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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 April 2011 (07.04.2011)

PCT

(10) International Publication Number
WO 2011/041736 A1

(51) International Patent Classification:
G06F 13/00 (2006.01)

(21) International Application Number:
PCT/US2010/051207

(22) International Filing Date:
1 October 2010 (01.10.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/248,307 2 October 2009 (02.10.2009) US

(72) Inventors; and
(71) Applicants : **SONG, Young Gil** [KR/US]; 2329 Santa Catalina Street, Palo Alto, California 94303 (US). **DUKKER, Stephen** [US/US]; 2830 Buchanan Street, San Francisco, California 94123 (US).

(74) Agents: **MADDEN, Robert B.** et al.; Schwegman, Lundberg & Woessner, P.A., P.O. Box 2938, Minneapolis, Minnesota 55402 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, 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, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, 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, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

WO 2011/041736 A1

(54) Title: SYSTEM AND METHOD FOR A THIN-CLIENT TERMINAL SYSTEM USING A SERIAL BUS

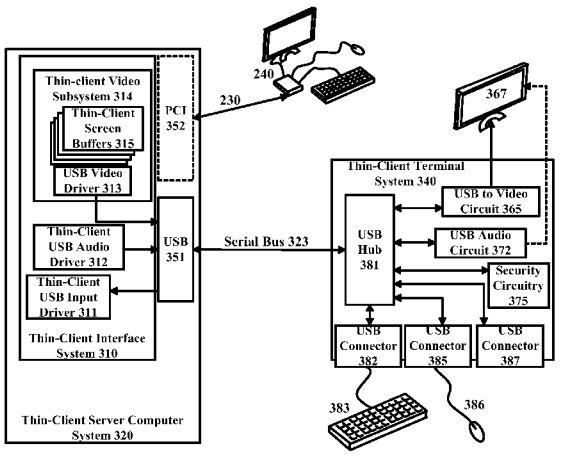

FIG. 3

(57) Abstract: Thin-client terminal systems allow computer systems to be shared by multiple computer users. With modern technology, the cost of implementing a thin-client terminal system can be very low. To expand the market for thin-client terminal systems, a serial bus interface is used to couple a thin-client terminal system to a computer system.

SYSTEM AND METHOD FOR A THIN-CLIENT TERMINAL SYSTEM USING A SERIAL BUS

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of United States Provisional Patent Application Serial No. 61/248,307, filed October 2, 2009 ("SYSTEM AND METHOD FOR A THIN-CLIENT TERMINAL SYSTEM USING A SERIAL BUS"), which is incorporated herein in its entirety by this reference.

TECHNICAL FIELD

The present invention relates to the fields of terminal systems. In particular, but not by way of limitation, the present invention discloses techniques for implementing a thin-client graphics terminal system.

BACKGROUND OF THE INVENTION

Centralized computer systems with multiple independent terminal systems for accessing the centralized computer systems were once the dominant computer system architecture. These centralized computer systems were initially very expensive mainframe or mini-computer systems that were shared by multiple computer users. Each of the computer system users accessed the centralized computer systems using a computer terminal system coupled to the centralized computer systems.

In the late 1970s and early 1980s, semiconductor microprocessors and memory devices allowed for the creation of inexpensive personal computer systems. Personal computer systems revolutionized the computing industry by allowing each individual computer user to have access to a full computer system without having to share the computer system with any other computer user. Each personal computer user could execute their own software applications and any problems with the computer system would only affect that single personal computer system user.

Although personal computer systems have become the dominant form of computing in the modern world, there has been a resurgence of the centralized

computer system model wherein multiple computer users access a single server system using modern terminal systems that include high-resolution graphics. Computer terminal systems can significantly reduced computer system maintenance costs since computer terminal users cannot easily introduce computer viruses into the main computer system or load other unauthorized computer programs. Terminal based computing also allows multiple users to easily share the same set of software applications.

Modern personal computer systems have become increasingly powerful in the decades since the late 1970's personal computer revolution. Modern personal computer systems are now more powerful than the shared mainframe and mini-computer systems of the 1970's. In fact, modern personal computer systems are so powerful that the vast majority of the computing resources in modern personal computer systems generally sit idle when a typical computer user uses a modern personal computer system. Thus, personal computer systems can now easily serve multiple computer users.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, which are not necessarily drawn to scale, like numerals describe substantially similar components throughout the several views. Like numerals having different letter suffixes represent different instances of substantially similar components. The drawings illustrate generally, by way of example, but not by way of limitation, various embodiments discussed in the present document.

FIG. 1 illustrates a diagrammatic representation of machine in the example form of a computer system within which a set of instructions, for causing the machine to perform any one or more of the methodologies discussed herein, may be executed.

FIG. 2A illustrates a block diagram of a first example embodiment of a thin-client terminal system coupled to a thin-client server computer system.

FIG. 2B illustrates a high-level block diagram of the example single thin-client server computer system of **FIG. 2A** supporting multiple individual thin-client terminal systems using multi-conductor wire that includes analog signals and electrical power.

FIG. 3 illustrates a block diagram of a first example embodiment of a thin-client terminal system implemented using a serial bus as a data communication link to a server.

FIG. 4 illustrates a block diagram of a example second embodiment of a thin-client terminal system implemented using a serial bus as a data communication link to a server.

FIG. 5 illustrates a block diagram of a example thin-client environment wherein connections between thin-client terminal systems and a thin-client server system are implemented using a serial bus as a data communication link.

FIG. 6 illustrates a flowchart of an example embodiment of a method of providing a thin-client terminal system.

DETAILED DESCRIPTION

The following detailed description includes references to the accompanying drawings, which form a part of the detailed description. The drawings show illustrations in accordance with example embodiments. These embodiments, which are also referred to herein as "examples," are described in enough detail to enable those skilled in the art to practice the invention. It will be apparent to one skilled in the art that specific details in the example embodiments are not required in order to practice the present invention. For example, although the example embodiments are mainly disclosed with reference to a thin-client system, the teachings can be used in other environments. The example embodiments may be combined, other embodiments may be utilized, or structural, logical and electrical changes may be made without departing from the scope what is claimed. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope is defined by the appended claims and their equivalents.

In this document, the terms "a" or "an" are used, as is common in patent documents, to include one or more than one. In this document, the term "or" is used to refer to a non-exclusive or, such that "A or B" includes "A but not B," "B but not A," and "A and B," unless otherwise indicated. Furthermore, all publications, patents, and patent documents referred to in this document are incorporated by reference herein in their entirety, as though individually

incorporated by reference. In the event of inconsistent usages between this document and those documents so incorporated by reference, the usage in the incorporated reference(s) should be considered supplementary to that of this document; for irreconcilable inconsistencies, the usage in this document controls.

Computer Systems

The present disclosure concerns digital computer systems. **FIG. 1** illustrates a diagrammatic representation of machine in the example form of a computer system **100** that may be used to implement portions of the present disclosure. Within computer system **100** there are a set of instructions **124** that may be executed for causing the machine to perform any one or more of the methodologies discussed herein. In a networked deployment, the machine may operate in the capacity of a server machine or a client machine in client-server network environment, or as a peer machine in a peer-to-peer (or distributed) network environment. The machine may be a personal computer (PC), a tablet PC, a set-top box (STB), a Personal Digital Assistant (PDA), a cellular telephone, a web appliance, a network router, switch or bridge, or any machine capable of executing a set of computer instructions (sequential or otherwise) that specify actions to be taken by that machine. Furthermore, while only a single machine is illustrated, the term "machine" shall also be taken to include any collection of machines that individually or jointly execute a set (or multiple sets) of instructions to perform any one or more of the methodologies discussed herein.

The example computer system **100** includes a processor **102** (e.g., a central processing unit (CPU), a graphics processing unit (GPU) or both), a main memory **104** and a flash memory **106**, which communicate with each other via a bus **108**. The computer system **100** may further include a video display adapter **110** that drives a video display system **115** such as a Liquid Crystal Display (LCD) or a Cathode Ray Tube (CRT). The computer system **100** also includes an alphanumeric input device **112** (e.g., a keyboard), a cursor control device **114** (e.g., a mouse or trackball), a disk drive unit **116**, a signal generation device **118** (e.g., a speaker) and a network interface device **120**.

The disk drive unit **116** includes a machine-readable medium **122** on which is stored one or more sets of computer instructions and data structures (e.g., instructions **124** also known as 'software') embodying or utilized by any one or more of the methodologies or functions described herein. The instructions **124** may also reside, completely or at least partially, within the main memory **104** and/or within the processor **102** during execution thereof by the computer system **100**, the main memory **104** and the processor **102** also constituting machine-readable media.

The instructions **124** may further be transmitted or received over a computer network **126** via the network interface device **120**. Such transmissions may occur utilizing any one of a number of well-known transfer protocols such as the well known File Transport Protocol (FTP).

While the machine-readable medium **122** is shown in an example embodiment to be a single medium, the term "machine-readable medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term "machine-readable medium" shall also be taken to include any medium that is capable of storing, encoding or carrying a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies described herein, or that is capable of storing, encoding or carrying data structures utilized by or associated with such a set of instructions. The term "machine-readable medium" shall accordingly be taken to include, but not be limited to, solid-state memories, optical media, and magnetic media.

For the purposes of this specification, the term "module" includes an identifiable portion of code, computational or executable instructions, data, or computational object to achieve a particular function, operation, processing, or procedure. A module need not be implemented in software; a module may be implemented in software, hardware/circuitry, or a combination of software and hardware.

Personal Computer Revolution

Before the advent of the inexpensive personal computer, the computing industry largely used centralized mainframe or mini-computers that were coupled to a plurality of "dumb" terminal systems. Such terminal systems are

referred to as 'dumb' terminals since the computing ability resided within the mainframe or mini-computer and the terminal system was merely used to display output information on a video screen and accept alpha-numeric input from a keyboard... No software applications execute locally on the terminal system itself (except dedicated firmware to implement the terminal functionality). Computer operators shared the mainframe computer among multiple individual computer users that each used individual terminal systems coupled to the mainframe computer. These terminal systems generally had very limited graphics capabilities and were mostly displaying only alpha-numeric characters on the display screen of the terminal system.

With the introduction of the modern personal computer system, the use of dumb terminals largely disappeared since personal computer systems were much more cost effective. Individual personal computer users could run useful software applications on their own personal computer system. When the services of a dumb terminal were required to interface with a legacy terminal-based mainframe computer system, a personal computer system could easily execute a terminal emulation program that would emulate the operations of a dumb terminal at a low cost that was generally similar to the cost of a dedicated dumb terminal. Thus, a single system could operate as both a personal computer system for running local applications and a terminal system to access a larger terminal-based computer system.

During the personal computer revolution, personal computers introduced high resolution graphics and cursor control devices (such as the computer mouse) to personal computer users. The combination of high-resolution graphics displays and cursor control devices allowed for much more intuitive computer user interfaces than a primitive text-only display screen. For example, virtually all current personal user interface systems now use multiple windows, icons, and pull-down menus that are implemented with high resolution graphics and navigated with a cursor control device. Furthermore, high-resolution graphics allowed for applications that used photos, videos, and graphical images.

Over the past few decades, personal computer systems have greatly increased in power. Processors run at much higher clock speeds and process larger amounts of data per each clock cycle. Processors now even have multiple

internal cores such that personal computer systems are now often multi-processor systems. The main memory systems in personal computer systems have gone from being measured in kilobytes to gigabytes. And hard drives that did not even exist for personal computers when personal computers were first introduced now store terabytes of data. Thus, at this point in history, even average personal computer systems are now much more powerful than the mainframe systems that personal computer systems were displacing. Modern personal computer operating systems now even include features for supporting multiple users simultaneously just like the old centralized mainframe computer systems.

Modern Thin-Client Terminal Systems

In recent years, a new generation of terminal systems that support high-resolution graphics have been introduced into the computer market. These new terminal systems have allowed a new generation of users to rediscover many of the advantages of a terminal-based computing architecture. For example, computer terminals allow for improved computer system security and reduced maintenance costs since users of computer terminal systems cannot easily introduce computer viruses by downloading or installing new software into the computer system from the terminal system. Thus, with a centralized computer system having multiple terminals, only the main centralized computer server system needs to be closely monitored and maintained. The stateless terminal systems require almost no maintenance at all.

One category of these modern terminal systems is called "thin client" systems since the terminal systems are a "client" to main computer system that acts as a server and the terminal systems are designed to be very simple and limited (thus "thin"). The thin-client terminal systems primarily depend on a thin-client server system for all (or nearly all) of their application processing activities. A thin-client terminal system thus mainly focuses only on conveying output from the centralized server system to the user and input from the user to the centralized server system.

The new generation of computer terminal systems provide features that did not exist during the prior era of computer terminal usage. Specifically, modern terminal systems include modern amenities such as high-resolution graphics

capabilities, audio output, and cursor control system input (mouse, trackpad, trackball, etc.). Thus, modern terminal systems can provide all the features that users of modern personal computer systems have become accustomed to using.

A First Thin-Client System Example Embodiment

FIG. 2A illustrates a block diagram of a first type of thin-client terminal architecture. In the thin-client architecture of **FIG. 2A**, a server computer system **220** is illustrated coupled to one (of possibly many) thin-client terminal system **240**. The thin-client server computer system **220** and thin-client terminal system **240** are coupled with a multi-conductor cable **230** that carries input from a user of the thin-client terminal system **240** to the thin-client server computer system **220** and output from the thin-client server computer system **220** to the thin-client terminal system **240**.

FIG. 2B illustrates a conceptual diagram of the server computer system **220** from **FIG. 2A** providing computer processing resources to a plurality of individual thin-client terminal systems **240**. A single thin-client server computer system **220** is coupled to several individual thin-client terminal systems **240** in a hub-and-spoke arrangement since the embodiment of **FIG. 2A** requires a direct connection between the thin-client server computer system **220** and each of the thin-client terminal systems **240**. The individual thin-client terminal systems **240** are served using thin-client server network software **297** running on thin-client server computer system **220**.

Referring back to **FIG. 2A**, the thin-client terminal system **240** acts largely as a simple pass-through system such that most of the hardware for driving the thin-client terminal system **240** actually resides within the server computer system **220**. This type of thin-client system architecture allows the actual thin-client terminal devices **240** in the implementation of **FIG. 2A** to be very inexpensive. However, to use the simple thin-client terminal system **240** illustrated in **FIG. 2A** with a personal computer system (such as thin-client server computer system **220**), additional add-on hardware and software needs to be added to the personal computer system. In one embodiment, the add-on hardware may be implemented as an add-on PCI card that may be added to the personal computer system. However, other methods of adding the needed

hardware may be used such as using an add-on Universal Serial Bus (USB) peripheral device.

In the embodiment of **FIG. 2A**, a thin-client interface system **210** is responsible for interacting with all of the attached thin-client terminal systems **240**. To generate video output for each thin-client terminal system **240**, a thin client video subsystem **214** in the server system **220** maintains a screen buffer **215** for each of the each thin-client terminal systems **240**. Video display circuitry within the server system **220** reads the screen buffer **215** contents and drives a video output signal **221** for each thin-client terminal system **240**. Relatively simple video circuitry **265** in the thin-client terminal system **240** passes the video output signal to a video display monitor **267**. Audio may be handled in a similar manner wherein a thin-client audio system **212** generates audio output **222** for each thin-client terminal systems **240**. In the embodiment of **FIG. 2A**, the audio information is also passed from audio circuitry **272** to the audio input of a display monitor **267** that is capable of outputting audio. In one embodiment, the thin-client audio system **212** outputs a digital auto signal to the thin-client terminal system **240** which is then decoded and demodulated by the audio circuitry **272** into an analog audio signal at the thin-client terminal system **240**.

Input from the thin-client terminal system **240** is handled using an input control system **281** that receives user input information from a keyboard **283** (coupled to a keyboard connector **282**) and a cursor control device **286** (such as a mouse) that is coupled to a cursor control device input connector **285**. The input control system **281** encodes the user input information (keystrokes and cursor control device movements) and passes that user input information to a thin-client input interface system **211** in the server system **220**. In one particular embodiment, the design of the thin-client terminal systems **240** is so efficient that each thin-client terminal system **240** receives all of its needed electrical power from a power out conductor **223** in the multi-conductor wire **230**.

On the server side, the thin-client server computer system **220** is equipped with software for interacting with one or more thin-client terminal systems. As illustrated in **FIG. 2A**, a thin-client interface system **210** within thin-client server system **220** supports the thin-client terminal system **240** (as

well as other thin-client terminal systems depending on the implementation) coupled to thin-client server system **220**. Each thin-client terminal system **240** supported by thin-client server system **220** will have its own dedicated screen buffer **215** within the thin-client video subsystem **214** of the thin-client server system **220**.

The thin-client terminal system illustrated in **FIGS. 2A** and **2B** is very inexpensive and operates very well. But the thin-client terminal system illustrated in **FIGS. 2A** and **2B** does have some drawbacks. As set forth in **FIG. 2B**, each thin-client terminal system **240** is coupled to the thin-client server system **220** with its own individual multi-conductor cable **230**. Thus, there must be an equal number of interfaces on the thin-client server system **220** to accept the multi-conductor cables **230**. An ordinary personal computer lacks such interfaces such that a personal computer system must be modified by opening up the personal computer and adding one more peripheral cards to provide these interfaces. Peripheral Component Interconnect (PCI) cards may be added to a personal computer system provide such interfaces. In one embodiment, each PCI card may add up to five thin-client terminals. However, many personal computer users are uncomfortable with opening up a computer system and adding peripheral cards to the computer system. Thus, such users would never purchase the system disclosed in **FIGS. 2A** and **2B**.

A USB-based Thin-Client Terminal System Example Embodiment

To provide an inexpensive alternative to the thin-client terminal system illustrated in **FIGS. 2A** and **2B**, the present disclosure introduces a serial bus-based thin-client terminal system. Specifically, **FIG. 3** illustrates a block diagram of a first embodiment of a thin-client terminal system **340** implemented using a serial bus **323** as a data communication link to a server.

The thin-client terminal system **340** contains a USB hub circuit **381**. Although the USB hub circuit **381** is very much like other USB hub circuits and may be implemented with an off-the-shelf USB hub integrated circuit, the USB hub circuit **381** includes an identifier that will identify it as a thin-client terminal system instead of a typical USB hub. In that manner, when the thin-client terminal system **340** is coupled to a USB host controller of the personal computer system, the USB host controller of the personal computer system will

activate a USB driver associated with the thin-client terminal system **340** upon receipt of the identifier.

Coupled to the USB hub circuit **381** are USB connectors **382** and **385** for allowing a keyboard **383** and cursor control device **386** to the coupled to the thin-client terminal system **340**. In this manner, user input systems are provided to the user of the thin-client terminal system **340**.

In addition to the USB connectors **382** and **385** for user input, an additional USB connector **387** may be provided. It is contemplated that more than one additional USB connector may be provided. In this manner, a user of the thin-client terminal system **340** can use supported USB peripherals such as USB memory sticks to store personal data files. Various other USB devices may also be supported. However, the thin-client interface system **310** in the server system **320** may limit the types of USB devices that may be used for security and performance reasons. For example, if a user attempted to use a video capture device, the bandwidth usage of the serial bus **323** and the processing power of the server system **320** may become overtaxed.

To provide audio capabilities, a USB-based audio circuit **372** may be coupled the USB hub circuit **381**. Numerous off-the-shelf integrated circuits for receiving digital audio information on a USB connection and outputting audio may be used to implement the USB-based audio circuit **372**.

Finally, to provide display capabilities for the thin-client terminal system **340**, a USB-to-video circuit **365** is coupled to the USB hub circuit **381**. As with the USB-based audio circuit **372**, there are off-the-shelf integrated circuits that may be used to implement the USB-based video circuit **365**. The USB-to-video circuit **365** receives digital video information on a USB connection and then outputs a video signal to drive a personal computer display. A typical USB-to-video circuit **365** receives a stream of digital display data that is divided into individual scan lines. The USB-to-video circuit **365** then uses this digital video data to render an analogous video signal such as a VGA video signal to drive the local terminal display device **367**. Thus, thin-client terminal system **340** retains its characteristic as a pass-through system while also offering a generic and commonly used mechanism (e.g., USB) by which to connect the thin-client terminal system **340** to the thin-client server computer system **320**.

To drive the new serial bus-based thin-client terminal system **340**, the terminal software on the thin-client server system **320** must be modified. However, no hardware modification of a typical personal computer system is needed to drive the serial bus-based thin-client terminal system **340**. To handle the new serial bus-based thin-client terminal system **340**, USB drivers are added for the input and output functions of the serial bus-based thin-client terminal system **340**.

A USB video driver **313** has been added to the thin-client server system **320** to handle video for the serial bus-based thin-client terminal system **340**. The USB video driver **313** operates as a standard video driver in the operating system of the thin-client server system **320**. The USB video driver **313** sends video data to the USB host controller **351** of the thin-client server system **320** which is then transmitted to the serial bus-based thin-client terminal system **340**. The thin-client USB audio driver **312** operates in a similar manner. All audio requests for thin-client terminal system **340** are directed to the USB audio driver **312** which encodes the audio information and transmits the sound information across series bus **323** using USB host controller **351**.

User input information from the thin-client terminal system **340** will be transmitted from USB hub **381** in the thin-client terminal system **340** across serial bus **323** to USB host controller **351**. The USB host controller **351** will then provide the user input information to thin-client USB input driver **311**. Note that the thin-client interface software **310** will know the input information is specifically from thin-client terminal system **340** since that input information was delivered from USB hub **381** that identified itself as a terminal system.

To prevent unscrupulous entities from creating inferior copies of the thin-client terminal system **340**, the thin-client terminal system **340** may include security circuitry **375**. The thin-client interface system **310** in the thin-client server system **320** will consult with the security circuitry **375** to determine whether the thin-client terminal system **340** is an approved authentic thin-client terminal system. If a thin-client terminal system **340** fails to properly authenticate itself, then the thin-client terminal system may be deemed an unauthorized device such that the thin-client server system **320** may refuse to provide service to that thin-client terminal system **340**. Numerous different

security authentication systems may be used to implement the security circuitry **375**. Examples of security systems include having the thin-client server system **320** consult a centralized licensing server to determine if a particular encrypted serial number in the security circuitry **375** is authentic and has been activated, allowing a smartcard to be coupled to the security circuitry **375** to activate the thin-client terminal system **340**, and receiving a license code that can be entered into a thin-client server system **320** that will allow it to operate with the thin-client terminal system **340** having the security circuitry **375**.

The thin-client terminal system **340** can be allowed to operate in parallel with an existing thin-client terminal system, such as thin-client terminal system **240** of **FIG. 2**. Specifically, the thin-client server system **320** may include a PCI interface card **352** used to implement the system of **FIGS. 2A** and **2B**. In this manner, the thin-client server system **320** can provide terminal services to both the thin-client terminal system **240** implemented with a multi-conductor cable **230** and to the thin-client terminal system **340** implemented with a serial bus **323**.

Various different implementations of the serial bus-based thin-client terminal system may be created. **FIG. 4** illustrates an alternate implementation wherein two different terminal workstations **482** and **483** are illustrated. The two different workstations are supported with a single USB-to-dual-head video circuit **465**. The USB-to-dual-head video circuit may be a graphics circuit that handles video data driven by the thin-client server computer system to the thin-client terminal system. Similar to the USB-to-video circuit **365** of **FIG. 3**, the USB-to-dual-head video circuit uses the driven video data to render an analog video signal such as a VGA video signal to drive two local terminal display device **437** and **427** for two thin-client terminal systems. In this manner, two terminal workstations **482** and **483** can be supported using a single dual thin-client terminal system **441**.

Thus, the system disclosed in **FIG. 3** allows users who do not wish to add hardware into a computer system to easily deploy a thin-client terminal system. The user simply adds serial bus based thin-client terminal systems to the externally exposed serial bus of the computer system. **FIG. 5** illustrates an example deployment of a thin-client terminal environment that uses serial bus

based thin-client terminal systems **540**. The thin-client terminal systems **540** may be coupled directly to the thin-client server system **520** or coupled to the thin-client server system **520** through the use of an additional USB hub **598**.

An Example Method for Providing a Thin-Client Terminal System

FIG. 6 illustrates an example method **600** of providing a thin-client terminal system. At operation **602**, a thin-client terminal system may be connected to a thin-client server system. The connection may be accomplished by connecting a serial bus cable between a serial bus host controller of the thin-client server system and a serial bus hub of the thin-client terminal system. In an example embodiment, the serial bus interface employed may be of the USB format.

At operation **604**, the serial bus hub of the thin-client terminal system may transmit an identifier to the thin-client server system that identifies the serial bus hub as being associated with a thin-client terminal system. In response to the identifier, the thin-client server system may activate a serial bus driver associated with the thin-client terminal system. The serial bus driver may support the thin-client terminal system by driving output data to the thin-client terminal system.

At operation **606**, the serial bus hub of the thin-client terminal system may receive output data from the thin-client server system. The output data may be encoded according to a serial bus data format. The output data may included encoded video data and audio data.

At operation **608**, a serial bus-to-video circuit in the thin-client terminal system may receive the encoded output video data and convert the encoded output video data into an analog video signal. In an example embodiment, the analog video signal may be a VGA signal.

At operation **610**, the serial-bus-to-video circuit in the thin-client terminal system may render a first video display device using the analog video signal. In additional example embodiments, the serial-bus-to-video circuit may render a second video display device using the analog video signal.

At operation **612**, the thin-client terminal system may transmit user input data to the thin-client server computer system via the serial bus hub. The user input data may be received from one or more serial bus input devices (e.g.,

keyboard, mouse) connected to serial bus connectors in the thin-client terminal system.

Additional operations of the example method **600** may include authenticating the thin-client terminal system using a security circuit. If a determination is made that the thin-client terminal system is unauthentic, the security circuit may prevent the thin-client terminal system from interfacing with the thin-client server system. Authentication of the thin-client terminal system may comprise consulting a centralized licensing server to determine that an encrypted serial number in the thin-client terminal system is authentic and has been activated. Authentication of the thin-client terminal system may further comprise using a smartcard coupled to the security circuit to activate the thin-client terminal system.

Authentication of the thin-client terminal system also may include receiving a license code enabling the thin-client terminal system to operate.

The preceding technical disclosure is intended to be illustrative, and not restrictive. For example, the above-described embodiments (or one or more aspects thereof) may be used in combination with each other. Other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the claims should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled. In the appended claims, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Also, in the following claims, the terms "including" and "comprising" are open-ended, that is, a system, device, article, or process that includes elements in addition to those listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects.

The Abstract is provided to comply with 37 C.F.R. §1.72(b), which requires that it allow the reader to quickly ascertain the nature of the technical disclosure. The abstract is submitted with the understanding that it will not be used to interpret or limit the scope or meaning of the claims. Also, in the above Detailed Description, various features may be grouped together to streamline the

disclosure. This should not be interpreted as intending that an unclaimed disclosed feature is essential to any claim. Rather, inventive subject matter may lie in less than all features of a particular disclosed embodiment. Thus, the following claims are hereby incorporated into the Detailed Description, with each claim standing on its own as a separate embodiment.

WHAT IS CLAIMED IS:

1. A thin-client terminal system, comprising:

a serial bus hub coupled to a server system via a serial bus cable and configured to:

receive serial output data from the server system via the serial bus cable;

transmit input data via the serial bus cable to the server system; and

identify the serial bus hub as associated with the thin-client terminal system;

a first serial bus interface communicatively coupled to the serial bus hub and configured to receive the input data from an input device; and

a serial bus-to-video circuit configured to:

convert received serial output data into a video signal; and

render a first video display device using the video signal, the first video display device connected to the thin-client terminal system.

2. The thin-client terminal system of claim 1, further comprising a second serial bus interface communicatively coupled to the serial bus hub and configured to receive additional user input.

3. The thin-client terminal system of claim 1, further comprising a security circuit configured to authenticate the thin-client terminal system, wherein based on a determination that the thin-client terminal system is unauthentic, the security circuit prevents the thin-client terminal system from interfacing with the thin-client server system.

4. The thin-client terminal system of claim 3, wherein the security circuit configured to authenticate the thin-client terminal system comprises consulting a centralized licensing server to determine that an encrypted serial number in the security circuit is authentic and has been activated.

5. The thin-client terminal system of claim 3, wherein the security circuit configured to authenticate the thin-client terminal system comprises using a smartcard coupled to the security circuit to activate the thin-client terminal system.

6. The thin-client terminal system of claim 3, wherein the security circuit configured to authenticate the thin-client terminal system comprises the security circuit receiving a license code enabling the thin-client terminal system to operate.

7. The thin-client terminal system of claim 1, wherein the serial bus-to-video circuit is further configured to render a second video display device using the video signal.

8. A server system for supporting a thin-client terminal system, the server system comprising:

a video subsystem comprising:

a screen buffer configured to store video data for the thin-client terminal system; and

a serial bus video driver configured to drive a video signal to the thin-client terminal system using the stored video data;

a thin-client input driver configured to process input data received from the thin-client terminal system; and

a serial bus host controller configured to transmit the video signal to a serial bus hub of the thin-client terminal system.

9. The thin-client server system of claim 8, wherein the serial bus host controller is further configured to receive an identifier from the serial bus hub of the thin-client terminal system, the receipt of the identifier causing the serial bus host controller to activate a serial bus driver associated with the thin-client terminal system.

10. The thin-client server system of claim 8, further comprising a thin-client serial bus audio driver configured to drive an audio signal to the thin-client terminal system via the serial bus host controller.

11. A thin-client terminal system, comprising:

means for connecting the thin-client terminal system to a thin-client server system;

means for identifying the connecting means as associated with the thin-client terminal system;

means for receiving output data from the thin-client server system;

means for transmitting user input data to the thin-client server system;

first means for receiving the user input data;

means for converting the received output data into a video signal; and

means for rendering a first video display device using the video signal.

12. The thin-client terminal system of claim 11, further comprising second means for receiving the user input data.

13. The thin-client terminal system of claim 11, further comprising means for authenticating the thin-client terminal system, wherein based on a determination that the thin-client terminal system is unauthentic, the authenticating means prevents the thin-client terminal system from interfacing with the thin-client server system.

14. The thin-client terminal system of claim 13, wherein the authenticating means consults a centralized licensing server to determine that an encrypted serial number in the security circuit is authentic and has been activated.

15. The thin-client terminal system of claim 13, wherein the authenticating means uses a smartcard coupled to the security circuit to activate the thin-client terminal system.

16. The thin-client terminal system of claim 13, wherein the authenticating means receives a license code enabling the thin-client terminal system to operate.

17. The thin-client terminal system of claim 11, wherein the rendering means renders a second video display device using the video signal.

18. A method of providing a thin-client terminal system, the method comprising:

connecting a serial bus hub to a serial bus host controller in a server system;

transmitting an identifier to the serial bus host controller identifying the serial bus hub as being associated with the thin-client terminal system;

receiving serial output data from the server system;

converting received serial output data into a video signal;

rendering a first video display device using the video signal; and

transmitting user input data via the serial bus hub to the thin-client server system, the user input data received by a serial bus interface communicatively coupled to the serial bus hub.

19. The method of claim 18, further comprising authenticating the thin-client terminal system, wherein based on a determination that the thin-client terminal system is unauthentic, a security circuit prevents the thin-client terminal system from interfacing with the thin-client server system.

20. The method of claim 19, wherein the authenticating comprises consulting a centralized licensing server to determine that an encrypted serial number in the thin-client terminal system is authentic and has been activated.

21. The method of claim 19, wherein the authenticating comprises using a smartcard coupled to the security circuit to activate the thin-client terminal system.

22. The method of claim 19, wherein the authenticating comprises receiving a license code enabling the thin-client terminal system to operate.

23. The method of claim 18, further comprising rendering a second video display device using the video signal.

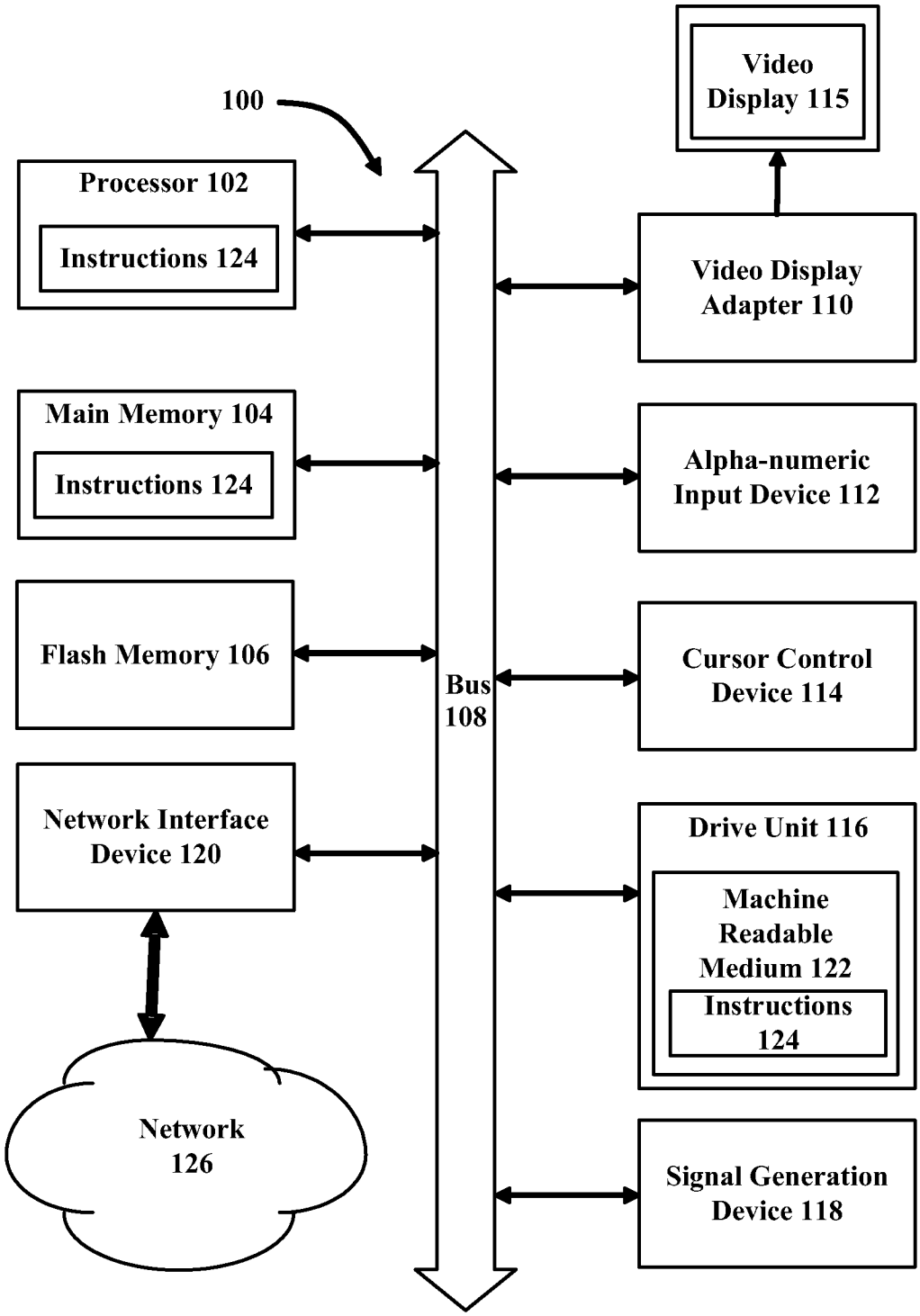
100
Processor 102
Instructions 124
Main Memory 104
Instructions 124
Flash Memory 106
Network Interface Device 120
Network 126
Bus 108
Video Display 115
Video Display Adapter 110
Alpha-numeric Input Device 112
Cursor Control Device 114
Drive Unit 116
Machine Readable Medium 122
Instructions 124
Signal Generation Device 118

FIG. 1

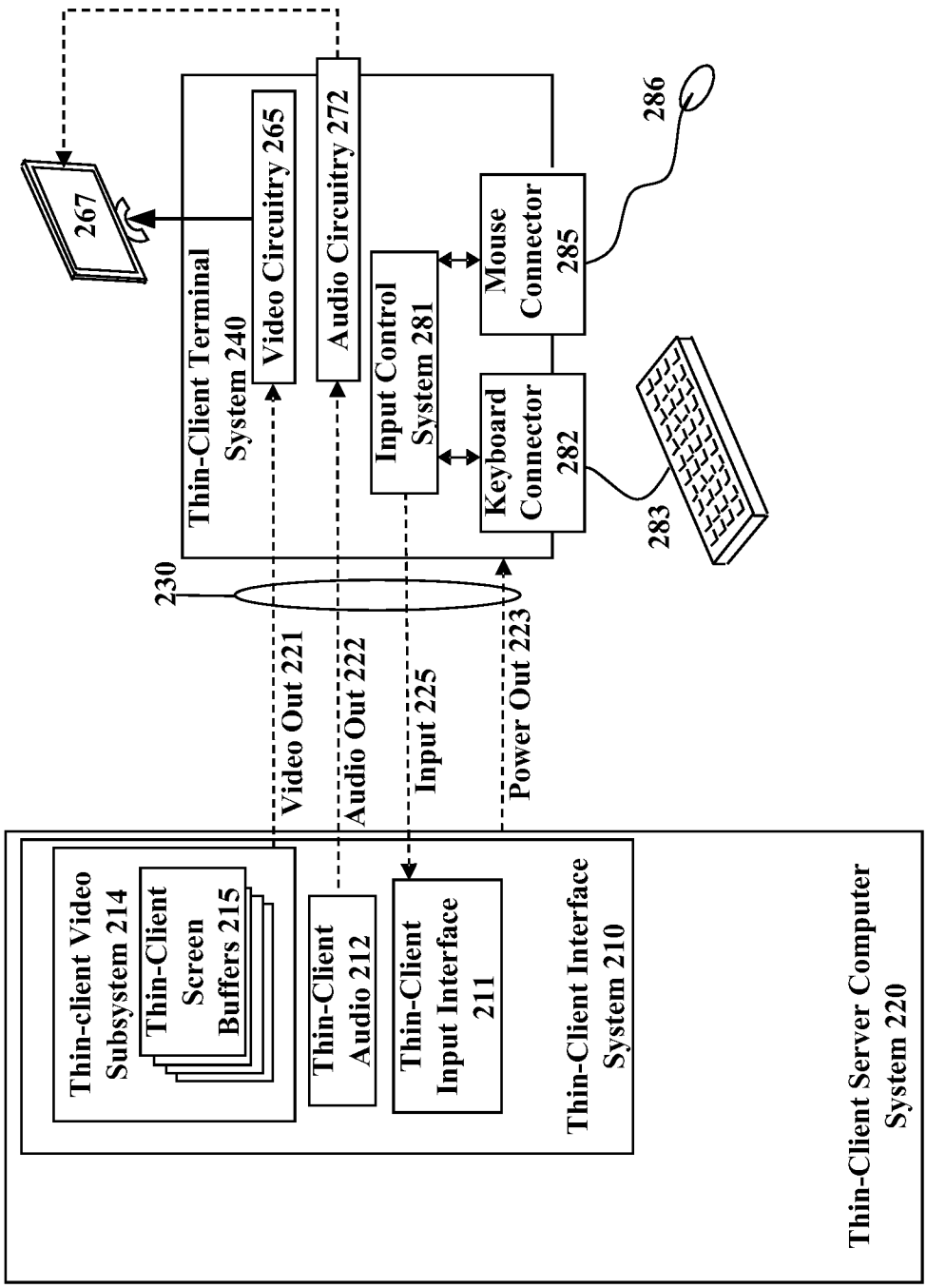
Thin-client Video Subsystem 214
Thin-Client Screen Buffers 215
Thin-Client Audio 212
Thin-Client Input Interface 211
Thin-Client Interface System 210
Thin-Client Server Computer System 220
Video Out 221
Audio Out 222
Input 225
Power Out 223
230
Thin-Client Terminal System 240
Video Circuitry 265
Audio Circuitry 272
Input Control System 281
Keyboard Connector 282
Mouse Connector 285
267
283
286

FIG. 2A

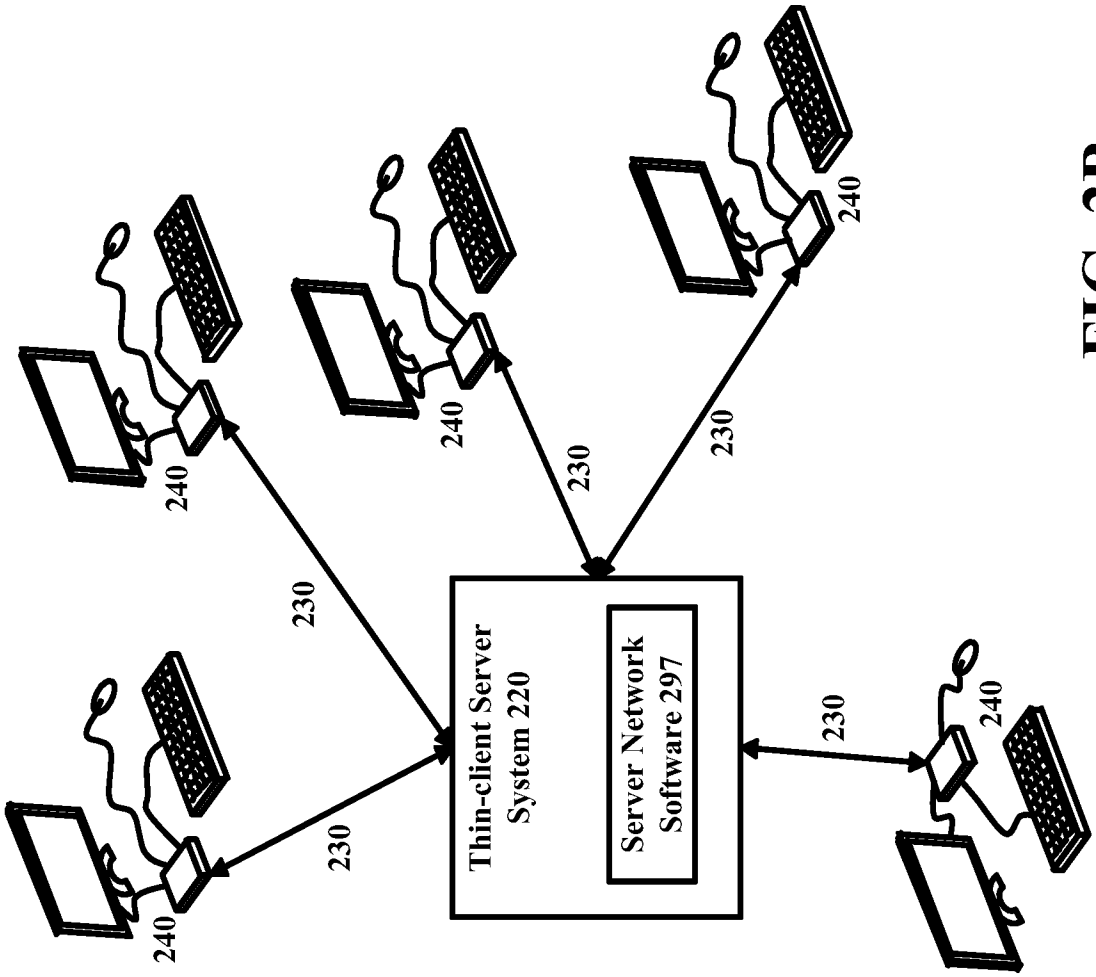
Thin-client Server System 220
Server Network Software 297
230
230
230
230
240
240
240
240
240

FIG. 2B

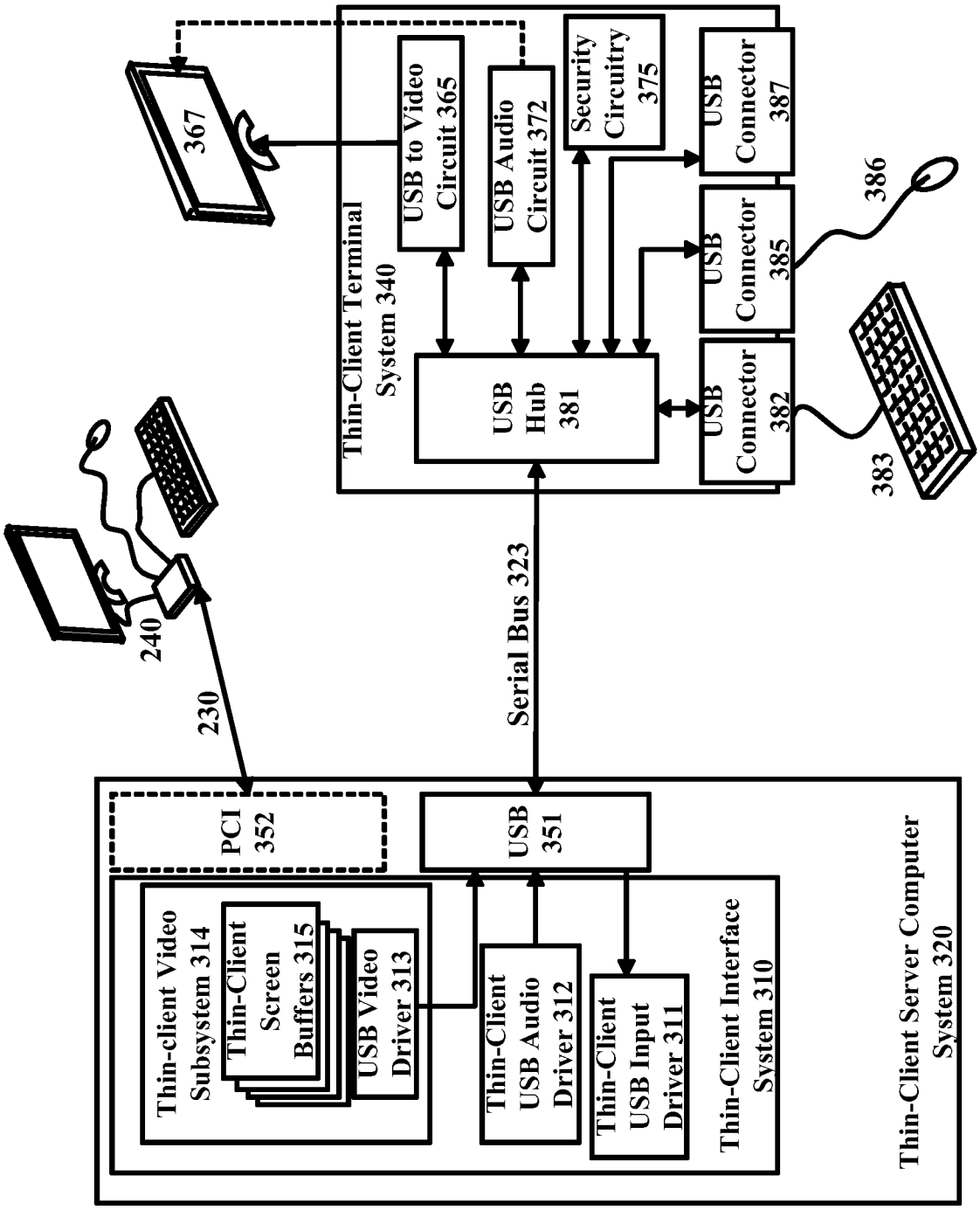
Thin-Client Server Computer System 320
Thin-Client Interface System 310
Thin-Client USB Input Driver 311
Thin-Client USB Audio Driver 312
USB Video Driver 313
Thin-Client Screen Buffers 315
Thin-client Video Subsystem 314
PCI 352
USB 351
Serial Bus 323
230
240
Thin-Client Terminal System 340
USB Hub 381
USB Connector 382
USB Connector 385
USB Connector 387
USB Audio Circuit 372
USB to Video Circuit 365
Security Circuitry 375
367
383
386

FIG. 3

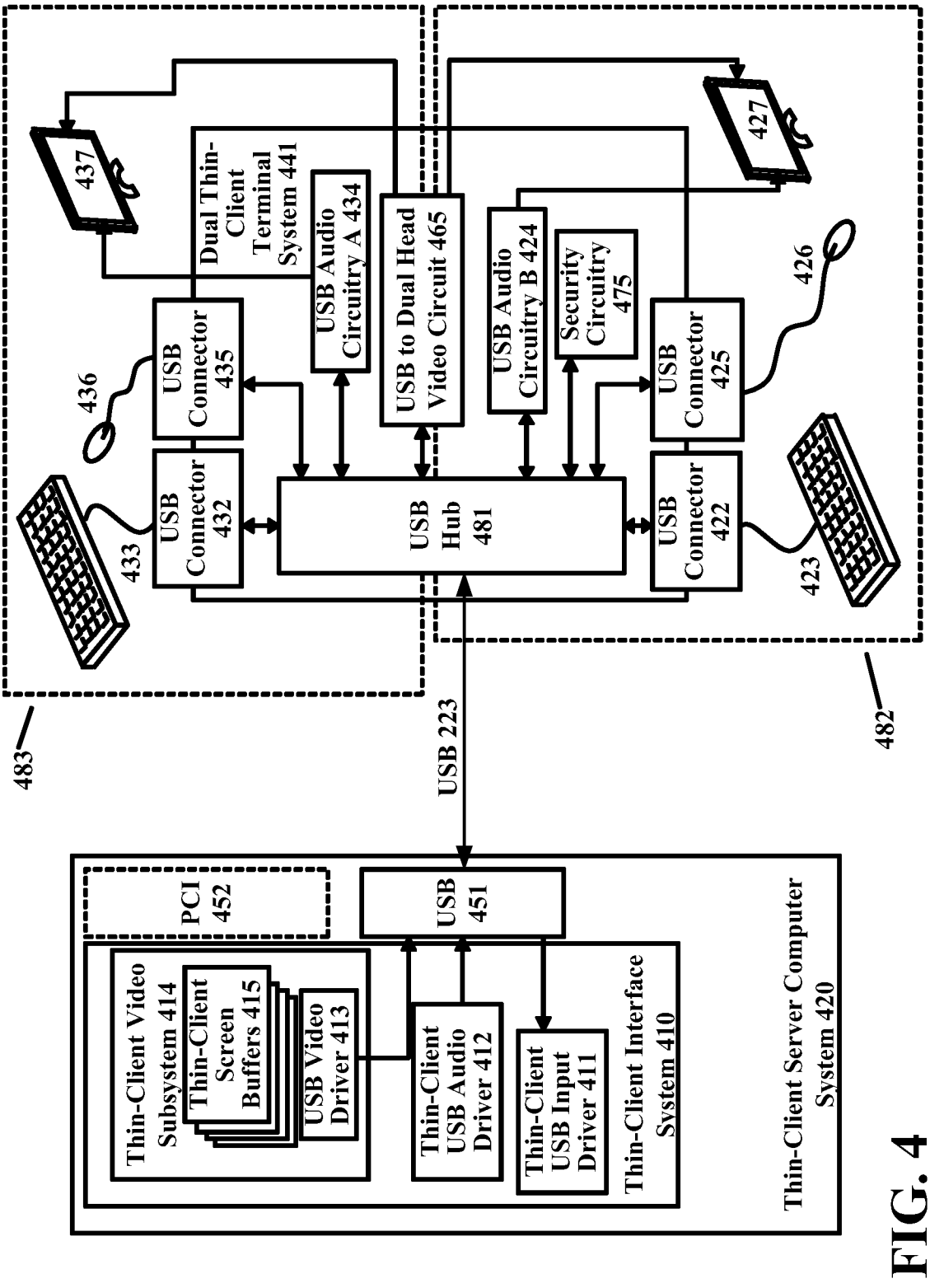
Thin-Client Server Computer System 420
Thin-Client Interface System 410
Thin-Client Video Subsystem 414
Thin-Client Screen Buffers 415
USB Video Driver 413
Thin-Client USB Audio Driver 412
Thin-Client USB Input Driver 411
PCI 452
USB 451
USB 223
USB Hub 481
USB Connector 432
USB Connector 435
USB Connector 422
USB Connector 425
USB Audio Circuitry A 434
USB Audio Circuitry B 424
USB to Dual Head Video Circuit 465
Security Circuitry 475
Dual Thin-Client Terminal System 441
433
436
423
426
427
437
483
482

FIG. 4

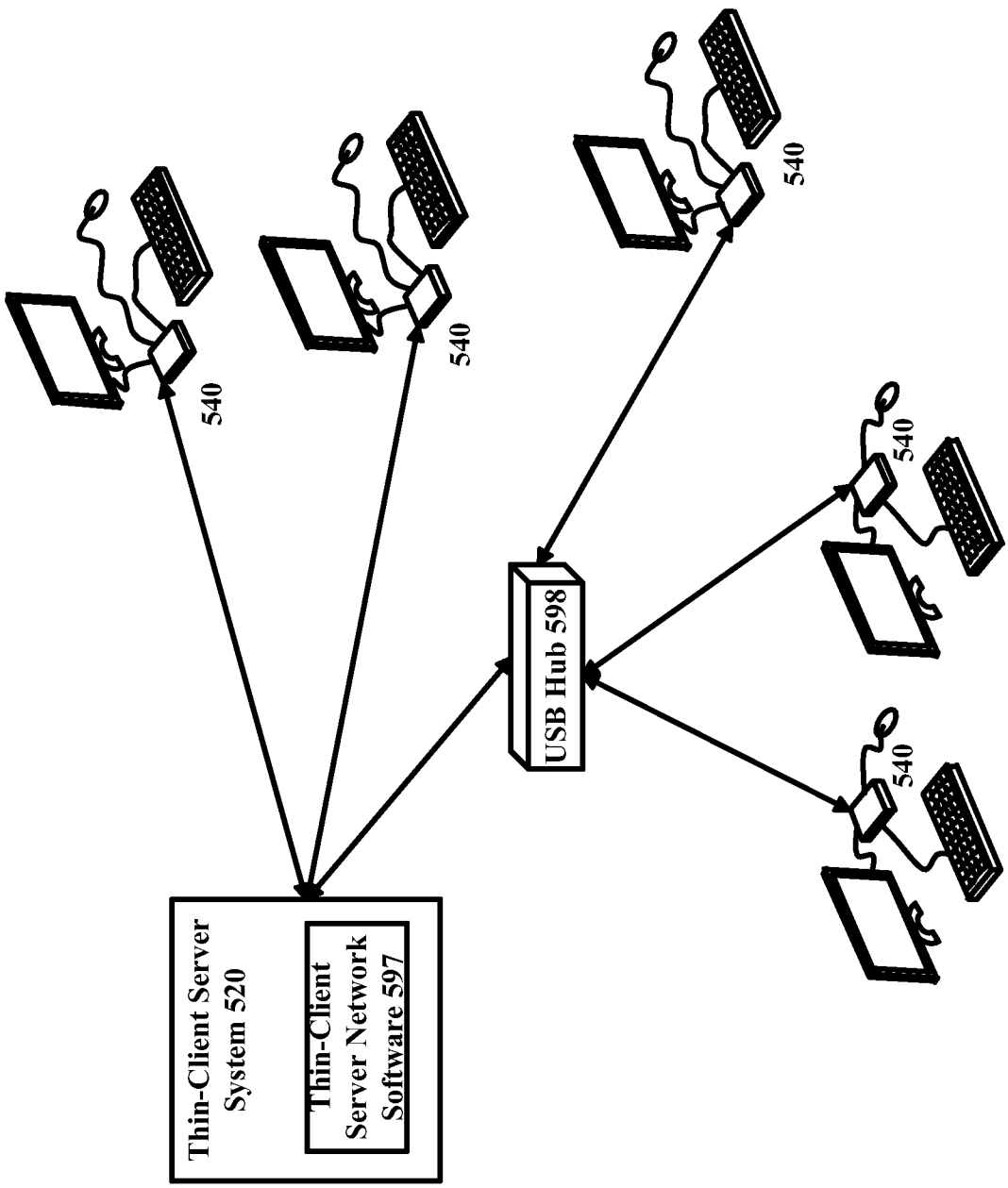
Thin-Client Server System 520
Thin-Client Server Network Software 597
USB Hub 598
540
540
540
540
540

FIG. 5

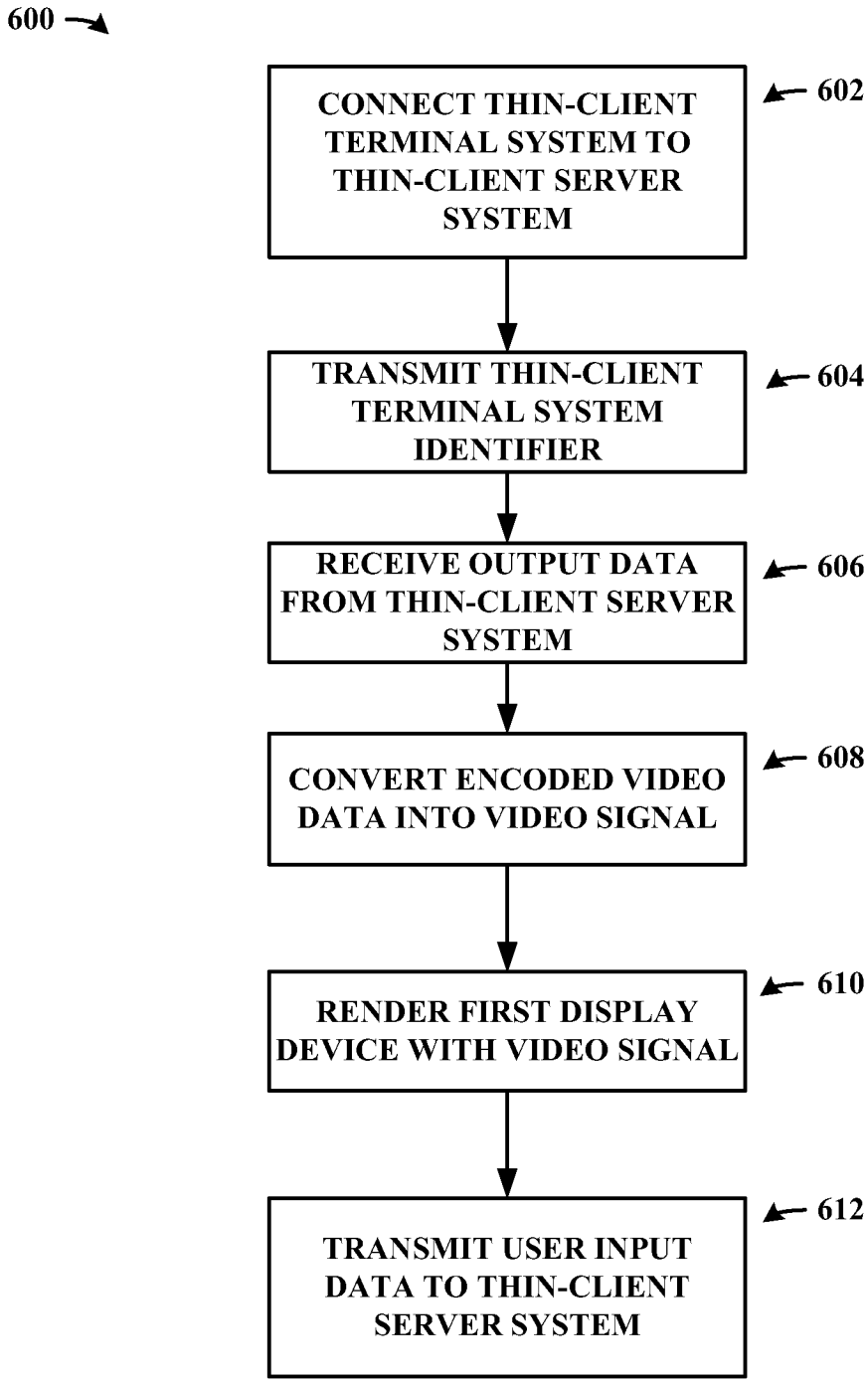
600
CONNECT THIN-CLIENT TERMINAL SYSTEM TO THIN-CLIENT SERVER SYSTEM
602
TRANSMIT THIN-CLIENT TERMINAL SYSTEM IDENTIFIER
604
RECEIVE OUTPUT DATA FROM THIN-CLIENT SERVER SYSTEM
606
CONVERT ENCODED VIDEO DATA INTO VIDEO SIGNAL
608
RENDER FIRST DISPLAY DEVICE WITH VIDEO SIGNAL
610
TRANSMIT USER INPUT DATA TO THIN-CLIENT SERVER SYSTEM
612

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 10/51207

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G06F 13/00 (2010.01)
USPC - 710/107
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
USPC:710/107

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 710/110, 107, 300; 709/201, 217, 219, 223; 370/229, 230; 379/201.01; 700/1, 2 (keyword limited; terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Electronic Database Searched: PubWEST(PGPB, USPT, EPAB, JPAB), Google Scholar
Search Terms Used: serial, bus, cable, port, communicate, connector, USB, hub, multiple, plurality, many, thin, slim, lean, client, terminal distributed, workstation, server, host, controller, input, mouse, keyboard, enter, pointing, data, information, device, video, gr

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2001/0056464 A1 (Ishihara et al.) 27 December 2001 (27.12.2001), see entire document; especially para [0010]-[0011], [0013]-[0015], [0017], [0019]-[0020], [0028]-[0047], [0064], [0068], Fig. 1-4	1-3, 6-13, 16-19, 22-23 ---------- 4-5, 14-15, 20-21
Y	US 2008/0294763 A1 (Uchida) 27 November 2008 (27.11.2008), see para [0041]-[0043], [0045] -[0049], [0066], Fig. 1-2	4-5, 14-15, 20-21
A	US 2009/0094365 A1 (Orady et al.) 09 April 2009 (09.04.2009), see entire document	1-23
A	US 2007/0268824 A1 (Kodaka et al.) 22 November 2007 (22.11.2007), see entire document	1-23
A	US 2007/0185969 A1 (Davis) 09 August 2007 (09.08.2007), see entire document	1-23
A	US 2007/0097130 A1 (Margulis) 03 May 2007 (03.05.2007), see entire document	1-23
A	US 2007/0054696 A1 (Cooner et al.) 08 March 2007 (09.03.2007), see entire document	1-23
A	US 2005/0193396 A1 (Stafford-Fraser et al.) 01 September 2005 (01.09.2005), see entire document	1-23

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 November 2010 (17.11.2010)	23 NOV 2010
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)