(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 January 2008 (17.01.2008)

PCT

(10) International Publication Number
WO 2008/008806 A2

(51) International Patent Classification:
G06F 15/16 (2006.01)

(21) International Application Number:
PCT/US2007/073209

(22) International Filing Date: 11 July 2007 (11.07.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/456,613 11 July 2006 (11.07.2006) US

(71) Applicant and
(72) Inventor: **KHALATIAN, Igor** [US/US]; 3 Monticello Court, Morganville, NJ 07751 (US).

(74) Agent: **RODRIGUEZ, Michael A.**; Guerin & Rodriguez, LLP, 5 Mount Royal Avenue, Mount Royal Office Park, Marlborough, Massachusetts 01752 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) **Title:** ONE-CLICK UNIVERSAL SCREEN SHARING

(57) **Abstract:** Described are systems and methods for screen sharing between computing systems. A guest system and a host system are coupled to a server over a network. The guest system automatically executes program code embedded in a web page received from the server. The program code sends a request to the server for image data corresponding to an image on a display screen of the host system. The host system automatically executes program code embedded in a web page received from the server. The program code captures image data from the display screen of the host system and sends the captured image data to the server. The server sends captured image data received from the host system to the guest system in response to the request from the guest system. The guest and host systems can participate in a screen-sharing session without having to download and install special software.

WO 2008/008806 A2

ONE-CLICK UNIVERSAL SCREEN SHARING

FIELD OF THE INVENTION

The invention relates generally to screen sharing between computing systems connected to a network. More specifically, the invention relates to screen sharing that does not require the computing systems to deliberately download and install software in order to participate.

COPYRIGHT NOTICE/PERMISSION

BACKGROUND

Screen sharing between computing devices has a myriad of practical applications. For one, screen sharing enables remote technical support. Another practical use is collaboration between a host and a viewer. A host can give a presentation to one or more remote viewers, perform demonstrations, review documents, and share images.

Numerous implementations of screen sharing presently exist. One well-known implementation is virtual network computing (VNC). VNC is a screen sharing system that enables a user to view and interact with another computer remotely over the Internet. VNC has two components: a server component and a client (i.e., viewer) component. User interface commands pass from the viewer computer to the remote computer, which sends back screen updates.

Like many screen-sharing implementations, however, setting up a VNC screen sharing system requires downloading and installing special software at one or both of the client and remote computer systems. Use of such client software can require changing the computer system's configuration or setting viewing preferences. Moreover, many standard and personal firewalls often block ports commonly used by some screen sharing systems, requiring an administrator to configure the firewalls explicitly to allow traffic on these ports. Still other screen-sharing systems are operating system dependent (e.g., MAC OS, Windows) and, therefore, are unable to gain widespread adoption.

SUMMARY

In one aspect, the invention features a method for sharing an image on a display screen of a computing system. A region on a web page displayed in a browser window on the display screen of the computing system is activated with an input device in order to host a screen-sharing session. In response to launching the screen-sharing session, program code is received automatically over a network. The program code is automatically executed by a browser upon receiving the program code. The execution of the program code captures an image on the display screen of the computing system.

In another aspect, the invention features a method for viewing at a local computing system an image on a display screen of a remote computing system. A region on a web page displayed in a browser window on a display screen of the local computing system is activated with an input device in order to a join a screen-sharing session. In response to activating the region on the web page, program code is received automatically over a network. The program code is executed automatically upon receipt by a browser to generate an HTTP request for image data. Image data corresponding to the display screen of the remote computing system are received in response to the request. The image data corresponding to the display screen of the remote computing system are displayed on the display screen of the local computing system.

In still another aspect, the invention features a method of conducting a screen-sharing session during which a user of a guest computing system can view an image displayed on a display screen of a host computing system. A first web page with embedded program code is sent to the host computing system, the program code capturing image data corresponding to the image displayed on the display screen of the host computing system. A second web page with embedded program code is sent to the guest computing system for generating a request for image data. From the host computing system are received image data representing a screen image of the host computing system. A request is received from the guest computing system for image data. Image data received from the host computing system are sent to the guest computing system in response to the request received from the guest computing system.

In yet another aspect, the invention features a screen-sharing system comprising a guest computing system and a host computing system coupled to a server system over a network. The guest computing system automatically executes program code embedded in a web page received from the server system. The program code sends a request to the server system for image data corresponding to an image on a display screen of the host computing system. The host computing system automatically executes program code embedded in a web page received from the server system. This program code captures image data from the display screen of the host computing system and sends the captured image data to the server system. The server system sends captured image data received from the host computing system to the guest computing system in response to the request from the guest computing system.

In still yet another aspect, the invention features a method for enabling screen-sharing functionality on a computing system. The method comprises pasting hypertext markup language (HTML) code into a web page accessed by the computing system through a Web browser. The HTML code produces a region on the web page, which, when activated, launches a screen-sharing session.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and further advantages of this invention may be better understood by referring to the following description in conjunction with the accompanying drawings, in which like numerals indicate like structural elements and features in various figures. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

FIG. 1 is a block diagram representation of a screen-sharing system constructed in accordance with the invention.

FIG. 2 is a flow diagram of an embodiment of a process by which a guest computing system participates in a screen-sharing session.

FIG. 3 is a flow diagram of an embodiment of a process by which a host computing system hosts the screen-sharing session.

FIG. 4A and FIG. 4B are flow diagrams of an embodiment of a process by which a server system orchestrates a screen-sharing session between the host and guest computing systems.

FIG. 5 is a flow diagram of an embodiment of a process by which the host computing system can identify changes in a screen image since the previous screen update.

FIG. 6 is a diagram representing an embodiment of the screen image being iteratively partitioned when isolating a sub-image with detected image changes.

FIG. 7 is a flow diagram of an embodiment of a process by which the host computing system can identify changes in a screen image since the previous screen update.

FIG. 8 is a flow diagram of a process by which the host computing system can become enabled for hosting screen-sharing sessions.

FIG. 9 is a listing of exemplary HTML (Hypertext Markup Language Text) code that can be used to enable a host computing system for hosting screen-sharing sessions.

FIG. 10 is a flow diagram of an embodiment of a process by which a guest computing system can obtain remote control of the screen and computer of a host computing system.

DETAILED DESCRIPTION

Web-based screen-sharing systems constructed in accordance with the invention employ standard browser technology to share the screen image of a host computing system with one or more guest computing systems in near real-time. Because browser technology has become widespread, most any web-enabled computing system can participate in the screen sharing of the present invention. Participating computing systems do not need to deliberately download and install special software in order to become capable of screen sharing. Rather, such computing systems can engage in screen sharing using readily available standard browser plug-ins, executing universally accepted HTML code, and communicating in accordance with the universally adopted HTTP (HyperText Transport Protocol). Further, the screen sharing is operating system independent. Thus, in this sense, the screen sharing of the present invention is universal.

In brief overview, a guest computing system (a viewer) and a host computing system (a screen sharer) are coupled to a server system over a network. The host computing system and guest computing systems each communicates with the server system through their web browser. Upon visiting the server system, the host computing system automatically downloads and executes an applet that includes screen-capture program code – screen sharing in accordance with the invention works with the screen of the host computing system as an image. Currently available software (e.g., JAVA version 1.3 and higher) includes program code for capturing the pixel data of the host screen image. Upon automatically executing this host applet, the host computing system sends the captured image data to the server. Broadband Internet access through, e.g., cable and DSL (Digital Subscriber Line), provide sufficient bandwidth for transporting the image data.

During an established screen-sharing session, the browser of the guest computing system also downloads an applet from the server. This guest applet continuously sends requests for image data to the server. In response, the server supplies image data received from the host. The guest computing system repaints its display screen with the received image data, thus reproducing the image of the host screen at the guest computing system.

FIG. 1 shows an embodiment of a screen-sharing system 10 configured for screen sharing in accordance with the present invention. The screen-sharing system 10 includes a host computing system 12 and a guest computing system 14 in communication with a server system 16 over a network 18. Each of the host and guest computing systems 12, 14 may reside behind a respective firewall 20-1, 20-2. As described herein, the firewalls 20-1, 20-2 do not impede screen sharing between the host and guest computing systems 12, 14.

Each computing system 12, 14 includes a display screen 21 and a processor 22 in communication with system memory 24 over a signal bus 26. Exemplary implementations of the computing systems 12, 14 include, but are not limited to, personal computers (PC), Macintosh computers, workstations, laptop computers, kiosks, hand-held devices, such as a personal digital assistant (PDA), cellular phones, navigation and global positioning systems, and network terminals.

The system memory 24 includes non-volatile computer storage media, such as read-only memory (ROM) 28, and volatile computer storage media, such as random-access memory (RAM) 30. Typically stored in the ROM 28 is a basic input/output system (BIOS), which contains program code for controlling basic operations of the computing systems 12, 14 including start-up of the computing device and initialization of hardware. Stored within the RAM 30 are program code and data. Program code includes, but is not limited to, application programs 32, program modules 34 (e.g., browser plug-ins), and an operating system 36 (e.g., Windows 95, Windows 98, Windows NT 4.0, Windows XP, Windows 2000, Linux, and Macintosh).

Application programs 28 on the computing systems 12, 14 include browser software. The browser software can be any commercially available Web browser, e.g., Microsoft INTERNET EXPLORER®, Mozilla FIREFOX®, NETSCAPE®, and SAFARI®. Currently, most computing devices already have an installed browser when purchased from a manufacturer and deployed in the business, enterprise, or home. When the browser of a computing system visits a Web site with an embedded applet, the computing system automatically downloads the applet from the Web server and automatically executes it. Execution of the applet may require the support of various browser plug-ins 34 (e.g., JAVA, ACTIVEX).

In one embodiment, the browser of each computing system 12, 14 is a JAVA-enabled browser with an interpreter, e.g., a JAVA virtual machine, for interpreting JAVA bytecode (i.e., applets, scripts) and applications. Most commercially available Web browsers have the JAVA bytecode interpreter built into the Web browser. Because they are translated into an intermediate processor-independent bytecode supported by Java Virtual Machine, JAVA applets are operating system independent. In other embodiments, the browser of the guest computing system 14, the browser of the host computing system 12, or browsers of both computing systems 12, 14 are ACTIVEX-enabled, which execute downloaded ActiveX controls. In general, the principles of the invention apply to any browser capable of running applets or controls that perform screen capture.

Other application programs 28 can include, but are not limited to, an electronic mail client program, an instant messaging, and office applications, such as spreadsheet, word processor, and slide presentation software. Each application program 28 can be a proprietary or commercially available program and can run in conjunction with screen-sharing

Typically, the signal bus 26 connects the processor 22 to various other components of the computing system 12, 14 including, for example, a user-input interface, a memory interface, a peripheral interface, a video interface, a local network interface, and a wide-area network interface (not shown). The display screen 21 connects to the signal bus 26 through the video interface. Exemplary implementations of the signal bus include, but are not limited to, a Peripheral Component Interconnect (PCI) bus, an Industry Standard Architecture (ISA) bus, an Enhanced Industry Standard Architecture (EISA) bus, and a Video Electronics Standards Association (VESA) bus. Over a wire or wireless link, the user-input interface is in communication with one or more user-input devices, e.g., a keyboard, a mouse, trackball, touch-pad, touch-screen, microphone, joystick, by which a user can enter information and commands into the computing system 12, 14. Each computing system 12, 14 can reside behind a firewall 20-1, 20-2, such as ZoneAlarm™, a MICROSOFT XP® built-in, or Norton Security™ firewalls, or external firewalls to isolate the computing system from the network 18.

Embodiments of the network 18 include, but are not limited to, local-area networks (LAN), metro-area networks (MAN), and wide-area networks (WAN), such as the Internet or World Wide Web. Each computing system 12, 14 can connect to the server 16 over the network 18 through one of a variety of connections, such as standard telephone lines, digital subscriber line (DSL), asynchronous DSL, LAN or WAN links (e.g., T1, T3), broadband connections (Frame Relay, ATM), and wireless connections (e.g., 802.11(a), 802.11(b), 802.11(g)).

In one embodiment, the server 16 is a Web server and includes a server engine. The server engine receives HTTP requests to access web pages identified by URLs and provides the appropriate web page to the requesting computing system 12, 14. The server engine can also send an identifier to each computing system 12, 14 when that computing system first communicates with the server 16. In subsequent communications with the server 16, each computing system 12, 14 includes its identifier so that the server 16 can identify the source.

In general, the server 16 orchestrates the screen-sharing session between the host and guest computing systems 12, 14. The server 16 establishes a first HTTP connection 40 with the host 12 and a second HTTP connection 42 with the guest 14. By the first connection 40, the server 16 continuously receives image (i.e., pixel) data corresponding to the screen image of the host 12. Over the second connection 42, the server 16 continuously receives requests for image data from the guest 14 and responds with image data received from the host 12. In effect, the server 16 is the hub of a connection 44 established between the host system 12 and the guest system 14 for purposes of screen sharing.

FIG. 2 shows an embodiment of a general process 100 of screen sharing in accordance with the present invention from the perspective of the guest 14. When a user of the guest system 14 decides to participate in sharing the screen of the host system 12, the user obtains (step 102) a session code (or passcode). The user can receive this session code by telephone, email, instant messaging, or any other mode of direct or indirect communication, typically, although not necessarily, with the user of the host system 12.

At step 104, the user of the guest 14 launches the browser software and visits a specific website hosted by the server 16. The browser can have a graphical screen-sharing button (e.g., within a toolbar) that, when pressed, sends an HTTP request to the server 16 to visit the specific website. Within the guest browser, a web page presents the guest with various options including an option to join a presentation. When the guest 14 chooses to join the presentation, the guest browser displays another web page having a field within which the guest 14 enters (step 106) the session code and, optionally, additional data, such as a Guest name (used, e.g., in Web Conferencing) and a special operator password (used, e.g., in customer-support situations).

When the session code is valid, the guest 14 receives, from the server 16, a web page with embedded program code (e.g., a JAVA applet), and automatically and continuously executes (step 108) this program code. Execution of the program code causes the guest 14 to establish a connection with server 16 and to send (step 110) an HTTP request regularly to the server 16 requesting pixel-level data corresponding to the screen image of the host screen. By convention, HTTP requests and responses transported over this connection are addressed to well-known port number 80 or to port 443 for secure https connections. Accordingly, for there to be any browser-to-Web server interaction over the network 18, port 80 needs to be open in the firewall 20-2. Consequently, screen-sharing traffic is able to pass through the firewall 20-2 unblocked.

In response to the HTTP request, the guest 14 receives (step 112) image data and screen coordinates from the server 16. The image data received can correspond to a portion of the display screen display of the host computing system 12 or to the display screen in its entirety. The guest computing system 14 uses the screen coordinates to repaint (step 114) its display screen with the image data obtained from the server 16. Accordingly, the user of the guest computing system 14 sees the screen image of the host computing system 12.

Until the screen sharing session is terminated, the guest computing system 14 continuously sends (step 116) requests to the server, receives image data from the server, and repaints its display screen accordingly. In one embodiment, the guest 14 sends another request for image data to the server 16 as soon as the guest 14 repaints its display screen. That is, the guest 14 continuously issues requests as quickly as it is able. In another embodiment, the guest 14 sends a request periodically at a predetermined frequency (e.g., 1s). Any changes to the screen of the host 12 appear real-time in the browser window of the guest 14.

Advantageously, the user of the guest computing system 14 does not deliberately download and install software at the guest computing system 14 in order to participate in screen sharing. In contrast, the guest computing system 14 receives and executes the applet automatically in response to visiting the server web page, without the user of the guest 14 being aware of any downloaded applet.

Although this embodiment of the process 100 includes an exchange of a session code, a screen-sharing session can be established without the use of any session code and session code authentication (i.e., steps 102 and 106 are optional).

FIG. 3 shows an embodiment of a general process 200 of screen sharing in accordance with the present invention from the perspective of the host computing system 12. At step 202, a user of the host 12 determines to host a screen-sharing session and launches the Web browser. The Web browser can display a graphical button that the user can press (step 204) to visit a screen-sharing web page hosted by the server 16. Alternatively, the user can enter the URL of the screen-sharing web page into the address field in the browser window, click on a link, or click on an icon in a browser toolbar, to list but a few mechanisms by which the user can visit the screen-sharing web page.

The screen-sharing web page can display various options, including an option to host a screen-sharing session. When the user chooses (step 206) the option to host a screen-sharing session, the host 12 receives a session code (which appears in a new web page presented to the host 12). In one embodiment, the host 12 receives the session code only if authorized to host screen-sharing sessions, as described below.

When the host 12 is establishing a screen-sharing session with the server 16 for a first time, a security certificate appears (step 207) at the host 12 (i.e., before the host 12 sees the session code). The user of the host 12 accepts the certificate to establish a secure connection with the server 16. In general, a security certificate appears for each new screen-sharing session, although the user of the host 12 can elect always to trust certificates from the server 16 so that subsequent screen-sharing sessions do not prompt a reappearance of the security certificate.

Although this embodiment of the process 200 includes the use of a session code, a screen-sharing session can be established without the use of any session code and session code authentication (i.e., steps 206 through 208 are optional).

At step 208, the user of the host computing system 12 distributes the session code to the guest. (For multiple guests, the user of the host 12 distributes the same session code to each guest). Exemplary methods for distributing the session code are described above. It is to be understood that the distribution of the session code does not need not occur at this particular point in the process 200: the host 12 can begin sending image data to the server 16, as described below, before the session code is given to any guests.

At step 210, the host 12 receives and executes program code from the server 16 (e.g., a JAVA applet embedded in the new downloaded web page that displays the session code). The program code includes a screen-capture method for capturing a pixel-level snapshot of the screen of the host 12. In one embodiment, the screen-capture method employs a JAVA version 1.3 method called createScreenCapture(). An input parameter to the JAVA createScreenCapture method is a rectangle that defines the screen boundaries within which pixels are to be captured. Thus, the createScreenCapture method can be used to capture a specific area of the screen or of a specific visual object. The createScreenCapture method returns a pixel buffer containing the image (i.e., pixel data).

In general, the size of captured pixel buffer can be large. For example, for a 32-bit color screen with a resolution of 1280 X 1024, the size of a pixel buffer is at least 5,242,880 bytes (32 * 1280 * 1024). Transmitting this amount of data with sufficient frequency to achieve an animated screen image at the guest 14 may be unfeasible in networks where the bandwidth is insufficient to support the pixel data traffic.

Rather than send the entire screen image upon each execution of the screen-capture method, in one embodiment, the host 12 determines (step 212) which sub-image of the screen image has changed since the last transmission of the pixel buffer and sends that sub-image to the server 16. To make this determination, the host 12 runs program code (downloaded to the host 14 with the screen-capture code or as a result of executing the screen-capture code) that isolates the area of change to a rectangular sub-image, as described in more detail below.

The host 12 compresses (step 214) the changed rectangular sub-image into a file, using either a JPEG (Joint Photographic Experts Group) or PNG (Portable Network Graphics) codec, and transmits (step 216) the compressed rectangle sub-image with its rectangle coordinates (x, y, height, and width) to the server 16. Depending on the contents of the screen image, the host 12 automatically and dynamically chooses the particular compression type. For example, JPG compression is preferred for high quality images and photographs, whereas PNG compression is preferred for the graphical applications, websites, etc. The connection between the host 12 and the server 16 transports HTTP requests and responses addressed to well-known port number 80 or to port 443 for secure https connections. Again, screen-sharing traffic is able to pass unblocked through any firewall 20-1 (FIG. 1).

The host computing system 12 continuously (step 218) determines screen image changes, compresses the image data, and sends the compressed image data to the server 16 until the screen-sharing session is terminated. In one embodiment, the host 12 starts determining screen image changes as soon as it transmits the compressed image data. That is, the host 12 continuously determines changes to the screen, compresses the changes, and forwards the changes to the server 16 as quickly as it is able. In another embodiment, the host 12 determines changes periodically at a predetermined frequency (e.g., 1s). After the host 12 starts sharing its screen, the screen continues to be shared provided the browser window remains open, although the browser window need not be the topmost window nor be maximized.

FIG. 4A and FIG. 4B show an embodiment of a general process 300 of screen sharing in accordance with the present invention from the perspective of the server computing system 16. The particular numbering of the steps of the process 300 is not intended to imply that the process 300 occurs serially. For instance, during part of the process 300, the server 16 is communicating with the host 12 while communicating with the guest 14.

At step 302, the server 16 receives an HTTP request from the host 12 for hosting a screen-sharing session. From the HTTP request, the server 16 is able to determine its originator (e.g., the HTTP request includes an identifier sent to the host 12 by the server 16 during a previous interaction between the two systems 12, 16). In a database of registered hosts, the server 16 determines (step 304) whether the originator of the HTTP request (here, the host 12) is authorized to host screen-sharing sessions. If the host 12 is not among the list of registered hosts, the server 16 can reject the connection or offer to register the host.

If the host 12 is a registered user, the server 16 produces (step 306) a session code (e.g., randomly generated) and sends the session code to the host 12, for display on the host screen. The server 16 also sends the screen-capture program code, described above, to the host 12. The server 16 determines (step 310) when a guest connects or is already connected to this session. Alternatively, the server 16 determines that the screen-sharing session terminates (step 312), because, e.g., the host 12 cancels the session.

At step 314, the server 16 receives an HTTP request from the guest 14 for joining a screen-sharing session and presents a web page with a field for receiving a session code. The server 16 verifies (step 316) a session code submitted by the user of the guest 14. If the session code corresponds to a session code given to the host 12, the server 16 sends (step 318) an applet to the guest 14. In addition, the server 16 uses the session code to link the guest 14 to the host 12. For example, the server 16 can maintain a table for tracking screen-sharing sessions and generate (step 320) a new entry in the table representing the screen-sharing session between the guest 14 and the host 12. The session code can be used as an index to the table entry. In addition, the session code can operate within the table to link multiple guests to a single host (in those instances when multiple guests are participating in a screen-sharing session). For embodiments that do not use a session code, steps 306 and 316 are not performed.

During the screen-sharing session, the server 16 receives (step 322) screen image data from the host 12. The server 16 stores (step 324) screen image data updates received from the host 12 in a buffer. While communicating with the host 12, the server 16 is also communicating with the guest 14. At step 326, the server 16 receives a request from the guest 14 for screen image data.

In general, the server 16 forwards (step 328) image data received from the host 12 to the guest 14. More specifically, the server 16 makes a determination as to which image data to send. To illustrate, the server 16 can track the last update to the host screen image that the server 16 sent to the guest 12. When the server 16 receives a subsequent request for image data from the guest 14, the server 16 identifies which image updates it has received from the host 12 since sending the last update to the guest 14. If more than one screen image update has since arrived from the host 12, instead of sending the next update in the series of unsent updates, the server 16 analyzes the unsent updates to determine if any one of them can be bypassed of if certain updates could be efficiently combined.

As an oversimplified illustration, consider for example that the last screen image update sent to the guest is number 100, and that subsequent updates numbered 101 through 120 arrive at the server from the host. When the next request arrives from the guest 14, the server 16 does not merely send the screen image update number 101. Rather, the server 16 analyzes the newly arrived screen image updates (here, 101 through 120) to determine if any of the later screen image updates encompasses one or more of the previous updates.

For example, screen image update number 120 may be a full screen update sent by the host 12 to establish image synchronization with the guest 14. Consequently, it is enough for the server 16 to send screen image update number 120 to the guest 14, because the other updates 101 through 119 are no longer needed (being subsumed by the full screen update). On a lesser scale, one of the later screen image updates may relate to a sub-image that fully encompasses the sub-image of an earlier screen image update. The server 16 can also combine non-overlapping screen image updates.

By discarding subsumed screen image updates and combining updates wherever appropriate, the server 16 avoids needless expenditure of bandwidth. This mechanism is particularly useful when the host uploads screen image updates at a faster rate than the guest downloads updated screen image data, or, in general, when the speed of the host 12 and multiple guests differ substantially.

FIG. 5 shows an embodiment of a general process 400 performed by the host 12 to determine which rectangular sub-image of the screen image has changed (since the last screen capture). At step 402, the host 12 receives a captured screen image and divides the screen into grids. The screen image is saved (step 404) to a buffer, b, as a matrix of grids. At step 406, the host 12 determines whether this is a first occurrence of a capture of the screen image. If this capture is the first occurrence, the image is saved (step 408) in a buffer, bp, as a matrix of grids. The program code executing at the host 12 returns (step 410) the coordinates of the full screen image. Full screen coordinates include the screen origin (0, 0), the screen width, and the screen height. The program code then exits (step 412).

If, instead, this capture is a subsequent occurrence, the image contents in the buffer, b, for each grid are compared (step 414) with the image content in the buffer, bp. A process for determining differences is described below in connection with FIG. 7. If, at step 416, no differences are detected for any of the grids, the program code returns (step 418) the coordinates of a full-screen image. If image data changes in any one or more of the grids, the new image grids are copied (step 420) the buffer, bp. The program code then determines (step 424) a sub-image that encompasses the changes.

Various techniques can be used to find the sub-image that encompasses the pixel changes. For example, a first technique compares sub-images in grids one at a time, like squares in a chessboard, to determine whether that sub-image has changed.

A second technique executes similarly to the first technique, except that the second techniques divides the screen image into grids by dividing the image into four sections, as shown in FIG. 6. Each sub-image that contains a difference is subdivided into quarters until a sub-image containing the pixel changes is small enough for transmission. FIG. 6 shows the fourth quadrant subdivided thrice to arrive at an acceptably sized sub-image 450 having changes for transmission to the server 16. This technique can arrive at small sub-images faster than the first technique, except that changes occurring near the middle of the screen can involve all four initial sub-images. In such instances, the first technique is preferred. In one embodiment, the host 12 combines the two techniques, adaptively selecting the technique that is more appropriate for the particular screen-sharing situation.

FIG. 7 shows an embodiment of a process 500 by which the host computing system 12 detects pixel changes in the screen image. At step 502, the screen image is received and divided into grids. The image of each new grid is compared (steps 504) to the corresponding grid of the screen image in the buffer, bp. If no differences are detected, at step 506 the process 500 returns 0 (for no differences). If differences are found, at step 508 the process 500 returns N, where N is the number of pixel differences detected between the two compared grid images.

FIG. 8 shows an embodiment of a process 550 for enabling the host computing system 12 to conduct screen-sharing sessions in accordance with the invention. At step 552, the user of the host computing system 12 launches the web browser and visits a web page that has HTML code for conducting screen sharing in accordance with the invention. The user copies (steps 554) the HTML code from the web page (e.g., into the clipboard) and pastes (steps 558) that HTML code into a web page used by the host computing system 12 for hosting screen-sharing session. Alternatively, the HTML code can be e-mailed to the user. As another example, after the user registers with the server system 16, a browser window opens with instructions for copying and pasting the HTML code. Other methods of distributing the HTML code can be practiced without departing from the principles of the invention.

The HTML code produces a screen-sharing graphical button that appears whenever a user of a computing system visits the web page with the HTML code. Activating the graphical button (e.g., with one mouse click) launches a screen-sharing session. This embodiment of the HTML code does not authenticate the host at the server 16. Accordingly, anyone can host a screen-sharing session by visiting the web page and pressing the graphical screen-sharing button. This universality becomes particularly useful in customer support applications. In such customer support applications, an operator (i.e., an individual who is providing the customer support) may be required to provide an “operator’s password” in order to see the screen (i.e., become a guest of the screen-sharing session).

As an illustrated example, most business enterprises maintain a web site that hosts one or more web pages that are accessible to their current and prospective customers. Any given enterprise can copy the screen-sharing HTML code into its “contact us” or “help” web page. A visitor of that web page sees the graphical screen-sharing button.

In one embodiment, activating the screen-sharing button invokes a pop-up window with a session code that the visitor can share with a guest (presumably, the host of the “contact us” web page). Instead of invoking a pop-up window, in another embodiment activation of the screen-sharing button switches the user to another host web page with the session code. The visitor shares this session code with an operator associated with the host. After the operator (turned guest) connects with the session code, the visitor (turned host) is sharing its screen. Before being allowed to view the screen, the operator is asked to provide a password to ensure that only an authorized operator, i.e., an authorized representative of the enterprise, provides the customer support. The screen sharing between the visitor-host and operator-guest can be used to supplement a telephone conversation between the parties. Alternatively, the visitor-host and operator-guest can engage in a chat session or exchange emails while screen sharing.

It is to be understood that such one-click screen-sharing can be added as a feature to web pages in a variety of forms, e.g., as a graphical button in a toolbar, as a menu item, as an icon on a search engine. Application programs, such as instant messaging and office applications, can be adapted to provide one-click screen sharing. In addition, the graphical button can be transmitted to other potential users through a variety of communication modes, including, but not limited to, chat messaging, instant messaging, and email. Instead of, or in addition to, the graphical button, an invitation URL can be transmitted to other potential users through any of the communication modes available for transmitting the graphical button.

FIG. 9 shows an embodiment of HTML code that can be copied and pasted into a web page in order to provide screen-sharing capability at the host computing system. The exemplary URL within the HTML code (www.showscreen.com) is a URL for the server 16. The HTML code opens a new window and redirects the browser to the server 16 from which the host applet is downloaded. This embodiment of the HTML code does not authenticate the host.

FIG. 10 shows an embodiment a process 600 by which the guest computing system 14 (FIG. 1) can obtain remote control of the screen and computer of the host computing system 12 (FIG. 1) during a screen-sharing session. To participate in the performance of a remote control activity, the host computing system 12 and the guest computing system 14 do not need to download and install special software. Remote control capability is achieved using certain JAVA functions (i.e., operating system independent code) running on the host and guest computing systems. Certain JAVA functions enable the guest 14 to capture and track the position (coordinates) of the mouse, the state of the mouse (which mouse buttons are activated), and the state of the keyboard, regarding which buttons are pressed and released. Other particular JAVA functions enable the host computing system 12 to perform mouse and keyboard events. The Java functions at the host computing system 12 include:

mouseMove(), which moves the mouse pointer to given screen coordinates;

mousePress(), which presses one or more mouse buttons;

mouseRelease(), which releases one or more mouse buttons;

keyPress(), which presses a given key; and

keyRelease(), which releases a given key.

In brief overview, during a remote control session the guest computing system 14 runs its JAVA functions to track mouse and keyboard events that occur at the host computing system 12 and the host computing system 12 runs its JAVA functions to perform the mouse and keyboard events that occur at the guest computing system 14 (within a particular browser window corresponding to the remote control activity).

More specifically, during an exemplary remote control process 600, the guest 14 requests (step 602) remote control of the host computing system 12 while the host 12 and guest 14 are engaged in a screen-sharing session. A dialog window opens (step 604) on the screen of the host computing system 12 prompting the host user to allow remote control. When, at step 606, the host user allows remote control, the guest computing system 14 captures (step 608) the coordinates of the mouse pointer and the states of the mouse and keyboard. Such information is delivered to the guest computing system 14 over HTTP connections (i.e., between guest 14 and server 16, between server 16 and host 12). While keeping the mouse pointer within the browser window associated with the remote control activity, the guest user performs (step 610) certain mouse and keyboard movements and events, typically designed to cause a particular action to occur at the host computing system 12 (e.g., to open a file or a file folder). The mouse and keyboard events are transmitted (step 612) to the host computing system 12 over the HTTP connections.

Before the host user allows the remote control activity, the special JAVA functions are inactive at the host computing system 12; upon acceptance of the remote control activity, the special JAVA functions begin to execute. At step 614, the host computing system 12 receives the mouse and keyboard events over the HTTP connections and provides the input to the appropriate special JAVA function, which performs the associated mouse or keyboard event. In effect, the host computing system 12 executes the mouse and keyboard events performed at the guest 14 as though they originated locally at the host 12. Accordingly, the guest user is able to manipulate remotely the mouse and keyboard of the host computing system 12, and thereby control operation of the guest 14.

Aspects of the present invention may be implemented, in whole or in part, as one or more computer-readable software programs embodied on or in one or more articles of manufacture. The article of manufacture can be, for example, any one or combination of a floppy disk, a hard disk, hard-disk drive, a CD-ROM, a DVD-ROM, a flash memory card, an EEPROM, an EPROM, a PROM, a RAM, a ROM, or a magnetic tape. In general, any standard or proprietary, programming or interpretive language can be used to produce the computer-readable software programs. Examples of such languages include C, C++, Pascal, JAVA, BASIC, Visual Basic, and Visual C++. The software programs may be stored on or in one or more articles of manufacture as source code, object code, interpretive code, or executable code.

Although the invention has been shown and described with reference to specific preferred embodiments, it should be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the following claims. For example, the guest computing system 14 can operate in a mode, called the HTTP mode, when a JAVA applet is not used. In this mode, the above-described functionality is achieved through JAVASCRIPT AND HTML.

What is claimed is:

CLAIMS

1. A method for sharing an image on a display screen of a computing system, the method comprising:

   activating a region on a web page displayed in a browser window on the display screen of the computing system with an input device in order to host a screen-sharing session;

   automatically receiving, in response to launching the screen-sharing session, program code over a network;

   automatically executing the program code by a browser upon receiving the program code; and

   capturing, by the execution of the program code, an image on the display screen of the computing system.

2. The method of claim 1, wherein the step of activating a region on a web page with an input device in order to host a screen-sharing session occurs with a single click of the input device.

3. The method of claim 1, further comprising the step of sending the captured image data to a server over the network.

4. The method of claim 3, further comprising the step of detecting at least one change in the image on the display screen since captured image data was last sent to the server, and wherein the step of sending the captured image data includes sending each detected image change to the server.

5. The method of claim 3, further comprising the step of compressing the captured image data before sending the captured image data to the server over the network

6. The method of claim 5, wherein the step of compressing includes the step of selecting a file type in which to save the compressed image data.

7. The method of claim 6, wherein the file type is one of a JPG and a PNG file type.

8. The method of claim 1, further comprising the step of receiving a session code to be shared with a user of a guest computing system in order to participate in the screen-sharing session.

9. The method of claim 1, wherein the program code includes a JAVA applet that uses a screen-capture method.

10. The method of claim 1, further comprising:

authorizing a guest computing system to remotely control the computing system over the network;

activating, in response to the authorization of remote control, operating-system independent program code at the computing system, the operating-system independent program code being responsive to input device events;

generating input device events at the guest computing system and transmitting said input device events to the computing system over the network; and

executing the operating-system independent program code in response to the input device events received over the network.

11. The method of claim 10, wherein the operating-system independent program code includes a JAVA function.

12. The method of claim 10, wherein the input device events are transmitted over the network through an HTTP connection.

13. A method for viewing at a local computing system an image on a display screen of a remote computing system, the method comprising:

activating a region on a web page displayed in a browser window on a display screen of the local computing system with an input device in order to a join a screen-sharing session;

automatically receiving, in response to activating the region on the web page, program code over a network;

automatically executing the program code upon receipt to generate an HTTP request for image data;

receiving image data corresponding to the display screen of the remote computing system in response to the request; and

displaying the image data corresponding to the display screen of the remote computing system on the display screen of the local computing system.

14. The method of claim 13, further comprising the step of supplying a session code to a web page to become a participant in the screen sharing-session.

15. The method of claim 13, further comprising the step of supplying an operator password to become authorized for participating in the screen-sharing session.

16. The method of claim 13, further comprising:

receiving authorization to obtain remote control of the remote computing system; and

transmitting to the remote computing system, in response to obtaining authorization to acquire remote control, input device events that occur at the local computing system, such input device events to be acted upon by operating-system independent program code running at the remote computing system.

17. The method of claim 16, wherein the operating-system independent program code includes a JAVA function.

18. The method of claim 16, wherein the input device events are transmitted over the network through an HTTP connection.

19. A method of conducting a screen-sharing session during which a user of a guest computing system can view an image displayed on a display screen of a host computing system, the method comprising:

sending a first web page with embedded program code to the host computing system for capturing image data corresponding to an image displayed on the display screen of the host computing system;

sending a second web page with embedded program code to the guest computing system for generating a request for image data;

receiving, from the host computing system, image data representing an image displayed on the display screen of the host computing system;

receiving a request from the guest computing system for image data; and

sending image data received from the host computing system to the guest computing system in response to the request received from the guest computing system.

20. The method of claim 19, further comprising the step of determining from multiple updates of image data received from the host computing system, which image data to send to the guest computing system.

21. The method of claim 19, further comprising the step of providing a session code to the host computing system.

22. The method of claim 19, further comprising the step of maintaining a registry of host computing systems authorized to host screen-sharing sessions.

23. The method of claim 22, further comprising the step of searching the registry using an identifier provided by the host computing system to determine whether the host computing system is authorized to host the screen-sharing session.

24. A screen-sharing system comprising:

a guest computing system and a host computing system coupled to a server system over a network,

the guest computing system automatically executing program code embedded in a web page received from the server system, the program code sending a request to the server system for image data corresponding to an image on a display screen of the host computing system,

the host computing system automatically executing program code embedded in a web page received from the server system, the program code capturing image data from the display screen of the host computing system and sending the captured image data to the server system, and

the server system sending captured image data received from the host computing system to the guest computing system in response to the request from the guest computing system.

25. The system of claim 24, wherein the host computing system authorizes a remote control session with the guest computing system and activates, in response to authorizing the remote control session, operating-system independent program code for processing input device events, the host computing system receiving over the network input device events generated at the guest computing system, wherein the operating-system independent program code running at the host computing

system processes the input device events received over the network.

26. The system of claim 25, wherein the operating-system independent program code includes JAVA.

27. The system of claim 25, wherein the input device events are transmitted over the network through an HTTP connection.

28. A method for enabling screen-sharing functionality on a computing system, the method comprising pasting hypertext markup language (HTML) code into a web page accessed by the computing system through a Web browser, the HTML code producing a region on the web page, which, when activated, launches a screen-sharing session.

29. The method of claim 28, further comprising the step of launching the screen-sharing session by activating the region on the web page with a single click of an input device.

30. A method for obtaining remote control of a host computing system, the method comprising:

establishing a screen-sharing session with the host computing system;

obtaining authorization to acquire remote control of the host computing system; and

transmitting to the host computing system, in response to obtaining authorization to acquire remote control, input device events that occur at a guest computing system, such input device events to be acted upon by operating-system independent program code running at the host computing system for controlling input events.

31. The method of claim 30, further comprising the step of activating the operating-system independent program code at

the host computing system upon authorization of remote control.

32. The system of claim 30, wherein the operating-system independent program code includes a JAVA function.

33. The system of claim 30, wherein the input device events are transmitted over the network through an HTTP connection.

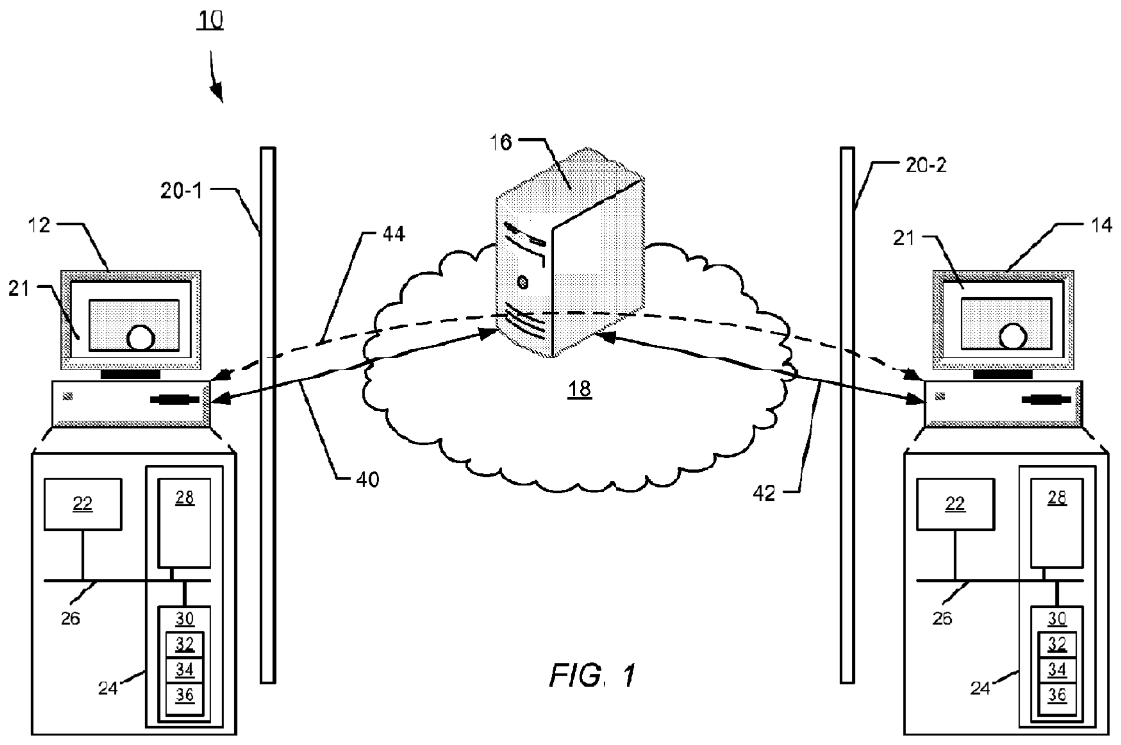

10
16
20-1
20-2
12
21
44
21
14
18
40
42
22
28
26
30
32
34
36
24
22
28
26
30
32
34
36
24

FIG. 1

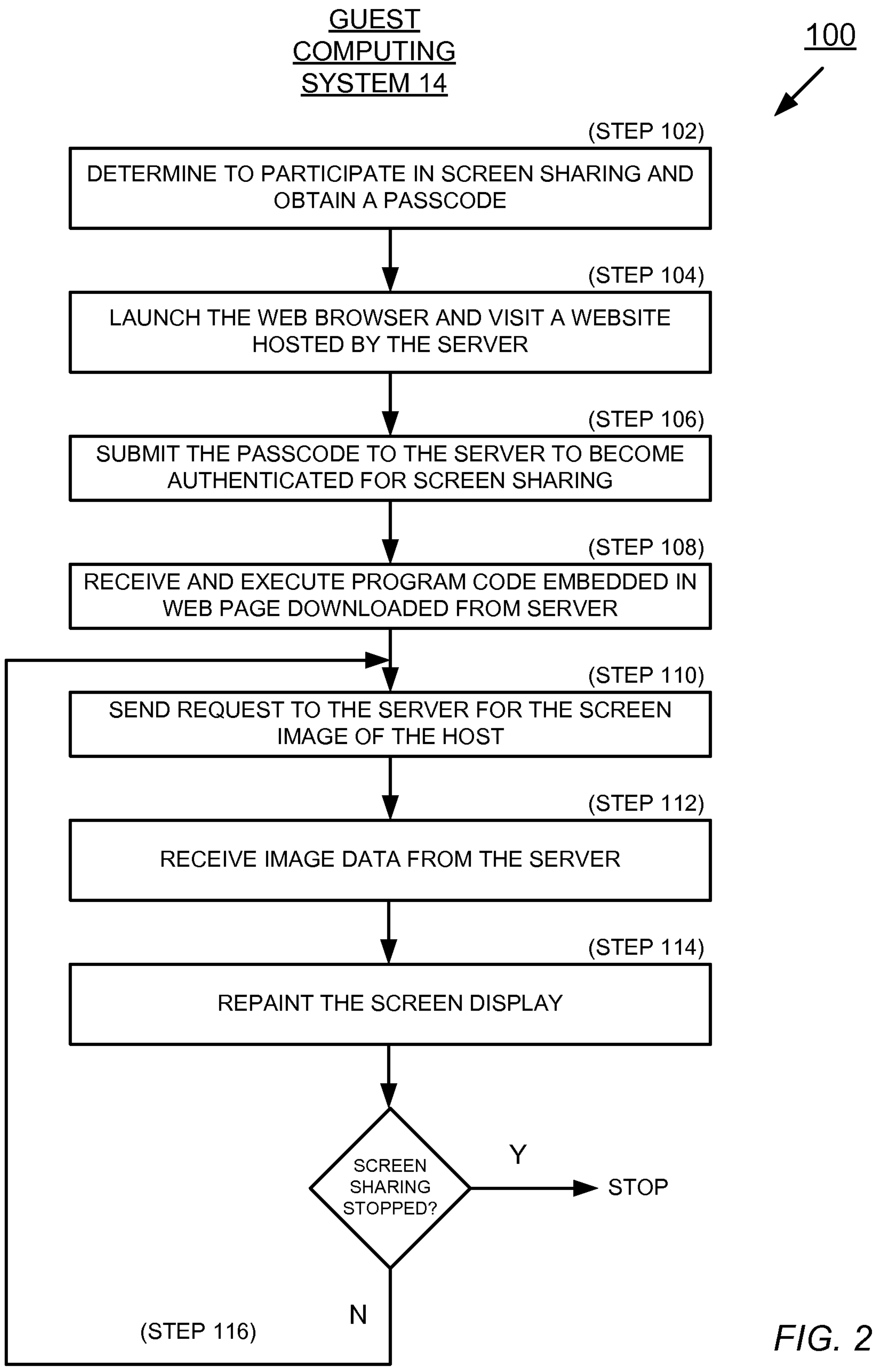

GUEST COMPUTING SYSTEM 14
100
(STEP 102)
DETERMINE TO PARTICIPATE IN SCREEN SHARING AND OBTAIN A PASSCODE
(STEP 104)
LAUNCH THE WEB BROWSER AND VISIT A WEBSITE HOSTED BY THE SERVER
(STEP 106)
SUBMIT THE PASSCODE TO THE SERVER TO BECOME AUTHENTICATED FOR SCREEN SHARING
(STEP 108)
RECEIVE AND EXECUTE PROGRAM CODE EMBEDDED IN WEB PAGE DOWNLOADED FROM SERVER
(STEP 110)
SEND REQUEST TO THE SERVER FOR THE SCREEN IMAGE OF THE HOST
(STEP 112)
RECEIVE IMAGE DATA FROM THE SERVER
(STEP 114)
REPAINT THE SCREEN DISPLAY
SCREEN SHARING STOPPED?
Y
STOP
N
(STEP 116)

FIG. 2

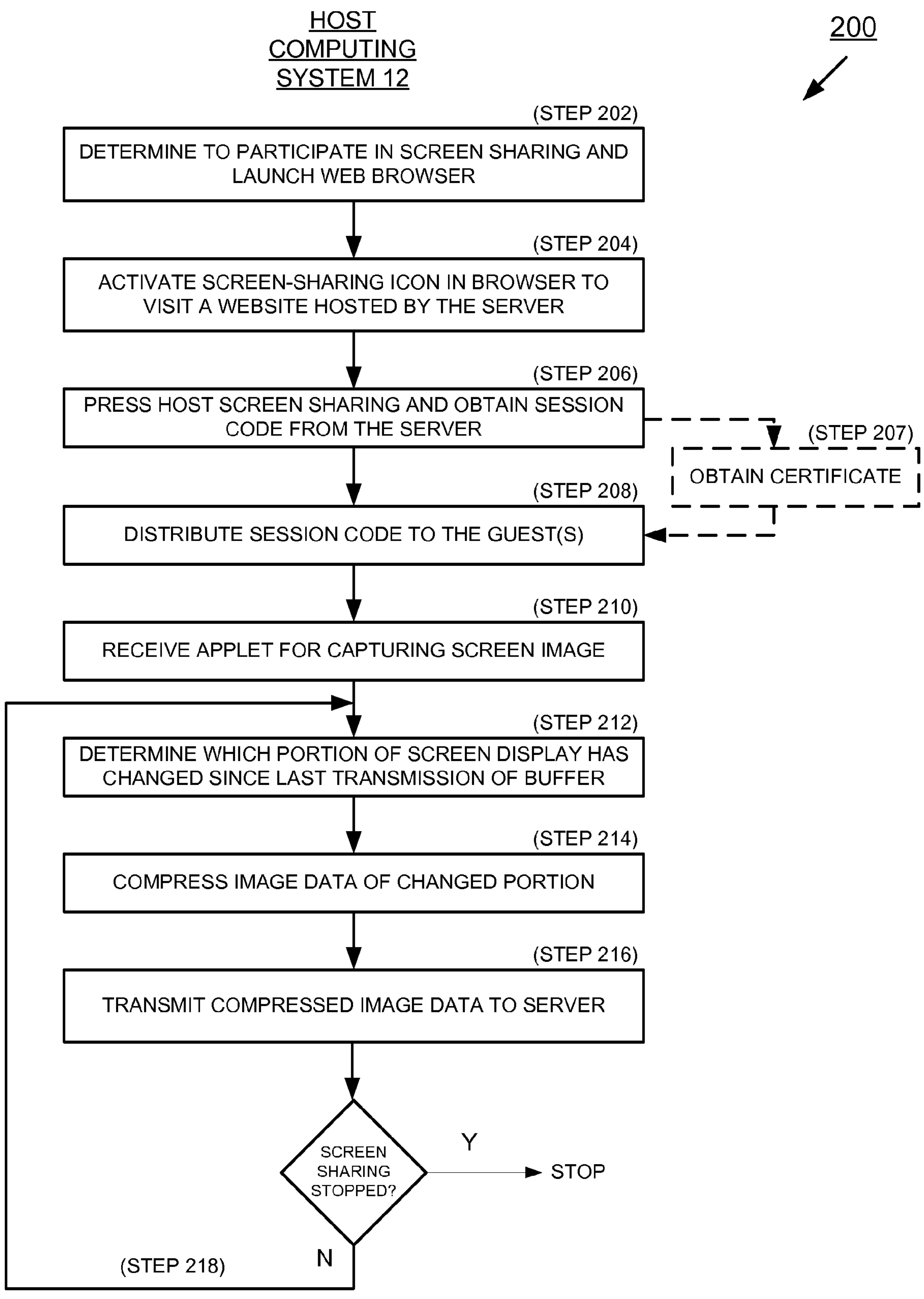

HOST COMPUTING SYSTEM 12
200
(STEP 202)
DETERMINE TO PARTICIPATE IN SCREEN SHARING AND LAUNCH WEB BROWSER
(STEP 204)
ACTIVATE SCREEN-SHARING ICON IN BROWSER TO VISIT A WEBSITE HOSTED BY THE SERVER
(STEP 206)
PRESS HOST SCREEN SHARING AND OBTAIN SESSION CODE FROM THE SERVER
(STEP 207)
OBTAIN CERTIFICATE
(STEP 208)
DISTRIBUTE SESSION CODE TO THE GUEST(S)
(STEP 210)
RECEIVE APPLET FOR CAPTURING SCREEN IMAGE
(STEP 212)
DETERMINE WHICH PORTION OF SCREEN DISPLAY HAS CHANGED SINCE LAST TRANSMISSION OF BUFFER
(STEP 214)
COMPRESS IMAGE DATA OF CHANGED PORTION
(STEP 216)
TRANSMIT COMPRESSED IMAGE DATA TO SERVER
SCREEN SHARING STOPPED?
Y
STOP
N
(STEP 218)

FIG. 3

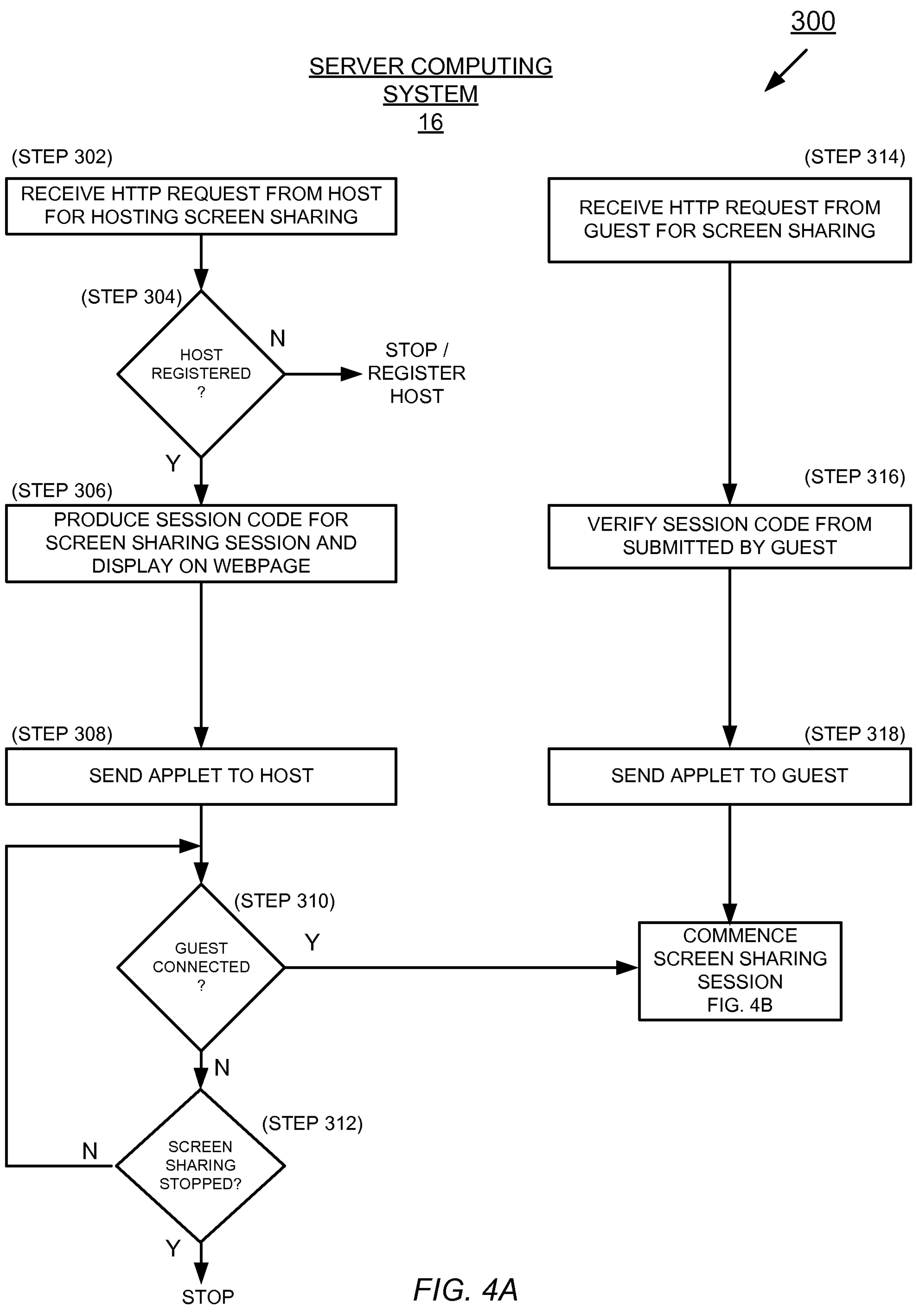

300
SERVER COMPUTING SYSTEM 16
(STEP 302)
RECEIVE HTTP REQUEST FROM HOST FOR HOSTING SCREEN SHARING
(STEP 304)
HOST REGISTERED ?
N
STOP / REGISTER HOST
Y
(STEP 306)
PRODUCE SESSION CODE FOR SCREEN SHARING SESSION AND DISPLAY ON WEBPAGE
(STEP 308)
SEND APPLET TO HOST
(STEP 310)
GUEST CONNECTED ?
Y
N
(STEP 312)
SCREEN SHARING STOPPED?
N
Y
STOP
(STEP 314)
RECEIVE HTTP REQUEST FROM GUEST FOR SCREEN SHARING
(STEP 316)
VERIFY SESSION CODE FROM SUBMITTED BY GUEST
(STEP 318)
SEND APPLET TO GUEST
COMMENCE SCREEN SHARING SESSION FIG. 4B

FIG. 4A

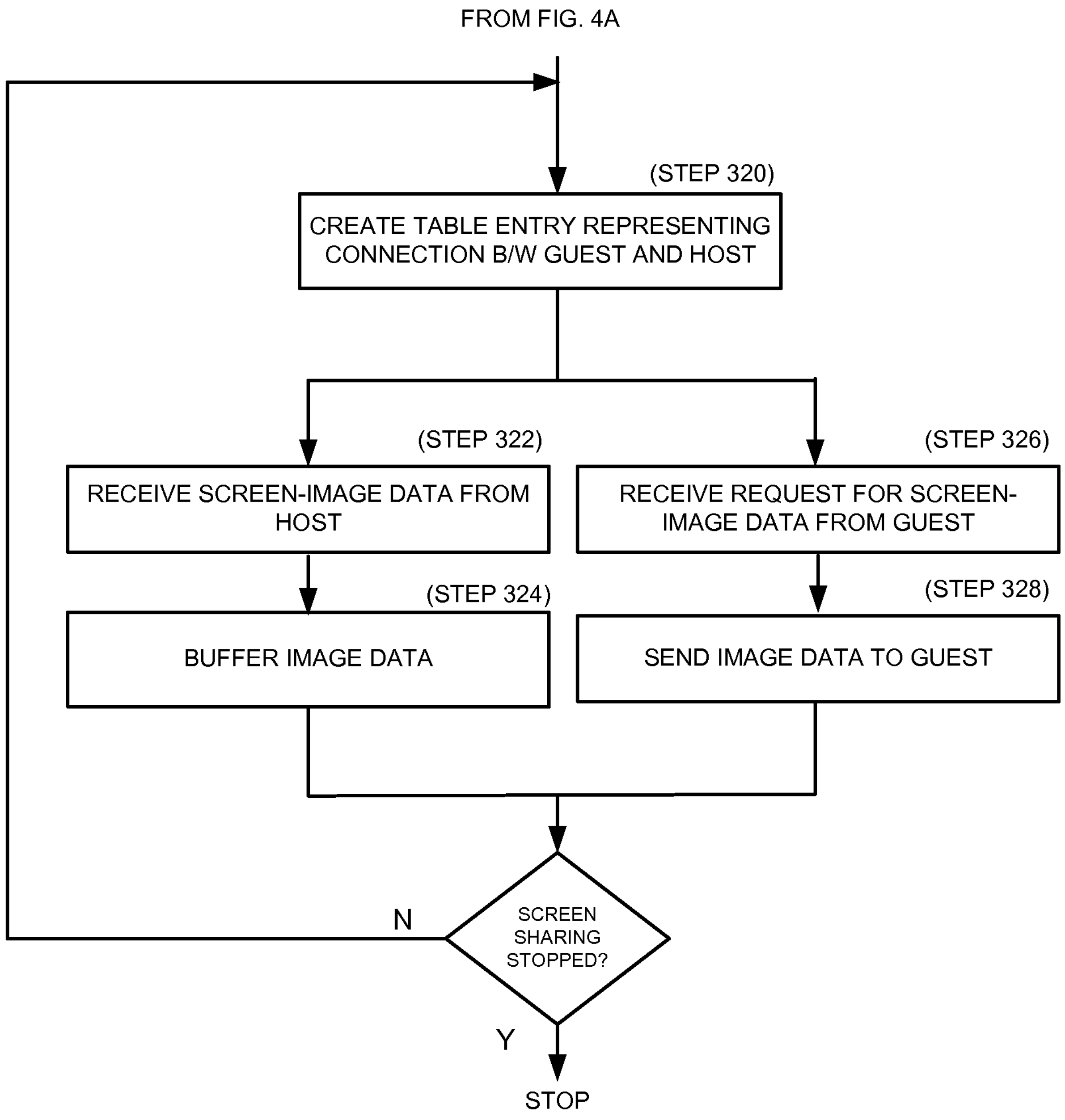
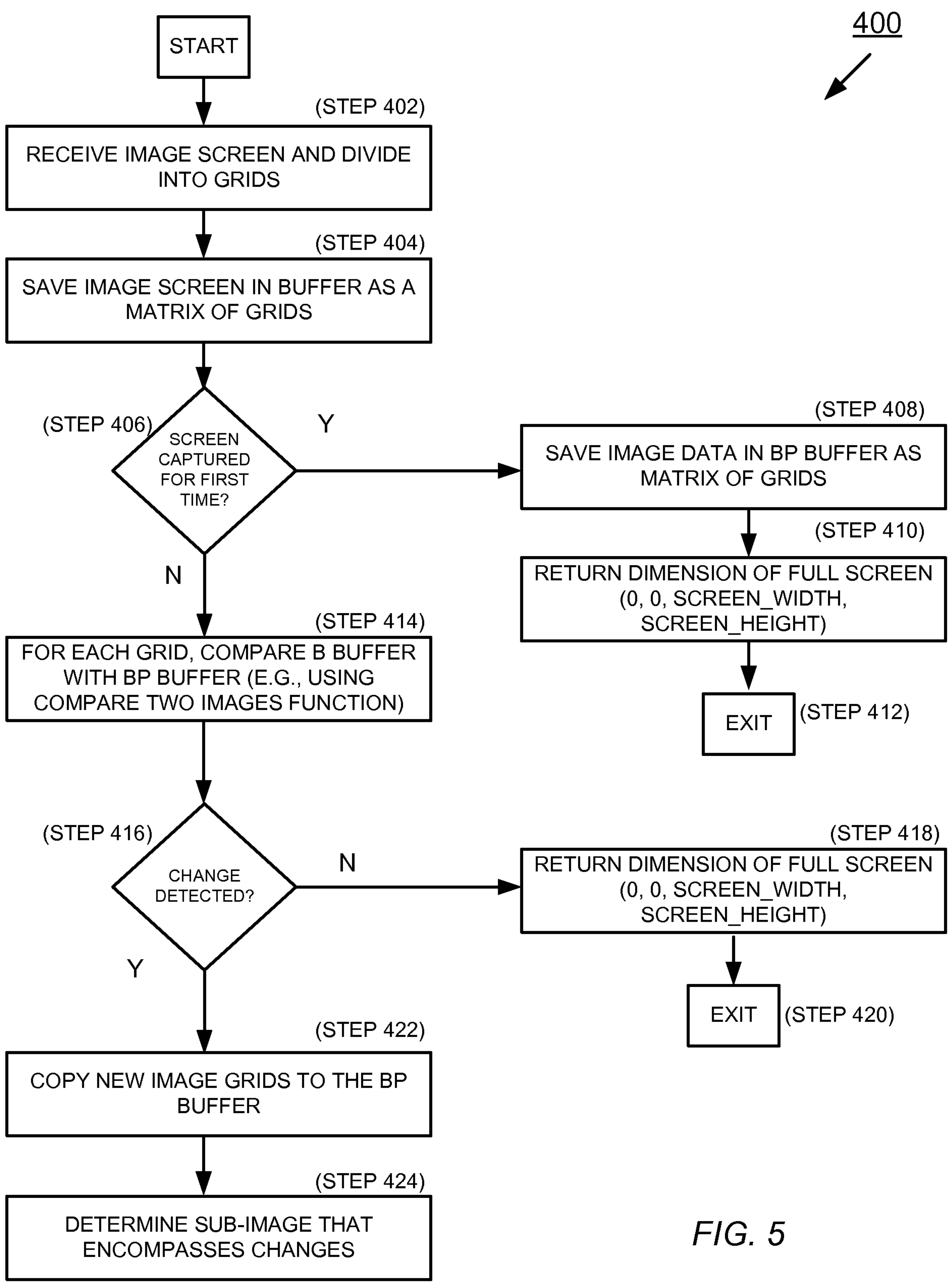

FROM FIG. 4A
(STEP 320)
CREATE TABLE ENTRY REPRESENTING CONNECTION B/W GUEST AND HOST
(STEP 322)
RECEIVE SCREEN-IMAGE DATA FROM HOST
(STEP 324)
BUFFER IMAGE DATA
(STEP 326)
RECEIVE REQUEST FOR SCREEN-IMAGE DATA FROM GUEST
(STEP 328)
SEND IMAGE DATA TO GUEST
SCREEN SHARING STOPPED?
N
Y
STOP

FIG. 4B



400
START
(STEP 402)
RECEIVE IMAGE SCREEN AND DIVIDE INTO GRIDS
(STEP 404)
SAVE IMAGE SCREEN IN BUFFER AS A MATRIX OF GRIDS
(STEP 406)
SCREEN CAPTURED FOR FIRST TIME?
Y
(STEP 408)
SAVE IMAGE DATA IN BP BUFFER AS MATRIX OF GRIDS
(STEP 410)
RETURN DIMENSION OF FULL SCREEN (0, 0, SCREEN_WIDTH, SCREEN_HEIGHT)
EXIT
(STEP 412)
N
(STEP 414)
FOR EACH GRID, COMPARE B BUFFER WITH BP BUFFER (E.G., USING COMPARE TWO IMAGES FUNCTION)
(STEP 416)
CHANGE DETECTED?
N
(STEP 418)
RETURN DIMENSION OF FULL SCREEN (0, 0, SCREEN_WIDTH, SCREEN_HEIGHT)
EXIT
(STEP 420)
Y
(STEP 422)
COPY NEW IMAGE GRIDS TO THE BP BUFFER
(STEP 424)
DETERMINE SUB-IMAGE THAT ENCOMPASSES CHANGES

FIG. 5

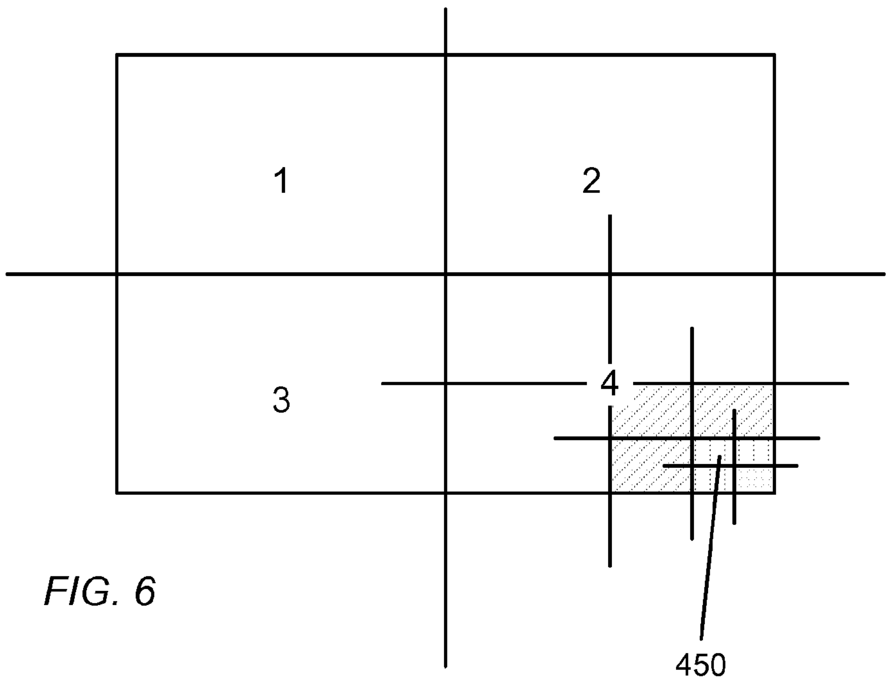

1
2
3
4
450

FIG. 6

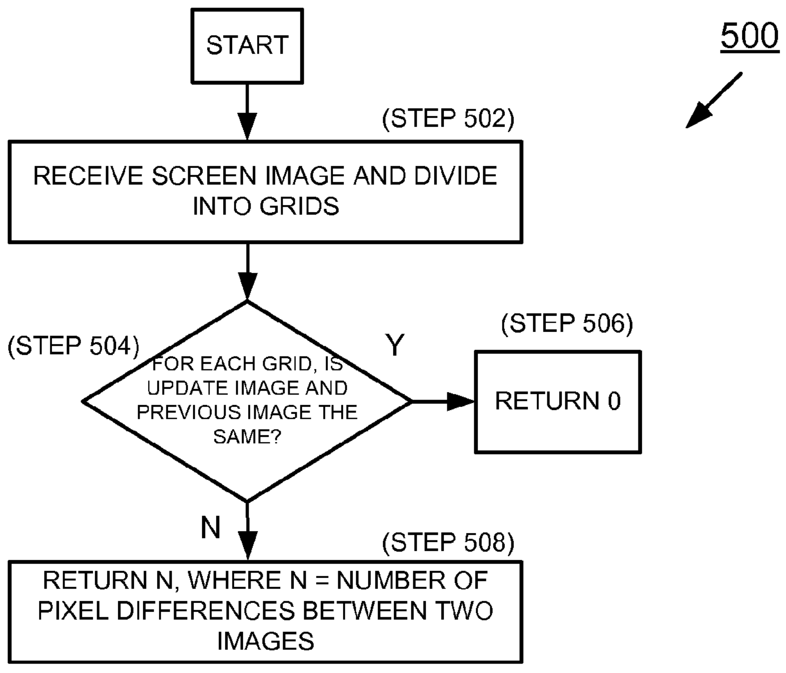

500
START
(STEP 502)
RECEIVE SCREEN IMAGE AND DIVIDE INTO GRIDS
(STEP 504)
FOR EACH GRID, IS UPDATE IMAGE AND PREVIOUS IMAGE THE SAME?
Y
(STEP 506)
RETURN 0
N
(STEP 508)
RETURN N, WHERE N = NUMBER OF PIXEL DIFFERENCES BETWEEN TWO IMAGES

FIG. 7

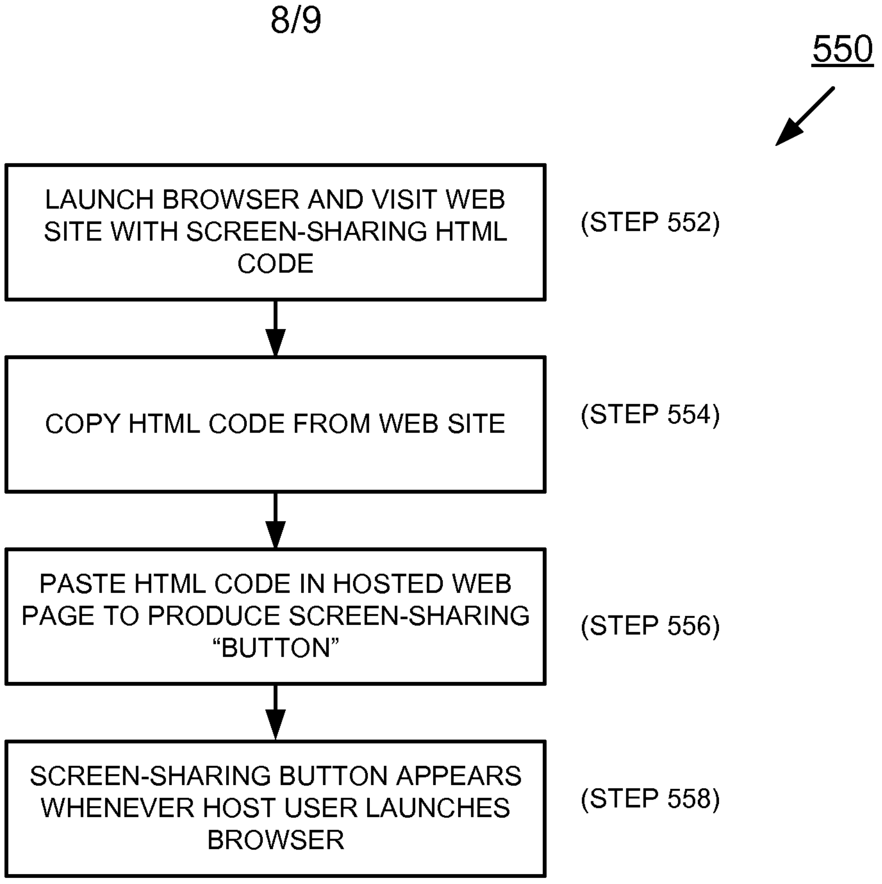

550
LAUNCH BROWSER AND VISIT WEB SITE WITH SCREEN-SHARING HTML CODE
(STEP 552)
COPY HTML CODE FROM WEB SITE
(STEP 554)
PASTE HTML CODE IN HOSTED WEB PAGE TO PRODUCE SCREEN-SHARING “BUTTON”
(STEP 556)
SCREEN-SHARING BUTTON APPEARS WHENEVER HOST USER LAUNCHES BROWSER
(STEP 558)

FIG. 8

```
<a href="http://www.showscreen.com/showscreen/auto_host3.asp" target="_blank"
onClick="this.newWindow = window.open('http://www.showscreen.com/showscreen/
auto_host3.asp?url=' + document.location, 'ShowScreen',
'toolbar=0,scrollbars=0,location=0,statusbar=0,menubar=0,resizable=1,width=300,height=100');
this.newWindow.focus();this.newWindow.opener=window;return false;"><img alt="ShowScreen
by HelpMeeting"
src="http://www.showscreen.com/showscreen/images/iexplore.gif" width="88" height="31"
border="0"></a
```

FIG. 9

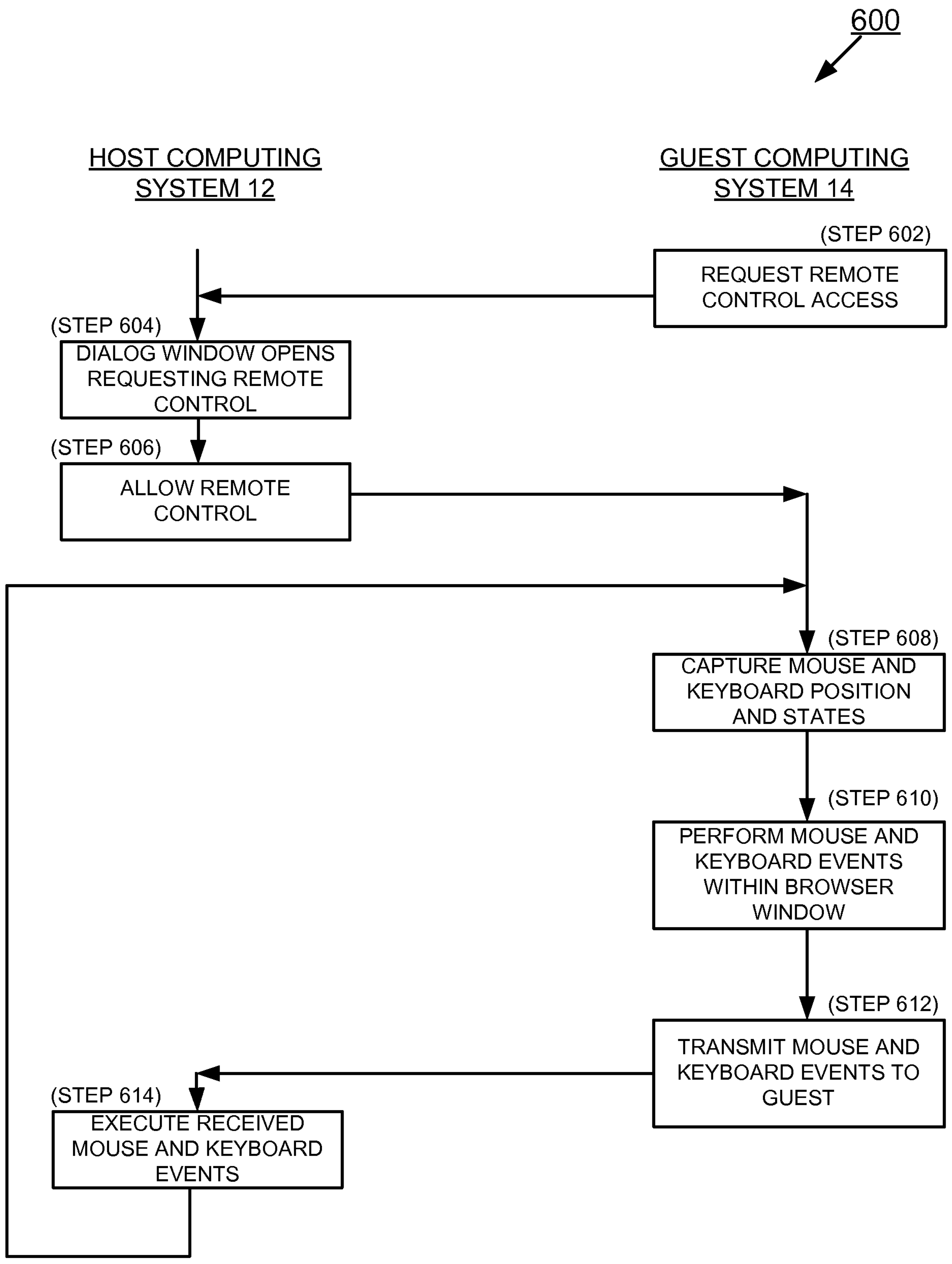

600
HOST COMPUTING SYSTEM 12
GUEST COMPUTING SYSTEM 14
(STEP 602)
REQUEST REMOTE CONTROL ACCESS
(STEP 604)
DIALOG WINDOW OPENS REQUESTING REMOTE CONTROL
(STEP 606)
ALLOW REMOTE CONTROL
(STEP 608)
CAPTURE MOUSE AND KEYBOARD POSITION AND STATES
(STEP 610)
PERFORM MOUSE AND KEYBOARD EVENTS WITHIN BROWSER WINDOW
(STEP 612)
TRANSMIT MOUSE AND KEYBOARD EVENTS TO GUEST
(STEP 614)
EXECUTE RECEIVED MOUSE AND KEYBOARD EVENTS

FIG. 10