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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
25 June 2015 (25.06.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/094166 A1

(51) International Patent Classification:
H04N 7/15 (2006.01)

(21) International Application Number:
PCT/US2013/075448

(22) International Filing Date:
16 December 2013 (16.12.2013)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant *(for all designated States except US)*: **INTEL CORPORATION** [US/US]; 2200 Mission College Blvd, Santa Clara, California 95052 (US).

(72) Inventors; and
(71) Applicants *(for US only)*: **RAJENDRAN, Venkatesh** [IN/US]; 17018 NW Orion Greens C, Beaverton, Oregon 97006 (US). **SHAO, Lei** [CN/US]; 3745 Miramar Way, Apt. 3, Santa Clara, California 95051 (US). **SAHIB, Anees A.** [IN/IN]; No 31, 5th Main, Near Christ School, Bangalore 560032 (IN). **CHAUHAN, Madhav Singh** [IN/IN]; Fernhill Garden Apartment Flat No#E4-GK, HSR Layout Sector 6, Opp Aranya Restaurant, Bangalore 560102 (IN). **CHEN, Inching** [US/US]; 12869 NW Lorraine Drive, Portland, Oregon 97220 (US).

(74) Agents: **PFLEGER, Edmund P.** et al.; Grossman, Tucker, Perreault & Pfleger, PLLC, 55 South Commercial Street, Manchester, New Hampshire 03101 (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, BN, 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, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, KM, ML, MR, NE, SN, TD, TG).

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

(54) **Title**: VIDEO CONFERENCING WITH IMPROVED BANDWIDTH EFFICIENCY OVER WIRELESS DISPLAY (WIDI) CHANNEL

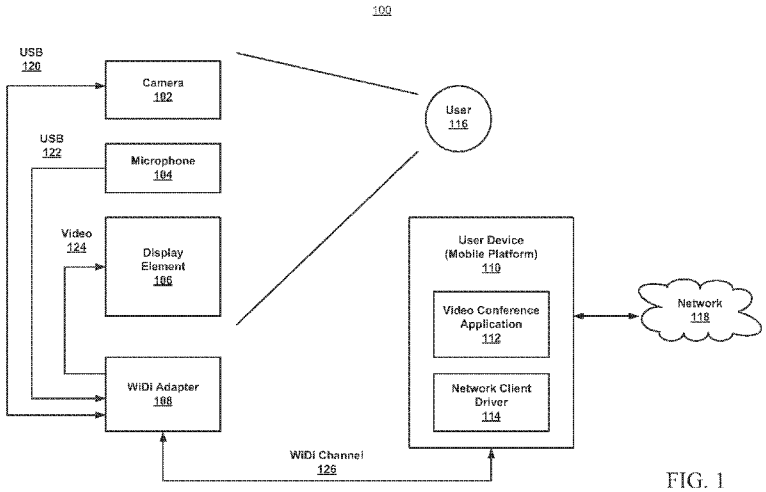

FIG. 1

(57) **Abstract**: Generally, this disclosure provides devices, systems and methods for video conferencing with improved bandwidth efficiency using a WiDi system that provides display rendering and peripheral sharing capability, to a user platform, over a wireless local area network. A mobile platform may include a processor, a memory coupled to the processor and a video conference application module coupled to the processor. The platform may also include a network client driver module to provide communication over the WiDi channel between the video conference application and a WiDi adapter. The platform may further include a video descriptor configuration module to provide filtered video descriptors to the video conference application. The filtered video descriptors are based on a list of video descriptors provided by a USB camera coupled to the WiDi adapter and transmitted over the WiDi channel, wherein the filtering removes video descriptors associated with uncompressed video formats.

WO 2015/094166 A1

VIDEO CONFERENCING WITH IMPROVED BANDWIDTH EFFICIENCY OVER WIRELESS DISPLAY (WIDI) CHANNEL

FIELD

The present disclosure relates to video conferencing, and more particularly, to improved bandwidth efficiency for video conferencing using a Wireless Display (WiDi) system providing display rendering and peripheral sharing capability over a wireless local area network.

BACKGROUND

Video conferencing systems allow users to communicate with each other over network connections using cameras, microphones and display elements that are coupled to the user's computing platform/device. The user platform may, for example, be a mobile platform such as a smartphone, tablet, laptop or Ultrabook which is configured to host a video conferencing application that transmits and receives video (and audio) between the local user and remote users over the network.

To provide additional convenience and/or flexibility in the video conferencing system, a WiDi adapter may be used to wirelessly link the camera, microphone and display element to the user platform. Typically, however, the wireless link presents a performance bottleneck due to limitations in the available wireless bandwidth between the WiDi adapter and the platform. The bandwidth limitation problem is particularly significant because video conferencing applications generally require a multiplexed video stream from the camera that includes both compressed and uncompressed (or lesser compressed) video formats. The uncompressed video may be required for local preview while the compressed video is used for network transmission. This combination of compressed and uncompressed video can consume more than 100 Megabits per second (Mbps) of bandwidth, even for video formats of lower resolution.

BRIEF DESCRIPTION OF THE DRAWINGS

Features and advantages of embodiments of the claimed subject matter will become apparent as the following Detailed Description proceeds, and upon reference to the Drawings, wherein like numerals depict like parts, and in which:

Figure 1 illustrates a top level system diagram of one example embodiment consistent with the present disclosure;

Figure 2 illustrates a block diagram of one example embodiment consistent with the present disclosure;

Figure 3 illustrates a message flow diagram of one example embodiment consistent with the present disclosure;

Figure 4 illustrates a block diagram of another example embodiment consistent with the present disclosure;

Figure 5 illustrates a block diagram of another example embodiment consistent with the present disclosure;

Figure 6 illustrates a flowchart of operations of one example embodiment consistent with the present disclosure; and

Figure 7 illustrates a platform of one example embodiment consistent with the present disclosure.

Although the following Detailed Description will proceed with reference being made to illustrative embodiments, many alternatives, modifications, and variations thereof will be apparent to those skilled in the art.

DETAILED DESCRIPTION

Generally, this disclosure provides devices, systems and methods for video conferencing with improved bandwidth efficiency using a Wireless Display (WiDi) system that provides display rendering and peripheral sharing capability, to a user platform, over a wireless local area network. The user platform may have a network client driver to communicate with the WiDi system. In some embodiments, the network client driver may implement a Universal Serial Bus (USB) over Internet Protocol (IP), also referred to as UoIP, communications protocol. In some embodiments, the network client driver may implement a USB over Wireless Fidelity (WiFi) communications protocol.

A WiDi adapter provides a communications channel between the user platform or device, which may be a mobile platform, and a camera, microphone and

display element. The user device is configured to host a video conferencing application and further includes a network client driver configured to improve bandwidth efficiency over the WiDi channel. The network (or UoIP) client driver may include a video descriptor configuration module configured to filter out uncompressed (e.g., raw) video format descriptors presented by the camera such that the video conferencing application module limits requests to compressed video formats. In some embodiments, the network client driver may further include a multiplexed format generation module configured to receive a compressed format video stream from the WiDi adapter, generate an uncompressed (or less compressed) format video stream based on that received stream, and provide a multiplexed version of the compressed and uncompressed streams to the video conferencing application module. In some embodiments, the network client driver may further include a frame rate adaptation module configured to dynamically adapt video frame rate based on detected motion levels.

Figure 1 illustrates a top level system diagram 100 of one example embodiment consistent with the present disclosure. A system is configured to enable a user 116 to engage in a video conference with one or more remote users over network 118. The system is shown to include a video camera 102, a microphone 104, a display element 106, a WiDi adapter 108 and a user device or mobile platform 110, such as, for example, a smartphone, tablet, laptop or Ultrabook. The user device 110 may further include a video conference application module 112 and a network client driver module 114 configured to provide improved bandwidth efficiency, the operations of which will be explained in greater detail below.

The camera 102 and microphone 104 may be configured to communicate with the WiDi apater 108 over USB connections 120 and 122 respectively to provide video and audio of user 116 for transmission over network 118 to remote conference users. The display element 106 may be configured as a relatively large screen (for example as compared to the display element of user device 110) such as a high definition video display element (or television) and may be coupled to the WiDi adapter through a High Definition Multimedia Interface (HDMI) connection. Display element 106 may provide video and audio to user 116 that originates from one or more of the remote conference users over network 118.

WiDi Adapter 108 may be configured to provide a wireless channel 126 between devices 102, 104, 106 and user device 110. The WiDi channel 126 may

include a forward channel to carry video from user device 110 to display element 106. The WiDi channel 126 may also include a back channel to carry video from camera 102 (and audio from microphone 104) to user device 110. In some embodiments, The WiDi adapter may be configured to encode data on the back channel in a UoIP format or a USB over WiFi format to be provided to the network client driver 114. The WiDi channel may therefore be enabled for bidirectional traffic allowing for real-time wireless interactions suitable for video conferencing. In particular, a USB camera/microphone 102,104 may be connected directly to the television side of the WiDi adapter 108 and operate as a virtual device of the user platform 110.

In some embodiments, the network 118 may be a local area network (LAN), wide area network (WAN), the internet, and/or a wireless communications network of any type including current or future versions of Third Generation (3G) mobile phones, Fourth Generation (4G) mobile phones, Bluetooth, Worldwide Interoperability for Microwave Access (WiMax), or Wireless Fidelity (Wi-Fi) networks.

Figure 2 illustrates a block diagram 200 of one example embodiment consistent with the present disclosure. The WiDi Adapter 108 is shown to include a video descriptor filter 204. In some embodiments, the video descriptor filter 204 may be implemented in an optional UoIP dock 202. The network client driver is shown to include a video descriptor configuration module 206, a multiplexed format generation module 208 and a frame rate adaptation module 210. The operations of the multiplexed format generation module 208 and frame rate adaptation module 210 will be described in greater detail below, particularly in connection with the descriptions of figures 4 and 5.

The camera 102 may be configured to support a relatively large number of video payload descriptors associated with different available video formats. These formats may include, for example, uncompressed or raw video, Motion-JPEG (MJPEG) encoded video and H.264 encoded video, each of which may be provided at multiple levels of resolution. Video conferencing applications typically request uncompressed data from cameras for resolutions of 480 pixels (480p) and below. Raw (uncompressed) video at resolution of 640x480 pixels at 24 frames per second (fps) can consume approximately 150 Mbps of bandwidth which generally exceeds the bandwidth capabilities of a WiDi channel between the camera 102 and the platform 110. The video descriptor filter 204 and/or the video descriptor configuration module 206 may be configured to filter out any video payload

descriptors, provided by the camera, that are associated with uncompressed video formats. This may have the effect of requiring the video conference application 112 to request compressed video data formats, such as, for example MJPEG compression which may consume approximately 15 Mbps of bandwidth, providing a factor of 10 improvement.

In some embodiments, the video descriptor filtering may be performed in the UoIP dock 202 of the WiDi adapter, for example by video descriptor filter module 204. In other embodiments, the video descriptor filtering may be performed in the network client driver 114 on the platform 110, for example by video descriptor configuration module 206.

Figure 3 illustrates a message flow diagram 300, associated with video descriptor filtering, of one example embodiment consistent with the present disclosure. A connection request 302 to share the camera is issued by network client driver 114 to WiDi adapter 108. In turn, WiDi adapter 108 queries the camera 102 for a descriptor configuration 304. The video descriptor filter module 204 creates a local (to the WiDi adapter) descriptor configuration 306(a) by removing uncompressed video data formats from the descriptor configuration 306(b) provided by the camera 102. The WiDi adapter 108 then returns an indication that the camera has been successfully shared 308. At a subsequent time, the network client driver 114 requests a camera descriptor configuration 310 from the WiDi adapter 108, for example on behalf of the video conference application. The WiDi adapter 108 then provides the locally created descriptor configuration with uncompressed video formats removed 312.

Figure 4 illustrates a block diagram 400 of another example embodiment consistent with the present disclosure. Multiplexed format generation module 208 is shown to include an H.264 compressed video decoder module 402 and an MJPEG video compression encoder module 404. Video conference application is shown to include an MJPEG video compression decoder module 406, image resize modules 408, 410 and network provided format video compression decoder module 412. While the embodiment descriptions herein refer to H.264 and MJPEG formats for illustrative purposes, it will be appreciated that the any type of compression/decompression formats or schemes, whether existing or future developed, may be employed in a similar manner consistent with this disclosure. In particular, H.264 compression may be replaced with a first type of compression and

MJPEG compression may be replaced with a second type of compression, where the first type provides a greater level of compression than the second type.

Video conference applications typically request a multiplexed video payload that includes, for example, both H.264 encoded video, which provides a greater level of compression for network transmission, and MJPEG encoded video, which provides a lower level of compression for local playback. In this embodiment, however, the network client driver 114 requests that the camera 102 provides only H.264 (or first type) encoded video through the WiDi channel, with resulting bandwidth reduction. Module 402 decodes the H.264 video and provides the decoded video to module 404, which then encodes the video to MJPEG (or second type) format. The MJPEG format video is then synchronized and multiplexed with the H.264 format video to generate a multiplexed payload format that is provided to and satisfies the requirements of the video conference application 112.

The video conference application 112 may then decoded the MJPEG video component of the multiplexed stream (module 406) and perform any desired image resizing (module 408) before transmitting the video back over the WiDi channel to the display element 106 for local preview of the camera image. Remote video received from the network 118 is also decoded (module 412) and resized (module 410) for transmission over the WiDi channel to the display element 106 for display of the remote users (or other audio/visual material) associated with the video conference.

Figure 5 illustrates a block diagram 500 of another example embodiment consistent with the present disclosure. Additional bandwidth efficiencies may be realized through frame rate adaptation/reduction based on motion level detection. Network client driver 114 is shown to include multiplexed format generation module 208, as described above, and frame rate adaptation module 210 which may further include motion level detection module 502. Although video conferencing applications may support relatively high frame rates, for example 30 fps, a person speaking in front of a static background may generate relatively little motion that can be captured with a lower frame, for example 15 fps, with satisfactory image quality or smoothness.

Motion level detection module 502 may be configured to analyze the H.264 decoded video provided by module 402 and generate statistics associated with motion levels in the decoded video. The frame rate adaptation module may request a reduction in the frame rate provided by camera 102 based on these statistics. For one

example, if no motion is detected, a frame may not need to be transmitted over the WiDi channel. For another example, if the motion statistics indicate that motion is evenly distributed over consecutive frames, the frame rate may be reduced, increasing the bandwidth efficiency over the WiDi channel. It will be appreciated that frame rate reduction may also advantageously reduce power consumption and increase battery life in the platform 110.

In some embodiments, camera 102 may be configured to implement frame rate adaptation and to host motion level detection module 502.

Figure 6 illustrates a flowchart of operations 600 of one example embodiment consistent with the present disclosure. At operation 610, communication is provided over a WiDi channel between a video conference application and a WiDi adapter. At operation 620, video descriptors are received from a USB camera coupled to the WiDi adapter, the video descriptors transmitted over the WiDi channel. At operation 630, the video descriptors are filtered to remove descriptors associated with uncompressed video formats. At operation 640, the filtered video descriptors are provided to the video conference application.

Figure 7 illustrates a platform 700 of one example embodiment consistent with the present disclosure. Platform 700, which may, for example, be user device/mobile platform 110, is shown to include processor 710, memory 720, operating system 730, I/O system 740, platform display element 750 and network interface 760. In some embodiments, platform display element 750 may be a touchscreen display. Platform 700 may also include network client driver 114 and video conference application 112 as described previously. Any or all components of platform 700 may be interconnected by a bus 770 or other suitable communication/coupling mechanism. The platform 700 may be a mobile communication and/or computing device, such as, for example, a smartphone, a tablet, a laptop computing device, an Ultrabook or any other suitable device.

Examples of platform 700 may include, but are not limited to, a mobile communication device such as a cellular handset or a smartphone based on the Android® OS, iOS®, Windows® OS, Blackberry® OS, Palm® OS, Symbian® OS, etc., a mobile computing device such as a tablet computer like an iPad®, Surface®, Galaxy Tab®, Kindle Fire®, etc., an Ultrabook® including a low-power chipset manufactured by Intel Corporation, a netbook, a notebook, a laptop or a palmtop.

In platform 700, processor 710 may comprise one or more processors situated in separate components, or alternatively, one or more processing cores embodied in a single component (e.g., in a System-on-a-Chip (SoC) configuration) and any processor-related support circuitry (e.g., bridging interfaces, etc.). Example processors may include, but are not limited to, various x86-based microprocessors available from the Intel Corporation including those in the Pentium, Xeon, Itanium, Celeron, Atom, Core i-series product families, Advanced RISC (e.g., Reduced Instruction Set Computing) Machine or "ARM" processors, etc. Examples of support circuitry may include chipsets (e.g., Northbridge, Southbridge, etc. available from the Intel Corporation) configured to provide an interface through which processor 710 may interact with other system components that may be operating at different speeds, on different buses, etc. in platform 700. Some or all of the functionality commonly associated with the support circuitry may also be included in the same physical package as the processor (e.g., such as in the Sandy Bridge family of processors available from the Intel Corporation).

Embodiments of the methods described herein may be implemented in a system that includes one or more storage mediums having stored thereon, individually or in combination, instructions that when executed by one or more processors perform the methods. Here, the processor may include, for example, a system CPU (e.g., core processor) and/or programmable circuitry. Thus, it is intended that operations according to the methods described herein may be distributed across a plurality of physical devices, such as processing structures at several different physical locations. Also, it is intended that the method operations may be performed individually or in a subcombination, as would be understood by one skilled in the art. Thus, not all of the operations of each of the flow charts need to be performed, and the present disclosure expressly intends that all subcombinations of such operations are enabled as would be understood by one of ordinary skill in the art.

The storage medium may include any type of tangible medium, for example, any type of disk including floppy disks, optical disks, compact disk read-only memories (CD-ROMs), compact disk rewritables (CD-RWs), digital versatile disks (DVDs) and magneto-optical disks, semiconductor devices such as read-only memories (ROMs), random access memories (RAMs) such as dynamic and static RAMs, erasable programmable read-only memories (EPROMs), electrically erasable

programmable read-only memories (EEPROMs), flash memories, magnetic or optical cards, or any type of media suitable for storing electronic instructions.

"Circuitry", as used in any embodiment herein, may comprise, for example, singly or in any combination, hardwired circuitry, programmable circuitry, state machine circuitry, and/or firmware that stores instructions executed by programmable circuitry. An "application" (app), "agent" or "service" may be embodied as code or instructions which may be executed on programmable circuitry such as a host processor or other programmable circuitry and may, in some embodiments, work in conjunction with or as a component of an Operating System. A module, as used in any embodiment herein, may be embodied as circuitry. The circuitry may be embodied as an integrated circuit, such as an integrated circuit chip.

Thus, the present disclosure provides devices, methods, systems and computer-readable storage medium for video conferencing with improved bandwidth efficiency using a WiDi system that provides display rendering and peripheral sharing capability, to a user platform, over a wireless local area network. The following examples pertain to further embodiments.

The device may include a network client driver module to provide communication over a WiDi channel between a video conference application and a WiDi adapter. The device of this example may also include a video descriptor configuration module to provide filtered video descriptors to the video conference application, the filtered video descriptors based on a list of video descriptors provided by a USB camera coupled to the WiDi adapter, the list transmitted over the WiDi channel, and the filtering removes video descriptors associated with uncompressed video formats.

Another example device includes the forgoing components and further includes a multiplexed format generation module to: receive compressed video of a first type from the WiDi adapter over the WiDi channel; decode the compressed video of the first type to generate video of a second type, and the first type is associated with a greater level of compression than the second type; synchronize and multiplex the first type and the second type video; and provide the multiplexed video to the video conference application module.

Another example device includes the forgoing components and the first type video conforms to an H.264 format standard and the second type video conforms to an MJPEG format standard or an uncompressed format.

Another example device includes the forgoing components and further includes a frame rate adaptation module to detect a level of motion associated with a video received from the USB camera over the WiDi channel and to generate a frame rate request based on the level of motion.

Another example device includes the forgoing components and is further to transmit the frame rate request to the USB camera over the WiDi channel.

Another example device includes the forgoing components and the WiDi channel includes a forward channel and a back channel, the forward channel to provide a first video stream from the video conference application to a display element, the back channel to provide a second video stream from the USB camera to the network client driver.

Another example device includes the forgoing components and the device is incorporated in a mobile platform, and the mobile platform is a smartphone, a tablet, a laptop or an Ultrabook.

According to another aspect there is provided a method. The method may include providing communication over a WiDi channel between a video conference application and a WiDi adapter. The method of this example may also include receiving video descriptors from a USB camera coupled to the WiDi adapter, the video descriptors transmitted over the WiDi channel. The method of this example may further include filtering the video descriptors to remove descriptors associated with uncompressed video formats. The method of this example may further include providing the filtered video descriptors to the video conference application.

Another example method includes the forgoing operations and further includes receiving compressed video of a first type from the WiDi adapter over the WiDi channel; decoding the compressed video of the first type to generate video of a second type, and the first type is associated with a greater level of compression than the second type; synchronizing and multiplexing the first type and the second type video; and providing the multiplexed video to the video conference application.

Another example method includes the forgoing operations and the first type video conforms to an H.264 format standard and the second type video conforms to an MJPEG format standard or an uncompressed format.

Another example method includes the forgoing operations and further includes detecting a level of motion associated with a video received from the USB camera over the WiDi channel and generating a frame rate request based on the level of motion.

Another example method includes the forgoing operations and further includes transmitting the frame rate request to the USB camera over the WiDi channel.

Another example method includes the forgoing operations and the WiDi channel includes a forward channel and a back channel, the forward channel to provide a first video stream from the video conference application to a display element, the back channel to provide a second video stream from the USB camera to the network client driver.

According to another aspect there is provided a mobile platform. The platform may include a processor and a memory coupled to the processor. The platform of this example may also include a video conference application module coupled to the processor. The platform of this example may further include a network client driver module to provide communication over a WiDi channel between the video conference application and a WiDi adapter. The platform of this example may further include a video descriptor configuration module to provide filtered video descriptors to the video conference application, the filtered video descriptors based on a list of video descriptors provided by a USB camera coupled to the WiDi adapter, the list transmitted over the WiDi channel, and the filtering removes video descriptors associated with uncompressed video formats.

Another example platform includes the forgoing components and further includes a multiplexed format generation module to: receive compressed video of a first type from the WiDi adapter over the WiDi channel; decode the compressed video of the first type to generate video of a second type, and the first type is associated with a greater level of compression than the second type; synchronize and multiplex the first type and the second type video; and provide the multiplexed video to the video conference application module.

Another example platform includes the forgoing components and the first type video conforms to an H.264 format standard and the second type video conforms to an MJPEG format standard or an uncompressed format.

Another example platform includes the forgoing components and further includes a frame rate adaptation module to detect a level of motion associated with a video received from the USB camera over the WiDi channel and to generate a frame rate request based on the level of motion.

Another example platform includes the forgoing components and is further to transmit the frame rate request to the USB camera over the WiDi channel.

Another example platform includes the forgoing components and the WiDi channel includes a forward channel and a back channel, the forward channel to provide a first video stream from the video conference application to a display element, the back channel to provide a second video stream from the USB camera to the network client driver.

Another example platform includes the forgoing components and the platform is a smartphone, a tablet, a laptop or an Ultrabook.

According to another aspect there is provided a system. The system may include a means for providing communication over a WiDi channel between the video conference application and the WiDi adapter. The system of this example may also include a means for receiving video descriptors from a USB camera coupled to the WiDi adapter, the video descriptors transmitted over the WiDi channel. The system of this example may further include a means for filtering the video descriptors to remove descriptors associated with uncompressed video formats. The system of this example may further include a means for providing the filtered video descriptors to the video conference application.

Another example system includes the forgoing components and further includes a means for receiving compressed video of a first type from the WiDi adapter over the WiDi channel; a means for decoding the compressed video of the first type to generate video of a second type, and the first type is associated with a greater level of compression than the second type; a means for synchronizing and multiplexing the first type and the second type video; and a means for providing the multiplexed video to the video conference application.

Another example system includes the forgoing components and the first type video conforms to an H.264 format standard and the second type video conforms to an MJPEG format standard or an uncompressed format.

Another example system includes the forgoing components and further includes a means for detecting a level of motion associated with a video received from the USB camera over the WiDi channel and generating a frame rate request based on the level of motion.

Another example system includes the forgoing components and further includes a means for transmitting the frame rate request to the USB camera over the WiDi channel.

Another example system includes the forgoing components and the WiDi channel includes a forward channel and a back channel, the forward channel to provide a first video stream from the video conference application to a display element, the back channel to provide a second video stream from the USB camera to the network client driver.

According to another aspect there is provided at least one computer-readable storage medium having instructions stored thereon which when executed by a processor, cause the processor to perform the operations of the method as described in any of the examples above.

According to another aspect there is provided an apparatus including means to perform a method as described in any of the examples above.

The terms and expressions which have been employed herein are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described (or portions thereof), and it is recognized that various modifications are possible within the scope of the claims. Accordingly, the claims are intended to cover all such equivalents. Various features, aspects, and embodiments have been described herein. The features, aspects, and embodiments are susceptible to combination with one another as well as to variation and modification, as will be understood by those having skill in the art. The present disclosure should, therefore, be considered to encompass such combinations, variations, and modifications.

CLAIMS

What is claimed is:

1. An interface device for coupling a video conference application to a wireless display (WiDi) adapter, said device comprising:

a network client driver module to provide communication over a WiDi channel between said video conference application and said WiDi adapter; and

a video descriptor configuration module to provide filtered video descriptors to said video conference application, said filtered video descriptors based on a list of video descriptors provided by a USB camera coupled to said WiDi adapter, said list transmitted over said WiDi channel, wherein said filtering removes video descriptors associated with uncompressed video formats.

2. The device of claim 1, further comprising a multiplexed format generation module to:

receive compressed video of a first type from said WiDi adapter over said WiDi channel;

decode said compressed video of said first type to generate video of a second type, wherein said first type is associated with a greater level of compression than said second type;

synchronize and multiplex said first type and said second type video; and

provide said multiplexed video to said video conference application module.

3. The device of claim 2, wherein said first type video conforms to an H.264 format standard and said second type video conforms to an MJPEG format standard or an uncompressed format.

4. The device of claim 1, further comprising a frame rate adaptation module to detect a level of motion associated with a video received from said USB camera over said WiDi channel and to generate a frame rate request based on said level of motion.

5. The device of claim 4, further to transmit said frame rate request to said USB camera over said WiDi channel.

6. The device of claim 1, wherein said WiDi channel comprises a forward channel and a back channel, said forward channel to provide a first video stream from said video conference application to a display element, said back channel to provide a second video stream from said USB camera to said network client driver.

7. The device of claim 1, wherein said device is incorporated in a mobile platform, and said mobile platform is a smartphone, a tablet, a laptop or an Ultrabook.

8. A method for interfacing a video conference application to a wireless display (WiDi) adapter, said method comprising:

providing communication over a WiDi channel between said video conference application and said WiDi adapter;

receiving video descriptors from a USB camera coupled to said WiDi adapter, said video descriptors transmitted over said WiDi channel;

filtering said video descriptors to remove descriptors associated with uncompressed video formats; and

providing said filtered video descriptors to said video conference application.

9. The method of claim 8, further comprising:

receiving compressed video of a first type from said WiDi adapter over said WiDi channel;

decoding said compressed video of said first type to generate video of a second type, wherein said first type is associated with a greater level of compression than said second type;

synchronizing and multiplexing said first type and said second type video; and

providing said multiplexed video to said video conference application.

10. The method of claim 9, wherein said first type video conforms to an H.264 format standard and said second type video conforms to an MJPEG format standard or an uncompressed format.

11. The method of claim 8, further comprising detecting a level of motion associated with a video received from said USB camera over said WiDi channel and generating a frame rate request based on said level of motion.

12. The method of claim 11, further comprising transmitting said frame rate request to said USB camera over said WiDi channel.

13. The method of claim 8, wherein said WiDi channel comprises a forward channel and a back channel, said forward channel to provide a first video stream from said video conference application to a display element, said back channel to provide a second video stream from said USB camera to said network client driver.

14. A computer-readable storage medium having instructions stored thereon which when executed by a processor result in the following operations for interfacing a video conference application to a wireless display (WiDi) adapter, said operations comprising:

providing communication over a WiDi channel between said video conference application and said WiDi adapter;

receiving video descriptors from a USB camera coupled to said WiDi adapter, said video descriptors transmitted over said WiDi channel;

filtering said video descriptors to remove descriptors associated with uncompressed video formats; and

providing said filtered video descriptors to said video conference application.

15. The computer-readable storage medium of claim 14, further comprising the operations of:

receiving compressed video of a first type from said WiDi adapter over said WiDi channel;

decoding said compressed video of said first type to generate video of a second type, wherein said first type is associated with a greater level of compression than said second type;

synchronizing and multiplexing said first type and said second type video; and

providing said multiplexed video to said video conference application.

16. The computer-readable storage medium of claim 15, wherein said first type video conforms to an H.264 format standard and said second type video conforms to an MJPEG format standard or an uncompressed format.

17. The computer-readable storage medium of claim 14, further comprising the operations of detecting a level of motion associated with a video received from said USB camera over said WiDi channel and generating a frame rate request based on said level of motion.

18. The computer-readable storage medium of claim 17, further comprising the operations of transmitting said frame rate request to said USB camera over said WiDi channel.

19. The computer-readable storage medium of claim 14, wherein said WiDi channel comprises a forward channel and a back channel, said forward channel to provide a first video stream from said video conference application to a display element, said back channel to provide a second video stream from said USB camera to said network client driver.

20. A mobile platform for video conferencing, said platform comprising:

a processor;

a memory coupled to said processor;

a video conference application module coupled to said processor;

a network client driver module to provide communication over a WiDi channel between said video conference application and a WiDi adapter; and

a video descriptor configuration module to provide filtered video descriptors to said video conference application, said filtered video descriptors based on a list of video descriptors provided by a USB camera coupled to said WiDi adapter, said list transmitted over said WiDi channel, wherein said filtering removes video descriptors associated with uncompressed video formats.

21. The mobile platform of claim 20, further comprising a multiplexed format generation module to:

receive compressed video of a first type from said WiDi adapter over said WiDi channel;

decode said compressed video of said first type to generate video of a second type, wherein said first type is associated with a greater level of compression than said second type;

synchronize and multiplex said first type and said second type video; and

provide said multiplexed video to said video conference application module.

22. The mobile platform of claim 21, wherein said first type video conforms to an H.264 format standard and said second type video conforms to an MJPEG format standard or an uncompressed format.

23. The mobile platform of claim 20, further comprising a frame rate adaptation module to detect a level of motion associated with a video received from said USB camera over said WiDi channel and to generate a frame rate request based on said level of motion.

24. The mobile platform of claim 23, further to transmit said frame rate request to said USB camera over said WiDi channel.

25. The mobile platform of claim 20, wherein said WiDi channel comprises a forward channel and a back channel, said forward channel to provide a first video stream from said video conference application to a display element, said back channel to provide a second video stream from said USB camera to said network client driver.

26. The mobile platform of claim 20, wherein said mobile platform is a smartphone, a tablet, a laptop or an Ultrabook.

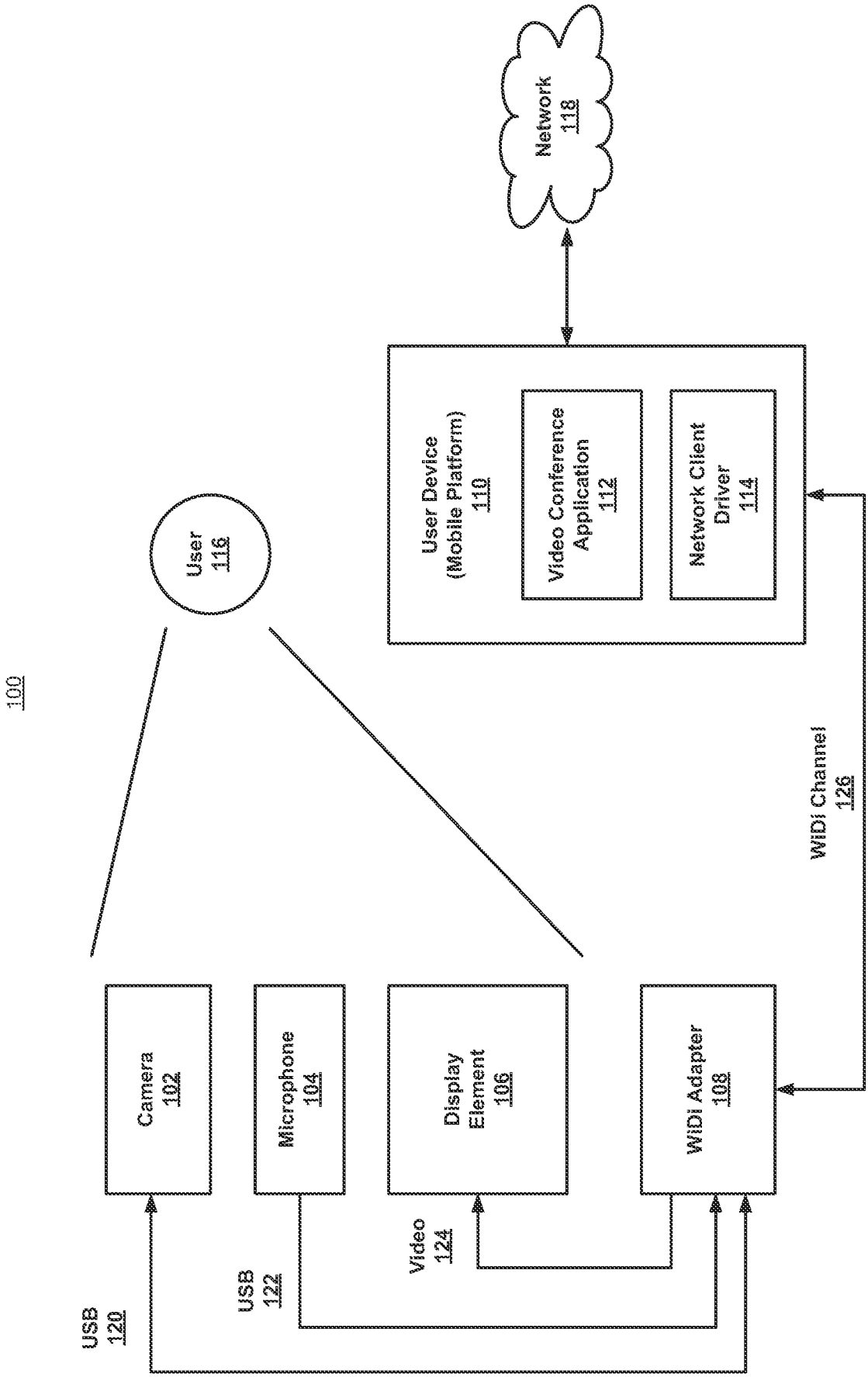
100
Network
118
User Device
(Mobile Platform)
110
Video Conference
Application
112
Network Client
Driver
114
User
116
WiDi Channel
126
Camera
102
Microphone
104
Display
Element
106
WiDi Adapter
108
USB
120
USB
122
Video
124

FIG. 1

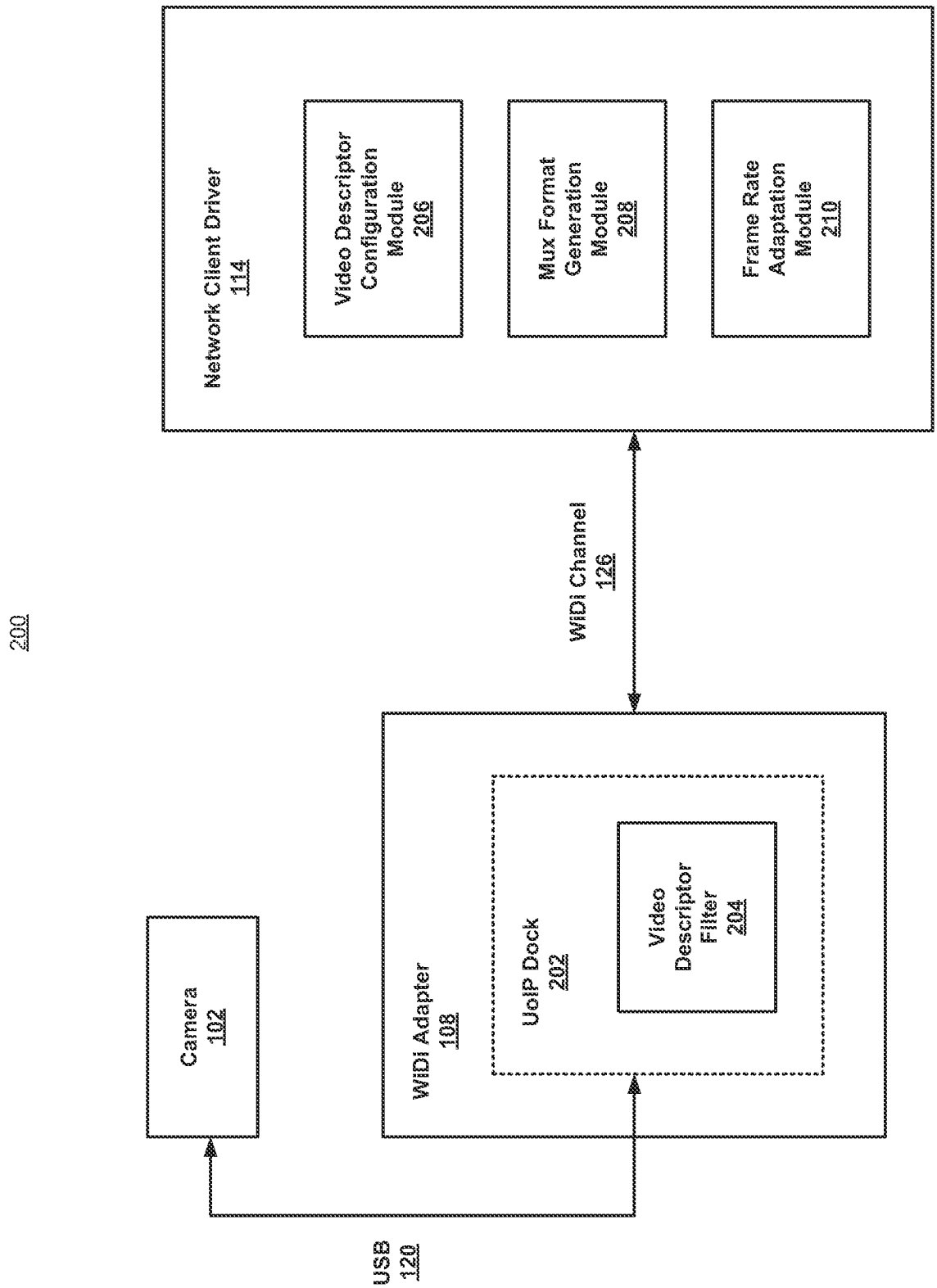
200
Network Client Driver
114
Video Descriptor
Configuration
Module
206
Mux Format
Generation
Module
208
Frame Rate
Adaptation
Module
210
WiDi Channel
126
WiDi Adapter
108
UoIP Dock
202
Video
Descriptor
Filter
204
Camera
102
USB
120

FIG. 2

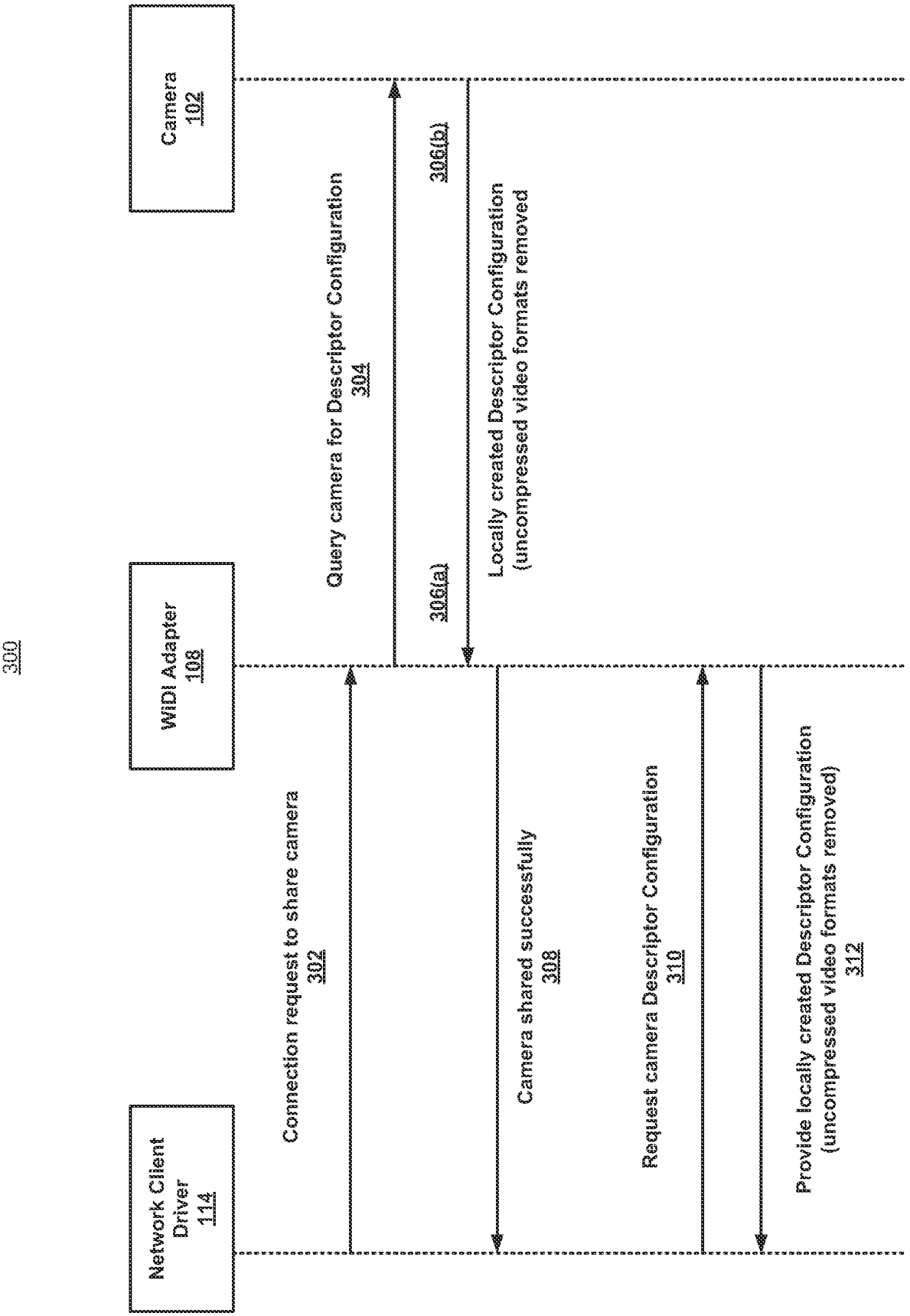
300
Network Client Driver 114
WiDi Adapter 108
Camera 102
Connection request to share camera 302
Query camera for Descriptor Configuration 304
306(a)
306(b)
Locally created Descriptor Configuration (uncompressed video formats removed
Camera shared successfully 308
Request camera Descriptor Configuration 310
Provide locally created Descriptor Configuration (uncompressed video formats removed) 312

FIG. 3

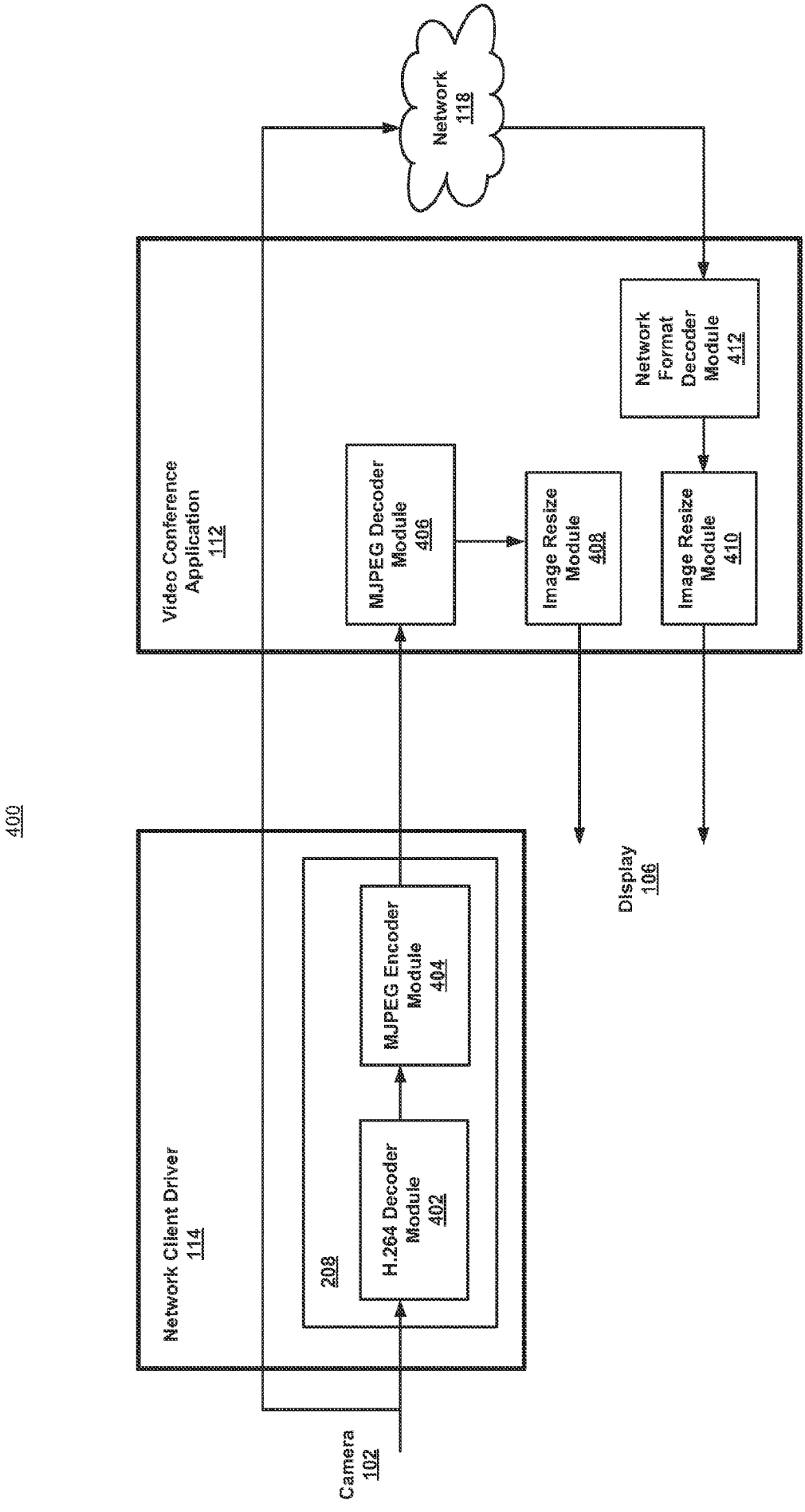
400
Network
118
Video Conference Application
112
Network Format Decoder Module
412
MJPEG Decoder Module
406
Image Resize Module
408
Image Resize Module
410
Display
106
Network Client Driver
114
208
MJPEG Encoder Module
404
H.264 Decoder Module
402
Camera
102

FIG. 4

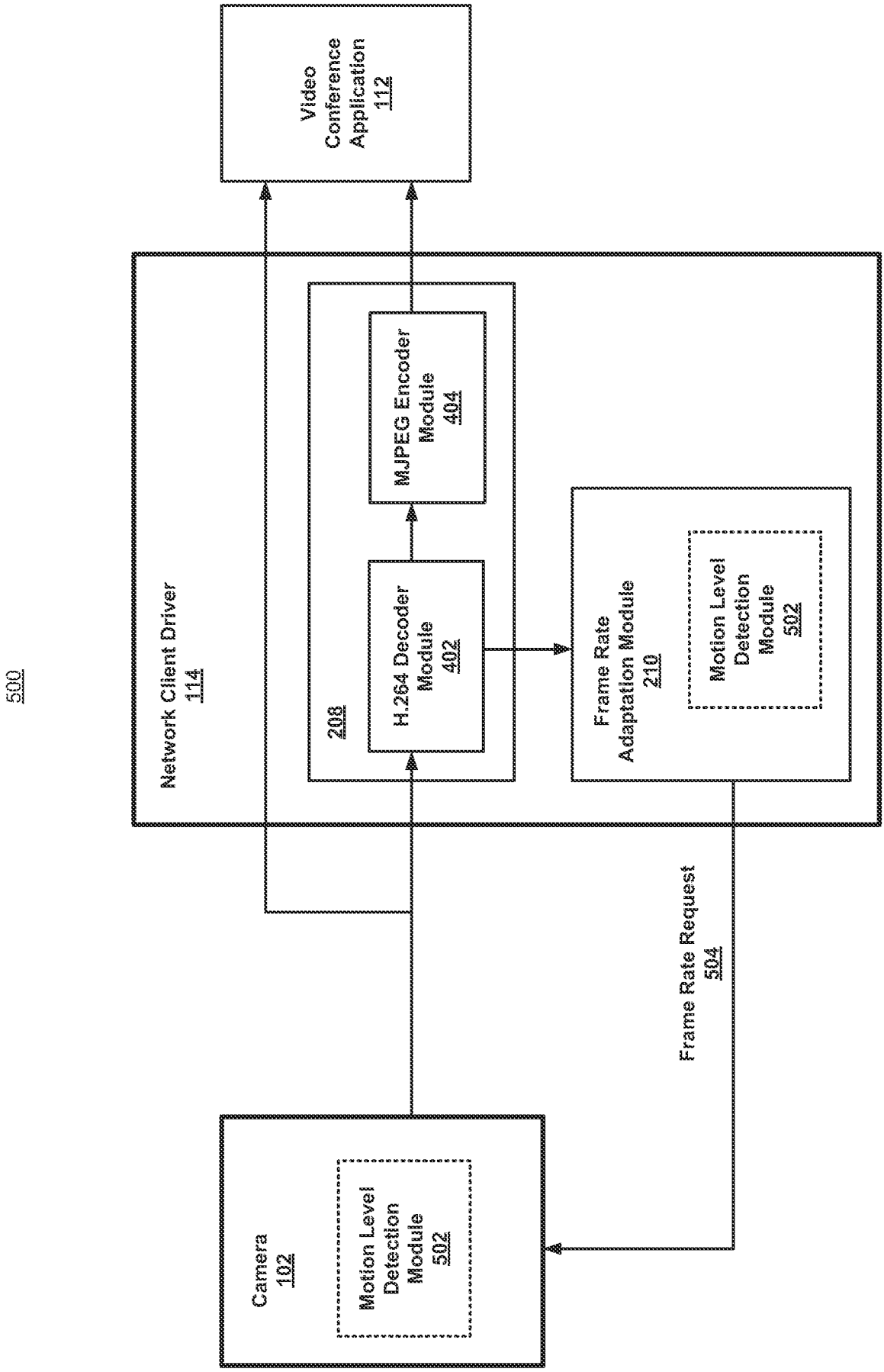
500
Video Conference Application 112
Network Client Driver 114
208
H.264 Decoder Module 402
MJPEG Encoder Module 404
Frame Rate Adaptation Module 210
Motion Level Detection Module 502
Frame Rate Request 504
Camera 102
Motion Level Detection Module 502

FIG. 5

600

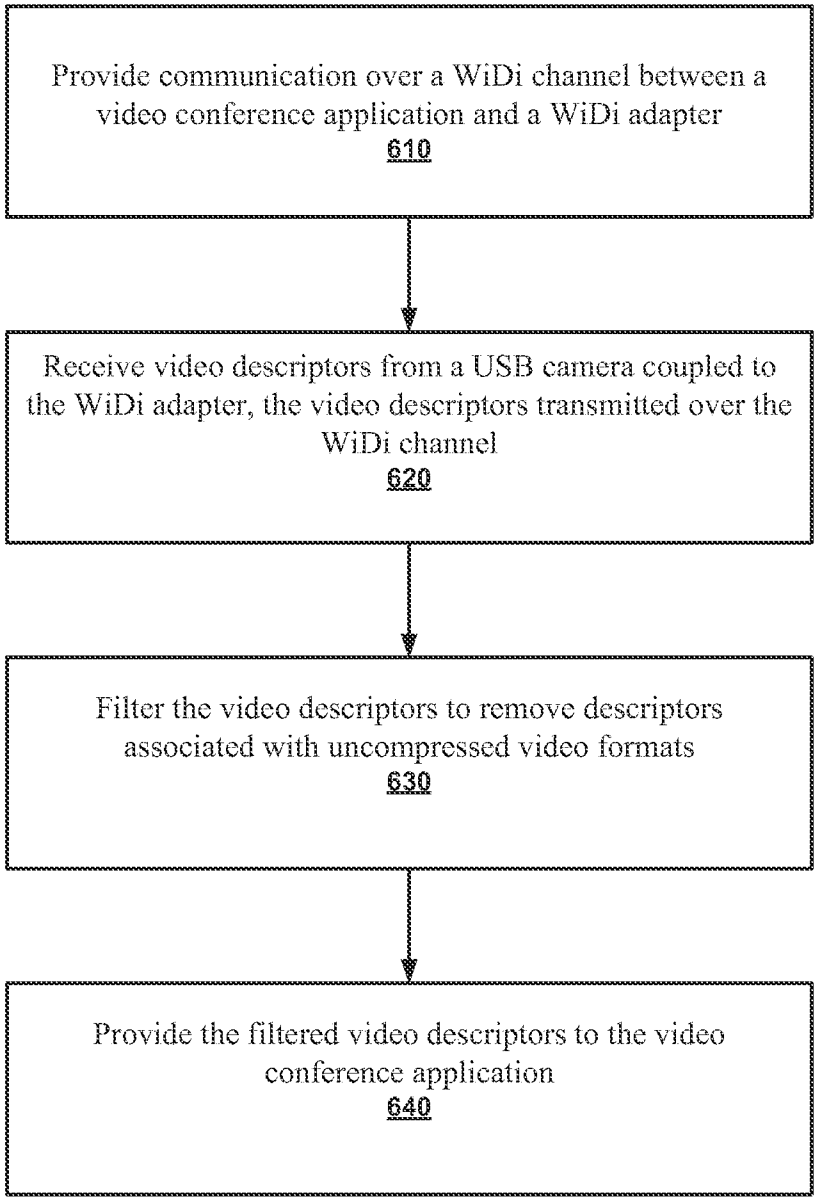
Provide communication over a WiDi channel between a video conference application and a WiDi adapter
610
Receive video descriptors from a USB camera coupled to the WiDi adapter, the video descriptors transmitted over the WiDi channel
620
Filter the video descriptors to remove descriptors associated with uncompressed video formats
630
Provide the filtered video descriptors to the video conference application
640

FIG. 6

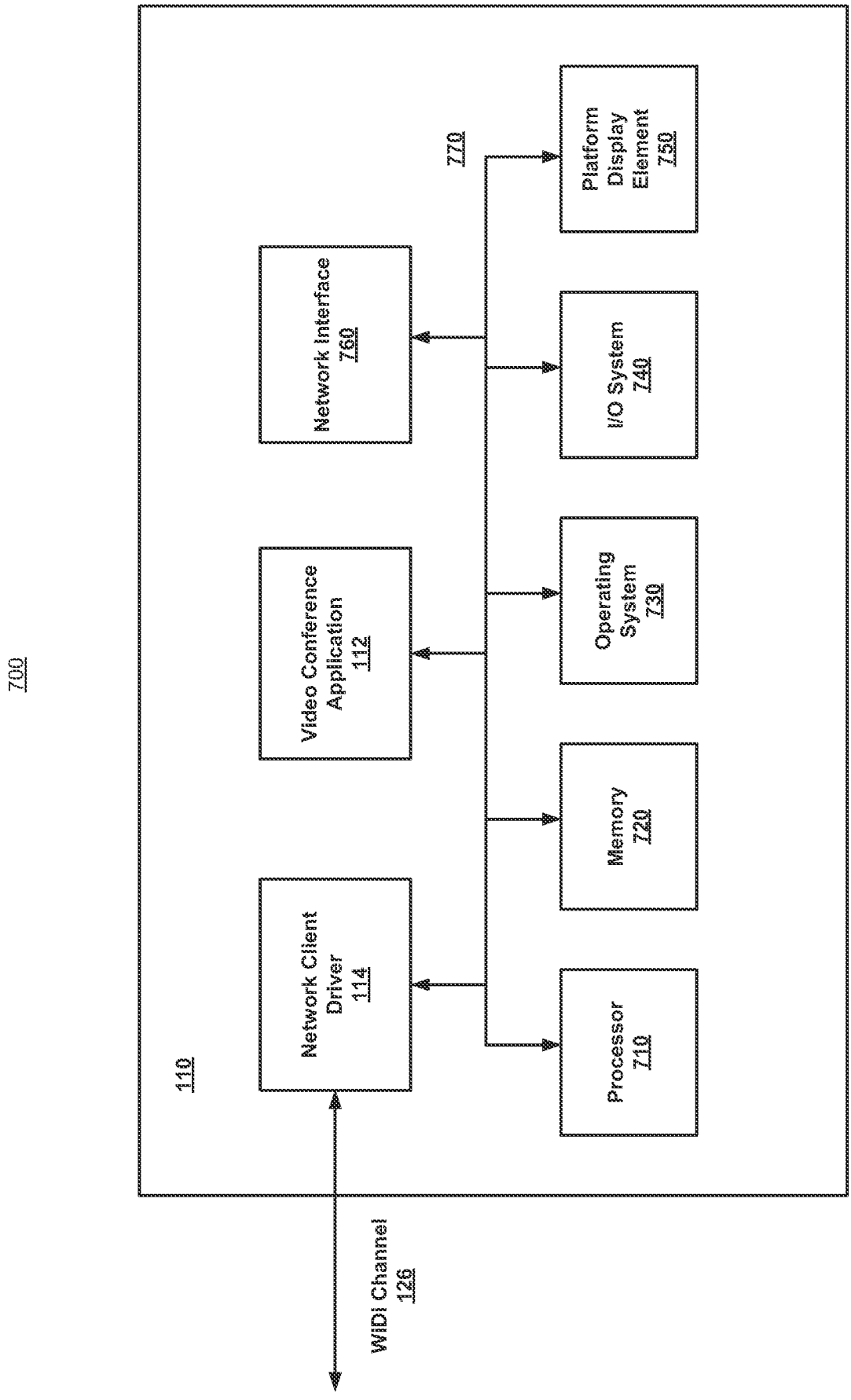
700
110
Network Client Driver 114
Video Conference Application 112
Network Interface 760
Processor 710
Memory 720
Operating System 730
I/O System 740
Platform Display Element 750
770
WiDi Channel 126

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/075448

A. CLASSIFICATION OF SUBJECT MATTER

H04N 7/15(2006.01)i

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)
H04N 7/15; H01Q 11/12; H04J 3/07; H04N 7/26; H04N 7/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: WiDi (wireless display), video type, filtering, converting

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 2013-0315298 A1 (JIE GAO et al.) 28 November 2013 See paragraphs [0010], [0024]; and figure 1.	1-3,6-10,13-16,19-22,25,26 4,5,11,12,17,18,23,24
Y	US 2003-0030720 A1 (GEORGE T. HUTCHINGS) 13 February 2003 See paragraphs [0016], [0025]; claims 15, 19; and figure 1.	1-3,6-10,13-16,19-22,25,26
Y	US 2012-0147952 A1 (GUY COTE et al.) 14 June 2012 See paragraphs [0016], [0023]; and figure 1.	2,3,9,10,15,16,21,22
A	US 2013-0308659 A1 (TJO SAN JAO) 21 November 2013 See paragraphs [0008], [0010]; and figure 1.	1-26
A	US 2012-0164961 A1 (JIE GAO et al.) 28 June 2012 See paragraphs [0025], [0028]; and figure 1.	1-26

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* 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
28 August 2014 (28.08.2014)	**01 September 2014 (01.09.2014)**

Name and mailing address of the ISA/KR
International Application Division
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon Metropolitan City, 302-701,
Republic of Korea
Facsimile No. +82-42-472-7140

Authorized officer
KIM, Seong Woo
Telephone No. +82-42-481-3348

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/075448

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013-0315298 A1	28/11/2013	US 2012-076199 A1	29/03/2012
		US 8520728 B2	27/08/2013
		WO 2012-040659 A2	29/03/2012
		WO 2012-040659 A3	07/06/2012
US 2003-0030720 A1	13/02/2003	DE 10236679 A1	03/04/2003
US 2012-0147952 A1	14/06/2012	US 2007-030903 A1	08/02/2007
		US 2011-032992 A1	10/02/2011
		US 7881384 B2	01/02/2011
		US 8144783 B2	27/03/2012
US 2013-0308659 A1	21/11/2013	CA 2598176 A1	20/07/2006
		CA 2598176 C	11/05/2010
		CN 101124756 A	13/02/2008
		EP 1836788 A2	26/09/2007
		JP 2008-527923 A	24/07/2008
		JP 4740259 B2	03/08/2011
		US 2006-153244 A1	13/07/2006
		US 2010-265969 A1	21/10/2010
		US 7782812 B2	24/08/2010
		US 8509143 B2	13/08/2013
		WO 2006-076264 A2	20/07/2006
		WO 2006-076264 A3	05/04/2007
US 2012-0164961 A1	28/06/2012	US 2014-011456 A1	09/01/2014
		US 8583054 B2	12/11/2013
		WO 2012-088460 A2	28/06/2012
		WO 2012-088460 A3	16/08/2012