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(54) **INFORMATION DELIVERY APPARATUS, INFORMATION REPRODUCTION APPARATUS, AND INFORMATION PROCESSING METHOD**

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(57) **ABSTRACT**

An information delivery apparatus includes an encoding information collection unit which collects information used to encode content information, a generation unit which predicts decode processes of the content information based on the collected information, and generates configuration information used to configure data paths required to execute the decode processes, an embedding unit which embeds the configuration information in the content information, and a delivery unit which delivers the content information embedded with the configuration information.

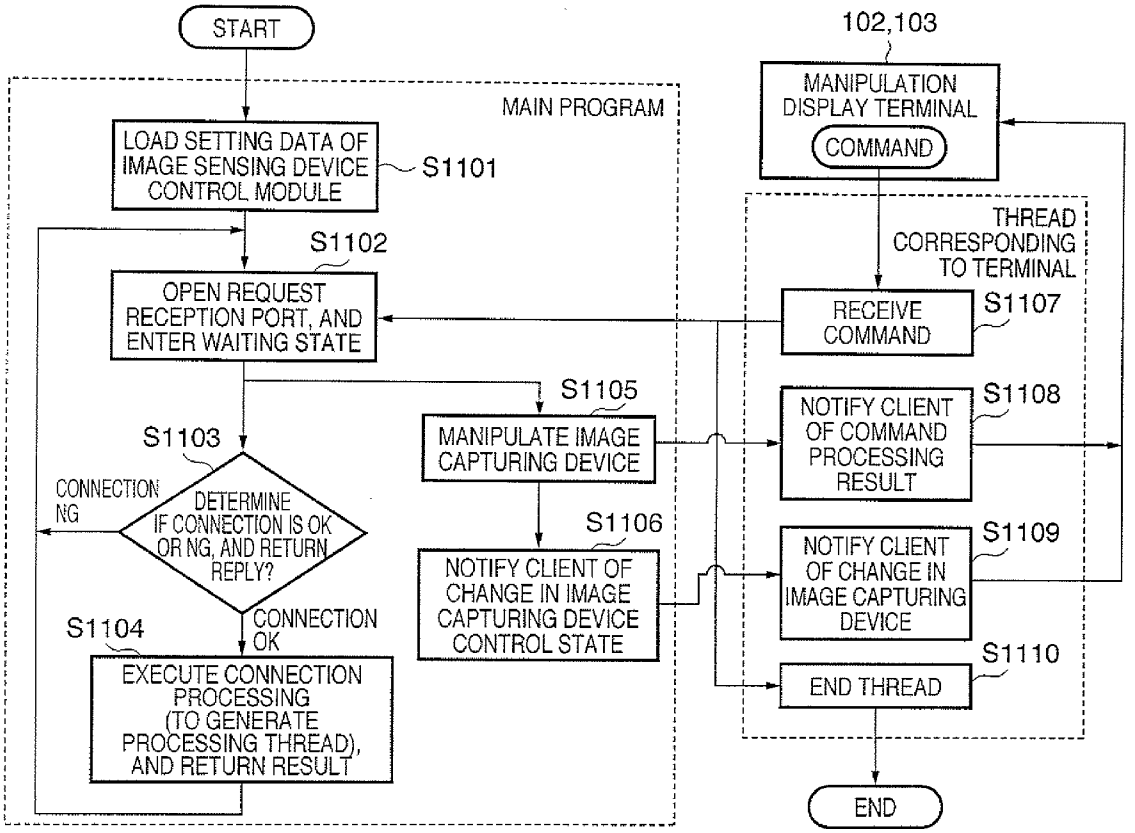


FIG. 1

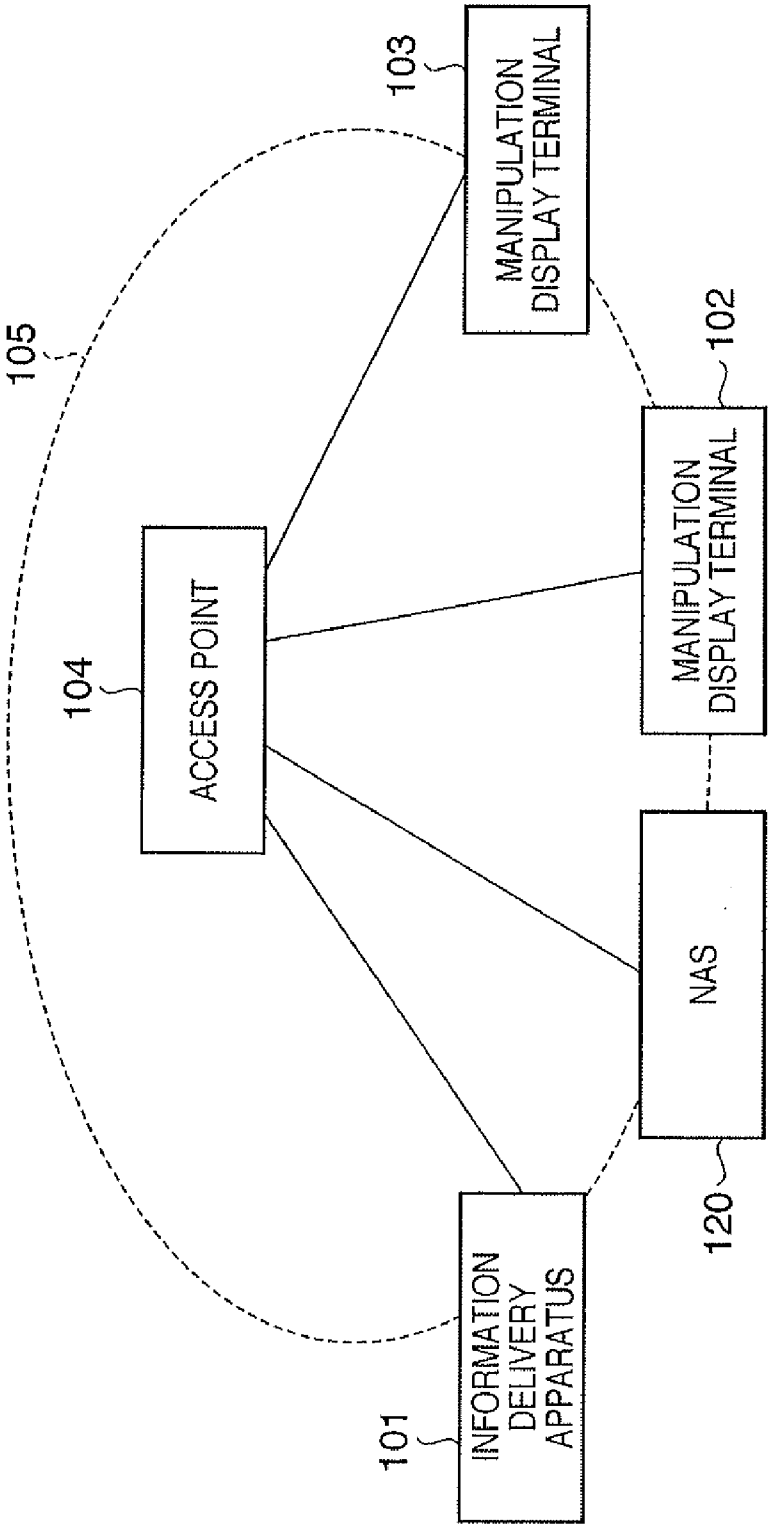

105
103
MANIPULATION DISPLAY TERMINAL
102
MANIPULATION DISPLAY TERMINAL
104
ACCESS POINT
NAS
120
101
INFORMATION DELIVERY APPARATUS

FIG. 2

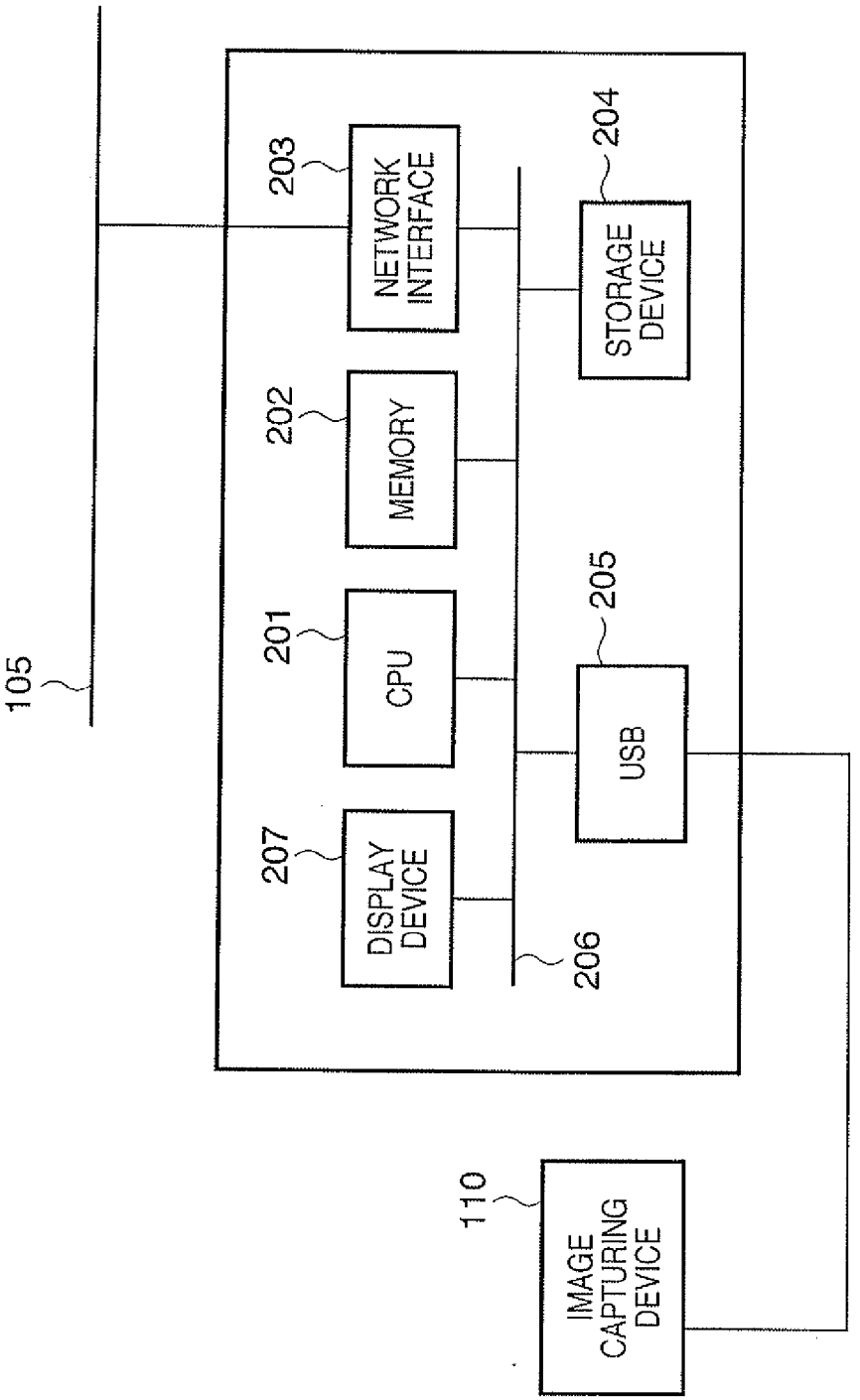

105
201
CPU
202
MEMORY
203
NETWORK INTERFACE
204
STORAGE DEVICE
205
USB
206
207
DISPLAY DEVICE
110
IMAGE CAPTURING DEVICE

FIG. 3

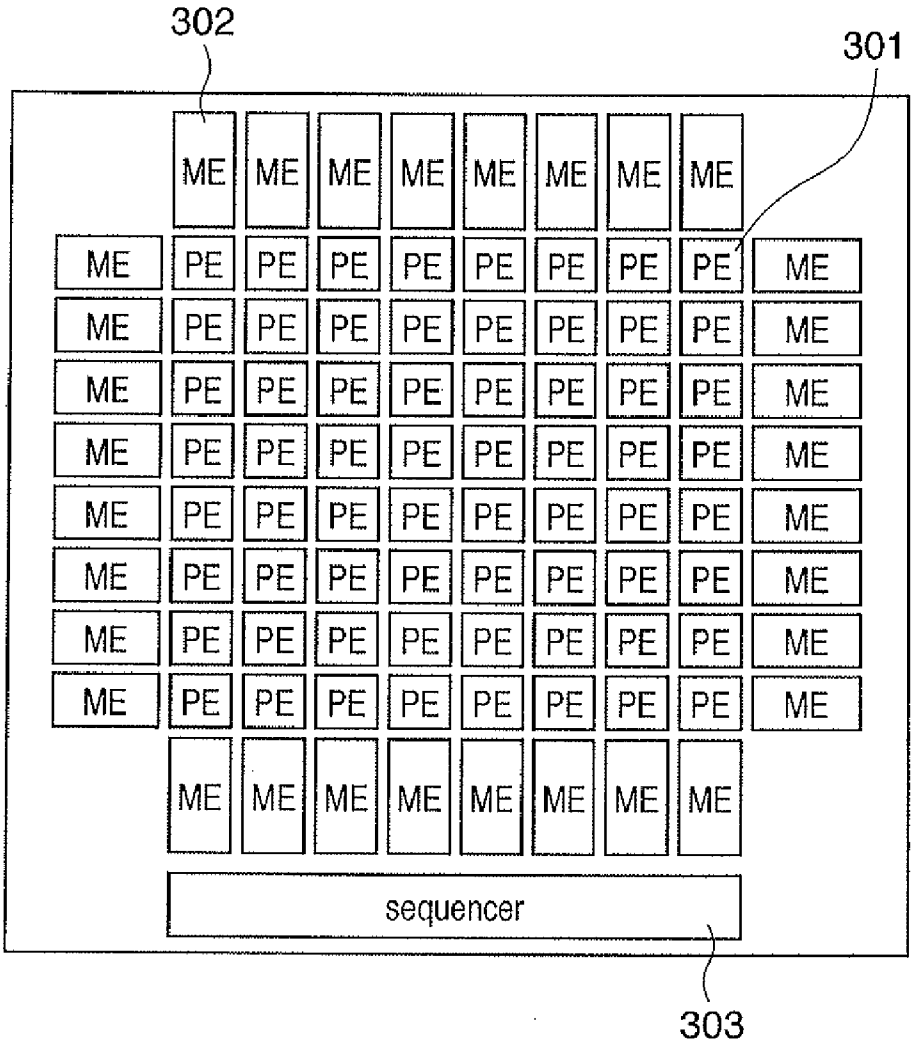


FIG. 4

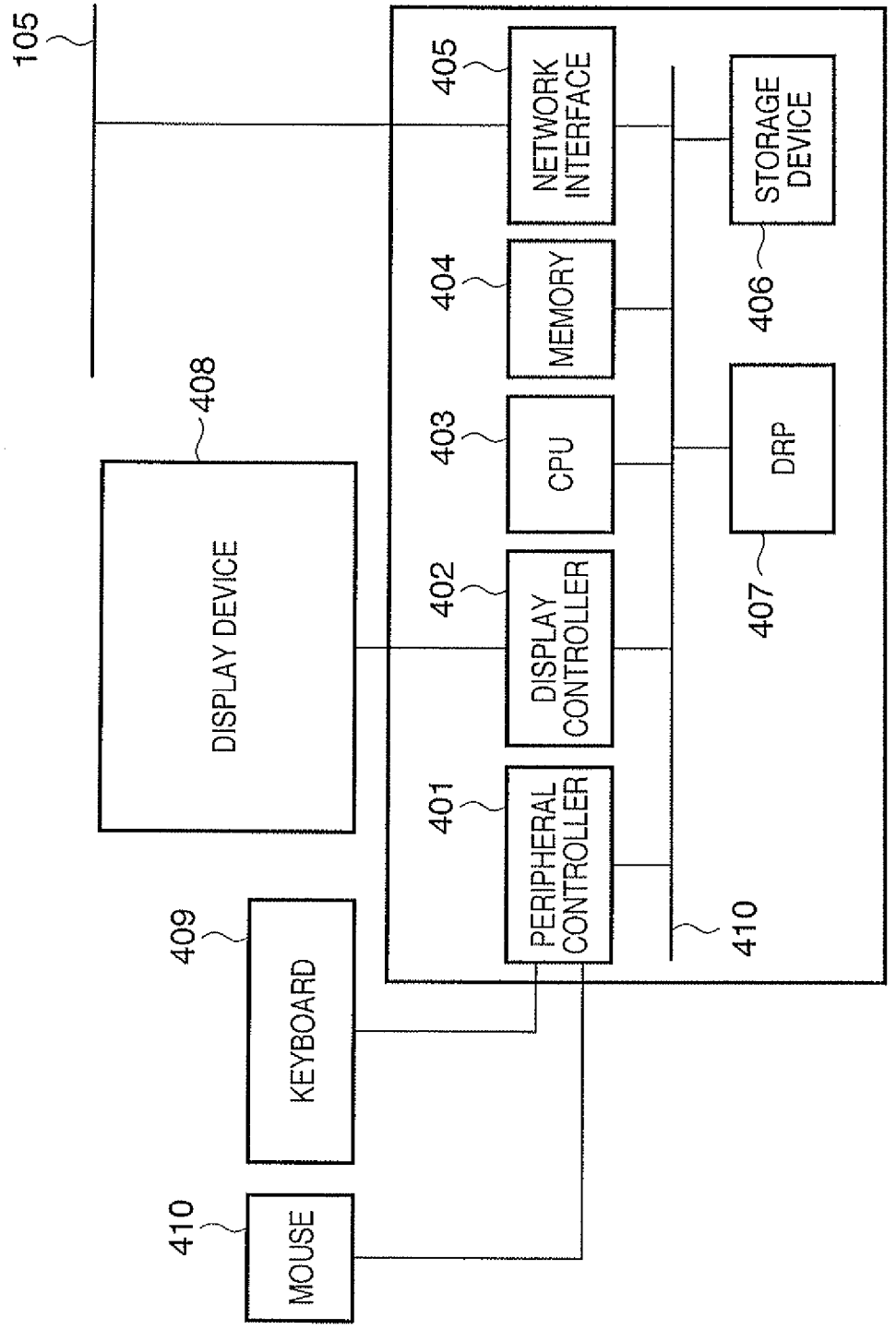

105
405
NETWORK INTERFACE
STORAGE DEVICE
406
404
MEMORY
408
403
CPU
DRP
407
DISPLAY DEVICE
402
DISPLAY CONTROLLER
401
PERIPHERAL CONTROLLER
410
409
KEYBOARD
410
MOUSE

FIG. 5A

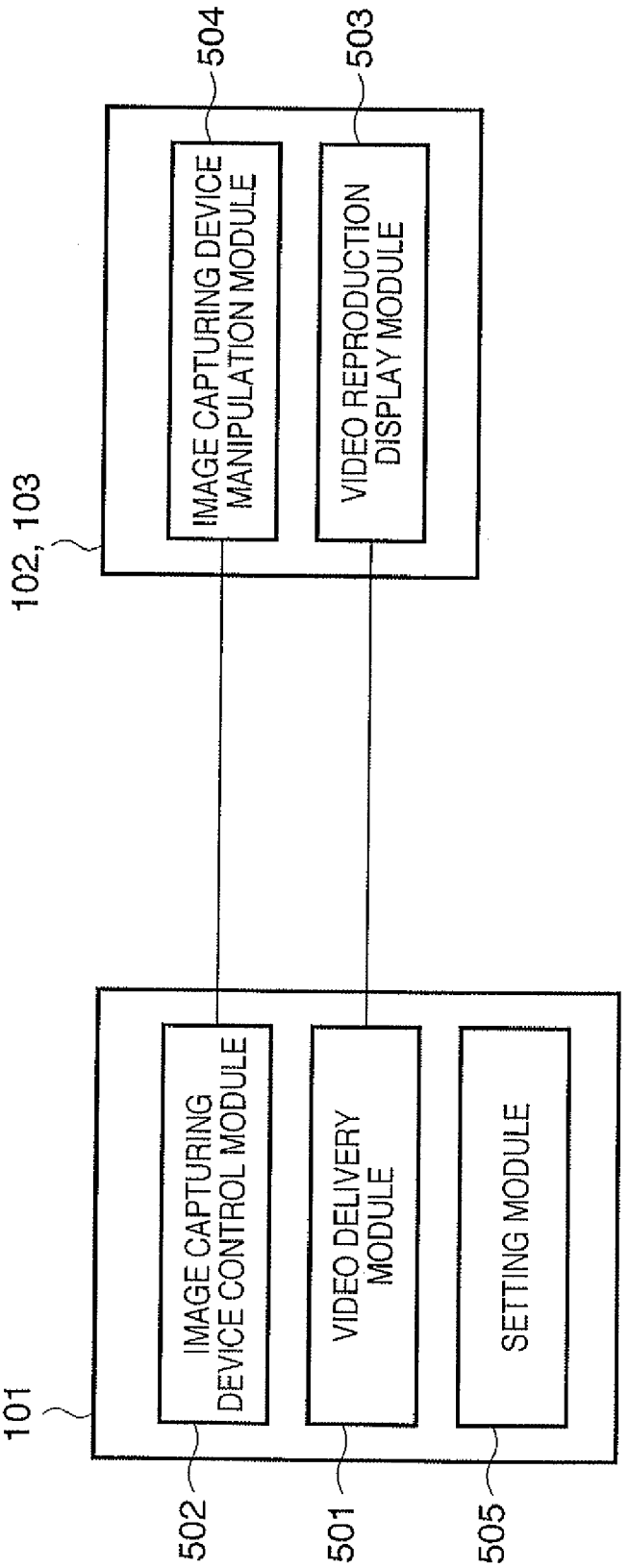

504
503
IMAGE CAPTURING DEVICE MANIPULATION MODULE
VIDEO REPRODUCTION DISPLAY MODULE
102, 103
IMAGE CAPTURING DEVICE CONTROL MODULE
VIDEO DELIVERY MODULE
SETTING MODULE
101
502
501
505

FIG. 5B

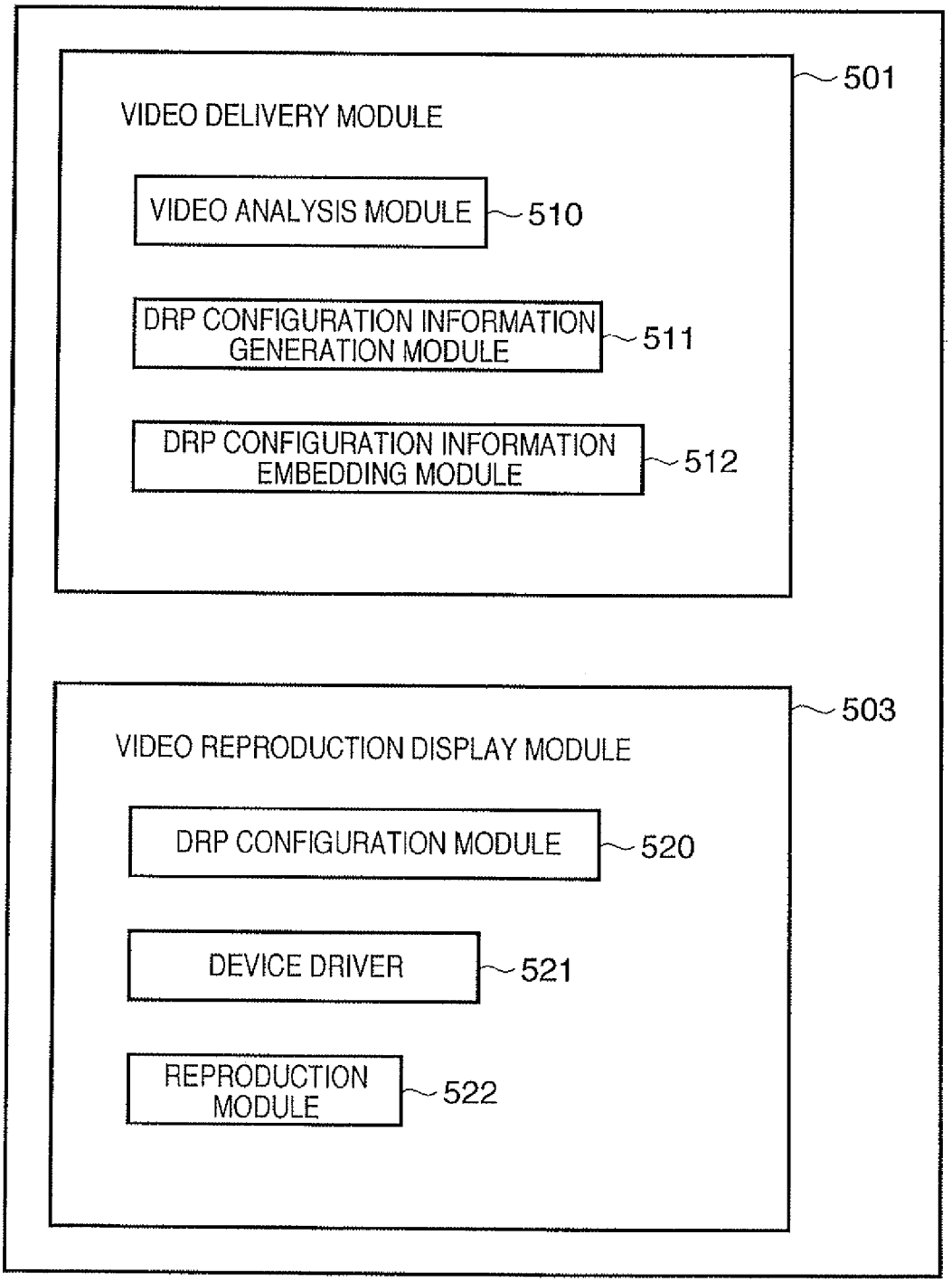

501
VIDEO DELIVERY MODULE
VIDEO ANALYSIS MODULE
510
DRP CONFIGURATION INFORMATION GENERATION MODULE
511
DRP CONFIGURATION INFORMATION EMBEDDING MODULE
512
503
VIDEO REPRODUCTION DISPLAY MODULE
DRP CONFIGURATION MODULE
520
DEVICE DRIVER
521
REPRODUCTION MODULE
522

FIG. 6

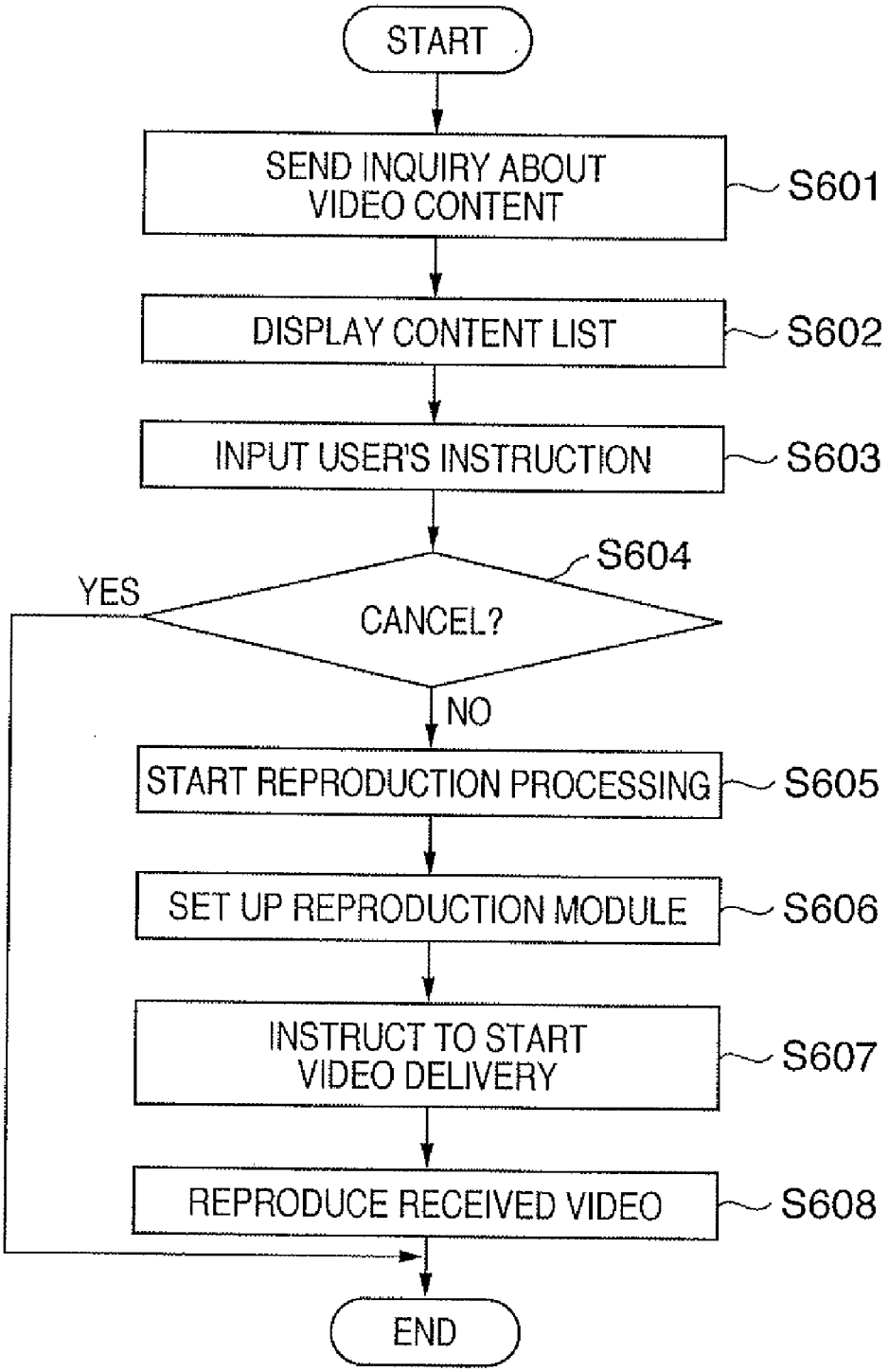

START
SEND INQUIRY ABOUT VIDEO CONTENT
S601
DISPLAY CONTENT LIST
S602
INPUT USER'S INSTRUCTION
S603
S604
CANCEL?
YES
NO
START REPRODUCTION PROCESSING
S605
SET UP REPRODUCTION MODULE
S606
INSTRUCT TO START VIDEO DELIVERY
S607
REPRODUCE RECEIVED VIDEO
S608
END

FIG. 7

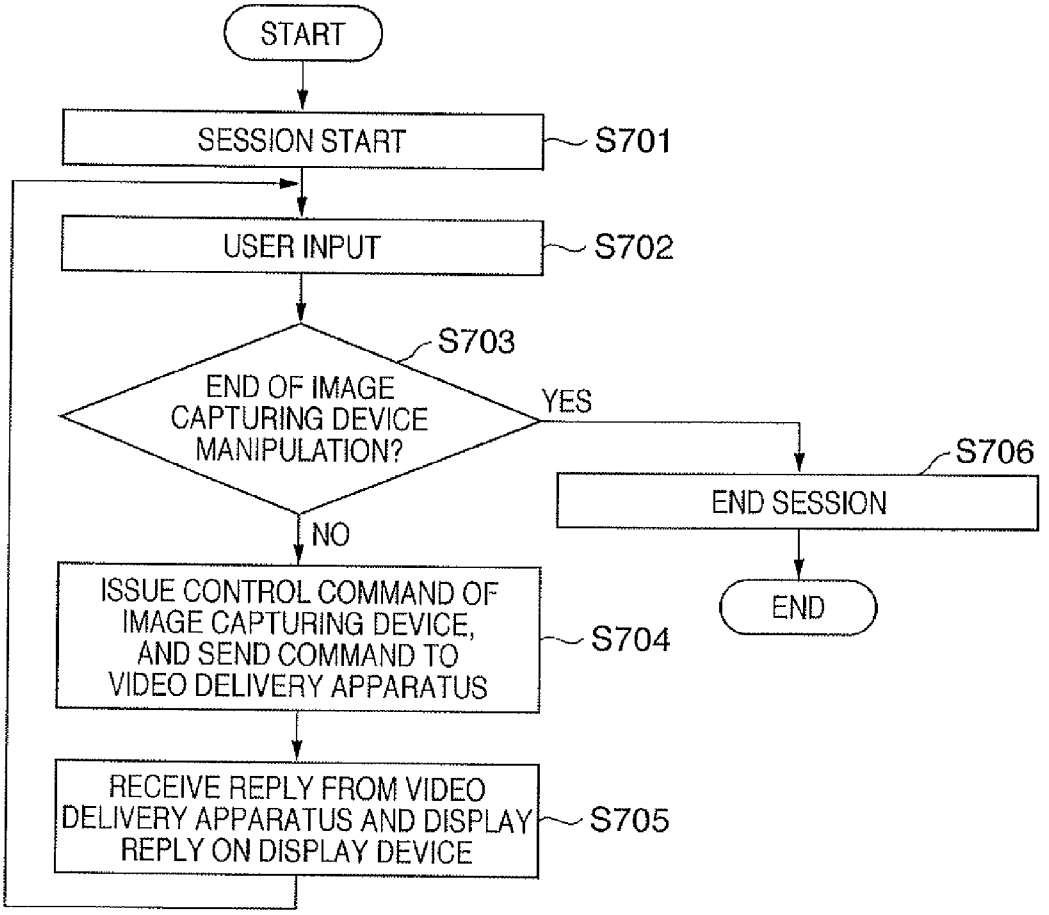

START
SESSION START
S701
USER INPUT
S702
S703
END OF IMAGE CAPTURING DEVICE MANIPULATION?
YES
NO
S706
END SESSION
END
ISSUE CONTROL COMMAND OF IMAGE CAPTURING DEVICE, AND SEND COMMAND TO VIDEO DELIVERY APPARATUS
S704
RECEIVE REPLY FROM VIDEO DELIVERY APPARATUS AND DISPLAY REPLY ON DISPLAY DEVICE
S705

FIG. 8

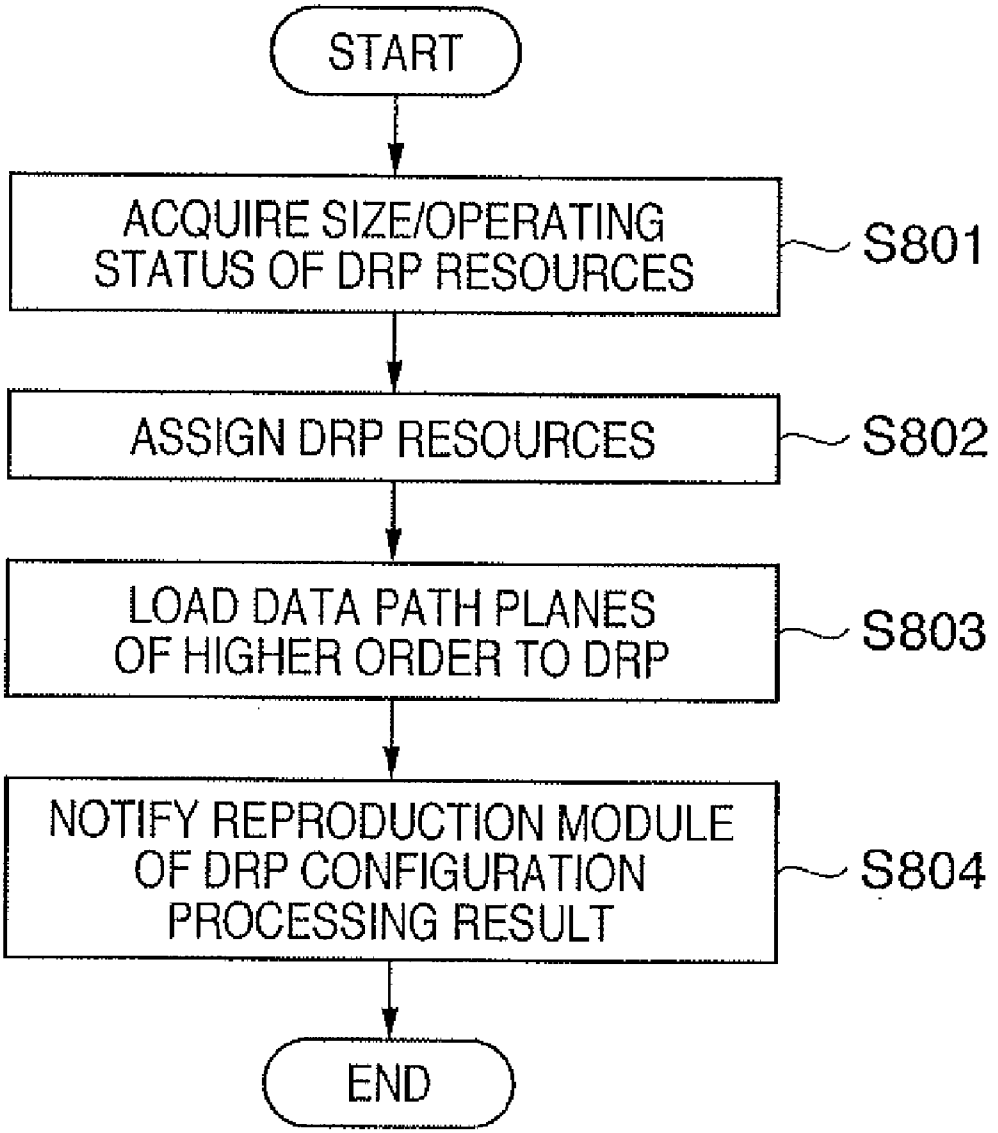
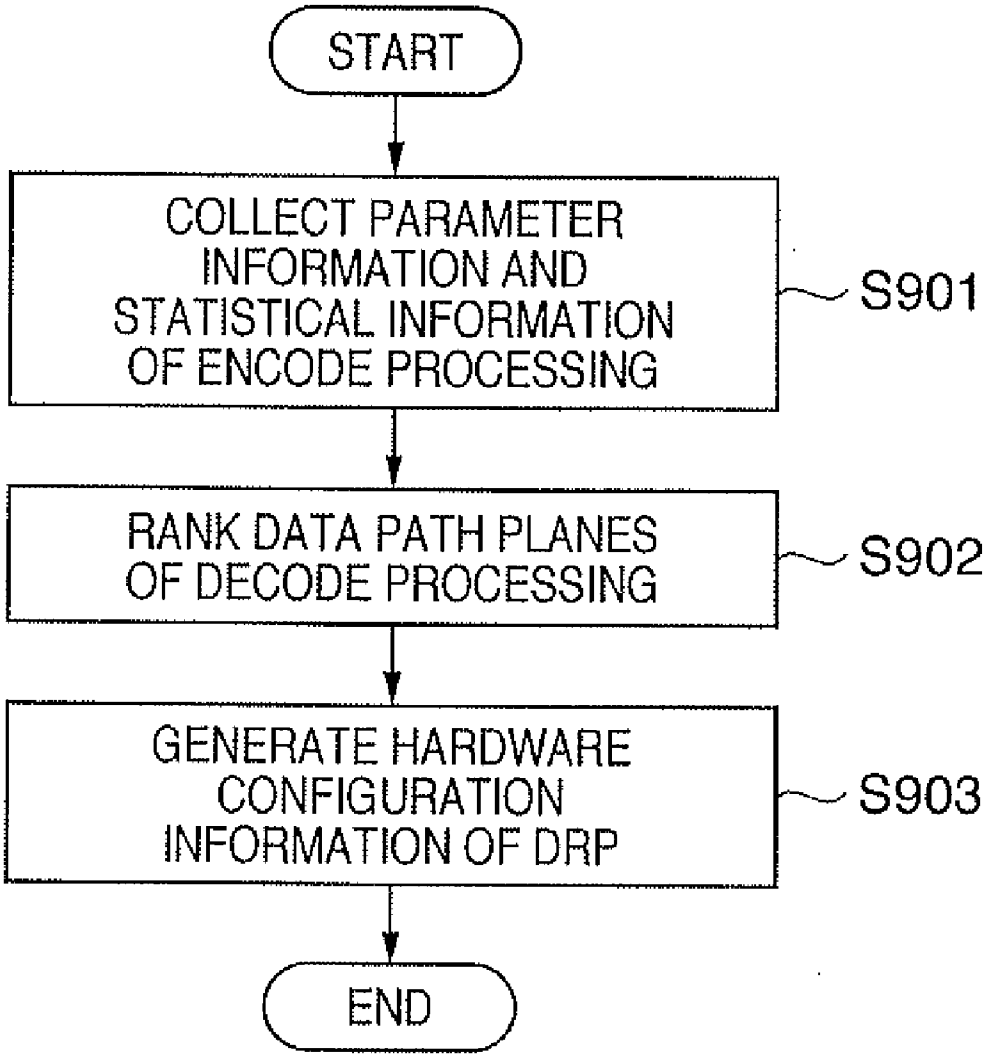

START
ACQUIRE SIZE/OPERATING STATUS OF DRP RESOURCES
S801
ASSIGN DRP RESOURCES
S802
LOAD DATA PATH PLANES OF HIGHER ORDER TO DRP
S803
NOTIFY REPRODUCTION MODULE OF DRP CONFIGURATION PROCESSING RESULT
S804
END

FIG. 9


START
COLLECT PARAMETER INFORMATION AND STATISTICAL INFORMATION OF ENCODE PROCESSING
S901
RANK DATA PATH PLANES OF DECODE PROCESSING
S902
GENERATE HARDWARE CONFIGURATION INFORMATION OF DRP
S903
END

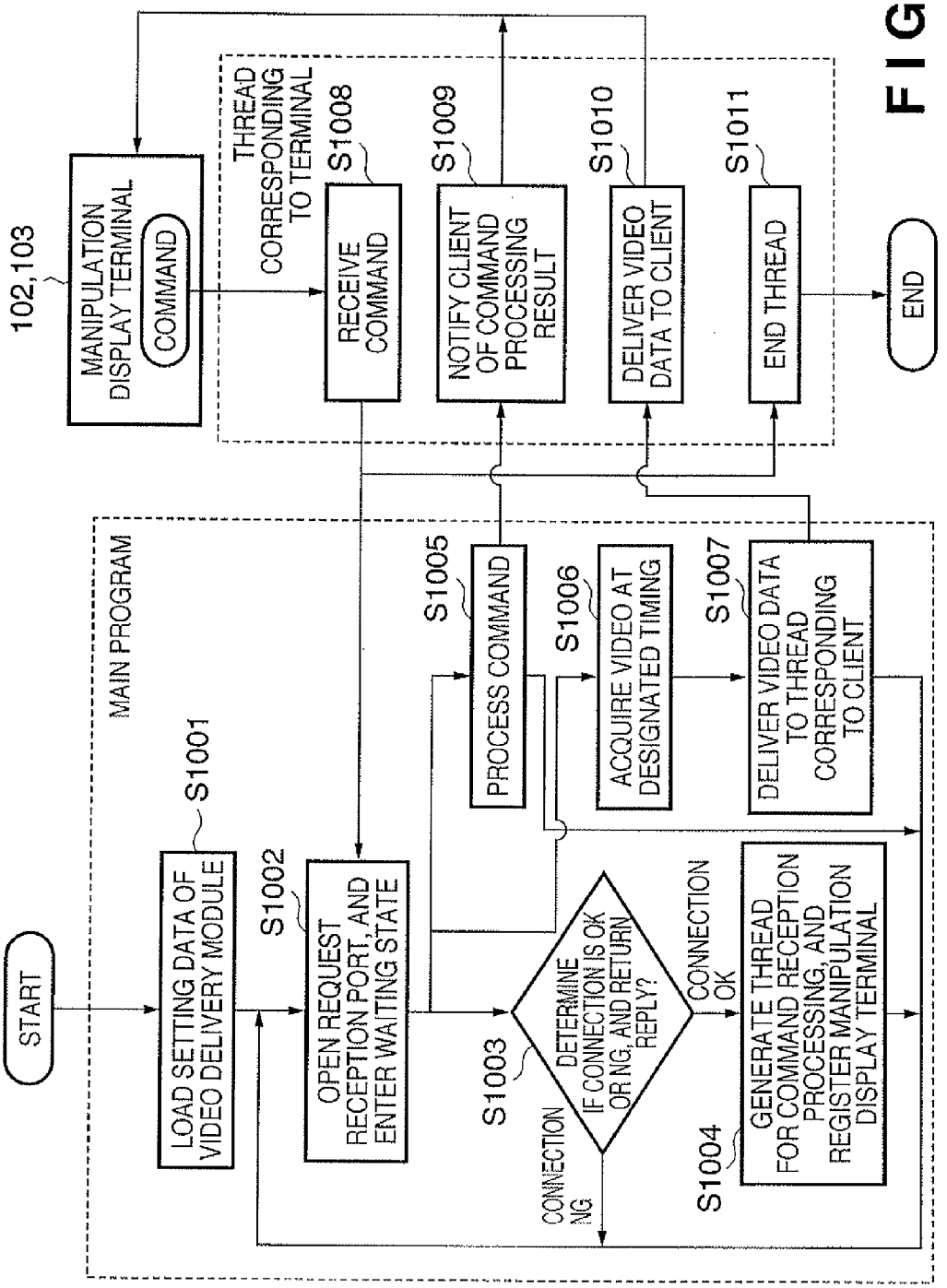

START
MAIN PROGRAM
S1001
LOAD SETTING DATA OF VIDEO DELIVERY MODULE
S1002
OPEN REQUEST RECEPTION PORT, AND ENTER WAITING STATE
S1003
DETERMINE IF CONNECTION IS OK OR NG, AND RETURN REPLY?
CONNECTION OK
CONNECTION NG
S1004
GENERATE THREAD FOR COMMAND RECEPTION PROCESSING, AND REGISTER MANIPULATION DISPLAY TERMINAL
S1005
PROCESS COMMAND
S1006
ACQUIRE VIDEO AT DESIGNATED TIMING
S1007
DELIVER VIDEO DATA TO THREAD CORRESPONDING TO CLIENT
102,103
MANIPULATION DISPLAY TERMINAL
COMMAND
THREAD CORRESPONDING TO TERMINAL
S1008
RECEIVE COMMAND
S1009
NOTIFY CLIENT OF COMMAND PROCESSING RESULT
S1010
DELIVER VIDEO DATA TO CLIENT
S1011
END THREAD
END

FIG. 10

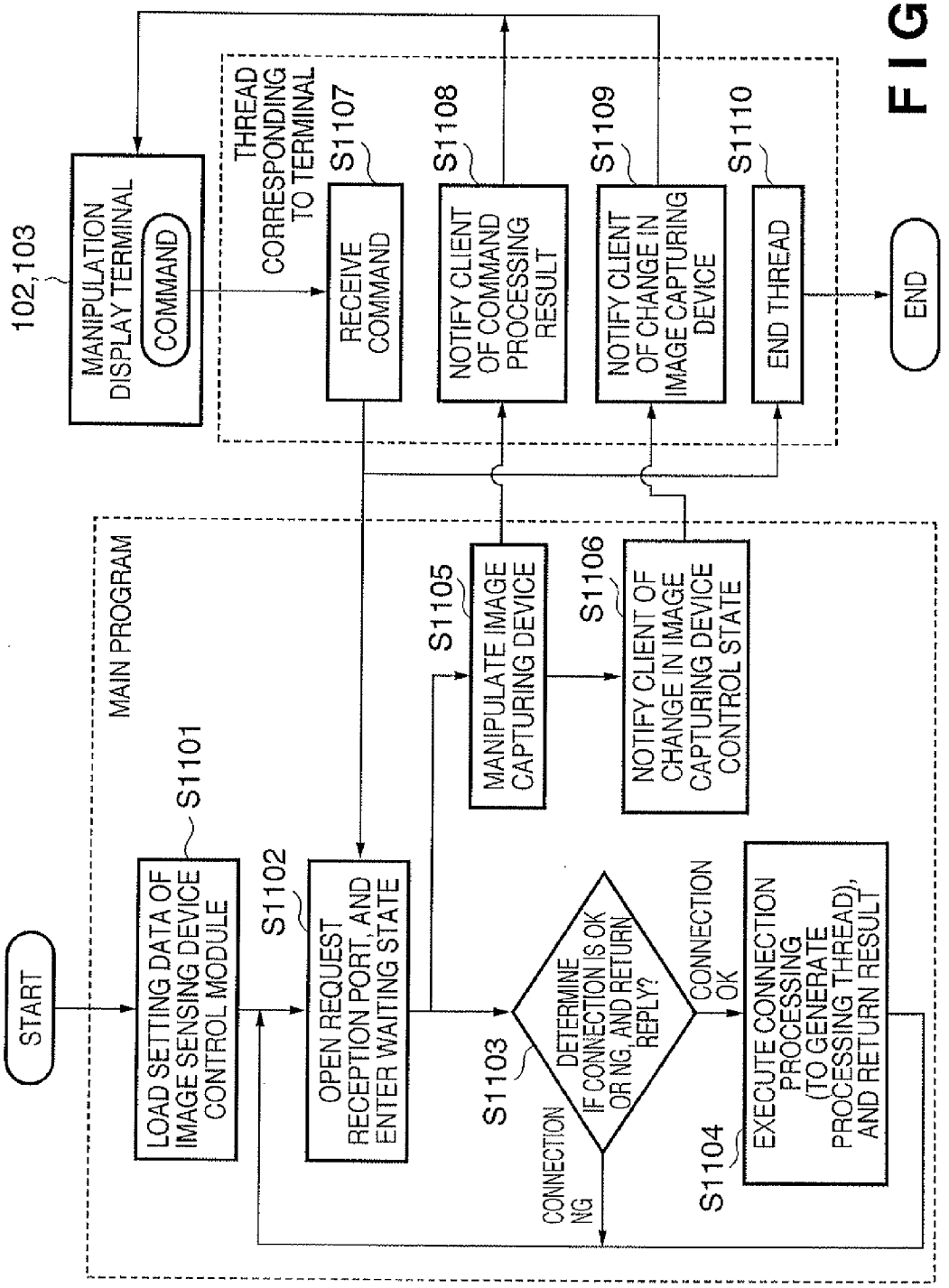

START
MAIN PROGRAM
S1101
LOAD SETTING DATA OF IMAGE SENSING DEVICE CONTROL MODULE
S1102
OPEN REQUEST RECEPTION PORT, AND ENTER WAITING STATE
S1103
DETERMINE IF CONNECTION IS OK OR NG, AND RETURN REPLY?
CONNECTION NG
CONNECTION OK
S1104
EXECUTE CONNECTION PROCESSING (TO GENERATE PROCESSING THREAD), AND RETURN RESULT
S1105
MANIPULATE IMAGE CAPTURING DEVICE
S1106
NOTIFY CLIENT OF CHANGE IN IMAGE CAPTURING DEVICE CONTROL STATE
102,103
MANIPULATION DISPLAY TERMINAL
COMMAND
THREAD CORRESPONDING TO TERMINAL
S1107
RECEIVE COMMAND
S1108
NOTIFY CLIENT OF COMMAND PROCESSING RESULT
S1109
NOTIFY CLIENT OF CHANGE IN IMAGE CAPTURING DEVICE
S1110
END THREAD
END

FIG. 11

FIG. 12

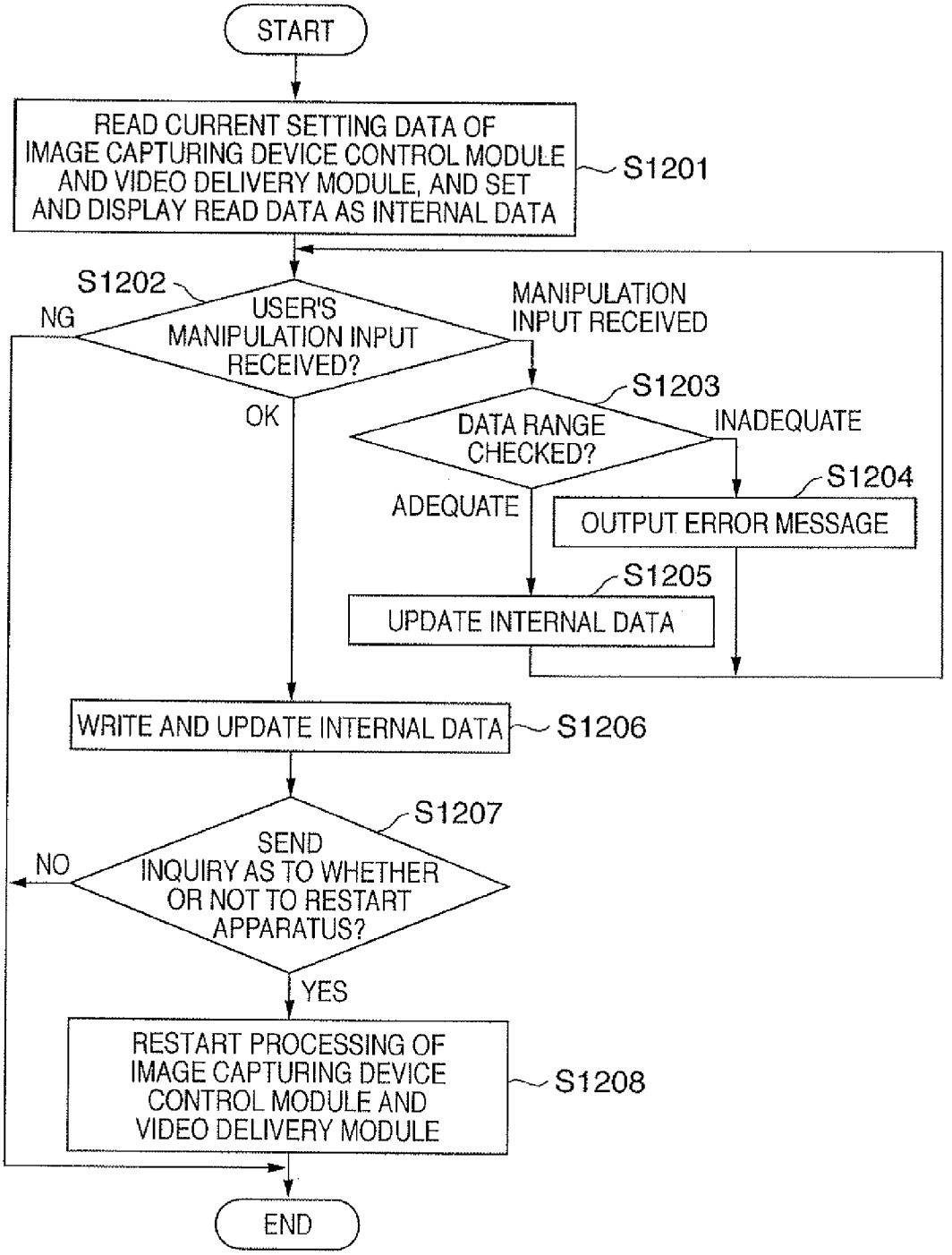
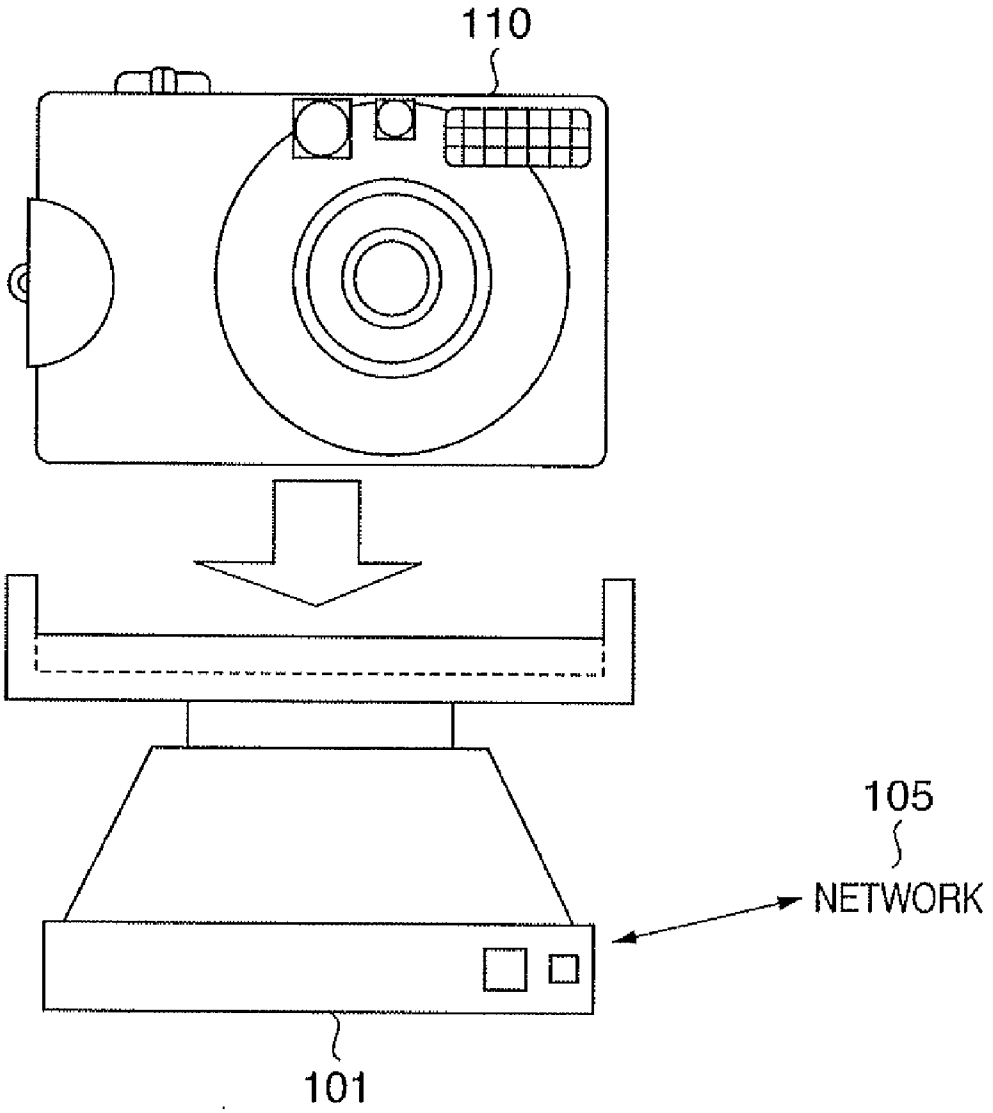

START
READ CURRENT SETTING DATA OF IMAGE CAPTURING DEVICE CONTROL MODULE AND VIDEO DELIVERY MODULE, AND SET AND DISPLAY READ DATA AS INTERNAL DATA
S1201
S1202
USER'S MANIPULATION INPUT RECEIVED?
NG
OK
MANIPULATION INPUT RECEIVED
S1203
DATA RANGE CHECKED?
INADEQUATE
ADEQUATE
S1204
OUTPUT ERROR MESSAGE
S1205
UPDATE INTERNAL DATA
WRITE AND UPDATE INTERNAL DATA
S1206
S1207
SEND INQUIRY AS TO WHETHER OR NOT TO RESTART APPARATUS?
NO
YES
RESTART PROCESSING OF IMAGE CAPTURING DEVICE CONTROL MODULE AND VIDEO DELIVERY MODULE
S1208
END

FIG. 13



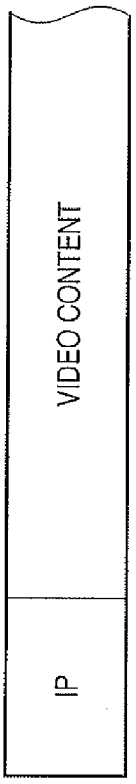


FIG. 14A

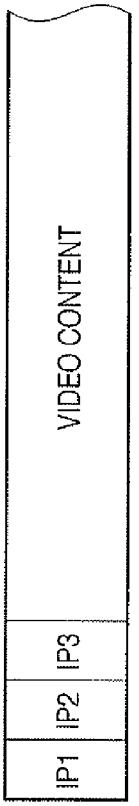


FIG. 14B

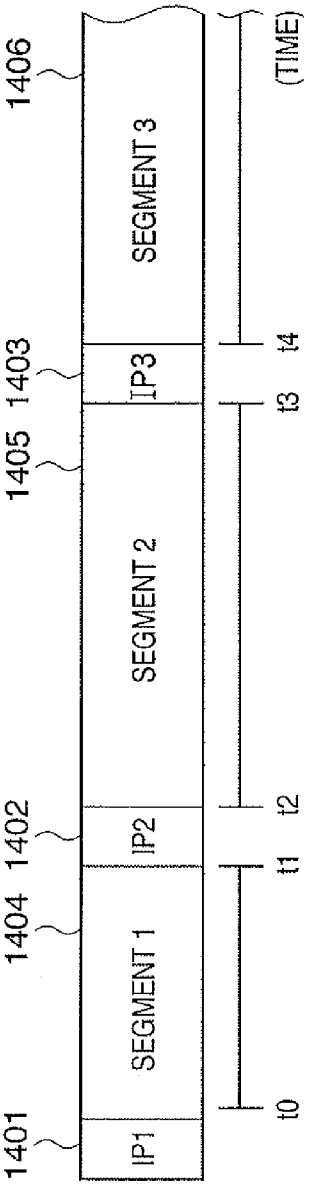
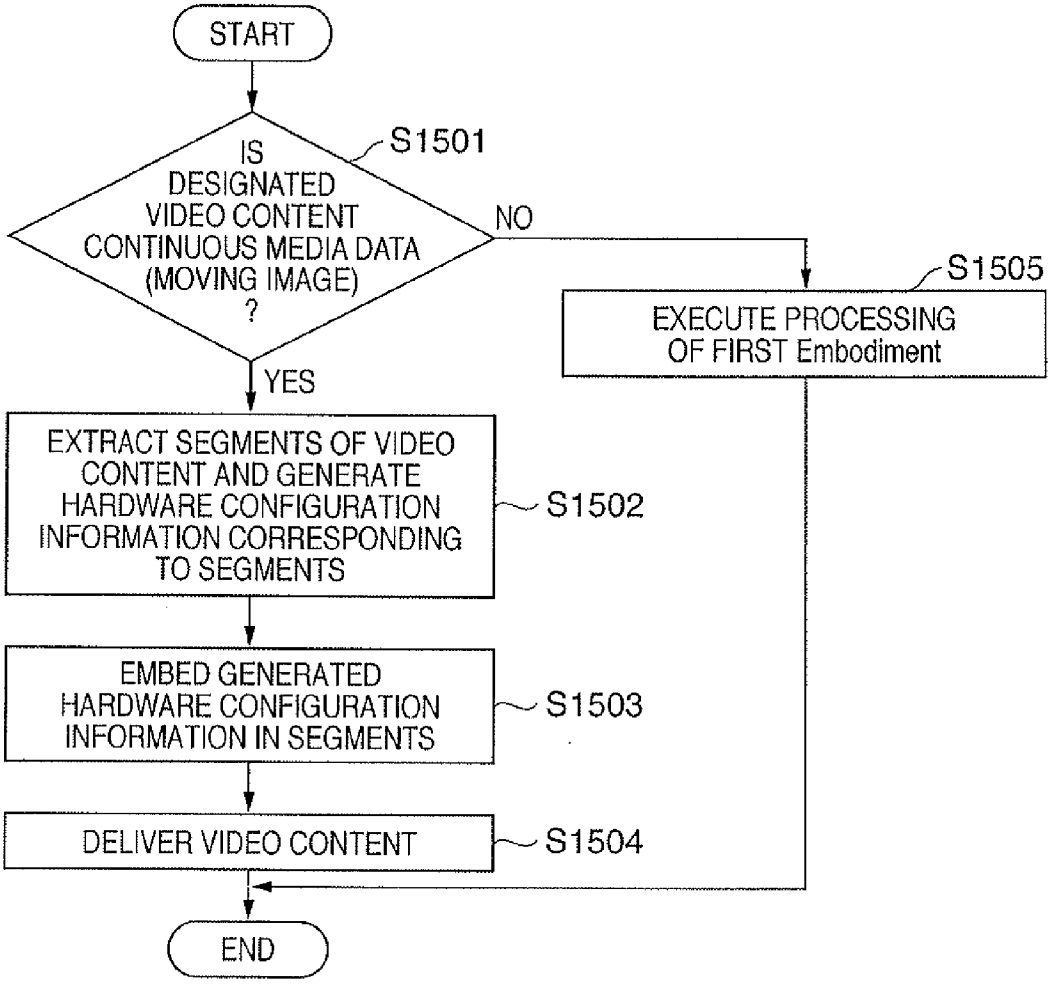


FIG. 14C

FIG. 15


START
IS DESIGNATED VIDEO CONTENT CONTINUOUS MEDIA DATA (MOVING IMAGE) ?
S1501
NO
YES
S1505
EXECUTE PROCESSING OF FIRST Embodiment
EXTRACT SEGMENTS OF VIDEO CONTENT AND GENERATE HARDWARE CONFIGURATION INFORMATION CORRESPONDING TO SEGMENTS
S1502
EMBED GENERATED HARDWARE CONFIGURATION INFORMATION IN SEGMENTS
S1503
DELIVER VIDEO CONTENT
S1504
END

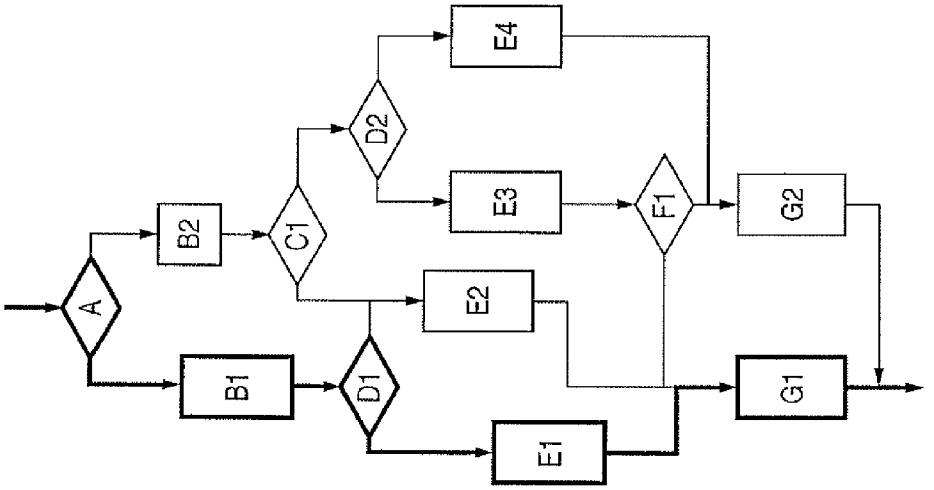


FIG. 16B

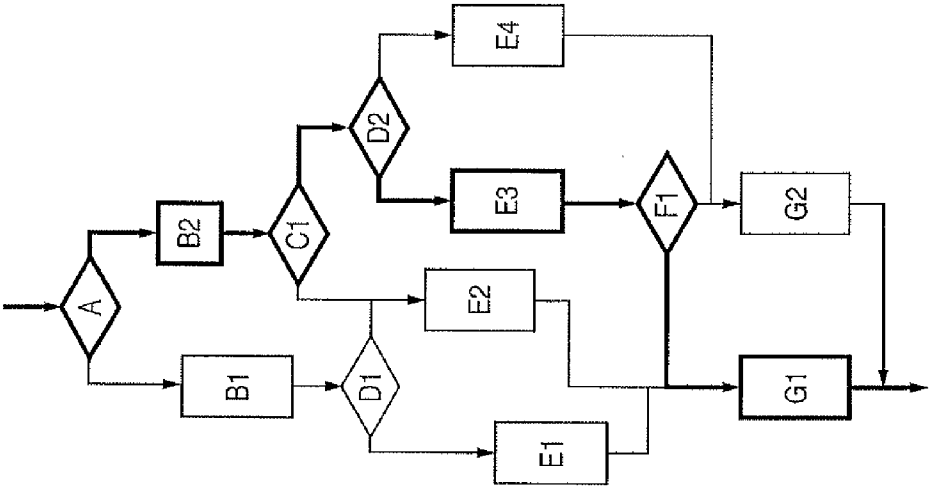


FIG. 16A

INFORMATION DELIVERY APPARATUS, INFORMATION REPRODUCTION APPARATUS, AND INFORMATION PROCESSING METHOD

TECHNICAL FIELD

[0001] The present invention relates to a technology for delivering video information and reproducing the delivered video information.

BACKGROUND ART

[0002] The background art of the present invention will be explained from the viewpoints of a network camera technology, network interconnection technology, home network connection technology, dynamically reconfigurable hardware technology, and the like.

[0003] [Network Camera Technology]

[0004] A technology for delivering a captured live video using a communication infrastructure such as the Internet or the like, and instructing camera settings, camera manipulations, and the like to capture a video has been established (e.g., Japanese Patent Laid-Open Nos. 09-289607 and 2001-285179). In a video delivery system or the like using the communication infrastructure, camera control such as pan, tilt, zoom, and backlight correction can be provided via a network in addition to video delivery. Such video delivery system comprises an access control function, and can limit camera control and video delivery in accordance with the user's access permissions.

[0005] Furthermore, this system can impose limitations on a region to be captured by the camera control. For example, the following limitations are imposed: an authorized user can use all zoom functions of a camera, but a normal user can use only some of the zoom functions. The same applies to pan and tilt functions.

[0006] PTP (Picture Transfer Protocol) has been specified as a protocol for manipulating a digital camera and digital camcorder via a device connection interface such as USB. The PTP allows standard image capturing settings, and transfer of videos of a digital camera. On the other hand, some camera devices have unique settings and manipulations which cannot be described by the PTP.

[0007] [Network Interconnection Technology]

[0008] As a technology for interconnecting devices connected to a network, for example, UPnP (Universal Plug and Play) was proposed in 1999 by Microsoft, and has been popularized and examined by the UPnP forum.

[0009] In the UPnP, the properties and capabilities of each other's devices are recognized via steps of (1) addressing, (2) discovery, and (3) description (capability description). The UPnP is specified to make (4) control, (5) sending an event, and (6) presentation based on the recognition in steps (1) to (3). In the description (capability description) step in the UPnP, capability descriptions of each other's devices to be connected are exchanged. The UPnP principally aims at reducing configuration by a user and the like as much as possible, by making manipulations or status reflection according to the capability of a communication partner in the subsequent control step and the event sending step.

[0010] [Home Network Connection Technology]

[0011] DLNA (Digital Living Network Alliance) is designing the specifications on the assumption of audio visual delivery use in home networks. The DLNA designs the specifications that strictly specify audio visual codecs and media transfer protocols based on the UPnP specifications (including the UPnP AV specifications) so as to further improve connectability.

[0012] The home network connection technology, such as the DLNA or the like, mainly covers delivery of video and music data stored in a storage device (storage) such as an HDD recorder or the like, but it can also be applied to delivery of live videos. For example, the UPnP AV specifications specify a media transfer protocol between Media Server and Media Renderer to be out-of-band. On the other hand, the DLNA specifications specify HTTP (HyperText Transfer Protocol) or RTP (Real-time Transport Protocol).

[0013] [Dynamically Reconfigurable Hardware Technology, Etc.]

[0014] A DRP (Dynamically Reconfigurable Processor) is a known dynamically reconfigurable hardware technology or dynamically reconfigurable processor.

[0015] A Field Programmable Gate Array, or FPGA, is a conventionally available dynamically reconfigurable hardware technology. The DRP is the same as the conventional FPGA since it allows operations and behaviors according to hardware configuration information, also called Intellectual Property, or "IP", by writing the hardware configuration information to a microprocessor or ASIC.

[0016] The DRP can designate the operations of the microprocessor or the like using the hardware configuration information, and forms processing blocks that implement information processing according to the hardware configuration information.

[0017] The DRP can rewrite the processing blocks for short time cycles (e.g., one clock), and can virtually develop many processing circuits in a limited LSI area compared to the FPGA which two-dimensionally develops and connects all processing blocks. As a result, the DRP can shorten the wiring length upon execution of certain processing and can increase the operation speed.

[0018] [Embedded Intellectual Property (IP) Technology]

[0019] A technology that implements various hardware design data and distributes them as embedded Intellectual Property (IP) has come into widespread use. Typically, various hardware module functions are described on a data path level. Then, the embedded IP is supplied as a library that can be linked to the logic synthesis development environment of hardware using HDL (Hardware Description Language: Verilog, VHDL, or the like) of the user.

[0020] In recent years, along with the prevalence of digital cameras or digital videos and the introduction of video devices in home, a wide variety of video content is easily generated. As a result, in order to handle a wide variety of video information (video content), digital cameras and digital video or hardware and software of players become larger in scale and more complicated, thus raising the development cost, purchase price, or consumption power of the devices.

[0021] Especially, video content are shared via networks in home, and different kinds of video content can be easily accessed, thus further distinguishing the aforementioned problems.

[0022] The present invention has been made to solve such problems, and has as its object to provide a technology that

implements reproduction processing according to video information (video content) with low cost and low consumption power.

DISCLOSURE OF INVENTION

[0023] Embodiments of the present invention are provided to overcome the above-described drawbacks of the related technology.

[0024] According to an aspect of the present invention, an embodiment is directed to an information delivery apparatus which can deliver content information, comprising:

[0025] a generation unit adapted to generate configuration information required to configure data paths of a reconfigurable processor that executes reproduction processing of the content information; and

[0026] a delivery unit adapted to deliver the content information and the configuration information generated by said generation unit.

[0027] According to another aspect of the present invention, an embodiment is directed to an information reproduction apparatus which receives and reproduces content information delivered by an information delivery apparatus, comprising:

[0028] a reconfigurable processor adapted to execute reproduction processing of the content information;

[0029] an assignment unit adapted to assign resources of said reconfigurable processor which reproduces the content information; and

[0030] a configuration unit adapted to configure data paths of the resources of said reconfigurable processor assigned by said assignment unit based on configuration information delivered by the information delivery apparatus.

[0031] According to the present invention, reproduction processing according to video information can be implemented with low cost and low consumption power.

[0032] Further features of the present invention will become apparent from the following description of exemplary embodiments with reference to the attached drawings.

BRIEF DESCRIPTION OF DRAWINGS

[0033] FIG. **1** is a diagram showing a typical use mode of an information delivery apparatus according to an embodiment of the present invention;

[0034] FIG. **2** is a block diagram showing an example of the hardware arrangement which makes an information delivery apparatus **101** operate;

[0035] FIG. **3** is a view for explaining a reconfigurable processor (DRP) according to the embodiment of the present invention;

[0036] FIG. **4** is a block diagram showing an example of the hardware arrangement which makes manipulation display terminals **102** and **103** operate;

[0037] FIG. **5**A is a diagram showing the configuration of program modules according to the embodiment of the present invention;

[0038] FIG. **5**B is a diagram showing an example of the configuration of program modules included in a video delivery module **501** and a video reproduction display module **503**;

[0039] FIG. **6** is a flowchart for explaining the processing of the video reproduction display module **503** in the manipulation display terminal;

[0040] FIG. **7** is a flowchart for explaining the processing of an image capturing device manipulation module **504** in the manipulation display terminal;

[0041] FIG. **8** is a flowchart for explaining the processing of a DRP configuration module **520** in the manipulation display terminal;

[0042] FIG. **9** is a flowchart for explaining the processing of a DRP configuration information generation module **511** in the information delivery apparatus **101**;

[0043] FIG. **10** is a flowchart for explaining the processing of the video delivery module **501** in the information delivery apparatus **101**;

[0044] FIG. **11** is a flowchart for explaining the processing of an image capturing device control module **502** in the information delivery apparatus **101**;

[0045] FIG. **12** is a flowchart for explaining the processing of a setting module **505** in the information delivery apparatus **101**;

[0046] FIG. **13** is a view for exemplifying a state in which an image capturing device **110** is attached to the information delivery apparatus **101**;

[0047] FIGS. **14**A to **14**C are views for exemplifying embedded states of hardware configuration information in video content;

[0048] FIG. **15** is a flowchart showing the procedure of the schematic processing according to the second embodiment from the viewpoint of a difference from the first embodiment; and

[0049] FIGS. **16**A and **16**B are views for exemplifying data paths to be analyzed depending on video content.

BEST MODE FOR CARRYING OUT THE INVENTION

First Embodiment

[0050] The first embodiment of the present invention will be described hereinafter with reference to the accompanying drawings. An information delivery apparatus according to the embodiment comprises an arrangement which predicts and analyzes reproduction processing of information to be delivered, and can embed hardware configuration information (IP) in the information to be delivered. Content information to be delivered by the information delivery apparatus includes, for example, audio information, music information, and video information, i.e., still images and moving images, with delivery of moving images to be described in detail in the second embodiment, and with these pieces of information to be referred to as "content information" hereinafter. In the following description, delivery of video information, or video content will be exemplified. However, the gist of the present invention is not limited to such specific example, and the content information to be delivered includes audio information, including music information and the like.

[0051] The information delivery apparatus according to the embodiment predicts data paths of reproduction processing according to the contents of a video content, and embedding a plurality of IPs at the head the video content in turn, from data paths to be used frequently.

[0052] FIG. **1** is a diagram showing a typical use mode of an information delivery apparatus according to the embodiment of the present invention. An information delivery apparatus (video content source) **101** and manipulation display terminals (video viewers) **102** and **103** are connected to a network **105**. An image capturing device **110** can be detachably

attached to the information delivery apparatus **101**. FIG. **13** exemplifies a state in which the image capturing device **110** is attached to the information delivery apparatus **101**. The image capturing device **110** includes devices which can capture still images or moving images such as digital cameras, digital video cameras, and the like. The information delivery apparatus **101** can deliver image data captured by the image capturing device **110** as a video content via the network **105** while embedding hardware configuration information (IP) in the video content.

[0053] To the network **105**, a network attached storage (NAS) **120** is further connected. The NAS **120** can accept a data storage or browse request from other devices connected to the network **105**. The NAS **120** can also comprise a home NAS, a large-scale NAS for business use, or a storage service provided by another device.

[0054] The manipulation display terminal **102** sends a video delivery request to the information delivery apparatus **101** via a network access point (access point (AP)) **104**. Upon reception of the video delivery request, the information delivery apparatus **101** delivers video data corresponding to the video delivery request to the manipulation display terminal **102** via the access point **104**. Upon reception of the delivered video data, the manipulation display terminal **102** allows the user to watch a video at the terminal.

[0055] Also, the manipulation display terminal **102** or **103** can send manipulation requests such as pausing, fast-forwarding, and the like of the video content to be sent, and an image capturing request of a video content using the image capturing device **110** to the information delivery apparatus **101** via the access point **104**.

[0056] In FIG. **1**, the network **105** may be a network managed in home or an organization, or the Internet, which is in widespread use. Furthermore, two-way communication media between devices may be wired or wireless.

[0057] (Example of Arrangement of Information Delivery Apparatus)

[0058] FIG. **2** is a block diagram showing an example of the hardware arrangement which makes the information delivery apparatus **101** operate. The information delivery apparatus **101** has a storage device **204** which stores programs and processing results, a CPU **201** which executes various kinds of processing based on programs, and a network interface **203** required to connect the network **105**. Furthermore, the information delivery apparatus **101** has a USB interface (USB) **205** required to connect the image capturing device **110** such as a digital camera or the like, and a memory **202** which serves as a work area upon execution of processing by the CPU **201**. Also, the information delivery apparatus **101** comprises a display device **207**, which can display setting information of program modules, update results of the setting information based on user's operation input, and the like.

[0059] The CPU **201**, memory **202**, network interface **203**, storage device **204**, USB **205**, and display device **207** are connected via an internal bus **206** of the information delivery apparatus **101**, and can communicate with each other.

[0060] The storage device **204** may comprise a non-volatile memory such as an HDD device, flash memory, or the like in addition to a RAM that allows high-speed access, or may comprise a removable storage device. The network interface **203** may comprise a wireless interface in addition to a wired interface. The interface used to connect the image capturing device **110** (e.g., digital camera) is not limited to USB, and may comprise, e.g., IEEE 1394.

[0061] (Description of Reconfigurable Processor)

[0062] FIG. **3** is a view for explaining a reconfigurable processor (DRP) according to the embodiment. A DRP core has 64 (8×8) PEs processing elements **301** arranged in a matrix as basic units, and MEs memory elements **302** located around the PEs.

[0063] Furthermore, the DRP comprises data switches (not shown) which freely couple elements such as the PEs **301** and MEs **302**, a sequencer **303** which designates a data path plane described in hardware configuration information (IP), and the like. The DRP can be configured by one or more DRP cores, an FPU (Floating Point Unit), an external memory controller, an inter-processor communication controller such as a bus or the like, a clock, and the like.

[0064] The sequencer **303** can cooperate the PEs **301** and MEs **302** by switching the data path plane of the PEs **301** and MEs **302** in the DRP. When the DRP comprises a plurality of sequencers **303**, a data path plane can be configured for some designated PEs **301** and MEs **302**.

[0065] The sequencer **303** can issue a data path plane designation pointer in response to a trigger event from the PEs **301**. Also, the sequencer **303** can also issue the data path plane designation pointer in response to an external signal from the CPU **201** or the like. The sequencer **303** can reconfigure the data path plane configured by a combination of the PEs by switching processing functions of each PE **301** by the designation pointer.

[0066] The configuration of the DRP core is not limited to that of the 8×8 matrix of the PEs **301**. For example, the sequencers **303** of a plurality of DRP cores may share a pointer signal used to designate the data path plane to configure a data path plane with a larger scale. The individual sequencers **303** may be independently controlled and may be assigned with different tasks.

[0067] FIGS. **16**A and **16**B exemplify data paths analyzed depending on video contents. A data path of reproduction processing starts from, e.g., checking process A to execute process B**1** or B**2**. In a data path of process B**1**, process E**1** or E**2** is executed depending on the checking result in process D**1**, and the process then ends after execution of process G**1**.

[0068] On the other hand, in a data path of process B**2**, the process advances to process E**2** or D**2** depending on a result of checking process C**1**. A data path which advances to process E**2** ends after execution of process G**1**.

[0069] Process E**3** or E**4** is executed depending on the checking result in checking process D**2**. A data path that advances to process E**3** ends after execution of process G**1** or G**2** depending on the checking result in checking process F**1**. A data path that advances to process E**4** ends after execution of process G**2**.

[0070] Resources (PE **301**, ME **302**, and the like) of an information processing processor (DRP **407**) on the reproduction side are assigned according to the scale and operating status of the information processing processor. Hardware configuration information (IP) is generated to designate a data path plane which minimizes consumption power and the like on the reproduction side (manipulation display terminal **102** or **103**) by the assigned resources of the information processing processor (DRP **407**).

[0071] For example, upon reproducing video content A, a data path (indicated by the bold line) in FIG. **16**A is predicted, and hardware configuration information (IP) is generated to designate this data path and is embedded in video content A. Upon reproducing another video content B, a data path (indi-

cated by the bold line) in FIG. **16**B is predicted, and hardware configuration information (IP) is generated to designate the data path and is embedded in video content B.

[0072] (Example of Arrangement of Manipulation Display Terminal)

[0073] FIG. **4** is a block diagram showing an example of the hardware arrangement which makes the manipulation display terminals **102** and **103** operate. Each of the manipulation display terminals **102** and **103** has a storage device **406** which stores programs and processing results, a CPU **403** which executes various kinds of processing based on programs, and a network interface **405** required to connect the network **105**. Each of the manipulation display terminals **102** and **103** has a display device **408** which displays processing results and video content, a display controller **402** which controls the display device **408**, and a memory **404** which serves as a work area upon execution of processing by the CPU **403**. Furthermore, each of the manipulation display terminals **102** and **103** has a peripheral controller **401** which accepts a user's inputs, and a DRP **407** which is dynamically reconfigurable according to hardware configuration information (IP). The peripheral controller **401**, display controller **402**, CPU **403**, memory **404**, network interface **405**, storage device **406**, and DRP **407** are connected via an internal bus **410** of the manipulation display terminal, and can communicate with each other.

[0074] The storage device **406** may comprise a non-volatile memory such as an HDD device, flash memory, or the like in addition to a RAM that allows high-speed access, or may comprise a removable storage device. The network interface **405** may comprise a wireless interface in addition to a wired interface.

[0075] The peripheral controller **401** accepts input information input from input devices, for example, a keyboard **409** and a mouse **410**, and passes data to the CPU **403**, storage device **406**, and the like via the internal bus **410**. Note that the input devices are not limited to the keyboard **409**, mouse **410**, and the like, and a manipulation unit such as an infrared remote controller or the like may be used. When the infrared remote controller is used as the input device, the peripheral controller **401** may be configured as an LED controller or external sensor input/output controller.

[0076] The DRP **407** may be an independent processor, or a functional circuit (IP core) mounted on an LSI of the CPU **403** or the like.

[0077] The configuration of program modules installed in the information delivery apparatus **101** and manipulation display terminals **102** and **103** will be described below. FIG. **5**A is a diagram showing the arrangement of program modules. The information delivery apparatus **101** includes a video delivery module **501**, image capturing device control module **502**, and setting module **505**. Each of the manipulation display terminals **102** and **103** includes a video reproduction display module **503** and image capturing device manipulation module **504**. These program modules are stored in the storage devices **204** and **406** in the respective apparatuses, and can be executed by the CPUs **201** and **403** of the respective apparatuses, and the DRPs **407** in the manipulation display terminals **102** and **103**.

[0078] FIG. **5**B is a diagram showing an example of the configuration of program modules included in the video delivery module **501** and video reproduction display module **503**. The video delivery module **501** includes a video analysis module **510**, DRP configuration information generation module **511**, and DRP configuration information embedding module **512**.

[0079] The video reproduction display module **503** includes a reproduction module **522** which executes reproduction of the delivered video content, a DRP configuration module **520**, a device driver **521** which requests the DRP of some reproduction processes, and the like. The practical processing of the program modules according to the embodiment of the present invention will be described later with reference to FIGS. **6** to **12**.

[0080] Commands which the information delivery apparatus **101** receives from the manipulation display terminal **102** or **103** via the network **105** and access point **104** can be categorized as follows.

[0081] (1) Session Control Command

[0082] Some commands require that a session be established between the information delivery apparatus **101** and manipulation display terminal **102** or **103**. A session control command is specified as a command for the purpose. For example, the category of the command includes a session start command and end command.

[0083] (2) Image Capturing Device Control Command

[0084] A command used to transfer the image capturing device control right is specified for manipulation commands which require exclusive access control in access on the information delivery apparatus **101**. For example, manipulations such as a zoom manipulation of the image capturing device **110**, delivered video delete manipulation, and the like require exclusive access control. The manipulation display terminal **102** or **103** which holds the image capturing device control right can control the image capturing device **110** with this command. Note that not only control of the image capturing device **110** but also some commands (e.g., panpod pan/tilt control or the like) associated with the information delivery apparatus **101** are included in this command category since the image capturing device control right is required.

[0085] (3) Camera Browse Command

[0086] This command is a manipulation command associated with the internal state (including storage and delivery of stored video contents and the like) on the information delivery apparatus **101**.

[0087] (4) Image Capturing Device Setting Command

[0088] This command is a manipulation command used to change the settings of the information delivery apparatus **101**.

[0089] (Operation Flowcharts of Manipulation Display Terminals and Information Delivery Apparatus)

[0090] The operation flowcharts of the manipulation display terminals **102** and **103** and the information delivery apparatus **101** will be described hereinafter. Note that the manipulation display terminals **102** and **103** have already separately acquired connection information to the information delivery apparatus **101**, routing information to the AP (access point) **104** in the middle of a route, and the like. Since these pieces of information can be acquired using the known IP (Internet Protocol) technology, UPnP (Universal Plug-n-Play) technology, Web (World Wide Web) technology, and the like, a description thereof will be omitted.

[0091] (Processing of Video Reproduction Display Module **503**)

[0092] FIG. **6** is a flowchart for explaining the processing of the video reproduction display module **503** in the manipulation display terminal **102** or **103**. The CPU **403** executes the processing of the video reproduction display module **503**.

[0093] In step S**601**, the CPU **403** sends an inquiry about video contents that can be provided by the information delivery apparatus **101**. Note that video contents include video contents stored in the information delivery apparatus **101**, and live video contents acquired from the image capturing device **110**. These contents will be generically referred to as video contents.

[0094] Assume that each video content is appended with information such as the resolution, codec, reproducing time, data rate (bit rate), title and language, or the like, and video content attribute information such as an access control attribute, copyright protection scheme (including an encryption/decryption scheme), or the like.

[0095] Upon sending the inquiry in this step, the CPU **403** can designate video contents by designating some pieces of video content attribute information. For example, the CPU **403** may designate to request the information delivery apparatus **101** to add, to an inquiry result, information indicating whether or not each video content includes hardware configuration information (IP) of the DRP **407**, the scale (how to built the data path plane) of the hardware configuration information (IP), and the like. The information delivery apparatus **101** sends the inquiry result of the video content to the manipulation display terminal **102** or **103** as a request source.

[0096] In step S**602**, the CPU **403** displays a list of video content obtained from the information delivery apparatus **101** on the display device **408**, and waits for a user's selection instruction about which of video contents is to be reproduced.

[0097] In step S**603**, the CPU **403** receives the user's selection instruction. If the user cancels reproduction (YES in S**604**), the process ends.

[0098] On the other hand, if it is determined in step S**604** that the CPU **403** receives the user's selection instruction indicating that he or she designates one of the video content which are displayed in the list, and requests to reproduce it (NO in S**604**), the process advances to step S**605**.

[0099] In step S**605**, the CPU **403** starts reproduction processing of the video content selected by the user. The CPU **403** launches the reproduction module **522** which executes the reproduction processing of the video content.

[0100] In step S**606**, the CPU **403** acquires various kinds of information required for the reproduction module **522**, and sets up the reproduction module **522**. Note that various kinds of information required to set up the reproduction module **522** include information which is acquired from the information delivery apparatus **101** and is associated with the resolution, codec, copyright protection scheme (including an encryption/decryption scheme), or the like of the video content to be reproduced. The reproduction module **522** in this embodiment is configured to request the manipulation display terminal DRP processing of some reproduction processes based on the hardware configuration information (IP) designated in the video content.

[0101] In step S**607**, the CPU **403** instructs the information delivery apparatus **101** to deliver the designated video content.

[0102] In step S**608**, the CPU **403** receives information sent from the information delivery apparatus **101**, and the reproduction module reproduces the video content on the display device **408** based on the received information.

[0103] Note that the information of the video content includes information obtained by appropriately demultiplexing video and audio streams multiplexed on the communication path with the information delivery apparatus **101**, and appropriately coupling packetized video bitstreams. Since the processing in the reproduction module **522** is the same as normal video bitstream reproduction processing, a description thereof will be omitted.

[0104] Also, a hardware configuration information (IP) group of the DRP which is embedded in the video content is demultiplexed before the beginning of the processing of this step (S**608**). The hardware configuration information (IP) group demultiplexed (extracted) from the video content is transferred to the DRP configuration module **520** (see FIG. **5**B) of the video reproduction display module **503**. The DRP configuration module **520** reconfigures the hardware configuration (processing elements PE (FIG. **3**)) based on the received hardware configuration information (IP) group.

[0105] The reproduction module **522** can reproduce the video content using the reconfigured processing elements PE of the DRP **407** in the process of step S**608**.

[0106] In accordance with the hardware configuration information (IP) demultiplexed from the video content, resetup or substitution of the reproduction module **522** can be made.

[0107] After completion of step S**608**, the process ends. Note that if the user's cancel manipulation is determined in step S**604**, the processing of the video reproduction display module **503** ends. Alternatively, the process may return to step S**601**, S**602**, or S**606**, and the manipulation display terminal may be set in a standby state to wait for a user's instruction again.

[0108] (Processing of Image Capturing Device Manipulation Module **504**)

[0109] FIG. **7** is a flowchart for explaining the processing of the image capturing device manipulation module **504** in the manipulation display terminal **102** or **103**. The CPU **403** executes the processing of the image capturing device manipulation module **504**.

[0110] In step S**701**, the CPU **403** displays a GUI associated with manipulations of the image capturing device **110** on the display device **408**. The CPU **403** establishes a session between the information delivery apparatus **101** and manipulation display terminal **102** or **103** using the aforementioned session control command.

[0111] In step S**702**, the CPU **403** waits for a user's instruction associated with a manipulation of the image capturing device **110**.

[0112] The CPU **403** receives a user's instruction associated with a manipulation of the image capturing device **110**, and checks in step S**703** if the user's instruction is a manipulation end instruction of the image capturing device **110**.

[0113] If the user's instruction is a manipulation end instruction of the image capturing device **110** (YES in S**703**), the CPU **403** advances the process to step S**706**, thus ending the session.

[0114] On the other hand, if it is determined in step S**703** that the user's instruction is not a manipulation end instruction of the image capturing device **110** (NO in S**703**), the CPU **403** advances the process to step S**704**.

[0115] In step S**704**, the CPU **403** issues a control command of the image capturing device **110** for the designated control of the image capturing device **110**, and sends the command to the information delivery apparatus **101**.

[0116] In step S**705**, the manipulation display terminal **102** or **103** receives, from the information delivery apparatus **101**, a video content captured by the image capturing device **110** as a response (reply) to the control command of the image cap-

turing device issued in step S704 above. The CPU **403** controls the reproduction module **522** to display the received video content on the display device **408** of the manipulation display terminal **102** or **103** in accordance with its content.

[0117] Upon completion of the process in step S705, the process returns to step S702 again to repeat the same processes.

[0118] When the manipulation of the image capturing device **110** is to end finally, the CPU **403** advances the process to step S706, and ends the session between the information delivery apparatus **101** and manipulation display terminal **102** or **103**.

[0119] Note that the information delivery apparatus **101** can append hardware configuration information (IP) to the video content delivered in step S705 in FIG. **7**, and can deliver the video content to the manipulation display terminal **102** or **103**. The manipulation display terminal **102** or **103** demultiplexes (extracts) a hardware configuration information (IP) group from the video content (captured by the image capturing device **110**) sent from the information delivery apparatus **101**, and transfers it to the DRP configuration module **520**. The DRP configuration module **520** reconfigures the hardware configuration (processing elements PE (FIG. **3**)) based on the transferred hardware configuration information (IP) group. The reproduction module **522** can reproduce the video content captured by the image capturing device **110** using the reconfigured processing elements PE of the DRP **407**.

[0120] (Processing of DRP Configuration Module **520**)

[0121] The processing of the DRP configuration module **520** in the manipulation display terminal **102** or **103** will be described below with reference to FIG. **8**. The CPU **403** executes the processing of the DRP configuration module **520**.

[0122] In step S801, the CPU **403** acquires information associated with the scale (size) and operating status of the resources of the DRP **407** equipped in the manipulation display terminal **102** or **103**.

[0123] In step S802, the CPU **403** assigns the resources of the DRP **407** in association with the reproduction processing of the video content based on at least one of the acquired information associated with the scale (size) and operating state of the DRP **407**. Typically, the CPU **403** can assign processing elements PE as idle DRP resources of those which configure the DRP **407**. Furthermore, the CPU **403** can set DRP resources to be assigned to reproduce of the video content in consideration of conditions such as priority of processing and the like.

[0124] In step S803, the CPU **403** loads a data path plane into the DRP **407** (it reconfigures the resources of the DRP **407**). For example, the CPU **403** loads data path planes of higher levels (higher priority levels) of the designated hardware configuration information group for the DRP in correspondence with the resources of the DRP **407** assigned in step S803 above.

[0125] In step S804, the CPU **403** notifies the reproduction module **522** of success or failure of loading, a sequence number (instruction pointer of the DRP **407**) assigned to each data path plane, and the like. The reproduction module **522** can execute reproduction processing of the video content using the configured data path planes via the sequence numbers.

[0126] If necessary, the reproduction module **522** may be substituted and may then be re-set up.

[0127] For example, assume that the DRP **407** of the manipulation display terminal **102** or **103** is configured by PEs which can hold 256 data path planes, and processing for 200 data path planes of these planes is being executed at a higher priority level than the video reproduction processing of this embodiment. In this case, the remaining 56 planes are data path planes which can be used in the video reproduction processing. In this case, of the hardware configuration information (IP) group designated in the video content, the DRP **407** of the manipulation display terminal **102** or **103** is reconfigured (loaded) in turn by the IPs of higher priority levels.

[0128] (Processing of DRP Configuration Information Generation Module **511**)

[0129] FIG. **9** is a flowchart for explaining the processing of the DRP configuration information generation module **511** in the image capturing device **110**.

[0130] This processing of the DRP configuration information generation module **511** predicts a data path used in the reproduction processing of the reproducer (manipulation display terminal **102** or **103**) upon execution of the encoding processing by the information delivery apparatus **101**. Then, this processing can generate a hardware configuration information (IP) group for the DRP **407**, which is embedded in the video content. The CPU **201** executes the DRP configuration information generation module **511**.

[0131] In step S901, the CPU **201** collects parameter information for each encode rule applied to the encode processing of the video content, and statistical information of encoded video data generated during the encode processing.

[0132] Note that the parameter information for each encoding rule includes, e.g., a macroblock division size, the presence/absence and range of intra-frame prediction, the presence/absence of B-frames (Bi-directional frames), the range of reference frames, bit rate control information, and the like. Also, the parameter information may include unique parameters depending on encode schemes. For example, the parameter information may include mode designation of CABAC (Context-based Adaptive Binary Arithmetic Coding) of H.264 (MPEG-4 Part 10 AVC) or the like.

[0133] In step S902, the CPU **201** predicts processes of decode processing from the information collected in step S901 above. More specifically, the CPU **201** calculates use statistics (frequencies) of data paths in the decode processing, and ranks respective data paths.

[0134] In step S903, the CPU **201** generates hardware configuration information (IP) of the DRP for the video content based on the ranks of the data paths of the respective decode processes and the size of the corresponding hardware configuration information of the DRP. In the process of step S902, if there are a plurality of hardware configuration information (hardware configuration information group) required to configure a plurality of ranked data paths, a group of a plurality of pieces of hardware configuration information (IP) of the DRP are generated. At this time, information such as the above rank information or the like is added to the hardware configuration information (IP) group of the DRP in addition to each individual hardware configuration information of the DRP.

[0135] Furthermore, the hardware configuration information (IP) group of the DRP describes designation information of pipeline processing or parallel processing of individual data path planes in the reproduction processing as needed.

[0136] The DRP configuration information embedding module **512** can embed the hardware configuration informa-

tion generated in step S**903** in the video content. The DRP configuration information embedding module **512** predicts data paths of the reproduction processing in accordance with the content of the video content, and can embed the hardware configuration information in the video content in turn from data paths which are used frequently. For example, as shown in FIGS. **14**A and **14**B, the DRP configuration information embedding module **512** can embed a group of a plurality of pieces of hardware configuration information (IP) in the header field at the head of the video content.

[0137] By pipeline designation of the reproduction processing, not only the same processing sequence as software processing is replaced by hardware processing, but also a plurality of processing blocks in the reproduction processing can undergo pipeline processing and parallel processing and their processing results can be combined.

[0138] Assume that the hardware configuration information of the DRP required to configure data paths corresponding to individual processing blocks of the reproduction processing is compiled in advance and is stored in the storage device **204** of the information delivery apparatus **101**.

[0139] (Processing of Video Delivery Module **501**)

[0140] The processing of the video delivery module **501** will be described below. FIG. **10** is a flowchart for explaining the processing of the video delivery module **501** in the information delivery apparatus **101**. The CPU **201** executes the processing of the video delivery module **501**.

[0141] In step S**1001**, the CPU **201** reads out operation setting information of the video delivery module, and starts an operation based on the operation setting information. In this step, the CPU **201** generates a thread for acquiring and encoding the video content (in an idle state at the time of generation).

[0142] In step S**1002**, the CPU **201** opens a request reception port, and enters a waiting state (request reception state) to wait for a request from the manipulation display terminal **102** or **103** as a client.

[0143] Upon reception, as a request, of, e.g., a video delivery request, a command request such as encode parameter change, browsing, or the like, and so forth, the CPU **201** exits step S**1002** and advances the process to step S**1005** to process various commands. On the other hand, if a command is a connection request from the manipulation display terminal **102** or **103**, the CPU **201** checks in step S**1003** if connection is OK or NG.

[0144] If it is determined in step S**1003** that connection is NG, the CPU **201** returns an error code indicating that connection is NG, and returns the process to step S**1002**.

[0145] On the other hand, if connection is OK, the CPU **201** advances the process to step S**1004**. The CPU **201** generates, as connection processing, a thread (corresponding to steps S**1008** to S**1011**) which executes reception processing of a command as the manipulation display terminal **102** or **103** as a client. The CPU **201** registers the manipulation display terminal **102** or **103** as a client. If the thread that acquires and encodes the video content is idle, the CPU **201** exits this step after it instructs that thread to start its operation, and returns the process to step S**1002**.

[0146] Of the flowchart shown in FIG. **10**, steps S**1008** to S**1011** form a flowchart for explaining the processing of the thread which is generated by the process in step S**1004** and corresponds to each client.

[0147] In step S**1008**, the CPU **201** receives a command from the corresponding client. If a command from the manipulation display terminal **102** or **103** reaches, the CPU **201** receives the command, and transfers it to step S**1002** of a main program that implements the video delivery processing.

[0148] The CPU **201** receives the command in step S**1002** of the main program, and if that command is an encode parameter change command, browsing command, or the like, the CPU **201** advances the process to step S**1005**.

[0149] The CPU **201** executes the processing of the received command (for example, a change manipulation of settings associated with video encode or the like, browsing in the information delivery apparatus, or the like) in step S**1005**. The CPU **201** notifies step S**1009** of the thread corresponding to the client, which receives the command request, of the command processing result (a code indicating success or failure of the manipulation or a browsing result).

[0150] In step S**1009**, the CPU **201** notifies the manipulation display terminal **102** or **103** as the client of the result transferred from the process in step S**1005** of the main program.

[0151] On the other hand, in step S**1006** of the main program side, the CPU **201** executes processing corresponding to an operation start instruction to the thread, which acquires and encodes the video content, in step S**1004**. That is, in step S**1006** the CPU **201** acquires video data at time intervals which are set in advance. For example, the information delivery apparatus **101** acquires video data (video content) from the image capturing device **110** via the USB interface **205**, and encodes the video data as needed. Alternatively, the information delivery apparatus **101** acquires a video content stored in itself, and encodes video data as needed.

[0152] Furthermore, in step S**1007** the CPU **201** delivers the encoded video data to the thread corresponding to the client.

[0153] In the process of the thread corresponding to the client in step S**1010**, the CPU **201** checks the presence/absence of a next video frame sending request from the client. If the request is present, the CPU **201** delivers the encoded video data to the client (manipulation display terminal **102** or **103**).

[0154] In the process of the thread corresponding to the client, the information delivery apparatus **101** receives a next video frame sending request (which is generally returned in response to completion of reception of video data at the client) from the client. At this time, the CPU **201** sets a video frame sending request flag. If this flag is set, the information delivery apparatus **101** continues acquisition and delivery of the next video data. Upon reception of a connection end command from the client (manipulation display terminal **102** or **103**), the information delivery apparatus **101** notifies the main program of the connection end command, and ends its own thread in step S**1011**.

[0155] The information delivery apparatus **101** delivers the encoded video data (video content) to the client in step S**1010**. This video content is embedded with a hardware configuration information group of the DRP **407** according to the encode content at the time of first delivery, at the time of changes in encoding parameter, or the like. The hardware configuration information group is the processing result of the DRP configuration information generation module described using FIG. **9**. The hardware configuration information can be embedded in the video content by adding it to, e.g., a user defined field in a header field or the like of the format in the video content.

[0156] (Processing of Image Capturing Device Control Module **502**)

[0157] The processing of the image capturing device control module **502** will be described below. FIG. **11** is a flowchart for explaining the processing of the image capturing device control module **502** in the information delivery apparatus **101**. The CPU **201** executes the processing of the image capturing device control module **502**.

[0158] In step S**1101**, the CPU **201** reads out operation setting information of the image capturing device control module **502**, and starts an operation based on the operation setting information.

[0159] In step S**1102**, the CPU **201** opens a request reception port, and enters a waiting state (request reception state) to wait for a request from the manipulation display terminal **102** or **103** as a client. That is, the CPU **201** waits for a request from the manipulation display terminal **102** or **103** as the client.

[0160] Upon reception, as a request, of, e.g., a command request associated with control of the image capturing device **110**, or the like, the CPU **201** exits step S**1102** and advances the process to step S**1105** to process various commands. On the other hand, if a command is a connection request from the manipulation display terminal **102** or **103**, the CPU **201** checks in step S**1103** if connection is OK or NG.

[0161] If it is determined in step S**1103** that connection is NG, the CPU **201** returns an error code indicating that connection is NG, and returns the process to step S**1102**.

[0162] On the other hand, if connection is OK, the CPU **201** advances the process to step S**1104**. The CPU **201** generates, as connection processing, a thread (corresponding to steps S**1107** to S**1110**) which executes reception processing of a command as the manipulation display terminal **102** or **103** as a client. The CPU **201** registers the manipulation display terminal **102** or **103** as a client, and returns the process to step S**1102**.

[0163] Of the flowchart shown in FIG. **11**, steps S**1107** to S**1110** form a flowchart for explaining the processing of the thread which is generated by the process in step S**1104** and corresponds to each client.

[0164] In step S**1107**, the CPU **201** receives a command from the corresponding client. If a command from the manipulation display terminal **102** or **103** reaches, the CPU **201** receives the command, and transfers it to step S**1102** of a main program that implements control of the image capturing device **110** (manipulations of the image capturing device).

[0165] The CPU **201** receives the command in step S**1102** of the main program, and if that command is a manipulation command of the image capturing device **110**, the CPU **201** advances the process to step S**1105**.

[0166] The CPU **201** executes the manipulation of the image capturing device **110** in accordance with the received command in step S**1105**. The CPU **201** notifies the thread corresponding to the client, which receives the manipulation request of the image capturing device **110**, of the command processing result (a code indicating success or failure of the manipulation).

[0167] In step S**1108**, the CPU **201** notifies the manipulation display terminal **102** or **103** as the client of the result transferred from the process in step S**1105** of the main program.

[0168] On the other hand, in step S**1106** of the main program side, the CPU **201** notifies the thread corresponding to the client of a change in control state (e.g., a change in pan, tilt, or zoom value) which has occurred by the manipulation of the image capturing device **110**. In the processing of the thread corresponding to the client, the CPU **201** notifies the client of a change in control state of the image capturing device **110** in step S**1109**.

[0169] Upon reception of a connection end command from the client (manipulation display terminal **102** or **103**), the thread corresponding to the client notifies the main program of the connection end command, and ends itself in step S**1110**.

[0170] Note that a plurality of manipulation dis terminals can request assignment of the manipulation right of the image capturing device **110** before issuance of practical manipulation commands in terms of handling of manipulation commands to avoid contention of the process upon input of manipulation commands of the image capturing device **110**. In this case, each manipulation display terminal issues a request command of acquisition of the control right of the image capturing device **110**. Upon reception of this request command, the processing of the image capturing device control module **502** selects one of processes of rejection, assignment, and waiting from the current assigned state of the image capturing device control right, and returns the selected process to the manipulation display terminal, thus arbitrating assignment of the image capturing device control right.

[0171] The image capturing device control right is deprived due to, e.g., an elapse of shorter one of a specific time period determined in advance or a time period until the manipulation display terminal ends connection, and is assigned to the manipulation display terminal in the waiting state. The client (manipulation display terminal) can control the image capturing device **110** by issuing manipulation commands during a period from acquisition to deprival of the image capturing device control right.

[0172] (Processing of Setting Module **505**)

[0173] The processing of the setting module **505** will be described below. FIG. **12** is a flowchart for explaining the processing of the setting module **505** in the information delivery apparatus **101**. The CPU **201** executes the processing of the setting module **505**.

[0174] In step S**1201**, the CPU **201** reads out setting information associated with the image capturing device control module **502** and video delivery module **501**, and sets the readout information as internal data. The set internal data is displayed on the display device **207** of the information delivery apparatus **101**. Data set as the internal data includes, e.g., data associated with network settings of a network interface, and values associated with band limitations (including QoS settings) and encryption key information. The data associated with the network settings includes, e.g., an IP address, subnet address, subnet mask, routing address, multicast advisability, and the like. The encryption key information includes, e.g., information such as IPsec settings in case of IPv6, WEP (Wired Equivalent Privacy) setting of a wireless LAN, and the like.

[0175] The CPU **201** can set addition or deletion of hardware configuration information (IP) of the compiled DRP stored in the storage device **204** of the information delivery apparatus **101** or use advisability of the DRP by this processing.

[0176] Assume that the setting information (internal data) is stored in a specific file or a system database such as a registry or the like. The CPU **201** receives user's manipulation inputs (e.g., manipulation inputs of the information

delivery apparatus **101** or instructions from the manipulation display terminals **102** and **103**), and reflects the user's manipulation inputs in the internal data by repeating step S**1202** and subsequent steps.

[0177] In step S**1202**, the CPU **201** waits for a user's manipulation input. Upon reception of a manipulation input associated with change or updating of the internal data, the CPU **201** advances the process to step S**1203**.

[0178] The CPU **201** checks in step S**1203** if the manipulation input (e.g., a manipulation input value) falls within an adequate range, thus determining the adequacy of the manipulation input. Upon determining the adequacy of the manipulation input, for example, when the setting information (internal data) suffers inconsistency, or when a parameter setting or the like beyond the specification of hardware is made as the manipulation input, it is determined that such manipulation input is inadequate.

[0179] If the manipulation input is inadequate, the CPU **201** advances the process to step S**1204** to output an error message. The CPU **201** returns the process to step S**1202** without reflecting the user's manipulation input received in step S**1202** above in the internal data.

[0180] On the other hand, if it is determined in step S**1203** that the manipulation input is adequate, the CPU **201** advances the process to step S**1205**. The CPU **201** then updates the internal data displayed on the display device **207** and returns the process to step S**1202**.

[0181] In step S**1202**, the CPU **201** displays the updated internal data on the display device **207** to allow the user to confirm the updated internal data. Upon reception of an input such as selection of an "OK" button (not shown) or the like that accepts the updated content of the internal data, the CPU **201** advances the process to step S**1206**. On the other hand, upon detection of selection of, e.g., an "NG" button (not shown) which indicates that the user determines that the updating of the internal data is inadequate (NG in S**1202**), the CPU **201** ends the process.

[0182] In step S**1206**, the CPU **201** writes the internal data in a specific file or the like which stores the internal data associated with the image capturing device control module **502** and video delivery module **501**, thus updating the content of the file.

[0183] In step S**1207**, the CPU **201** displays, on the display device **207**, an inquiry dialog as to whether or not to restart the information delivery apparatus **101** to reflect the updated internal data.

[0184] If the information delivery apparatus **101** is to be started (YES in S**1207**), the CPU **201** advances the process to step S**1208** to restart the image capturing device control module **502**, video delivery module **501**, and the like, thus ending the processing of the setting module. If it is determined in step S**1207** that the information delivery apparatus **101** is not to be restarted (NO in S**1207**), the CPU **201** ends the processing.

[0185] The information delivery apparatus according to this embodiment, which delivers the video content, predicts the reproduction processing status in each manipulation display terminal, and can embed hardware configuration information in the video content in correspondence with the prediction result.

[0186] According to this embodiment, by embedding the hardware configuration information in the video content, the video content can be reproduced under the conditions suited to the video content to be reproduced and the hardware resources of the manipulation display terminal. In this way, the video content reproduction processing can be implemented with low cost and low consumption power.

Modification of First Embodiment

[0187] The first embodiment has exemplified the case wherein the hardware configuration information is optimized while paying attention to the decode processing of compressed signals in the reproduction processing. However, application of the hardware configuration information is not limited to the decode processing. For example, when the hardware configuration information is applied to authentication processing, encryption/decryption processing, or the like, the copyrights of video content and the like can be further securely protected using key information securely held in hardware.

[0188] When the hardware configuration information is applied to high-image quality processing on the reproduction side such as de-blocking filter processing or the like, hardware high-image quality processing with a scale without excess or deficiency in image quality level can be implemented according to the video content.

[0189] The first embodiment has exemplified the case wherein the data paths are ranked while paying attention mainly to the use statistics (frequencies) of data paths of the decode processing (to decode compressed signals) in the reproduction processing. However, the present invention is not limited to such specific criteria of ranking. For example, ranking criteria that minimize, e.g., the memory access of intermediate data may be adopted. Furthermore, ranking criteria that use a processing method (data resident type processing method) that switches data path planes while holding intermediate data in the memory elements ME **302** in the DRP **407** may be adopted.

[0190] The first embodiment has exemplified the case wherein each of the manipulation display terminals **102** and **103** comprises the dynamically reconfigurable DRP **407**. However, the gist of the present invention is not limited to such specific example. For example, the information delivery apparatus **101** may comprise the DRP **407**. In this case, not only flexible encoding processing of media can be implemented, but also communication offloading according to the video delivery status can be implemented. Hence, the processing can be further efficiently made compared to the conventional software processing. Especially, remarkable effects can be obtained when the information delivery apparatus **101** is managed under limited power environments such as PoE (Power over Ethernet: for example, IEEE802.3af standard), battery driving, and the like.

[0191] This embodiment has explained the information delivery apparatus **101** to which the digital camera is detachable as the image capturing device **110**. However, the gist of the present invention is not limited to such specific example. For example, a network camera which incorporates the image capturing device **110** may be used as the information delivery apparatus **101**. More specifically, in the process in step S**1006** in FIG. **10**, video data are acquired from the image capturing device **110** (digital camera) at time intervals which are set in advance via the USB interface. Alternatively, video data may be acquired from the network camera.

[0192] The first embodiment has exemplified the case wherein the hardware configuration information which is compiled in advance is stored in the storage device **204** of the information delivery apparatus **101**. However, the gist of the present invention is not limited to such specific example. For

example, the hardware configuration information of the DRP may be stored in a NAS in the network or a server on the Internet. In this case, the latest hardware configuration information stored in the server on the Internet may be copied to the storage device **204** of the information delivery apparatus **101** periodically or in accordance with a user's instruction.

[0193] The hardware configuration information of the DRP may be generated by software processing. For example, generation rules of the hardware configuration information are determined, and are compiled to generate hardware configuration information in consideration of the attributes of the video content, the status of hardware resources on the reproduction side, and the like.

[0194] In this case, the information delivery apparatus **101** may generate the hardware configuration information or another information processing apparatus (not shown) connected to the network **105** may execute generation processing and may send the result to the information delivery apparatus **101**.

[0195] With the above arrangement, the video content reproduction processing can be implemented with low cost and low consumption power.

Second Embodiment

[0196] This embodiment will explain an arrangement in which the dynamically reconfigurable processor (DRP) **407** is arranged in each of the manipulation display terminals **102** and **103** as in the first embodiment. In the following description, the same reference numerals in this embodiment denote the same parts as in the first embodiment.

[0197] The information delivery apparatus **101** predicts the reproduction processing status in each of the manipulation display terminals **102** and **103**, and can embed hardware configuration information (IP) in a video content in correspondence with the prediction result. The video content to be reproduced in this embodiment is continuous media data (moving image). The information delivery apparatus **101** extracts divisions of a video content as continuous media data (moving image) in the time axis direction. The information delivery apparatus **101** is characterized by comprising an arrangement that embeds hardware configuration information of a corresponding DRP **407** in each divided video content unit (segment).

[0198] The divisions of a typical video content in this embodiment include units such as GOP (Group of Pictures) and GOV (Group of VOPs) of MPEG-2 and MPEG-4. Also, the video content may be divided in synchronism with signals which detect scene changes of the video content.

[0199] FIG. **15** is a flowchart showing the procedure of the schematic processing according to the second embodiment from the viewpoint of a difference from the first embodiment. The CPU **201** executes the processing of the DRP configuration information generation module **511**, DRP configuration information embedding module **512**, and video delivery module **501** in the information delivery apparatus **101**.

[0200] The CPU **201** checks in step S**1501** if a video content designated by the user is continuous media data (moving image). If the designated video content is not continuous media data (moving image) (NO in S**1501**), the CPU **201** advances the process to step S**1505** to execute the video content delivery processing described in the first embodiment.

[0201] If it is determined in step S**1501** that the designated video content is continuous media data (moving image) (YES in S**1501**), the CPU **201** advances the process to step S**1502**. In step S**1502**, the CPU **201** extracts divisions of the video content, and generates corresponding hardware configuration information (IP) for each divided video content unit (segment) in the processing of the DRP configuration information generation module **511**.

[0202] In the processing of the DRP configuration information generation module **511**, the CPU **201** extracts segments of the video content, and collects information of the video content segments as in the process in step S**901** in FIG. **9**. Furthermore, as in the process in step S**902** in FIG. **9**, the CPU **201** predicts process of the decode processing for each segment based on the collected information, and generates a hardware configuration information (IP) group of the DRP for respective segments.

[0203] In step S**1503**, the CPU **201** embeds hardware configuration information corresponding to each segment generated in step S**1502** in the video content in the processing of the DRP configuration information embedding module **512**. In the processing of the DRP configuration information embedding module **512**, the CPU **201** predicts data paths of the reproduction processing in accordance with the content of the video content. The CPU **201** can embed hardware configuration information in respective segments of the video content (continuous media data) in turn from data paths which are used frequently. For example, as shown in FIG. **14**C, a group of a plurality of pieces of hardware configuration information can be embedded in header fields **1401** to **1403** at the heads of respective segments **1404** to **1406**.

[0204] The practical processing for, e.g., generating hardware configuration information corresponding to each segment is executed by the same processes as in steps of the flowchart shown in FIG. **9**.

[0205] In the processing of the video delivery module **501** in step S**1504**, the CPU **201** executes processing corresponding to that in FIG. **10** of the first embodiment. In the processing corresponding to step S**1009**, the CPU **201** delivers the encoded video content. In this case, the CP **201** embeds, for respective segments, a hardware configuration information group according to the encode content at the time of first delivery, at the time of changes in encoding parameter, or the like.

[0206] The video delivery module **501** delivers the encoded video content (segments **1**, **2**, and **3** in FIG. **14**C) embedded with the hardware configuration information (IP**1**, IP**2**, and IP**3**) in each segment, thus ending the processing.

[0207] Upon reception of the delivered video content, the manipulation display terminal **102** or **103** launches the reproduction module **522** and executes the reproduction processing by the processing of the video reproduction display module **503**. The video reproduction display module **503** appropriately demultiplexes video data, audio data, and a hardware configuration information group multiplexed on a communication path upon transferring the information of the video content to the reproduction module **522**, as in the first embodiment.

[0208] In the processing corresponding to step S**605** in FIG. **6**, the reproduction module **522** set up by the CPU **201** executes the reproduction processing using the DRP configured based on the hardware configuration information corresponding to each segment. If the hardware configuration information corresponding to each segment requires, re-setup and substitution of the reproduction module are made as in the first embodiment.

[0209] The information delivery apparatus according to this embodiment, which delivers a video content, can embed a plurality of pieces of hardware configuration information in divisions (segments) of the video content in accordance with the time axis of the video content serving as continuous media data.

[0210] According to this embodiment, by embedding hardware configuration information in continuous media data, the video content can be reproduced under the conditions according to the hardware resources of the manipulation display terminal. As a result, the reproduction processing of the video content can be implemented at low cost and low consumption power.

[0211] According to this embodiment, efficient video content delivery can be attained when the entire video content cannot be recognized at the time of delivery and only content information can be recognized like in streaming delivery of real-time video data.

Modification of Second Embodiment

[0212] The second embodiment has exemplified the case wherein the DRP configuration information generation module **511** is applied to a part (segment) of the video content. However, an intermediate operation may be used. For example, the processing of the DRP configuration information generation module **511** is applied to a part (segment) of the video content, and log information of a hardware configuration information group generated so far may be reflected in the video content to be reproduced.

[0213] The second embodiment has exemplified the case wherein hardware configuration information based on the prediction result of the processing content on the reproduction side (manipulation display terminal **102** or **103**) is embedded in a part (segment) of the video content upon delivering the video content. However, embedding in a part of the video content may not often be synchronized with generation of hardware configuration information based on the prediction result. In such case, for example, the reconfiguration processing (loading and rewriting of hardware configuration information) time of the DRP **407** on the reproduction side is calculated/predicted, and hardware configuration information can be delivered at an appropriate timing in a video stream.

[0214] With the above arrangement, the video content reproduction processing can be implemented with low cost and low consumption power.

Other Embodiments

[0215] Note that the objects of the present invention are also achieved by supplying a storage medium, which records a program code of a software program that can implement the functions of the above-mentioned embodiments to a system or apparatus. Also, the objects of the present invention are also achieved by reading out and executing the program code stored in the storage medium by a computer (or a CPU or MPU) of the system or apparatus.

[0216] In this case, the program code itself read out from the storage medium implements the functions of the above-mentioned embodiments, and the storage medium which stores the program code constitutes the present invention.

[0217] As the storage medium for supplying the program code, for example, a flexible disk, hard disk, optical disk, magneto-optical disk, CD-ROM, CD-R, nonvolatile memory card, ROM, and the like may be used.

[0218] The functions of the above-mentioned embodiments may be implemented by executing the readout program code by the computer. Also, functions of the above-mentioned embodiments may be implemented by some or all of actual processing operations executed by an OS (operating system) running on the computer on the basis of an instruction of the program code.

[0219] While the present invention has been described with reference to exemplary embodiments, it is to be understood that the invention is not limited to the disclosed exemplary embodiments. The scope of the following claims is to be accorded the broadest interpretation so as to encompass all such modifications and equivalent structures and functions.

[0220] This application claims the benefit of Japanese Patent No. 2006-95852, filed Mar. 30, 2006, which is hereby incorporated by reference herein in its entirety.

1. An information delivery apparatus which can deliver content information, comprising:

a generation unit adapted to generate configuration information required to configure data paths of a reconfigurable processor that executes reproduction processing of the content information; and

a delivery unit adapted to deliver the content information and the configuration information generated by said generation unit.

2. The apparatus according to claim **1**, wherein the configuration information includes designation information of at least one of pipeline processing and parallel processing between the data paths.

3. The apparatus according to claim **1**, wherein the configuration information includes information used to rank the data paths based on use frequencies of the data paths in decode processing.

4. The apparatus according to claim **1**, wherein when the content information is moving image information,

said generation unit extracts divisions of content information, and generates configuration information corresponding to divided content information.

5. An information reproduction apparatus which receives and reproduces content information delivered by an information delivery apparatus, comprising:

a reconfigurable processor adapted to execute reproduction processing of the content information;

an assignment unit adapted to assign resources of said reconfigurable processor which reproduces the content information; and

a configuration unit adapted to configure data paths of the resources of said reconfigurable processor assigned by said assignment unit based on configuration information delivered by the information delivery apparatus.

6. The apparatus according to claim **5**, wherein said assignment unit assigns the resources of said reconfigurable processor in accordance with at least one of a size and operating status of said reconfigurable processor.

7. The apparatus according to claim **5**, wherein when the configuration information includes information used to rank the data paths, said configuration unit configures the data paths of the resources of said reconfigurable processor in accordance with configuration information with a higher priority order.

8. An information processing method in an information delivery apparatus which can deliver content information, comprising:

a generation step of generating configuration information required to configure data paths of a reconfigurable processor that executes reproduction processing of the content information; and

a delivery step of delivering the content information and the configuration information generated in the generation step.

9. The method according to claim **8**, wherein the configuration information includes designation information of at least one of pipeline processing and parallel processing between the data paths.

10. The method according to claim **8**, wherein the configuration information includes information used to rank the data paths based on use frequencies of the data paths in decode processing.

11. An information processing method in an information reproduction apparatus which receives and reproduces content information delivered by an information delivery apparatus, comprising:

an assignment step of assigning resources of reconfigurable processor which executes reproduction processing of the content information;

a configuration step of configuring data paths of the resources of the reconfigurable processor assigned in the assignment step based on configuration information delivered by the information delivery apparatus; and

a reproduction step of reproducing the delivered content information using the data paths of the reconfigurable processor, which are configured in the configuration step.

12. The method according to claim **11**, wherein in the assignment step, the resources of the reconfigurable processor are assigned in accordance with at least one of a size and operating status of the reconfigurable processor.

13. The method according to claim **11**, wherein when the configuration information includes information used to rank the data paths, the data paths of the resources of the reconfigurable processor are configured in accordance with configuration information with a higher priority order in the configuration step.

14. A computer-readable storage medium storing a program for making a computer execute an information processing method according to claim **8**.

15. A computer-readable storage medium storing a program for making a computer execute an information processing method according to claim **11**.

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