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(54) **UPDATING A USER SESSION IN A MACH-DERIVED COMPUTER SYSTEM ENVIRONMENT**

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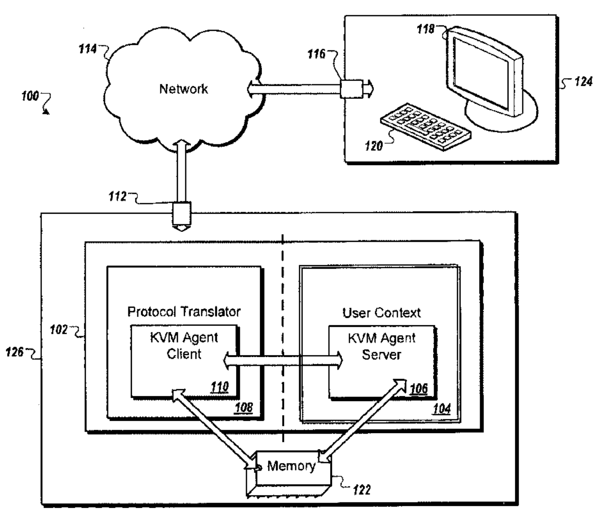
(57) **ABSTRACT**

Methods, apparatus, systems and computer program product for updating a user session in a terminal server environment. Transfer of display data corresponding to an updated user interface can occur via a memory shared between an agent server and an agent client in a terminal server environment. Access to the shared memory can be synchronized via token passing or other operation to prevent simultaneous access to the shared memory. Token sharing and synchronized input/output can be performed using FIFOs, sockets, files, semaphores and the like, allowing communications between the agent server and agent client communications to adapt to different operating system architecture.

35 Claims, 4 Drawing Sheets



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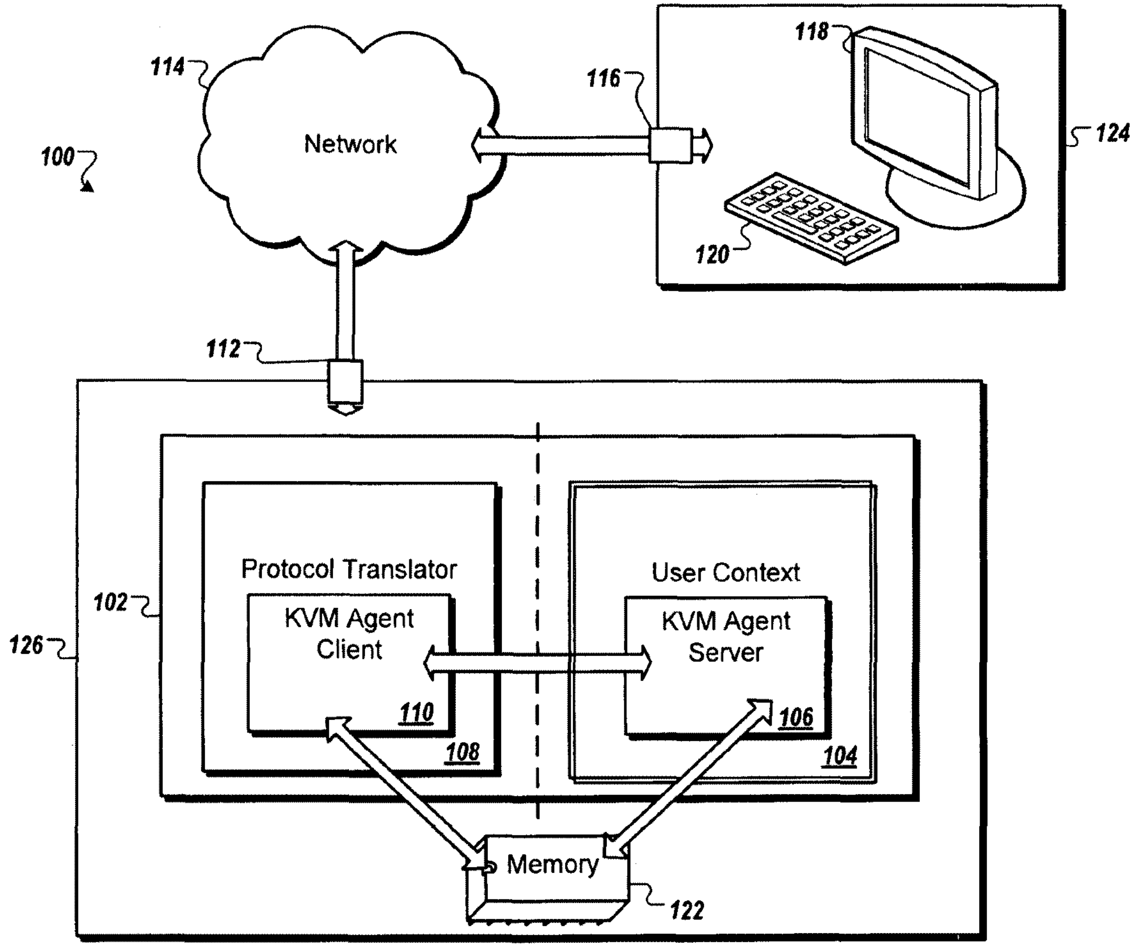
100
114
Network
116
118
124
120
112
126
102
Protocol Translator
KVM Agent Client
110
108
User Context
KVM Agent Server
106
104
Memory
122

FIG. 1

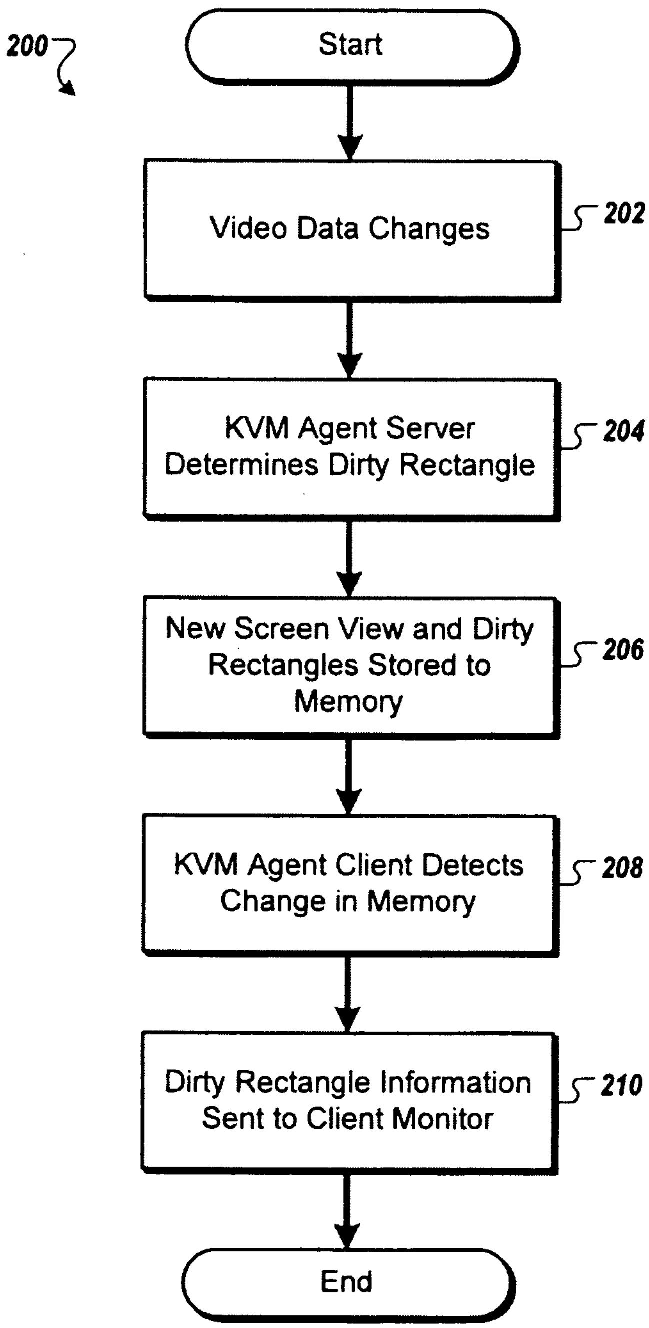
200
Start
Video Data Changes
202
KVM Agent Server Determines Dirty Rectangle
204
New Screen View and Dirty Rectangles Stored to Memory
206
KVM Agent Client Detects Change in Memory
208
Dirty Rectangle Information Sent to Client Monitor
210
End

FIG. 2

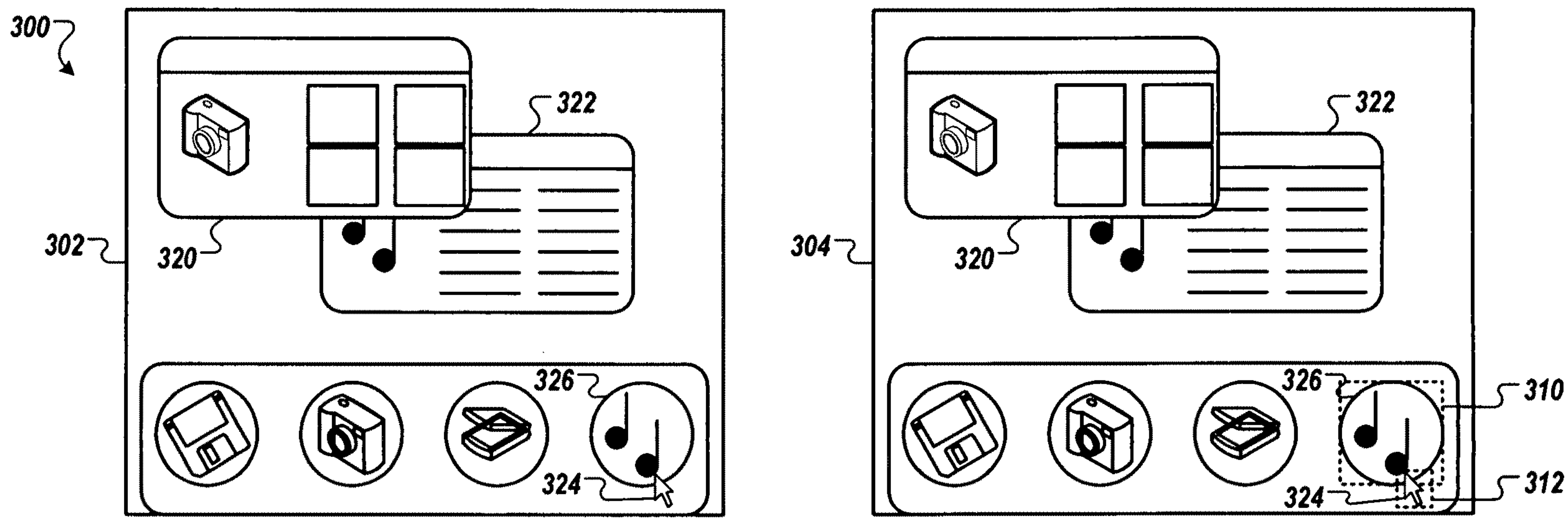

FIG. 3A

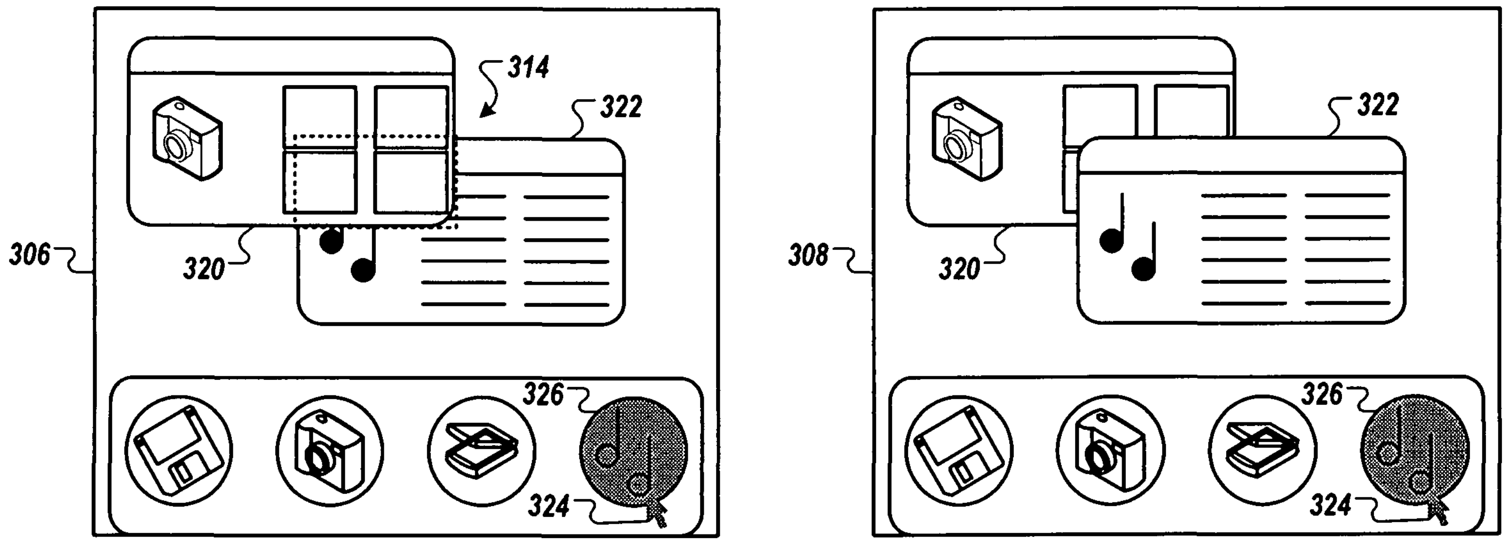

FIG. 3B

UPDATING A USER SESSION IN A MACH-DERIVED COMPUTER SYSTEM ENVIRONMENT

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue; a claim printed with strikethrough indicates that the claim was canceled, disclaimed, or held invalid by a prior post-patent action or proceeding.

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of provisional patent application Ser. No. 61/099,485, filed Sep. 23, 2008, which is incorporated by reference.

FEDERALLY SPONSORED RESEARCH

Not applicable.

SEQUENCE LISTING OR PROGRAM

Not applicable.

FIELD OF THE INVENTION

The invention relates to the field of computer networks. In particular, the present invention relates to methods, apparatus, systems and computer program product for updating a user session in a terminal server environment.

BACKGROUND

For enterprises large and small, consolidation of hardware and software is increasingly vital due to reasons of accessibility, reliability, data security, cost and the administration of applications and the network itself Managing remote users, their computing experience and their access to networks is similarly crucial. Many different types of institutions have used terminal server applications to provide a computing environment and to address these issues, despite having varied institutional and computing objectives. For instance, educational institutions deploy computer networks to allow teachers, students and staff to connect remotely, thereby allowing increased productivity, easier access to information, rapid communication and, ultimately, enhanced learning opportunities. Government agencies are perhaps more concerned with data security, which is why terminal services always have been essential to their information technology infrastructures. Thin client and network deployments have been mandated in several agencies—this allows all operations to be performed centrally, and secures and monitors information that may have been sent or received. Commercial organizations, as well, benefit from deploying terminal servers so that data transmission can be managed and controlled; for example, by requiring users to access data through smart cards and biometrics, and allowing editing and review of the data only within a secure environment, or by certain identified users. And in the case of organizations of all types there is a growing need for network users to access information via mobile or handheld devices from remote locations.

Centralized computing results in cost savings, ease of administration and enhanced security. Since almost all the

processing of an application is done on a central server, companies are not forced to continuously upgrade or replace client or user hardware to keep pace with the systems requirements of modern applications. Maintenance of applications is isolated to the application server and not each individual node, also reducing administrative overhead. Servers are usually located in secure data centers, reducing the risk of physical theft. Centralized malware and audit processes also facilitate enhanced security. In addition, replacing workstations with thin clients can reduce energy consumption, environmental costs, support cost, and hardware costs.

In certain terminal server environments, however, implementing multiple independent instances of applications to satisfy the demands of remote clients leads to issues in being able to securely and synchronously update the graphical display of server output. Simply transmitting the output from certain output agents, such as via window server, for example, may lead to information being passed across user session boundaries, as the graphical data available would be that created by the most recent client session to access the application. As a result, a need exists for an improved method for updating graphical display information securely and in a timely fashion in a terminal server environment. There is also a need for an improved means to transport data from a user's session in a terminal server environment, allowing improved communications with a remote device.

SUMMARY

The disclosed embodiments relate to methods, apparatus, systems and computer program product for updating a user session in a terminal server environment. In accordance with a preferred embodiment, the disclosed methods, apparatus, systems and computer program product allow faster and less-error-prone transfer of display data corresponding to an updated user interface via a memory shared between an agent server and an agent client in a terminal server environment. This shared server-client arrangement is sometimes described herein as a "KVM agent" server/client system (referring to keyboard, video and mouse). In certain embodiments, accessing the shared memory is synchronized via token passing or other operation to prevent simultaneous access to the shared memory. In certain embodiments, this token sharing and synchronized input/output can be performed using FIFO pipes, sockets, files, semaphores and the like, allowing communications between the agent server and agent client communications to adapt to different operating system architecture. In a preferred embodiment, the agent pair implementation is protocol independent. Thus, among the advantages disclosed herein, one or more aspects are to provide a faster and more robust computing environment. Other advantages relate to an improved ability to transfer large amounts of display-associated data. These and other advantages of the many aspects of the disclosed embodiments will become apparent from a review of the following description and corresponding figures.

DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

FIG. **1** is a graphical depiction of an exemplary computer network according to one embodiment of the disclosure.

FIG. **2** is a flow chart of an exemplary process for providing video data to a remote device.

FIGS. **3**A-B are graphical depictions of user interface instances exemplifying the use of dirty rectangles to indicate areas of change to a user interface.

DETAILED DESCRIPTION

Exemplary embodiments of the present invention are now described in detail, including depiction of the hardware components which serve as the context for the process embodiments.

FIG. **1** shows an example computer network **100**, which can include architectural elements corresponding to at least one input and/or output of a user context (or session). In some implementations, the computer network **100** can include a host system **126**. An operating system **102** can be executed on the host system **126**, the operating system **102** including one or more of a user context **104**, a KVM agent server **106**, a KVM agent client **110**, a protocol translator **108**, and a host communication socket **112**. The host system **126** also can include, a memory component **122**, which is accessible to the operating system **102** and the user context **104**. The computer network **100** further can include a remote system **124**. The remote system **124** can include one or more of a remote communications socket **116**, an output device **118**, such as a display and/or speakers, and at least one input device **120**, such as a keyboard and/or mouse. The remote system **124** and the host system **126** can communicate over a shared network **114**, which can be a public network, e.g. the Internet, a private network, e.g. a Local Area Network (LAN), or a combination thereof.

The remote system **124** can be any computing system configurable to communicate over the shared network **114**, such as a desktop computer, a laptop computer, a palm top computer, a server, a mobile communications device, and an embedded computing system. The remote system **124** can receive input and provide output through the input device **120** and the output device **118**. Further, the remote system **124** can be configured to communicate with the shared network **114** through a wired or wireless connection.

The host system **126** also can be any computing system configurable to communicate over the shared network **114**, such as a desktop computer, a laptop computer, a palm top computer, a server, a mobile communications device, and an embedded computing system. The operating system **102** can be executed on the host system **126**, and can be configured to provide an application environment in which one or more application programs can be executed. For example, the operating system **102** can be a Mac OS provided by Apple Inc. of Cupertino, Calif., a Windows operating system provided by Microsoft Corporation of Redmond, Wash., or a Linux operating system. In some implementations, the host system **126** can act as a server for the remote system **124**. Further, the host system **126** can be separated from the remote system **124** by any distance. For example, the remote system **124** can be a desktop computer located at an employee's home and the host system **126** can be a server located at an employer's site.

The user context **104**, which in some implementations can be referred to as a user session or a graphical session, can be configured as a single environment in which the user can access one or more functions of the operating system. A single user context is shown in FIG. **1**, but the operating system **102** can be configured to host multiple user contexts. In some implementations, each user context, such as the user context **104**, is kept separate from all other existing user contexts. For example, separate memory utilization, file system access, and/or process execution can be maintained for each user context. In this way, actions and/or functions associated with one user context can be isolated to reduce their impact on one or more other existing user contexts and the host operating system. It will be appreciated that some actions taken in one user context can affect one or more other user contexts. For example, use of system resources by one user context can directly or indirectly reduce the system resources available to one or more other user contexts. In another example, a user context can be given special privileges to monitor or interact with one or more other user contexts, such as for maintenance purposes.

The KVM agent server **106** and the KVM agent client **110** can provide remote input and output for a user context **104** hosted by the operating system **102**. For example, the KVM agent server **106** and the KVM agent client **110** can provide one or more of a control device input, such as a keyboard and/or mouse, an audio output, an image output, and/or a video output. The KVM agent client **110** and the KVM agent server **106** further can be configured to transmit information into and/or out of a user context, such as the user context **104**. In some implementations, the amount of data used to represent an input and/or an output can be small, such as keyboard input, mouse input, or an audio output representing a beep. This data can be passed from the KVM agent client **110** to the KVM agent server **106** directly using a software construct, such as a socket, pipe, port, FIFO, or inter-process message passing, e.g. Mach, without significantly impacting the operating system **102** or the host system **126**. Further, the message passing can be performed serially and asynchronously, such that the messages are passed in the correct order. The objects sending and/or receiving information can be idle between messages. In one example, key presses of A, B, and C can be passed and received in the order "A, B, C."

In some implementations, the amount of data used to represent an input and/or an output, such as biometric, video, or streaming audio data, can be too large for passing using a software construct, such as a socket, pipe, port or inter-process message passing. For example, the video data associated with a twenty-inch computer monitor can take up to forty seconds to be passed by software running on a modern hardware architecture. Many computer monitor screens can refresh at a rate of sixty times per second. Accordingly, direct message passing between the KVM agent client **110** and the KVM agent server **106** cannot accommodate the amount of data associated with video.

Large amounts of input and/or output data can be passed between the KVM agent server **106** and the KVM agent client **110** by way of shared memory **122**. Shared memory software tools such as Universal Pages Lists (UPL), POSIX, SYSV, the Unix environment program "pmap" and the X is not Unix (XNU) environment programs "MachVM" and "VM" can be used to share memory between the KVM agent client **110** and KVM agent server **106**. Further, metadata corresponding to the shared memory can be transmitted between the KVM agent client **110** and KVM agent server **106**. For example, the metadata can be transmitted via a socket, FIFO pipe or port. The metadata can describe any aspect of the shared memory, including what data is stored in the shared memory and the order in which the data is stored.

The protocol translator **108** can be configured to translate input and output data associated with the KVM agent client **110** into a protocol that can be utilized by a remote client, such as the Virtual Network Computer (VNC) protocol, the

Remote Desktop Protocol (RDP), or the X11 protocol. The protocol translator **108** can communicate with one or more remote clients via the host communication socket **112**. For example, a connection between the host communication socket **112** and the remote communication socket **116** can be established over a communication network, such as the shared network **114**. Communications between the host communication socket **112** and the remote communication socket **116** can be serial and asynchronous, such that the messages are passed in the correct order and the objects sending and receiving information can be idle during the time between messages. Output data can be presented through the output device **118**. In some implementations, the output device **118** can be a computer monitor, a speaker, a projector, or other device appropriate for outputting data generated by the operating system **102**. Further, input data can be entered using the input device **120**, which can be a keyboard, a mouse, a touch screen, a keypad, a joystick, a touch pad, or other device appropriate for receiving input, directly or indirectly, from a user.

FIG. **2** shows a flow chart of an example process (**200**) for providing video data to a remote device. Video data associated with a user context executing in an operating system can change (**202**) in response to many circumstances. For example, with respect to a user interface corresponding to a user context, the time presented by a clock can be incremented, a cursor can move to a new position, or data associated with an application can be altered. A KVM agent server associated with the user context can determine (**204**) which sections of the user interface have been updated. In some implementations, sections of a user interface that have been updated can be designated as rectangular spaces and can be referred to as 'dirty rectangles'.

An updated representation of the user interface for a user context and information corresponding to one or more dirty rectangles can be stored in a shared memory location (**206**). A KVM agent client can be configured to monitor the shared memory location and detect changes (**208**). When a change is detected, the KVM agent client can access the dirty rectangle information and transmit display information to a remote device (**210**) for presentation. In some implementations, information corresponding to the dirty rectangles can be transmitted. In other implementations, updated display information can be transmitted. The dirty rectangle information and/or updated display information can be transmitted via shared memory or a communications path, such as a socket, a pipe, a port, or messaging infrastructure. The client monitor can be associated with a remote system and can communicate with the operating system via a shared network, such as the Internet or a LAN. The output presented on the client monitor can be updated based on the dirty rectangles, so that only the portion of the interface that has changed is updated.

FIG. **3**A shows a plurality of user interface instances presented on a display, such as a display associated with a remote computing system. The user interface instance **302** precedes temporally the user interface instance **304**. For example, the user interface instances **302** and **304** can represent the display of a computer monitor which receives one or more output signals from an operating system. Further, the operating system generating the output signals can be executing on a computing system that is remote from the computing system to which the computer monitor is connected.

In the user interface instance **302**, a photo application window **320** is presented above a music application window **322**. Further, the photo application window **320** overlaps with, and thus partially obscures, the music application window **322**. Additionally, a mouse cursor **324** is presented in the user interface instance **302** such that it is positioned over a music program icon **326**. In the user interface instance **304**, the mouse cursor **324** and the music program icon **326** are highlighted, such as in response to a mouse click. Rectangles **310** and **312** can be generated by the operating system to represent a minimum bounding box around the mouse cursor **324** and the music program icon **326**. The rectangles **310** and **312** are illustrative of the areas in which the user interface instance has changed, as determined by the operating system, and are not displayed on the computer monitor. These rectangles **310** and **312** represent dirty rectangles that indicate areas of change to the user interface. Thus, the rectangles **310** and **312** represent the change between the user interface instance **302** and the user interface instance **304**.

In some implementations, the rectangles **310** and **312** also can be optimized. For example, the rectangles **310** and **312** can be combined to form one larger rectangle, such as by expanding one or more borders to form a single rectangle. In another example, two or more rectangles can be used to represent a single, nonrectangular shape. The two or more rectangles can be specified to minimize the portion of the user interface covered by the rectangles that has not changed. In some other implementations, nonrectangular shapes also can be used.

For example, input such as the click of a mouse may be made on the input device **120** of FIG. **1**. The remote system **124** can send this input information through the socket **116**, through the network **114** to the socket **112**. The input information then can be passed from the socket **112** to the protocol translator **108**, which can translate the input information and pass it to the KVM agent client **110**. The KVM agent client **110** can then pass the input to the KVM agent server **106**.

In this example, the user interface information can be updated from the user interface instance **302** to the user interface instance **304**. The information related to the dirty rectangles **310** and **324** can be sent from the KVM agent server **106** to the memory **122**. The KVM agent client **110** can detect change to the information stored in the memory **112** and can pass the dirty rectangle information to the protocol translator **108**. The protocol translator **108** can translate the dirty rectangle information and can send it through the socket **112** to the shared network **114**. The dirty rectangle information can then be routed over the shared network **114**, through the socket **116**, to the remote client **124**. The remote client **124** can use the dirty rectangle information to generate an updated interface for display on the output device **118**. In other embodiments, updated display information can be transmitted from the host system **126** to the remote system **124**, based on the dirty rectangles.

FIG. **3**B shows a plurality of user interface instances presented on a display, such as a display associated with a remote computing system. The user interface instance **306** precedes temporally the user interface instance **308**. The difference between the user interface instances **304** and **306** is illustrated by the rectangle **314**. The operating system can cause the music application window **322** to be displayed in front of the photo application window **320**, such as in response to a mouse click selecting the music application icon **326**. Thus, the music application window **322** now partially obscures the photo application window **320**. The operating system further can generate video output data to update only to the section of the display at which the change in overlap, represented by the rectangle **314**, has occurred.

The video output data generated can be passed to the remote client **124** to be displayed on the output device **118** as previously described.

In one example of desktop computing use, the area of a display output that is changed from one user interface instance to the next can be a small percentage of the total display area, such as 10%. However, the display output may not change between some user interface instances, for example if there is no input and the operating system does not change any of the displayed features. Alternatively, a large portion of the display output may change between some user interface instances. For example, an application launched in full screen mode can cause the entire display to change.

A rectangle, or other shape, defining an area of change can be expressed using a number of different conventions. For example, a rectangle can be defined by (X, Y, Height, Width), where X represents the distance between the lower left corner of a rectangle and the left side of the screen, Y represents the distance between the lower left corner of a rectangle and the bottom of the screen, Height represents the height of the rectangle, and Width represents the width of the rectangle. In another example, a rectangle, or other shape, can be defined by (X1, Y1, X2, Y2), where X1, Y1 represents the coordinates of the upper left corner of the rectangle and X2, Y2 represents the lower right corner of the rectangle. Any other system for expressing an object location also can be used.

In some implementations, information defining an area of change can be stored in the memory **122** along with the output information of the dirty rectangles **310**, **312**, or **314**. The information defining an area of change can be used to generate information for updating a display or other such output. For example, the protocol translator **108** and/or the remote system **124** can modify an output of a user interface instance in accordance with an identified dirty rectangle.

The embodiments described above are given as illustrative examples only. It will be readily appreciated by those skilled in the art that many deviations may be made from the specific embodiments; accordingly, the scope of the invention is to be determined by the claims below rather than being limited to the specifically described embodiments above. In addition, the flowcharts found in the figures are provided to instruct a programmer of ordinary skill to write and debug the disclosed embodiments without undue effort; the logic flow may include other steps and the system other components. The invention is not limited to a particular expression of source or object code. Accordingly, other implementations are within the scope of the claims.

What is claimed:

1. A *computer-implemented* method for updating a user instance, the method comprising:

creating at least one user *computer* context *configured to be executed* on a Mach-derived [system] *computing device* comprising at least one *computer* processor, wherein each of the at least one user *computer* context [incorporates] *is configured to incorporate* an agent server;

associating the agent server with an agent client, wherein the agent client and the agent server are *configured to be* executed on the Mach-derived [system] *computing device*, but in separate processes *and in separate Mach contexts*;

generating, by the agent server, data corresponding to an updated user instance,

wherein the data corresponding to the undated user instance comprises user *computer* data, wherein the user *computer* data comprises at least one of:

display data, audio data, biometric data, input data, image data, output data, video data, streaming data, touch screen data, keypad data, joystick data, touchpad data, keyboard data, mouse data, metadata, smart device data, input device data, data from another device appropriate for receiving input directly or indirectly from the user, computer monitor data, speaker data, projector data, data from another device appropriate for outputting data, or output device data;

determining, by the agent [sever] *server*, that any portion of the user *computer* data has been updated;

transferring the data [to] *corresponding to the updated user instance between the agent server and* the agent client via a *computer* system communication facility based on said determining,

wherein said transferring comprises:

transferring at least one of:

the user *computer* data, or

metadata corresponding to a shared memory [comprising], *wherein said shared memory comprises* the any portion of the updated user *computer* data,

between the agent server and the agent client, wherein at least one of the user *computer* data or the metadata is transmitted via the *computer* system communication facility,

wherein the *computer* system communication facility comprises at least one of:

a socket,

a file,

a port,

a shared computer memory, or

a pipe; and

transmitting the data *corresponding to the updated user instance* over a *communications* network to a remote *computer* system for update of the user instance based on the data *corresponding to the updated user instance*,

wherein said transmitting comprises:

transmitting at least of the user *computer* data, or the metadata, over the *communications* network to the remote *computer* system

for update of the user instance based on the updated user *computer* data or metadata.

2. The method of claim **1** wherein the *computer* system communication facility is selected from the group consisting of: a shared *computer* memory, a socket, a port, a first-in first-out buffer, and inter-process message passing.

3. The method of claim **2** wherein the inter-process message passing is a Mach inter-process communication.

4. The method of claim **1** wherein the agent client communicates with two or more agent servers.

5. The method of claim **1** wherein the transmitting the data over [a] *the communications* network is accomplished via a protocol translator.

6. The method of claim **5** wherein the agent client communicates with two or more protocol translators.

7. The method of claim **1** wherein the agent server communicates with two or more agent clients.

8. A computer network system comprising:

a Mach-derived *computing* network [system] *device* comprising one or more *computer* processor elements and one or more *computer* memory elements, wherein the Mach-derived *computing* network [system] *device* is in communication with two or more computing devices, and wherein the one or more *computer* processor elements are programmed or [adapted] *configured* to:

create a user *computer* context associated with each user instance, wherein each user *computer* context incorporates an agent server;

associate the agent server with an agent client, wherein the agent client and agent server are *configured to be* run on the Mach-derived *computing* network [system] *device*, but in separate processes *and in separate Mach contexts*;

generate, by the agent server, data corresponding to an updated user instance,

wherein the data corresponding to the [undated] *updated* user instance comprises user *computer* data, wherein the user *computer* data comprises at least one of:

display data, audio data, biometric data, input data, image data, output data, video data, streaming data, touch screen data, keypad data, joystick data, touchpad data, keyboard data, mouse data, metadata, smart device data, input device data, data from another device appropriate for receiving input directly or indirectly from the user, computer monitor data, speaker data, projector data, data from another device appropriate [for outputting] *to output* data, or output device data;

determine that any portion of the user *computer* data has been updated;

transfer the data [to] *corresponding to the updated user instance between the agent server and* the agent client via a *computer* system communication facility based on said [determining] *determination*,

wherein said transfer comprises:

transfer of at least one of:

the user *computer* data or

metadata corresponding to a shared memory [comprising], *wherein said shared memory comprises* the any portion of the updated user *computer* data,

between the agent server and the agent client, wherein the one or more processor elements are programmed or [adapted] *configured* to transmit at least one of the user *computer* data or the metadata via the *computer* system communication facility,

wherein the *computer* system communication facility comprises at least one of:

a socket,

a file,

a port,

a shared computer memory, or

a pipe; and

transmit the data *corresponding to the updated user instance* over a *communications* network to at least one of said two or more computing devices for update of the user instance based on the data *corresponding to the updated user instance*,

wherein said transmit comprises:

transmit of at least one of the user *computer* data, or the metadata, over the *communications* network to the at least one of said two or more computing devices for update of the user instance based on the updated user *computer* data or meta-data.

9. A non-transitory, tangible computer-readable storage media comprising stored instructions that, upon execution by at least one programmable *computer* processor, are operable to cause the at least one programmable *computer* processor to perform the method of claim **1**.

10. The method according to claim **1**, wherein said Mach-derived [system] *computing device* comprises at least one of: a laptop, a desktop, a palmtop, a client, a server, a mobile communications device, or an embedded computing device.

11. The method according to claim **1**, wherein the remote *computer* system comprises at least one of: a client, a thin client, a desktop, a server, a laptop, a palmtop, a mobile communications device, or an embedded computing device.

12. The method according to claim **1**, wherein the method comprises at least one of:

receiving data from at least one input facility; or

transferring data to at least one output facility.

13. The method according to claim **12**, wherein said at least one input facility comprises at least one of: a smartcard device, a biometric device, a direct input device, a storage media device, a keyboard, a *computer* memory, a storage device, a mouse, a touch pad device, a network device, a display touchscreen, a video input device, an audio input device, a keypad, or a joystick.

14. The method according to claim **13**, wherein said at least one output facility comprises at least one of: a smartcard device, a storage device, a direct output device, a storage media device, a *computer* memory, a display, a video output device, a monitor, a screen, a speaker, a projector, a network device, or a touchscreen display.

15. The method according to claim **12**, wherein [said] *the communications* network comprises at least one of: a public network, a private network, a local area network, a wide area network, an intranet, or an Internet public network.

16. The method according to claim **1** wherein the *computer* system communication facility comprises at least one of: a shared *computer* memory, a socket, a port, a pipe, a first-in first-out buffer, or an inter-process message passing facility.

17. The method according to claim **1** wherein said *computer* system communication facility comprises inter-process message passing.

18. The method according to claim **17**, wherein said inter-process message passing comprises Mach inter-process communication.

19. The method according to claim **2**, wherein said shared *computer* memory comprises at least one of: a Universal Pages Lists, POSIX, SYSV, pmap, or MachVM.

20. The method according to claim **5**, wherein said protocol translator comprises at least one of: a virtual network computer protocol; a remote desktop protocol; or an X**11** protocol.

21. The method according to claim **1**, wherein said Mach-derived [system] *computing device* comprises a Mach-derived terminal server.

22. The method according to claim **21**, wherein said Mach-derived terminal server comprises a Mac operating system (OS).

23. The method according to claim **1**, wherein said agent server is a KVM agent server.

24. The method according to claim **1**, wherein said agent client is a KVM agent client, further comprising configuring said KVM agent client to detect a change in [the] *a* shared *computer* memory.

25. A *computer-implemented* method for execution on a computing device comprising at least one *computer* processor and at least one *computer* memory, and wherein the computing device is [adapted] *configured* to be coupled to a *communications* network [for communication] *communicating* with a Mach-derived [system] *computing device* comprising at least one *computer* processor and at least one *computer* memory, the method comprising:

receiving, by the at least one *computer* processor of the computing device, an update to a user instance, wherein the update is received from the Mach-derived [system] *computing device*; and wherein the update was previously transmitted by the Mach-derived [system] *computing device* over the *communications* network, and wherein data *corresponding to the update to the user instance* was previously transferred over a *computer* system communication facility of the Mach-derived [system] *computing device*, wherein the data *corresponding to the update to the user instance* transferred comprises at least one of: user *computer* data, or metadata corresponding to a shared memory [comprising an T], *wherein said shared memory comprise any* portion of the updated user *computer* data, wherein the at least one of the user *computer* data or the metadata was transmitted via the *computer* system communication facility wherein the *computer* system communication facility comprises at least one of: a socket[.], a file, a port, *a shared computer memory,* or a pipe, wherein the data *corresponding to the update to the user instance* was created on the Mach-derived [system] *computing device*, wherein the Mach-derived [system] *computing device* comprises a user *computer* context comprising an agent server, the agent server associated with an agent client, wherein the agent client and the agent server execute on the Mach-derived [system] *computing device,* the agent client executing in a process separate from *and in a separate Mach context from* the agent server, wherein the data *corresponding to the update to the user instance* was generated by the agent server corresponding to the updated user instance, wherein the data corresponding to the updated user instance comprises the user *computer* data[.], wherein the user *computer* data comprises at least one of: display data, audio data, biometric data, input data, image data, output data, video data, streaming data, touch screen data, keypad data, joystick data, touch pad data[.], keyboard data, mouse data the metadata smart device data, input device data, data from another device appropriate for receiving input directly or indirectly from the user, computer monitor data, speaker data, projector data, data from another device appropriate for outputting data, or output device data;

transmitting, by the at least one *computer* processor of the computing device, input data received from at least one input device of the computing device, over the *communications* network to the Mach-derived [system] *computing device*; and

outputting, by the at least one *computer* processor of the computing[;] device, data included in the update of the user instance based on the data *corresponding to the update to the user instance* received from the Mach-derived [system] *computing device*.

26. The method according to claim **25**, wherein said *communications* network comprises at least one of:

a wireless *communications* network; or

a wired *communications* network.

27. A computing device system [for communicating] *configured to communicate*, over a *communciations* network, with a Mach-derived [system] *computing device* comprising at least one processor and at least one *computer* memory, *the computing device system* comprising:

a computing[,] device comprising:

at least one *computer* processor; and

at least one *computer* memory,

wherein said computing device is [adapted] *configured* to be coupled to the *communications* network for access to the Mach-derived [system] *computing device*,

wherein said at least one *computer* processor of said computing device is [adapted] *configured* to:

receive an update to a user [client] instance, wherein the update is *configured to be* received from the Mach-derived [system] *computing device* and wherein the update was previously transmitted by the Mach-derived [system] *computing device* over the *communciations* network, and wherein data *corresponding to the update to the user instance* was previously transferred over a *computer* system communication facility of the Mach-derived [system] *computing device*, wherein the data *corresponding to the update to the user instance* transferred comprises at least one of: user *computer* data, or metadata corresponding to a shared memory [comprising], *wherein said shared memory comprises* any portion of the updated user *computer* data wherein the at least one of the user *computer* data or the metadata was *configured to be* transmitted via the *computer* system communication facility, wherein the *computer* system communication facility comprises at least one of: a socket, a file, a port, *a shared computer memory,* or a pipe, wherein the data was *configured to be* created on the Mach-derived [system] *computing device*, wherein the Mach-derived [system] *computing device* comprises a user *computer* context comprising an agent server, the agent server associated with an agent client, wherein the agent client and the agent server *are configured to* execute on the Mach-derived [system] *computing device*, the agent client [executing] *configured to execute* in a process separate from *and in a separate Mach context from* the agent server, wherein the data *corresponding to the update to the user instance* was *configured to be* generated by the agent server corresponding to the updated user instance, wherein the data corresponding to the [updated] *update to a* user instance comprises the user *computer* data, wherein the user *computer* data comprises at least one of: display data, audio data, biometric data, input data, image data, output data, video data, streaming data, touch screen data, keypad data[.], joystick data, touch pad data, keyboard data, mouse data, the metadata, smart device data, input device data[.] data from another device appropriate for receiving input directly or indirectly from the user, computer monitor data, speaker data, projector data, data from another device appropriate [for outputting] *to output* data, or output device data;

transmit input data received from at least one input device of said computing device, over the *communications* network to the Mach-derived [system] *computing device*; and

output data included in the update of the user instance based on the data *corresponding to the update to the user instance* received from the Mach-derived [system] *computing device*.

28. The computing device system according to claim **27**, wherein the computing device system communicates via the *communications* network with the Mach-derived [system] *computing device* via at least one protocol comprising at least one of:

a virtual network computer protocol (VNC);

a remote desktop protocol (RDP); or

an X11 protocol.

29. The computing device system according to claim **27**, wherein said at least one *computer* processor of said computing device [adapted] *configured* to output comprises:

wherein said at least one *computer* processor of said computing device is [adapted] *configured* to:

render the updated user instance based on the output data included in the update of the user instance based on the data *corresponding to the update to the user instance* received from the Mach-derived [system] *computing device*.

30. The method according to claim **1**, wherein the method comprises at least one of:

implementing a plurality of independent instances of at least one application to satisfy demands of a plurality of remote *computer* systems;

providing a secure and synchronously updated graphical display of system output to a plurality of remote *computer* systems;

updating graphical display information securely and in a timely fashion in a terminal server environment;

transporting data from a user session in a terminal server environment;

allowing improved communication with at least one remote *computer* device;

updating at least one user session in a terminal server environment;

allowing improved transfer of large amounts of display-associated data; or

allowing faster and less-error-prone transfer of user *computer* data corresponding to an updated user interface via at least one *computer* memory shared between the agent server and the agent client in a terminal server environment.

31. The method according to claim **1**, wherein at least one of said Mach-derived [system] *computing device*, or said remote *computer* system comprises a computer system executing a Mach-derived operating system.

32. The method according to claim **31**, wherein said Mach-derived operating system comprises a MAC operating system (OS).

33. The computer network system according to claim **8**, wherein at least one of said Mach-derived network [system] *computing device*, or at least one of said two or more computing devices comprises a computer system [executing] *configured to execute* a Mach-derived operating system.

34. The computer network system according to claim **33**, wherein said Mach-derived operating system comprises a MAC operating system (OS).

35. The method according to claim **1**, wherein said remote *computer* system is local to said Mach-derived [system] *computing device*.

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