to sources of news, information, and services. By clicking on icon **426**, window **436** appears. Window **436** can also include folders and URL links to other web sites. The user is able to sort the URL links by category, alphabetical order, chronological order, or some other arrangements. When the user clicks on the highlighted URL link in window **436** (or in a folder within window **436**), the web page corresponding to that site is retrieved and displayed (i.e., on window **446**). The user can then enlarge window **446** for a larger display.

[0097] The contents within window **446** appear as data that can be manipulated by the user similar to data from other files. Thus, the user can select a section or all of the data in window **446** and saves it as a new file, or paste it onto an existing file. The user can also print, perform searches, and otherwise manipulate the data in window **446**.

[0098] Customization

[0099] The virtual desktop can be customized in accordance with the needs and preferences of the user. As part of the customization, the user can change the layout of the virtual desktop, the contents of the virtual desktop, the icon picture, the destination of the query box, the number of items on the desktop, the color of the windows, boxes, and toolbar, and so on. A database of pre-built objects can be provided to assist the user in customizing the desktop.

[0100] **FIG. 11** shows a simplified diagram of an embodiment of the customization process for the virtual desktop of the invention. Within a virtual desktop **1110**, a customize icon **1112** is provided that includes the tools available to assist the user in customizing the desktop.

[0101] In an embodiment, virtual desktop **1110** is partitioned into a grid of blocks. Each block in the grid corresponds to a desktop object. Each desktop object represents an application, a file, a folder, a personal document (e.g., address book, calendar, to-do list), or so on. By (double) clicking on customize icon **1112**, a customization window **1120** appears. Customization window **1120** includes a number of desktop objects **1122**, one for each block of the grid that has been assigned with an object. The user can create, arrange, or delete objects within the desktop as necessary. For example, similar to many PC desktops, the virtual desktop can include objects associated with word processing, spreadsheet, e-mail, and other applications. By clicking on a particular desktop object **1122**, a customize window **1130** appears which includes the tools to modify the selected object.

[0102] In another embodiment, the user is able to customize by adding and otherwise modifying items of the virtual desktop (i.e., without reference to the grid). In this embodiment, to edit or modify a particular icon, the user clicks on customize icon **1112** and window **1130** appears.

[0103] Window **1130** includes, for example, an icon listing **1132**, an item description listing **1134**, and a query box **1136**. Icon listing **1132** includes the icons of the applications available to the user, icons for files and folders, and icons for other features of the desktops (e.g., calendar, address book, and others). The user selects an icon to be associated with the selected object. Subsequently, the user is able to activate the object (i.e., launch an application) by clicking on the icon. Item description listing **1134** includes items associated with that object (e.g., to-do events, bookmarks, and so on). Query box **1136** allows the user to search for particular items. For example, for the e-mail application, query box **1136** can be used to search for e-mails from a particular recipient, e-mails sent on a particular date, and so on. Query box **1136** can also be coupled to an Internet based search engine to allow the user to search for news, information, and services on the web.

[0104] Security

[0105] Because the network stores the user's files and personal information, security is an important feature of the invention. In particular, security is provided during a session with the network and in the maintenance of the files. The user is allowed, to an extent, to choose the level of security to be maintained.

[0106] **FIG. 12** shows a diagram of an embodiment of the security provided for the virtual desktop of the invention. The first level of security is provided by the use of a secured login process. During the login process, a login window **1210** appears on the web page of the URL site server. Login window **1210** includes fields for the user identification and the user password. The login information is entered by the user and transmitted to the site server where it is compared with the information in a login database. The user is only granted access if the login information match. The login is typically performed as a secure transaction **1212** using, for example, a secured socket layer (SSL) that is defined by IEEE and ISO standards and supported by the browser application. Servers **1216** include collectively the site server, the backend servers, and other servers that may be contacted during a session.

[0107] Once logged in, the user is granted access to the user's virtual desktop. As shown in **FIG. 2**, firewall **232** exists between the Internet **210** and site server **230**. Firewall **232** supports transactions that use HTTP/FTP protocol. As a choice, the user is allowed to select encryption for the login process only, or encryption for the entire session. Thus, during an active session, the transactions can be secured or unsecured, which is indicated by dashed lines for transactions **1222**. If full encryption is selected, each transaction between the local PC and the site server is a secured process. Full encryption may slow down the communications between the local PC and the site server because of the extra encryption processing, but provides a secured computing

environment. Additionally, a virus check can be performed on files before the upload (and download) from the local PC to the network.

[**0108**] To terminate the session, the user logs out by clicking on a logout (LO) icon **1232** on a virtual desktop **1230**. The logout command is sent to servers **1216**. In an embodiment, as part of the logout process, servers **1216** execute (or direct execution) of a termination application **1240** which clears the RAM on the local PC **1250** and the hard dish cache so that "ghost" copies of files are destroyed upon termination of the session. Termination application **1240** can reside on the local PC (i.e., as part of the local PC operating system) that is activated by servers **1216**.

[**0109**] Virtual Desktop Processes

[**0110**] **FIGS. 13A and 13B** show a flow diagram that describes an implementation of an embodiment of the virtual desktop of the invention. The flow diagram describes implementation of some of the features recited above. Thus, **FIGS. 13A and 13B** should only be taken as representative, and not limitation, of the invention.

[**0111**] In **FIG. 13**A, at a step **1310**, the URL website that supports the virtual desktop receives a URL access from one of the local PC. In response, the URL sends its web page and a login window, at a step **1312**. Shortly thereafter, the URL receives, at a step **1314**, the login information and compares, at a step **1316**, the received login information with the login information stored at the URL for that user. At a step **1318**, a determination is made whether the received login information is valid. If the received login information is not valid, an error message is sent to the local PC, at a step **1320**, the login window is redisplayed, at a step **1322** (i.e., with the previously entered data removed from the login window fields), and the site server returns to step **1312**.

[**0112**] If the login is valid, the session starts at a step **1330**. The site server then directs one of the backend server to handle the session with the user. The security mode (e.g., no encryption, partial encryption, or full encryption), as selected by the user or the server, is then set by the server, at a step **1332**.

[**0113**] In **FIG. 13**B, at a step **1340**, a determination is made whether it is time to update the files (i.e., on the local PC or the virtual desktop). The file update can be part of the file synchronization process. The user, in various ways as described above, can designated the update time. If it is time to update the files, the file synchronization application (in conjunction with the file server) updates the files, at a step **1342**. Although not included in the flow diagram, it is presumed that the file sync application is already executed and running (i.e., at step **1330**). If the update time has not arrived, or after a file update, the backend server continues to a step **1350** where it is determined whether a user command has been received. If the answer is no, the backend server loops back to step **1340**.

[**0114**] Otherwise, if a user command has been received, the backend server proceeds through a series of decisions to determine the type of command received. At a step **1352**, a determination is made whether the command is to execute an application. If the answer is yes, the selected application is executed by the application server, at a step **1354**. Otherwise, at a step **1356** , a determination is made whether the command is to manipulate a file. If the answer is yes, the file management system is executed by the file server, at a step **1358**. Otherwise, at a step **1360**, a determination is made whether the command is to access and/or gather information and news. If the answer is yes, the news gathering application is executed, at a step **1362**. Otherwise, at a step **1364**, a determination is made whether the command is to modify the virtual desktop configuration. If the answer is yes, the virtual desktop configuration application is executed, at a step **1366**. Otherwise, at a step **1370**, a determination is made whether the command is to log out. If the answer is no, the backend server loops back to step **1340**. Otherwise, if the user chooses to log out, the virtual desktop application directs the termination application to clear to local RAM and hard disk cache, at a step **1380**.

[**0115**] **FIG. 14** shows a flow diagram that describes an implementation of an embodiment of the file synchronization of the invention. The flow diagram describes implementation of some of the file synchronization features recited above, and should only be taken as representative, and not limitation, of the invention.

[**0116**] In **FIG. 14**, at a step **1410**, a determination is made whether the file synchronization feature is enabled by the user, whether a sync folder exists, and whether the sync folder contains at least one file. If the answer is no to any of these inquires, the file synchronization is not performed. Otherwise, at a step **1412**, a determination is made whether the update time has been designated. If the answer is no, the user is queried to designate the update time, at a step **1414**. Alternatively, the file synchronization application can automatically select the update time. The file synchronization application then proceeds to a step **1420** where a determination is made whether the update time has arrived. If the answer is no, step **1420** is repeated. Otherwise, if it's time to update the files, the application retrieves information on the files in the sync folder on the local PC and the virtual desktop, at a step **1422**. At a step **1424**, a file from the sync folder is selected. A determination is then made, at a step **1426**, whether the selected file is current. This is performed by comparing the file information and noting the differences, as described above. If the selected file needs updating, at a step **1430**, the older file is updated with the newer file by either saving the newer file over the older file or saving the newer file as a new version or under a new name. At a step **1432**, a determination is made whether all files in the sync folders have been processed. If the answer is no, the application returns to step **1424** where the next file in the sync folder is selected. Otherwise, the file synchronization process terminates.

[**0117**] Virtual Desktop Implementation

[**0118**] The invention can be implemented in various manners using various software tools. A specific implementation is described below. However, alternative implementations of the invention can be made and are within the scope of the invention.

[**0119**] In a specific embodiment, the invention is implemented using a set of program modules that are linked together to perform the required functionality. In a specific embodiment, the modules are written using a software tool entitled Active Server Page from Microsoft Corporation. The modules reside within the backend server and are invoked (i.e., in response to a user command) to provide the requested service. A web server application entitled Internet

Information Server (IIS) from Microsoft Corporation executes the modules and provides features (e.g., SSL support) used by some of the modules.

[0120] Table 1 in the attached Exhibit lists a set of program modules and their functionality. The first column in Table 1 lists the name of the program module, the second column lists the link information, and the third column includes a description of the functionality of the modules. Most of the modules have a .asp extension to denote that they are written using Active Server Page from Microsoft Corporation. In the second column, for each particular module, the upper box lists other modules that link to this module, and the lower box lists other modules that are linked from this module. For example, the login.asp module links to the desktop.asp module. Correspondingly, the desktop.asp module (the third entry in Table 1) is linked from the login.asp module. As shown in Table 1, a module can link to multiple other modules, and multiple modules can link to a particular module.

[0121] The third column of Table 1 describes some of the functionality for each module. However, additional features and functionality can be programmed into the modules listed in Table 1, depending on the particular system requirements. Also, additional modules can be programmed and linked to those listed in Table 1. For example, although not explicitly shown in Table 1, modules that facilitate the execution of applications available on the virtual desktop (e.g., Words™, Excel™, Lotus™, and so on) can be written and deployed.

[0122] Table 2 lists the interactions between the program modules and the various servers within the network. The modules in Table 1 are listed again in the first column of Table 2. The second through sixth columns in Table 2 correspond to data server **276**, e-mail server **272**, viewer converter **270**, file server **280**, and controller server **240**, respectively. These various servers are shown in **FIG. 2**.

[0123] As noted earlier, the program modules reside in the backend server. Each of the other "specialty" servers (e.g., data server, e-mail server, viewer converter, file server, and controller server) performs a predefined set of tasks. Each of the specialty servers generally includes an "agent" that manages that server and communicates with the program modules residing in the backend server. The agents can be software products manufactured by various vendors, or customized software products written in any programming languages generally available. For example, the data server is managed by an SQL agent available from Microsoft Corporation, the viewer converter is managed by the Outside In Server© product from INSO Corporation, and the secure socket layer (SSL) function of the controller server is performed by a SSL agent from the Internet Information Server (IIS) product from Microsoft Corporation. The Outside In Server application is able to convert files of various formats (e.g., Words™, Excel™, PowerPoint™, Lotus™, Access™, and others) into HTML format for viewing online. Generally, no agents are required to manage the file server, as the program modules that access the file server also manage the file server.

[0124] The specialty servers are accessed as necessary by the program modules residing in the backend server. Table 2 lists the modules and the servers accessed by the modules, as indicated by the "Y" in the table entry. For example, the login.asp module can access the data server, the file server, and the controller server during execution of the login.asp module.

[0125] Table 3 lists the interactions between the program modules and the various databases within the system. The modules in Table 1 are listed again in the first column of Table 3. The second and third columns in Table 3 correspond to the user information database and the desktop database, respectively. The fourth through sixth columns correspond to the e-mail database, the seventh and eight columns correspond to the calendar database, the ninth and tenth columns correspond to the bookmark database, the eleventh column corresponds to the address book database, and the twelfth column corresponds to the friend database. Referring back to **FIG. 2**, the user information database is implemented in databases **242** and **274**, the e-mail database is implemented in database **274**, and the remaining databases in Table 3 are implemented in database **278**.

[0126] The user information database includes information associated with a particular user, including the login information. The desktop database includes information that define the user's desktop. The e-mail database includes information on the e-mails of the user. In an embodiment, the e-mail database is partitioned into three smaller databases for the e-mail message, the recipient, and the file attachment. The calendar database includes information on the user's calendar, and is partitioned into two smaller databases for the calendar event and the calendar sharing. Calendar sharing database includes the list of users authorized to access and/or update another user's calendar. The bookmark database includes information on the user's bookmark, and is partitioned into two smaller databases for the bookmarks themselves and the bookmark category. The bookmark categories are selectable by the user and are akin to folders for holding bookmarks associated with that user. The address book database includes information on the user's address book. And the friend database includes information on the user's friends.

[0127] As shown in Table 3, each module has access to a predetermined number of databases. For example, the login.asp module has read access to the user information database, and the userreg.asp module has read and write access to the same user information database.

[0128] In an embodiment, a load balance module tracks the amount of activity on each of the backend servers in the network. The module then determines a distribution of the workload that balances the network and provides good response time to a large number of user. The load balance module then distributes the workload between the backend servers. In an embodiment, the load balance module includes counters that keep track of the amount of processing performed by each of the backend servers.

[0129] Computer System

[0130] **FIG. 15** shows the basic subsystems of a server **1500** suitable for use with the invention. Server **1500** can implement, for example, user terminal **210**, site server **230**, controller server **240**, backend server **260**, viewer converter **270**, e-mail server **272**, database server **276**, file server **280**, and application server **290** in **FIG. 2**. In **FIG. 15**, computer system **1500** includes a bus **1512** that interconnects major subsystems such as a central processor **1514**, a system

memory **1516**, and external devices such as a display screen **1520** via a display adapter **1522**, a printer **1524** via a parallel port **1526**, a mouse **1528** and a keyboard **1530** via an input/output (I/O) controller **1532**, a fixed disk drive **1534** and a CD-ROM player **1536** via a hose adapter **1538**, a network interface card **1540**, and a floppy disk drive **1542** operative to receive a floppy disk **1544**.

[**0131**] Many other devices or subsystems (not shown) can be connected, such as a scanning device, a touch screen, and others. Also, it is not necessary for all of the devices shown in **FIG. 15** to be present to practice the present invention. Furthermore, the devices and subsystems may be interconnected in different ways from that shown in **FIG. 15**. The operation of a computer system such as that shown in **FIG. 15** is readily known in the art and is not discussed in detail in the present application. Source code to implement some embodiments of the present invention may be operatively disposed in system memory **1516** or stored on storage media such as fixed disk drive **1534**, floppy disk **1544**, or a CD-ROM **1546** that is operative with CD-ROM player **1536**.

[**0132**] For clarity, the invention has been described in the context of the Internet and for a specific implementation using support products available from Microsoft Corporation. The specific details are intended to be illustrative, and not limitations, of the invention. It will be recognized that alternative implementations of the invention and modifications of the techniques described herein can be made (i.e., to satisfy a particular design requirement). For example, the invention can be implemented within any computing network, including local area network, a campus network, a wide area network, or others. Further, the program modules that implement the invention can be written in other codes (e.g., C, C++, Java, or others). Accordingly, these variations are all within the scope of the invention

[**0133**] The previous description of the specific embodiments is provided to enable any person skilled in the art to make or use the invention. The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein, and as defined by the following claims.

What is claimed is:

1. A computer implemented method for providing a virtual desktop at a user's computing device selected from among a plurality of possible user's computing device, the method comprising:

receiving a URL from the selected computing device at a site server;

in response to the received URL, retrieving a personal web page from a file server, wherein the personal web page represents the virtual desktop, and wherein the virtual desktop includes links for applications and files accessible from the selected computing device;

returning the personal web page to the selected computing device;

receiving commands from the selected computing device via the personal web page at the site server; and

processing the commands at the site server.

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