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(54) Title: IP KVM DEVICES

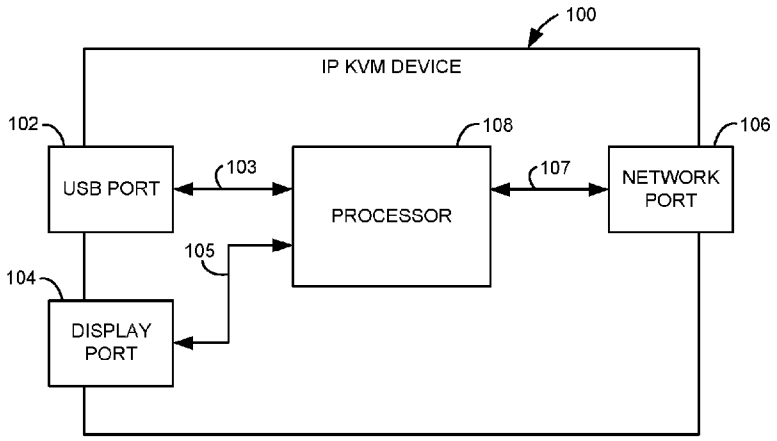


Fig. 1

(57) Abstract: One example of an internet protocol (IP) keyboard, video, mouse (KVM) device includes a universal serial bus, a display port, a network port, and a processor. The USB port is to be communicatively coupled to a host device. The display port is to be communicatively coupled to the host device. The network port is to be communicatively coupled to a network. The processor is communicatively coupled to the USB port, the display port, and the network port. The processor is to receive, via the display port, a multi-stream transport (MST) DisplayPort signal; demux the MST DisplayPort signal to provide a plurality of individual video streams; and output, via the network port, each individual video stream.

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

Published:

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IP KVM DEVICES

Background

[0001] Internet protocol (IP) keyboard, video, mouse (KVM) devices (e.g., dongles) may be used to enable a user to access a host device (e.g., server, workstation, computer, etc.) over a network. An IP KVM device may capture universal serial bus (USB) signals (e.g., keyboard signals, mouse signals, peripheral device signals, etc.) and video signals from the host device and encode them into packets for transmission over an ethernet link to a remote client device (e.g., computer). The remote client device may then decode the signals and output the video signals to a single display or multiple displays and use the USB signals for USB devices connected to the host device and/or the client device.

Brief Description of the Drawings

[0002] Fig. 1 is a block diagram illustrating one example of an internet protocol (IP) keyboard, video, mouse (KVM) device.

[0003] Figs. 2A-2E are flow diagrams illustrating one example of a method for operating the IP KVM device of Fig. 1.

[0004] Fig. 3 is a block diagram illustrating one example of a system including an IP KVM device.

[0005] Figs. 4A-4B are flow diagrams illustrating one example of a method for operating the IP KVM device in the system of Fig. 3.

[0006] Figs. 5A-5D are flow diagrams illustrating one example of a method for utilizing a plurality of display devices.

Detailed Description

[0007] In the following detailed description, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific examples in which the disclosure may be practiced. It is to be understood that other examples may be utilized and structural or logical changes may be made without departing from the scope of the present disclosure. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present disclosure is defined by the appended claims. It is to be understood that features of the various examples described herein may be combined, in part or whole, with each other, unless specifically noted otherwise.

[0008] Internet protocol (IP) keyboard, video, mouse (KVM) devices enable a user to connect to remote host devices (e.g., computer systems). The IP KVM device is connected to the remote host device and captures and emulates the keyboard, video, and mouse devices. Some users may use multiple displays to perform their work efficiently. If those users desire to work on a computer system remotely using an IP KVM device, the users are limited to the number of displays the IP KVM device supports. Many IP KVM devices support one or two displays. Some IP KVM devices support DisplayPort, but do not support multi-stream transport (MST) capabilities of DisplayPort. With MST, the data for multiple displays may be sent across a single DisplayPort cable. An IP KVM device that supports DisplayPort MST would be capable of transmitting a single display signal or multiple display signals from a single DisplayPort input.

[0009] MST was introduced in the DisplayPort 1.2 standard. MST allows multiple independent displays to be driven from a single DisplayPort signal by multiplexing several video streams into a single stream. With DisplayPort 1.2 MST, up to five monitors with 1680 x 1050 (WSXGA) resolution, up to four monitors with 1920 x 1080 (1080P) or 1920 x 1200 resolution, up to two monitors with 2560 x 1600 (WQXGA) resolution, or one monitor with 3840 x 2160 (UltraHD, 4K) or 4096 x 2160 (4K x 2K) resolution may be supported, where each monitor has a 60 frames per second refresh rate. For the

DisplayPort 1.3, 1.4, and 2.0 specifications, even more display streams and higher resolution streams are possible.

[0010] Accordingly, as disclosed herein, an IP KVM device communicatively coupled between a host device and a network may include a processor to receive a multi-stream transport (MST) DisplayPort signal from the host device, demux the MST DisplayPort Signal, and output each individual video stream over the network. The processor may emulate multiple displays and receive the MST DisplayPort signal based on the emulated multiple displays. The multiple displays may be emulated based on display properties of physical displays connected to the client/receiver. By using an IP KVM device that supports DisplayPort MST, the user is able to use more displays and thus be more efficient compared to typical IP KVM devices that do not support DisplayPort MST. In addition, by using the IP KVM devices disclosed herein that support DisplayPort MST, the host device environment may be decluttered by eliminating the use of a MST hub and associated cables.

[0011] Fig. 1 is a block diagram illustrating one example of an internet protocol IP KVM device 100. IP KVM device 100 includes a universal serial bus (USB) port 102, a display port 104 (e.g., DisplayPort port), a network port 106 (e.g., ethernet port), and a processor 108. The processor 108 is communicatively coupled to the USB port 102 through a communication path 103, the display port 104 through a communication path 105, and the network port 106 through a communication path 107.

[0012] As will be described in more detail below with reference to Fig. 3, the USB port 102 may be communicatively coupled to a host device (not shown). The display port 104 may be communicatively coupled to the host device. The network port 106 may be communicatively coupled to a network (not shown). The processor 108 may include a central processing unit (CPU), microprocessor, and/or other suitable logic circuitry for controlling the operation of IP KVM device 100. Processor 108 may include a memory (not shown), which may store machine readable instructions (e.g., software and/or firmware) to be executed by processor 108 to control the operation of IP KVM device 100. The memory may include a random access memory (RAM), a read-only

memory (ROM), or a combination thereof. In one example, the processor 108 implements the method 200 described below with reference to Figs. 2A-2E to control the operation of IP KVM device 100.

[0013] As illustrated in Fig. 2A at 202, processor 108 may receive, via the display port 104, a multi-stream transport (MST) DisplayPort signal. At 204, processor 108 may demux the MST DisplayPort signal to provide a plurality of individual video streams. At 206, processor 108 may output, via the network port 106, each individual video stream. As illustrated in Fig. 2B at 208, processor 108 may further emulate multiple displays. At 210, processor 108 may further receive, via the display port 104, the MST DisplayPort signal based on the emulated multiple displays.

[0014] As illustrated in Fig. 2C at 212, processor 108 may further receive display properties. At 214, processor 108 may further emulate each display of the multiple displays based on the display properties. For example, a user may have two 1080P monitors at 60 Hz and one 1920 x 1200 resolution monitor at 30 Hz. These three monitors would be difficult to support with a typical IP KVM device and would likely use multiple graphics interfaces to the IP KVM device, or even multiple IP KVM devices. With IP KVM device 100 described herein, a chain of these three monitors may be emulated to capture the exact resolutions and frame rates for the client/receiver to consume.

[0015] As illustrated in Fig. 2D at 216, processor 108 may further encode each individual video stream prior to outputting each individual video stream. In one example, each individual video stream may be transmitted to the client/receiver independently. In another example, as illustrated in Fig. 2E at 218, processor 108 may further multiplex the encoded individual video streams prior to outputting each individual video stream. In this case, the individual video streams are combined prior to transmission to the client/receiver. The outputted individual video streams (either independent or multiplexed) are then transmitted to a client/receiver, which decodes the individual video streams and outputs each decoded individual video stream to a corresponding physical display.

[0016] Fig. 3 is a block diagram illustrating one example of a system 300. System 300 includes an IP KVM device 100 as previously described and illustrated with reference to Fig. 1, a host device 302, a network 304, a client device 306, and a plurality of physical displays 318_1 to 318_N, where "N" is any suitable number of displays. The USB port 102 of IP KVM device 100 is communicatively coupled to the host device 302 through a communication path 310 to receive USB signals from the host device. The display port 104 of IP KVM device 100 is communicatively coupled to the host device 302 through a communication path 312 to receive display signals from the host device. The network port 106 of IP KVM device 100 is communicatively coupled to the network 304 through a communication path 314 to transmit USB signals and display signals over the network 304.

[0017] Client device 306 is communicatively coupled to network 304 through a communication path 316. Client device 306 includes a processor 308. Client device 306 is communicatively coupled to each of the plurality of displays 318_1 to 318_N through a communication path 320_1 to 320_N, respectively. The processor 308 may include a CPU, microprocessor, and/or other suitable logic circuitry for controlling the operation of client device 306. Processor 308 may include a memory (not shown), which may store machine readable instructions (e.g., software and/or firmware) to be executed by processor 308 to control the operation of client device 306. The memory may include a RAM, a ROM, or a combination thereof. Processor 308 may receive encoded individual video streams or encoded multiplexed video streams from IP KVM device 100. Processor 308 may decode the individual video streams or decode and demux the multiplexed video streams and output each individual video stream to a corresponding display 318_1 to 318_N. In one example, IP KVM device 100 implements the method 400 described below with reference to Figs. 4A-4B.

[0018] As illustrated in Fig. 4A at 402, IP KVM device 100 may receive a multi-stream transport (MST) DisplayPort signal from the host device 302 (e.g., via display port 104 and processor 108). At 404, IP KVM device 100 may demux the MST DisplayPort signal to provide a plurality of individual video streams (e.g., via processor 108). At 406, IP KVM device 100 may transmit each

individual video stream to the client device 306 over the network 304 (e.g., via processor 108 and network port 106). As illustrated in Fig. 4B at 408, IP KVM device 100 may emulate multiple displays (e.g., via processor 108) and receive the MST DisplayPort signal from the host device 302 based on the emulated multiple displays. In one example, the client device 306 receives each individual video stream and outputs each individual video stream to a corresponding physical display 318_1 to 318_N. The IP KVM device 100 may emulate the multiple displays based on display properties of the corresponding physical display 318_1 to 318_N for each individual video stream. To obtain the display properties, the IP KVM device 100 may request the client device 306 transmit the display properties for displays 318_1 to 318_N to the IP KVM device.

[0019] Figs. 5A-5D are flow diagrams illustrating one example of a method 500 for utilizing a plurality of display devices (e.g., displays 318_1 to 318_N). As illustrated in Fig. 5A at 502, method 500 includes emulating, via an internet protocol (IP) keyboard, video, mouse (KVM) device (e.g., IP KVM device 100), multiple displays. At 504, method 500 includes receiving, via the IP KVM device, a multi-stream transport (MST) DisplayPort signal from a host device (e.g., host device 302) based on the emulated multiple displays. At 506, method 500 includes demuxing, via the IP KVM device, the MST DisplayPort signal into a plurality of individual video streams. At 508, method 500 includes transmitting each individual video stream to a client device (e.g., client device 306). In one example, emulating the multiple displays includes emulating the multiple displays based on display properties of physical displays (e.g., displays 318_1 to 318_N) communicatively coupled to the client device.

[0020] As illustrated in Fig. 5B at 510, method 500 may further include encoding each individual video stream prior to transmitting each individual video stream to the client device. As illustrated in Fig. 5C at 512, method 500 may further include packetizing each encoded individual video stream prior to transmitting each individual video stream to the client device. As illustrated in Fig. 5D at 514, method 500 may further include receiving, via the client device, each individual video stream. At 516, method 500 may further include outputting, via

the client device, each individual video stream to a physical display (e.g., a display 318_1 to 318_N).

[0021] Although specific examples have been illustrated and described herein, a variety of alternate and/or equivalent implementations may be substituted for the specific examples shown and described without departing from the scope of the present disclosure. This application is intended to cover any adaptations or variations of the specific examples discussed herein. Therefore, it is intended that this disclosure be limited only by the claims and the equivalents thereof.

CLAIMS

1. An internet protocol (IP) keyboard, video, mouse (KVM) device comprising:

a universal serial bus (USB) port to be communicatively coupled to a host device;

a display port to be communicatively coupled to the host device;

a network port to be communicatively coupled to a network; and

a processor communicatively coupled to the USB port, the display port, and the network port, the processor to:

receive, via the display port, a multi-stream transport (MST) DisplayPort signal;

demux the MST DisplayPort signal to provide a plurality of individual video streams; and

output, via the network port, each individual video stream.

2. The IP KVM device of claim 1, wherein the processor is to further:

emulate multiple displays; and

receive, via the display port, the MST DisplayPort signal based on the emulated multiple displays.

3. The IP KVM device of claim 2, wherein the processor is to further:

receive display properties; and

emulate each display of the multiple displays based on the display properties.

4. The IP KVM device of claim 1, wherein the processor is to further:

encode each individual video stream prior to outputting each individual video stream.

5. The IP KVM device of claim 4, wherein the processor is to further:

multiplex the encoded individual video streams prior to outputting each individual video stream.

6. A system comprising:

an internet protocol (IP) keyboard, video, mouse (KVM) device;

a host device communicatively coupled to the IP KVM device;

a network communicatively coupled to the IP KVM device; and

a client device communicatively coupled to the network,

wherein the IP KVM device is to:

receive a multi-stream transport (MST) DisplayPort signal from the host device;

demux the MST DisplayPort signal to provide a plurality of individual video streams; and

transmit each individual video stream to the client device over the network.

7. The system of claim 6, wherein the IP KVM device comprises a processor to receive the MST DisplayPort signal, demux the MST DisplayPort signal, and transmit each individual video stream.

8. The system of claim 6, wherein the IP KVM device is to emulate multiple displays and receive the MST DisplayPort signal from the host device based on the emulated multiple displays.

9. The system of claim 8, wherein the client device receives each individual video stream and outputs each individual video stream to a corresponding physical display.

10. The system of claim 9, wherein the IP KVM device is to emulate the multiple displays based on display properties of the corresponding physical display for each individual video stream.

11. A method for utilizing a plurality of display devices, the method comprising:

emulating, via an internet protocol (IP) keyboard, video, mouse (KVM) device, multiple displays;

receiving, via the IP KVM device, a multi-stream transport (MST) DisplayPort signal from a host device based on the emulated multiple displays;

demuxing, via the IP KVM device, the MST DisplayPort signal into a plurality of individual video streams; and

transmitting each individual video stream to a client device.

12. The method of claim 11, wherein emulating the multiple displays comprises emulating the multiple displays based on display properties of physical displays communicatively coupled to the client device.

13. The method of claim 11, further comprising:

encoding each individual video stream prior to transmitting each individual video stream to the client device.

14. The method of claim 13, further comprising:

packetizing each encoded individual video stream prior to transmitting each individual video stream to the client device.

15. The method of claim 11, further comprising:

receiving, via the client device, each individual video stream; and

outputting, via the client device, each individual video stream to a physical display.

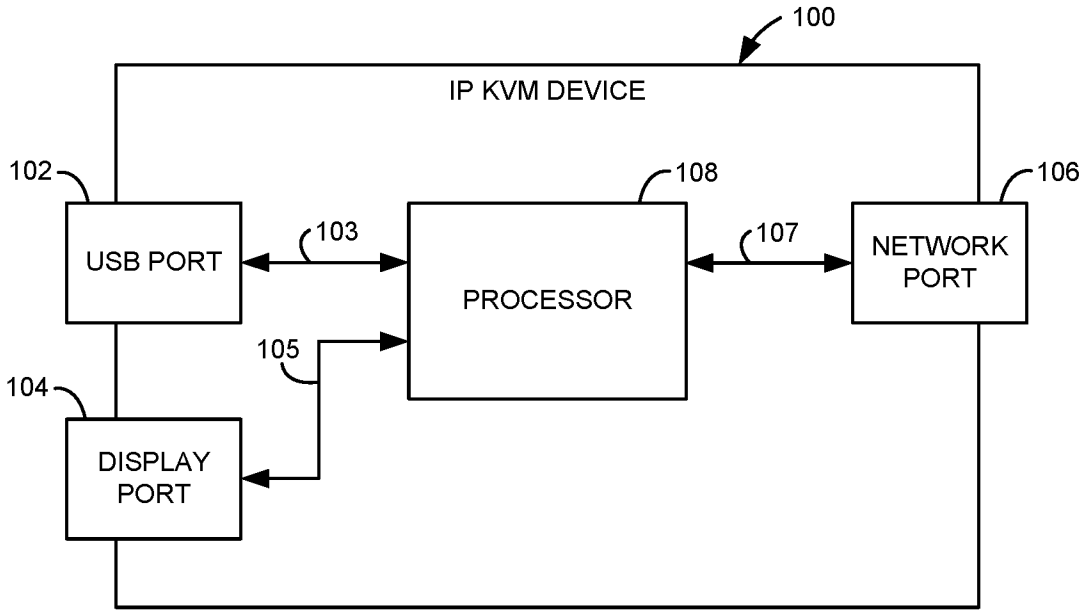

100
IP KVM DEVICE
102
USB PORT
103
108
PROCESSOR
107
106
NETWORK PORT
105
104
DISPLAY PORT

Fig. 1

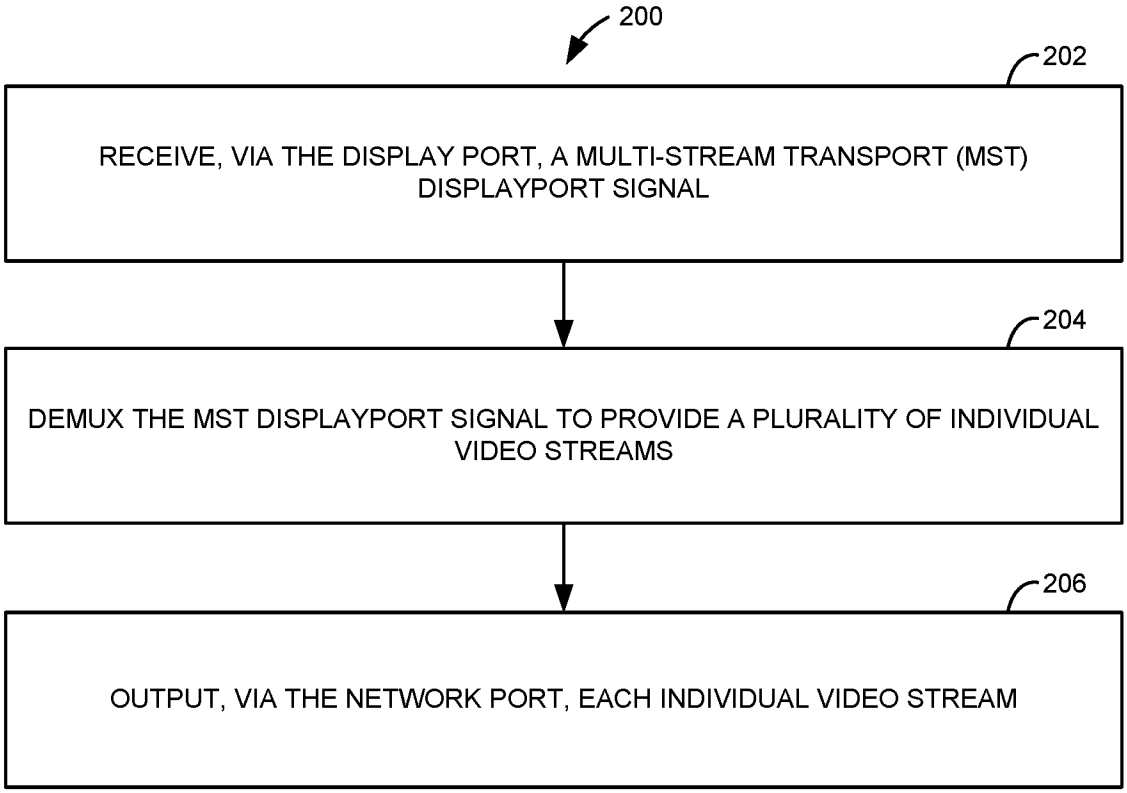

200
202
RECEIVE, VIA THE DISPLAY PORT, A MULTI-STREAM TRANSPORT (MST) DISPLAYPORT SIGNAL
204
DEMUX THE MST DISPLAYPORT SIGNAL TO PROVIDE A PLURALITY OF INDIVIDUAL VIDEO STREAMS
206
OUTPUT, VIA THE NETWORK PORT, EACH INDIVIDUAL VIDEO STREAM

Fig. 2A

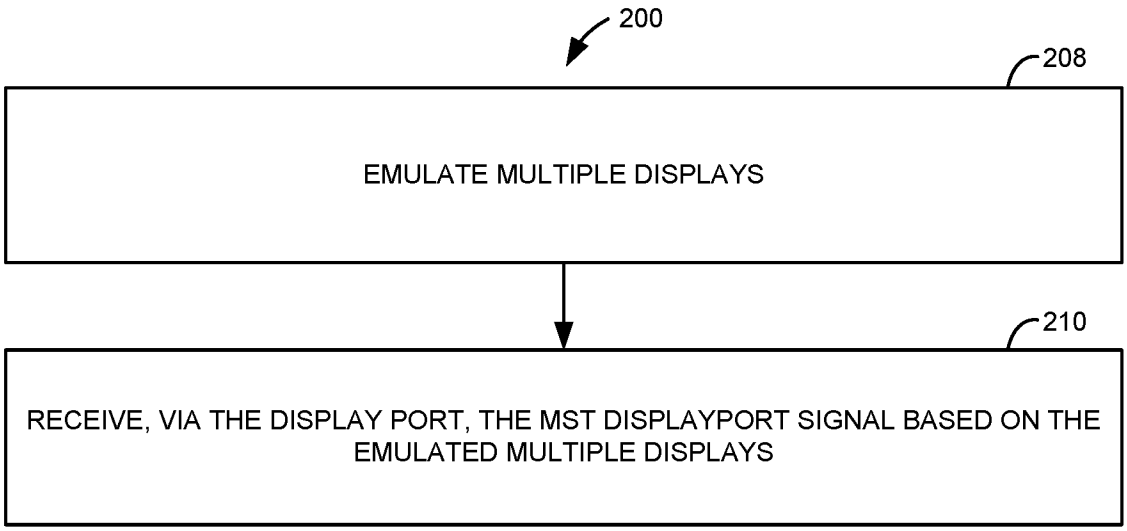

200
208
EMULATE MULTIPLE DISPLAYS
210
RECEIVE, VIA THE DISPLAY PORT, THE MST DISPLAYPORT SIGNAL BASED ON THE EMULATED MULTIPLE DISPLAYS

Fig. 2B

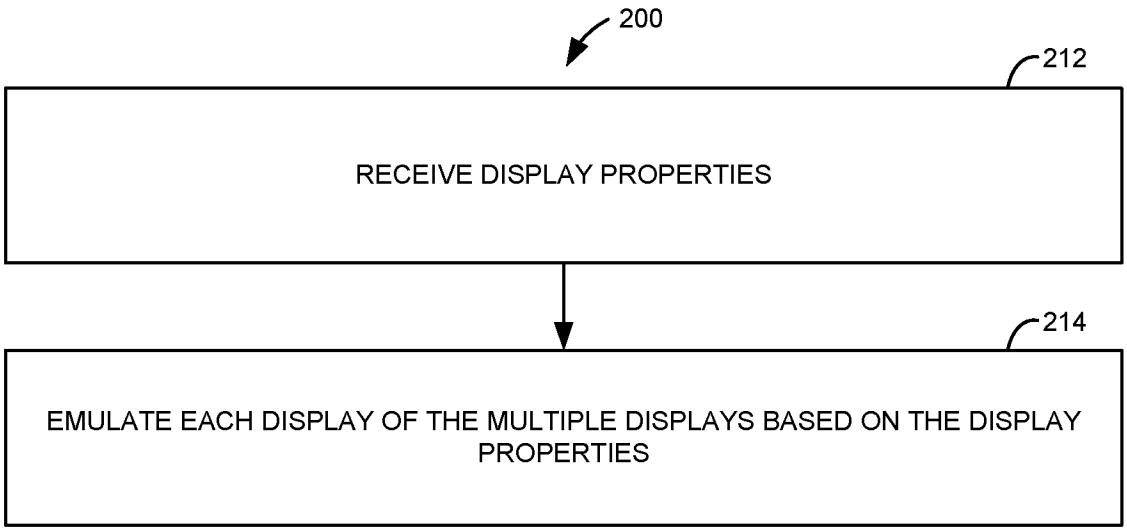

200
212
RECEIVE DISPLAY PROPERTIES
214
EMULATE EACH DISPLAY OF THE MULTIPLE DISPLAYS BASED ON THE DISPLAY PROPERTIES

Fig. 2C


200
216
ENCODE EACH INDIVIDUAL VIDEO STREAM PRIOR TO OUTPUTTING EACH INDIVIDUAL VIDEO STREAM

Fig. 2D

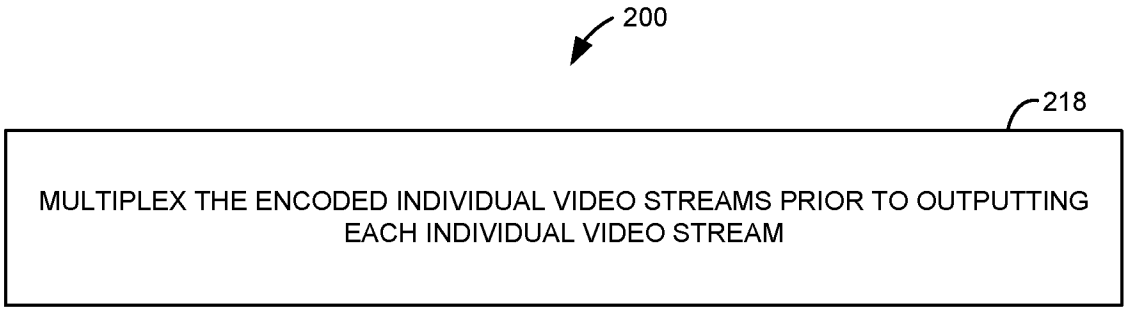

200
218
MULTIPLEX THE ENCODED INDIVIDUAL VIDEO STREAMS PRIOR TO OUTPUTTING EACH INDIVIDUAL VIDEO STREAM

Fig. 2E

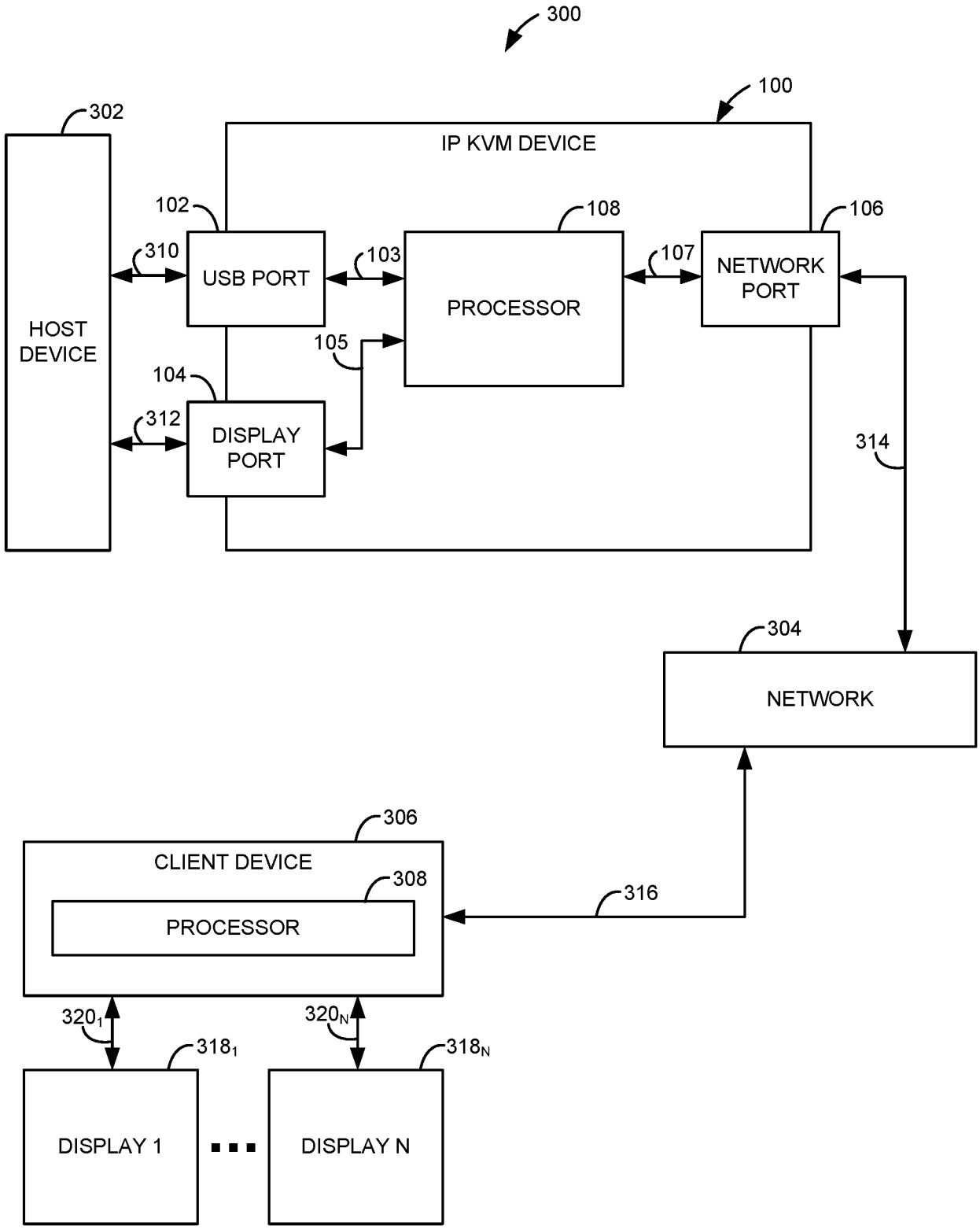

300
100
302
IP KVM DEVICE
102
108
106
310
103
107
USB PORT
PROCESSOR
NETWORK PORT
HOST DEVICE
105
104
312
DISPLAY PORT
314
304
NETWORK
306
CLIENT DEVICE
308
316
PROCESSOR
320$_1$
320$_N$
318$_1$
318$_N$
DISPLAY 1
DISPLAY N

Fig. 3

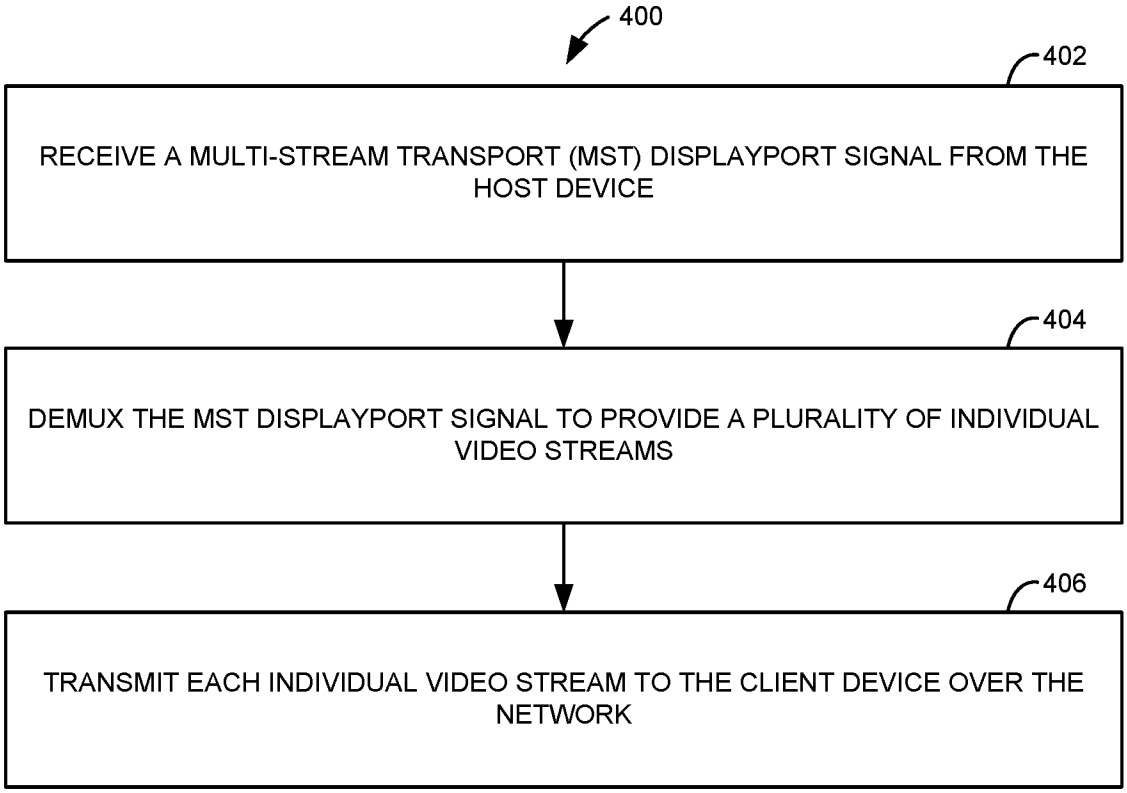

400
402
RECEIVE A MULTI-STREAM TRANSPORT (MST) DISPLAYPORT SIGNAL FROM THE HOST DEVICE
404
DEMUX THE MST DISPLAYPORT SIGNAL TO PROVIDE A PLURALITY OF INDIVIDUAL VIDEO STREAMS
406
TRANSMIT EACH INDIVIDUAL VIDEO STREAM TO THE CLIENT DEVICE OVER THE NETWORK

Fig. 4A

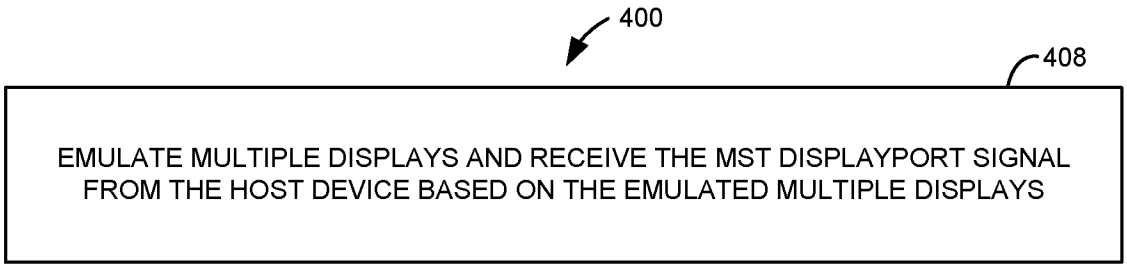

400
408
EMULATE MULTIPLE DISPLAYS AND RECEIVE THE MST DISPLAYPORT SIGNAL FROM THE HOST DEVICE BASED ON THE EMULATED MULTIPLE DISPLAYS

Fig. 4B

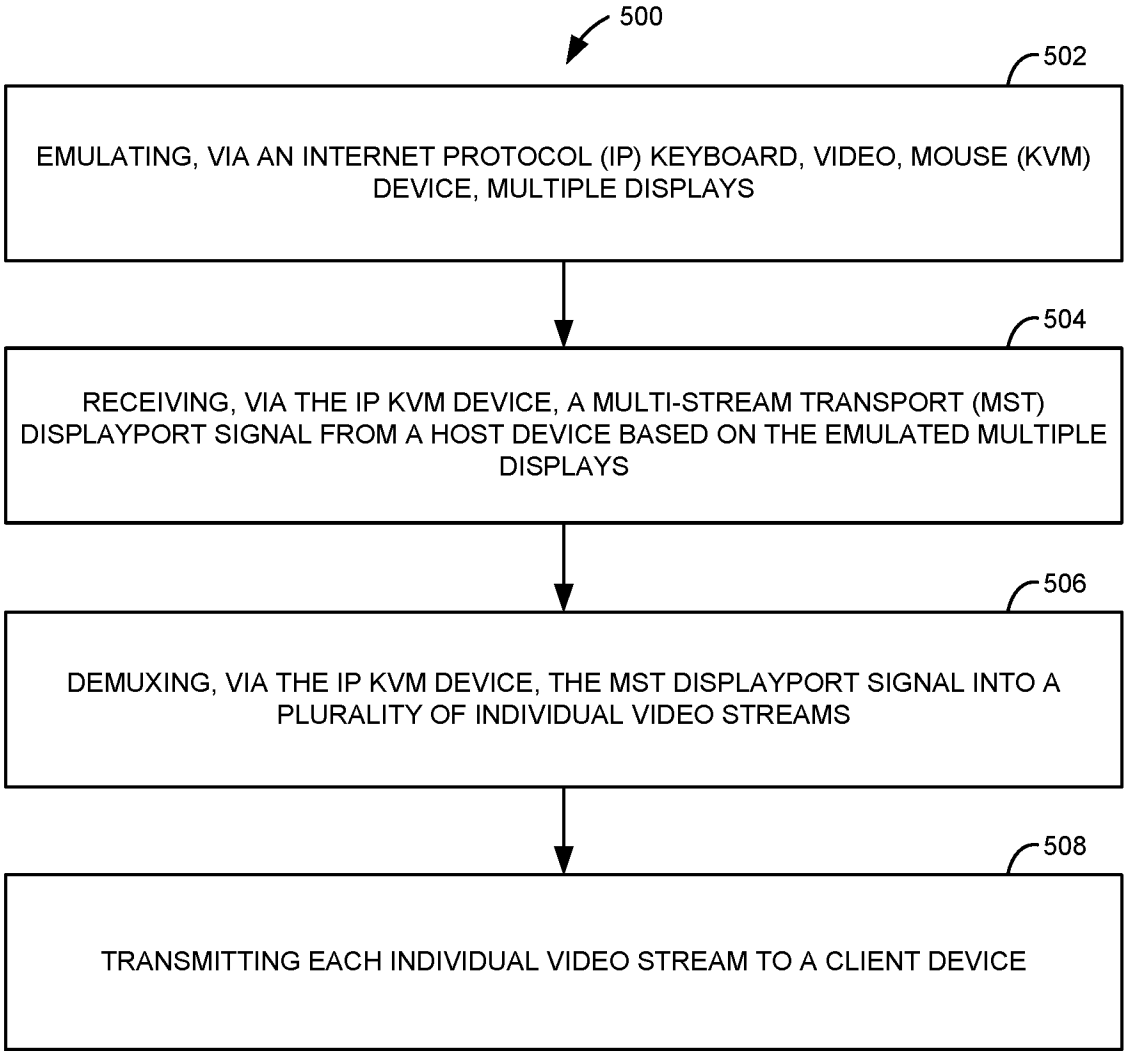

500
502
EMULATING, VIA AN INTERNET PROTOCOL (IP) KEYBOARD, VIDEO, MOUSE (KVM) DEVICE, MULTIPLE DISPLAYS
504
RECEIVING, VIA THE IP KVM DEVICE, A MULTI-STREAM TRANSPORT (MST) DISPLAYPORT SIGNAL FROM A HOST DEVICE BASED ON THE EMULATED MULTIPLE DISPLAYS
506
DEMUXING, VIA THE IP KVM DEVICE, THE MST DISPLAYPORT SIGNAL INTO A PLURALITY OF INDIVIDUAL VIDEO STREAMS
508
TRANSMITTING EACH INDIVIDUAL VIDEO STREAM TO A CLIENT DEVICE

Fig. 5A



Fig. 5B

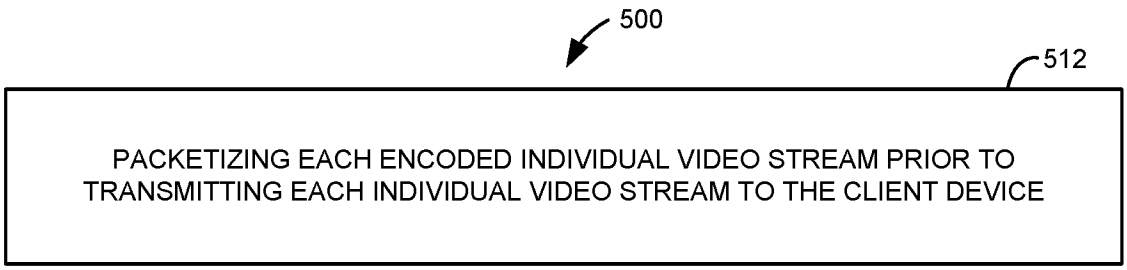


Fig. 5C

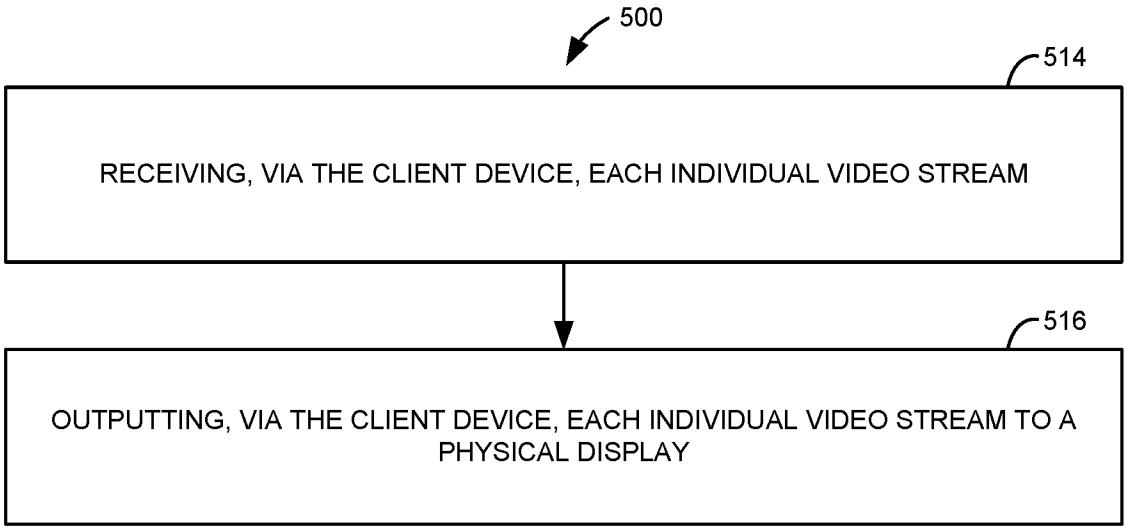


Fig. 5D

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 2020/056537

A. CLASSIFICATION OF SUBJECT MATTER

G06F 15/16 *(2006.01)*
H04L 12/00 *(2006.01)*

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)

G06F 15/00, 15/16, 16/00, 17/00, 13/00, 11/00, 21/00, H04L 12/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PatSearch (RUPTO internal), USPTO, PAJ, Esp@cenet, DWPI, EAPATIS, PATENTSCOPE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0265488 A1 (BIRGER ROI) 22.10.2009, [0002]-[0004], [0017], [0021]-[0023], [0026], [0044], [0047], [0049], [0052], [0055], [0056], [0058], [0061], [0072], [0075], [0082], [0088]	1-15
Y	US 2012/0079162 A1 (NXP B.V.) 29.03.2012, [0029], [0039], [0057], [0073]	1-15
Y	US 2013/0050084 A1 (HIGH SEC LABS LTD) 28.02.2013, [0075], [0191], [0233], [0241], [0301], [0376], [0439], [0520], [0529], [0530], [0579], [0582], [0588]	3, 5, 9-10, 12-15
A	US 2006/0215687 A1 (ATEN INT CO LTD) 28.09.2006	1-15

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

☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
24 June 2021 (24.06.2021)	01 July 2021 (01.07.2021)

Name and mailing address of the ISA/RU:	Authorized officer
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