

tal data signal in a digital data signal frequency band distinct from, and higher than, the analog telephone signal frequency band, the digital data signal being packet-based and being communicated bi-directionally over the telephone wire pair;

a first single enclosure;

a first device housed within said first single enclosure and connected to said telephone wire pair, said first device being couplable for bi-directional packet-based wireless communication with a first wireless digital data unit and being constructed to couple the digital data signal to the first wireless digital data unit;

a second single enclosure; and

a second device housed within said second single enclosure and connected to said telephone wire pair, said second device being couplable for bi-directional packet-based wireless communication with a second wireless digital data unit and being constructed to couple the digital data signal to the second wireless digital data unit;

wherein the digital data signal is an up/down frequency converted wireless signal.

23. The network according to claim 22 further constructed for analog telephony, wherein at least one of said first and second devices is connectable to an analog telephone device and constructed to couple the analog telephone signal to the analog telephone device.

24. The network according to claim 22 wherein at least one of said single devices enclosure is attached to a wall, or is integrated in a telephone outlet, or is mechanically and electrically attachable to and detachable from a telephone outlet.

25. The network according to claim 22 wherein said telephone wire pair concurrently carries a power signal, and at least part of at least one of said devices is further constructed to be powered by the power signal.

26. The network according to claim 22 wherein said digital data signal is spread-spectrum multi-carrier modulated, and the modulation is one of: OFDM; DMT; and CDMA.

27. The network according to claim 22 wherein the wireless communication is carried over a radio frequency license free band that is one of 900 MHz, 2.4 GHz and 5.8 GHz, and the wireless communication is IEEE802.11 standard based.

28. A device for transferring a digital data signal between a wireless medium and a wired medium, the wired medium being an AC power wire pair in a building, the AC power wire pair concurrently carrying an AC power signal in an AC power frequency band frequency multiplexed with the digital data signal carried in a wired digital data signal frequency band distinct from, and higher than, the AC power frequency band, the digital data signal being carried in the wireless medium in a radio frequency band, said device comprising:

a first AC power connector connectable to the AC power wire pair;

a high pass filter coupled to said first AC power connector for passing only signals in the wired digital data frequency band in the wired medium;

an antenna connected for radiating and receiving signals in the radio frequency band in the wireless medium; and

an up/down converter coupled between said antenna and said high pass filter and constructed to convert the digital data signal from the radio frequency band to the wired digital data frequency band,

wherein the digital data signal is communicated bi-directionally as a packet-based data signal.

29. The device according to claim 28, further constructed for coupling the AC power signal to an AC power unit, said device further comprising:

a second AC power connector connectable to the AC power unit; and

a low pass filter coupled between said first and second AC power connectors and for passing only the AC power signal.

30. The device according to claim 28 wherein the digital data signal is spread-spectrum multi-carrier modulated in the wireless medium.

31. The device according to claim 30 wherein the digital data signal is modulated with one of: OFDM; DMT; and CDMA in the wireless medium.

32. The device according to claim 28 and further comprising a single enclosure housing said first AC power connector and said up/down converter.

33. The device according to claim 32 wherein said enclosure is attachable to a wall, or is integrated in an AC power outlet, or is mechanically and electrically attachable to and detachable from an AC power outlet.

34. The device according to claim 28 wherein the device is further constructed to be powered by the AC power signal.

35. The device according to claim 28 wherein the radio frequency band is a license free band that is one of 900 MHz, 2.4 GHz and 5.8 GHz, and wherein the digital data signal in the radio frequency band is IEEE802.11 standard based.

36. A network for communication between first and second wireless digital data units over pre-existing AC power wiring in a building, said network comprising:

an AC power wire pair at least in part in a wall within the building, said wire pair being connected for concurrently carrying an AC power signal carried in an AC power signal frequency band frequency multiplexed with a digital data signal carried in a digital data signal frequency band distinct from, and higher than, the AC power signal frequency band, the digital data signal being packet-based and being communicated bi-directionally over the AC power wire pair;

a first single enclosure;

a first device housed within said first single enclosure and connected to said AC power wire pair, said first device being couplable for bi-directional packet-based wireless communication with a first wireless digital data unit and being constructed to couple the digital data signal to the first wireless digital data unit;

a second single enclosure; and

a second device housed within said second single enclosure and connected to said AC power wire pair, said second device being couplable for bi-directional packet-based wireless communication with a second

wireless digital data unit and being constructed to couple the digital data signal to the second wireless digital data unit,

wherein the digital data signal is an up/down frequency converted wireless signal in the wireless medium.

37. The network according to claim 36, further constructed for AC powering, wherein at least one of said first and second devices is connectable to an AC power device and is constructed to couple the AC power signal to the AC power device.

38. The network according to claim 36 wherein at least one of said first and second devices enclosure is attached to a wall, or is integrated in an AC power outlet, or is mechanically and electrically attachable to and detachable from an AC power outlet.

39. The network according to claim 36 wherein at least part of at least one device is further constructed to be powered by said AC power signal.

40. The network according to claim 36 wherein the digital data signal is spread-spectrum multi-carrier modulated.

41. The network according to claim 36 wherein the digital data signal is modulated with one of: OFDM; DMT; and CDMA.

42. The network according to claim 36 wherein the wireless communication is carried over a radio frequency license free band that is one of 900 MHz, 2.4 GHz and 5.8 GHz and wherein the wireless communication is IEEE802.11 standard based.

43. A device for configuring a network over a telephone wire pair in a building, the telephone wire pair carrying an analog telephone signal in an analog telephone frequency band, and the network carrying a wireless-based digital data signal in a digital data frequency band distinct from, and higher than, the analog telephone frequency band, said device comprising:

a data connector connectable to a data unit;

a transceiver coupled to said data connector, said transceiver being constructed to conduct packet-based wired digital data communication bi-directionally with the data unit;

a wireless modem coupled to said transceiver, said wireless modem being constructed to convey an up/down frequency converted wireless signal in the digital data frequency band over the telephone wire pair, and being further constructed for bi-directional packet-based digital data communication via a first telephone connector connectable to the telephone wire pair; and a high pass filter coupled between said first telephone connector and said wireless modem for passing only signals in the digital data frequency band.

44. The device according to claim 43 further constructed for coupling the analog telephone signal to an analog telephone device, said device further comprising:

a second telephone connector connectable to an analog telephone device; and

a low pass filter coupled between said first and second telephone connectors and for passing only the analog telephone signal.

45. The device according to claim 43, wherein said wireless modem is constructed to receive and transmit signals in a radio frequency band, and said device further

comprises an up/down converter coupled to said wireless modem and constructed to transfer signals from the radio frequency band to the digital data frequency band.

46. The device according to claim 45, wherein said up/down converter is heterodyne-based.

47. The device according to claim 43, further comprising a single enclosure housing said first telephone connector, said wireless modem, said data connector and said transceiver.

48. The device according to claim 47 wherein said enclosure is attachable to a wall, or is integrated in a telephone outlet, or is mechanically and electrically attachable to and detachable from a telephone outlet.

49. The device according to claim 43 wherein the telephone wire pair concurrently carries a power signal, and said device is further constructed to be powered by the power signal.

50. The device according to claim 43 wherein said wireless digital data signal is spread-spectrum multi-carrier modulated, and the modulation is one of OFDM, DMT and CDMA.

51. A device for configuring wired and wireless networks, the wired network including a telephone wire pair in a building, the telephone wire pair concurrently carrying an analog telephone signal in an analog telephone frequency band, and the network carrying a wired digital data signal in a wired digital data frequency band distinct from, and higher than, the analog telephone frequency band, said device comprising:

a data connector for connectable to a data unit;

a transceiver coupled to said data connector and constructed for receiving digital data packets from the data unit;

an antenna for radiating signals in a radio frequency band;

a wireless modem coupled between said antenna and said transceiver and constructed to transmit packet-based digital data;

a first telephone connector connectable to the telephone wire pair; and

a high pass filter coupled between said first telephone connector and said transceiver for passing only signals in the wired digital data frequency band;

wherein packets received from the data units are concurrently passed to said wireless modem to be transmitted as a wireless signal by said antenna and to said high pass filter to be carried over the telephone wire pair.

52. The device according to claim 51 further comprising an up/down frequency converter coupled between said high pass filter and said wireless modem, wherein the wired digital data signal carried over the telephone wire pair is obtained by up/down conversion of the wireless signal.

53. The device according to claim 52, wherein said up/down converter is heterodyne-based.

54. The device according to claim 51 further constructed for coupling the analog telephone signal to an analog telephone unit, said device further comprising:

a second telephone connector connectable to the analog telephone unit; and

a low pass filter coupled between said first and second telephone connectors for passing only the analog telephone signal.

55. The device according to claim 51, further comprising a single enclosure housing said first telephone connector, said wireless modem, said data connector and said transceiver.

56. The device according to claim 61, wherein said enclosure is attachable to a wall, or is integrated in a telephone outlet; or is mechanically and electrically attachable to and detachable from a telephone outlet.

57. The device according to claim 51, wherein the telephone wire pair concurrently carries a power signal, and said device is further constructed to be powered by said power signal.

58. The device according to claim 51 wherein the wireless signal is spread-spectrum multi-carrier modulated, and wherein the wireless signal is IEEE802.11 standard based and the modulation is one of OFDM, DMT and CDMA.

* * * * *

EXHIBIT 1024



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Miller, II

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(54) **TWO-TIER WIRELESS BROADBAND
ACCESS NETWORK**

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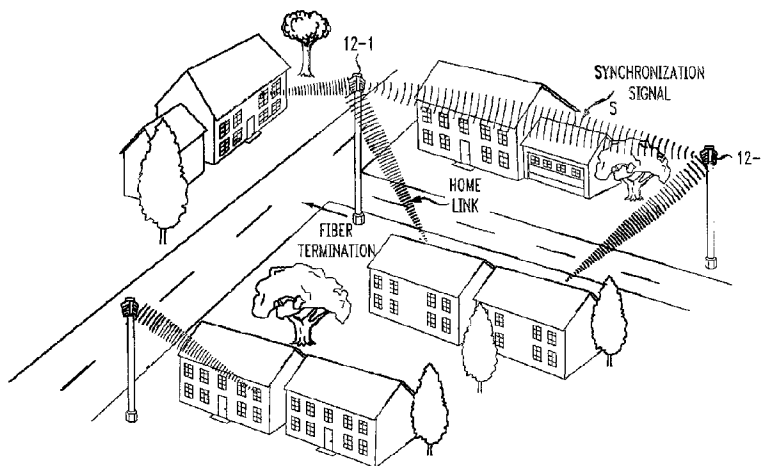
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(57) **ABSTRACT**

A wireless access network is based on a two-tier access point (AP) structure to provide effective and efficient wireless communication into an individual home/office building. A first tier of the network utilizes “neighborhood” APs, relatively low power, and utilized to provide wireless communication with a “nanocell” boundary (e.g., 300-1000 feet). A second tier of the network utilizes a set of “network concatenation devices” (window bridge), with a separate network concatenation device at each permanent facility in the nanocell that houses wireless devices. The network concatenation device is attached to a window, for example, of a home in communication with the neighborhood AP. The network concatenation device functions as a bridge to couple to each of the wireless devices within the home. This communication is then relayed in an efficient manner between the network concatenation device and the neighborhood AP. By using a number of neighborhood APs, rather extensive wireless coverage can be obtained.

18 Claims, 5 Drawing Sheets



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FIG. 1

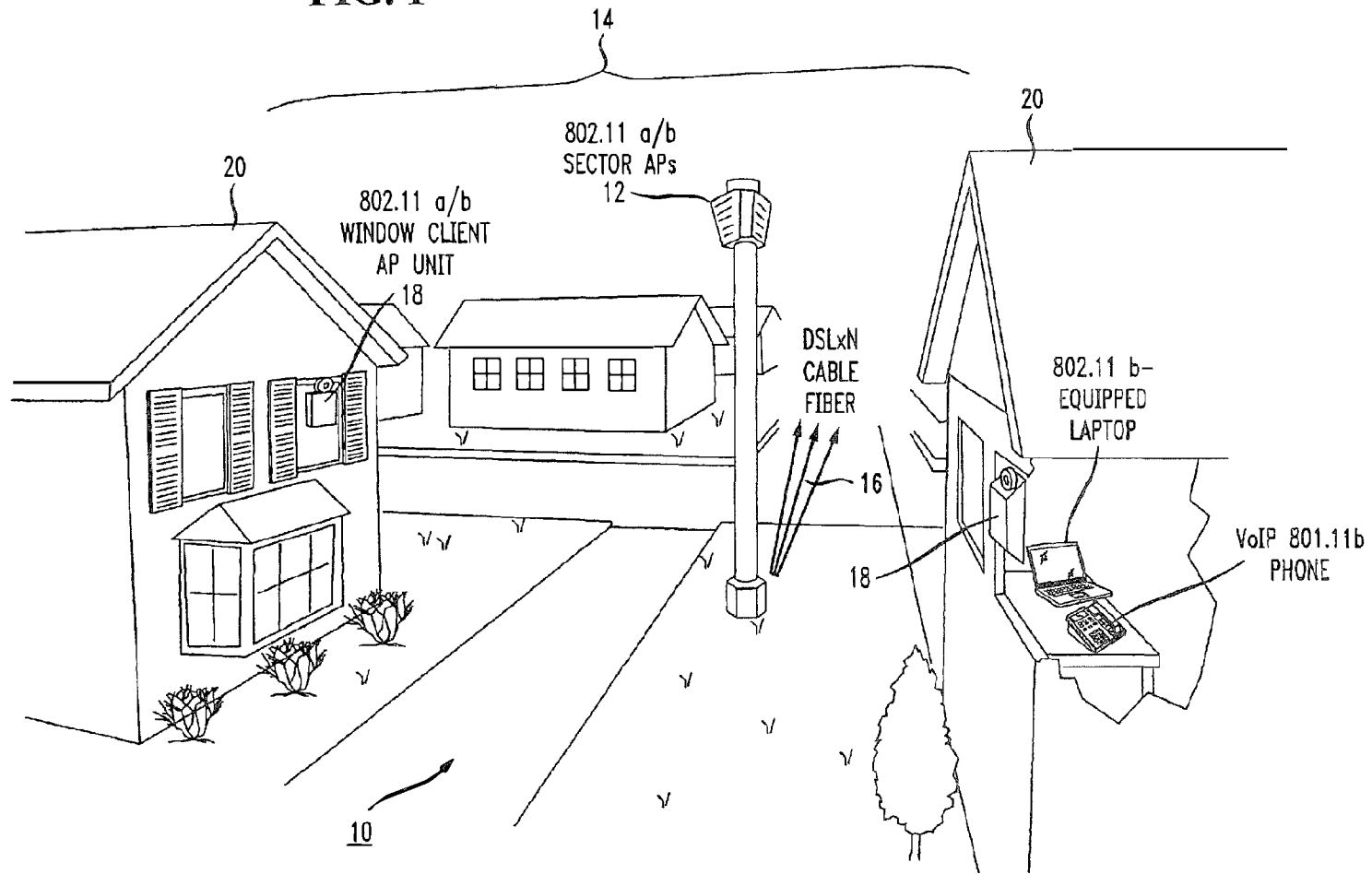


FIG. 2

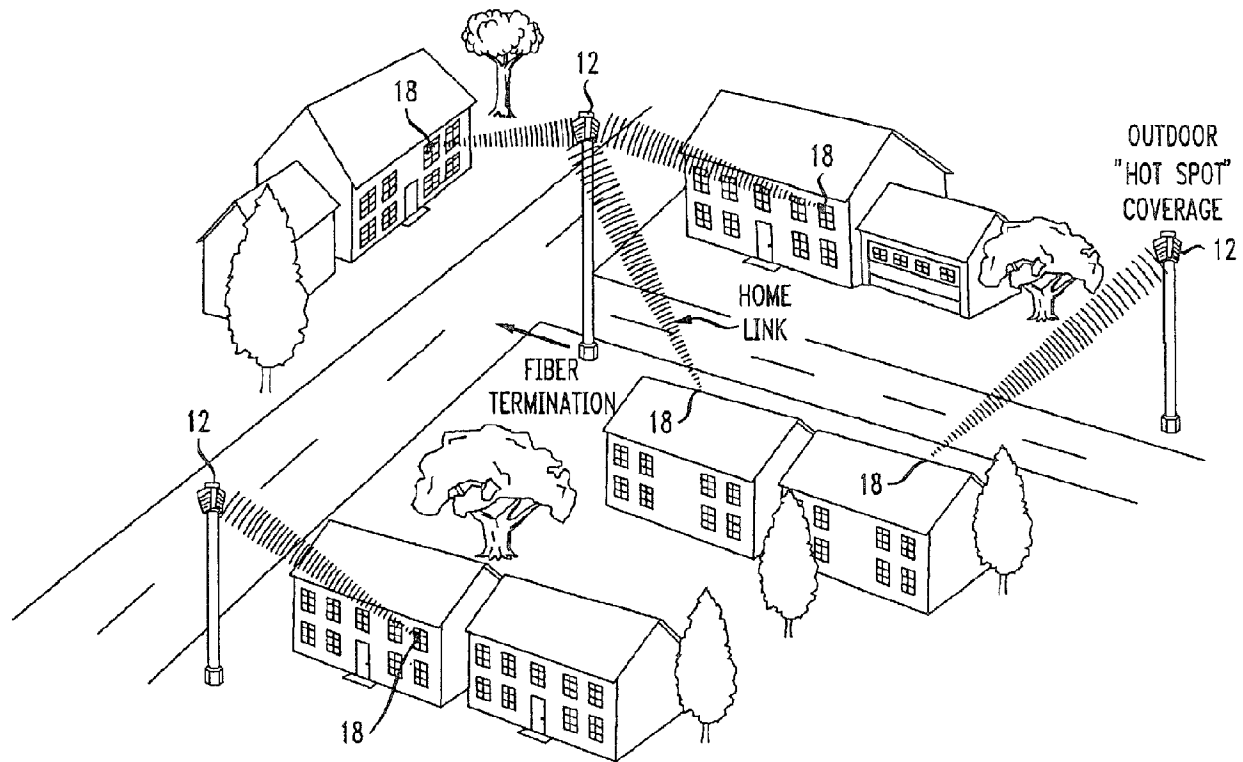


FIG. 3

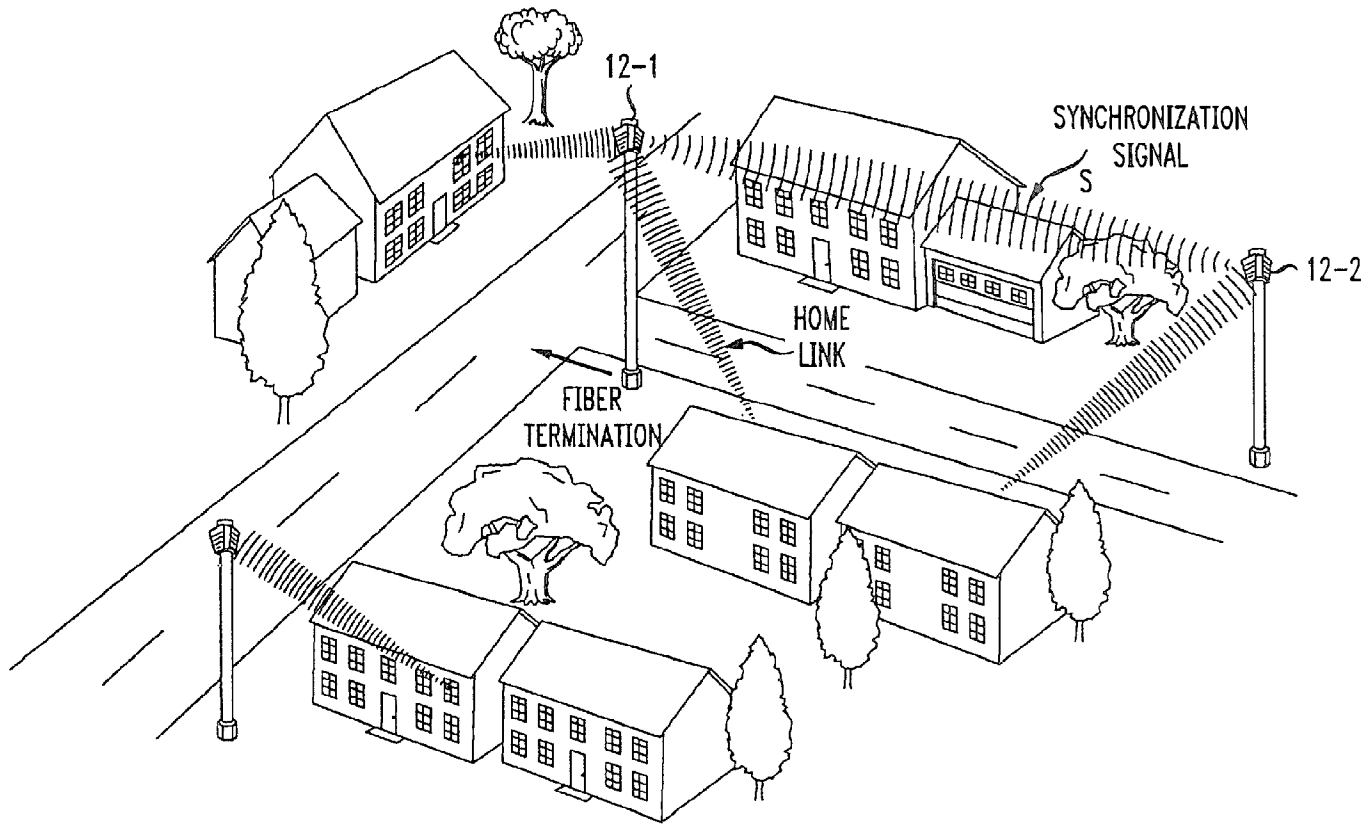


FIG. 4

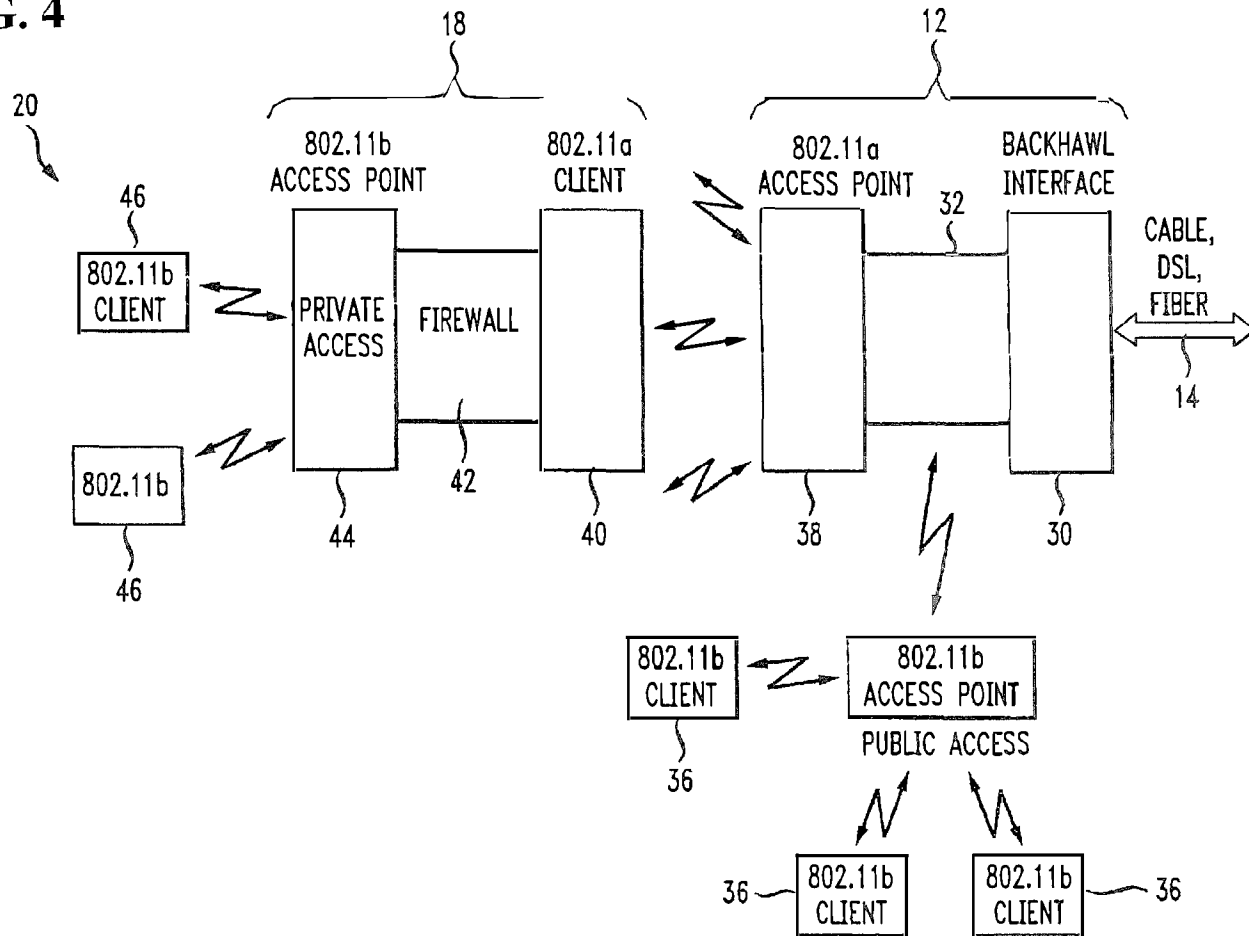
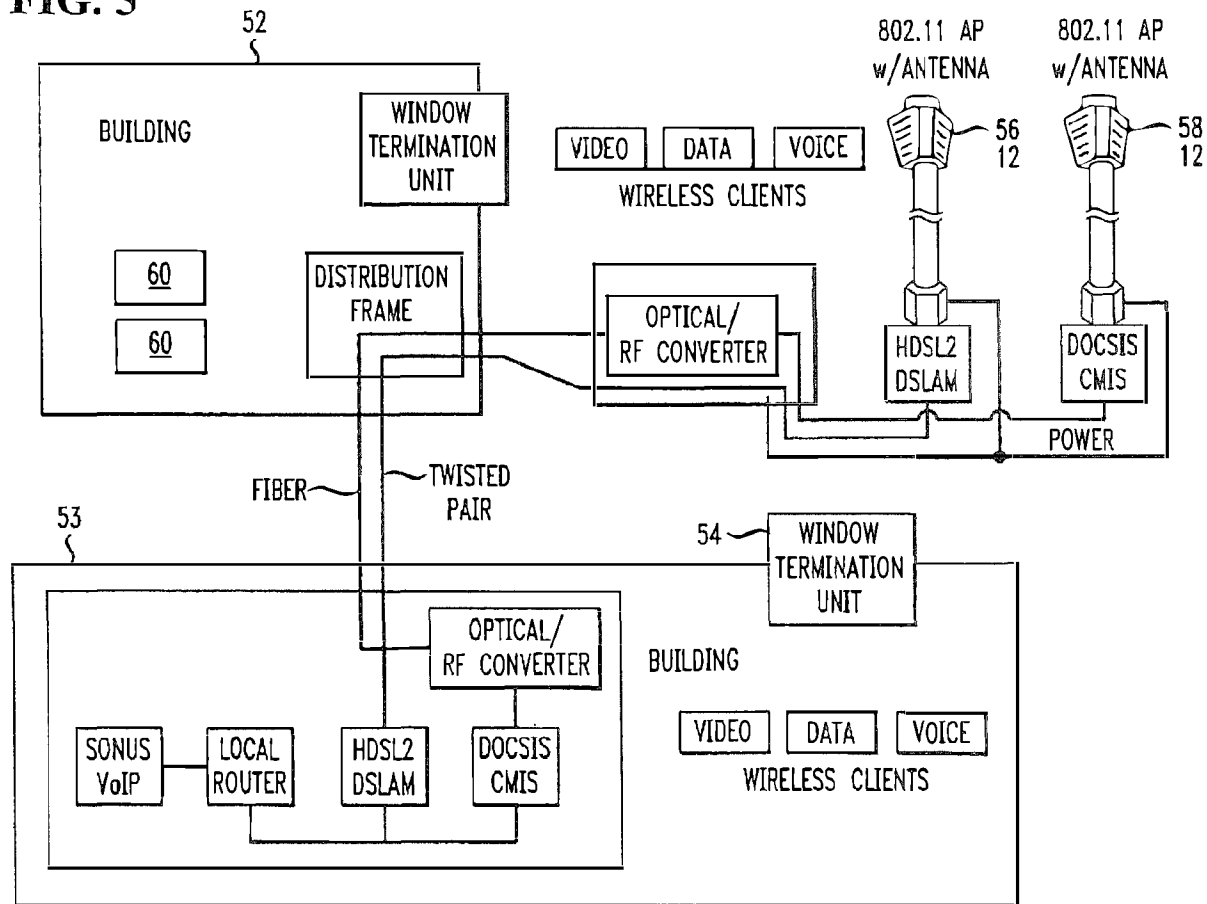


FIG. 5



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TWO-TIER WIRELESS BROADBAND ACCESS NETWORK

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Applications 60/660,786 filed Mar. 11, 2005 and 60/661,567 filed Mar. 14, 2005.

TECHNICAL FIELD

The present invention relates to wireless access networks and, more particularly, to the utilization of a two-tier access network useful in providing communication between a neighborhood access point (first tier) and a residence/office access point (second tier), with a network of the first tier access points then coupled into one or more backbone communication networks.

BACKGROUND OF THE INVENTION

Wireless LANs (WLANs) are defined as wireless networks that provide inexpensive, high-speed, wireless communications in office buildings, the home, public areas, and a variety of commercial and industrial locations. A "STation" (STA) in a WLAN can be a personal computer, a bar code scanner, or other mobile and/or stationary devices with the appropriate integrated chip set or wireless network interface card to provide the necessary connection over a wireless link to other stations. WLANs generally operate at peak speeds ranging between 1 and 54 Mbps, and have a range of between 15 and 300 meters.

Wireless LANs can provide wireless peer-to-peer communication between stations (defined as an "ad-hoc" group), as well as access to a conventional "wired" network. A single-cell WLAN using an Access Point (AP) may serve a group of stations communicating over the wireless medium, while connecting them to an external wired network. Alternatively, multi-cell WLANs provide greater range than single-cell WLANs with multiple access points interconnected by means of a wired network. An access point can be thought of as the counterpart to a base station of a mobile cellular communication system and functions as the gateway to the (wired) distribution system.

Conventional wireless LANs operate in the unlicensed portion of the spectrum, where they provide interference-free simultaneous transmission on multiple channels, each cell transmitting on a single (different) channel. The number of channels available varies with the spectrum allocation and physical layer technology. For example, the IEEE 802.11b standard provides three TDD channels for duplex data transmission at speeds up to 11 Mbps in the 2.4 GHz ISM band, while the IEEE 802.11a standard provides eight channels at speeds up to 54 Mbps in the 5 GHz band. In some environments, however, the number of channel frequencies available is insufficient to allow each cell to operate without experiencing co-channel interference. This interference limits the quality (i.e., increases the packet error rate) of transmission to stations.

Although wireless LANs have traditionally been used for data sessions only, where errors can be overcome by retransmission of packets, the growth of multimedia content is inducing a desire for so-called "streaming" support as well. Real-time streaming applications must deliver packets without any accumulation of delays, since delay renders packets useless for reconstitution of source waveforms. An example

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of a streaming application is a WLAN Voice-Over-IP (VoIP) phone, for example, an IEEE 802.11b phone, that uses the WLAN to convey voice telephony. The WLAN communicatively couples the IEEE 802.11b phone to other phones across the Internet, other IEEE 802.11b phones, and/or to other phones via various communication paths.

Aside from delays due to errors caused by interference, current arrangements using a WLAN to support voice communications can also be impaired by "contention" when multiple stations attempt to simultaneously transmit their packets. If the WLAN attempts to service both voice and data communications, the WLAN may not have sufficient capacity (due to the shared nature of the channel) to hold latency below that necessary to prevent interruptions or artifacts in the telephony streams. Other services, such as video conferencing and real-time streaming IP video, can experience similar difficulties. Moreover, roaming within a WLAN (between APs) can introduce significant gaps in service, where such gaps also violate the low latency requirements of real-time streaming communication.

Additionally, wireless LANs were originally conceived for primarily indoor operation, with cell sizes on the order of 100 feet (or less) in radius. Although outdoor operation can extend the cell size to perhaps a radius of 300 feet (with a lowered transmission rate), wireless LANs that attempt to provide both indoor and outdoor coverage experience poor link quality due to the difficulty of propagating RF signals through building walls (which are known to significantly attenuate the signal).

Attempts to use outdoor/indoor single-tier (i.e., single RF link from wired network to station) wireless LAN architectures for service provider local access applications are thus challenged by these issues of signal quality, co-channel interference and the inability to provide deterministic Quality-of-Service (QoS), as particularly required for voice/streaming video applications.

SUMMARY OF THE INVENTION

The needs remaining in the prior art are addressed by the present invention, which relates to wireless access networks and, more particularly, to the utilization of a two-tier access network comprised of concatenated wireless Neighborhood Area Networks (NANs) and Local Area Networks (LANs). Such an architecture provides communication between a neighborhood access point (first tier) that establishes an outdoor coverage area and is connected to one or more backbone communication networks, and a residence/office access point (second tier) that establishes a separate indoor network serving one or more wireless stations. The two networks are cascaded (concatenated) by a specialized bridge/gateway unit (also referred to as a network concatenation device) at their joint boundary, the network concatenation device usually installed at the "edge" of the premises (e.g., outside wall or window).

In accordance with the present invention, a first tier of the wireless access arrangement thus collects wireless traffic passing to the access or backbone network from a WLAN (or conventional "wired" LAN network) and forwards it to a neighborhood access point (AP). A second tier of the connection utilizes a wireless bridging device at the home/office as both a "station" terminating the NAN connection and an access point (AP) for the local area home/office network of wireless devices. The home/office link may be based on, for example, the IEEE 802.11a/b/g standard, with the neighborhood public access link based on (for example) the IEEE 802.11a or emerging 802.11n standards.

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The Neighborhood Area Network (NAN) is based on the use of "nano-cells", where each cell is on the order of 1000 feet (or less). Nanocells are sized to provide a trade-off between: (1) coverage area (established from, for example, a lamppost-height access points or base stations); (2) maintenance of high-integrity links to homes; and (3) the number of homes that can be served with broadband service. The trade-off acknowledges that NAN radio throughput is related to the amount of available spectrum, the signal-to-noise ratio of the links, the transmission rates that can be sustained with the links, and over how many homes the total throughput of the NAN cell must be divided.

The client (second tier) access point is a merging of two distinct devices; a client device that communicates via radio signals with the neighborhood access point, and a premises networking access point that provides communication between the various devices within the home/office location. In particular, a network concatenation device at the premises boundary may comprise an 802.11a station device and associated directional antenna, integrated with an 802.11b/g access point (also with a directional antenna), with "gateway" functionality interposed between the two to provide security, privacy, and network management capabilities within the home network. As such, the gateway may contain, for example, a router, firewall, performance monitor, remote configuration tool, and the like.

A preferred embodiment of the network concatenation device may be referred to as a "window bridge" inasmuch as it can be mounted on the inside of a glass window pane at the premises. The window glass provides a beneficial location for joining the NAN and WLAN networks because neither network experiences significant RF loss penetrating the glass (except for metallic-tinted windows). Accordingly, the window bridge optimizes the quality of the concatenated network connection, while permitting easy installation by a user. For example, a link quality indicator (e.g., bar graph indicator) on the unit can guide the user to the window with the best (strongest) signal from the NAN access point. However, it is to be understood that such a "window bridge" is only an exemplary embodiment of the more general "network concatenation device" of the present invention.

Advantageously, the utilization of a separate, unique network concatenation device for each home subscriber allows for the present invention to be used for multi-tenant building subscribers in apartments, malls, office parks, campuses, etc. In these multi-tenant situations, each subscriber is individually (but separately) connected to the first tier, neighborhood access point via their own (second tier) network concatenation device. Thus, each subscriber maintains a private, secure connection to the neighborhood access point. This is considered a significant advantage in that it allows separate services to be delivered to a multi-tenant building, where only some of the tenants have subscribed to the service or where there is no Ethernet wiring, or both.

It is an aspect of the present invention that existing, public wireless "hotspots" functionality may also be integrated with the two-tier access network, separating public and private access via VPN tunneling and separate authentication processes. As a result, private subscribers in the NAN may use portable devices outdoors (effectively using direct tier-1 links) while obtaining the same services and custom features as are accessible in their homes. Public users may also obtain access from the NAN access points, but are granted radio resources only on an "as available" basis, after the throughput needs of the subscribers have already been met.

Both NAN and WLAN networks preferentially use a scheduled QoS protocol, or the 802.11e HCCA operating

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mode. Such protocols provide strong QoS controls by suspending carrier sense multiple access (CSMA) RF medium access and substituting point-coordinated protocol based on transmission of an access request, submission of a Traffic Specification (TSPEC), execution of an admission control process, packet scheduling using Transmission Opportunities (TXOPs) and polling. Such a protocol provides deterministic QoS for various services (e.g., VoIP, video, data), as well as maintaining QoS under heavy system loads. In addition, the MediaPlex protocol provides for separate "reservation request" frames in the "contention-controlled" period where CSMA is suspended to prevent blocking of access requests.

Scheduled intervals in the "contention-controlled" interval of the 802.11 superframe can also be beneficially used to share the radio resource on a particular channel between NAN or WLAN access points, with appropriate synchronization between the access points. A separate communication channel may be used to maintain synchronization between the neighborhood access points, or synchronization may be achieved by allowing a second AP to be responsive to beacon timing of a first AP. By sharing time intervals in the superframe contention-controlled period, APs may operate nearby on the same RF channel without interfering with one another.

Other and further aspects of the present invention will become apparent during the course of the following discussion and by reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Referring now to the drawings,

FIG. 1 illustrates an exemplary environment for implementing the two-tier access arrangement of the present invention in a residential setting;

FIG. 2 is an artistic rendering of an exemplary neighborhood area in which the access arrangement of the present invention may be employed;

FIG. 3 contains a similar illustration as FIG. 2, in this case illustrating the presence of a synchronization signal between the various neighborhood (first tier) access points;

FIG. 4 is a block diagram of the various elements required to implement the inventive access arrangement of FIG. 1; and

FIG. 5 illustrates an alternative environment for implementing the present invention, in this case in an industrial/corporate/campus environment.

DETAILED DESCRIPTION

FIG. 1 illustrates an exemplary arrangement 10 for implementing the two-tier wireless broadband access system of the present invention. As shown, arrangement 10 includes a Neighborhood Area Network (NAN) access point (AP) 12 which is (preferably) centrally disposed within a nanocell 14, the nanocell itself composed of multiple sectors defined by separate APs and associated directional antennas. Each sector is capable of transmitting/receiving relatively low power signals (compatible with license-free operation) with AP 12. For example, each AP 12 may "illuminate" a segment area covering a radius of 1000 feet (or less). In a typical neighborhood, therefore, a single wireless AP 12 may communicate with a relatively few houses (or buildings). FIG. 2 contains a simple diagram of an exemplary residential setting in which a plurality of NAN APs 12 are used to provide communication within a neighborhood.

Wireless AP 12, as shown in FIG. 1, can be installed within a device similar to a utility pole, and includes a network connection 16 to a "backbone" wired network (not shown). Network connection 16 may comprise, for example, a coaxial

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cable connection, a fiber optic cable, free-space optical signal path, or a copper pair network connection (e.g., DSL). Wireless AP 12 is defined as the base station of the “first tier” of the two-tier access system, and provides communication using a conventional wireless communication standard, PHY, such as IEEE 802.11a/b/g, or a MAC protocol such as 802.11e HCCA. It is to be understood, however, that the two-tier access point arrangement of the present invention is equally applicable with other wireless communication system standards. Throughout the remainder of the discussion, therefore, the use of the IEEE 802.11a/b/g PHY standards and/or the 802.11e MAC standard should be considered as exemplary only.

In accordance with the present invention, broadband wireless access for the home is provided by using a network concatenation device (in one embodiment, a “window bridge”) 18, consisting of an access point that establishes the “second tier” of the access network to provide communication with one or more “stations” within the building. The network concatenation device includes a gateway processor/router attached to a permanent facility (such as residence 20 in FIG. 1) at a location on the facility that is capable of receiving a radio signal from wireless AP 12 and “illuminating” the interior of the residence with the RF signal for the second tier network. Indeed, during the installation process, a homeowner may walk through the house with network concatenation device 18 in hand and ascertain the location with the strongest signal and then attach network concatenation device 18 to a window at that location. Advantageously, network concatenation device 18 may be attached to the inside of a window, since glass is transparent to radio signals. Another network concatenation device 18 is illustrated as attached to a second residence 22 in FIG. 1. Referring to the block diagram of FIG. 2, a set of network concatenation devices 18 is illustrated as located at each home in communication with its associated neighborhood wireless AP 12. Those homes outside the border of a particular nanocell 14 will inevitably receive a stronger signal from another wireless AP disposed further along the street (although any portable device that enters a certain nanocell 14 will be able to communicate through this cell with the backbone network—in much the same manner as a cellphone call experiences “hand-off” between cells as the caller moves from destination to destination).

In order to maintain accurate and reliable communication between nanocells, a synchronization signal is transmitted between the group of neighborhood wireless APs 12. FIG. 3 contains a diagram of the same neighborhood illustration as shown in FIG. 2, in this case also illustrating the presence of a synchronization signal S used between a first neighborhood access point AP 12-1 and a second neighborhood AP 12-2.

FIG. 4 contains a high-level block diagram of the various components utilized to implement the two-tier broadband wireless access network in accordance with the present invention. As shown, neighborhood access point 12 includes a backhaul interface 30 that functions to re-package transmissions between the wireless standard used in the neighborhood and the particular “wired” standard used along network connection 16. A wireless router 32 is coupled to interface 30 and is used to direct wireless traffic between “public access” users of that particular access point as a “hotspot”, and the “private” network concatenation devices 18 associated with nanocell 14. As shown, traffic associated with “public” communications may flow through neighborhood AP 12, or may be accommodated by a separate 802.11b public access point 34 co-located with AP 12, where it may thereafter communicate with any 802.11b client terminals 36 in its vicinity.

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The 802.11a traffic associated with communication within nanocell 14 is thereafter directed by router 32 into an 802.11a access point module 38, which serves to broadcast/receive wireless transmissions between the various network concatenation devices 18. As shown in FIG. 4, an exemplary network concatenation device 18 will comprise an 802.11a client device 40 for communicating with the 802.11a access point module 38 (at neighborhood AP 12). The received information then passes through a gateway 42 and enters an 802.11b/g access point 44 (a private access point requiring validation), where access point 44 is thereafter connected to one or more 802.11b/g client devices 46 within residence 20 (FIG. 1 illustrating an 802.11b-equipped laptop computer and an 802.11b-equipped VoIP phone as two exemplary “client devices”).

FIG. 5 illustrates a portion of a campus-like arrangement 50 for utilizing the two-tier wireless access configuration of the present invention. A first facility 52 (possibly a residential building) and a second facility 53 (possibly a classroom/lab building) are shown, each including a network concatenation device 54. A pair of neighborhood access points 56, 58 are shown as disposed in a campus area that can freely communicate through the “open air” with network concatenation devices 54. Indeed, each network concatenation device 54 is installed in a window capable of receiving radio signals from (and transmitting signals to) neighborhood access points 56, 58. A set of wireless client devices 60 is shown in first facility 52, where these devices may comprise laptop computers associated with students who reside in this building. A second set of client devices 62 is shown in second facility 53, where these may be VoIP phones, laptops and other wireless devices useful in a classroom/laboratory setting. Other wireless client devices 64 are shown as within a nanocell 70 covered by neighborhood access points 56, 58.

In this case, a pair of neighborhood access points is used, with access point 56 coupled to a conventional telephone line (twisted pair) 72 backbone communication path, where this communication path is also connected to both facilities 52 and 53. A DSL modem 74 is used within neighborhood access point 56 to generate the wireless, RF output that is broadcast to all of the wireless client devices within range, particularly to window bridge units 54, where window bridge units 54 then distribute the signals to all associated client devices, as discussed above. In its other “mode”, neighborhood access point 56 functions as a “hotspot” (using the IEEE 802.11b standard, for example) to communicate with mobile client devices 64. Neighborhood access point 58 is shown as coupled to a fiber optic backbone path 76 that is also connected through facilities 52, 53. An optical/RF converter 78 is used to translate between the optical and radio domains, and a modem 80 is used to generate the radio output signal that is broadcast by access point 58.

Although this invention has been described with a certain degree of particularity, it is to be understood that the present disclosure has been made by way of preferred embodiments only and that numerous changes in the detailed construction and combination as well as arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter set forth.

What is claimed is:

1. A broadband wireless access network comprising:
 - a plurality of neighborhood access points, coupled to a backbone communication network, wherein each neighborhood access point is configured to provide public access wireless communication and private access wireless communication within a defined nanocell coverage area, wherein the public access wireless communication

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is provided when available throughput needs of network subscribers to the private access wireless communication are met, and wherein a particular communication channel is used by the plurality of neighborhood access points to maintain synchronization between the plurality of neighborhood access points to enable shared use of a second communication channel by adjacent nanocells; and

a plurality of network concatenation devices, each network concatenation device of the plurality of network concatenation devices uniquely associated with a network subscriber, wherein each network concatenation device is configured to form an indoor network serving a communication device at a location associated with a corresponding network subscriber.

2. The broadband wireless access network of claim 1, wherein wireless communication between a particular network concatenation device and an associated neighborhood access point is defined as a private access communication.

3. The broadband wireless access network of claim 2, wherein the private access communication is provided using a wireless Ethernet standard.

4. The broadband wireless access network of claim 1, wherein a neighborhood access point of the plurality of neighborhood access points comprises an access interface configured to directly communicate with mobile wireless client devices within the defined nanocell coverage area.

5. The broadband wireless access network of claim 4, wherein the neighborhood access point communicates with the mobile wireless client devices based on a wireless Ethernet standard.

6. The broadband wireless access network of claim 1, wherein the plurality of communication device includes a voice over internet protocol phone, a wireless laptop computer, or a wireless gaming device.

7. The broadband wireless access network of claim 1, wherein a unique set of network concatenation devices is associated with each neighborhood access point, and wherein a particular network concatenation device of a particular unique set of network concatenation devices associated with a particular neighborhood access point individually and separately communicates with the particular neighborhood access point, without direct communication between the particular network concatenation device and other network concatenation devices.

8. The broadband wireless access network of claim 1, wherein a network concatenation device of the plurality of network concatenation devices is configured to mount on a glass window and is configured to facilitate wireless communication between a neighborhood access point associated with the network concatenation device and a particular communication device associated with the network concatenation device.

9. The broadband wireless access network of claim 1, wherein the backbone communication network comprises a telecommunications network.

10. The broadband wireless access network of claim 9, wherein the telecommunications network utilizes a digital subscriber loop system.

11. The broadband wireless access network of claim 1, wherein the backbone communication network comprises a fiber optic communication network.

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12. The broadband wireless access network of claim 1, wherein the backbone communication network comprises a free-space optical network.

13. The broadband wireless access network of claim 1, wherein a neighborhood access point of the plurality of neighboring access points forms a first tier network connection, and wherein a network concatenation device coupled to the neighborhood access point forms a second tier network connection.

14. The broadband wireless access network of claim 13, wherein the network concatenation device comprises a neighborhood area network station including a directional antenna, a gateway function device with selective routing capabilities, and a wireless local access network access point interface associated with the directional antenna.

15. The broadband wireless access network of claim 13, wherein the network concatenation device comprises a wired Ethernet interface.

16. The broadband wireless access network of claim 13, wherein the network concatenation device is further configured to provide remote configuration, performance monitoring, a firewall, network address translation, and virtual private network tunneling support.

17. The broadband wireless access network of claim 13, wherein the network concatenation device further comprises a graphical user interface configured to display signal strength information that enables a user to determine a mounting location for the network concatenation device.

18. A method of providing wireless communication between a backbone communication network and a plurality of subscriber locations, the method comprising:

establishing a first tier of a two-tier broadband wireless access network, the first tier including a first neighborhood access point configured to provide public access wireless communication and private access wireless communication within a first nanocell coverage area, wherein the public access wireless communication is provided when available throughput needs of subscribers having access to the private access wireless communication are met, and wherein the first nanocell coverage area has a radius less than or equal to one thousand feet; establishing a second tier of the two-tier broadband wireless access network, the second tier including a plurality of network concatenation devices, wherein each network concatenation device is configured to form an indoor network serving a communication device at a location associated with a corresponding subscriber; maintaining synchronization via a particular communication channel between the first neighborhood access point and a second neighborhood access point to enable shared use by the first neighborhood access point and the second neighborhood access point of a second communication channel, wherein the first nanocell coverage area is adjacent to a second nanocell coverage area associated with the second neighborhood access point; and providing private access wireless communication via the first neighborhood access point to a portable communication device associated with a particular network concatenation device when the portable communication device is within the nanocell coverage area and outside of an area serviced by the indoor network associated with the particular network concatenation device.

* * * * *

UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 8,625,547 B1
APPLICATION NO. : 11/371578
DATED : January 7, 2014
INVENTOR(S) : Robert Raymond Miller, II

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

Column 7, Claim 6, Line 34, "wherein the plurality of communication device includes a"
should read --wherein the communication device includes a--.

Column 8, Claim 17, Lines 27-28, "strength infatuation that enables a user to determine a
mounting location for the network concatenation device." should read --strength information that
enables a user to determine a mounting location for the network concatenation device.--.

Signed and Sealed this
First Day of July, 2014



Michelle K. Lee
Deputy Director of the United States Patent and Trademark Office

EXHIBIT 1026

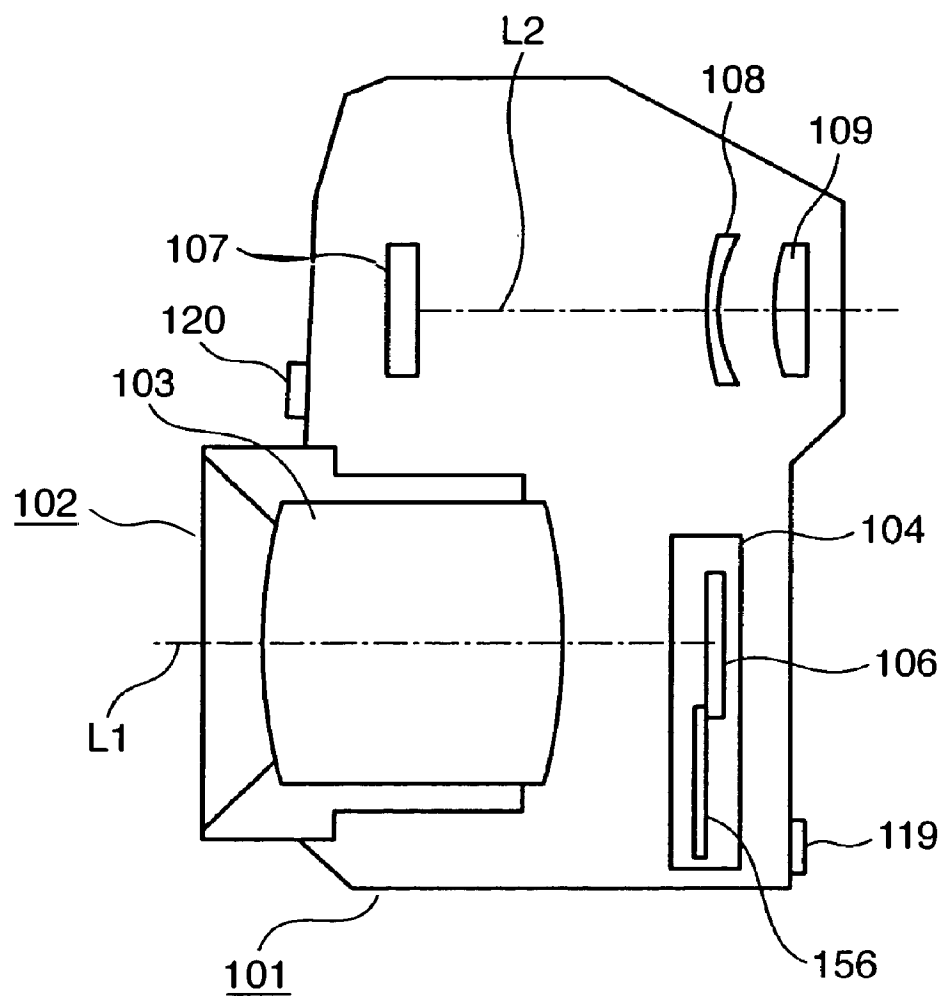
FIG. 1

FIG. 2

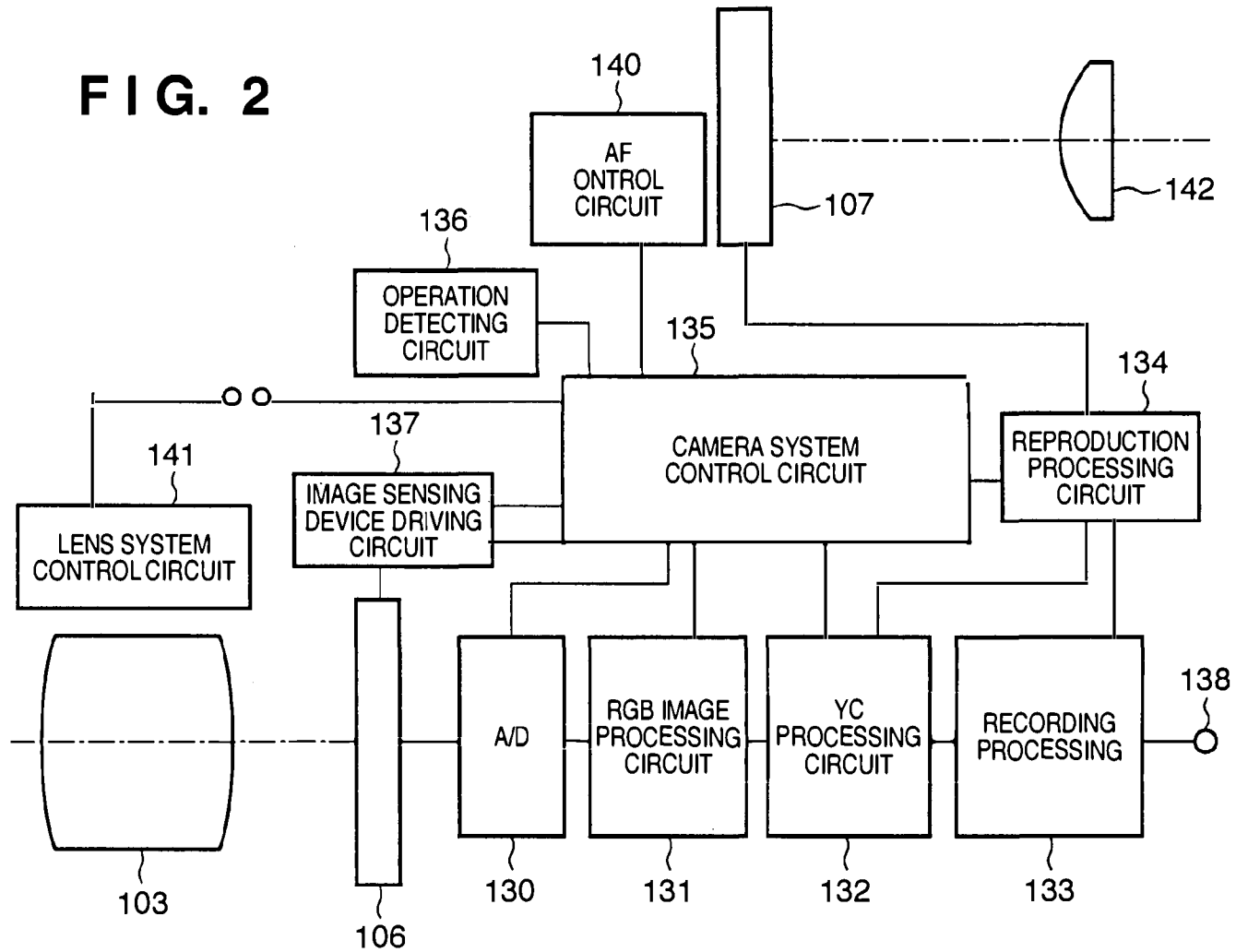


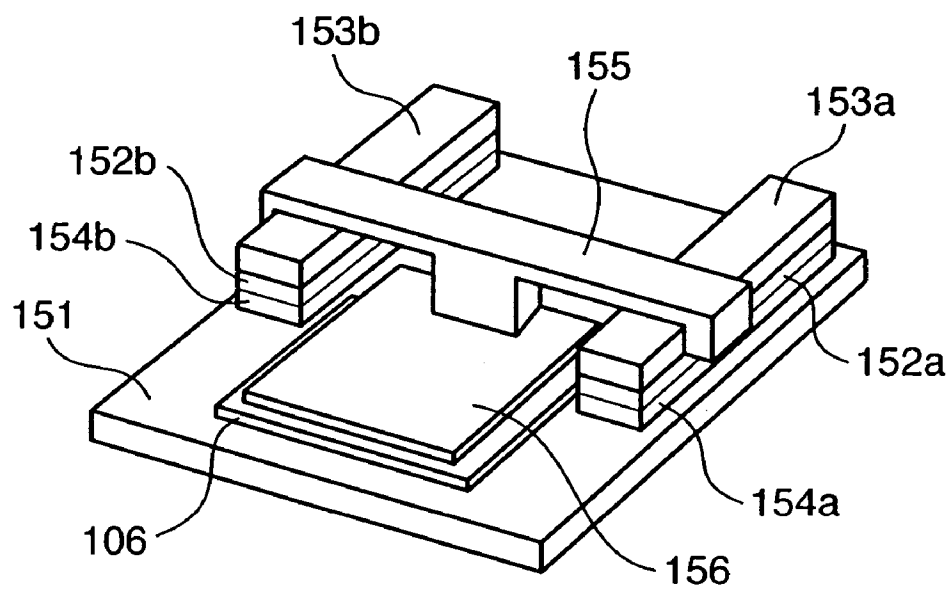
FIG. 3

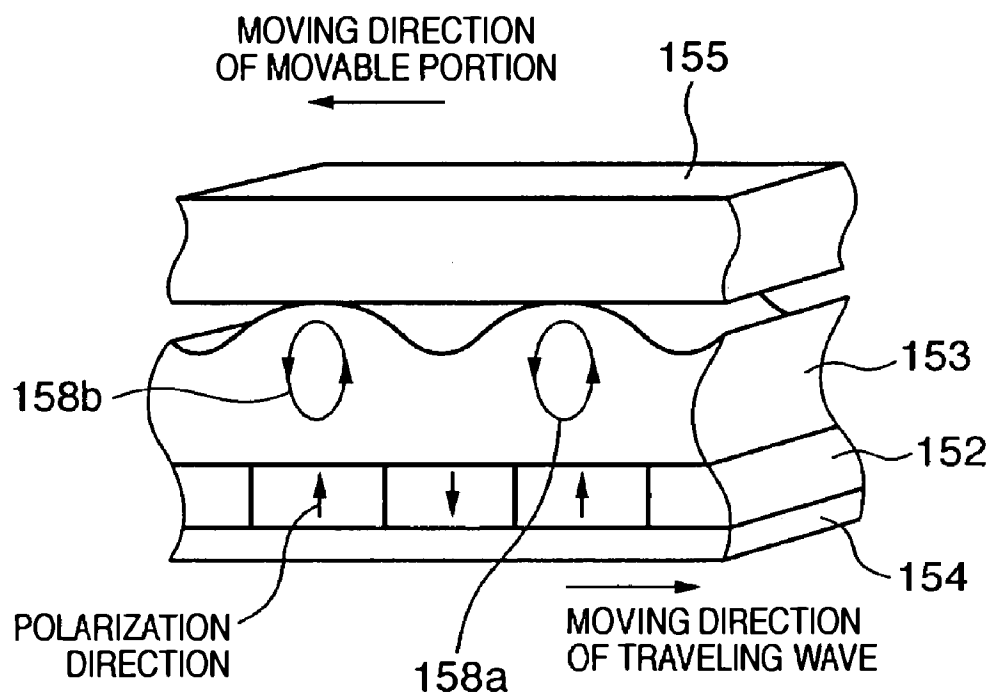
FIG. 4

FIG. 5

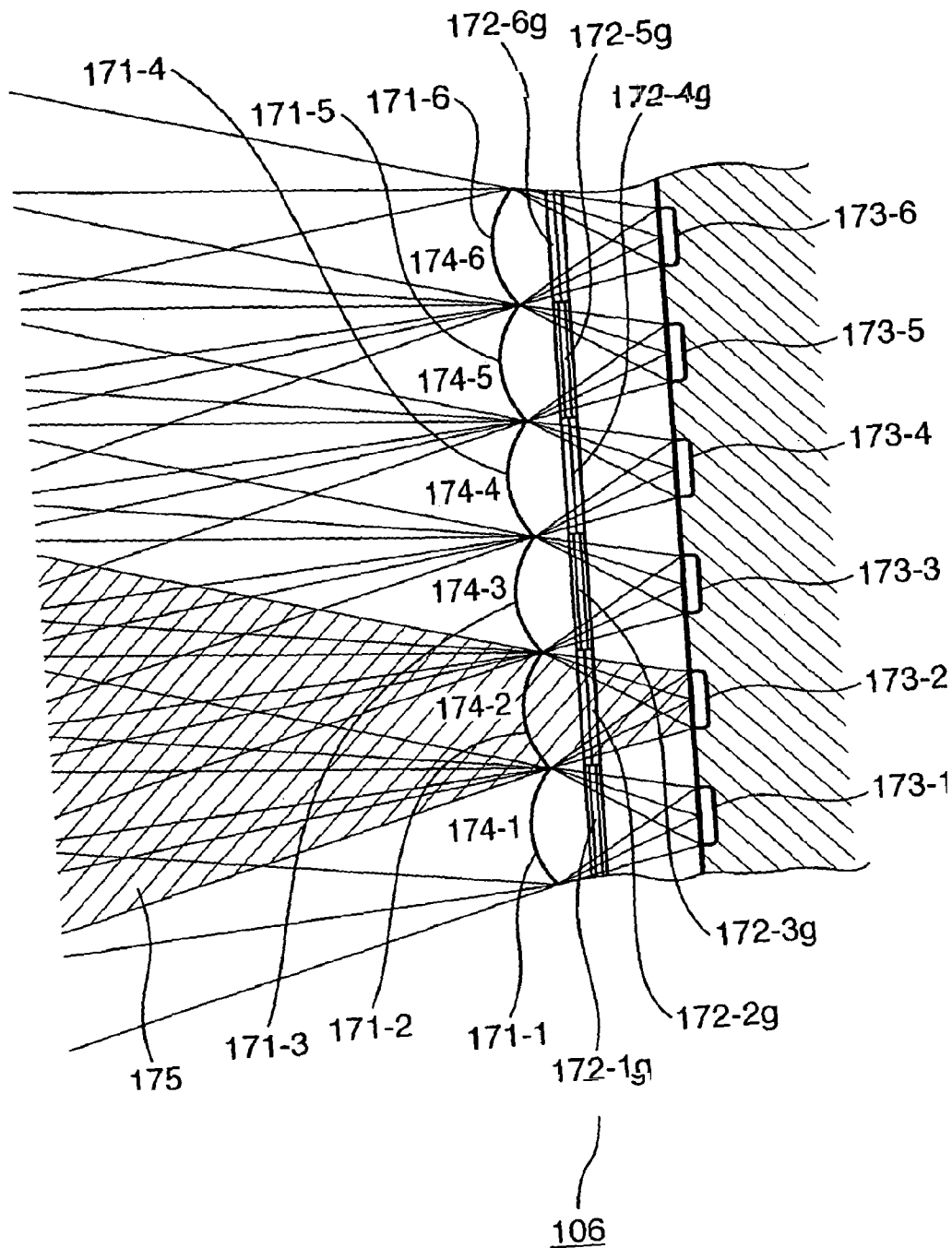


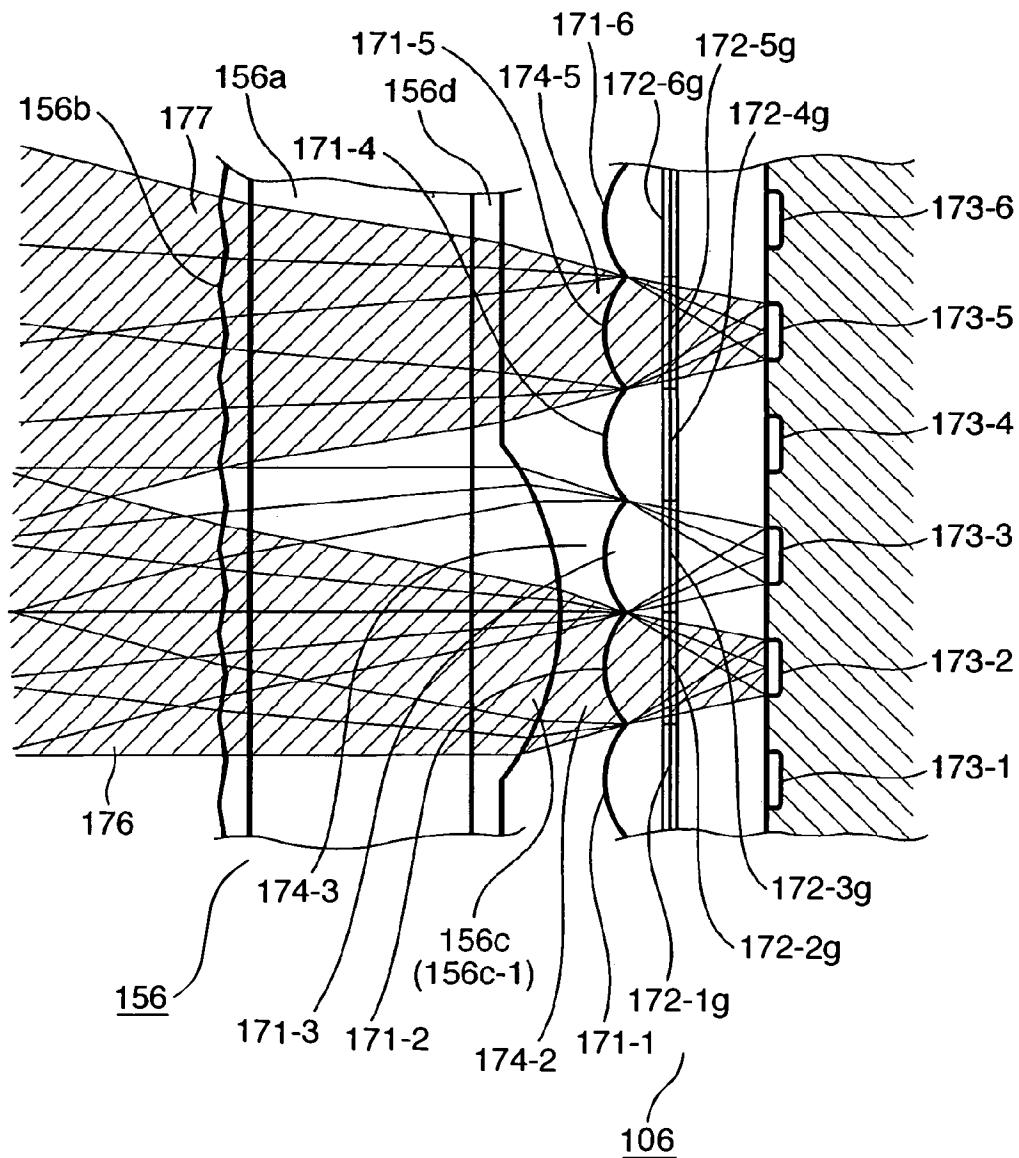
FIG. 6

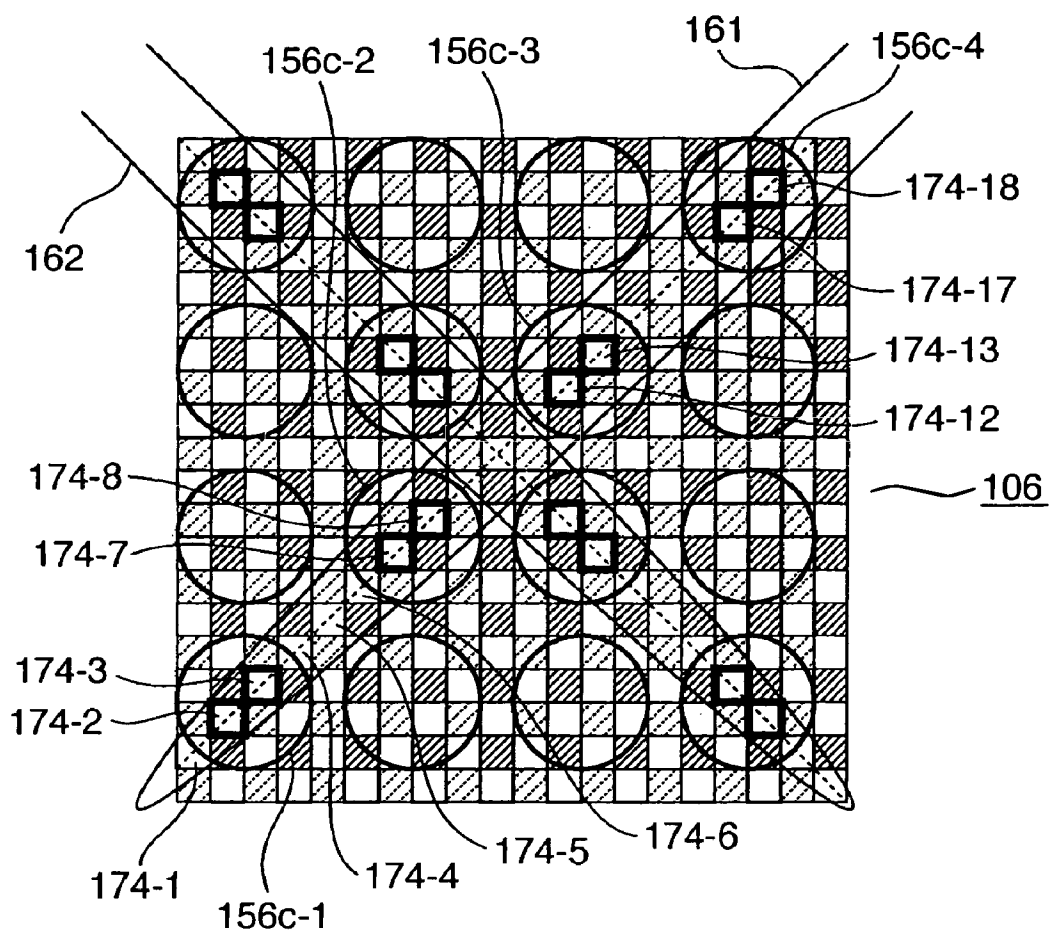
FIG. 7

FIG. 8

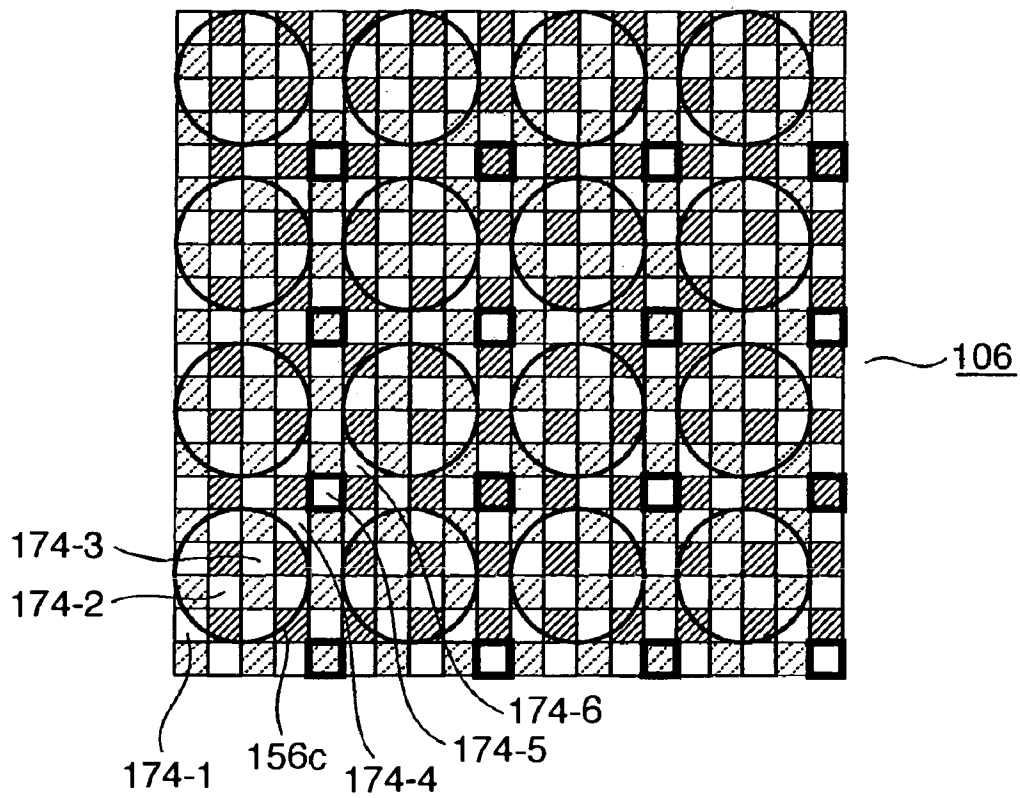


FIG. 9

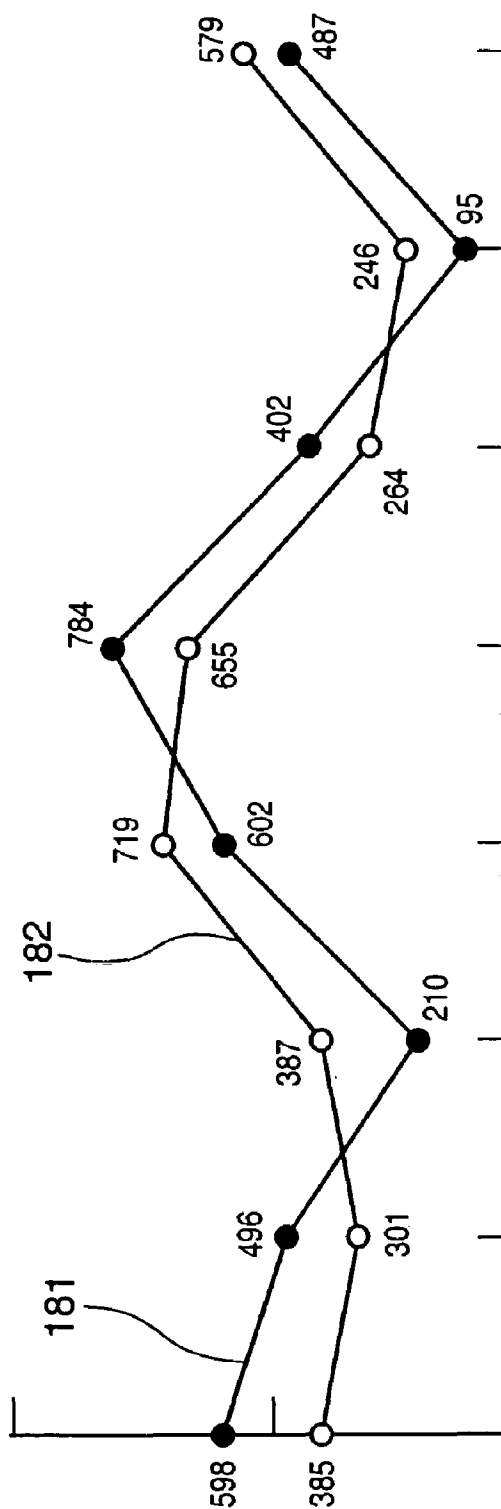


FIG. 10

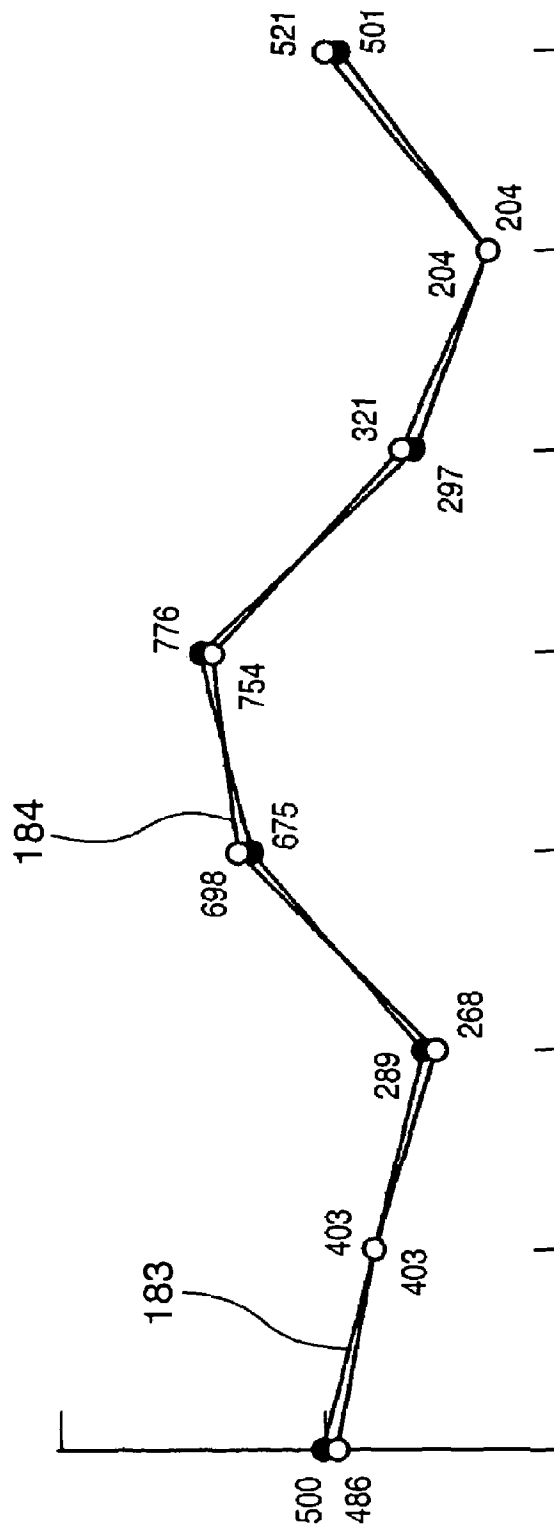


FIG. 11

G	B	G	B	G	B	G	B
R	G	R	G	R	G	R	G
G	B	G	B	G	B	G	B
R	G	R	G	R	G	R	G
G	B	G	B	G	B	G	B
R	G	R	G	R	G	R	G
G	B	G	B	G	B	G	B
R	G	R	G	R	G	R	G

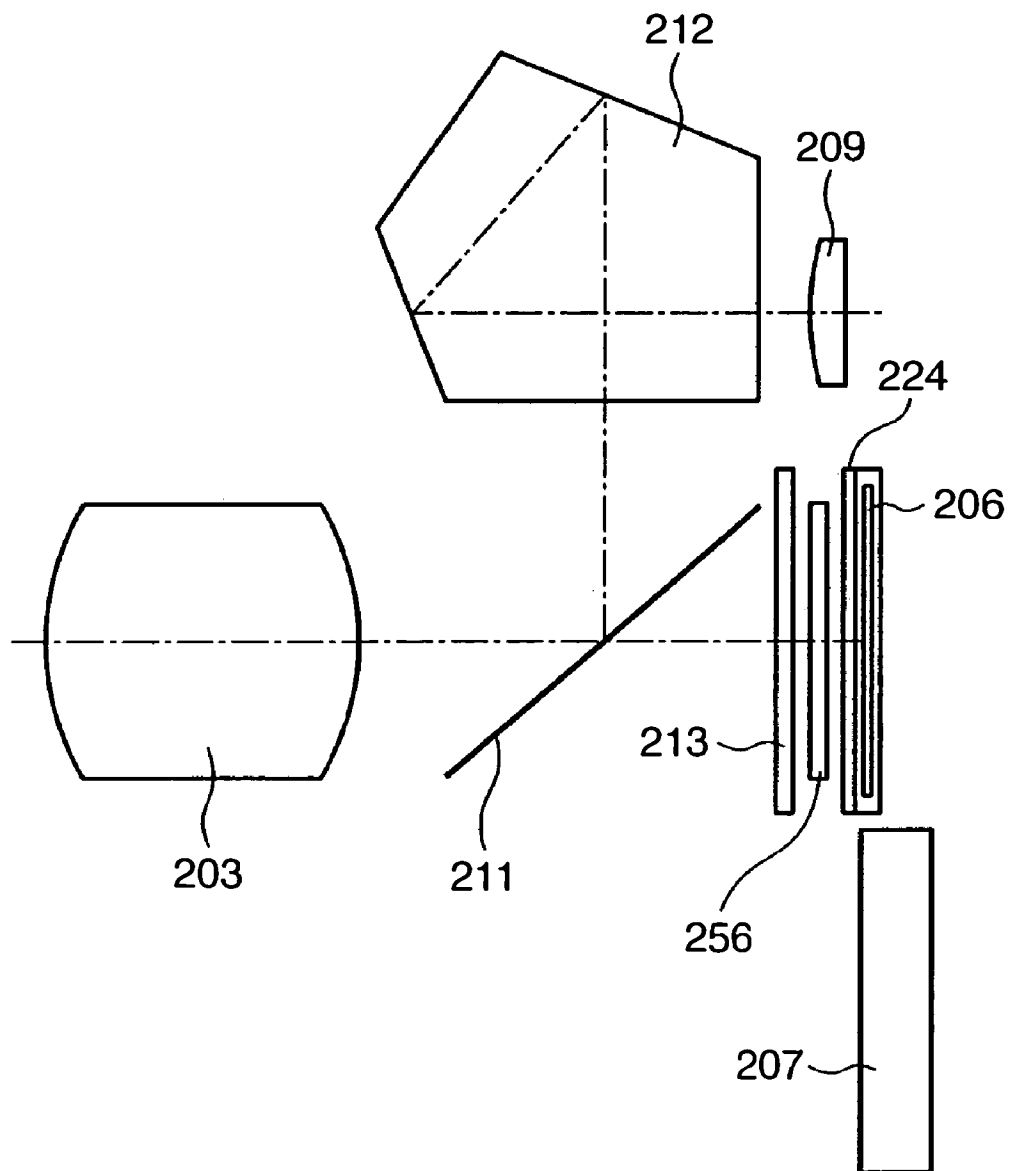
FIG. 12

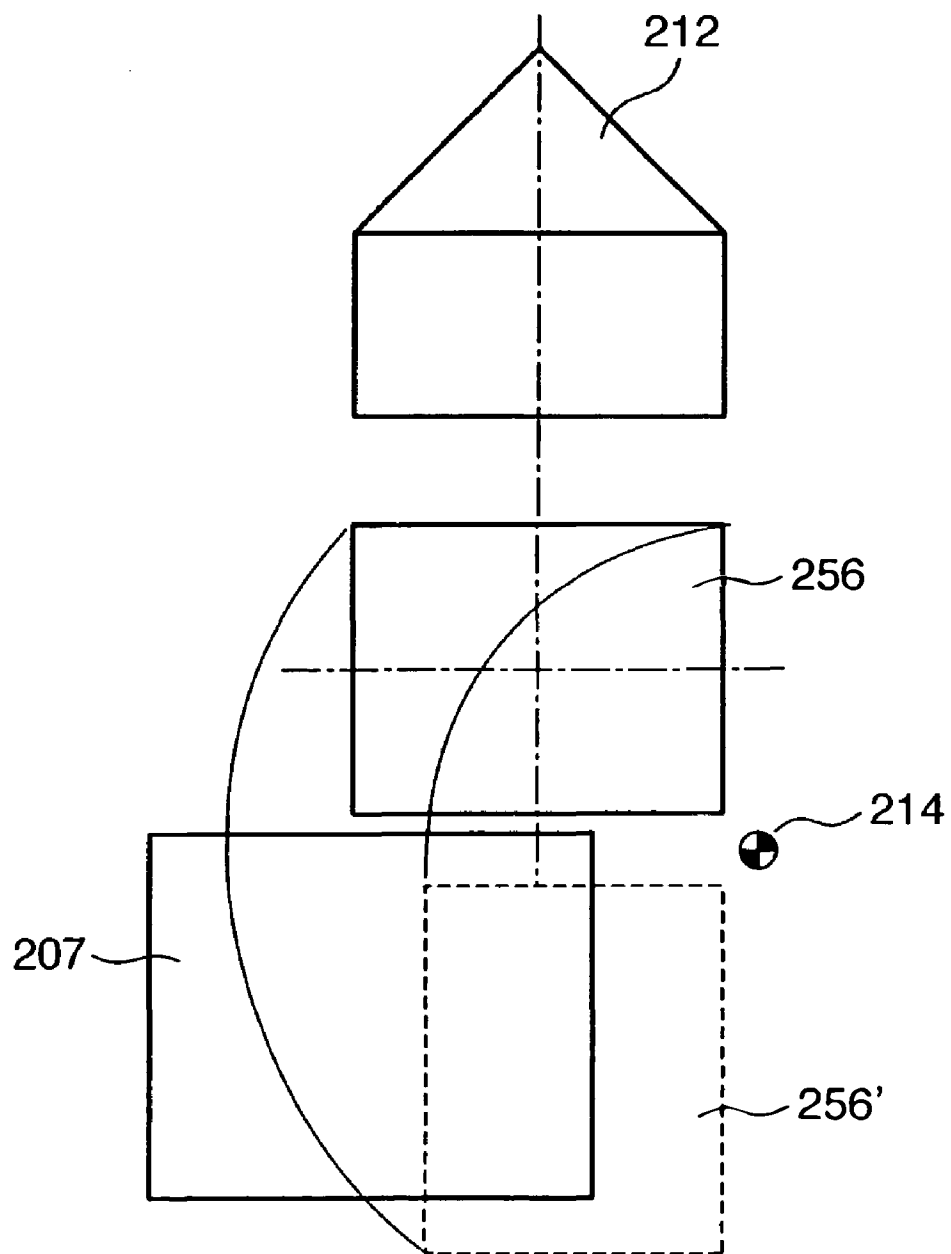
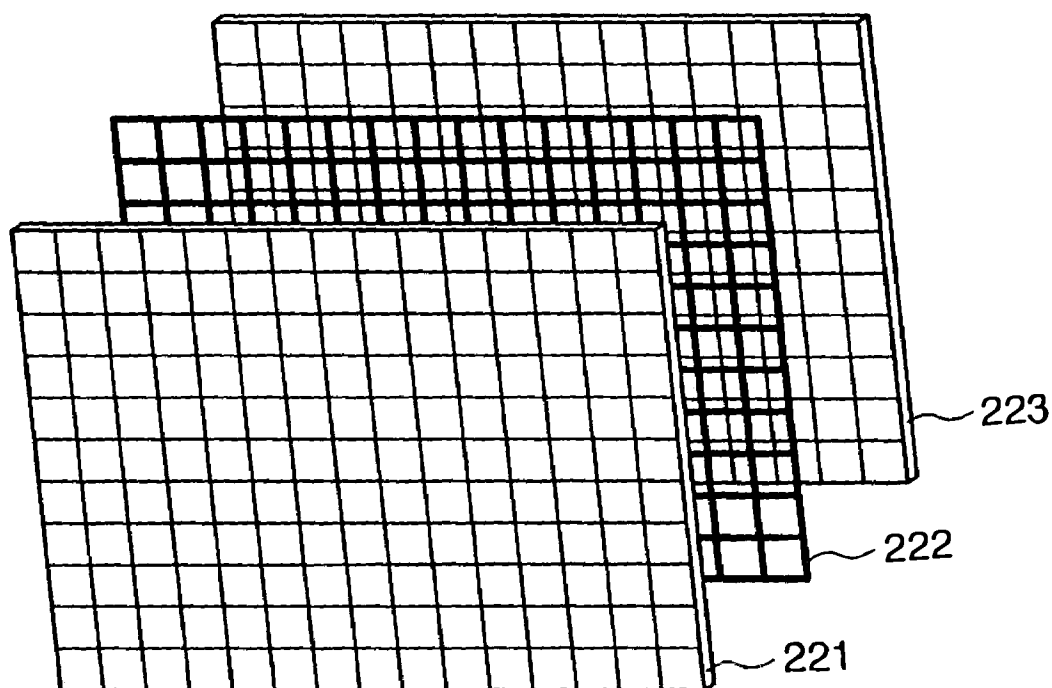
FIG. 13

FIG. 14



256

FIG. 15

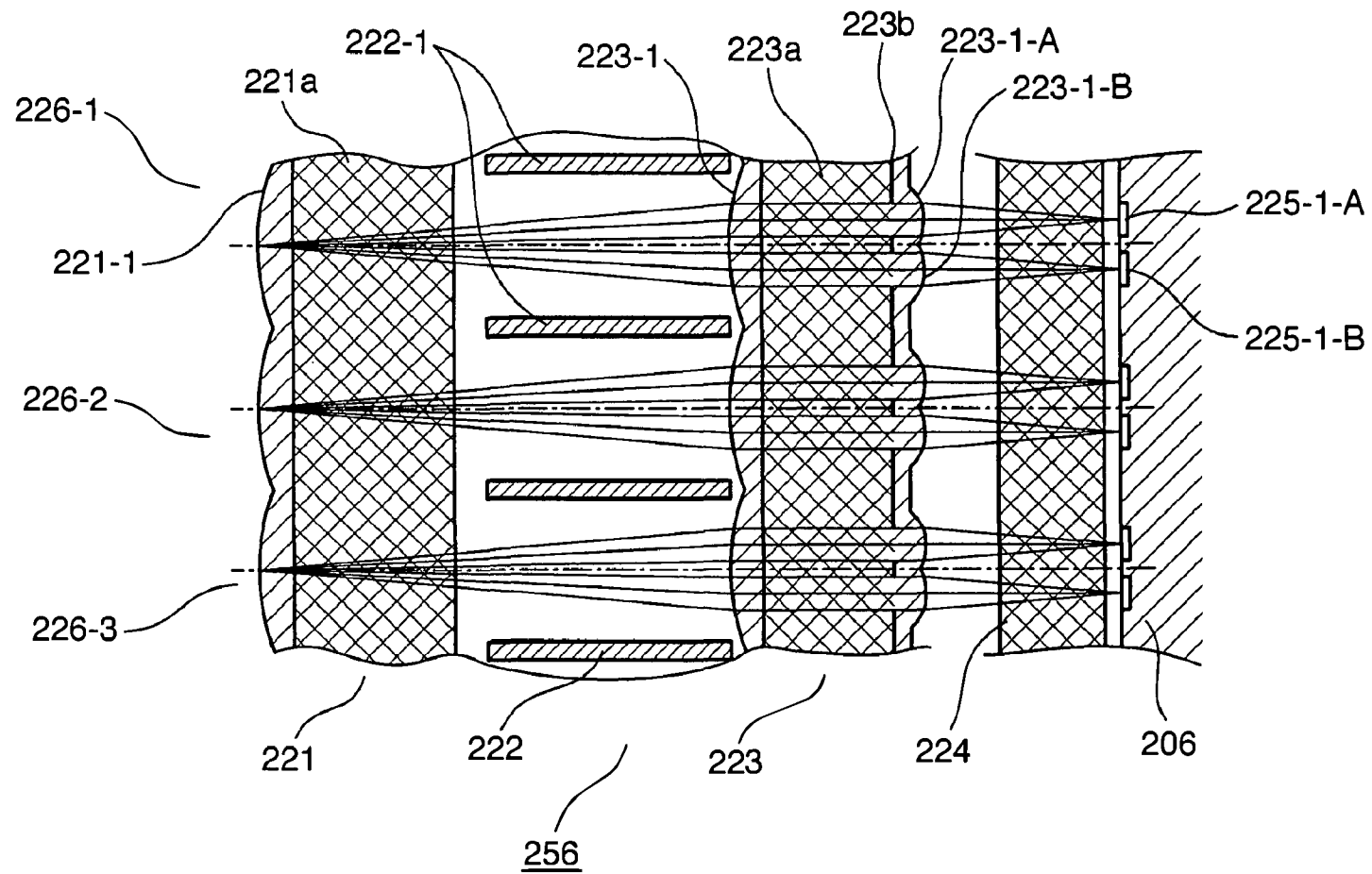


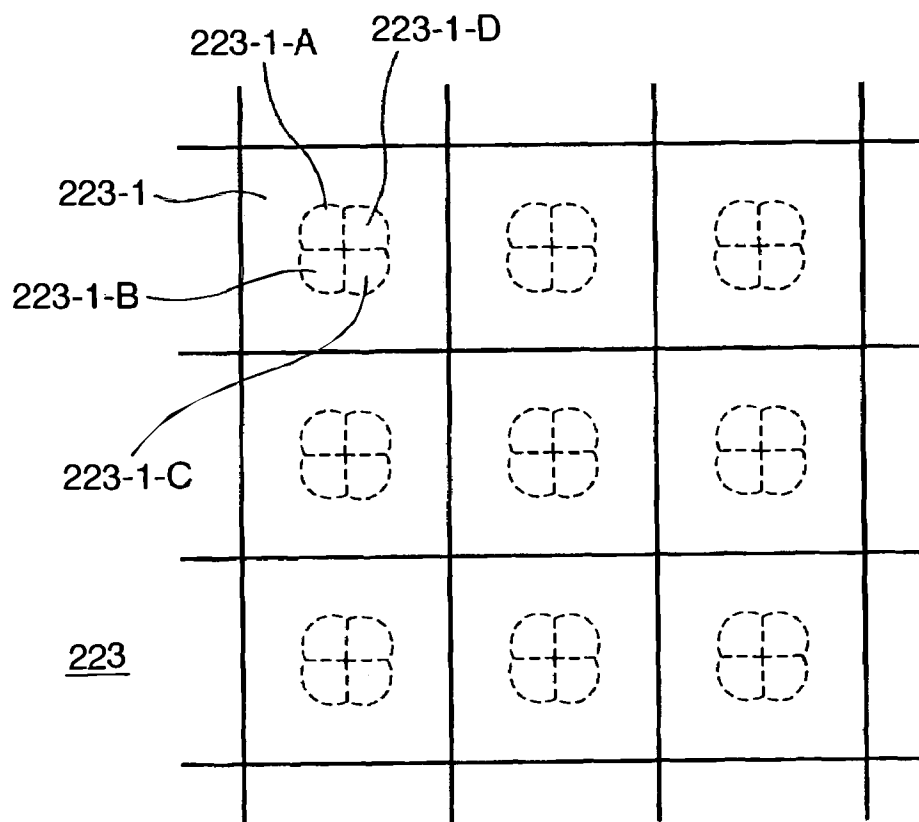
FIG. 16

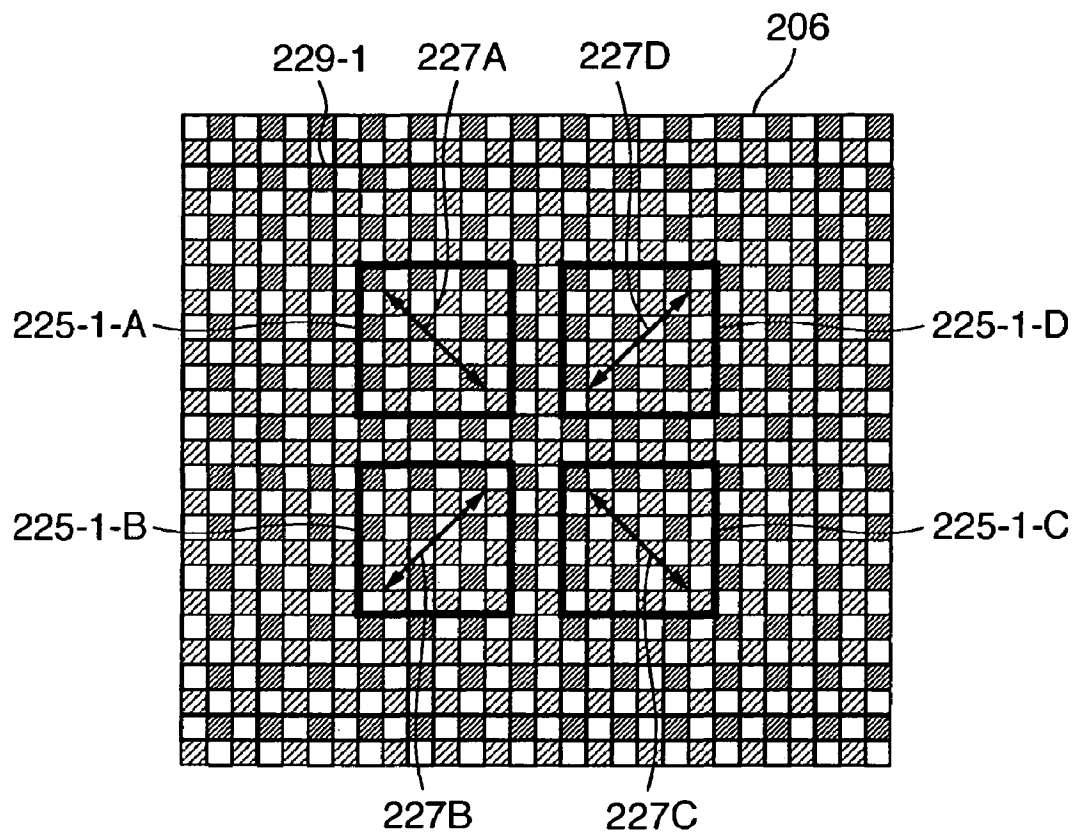
FIG. 17

FIG. 18

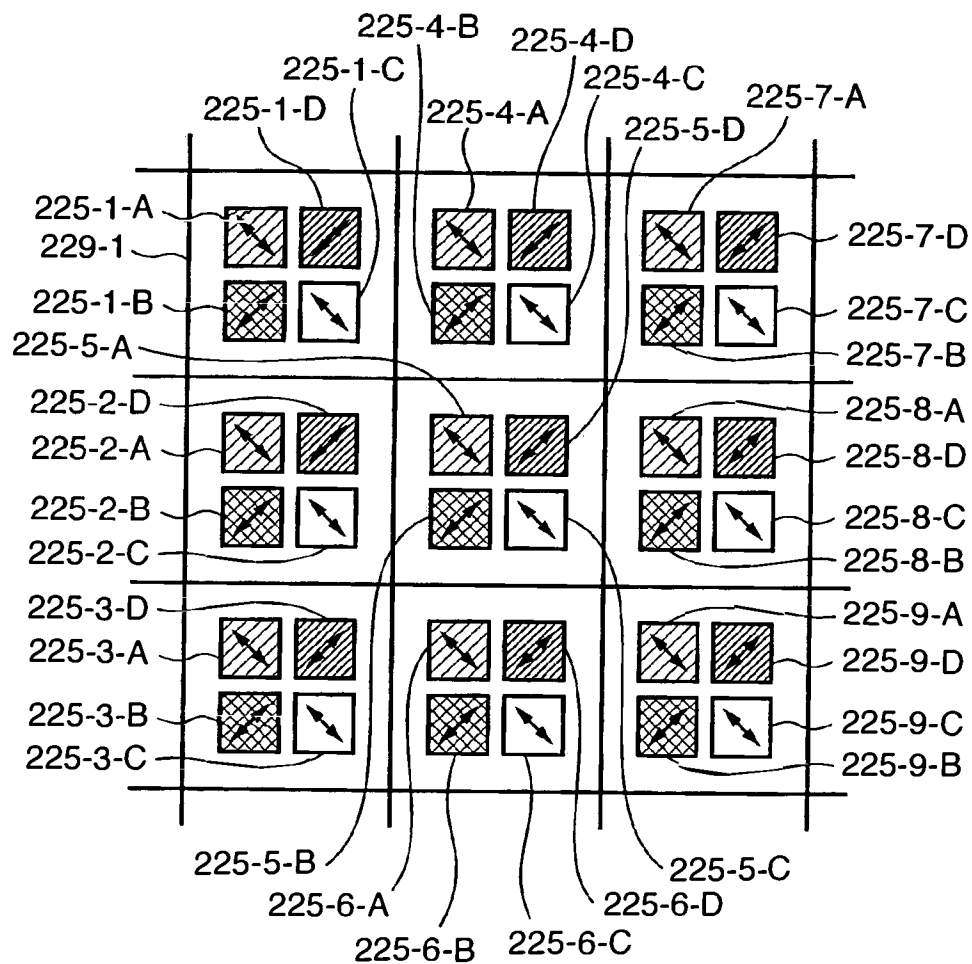


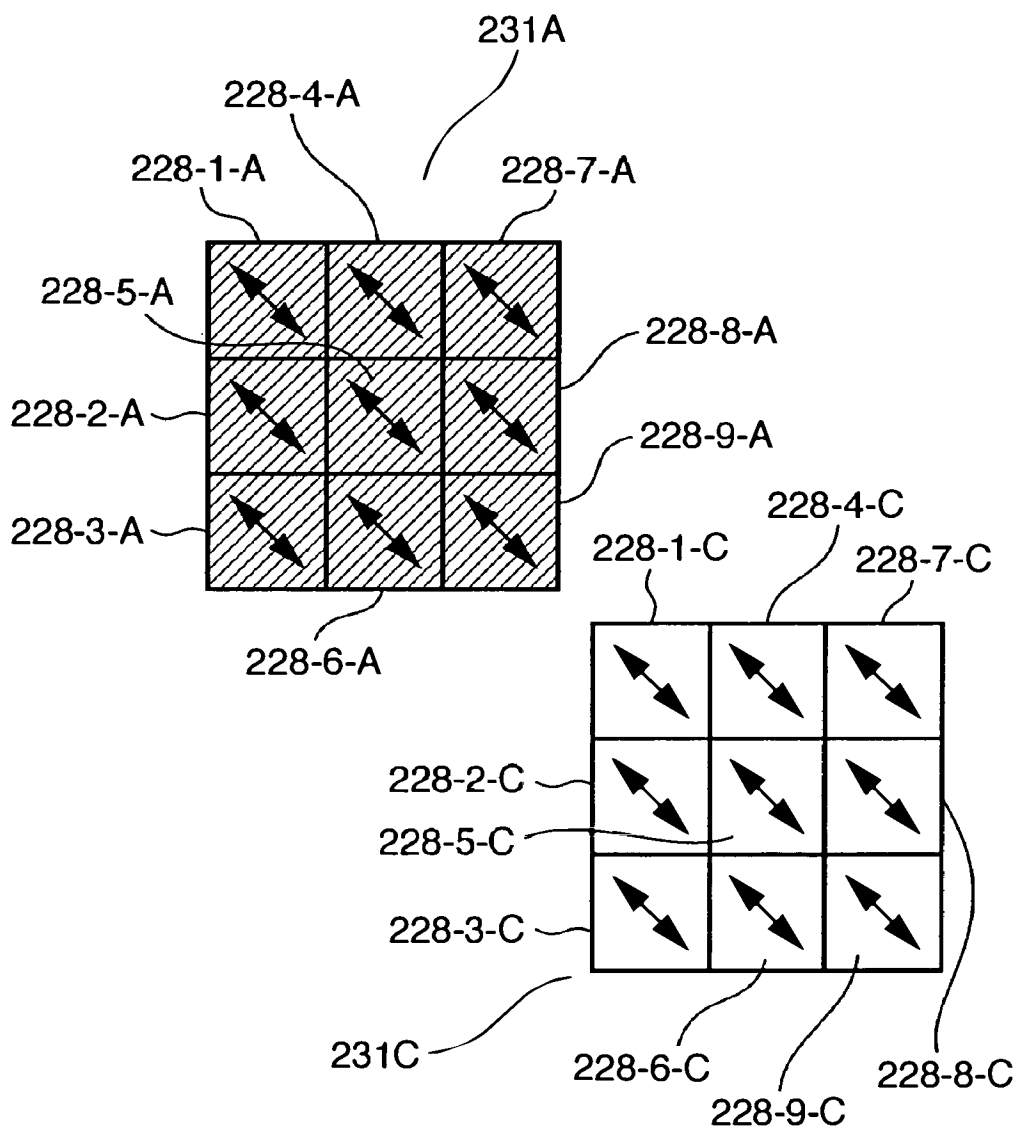
FIG. 19

FIG. 20

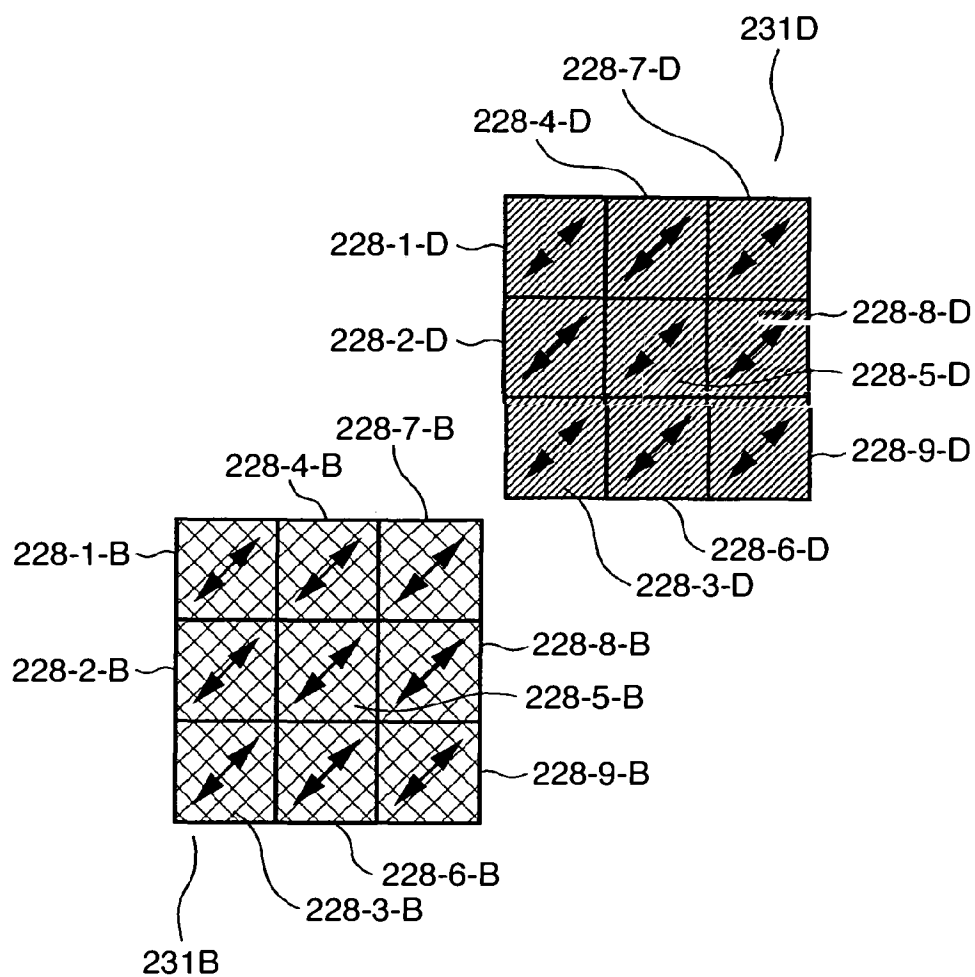
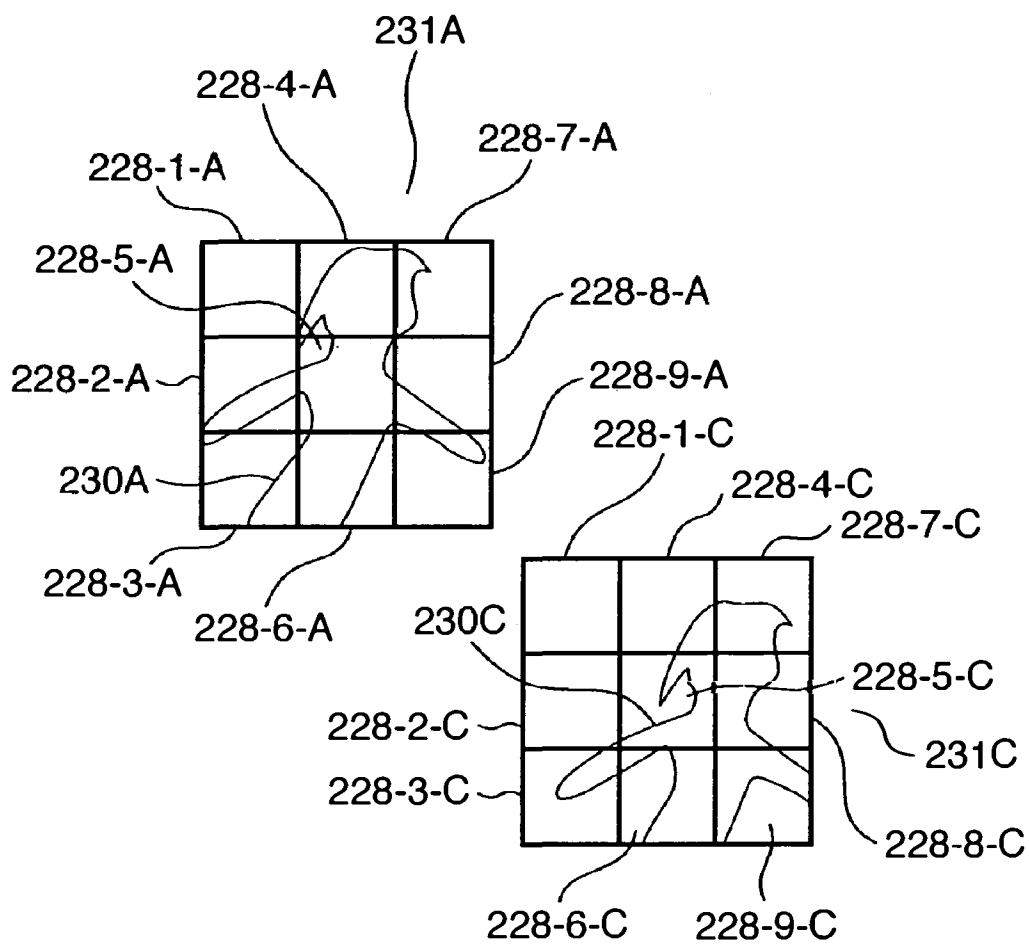


FIG. 21

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**IMAGE SENSING APPARATUS HAVING
IMAGE SIGNALS GENERATED FROM
LIGHT BETWEEN OPTICAL ELEMENTS OF
AN OPTICAL ELEMENT ARRAY**

FIELD OF THE INVENTION

The present invention relates to an image sensing device and, more particularly, to an image sensing apparatus having a focus detection function in addition to an image sensing function using an image sensing device.

BACKGROUND OF THE INVENTION

In a digital camera, in response to the pressing of the release button, an image sensing device such as a CCD or CMOS sensor is exposed to an object image for a desired period of time. The resultant image signal representing a still image of one frame is converted into a digital signal. Predetermined processing such as YC processing is then performed for the digital signal to obtain an image signal in a predetermined form. Digital image signals representing sensed images are recorded on a semiconductor memory in correspondence with the respective images. The recorded image signals are read out as needed to be displayed or converted into printable signals. Alternatively, such signals are output to a display apparatus to be displayed.

Conventionally, a digital camera performs focus detection by using an output from an image sensing device. In this case, focus detection is performed by a contrast detection scheme. In focus adjustment based on the contrast detection scheme, the sharpness of an object image formed by an image sensing optical system is obtained by evaluating an output from the image sensing device by a predetermined function, and the position of the image sensing optical system on the optical axis is adjusted such that the function value takes an extreme value.

Evaluation functions include, for example, a function that adds the absolute values of the differences between adjacent luminance signals within a focus detection area, a function that adds the squared differences between adjacent luminance signals within a focus detection area, and a function that similarly processes the differences between adjacent signals of R, G, and B image signals.

In general, in focus detection based on such a contrast detection scheme, since evaluation function values are obtained while the position of an image sensing optical system on the optical axis is slightly moved, it requires a considerable time to perform focus adjustment until an in-focus state is obtained.

Japanese Patent Laid-Open No. 2001-215406 discloses an arrangement in which the photodetection surface of an image sensing device is stepped to realize high-speed direction determination in focus control. More specifically, a plurality of image signals are acquired by setting slightly different optical path lengths, and a focusing direction is determined on the basis of the acquired image signals. The photographing lens is then moved in the determined focusing direction up to the in-focus position. However, this scheme includes both pixels with short optical path lengths and pixels with long optical path lengths and hence is not suited to an apparatus aiming at obtaining high-quality images. Although the image quality improves as the optical path length differences between pixels with short optical path lengths and pixels with long optical path lengths are reduced, it becomes difficult to perform direction determi-

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nation in focus control. It is therefore impossible to realize both high-speed focus control and high image quality.

On the other hand, as disclosed in U.S. Pat. No. 4,410,804, an image sensing apparatus incorporating a focus detection device based on a so-called phase difference detection scheme is also available, in which one or two pairs of light-receiving units are provided for each two-dimensional arranged microlens array, and the light-receiving units are projected onto the pupil of an image sensing optical system by using the microlenses, thereby dividing the pupil. In the phase difference detection scheme, an object image is formed by using two light beams passing through different portions of the pupil of the image sensing optical system, and the positional phase difference between the two objective images is detected on the basis of outputs from an image sensing device. This phase difference is then converted into a defocus amount of the image sensing optical system.

In focus detection based on the phase difference detection scheme, since a defocus amount can be obtained, the time required to obtain an in-focus state can be greatly shortened as compared with the contrast detection scheme.

In the image sensing device having the structure disclosed in U.S. Pat. No. 4,410,804, since one or two pairs of images formed by light beams passing through portions of the pupil of the image sensing optical system are output, these images have very low quality when evaluated in terms of image sensing performance for object images. The main cause for this is that in an out-of-focus background or foreground, unnatural image blur is caused by decentered light beams.

In order to eliminate such unnatural blur, there is available a method of combining one or two pairs of images formed by using portions of the pupil to obtain an image using all light beams passing through the pupil of the image sensing optical system in a pseudo manner. However, since signals are combined after they are output from the image sensing device, noise level is high due to amplifiers inside and outside the image sensing device. It is therefore difficult to obtain a high-quality image with a high S/N ratio similar to that of an image obtained by an image sensing device designed to obtain an image using all light beams passing through the pupil of the image sensing optical system.

Japanese Patent Laid-Open No. 07-168125 discloses an arrangement including a liquid crystal spatial optical modulator having a plurality of pixels between the microlenses and the photodetection surface of an image sensing device and is designed to form a three-dimensional image. This arrangement includes a spatial optical modulator which blocks the optical path between a microlens and a light-receiving unit of the image sensing device, and a control circuit which selectively causes light to be transmitted through only a given segment of the spatial optical modulator, thereby making the spatial optical modulator function as a shutter.

This arrangement indicates that images based on light beams passing through portions of the pupil of the photographing lens and images formed by using all light beams can be switched. However, since light is absorbed by the spatial optical modulator constituted by a liquid crystal layer and a polarizer, only an object with sufficient brightness can be captured.

Japanese Patent Laid-Open No. 11-119089 discloses a technique of using a single image sensing device both for image sensing operation and focus detection by extending and retracting a re-imaging optical system in and from a mirror box in a single-lens reflex camera. According to this technique, although high-speed focus adjustment can be performed by the phase difference detection scheme, a large

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retraction space and large energy are required to allow the large-size re-imaging optical system to move at high speed, resulting in an increase in the size of image sensing equipment.

SUMMARY OF THE INVENTION

The present invention has been made in consideration of the above problems in the prior art, and has as its object to realize an image sensing apparatus which satisfies both the requirements for focus detection performance and high-resolution, high image quality.

It is another object of the present invention to realize an image sensing apparatus which can concurrently perform focus detection operation and image display operation by using a single image sensing device.

It is still another object of the present invention to realize a compact image sensing apparatus.

In order to solve the above problems and achieve the above objects, there is provided an image sensing apparatus comprising an image sensing device having a plurality of pixels, an optical element array having a plurality of optical elements made to correspond one by one to each set of a plurality number of pixels of a plurality of pixels of the image sensing device, and a focusing device which generates, for each of the plurality of optical elements, one pair of focus detection signals in the pixels from light passing through the optical element, and performs focusing operation on the basis of focus detection signals generated in pairs for each of the optical elements.

Other objects and advantages besides those discussed above shall be apparent to those skilled in the art from the description of a preferred embodiment of the invention which follows. In the description, reference is made to accompanying drawings, which form a part thereof, and which illustrate an example of the invention. Such example, however, is not exhaustive of the various embodiments of the invention, and therefore reference is made to the claims which follow the description for determining the scope of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view showing the schematic arrangement of a digital color camera according to an embodiment of the present invention;

FIG. 2 is a block diagram showing the electrical arrangement of a digital color camera;

FIG. 3 is a perspective view showing the arrangement of an image sensing unit;

FIG. 4 is a perspective view showing a contact surface between a vibrator and a movable portion of a linear ultrasonic motor during operation;

FIG. 5 is a sectional view of an image sensing device;

FIG. 6 is a sectional view showing the second optical arrangement state in which light strikes the image sensing device after being transmitted through a lens array plate;

FIG. 7 is a plan view showing the lens array plate and image sensing device in a superimposed state;

FIG. 8 is a plan view showing the lens array plate and image sensing device in a superimposed state;

FIG. 9 is a graph showing a digital signal of an image input to an AF control unit;

FIG. 10 is a graph showing a digital signal of an image input to an AF control unit;

FIG. 11 is a view for explaining a Beyer arrangement;

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FIG. 12 is a sectional view of a camera taken in the lateral direction;

FIG. 13 is a front perspective view of the camera when viewed from the left in FIG. 12;

FIG. 14 is an exploded perspective view of the lens array plate;

FIG. 15 is a partial sectional view of the lens array plate and image sensing device;

FIG. 16 is a plan view of a re-imaging lens array plate when viewed from the light incident surface;

FIG. 17 is a plan view showing how object images are projected on the image sensing device;

FIG. 18 is a plan view showing how object images are projected on the image sensing by nine re-imaging optical systems;

FIG. 19 is a view for explaining how output values of pixel arrays at the positions where object images are projected are concatenated in terms of computation processing;

FIG. 20 is a view for explaining how output values of pixel arrays at the positions where object images are projected are concatenated in terms of computation processing; and

FIG. 21 is a view for explaining signal output value arrays while imaging optical systems are capturing human features and focus adjustment is tried.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The preferred embodiments of the present invention will be described below.

An outline of each embodiment will be described first.

An image sensing apparatus of each embodiment is an image sensing apparatus including an image sensing device having a plurality of pixels arranged. This apparatus includes an optical element array in which a plurality of optical elements incorporating the plurality of pixels of the image sensing device are juxtaposed. The apparatus obtains a pair of image sensing device signal outputs based on light beams received through the optical elements of the optical element array for each set of a plurality of optical elements, and generates a focus detection signal on the basis of the signal outputs.

In this arrangement, a pair of image sensing device signal outputs based on light beams received through the optical elements of the optical element array for each set of a plurality of optical elements are obtained, and a focus detection signal is generated on the basis of the signal outputs. This arrangement makes it possible to satisfy both the requirements for high focus detection performance and high-resolution, high image quality by using a single image sensing device. In addition, a compact image sensing apparatus can be realized.

The image sensing apparatus according to each embodiment is an image sensing apparatus including an image sensing device having a plurality of pixels arranged. When light beams are received through an optical element array constituted by a plurality of optical elements incorporating a plurality of pixels of the image sensing device, an image signal is formed on the basis of pixel outputs received through the gaps between a plurality of optical elements formed in the optical element array.

In this arrangement, an image signal is formed on the basis of pixel outputs received through the gaps between a plurality of optical elements formed in the optical element

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array. This makes it possible to concurrently perform display operation for monitoring a photographed image and focus detection operation.

In each embodiment, the above optical element array is formed by juxtaposing a plurality of re-imaging optical systems.

In this arrangement, since a plurality of re-imaging optical systems are juxtaposed in the optical element array, high-speed focus detection based on the phase difference detection scheme can be realized. In addition, since the optical element array is small in size, a large mechanism space is not required. When the optical element array is retracted, high image quality can be obtained by using all the pixels of the image sensing device.

In each embodiment, the apparatus can be switched between the first optical arrangement state, in which the image sensing device receives light without through the optical element array constituted by a plurality of optical elements incorporating a plurality of pixels of the image sensing device, and the second optical arrangement state, in which the image sensing device receives light through the optical element array.

In this arrangement, since the first optical arrangement state and second optical arrangement state can be switched, an image sensing apparatus can be realized, which can satisfy both the requirements for focus detection performance and image quality by using a single image sensing device.

In this embodiment, a focus detection signal is generated by using a pair of image sensing device signal output value arrays in which signal outputs change in accordance with the imaging state of the imaging optical system which forms an object image on the image sensing device.

In this arrangement, since a focus detection signal is generated by using a pair of image sensing device signal output value arrays in which signal outputs change in accordance with the imaging state of the imaging optical system which forms an object image on the image sensing device, high-speed focus detection based on the phase difference detection scheme can be realized.

In addition, in each embodiment, a focus detection signal is formed by using a signal output value array obtained by concatenating output values from a plurality of pixels, of the plurality of pixels of the image sensing device, which are positioned discretely.

In this arrangement, since a focus detection signal is formed by using a signal output value array obtained by concatenating output values from a plurality of pixels, of the plurality of pixels of the image sensing device, which are positioned discretely, high focus detection performance can be obtained by having a sufficiently large focus detection visual field while a reduction in the size of a mechanism for focus detection is achieved.

The embodiments of the present invention will be described in detail below.

First Embodiment

FIG. 1 is a view showing the schematic arrangement of a digital color camera which is image sensing equipment incorporating an image sensing apparatus according to the first embodiment of the present invention. This camera is a single-CCD digital color camera which uses an image sensing device such as a CCD or CMOS sensor. The camera obtains an image signal representing a moving or still image by continuously or sporadically driving the image sensing device. In this case, the image sensing device is an area

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sensor of a type that converts exposure light into an electrical signal for each pixel, stores electric charges corresponding to the light amount, and outputs the electric charges.

Referring to FIG. 1, reference numeral 101 denotes a camera body; and 102, a detachable photographing lens incorporating an imaging optical system 103. The photographing lens 102 is electrically and mechanically connected to the camera body 101 through a known mount. Photographed frames with various field angles can be obtained by interchanging photographing lenses with different focal lengths. The photographing lens 102 has a driving mechanism (not shown) and is focused on an object by moving a focusing lens as an element of the imaging optical system 103 along an optical axis L1 or forming a focusing lens using a transparent, elastic member with flexibility or a liquid lens and changing its refractive power by changing its interface form.

Reference numeral 106 denotes an image sensing device. An optical low-pass filter (not shown) which limits the cutoff frequency of the imaging optical system 103 so as not to form excessively high spatial frequency components of an object image on the image sensing device 106 is provided in an optical path from the imaging optical system 103 to the image sensing device 106. An infrared cut filter is also placed in the imaging optical system 103.

A lens array plate 156 is retractably placed in front of the light-receiving surface of the image sensing device 106. The lens array plate 156 is housed, together with a linear ultrasonic motor (to be described later), in a package 104 which allows effective capturing of light without the entrance of dust and moisture from the outside. The lens array plate 156 has a size that makes it possible to cover the entire surface of the image sensing device 106 when the plate is inserted to a position before the image sensing device 106. Note that the lens array plate 156 can also be called an optical element array.

The object image captured by the image sensing device 106 is displayed on a display apparatus 107. The display apparatus 107 is preferably formed from an organic EL spatial modulation device, liquid crystal spatial modulation device, a spatial modulation device using electrophoresis of particles, digital micro-mirror device, or the like because they are low in power consumption.

The image sensing device 106 is a CMOS process compatible sensor (to be simply referred to as a CMOS sensor hereinafter) which is one of amplification type solid-state image sensing devices. One of the characteristic features of the CMOS sensor is that the number of masks and the number of process steps can be greatly decreased as compared with a CCD because MOS transistors in an area sensor unit and MOS transistors in a peripheral circuit can be formed in the same step. Another characteristic feature of this sensor is that it allows random access to an arbitrary pixel. Therefore, the sensor facilitates reading of a signal limited to a focus detection visual field or a signal removed by decimation for display.

The image sensing device 106 performs focus detection operation, display image output operation, and high-resolution image output operation by using such characteristic features.

Reference numerals 108 and 109 denote a concave lens and convex lens, respectively, which are used for the observation of the display apparatus 107. These lenses have positive power as a whole and constitute a finder optical system. The diopter is adjusted by moving the convex lens

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109 along a finder optical axis L2 to provide an observer with optimal visibility of the display apparatus 107.

Reference numeral 119 denotes a main switch, and 120, a release button.

FIG. 2 is a block diagram showing the electrical arrangement of the digital color camera.

A portion of the camera which is associated with image sensing operation and recording operation will be described first. The camera has an image sensing system, image sensing system, recording/reproducing system, and control system. The image sensing system includes the imaging optical system 103 and image sensing device 106. The image processing system includes an A/D converter 130, RGB image processing circuit 131, and YC processing circuit 132. The recording/reproducing system includes a recording processing 133 and reproduction processing circuit 134. The control system includes a camera system control circuit 135, operation detecting circuit 136, and image sensing device driving circuit 137. Reference numeral 138 denotes a connection terminal which is standardized to be connected to an external computer or the like and transmit/receive data. These electric circuits are driven by a compact fuel cell (not shown).

The image sensing system is an optical processing system which forms an image on the image sensing plane of the image sensing device 106 through the imaging optical system 103. This system exposes the image sensing device 106 to an object image with a proper amount of light by adjusting the stop (not shown) of the photographing lens 102 and also adjusting a mechanical shutter (not shown) as needed. As the image sensing device 106, an image sensing device having 3,700 square pixels in the long side direction and 2,800 square pixels in the short side direction, i.e., a total of about 1,000,000 pixels is used. R (Red), G (Green), and B (Blue) color filters are alternately arranged for the respective pixels to form a so-called Bayer arrangement with four pixels constituting one combination, as shown in FIG. 11.

In the Bayer arrangement, G pixels which tend to be sensed strongly by the observer when he/she sees an image are arranged more in number than R and B pixels to improve the overall image performance. In general, in image processing which uses an image sensing device based on this scheme, luminance signals are mainly generated from G, and chrominance signals are generated from R, G, and B.

Each image signal read from the image sensing device 106 is supplied to the image processing system through the A/D converter 130. The A/D converter 130 is a signal conversion circuit which converts each image signal into a signal corresponding to the amplitude of the signal from the corresponding exposed pixel, e.g., a 10-bit digital signal, and outputs it. The subsequent image signal processing is executed by digital processing.

The image processing system is a signal processing circuit which obtains an image signal in a desired form from R, G, and B digital signals. This circuit converts R, G, and B chrominance signals into a YC signal represented by a luminance signal Y and color difference signals R-Y and B-Y or the like.

The RGB image processing circuit 131 is a signal processing circuit which processes a 3,700×2,800-pixel image signal received from the image sensing device 106 through the A/D converter 130, and includes a white balance circuit, a gamma correction circuit, and an interpolation computation circuit which increases the resolution of an image by interpolation computation.

The YC processing circuit 132 is a signal processing circuit which generates a luminance signal Y and color

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difference signals R-Y and B-Y. This circuit is comprised of a high-frequency luminance signal generating circuit which generates a high-frequency luminance signal YH, a low-frequency luminance signal generating circuit which generates a low-frequency luminance signal YL, and a color difference signal generating circuit which generates the color difference signals R-Y and B-Y. The luminance signal Y is formed by combining the high-frequency luminance signal YH and low-frequency luminance signal YL.

The recording/reproducing system is a processing system which outputs an image signal to a memory and outputs an image signal to the display apparatus 107. The recording processing 133 writes and reads image signal in and from the memory. The reproduction processing circuit 134 reproduces the image signal read out from the memory and outputs the signal to the display apparatus 107.

The recording processing circuit 133 incorporates a compression/decompression circuit which compresses a YC signal representing a still or moving image into a signal in a predetermined compression form, and decompresses compressed data when it is read out. The compression/decompression circuit includes a frame memory for signal processing. This circuit stores YC signals from the image processing system in the frame memory on a frame basis, and reads out signals for each set of a plurality of blocks to compress/code. Compression/coding is performed by, for example, performing two-dimensional quadrature transformation, normalization, and Huffman coding with respect to image signals on a block basis.

The reproduction processing circuit 134 is a circuit which matrix-converts the luminance signal Y and the color difference signals R-Y and B-Y into, for example, an RGB signal. The signal converted by the reproduction processing circuit 134 is output to the display apparatus 107 to display/play back a visible image. The reproduction processing circuit 134 may be connected to the display apparatus 107 through a radio communication means such as Bluetooth. This arrangement makes it possible to monitor an image sensed by the digital color camera from a remote place.

The control system includes the operation detecting circuit 136 which detects the operation of the release button 120 or the like, the camera system control circuit 135 which controls each unit including the position of the lens array plate 156 in accordance with the detection signal and generates and outputs a timing signal for image sensing operation, and the image sensing device driving circuit 137 which generates a driving signal for driving the image sensing device 106 under the control of the camera system control circuit 135.

The control system controls the image sensing system, image processing system, and recording/reproducing system in accordance with external operation. For example, upon detecting the pressing of the release button 120, the control system controls driving of the image sensing device 106, the operation of the RGB image processing circuit 131, compression processing in the recording processing 133, and the like.

A portion associated with focus adjustment will be described next. An AF control circuit 140 and lens system control circuit 141 are also connected to the camera system control circuit 135. These circuits communicate data necessary for each processing with each other through the camera system control circuit 135.

The AF control circuit 140 obtains an image sensing device signal output in the focus detection visual field set at an arbitrary position on a photographing frame, generates a focus detection signal on the basis of the signal output, and

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detects an imaging state. Upon detecting a defocus amount, the AF control circuit 140 converts it into a driving amount of the focusing lens as an element of the imaging optical system 103, and transmits the driving amount to the lens system control circuit 141 through the camera system control circuit 135. With respect to a moving object, the AF control circuit 140 indicates a focusing lens driving amount based on the result obtained by predicting a proper lens position in consideration of the time lag between the instant at which the release button 120 is pressed and the instant at which actual image sensing control is started. Upon determining that the luminance of an object is too low to obtain sufficient focus detection precision, the AF control circuit 140 illuminates the object with a white LED or fluorescent tube (not shown).

Upon reception of the focusing lens driving amount, the lens system control circuit 141 focuses the camera on the object by, for example, moving the focusing lens along the optical axis L1 using a driving mechanism (not shown) for the photographing lens 102.

When the AF control circuit 140 detects that the camera is focused on the object, the corresponding information is sent to the camera system control circuit 135. When the release button 120 is pressed at this time, image sensing control is performed by the image sensing system, image processing system, and recording/reproducing system as described above.

FIG. 3 is a perspective view showing the arrangement of part of the image sensing apparatus according to the first embodiment.

The image sensing apparatus includes the image sensing device 106, the lens array plate 156 driven by a linear ultrasonic motor, and an electrical circuit which generates an image signal and focus detection signal. Of these components, the image sensing device 106 and lens array plate 156 are housed in the package 104 having a window through which light is received, as described above.

The linear ultrasonic motor extends and retracts the lens array plate 156 onto and from the image sensing device 106 to switch between the first optical arrangement state, in which a light beam from the imaging optical system 103 is caused to be directly incident on the image sensing device 106, and the second optical arrangement state, in which a light beam is caused to be incident on the image sensing device 106 upon being transmitted through the lens array plate 156. The first optical arrangement state is used to generate a high-resolution image suitable for a large-size print or the like. The second optical arrangement state is used to generate a signal for focus detection and an image signal with a relatively small amount of data for display. The lens array plate 156 is a thin plate having a size that allows it to cover the front surface of the image sensing device 106, and hence can realize a very compact image sensing apparatus. In addition, the image sensing device 106 itself requires no special structure and hence can be easily obtained at a low price.

The linear ultrasonic motor is configured such that piezoelectric vibrators 152a and 152b formed from rectangular parallelepiped ceramic members are arranged parallel on a substrate 151, metal vibrators 153a and 153b are stacked on the piezoelectric vibrators 152a and 152b, and electrodes 154a and 154b are arranged under the piezoelectric vibrators 152a and 152b such that they are overlaid parallelly on the piezoelectric vibrators 152a and 152b to be mounted in tight contact therewith. A movable portion 155 which is made of polyphenylene sulfide resin and serves as a support member for the lens array plate 156 is supported across the vibrators

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153a and 153b so as to be linearly movable in only the longitudinal direction of the vibrators 153a and 153b. The two ends of the movable portion 155 are bent toward the vibrators 153a and 153b in the form of a hook so as not to come off the vibrators 153a and 153b.

The image sensing device 106 is placed between the piezoelectric vibrators 152a and 152b on the substrate 151, and the lens array plate 156 supported on the movable portion 155 faces the image sensing device 106 at a distance of several μm to several 100 μm .

Lens array plate driving operation in the image sensing apparatus having the above arrangement will be described.

FIG. 4 is a perspective view showing a contact surface between a vibrator and the movable portion of the linear ultrasonic motor during operation.

A piezoelectric vibrator 152 is polarized into several separate poles to have alternately opposite polarization directions. When a voltage is applied to an electrode 154 and vibrator 153 which are joined to the piezoelectric vibrator 152 in tight contact, distortion is produced inside the piezoelectric vibrator 152 due to the difference in polarization direction, and transmitted to the vibrator 153. Continuously performing this operation while changing the direction of distortion will produce vibrations in the vibrator 153. This in turn excites a traveling wave and ultrasonic vibrations 158a and 158b. The ultrasonic vibrations 158a and 158b then serve as driving power to move the movable portion 155 through a frictional force. At this time, since the moving direction of the traveling wave is opposite to the rotating direction of the ultrasonic vibrations 158a and 158b, the movable portion 155 moves in a direction opposite to the moving direction of the traveling wave.

In general, a linear ultrasonic motor has a high torque and hence has a fast response characteristic. This motor can therefore efficiently move the lens array plate 156 supported by the movable portion 155 at high speed.

A main photographing sequence in the digital color camera having the above arrangement will be described below.

(1) The main switch 119 is turned on.

(2) The camera system control circuit 135 controls the position of the lens array plate 156 to set the second optical arrangement state.

(3) A monitor image is displayed on the display apparatus 107 by using the image sensing system, image processing system, and recording/reproducing system.

(4) The image sensing system, AF control circuit 140, and lens system control circuit 141 control the focusing lens of the imaging optical system to focus the camera.

(5) When the operation detecting circuit 136 detects that the release button 120 is pressed, the camera system control circuit 135 controls the position of the lens array plate 156 to set the first optical arrangement state.

(6) The image sensing system and image processing system capture a high-resolution image.

(7) The flow of processing returns to (2).

According to the above arrangement and the above photographing sequence, focus adjustment, monitoring of a sensed image on the display apparatus, and image sensing of a high-resolution image can be performed by using signals from a single image sensing device. In addition, high-speed focus adjustment based on the phase difference detection scheme can be realized simultaneously with uniformity in field of depth with respect to optical images on the image monitor, a small time lag, and smooth moving image display.

The structure of the image sensing device 106 will be described next.

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FIG. 5 is a sectional view of the image sensing device 106 taken in the direction to cross the pixel array at 45°. FIG. 5 shows the first optical arrangement state in which light beams from the imaging optical system are directly incident on the image sensing device 106. The imaging optical system 103 is located on the left side in FIG. 5, and pixels 174-1, 174-2, 174-3, 174-4, 174-5, and 174-6 are densely arrayed on the image sensing device 106.

Each pixel of the image sensing device 106 is constituted by a set of a microlens, color filter, and light-receiving unit.

Light beams emerging from the imaging optical system 103 are incident on microlenses 171-1, 171-2, 171-3, 171-4, 171-5, and 171-6 through optical low-pass filters (not shown). Color filters are arranged behind the respective microlenses. Only light components in desired wavelength ranges are selected by these color filters and reach light-receiving units 173-1 to 173-6. There are three types of color filters, i.e., R, G, and B color filters. Since this device has the Beyer arrangement as described above, only one type of color filters appear on this cross-section. In the case shown in FIG. 5, green transmission color filters 172-1g, 172-2g, 172-3g, 172-4g, 172-5g, and 172-6g appear.

The refractive powers of the respective microlenses are set to project the respective light-receiving units 173-1, 173-2, 173-3, 173-4, 173-5, and 173-6 of the image sensing device onto the exit pupil of the imaging optical system 103. In this case, a projection magnification is preferably set to make a projection image of each light-receiving unit larger than the exit pupil of the imaging optical system 103 at full aperture so as to set an almost linear relationship between the amount of light incident on the light-receiving unit and the aperture area of the stop of the imaging optical system 103. In the first optical arrangement state, as a received light beam is represented by a hatched portion 175 with respect to the pixel 174-2, a high-resolution, high-quality image output can be obtained by the light beam passing through the entire exit pupil of the imaging optical system 103.

Note that when a fine pyramidal periodic structure having a smaller pitch than the wavelength of visible light is formed on the surface of each microlens to make it function as a so-called photonic crystal, the utilization efficiency of light can be improved by reducing surface reflections of light due to the refractive index difference between air and the microlens.

The second optical arrangement state in which images with small data amounts are output for focus detection processing and display operation will be described next.

FIG. 6 is a sectional view showing a state wherein light beams emerging from the imaging optical system 103 are incident on the image sensing device 106 through the lens array plate 156. The lens array plate 156 is inserted to a position near the image sensing device 106 in FIG. 5. Since the image sensing device 106 has already been described with reference to FIG. 5, the lens array plate 156 and its function will be described in detail below.

Referring to FIG. 6, reference numeral 156 denotes the lens array plate; 156a, the substrate glass of the lens array plate; 156b, an optical low-pass filter added to the substrate glass 156a by a manufacturing method such as a replica method or printing method; 156c, a lens formed on the substrate glass 156a by the replica method; and 156d, a flat portion formed on the substrate glass 156a by the replica method. In this case, the replica method is a manufacturing technique of additionally forming a given shape on a substrate having a simple shape with a resin and integrating them. In general, an ultraviolet curing resin or thermosetting resin is used. The resin is sandwiched between a mold and

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glass as a substrate. The resin is irradiated with ultraviolet light to be cured, thereby transferring the shape of the mold onto the glass. The optical low-pass filter 156b is used to add a stronger low-pass effect, unlike a filter originally incorporated in an optical path of the imaging optical system, in order to cope with a situation in which image sensing operation is not performed by using all the pixels of the image sensing device 106 in the second optical arrangement state.

The lens 156c can also be regarded as an optical element.

Manufacturing the lens array plate 156 by the replica method can reduce the manufacturing cost. A resin generally has a relatively high coefficient of linear expansion and a low Young's modulus. Integrating such a resin and a glass substrate having a relatively low coefficient of linear expansion and a high Young's modulus will suppress heat distortion and reduce a positional offset due to a temperature change with respect to the image sensing device 106 generally formed by using a crystal silicon base. This indicates that this lens array plate can be used in a wide temperature range.

On the light exit surface of the lens array plate 156, the lenses 156c and the flat portions 156d which are gap portions between the lenses are formed, through which light beams reaching the pixels for focus detection and light beams reaching the pixels for display are independently transmitted.

Each of FIGS. 7 and 8 is a plan view of the lens array plate 156 and image sensing device 106 in a superimposed state.

Each of FIGS. 7 and 8 is an enlarged view of some of the many pixels of the image sensing device, in which light beams are incident from the upper surface side of the drawing.

Pixel used for focus detection will be described first with reference to FIG. 7.

Referring to FIG. 7, the pixels 174-1 to 174-6 are the same pixels as those shown in the sectional view of FIG. 5. The pixels with the thick frames represent pixels used for focus detection. Of the pixels 174-1 to 174-6 in FIG. 5, the pixels 174-2 and 174-3 correspond to such pixels.

The lenses 156c of the lens array plate 156 are regularly formed at a pitch five times that of the pixels of the image sensing device 106 in both the vertical and horizontal directions; the ratio of the number of lenses 156c to the number of pixels is 1:25. Since the lens array plate 156 has a size that makes it cover the entire surface of the image sensing device 106, the number of lenses 156c is 400,000 with respect to 10,000,000 pixels of the image sensing device 106.

An incident optical path to the light-receiving unit of each pixel used for focus detection has a shape like that shown in FIG. 6. Light beams that are incident on any pixels are transmitted through the lenses 156c of the lens array plate 156. Consequently, as indicated by a hatched portion 176 representing a light beam received by the pixel 174-2 as a representative, a pixel located on the lower right of the lens 156c in FIG. 6 receives a light beam from the upper left in FIG. 6. In contrast, a pixel located upper right of the lens 156c, like the pixel 174-3, receives a light beam from the lower left in FIG. 6.

Such an optical path is formed for each lens 156c throughout the entire frame of the image sensing device 106, in which a pixel located on the lower right of the lens 156c receives a light beam from the upper left in FIG. 6, whereas a pixel located on the upper right of the lens 156c receives a light beam from the lower left in FIG. 6. Since each of the sectional views of FIGS. 5 and 6 is taken in the direction to

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cross the pixel array of the image sensing device 106 at 45°, each optical path in FIG. 6 indicates that a corresponding focus detection pixel receives a light beam from a semi-circular pupil formed by obliquely dividing the pupil of the imaging optical system 103.

A focus detection visual field and signal processing will be described next.

The pixel array {174-2, 174-3, 174-7, 174-8, 174-12, 174-13, 174-17, 174-18, . . . } indicated by an ellipse 161 in FIG. 7 is a focus detection pixel array forming a focus

detection visual field. All the pixels constituting the pixel array have green transmission color filters. In the first step in focus detection signal processing, the pixels are classified according to the respective areas on the pupil of the imaging optical system 103 to divide the pixel array into two groups. The pixels 174-2 and 174-3 corresponding to the lens 156c-1, the pixels 174-7 and 174-8 corresponding to the lens 156c-2, the pixels 174-12 and 174-13 corresponding to the lens 156c-3, the pixels 174-17 and 174-18 corresponding to the pixel 156c-4, . . . are pairs of pixels, each discriminated on an area on the pupil of the imaging optical system 103. One pair of signal outputs can be obtained, for each set of a plurality of lenses 156c, from the image sensing device 106 which has received light beams through the lens 156c.

That is, these outputs constitute one pair of image sensing device signal outputs formed, for each set of a plurality of optical elements of the optical element array, from light beams received through the optical element.

A focus detection signal is generated by obtaining a reconstruction pixel array {174-2, 174-7, 174-12, 174-17, . . . } and a reconstruction pixel array {174-3, 174-8, 174-13, 174-18, . . . } from the above pixels and processing the signal output waveforms from these pixel arrays. That is, reconstruction pixel arrays are formed by concatenating a plurality of pixels, of the plurality of pixels of the image sensing device 106, which are discretely positioned, and a focus detection signal is formed by using signal output value arrays obtained in this manner. More specifically, a state wherein signal output waveforms from two reconstruction pixel arrays are relatively shifted laterally is observed in accordance with the imaging state of an object image formed on a focus detection visual field by the photographing lens 102. The shifting directions of signal output waveforms are reversed depending on whether the camera is in a near-focus state or far-focus state. The principle of focus detection lies in detecting this phase difference (shift amount) by using a technique such as correlation computation.

Note that high focus detection precision can be maintained even during movement of an object by photoelectrically converting focus detection image signals within one focus detection visual field at substantially the same timing.

If a focus detection visual field is set in the longitudinal or lateral direction, red transmission color filters or blue transmission color filters can be provided for pixel arrays. In this case, after the pixels are classified according to the respective types of color filters, the resultant pixels are further classified according to the respective areas on the pupil to form reconstruction pixel arrays.

By setting a focus detection visual field at an arbitrary position on the image sensing device 106 and checking changes in the relative positions of a pair of image signals, the imaging state of the imaging optical system 103 at this position can be known.

Assume that a pixel array of focus detection pixels indicated by an ellipse 162 is simultaneously extracted in addition to the array indicated by the ellipse 161 in FIG. 7.

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In this case, even if an object image pattern parallel to one pixel array is projected and no amplitude is generated in the signal output waveform to result in a failure of focus detection based on the pixel array, an amplitude is generated in a signal output waveform from the other pixel array to allow focus detection.

Phase difference detection in focus detection signal processing will be described. Assume that the signal output value array obtained from the reconstruction pixel array {174-2, 174-7, 174-12, 174-17, . . . } is the first image sensing device signal output waveform, and the signal output value array obtained from the reconstruction pixel array {174-3, 174-8, 174-13, 174-18, . . . } is the second image sensing device signal output waveform. In this case, focus detection processing is performed by using a computation means for detecting a relative position change, i.e., a phase difference, between the first image sensing device signal output waveform formed from light beams passing through an area separated from the exit pupil of the imaging optical system 103 and the second image sensing device signal output waveform formed from light beams passing through the other area separated from the exit pupil of the imaging optical system.

FIGS. 9 and 10 are graphs showing image signals which are the values of image sensing device signal output values arrays input to the AF pupil area 40. FIG. 9 shows image sensing device signal output waveforms in a state wherein an object image is out of focus. FIG. 10 image sensing device signal output waveforms in a state wherein an object image is in focus.

Referring to FIG. 9, an image sensing device signal output waveform 181 corresponds to the signal output value array {598, 496, 210, 602, 784, 402, 95, 487} obtained from the reconstruction pixel array {174-2, 174-7, 174-12, 174-17, . . . }, and an image sensing device signal output waveform 182 corresponds to the signal output value array {385, 301, 387, 719, 655, 264, 246, 579} obtained from the reconstruction pixel array {174-3, 174-8, 174-13, 174-18, . . . }. In the state shown in FIG. 9, since the object image is out of focus, the image sensing device signal output waveform 181 does not coincide with the image sensing device signal output waveform 182; they are relatively shifted laterally.

Referring to FIG. 10, an image sensing device signal output waveform 183 corresponds to the signal output value array {500, 403, 289, 675, 776, 297, 204, 501} obtained from the reconstruction pixel array {174-2, 174-7, 174-12, 174-17, . . . }, and an image sensing device signal output waveform 184 corresponds to the signal output value array {486, 403, 268, 698, 754, 321, 204, 521} obtained from the reconstruction pixel array {174-3, 174-8, 174-13, 174-18, . . . }. In the state shown in FIG. 10, since the object image is in focus, the image sensing device signal output waveform 181 substantially coincides with the image sensing device signal output waveform 182.

An in-focus state can therefore be detected by determining the equality of a pair of signals. A defocus amount can be obtained by detecting a phase difference using a known technique using correlation computation, for example, the technique disclosed in Japanese Patent Publication No. 05-088445. More specifically, a focus detection signal is generated by using a pair of image sensing device signal output value arrays in which the phases of signal output waveforms change in accordance with the imaging state of the imaging optical system 103 which forms an object image on the image sensing device 106. Converting the obtained defocus amount into an amount by which the focusing lens

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of the imaging optical system 103 should be driven makes it possible to realize automatic focus adjustment. Since the amount by which the lens should be driven can be known in advance, the lens can be driven to an in-focus position by almost one driving operation, thus realizing very fast focus adjustment.

In the second optical arrangement state, acquisition of an image output with a small data amount which is used for display is allowed in addition to focus detection. FIG. 8 is a view for explaining pixels to be used to obtain an image output for display.

Referring to FIG. 8, reference numerals 174-1 to 174-6 denote pixels which are identical to those shown in FIG. 5. The pixels indicated by the thick lines are pixels used to obtain an image output with a small data amount. Of the pixels 174-1 to 174-6, the pixel 174-5 is such a pixel.

An incident optical path to the light-receiving unit of a pixel used to obtain an image output with a small data amount passes through the flat portion 156d of the lens array plate 156, as shown in FIG. 6. Consequently, as indicated by a hatched portion 177 representing a light beam received by the pixel 174-5 as a representative, this incident optical path has almost the same width as that of a hatched portion 175 representing a light beam received by the pixel 174-2 in FIG. 5. That is, this arrangement differs from the first optical arrangement state without the lens array plate 156 only in a reduction in high spatial frequency components due to the effect of the optical low-pass filter 156b and a slight optical path length difference due to the difference in refractive index between the lens array plate 156 and air. That is, in the second optical arrangement, light beams are received from the entire pupil of the imaging optical system 103.

Since such an optical path is formed for each flat portion 156d throughout the frame of the image sensing device 106, all the pixels placed behind the flat portions 156d according to the positional relationship shown in FIG. 6 receive light beams from the entire pupil of the imaging optical system 103. That is, when light beams are received through the lens array constituted by a plurality of lenses 156c incorporating a plurality of pixels of the image sensing device 106, an image signal can be formed on the basis of outputs from the pixels which receive the light beams through the gaps between the plurality of lenses 156c formed on the lens array.

In general, when an image is to be displayed on the display apparatus 107, it is required to achieve uniformity in depth of field between an optical image and a display image and realize a small display time lag between the instant at which an object image is captured and the instant at which the image is displayed on a liquid crystal spatial modulation device or the like, compared to display of an image with a resolution as high as that of an image to be printed.

When this image is displayed on the display apparatus 107, since light beams are received from the entire pupil, the same defocus state of the image as that of a high-resolution image sensed in the first optical arrangement state can be obtained. Therefore, an aperture effect of, for example, emphasizing a main object by defocusing the background can be fully known by observing an image on the display apparatus 107.

When the second optical arrangement state is switched to the first optical arrangement state for capturing high-resolution images by retracting the lens array plate 156, the imaging optical system 103 becomes out of focus to an extent corresponding to the optical path length difference between the lens array plate 156 and air. However, since this optical path length difference is a known fixed value, the

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focus of the imaging optical system 103 may be corrected by a predetermined amount in synchronism with the timing of the retraction of the lens array plate 156.

In addition, since the data amount of an image is small, the processing time is short, and the time lag between an optical image and a display image is very small. Therefore, smooth moving images at about 60 frames per sec can also be displayed. Although the data amount is small, sufficient image quality for TV broadcasting can be obtained, and hence image sensing equipment for both still images/moving images may be formed by using this image sensing apparatus.

Referring back to FIG. 8, consider the array of pixels indicated by the thick lines. Since these pixels are arranged for every five pixels in both the vertical and horizontal directions, the arrangement of these extracted pixels becomes a Beyer arrangement. Therefore, signal processing for the acquisition of a color image is the same as that for the acquisition of a high-resolution image in the first optical arrangement state. This allows the signal processing circuit to be commonly used in both the first and second optical arrangement states.

The above description has exemplified the case wherein the lens array plate 156 manufactured by the replica method is used as an optical element array. However, the present invention is not limited to this. For example, an optical element array can be formed from a gradient index lens or liquid crystal lens. Since either optical element array requires only a small mechanism space, compact image sensing equipment can be realized. When a liquid crystal lens is to be used, the liquid crystal may be electrically controlled instead of mechanical driving of the lens array plate. This can further save a mechanism space.

Second Embodiment

FIGS. 12 and 13 are views showing the schematic arrangement of a digital color camera incorporating an image sensing apparatus according to the second embodiment of the present invention. FIG. 12 is a sectional view of the camera taken in the lateral direction. FIG. 13 is a front perspective view of the camera when viewed from the left side in FIG. 12. This camera is a single-CCD digital color camera which uses an image sensing device such as a CCD or CMOS sensor. The camera obtains an image signal representing a moving or still image by continuously or sporadically driving the image sensing device. In this case, the image sensing device is an area sensor of a type that converts exposed light into an electrical signal for each pixel, stores electric charges corresponding to the light amount, and outputs the electric charges.

Referring to FIG. 12, reference numeral 203 denotes an imaging optical system which has a driving mechanism (not shown) and is focused on an object by moving a focusing lens as an element of the imaging optical system 203 along the optical axis direction or forming a focusing lens using a transparent, elastic member with flexibility or a liquid lens and changing its refractive power by changing its interface form.

Reference numeral 206 denotes an image sensing device. The image sensing device 206 is housed in a package having a cover glass 224 serving as a window member through which light is received. An optical low-pass filter (not shown) which limits the cutoff frequency of the imaging optical system 203 so as not to form spatial frequency components of an object image which have excessive frequencies on the image sensing device 206 is provided in an

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optical path from the imaging optical system **203** to the image sensing device **206**. An infrared cut filter is also placed in the imaging optical system **203**.

A lens array plate **256** is retractably placed in front of the light-receiving surface of the image sensing device **206** so as to be adjacent to the package of the image sensing device **206**. The image sensing apparatus includes the image sensing device **206**, the lens array plate **256**, and an electrical circuit which generates image signals and focus detection signals. The lens array plate **256** is a thin plate having a size that makes it possible to cover the entire surface of the image sensing device **206** when the plate is inserted to a position before the image sensing device **206**.

The object image captured by the image sensing device **206** is displayed on a display apparatus **207**. The display apparatus **207** is mounted on the rear surface of the camera and allows direct observation. The display apparatus **207** is preferably formed from an organic EL spatial modulation device, liquid crystal spatial modulation device, a spatial modulation device using electrophoresis of particles, or the like because they are low in power consumption.

The image sensing device **206** is a CMOS process compatible sensor (to be simply referred to as a CMOS sensor hereinafter) which is one of amplification type solid-state image sensing devices. One of the characteristic features of the CMOS sensor is that the number of masks and the number of process steps can be greatly decreased as compared with a CCD because MOS transistors in an area sensor unit and MOS transistors in a peripheral circuit can be formed in the same step. Another characteristic feature of this sensor is that it allows random access to an arbitrary pixel. As a color filter arrangement, a Beyer arrangement is used.

The image sensing device **206** performs focus detection operation, display image output operation, and high-resolution image output operation by using such characteristic features.

Unlike in the first embodiment, the lens array plate **256** is located outside the package of the image sensing device **206** and is not housed in the package together with the image sensing device **206**. A driving mechanism for the lens array plate **256** can be selected from various kinds of mechanisms. For example, a rotational driving mechanism constituted by an electromagnetic motor and a gear train can be used. Reference numeral **214** denotes the rotating shaft of the mechanism for driving the lens array plate **256**. The lens array plate **256** is moved to the position indicated by **256'** by the rotational driving mechanism (not shown) to retract from the image sensing device **206**. Note that the image sensing device **206** does not require any special structure including its package, and hence can be obtained more easily at a lower price than the image sensing device in the first embodiment.

Reference numeral **211** denotes a half mirror which splits an optical path from the imaging optical system **203** to make a split light beam strike the optical finder; **212**, a pentaprism; and **209**, a convex lens for the observation of an optical finder image.

The electrical arrangement of the digital color camera is basically the same as that in the first embodiment.

The rotational driving mechanism constituted by the electromagnetic motor and gear train (not shown) extends and retracts the lens array plate **256** to and from the image sensing device **206** to switch between the first optical arrangement state, in which a light beam from the imaging optical system **203** is caused to be directly incident on the image sensing device **206**, and the second optical arrange-

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ment state, in which a light beam is caused to be incident on the image sensing device **206** upon being transmitted through the lens array plate **256**. The position indicated by the lens array plate **256'** corresponds to the first optical arrangement state, whereas the position indicated by the lens array plate **256** corresponds to the second optical arrangement state. The first optical arrangement state is used to generate a high-resolution image suitable for a large-size print or the like. The second optical arrangement state is used to generate a signal for focus detection and an image signal with a relatively small amount of data for display.

Since the first and second optical arrangement states can be switched, focus adjustment, monitoring of a sensed image on the display apparatus, and image sensing of a high-resolution image can be performed by using signals from a single image sensing device. In addition, high-speed focus adjustment based on the phase difference detection scheme can be realized simultaneously with a small time lag and smooth moving image display. The main photographing sequence in the digital color camera is the same as that in the first embodiment. This apparatus switches, as needed, between the first optical arrangement state, in which the image sensing device receives light without through the optical element array constituted by a plurality of optical elements incorporating a plurality of pixels of the image sensing device, and the second optical arrangement state, in which the image sensing device receives light through the optical element array.

The structures of the image sensing device **206** and lens array plate **256** will be described next. FIG. **14** is an exploded perspective view of the lens array plate **256** as an optical element array.

The lens array plate **256** has a three-layer structure and is constituted by a condenser lens array plate **221**, partition assembly **222**, and re-imaging lens array plate **223** arranged from the light incident side in the order named. One of the optical units partitioned by the partition assembly **222** is a re-imaging optical system which forms a flat surface of the condenser lens array plate **221** which is in contact with the light incident plane into an image on the image sensing device **206**. That is, the optical element array is constituted by a plurality of juxtaposed re-imaging optical systems. A re-imaging plane is divided into small areas, and compact re-imaging optical systems are arranged in correspondence with the respective areas. Therefore, the overall structure is in the form of a thin plate, and requires a very small mechanism space.

The imaging optical system **203** forms an object image near the image sensing device **206**. After focus adjustment, the imaging optical system **203** forms an object image on the image sensing device **206**. The object image formed on the condenser lens array plate **221** by the imaging optical system **203** is formed again on the image sensing device **206** by the lens array plate **256**. In many cases, the object image formed on the condenser lens array plate **221** is out of focus. In addition, in focusing operation, an out-of-focus image is always subjected to re-imaging operation. In focus detection based on the phase difference detection scheme, since this operation can be done by only setting an initial phase difference, no problem arises.

FIG. **15** is a partial sectional view for explaining the structures of the lens array plate **256** and image sensing device **206** in more detail. Referring to FIG. **15**, light beams propagate from left to right.

The condenser lens array plate **221** is obtained by forming lens portions on a flat substrate glass **221a** by the replica method. A lens portion (e.g., **221-1**)凸exes on the inci-

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dent side to become a so-called condenser lens for efficiently guiding light to a re-imaging lens of the re-imaging lens array plate **223** located behind. There is no gap between adjacent lens portions, and hence the object image formed on the condenser lens array plate is guided to the image sensing device **206** without being blocked.

The re-imaging lens array plate **223** is obtained by forming lens portions on a flat substrate glass **223a** by the replica method as in the case of the condenser lens array plate **221**. However, the re-imaging lens array plate **223** differs from the condenser lens array plate **221** in that lens portions are formed on the upper and lower surfaces of the substrate glass. Each re-imaging lens of the re-imaging lens array plate **223** has a biconvex lens structure which has one optical axis on the light incident surface side and four optical axes on the light exit surface side. This lens forms, on the image sensing device **206**, four object images corresponding to the number of axes on the exit side.

FIG. **16** is a plan view of the re-imaging lens array plate **223** when viewed from the light incident surface, showing the positional relationship between an incident-side lens portion **223-1** and exit-side lens portions **223-1-A**, **223-1-B**, **223-1-C**, and **223-1-D**.

Four stop apertures **223b** are formed on the light exit side of the flat substrate glass **223a** by using a multilayer deposition film made of chromium oxide and chromium, which guide light passing therethrough to each of the above four-axis lenses. Note that since a light-shielding stop is available, a thermosetting resin is used for the replica method on the exit surface side, and the shape of a mold is transferred by heat.

The light beam which is transmitted through the lens portion **221-1** of the condenser lens array plate **221** and emerges from the flat substrate glass **221a** strikes the lens portion **223-1** of the re-imaging lens array plate **223** and passes through the stop **223b** of the flat substrate glass **223a** to emerge from the lens portions **223-1-A**, **223-1-B**, **223-1-C**, and **223-1-D**. Note that FIG. **15** shows only the lens portions **223-1-A** and **223-1-B**.

The light beam emerging from the lens array plate **256** is transmitted through the cover glass **224** of the package of the image sensing device **206** and reaches the area sensor area of the image sensing device **206**.

As described above, the re-imaging optical systems are constituted by condenser lenses, stop apertures, and re-imaging lenses, and are densely arranged.

FIG. **17** is a plan view showing the state of the object image projected on the image sensing device **206**.

An area **229-1** is equal in size to one re-imaging optical system **226-1** (**221-1**, **222-1**, **223-1**, **223-1-A**, **223-1-B**, **223-1-C**, and **223-1-D**) when it is projected. Areas each equal in size to this area are densely arranged without any gap.

Reference numerals **225-1-A**, **225-1-B**, **225-1-C**, and **225-1-D** denote images of the peripheries of the lens portions **221-1** of the condenser lens array plate **221** which are formed by the re-imaging optical system. Four images are formed owing to the effects of the lens portions **223-1-A**, **223-1-B**, **223-1-C**, and **223-1-D** of the re-imaging lens array plate **223**. The object image formed on a flat surface in contact with the lens portion **221-1** is formed again inside each of the four images by the imaging optical system **203**. Note that reference symbols A, B, C, and D indicating the lens portions of the re-imaging lens array plate **223** correspond to reference symbols A, B, C, and D representing the images.

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Since the images of the peripheries of the four lens portions **221-1** of the condenser lens array plate **221** are formed in the space on which one re-imaging optical system is projected, a re-imaging magnification β needs to be at least

$$\beta \geq -0.5$$

However, in order to suppress leakage of light between adjacent images, the magnification is preferably

$$\beta \geq -0.4$$

In addition, if the magnification is set to

$$-0.1 \geq \beta$$

in order to increase the number of pixels to be used for focus detection, high focus detection precision can be maintained. Therefore, the re-imaging magnification β is preferably set in the range of -0.1 to -0.4 , and more preferably to about 0.25 .

Since the lens portions **221-1** of the condenser lens array plate **221** project the stops **223b** onto the pupil of the imaging optical system **203**, four images **225-1-A**, **225-1-B**, **225-1-C**, and **225-1-D** are images formed by light beams passing through different pupil areas of the imaging optical system **203**. Consider therefore the two images **225-1-A** and **225-1-C**. When the imaging state of the object imaged by the imaging optical system **203** changes, these images approach or move away from each other as indicated by arrows **227A** and **227C**. These images are photoelectrically converted to obtain one pair of image sensing device signal outputs based on light beams received, for each set of a plurality of optical elements of the optical element array, through the optical elements. Consider next the two remaining images **225-1-B** and **225-1-D** to obtain another pair of image sensing device signal outputs based on the images moving in the directions indicated by arrows **227B** and **227D**.

Note that each of the images **225-1-A**, **225-1-B**, **225-1-C**, and **225-1-D** is an object image formed by one re-imaging optical system **226-1**, and only part of the luminance distribution of the object image is projected within this size. That is, an amplitude appears in a signal output only when an object image contains a sufficiently high frequency component, which is a contingent event. When a luminance distribution with a low spatial frequency is extracted by a short window, the resultant signal output contains no amplitude. Obviously, it is impossible to detect a phase difference in the object image in this state.

A focus detection visual field is therefore expanded by concatenating output values from a plurality of pixels, of the pixels of the image sensing device, which are located discretely, thereby facilitating capturing the luminance distribution of an object.

FIG. **18** is a plan view showing how object images are projected on the image sensing device **206** by a plurality of re-imaging optical systems, $3 \times 3 = 9$ re-imaging optical system in this case.

The object images described with reference to FIG. **17** are shown on the upper left in FIG. **18**. In order to discriminate areas on the pupil of the imaging optical system **203** through which imaging light beams pass, the images projected by lens portions A, B, C, and D are indicated by different hatchings.

In order to expand the focus detection visual field, pixel outputs at the positions where object images are projected may be concatenated. To allow pixel outputs to be concat-

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enated, the following conditions are required for two object images to be photoelectrically converted by two target pixel arrays:

(1) The two object images should be images obtained by forming a continuous surface into images on an object-side plane conjugate to an imaging plane of a re-imaging optical system.

(2) The two object images should be images formed by light beams passing through the same area on the pupil of the imaging optical system 203.

Each of FIGS. 19 and 20 is a view for explaining a state wherein output values from pixel arrays at the positions where object images are projected are concatenated in terms of computation processing in order to satisfy these conditions.

Referring to FIGS. 19 and 20, for example, reference numeral 228-1-A denotes a signal output value array from a pixel array for photoelectrically converting the object image 225-1-A in FIG. 18. In this case, a two-dimensional array is used for focus detection to obtain high detection precision.

Referring to FIG. 19, the signal output value arrays with reference symbols A and C are expanded to form data arrays 231A and 231C as a whole. The images move from the upper left to the lower right in FIG. 19, and these movements are reflected in the output values. Referring to FIG. 20, the signal output value arrays with reference symbols B and D are expanded to form data arrays 231B and 231D as a whole. The images move from the lower left to the upper right in FIG. 20, and these movements are reflected in the output values. Each of the data arrays 231A, 231C, 231B, and 231D contains data having a meaning as a continuous whole.

Assume that the movements of images in two directions are captured as shown in FIGS. 19 and 20. In this case, even if an object image pattern parallel to one pixel array is projected and no amplitude is generated in the signal output waveform to result in a failure of focus detection based on the pixel array, an amplitude is generated in a signal output waveform from the other pixel array to allow focus detection.

FIG. 21 is a view for making it easier to understand how each data array contains data having a meaning as a continuous whole. FIG. 21 shows, for example, how the imaging optical system 203 captures a human figure and focus adjustment is tried.

The signal output value arrays shown in FIG. 19 contain the values obtained by photoelectrically converting human images 230A and 230C. When the above two conditions are satisfied in this manner, even if output values from discontinuous areas on the image sensing device 206 are concatenated, a continuous signal can be obtained.

Although focus adjustment of the imaging optical system 203 is tried, the object images 230A and 230C on the signal output value arrays 231A and 231C differ in position for the following reason.

A re-imaging optical system (226-1, 226-2, 226-3, . . .) forms the object image formed on a flat surface in contact with the lens portion 221-1 of the condenser lens array plate 221 into an image on the image sensing device 206 again. When the lens array plate 256 retracts from the image sensing device 206 to the position indicated by 256' in FIG. 13, the focus adjustment of the imaging optical system 203 is performed to form a clear object image on the image sensing device 206. Therefore, while the focus adjustment of the imaging optical system 203 is done with respect to the image sensing device 206, the object image on the flat surface in contact with the lens portion 221-1 of the condenser lens array plate 221 becomes slightly out of focus. As

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a consequence, the object image data in the signal output value arrays 231A and 231C have pieces of information corresponding to positions located slightly far from each other, as shown in FIG. 21. If, however, this phase difference is stored as an initial phase difference and is subtracted from the detected phase difference, no problem arises in actual focus detection processing.

Since the image sensing device has the respective types of color filters, a phase difference may be detected for each color filter type or may be detected by using a given luminance signal.

As described above, pixel outputs at the positions where the images 225-1-A, 225-1-B, 225-1-C, 225-1-D, 225-2-A, 225-2-B, 225-2-C, 225-2-D, 225-3-A, 225-3-B, 225-3-C, 225-3-D, . . . are projected are extracted, and a state wherein signal output waveforms from are relatively shifted laterally is observed by using the signal output value arrays obtained by concatenating the extracted outputs, thereby checking the positional relationships between the images. This makes it possible to know the imaging state of the imaging optical system 203. That is, an in-focus state can be detected by determining uniformity between one pair of signals. A defocus amount can be obtained by detecting a relative position change amount using a known technique using correlation computation, for example, the technique disclosed in Japanese Patent Publication No. 05-088445. Converting the obtained defocus amount into an amount by which the focusing lens of the imaging optical system 203 should be driven makes it possible to realize automatic focus adjustment. Since the amount by which the lens should be driven can be known in advance, the lens can be driven to an in-focus position by almost one driving operation, thus realizing very fast focus adjustment.

A composite signal output value array for forming a focus detection visual field can be set from output values from an arbitrary position on the image sensing device 206.

In the second optical arrangement state, acquisition of an image output with a small data amount which is used for display or the like is allowed in addition to focus detection. For display, adding data at the positions corresponding to the signal output value arrays 231A, 231B, 231C, and 231D shown in FIGS. 19a and 20 into one new data array makes it possible to equivalently obtain the image data formed by photoelectrically converting object images formed by uniformly using the pupil of the imaging optical system 203. If this computation processing is performed throughout the image sensing device 206, in particular, an image suitable for monitoring a high-resolution image to be sensed can be obtained. Since the data amount is small, the processing time is short, and the display time lag between the instant at which an object image is captured and the instant at which the image is displayed on a liquid crystal spatial modulation device or the like can be reduced.

When the second optical arrangement state is switched to the first optical arrangement state for capturing high-resolution images by retracting the lens array plate 256, the imaging optical system 203 becomes out of focus to an extent corresponding to the optical path length difference between the lens array plate 256 and air. However, since this optical path length difference is a known fixed value, the focus of the imaging optical system 203 may be corrected by a predetermined amount in synchronism with the timing of the retraction of the lens array plate 256.

In contrast, if no function of monitoring images is required and it suffices if focus detection can be performed, the lens array plate 256 need not have a size that makes it

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cover the entire surface of the image sensing device **206**, and may be required to cover, for example, 50% of the area of the central portion.

The above description has exemplified the color camera. Obviously, however, the present invention is not limited to this and can be applied to infrared image sensing equipment and monochrome camera.

As has been described above, according to the above embodiments, an image sensing apparatus which satisfies both the requires for focus detection performance and high-resolution, high image quality can be realized.

In addition, an image sensing apparatus which can concurrently perform focus detection operation and image display operation by using a signal image sensing device can be realized.

Furthermore, a compact image sensing apparatus can be realized.

The present invention is not limited to the above embodiments and various changes and modifications can be made within the spirit and scope of the present invention. Therefore, to apprise the public of the scope of the present invention, the following claims are made.

What is claimed is:

1. An image sensing apparatus comprising:
an image sensing device having a plurality of pixels;
an optical element array having a plurality of optical elements made to correspond one by one to each set of

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a plurality number of pixels of a plurality of pixels of said image sensing device; and

a focusing device which generates, for each of the plurality of optical elements, one pair of focus detection signals in the pixels from light passing through the optical element, and performs focusing operation on the basis of focus detection signals generated in pairs for each of the optical elements,

wherein image signals are generated in the pixels from light passing through gaps between the optical elements of said optical element array.

2. The apparatus according to claim 1, wherein the optical element comprises a re-imaging optical system.

3. The apparatus according to claim 1, further comprising a switching device which switches between a first state in which light is received by said image sensing device without through said optical element array and a second state in which light is received by said image sensing device through said optical element array.

4. The apparatus according to claim 1, wherein the focusing operation is performed by using signals generated by concatenating the focus detection signals obtained from a plurality of pixels, of the plurality of pixels of said image sensing device, which are arranged discretely.

* * * * *

EXHIBIT 1031



US 20070091835A1

(19) **United States**(12) **Patent Application Publication**
Jo et al.(10) **Pub. No.: US 2007/0091835 A1**(43) **Pub. Date: Apr. 26, 2007**(54) **DEVICE AND METHOD TO PLAY BACK
CONTENTS ACCORDING TO RECEPTION
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H04J 3/08 (2006.01)(52) **U.S. Cl.** 370/315; 370/338(57) **ABSTRACT**

A device and method to play back contents according to a reception sensitivity, more specifically, a device and method to select a wireless communication system according to the reception sensitivity of wireless signals such as AirTV signals, digital multimedia broadcasting signals and wireless LAN signals, and playing back received multimedia content. The device includes a communication unit receiving multimedia content through a wireless communication device corresponding to a selection instruction message input by a user among one or more wireless communication devices; a reception sensitivity check unit checking the reception sensitivity of the received multimedia content; and an interface unit outputting the received multimedia content according to the reception sensitivity.

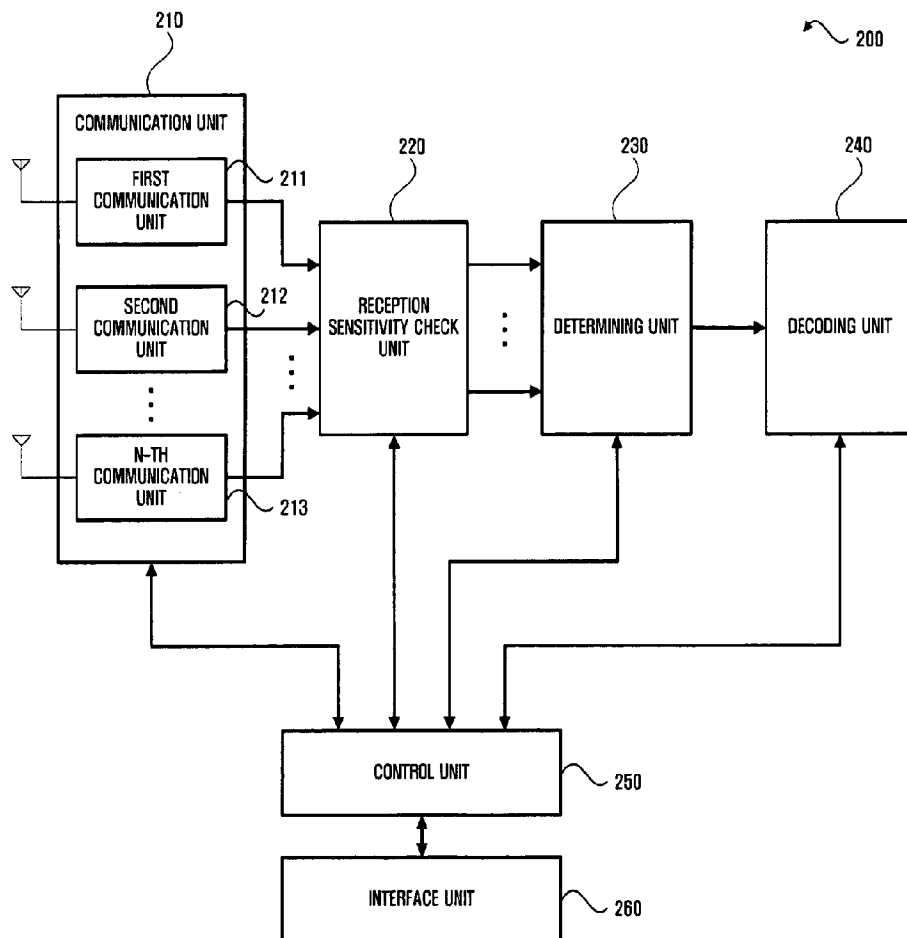


FIG. 1

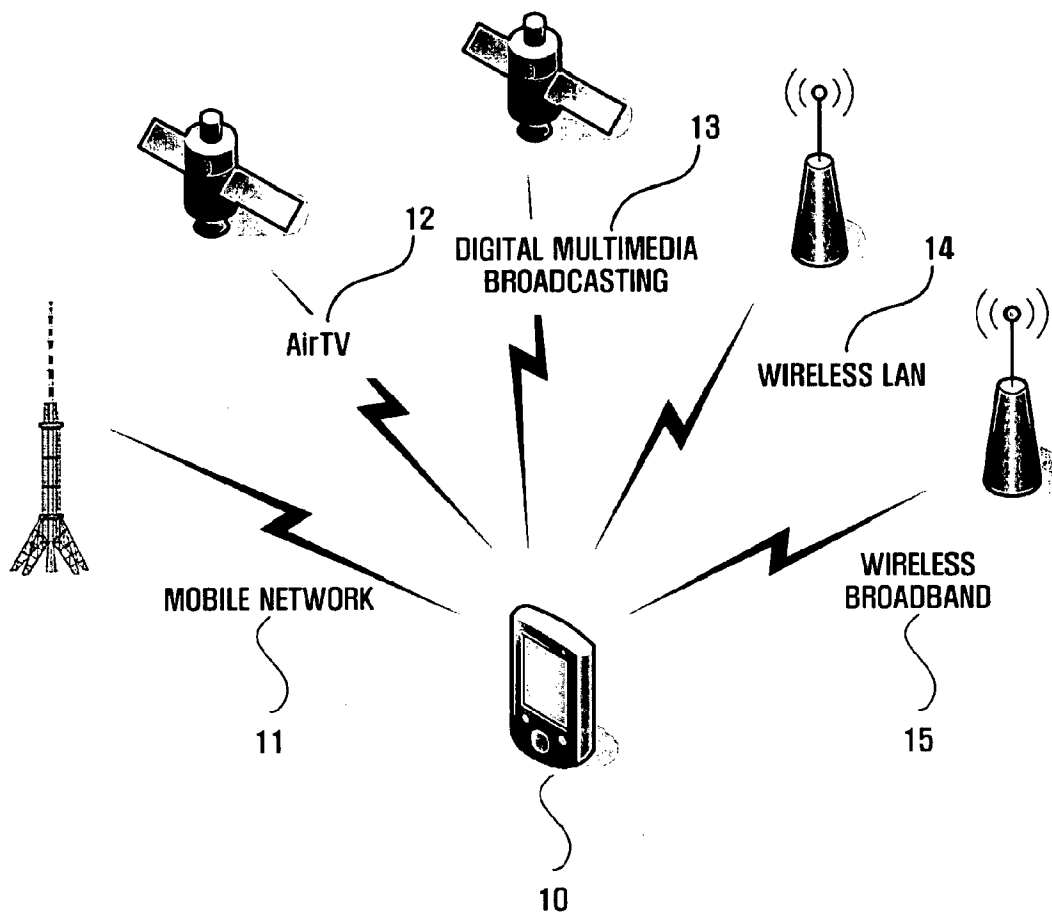


FIG. 2

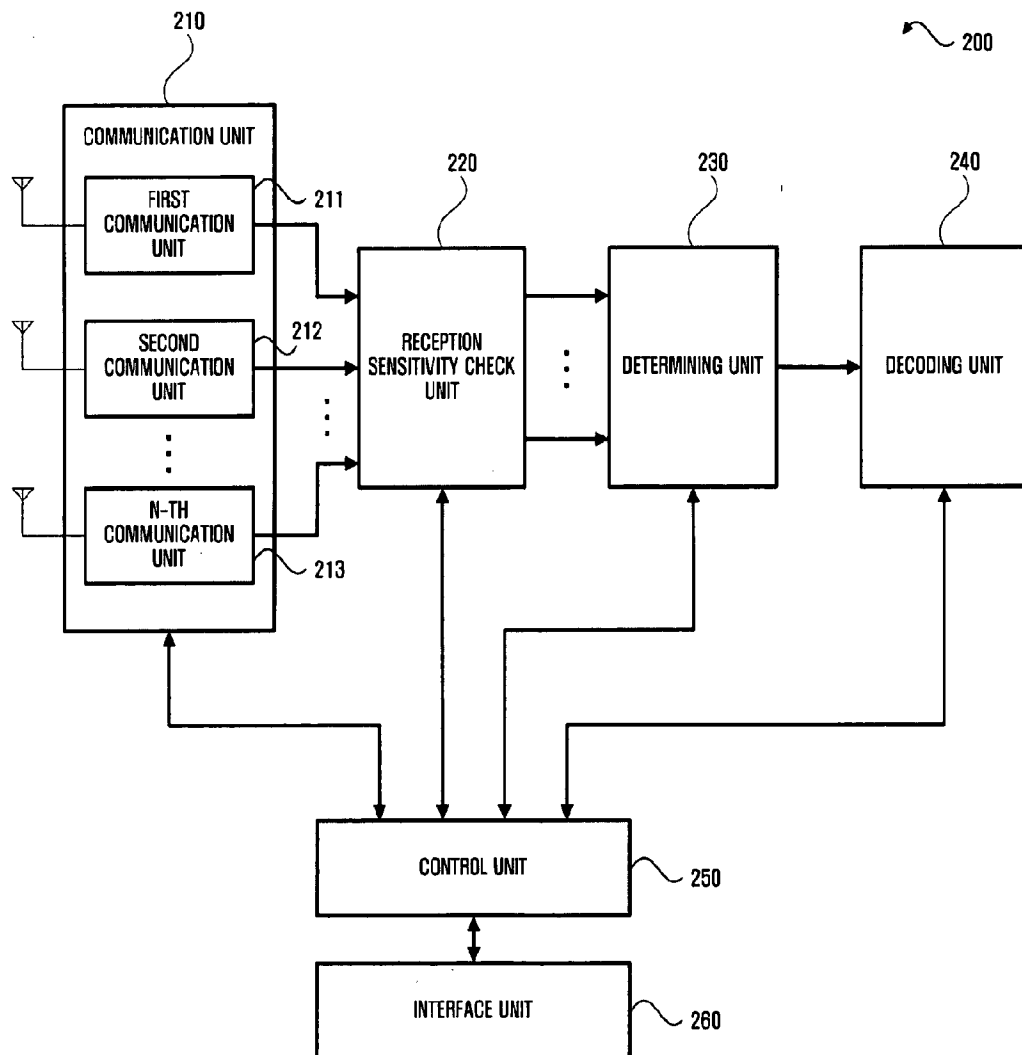


FIG. 3

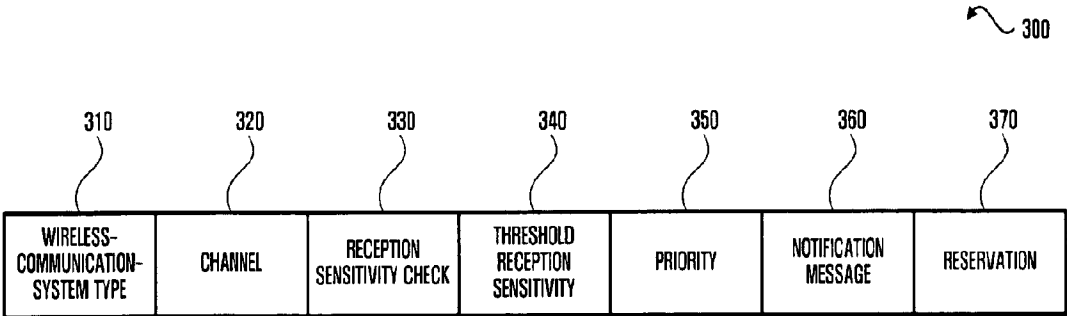


FIG. 4

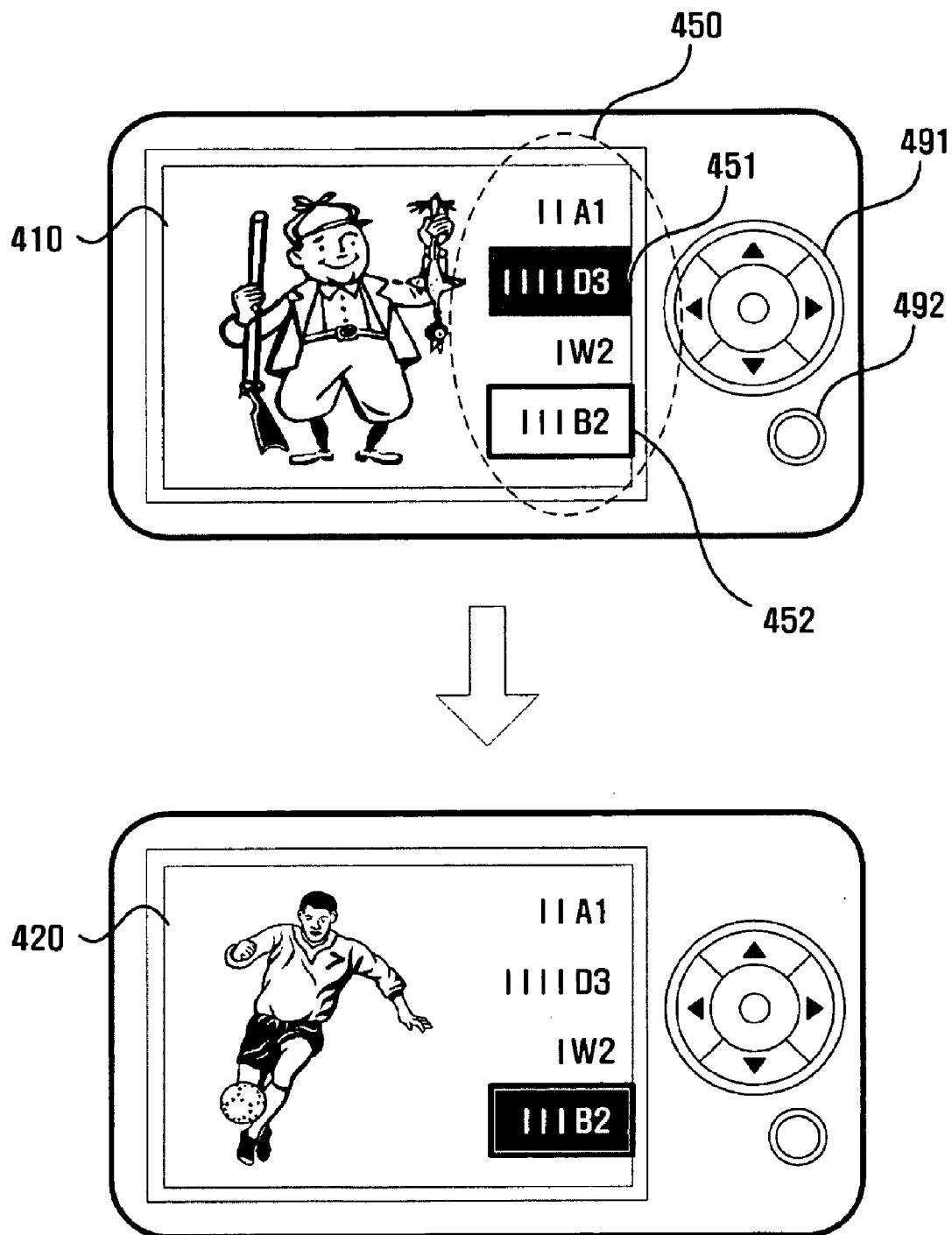


FIG. 5

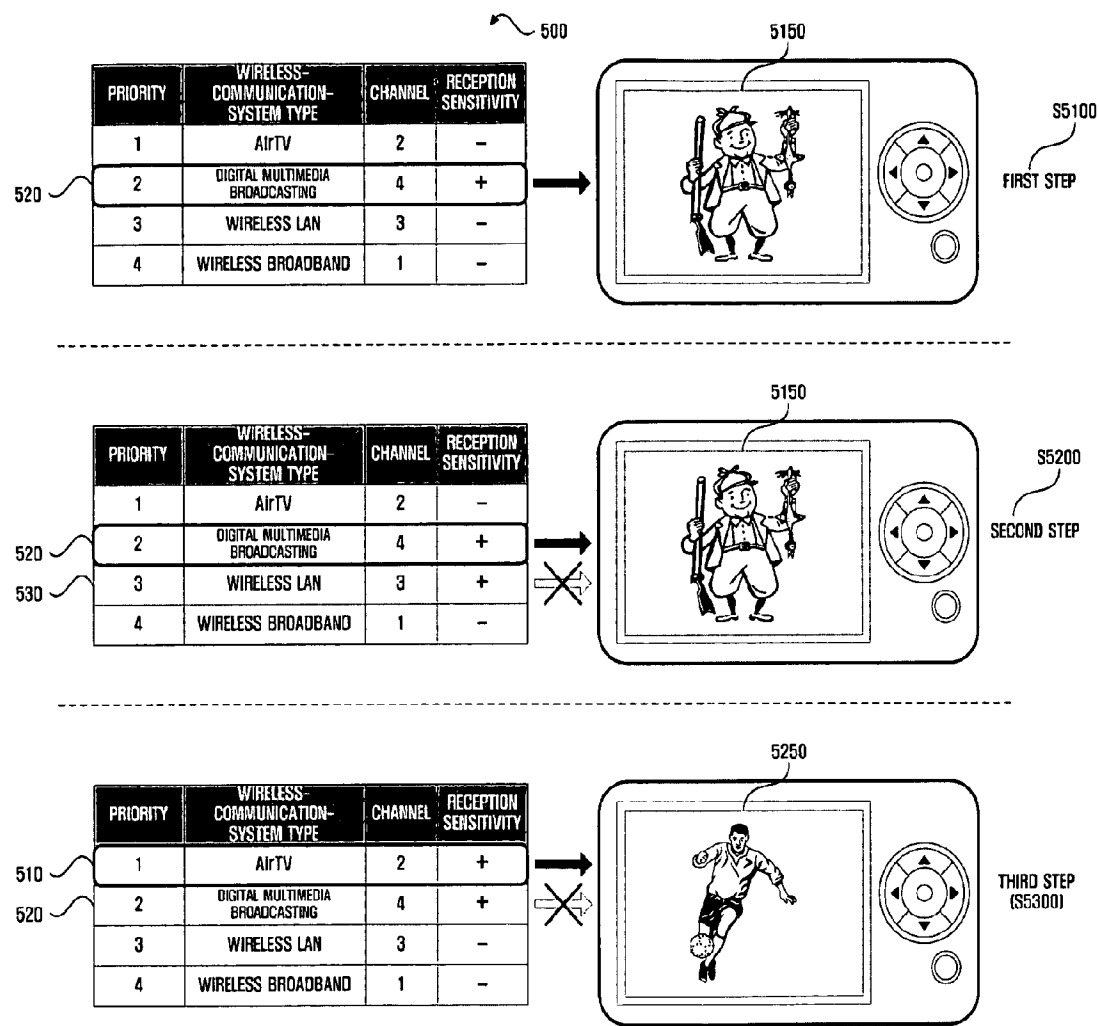


FIG. 6

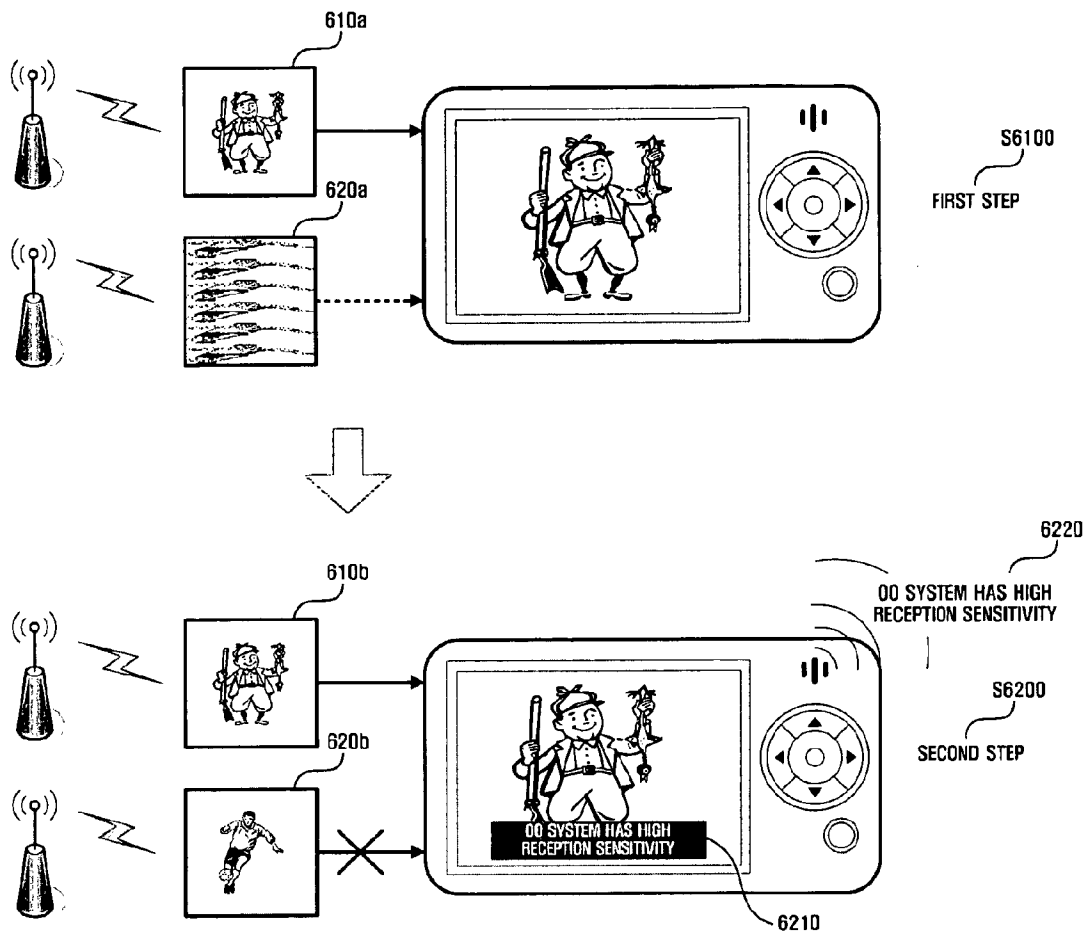
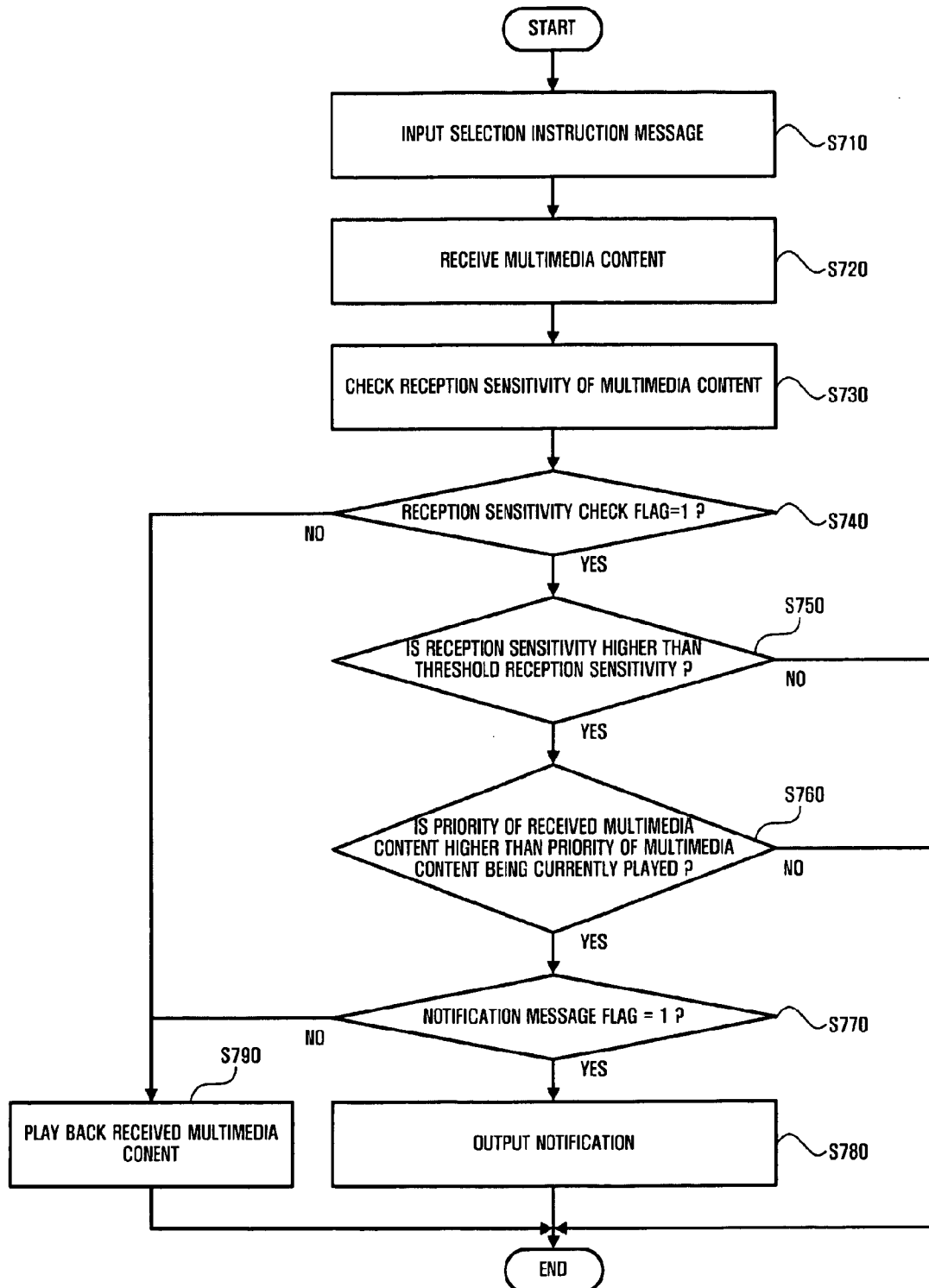


FIG. 7



DEVICE AND METHOD TO PLAY BACK CONTENTS ACCORDING TO RECEPTION SENSITIVITY

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Application No. 2005-99877, filed on Oct. 21, 2005, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention

[0003] Aspects of the present invention relate to a device and method to play back contents according to a reception sensitivity, and more particularly, to a device and method to select a wireless communication system according to the reception sensitivity of wireless signals, such as AirTV signals, digital multimedia broadcasting signals, or wireless LAN signals, and to play back received multimedia content.

[0004] 2. Description of the Related Art

[0005] With the evolution of communication and network techniques in recent years, wired network environments using a wire medium, such as a coaxial cable or an optical cable, have become increasingly replaced by wireless network environments using radio waves in various frequency bands.

[0006] FIG. 1 shows multimedia content provided by conventional wireless communication techniques. In order to share communication paths, a wireless LAN **14** uses, for example, the IEEE 802.11 communication standard, the IEEE 802.11a communication standard, the IEEE 802.11b communication standard, or the IEEE 802.11g communication standard. These standards are wireless network standards using CSMA/CA (carrier sense multiple access/collision avoidance) (i.e., an Ethernet protocol) to transmit data at a transfer rate of 11 Mbps to 54 Mbps.

[0007] In addition to wireless LANs based on the IEEE 802.11 communication standard, wireless networks based on the IEEE 802.16e communication standard have been developed. This standard is called a wireless broadband **15**. The wireless broadband **15** is an Internet service that uses a frequency bandwidth of 2.3 GHz and has a mobility of 60 km/h or more and a transfer rate of approximately 1 Mbps. The wireless broadband **15** has a maximum radio propagation distance of about 48 km, which is ten or more times larger than the service radius of the wireless LAN **14** that can be used in a service area called a hot-spot.

[0008] A user that wants to use a wireless network may access a local area network through a mobile network **11**. In the wireless network using the mobile network **11**, a base station relays between a wireless section and a wired section, which has an advantage in that a user in the mobile network **11** can use the wireless network.

[0009] A wireless technique to provide multimedia content can be applied to a satellite communication technique, which makes it possible for a user to view multimedia content transmitted from a satellite through a portable terminal **10**. An AirTV system **12** and a digital multimedia

broadcasting (hereinafter, referred to as DMB) system **13** may be used to display the multimedia content transmitted from the satellite.

[0010] The DMB systems **13** are classified into a terrestrial DMB system and a satellite DMB system according to a transfer means (a ground wave or a satellite, respectively). The terrestrial DMB systems are divided into an in-band type using an AM/FM band and an out-of-band type using a new frequency band. The in-band type has a bit rate of approximately 384 kbps, and the out-of-band type has a bit rate of approximately 526 kbps. The satellite DMB system provides a service in a frequency band of 2.535 to 2.655 GHz, which is an ultrahigh frequency considerably higher than the frequency band of the terrestrial DMB system. The terrestrial DMB system provides a service by using a transmitting station radiating radio waves, while the satellite DMB system provides a service by using a satellite outside of the earth's atmosphere. Therefore, the satellite DMB system can provide a service covering a wider range.

[0011] Although the AirTV system **12** has not yet been commercially used, the AirTV system **12** is expected to eventually provide approximately 60 TV channels with various languages, and Internet, e-mail, and data services at a transfer rate of approximately 40 Mbps.

[0012] As described above, wireless communication services can be provided through various wireless communication techniques. However, there are many wireless communication restrictions, such as a bandwidth restriction and an interference of radio waves, in providing services by using the various wireless communication techniques. That is, the portable terminal **10** may not smoothly receive multimedia content due to the surrounding environment and the communication environments. Therefore, in order to smoothly receive multimedia content, the user of the portable terminal **10** must move to a region where multimedia content is received at high reception sensitivity, or the user must receive the multimedia content only during a time period when the multimedia content is received at high reception sensitivity. The user of the portable terminal **10** provided with various wireless communication techniques should connect with a wireless communication system having a higher reception signal to receive multimedia content with a high reception sensitivity.

[0013] Korea Patent Unexamined Publication No. 2003-37373 discloses a method of realizing a roaming service that enables roaming between a wireless LAN and a mobile network and which detects the levels of reception signals received through a wireless LAN and a mobile network, compares the levels of the reception signals, and performs data communication through one of the wireless LAN and the mobile network having a higher signal level. However, in the above-mentioned method, comparison the levels of the received reception signals depends on the communication systems. This results in frequent switching between communication systems due to a variation in the surrounding environments, such as whenever the user moves from one place to another place. Therefore, there needs to be a method of stably receiving wireless communication signals without increasing the number of switching operations between communication systems.

SUMMARY OF THE INVENTION

[0014] Aspects of the present invention provide a technique to select a wireless communication system according to the reception sensitivity of wireless signals, such as AirTV signals, digital multimedia broadcasting signals, and wireless LAN signals and for playing back received multimedia content and to prevent an increase in the number of switching operations between wireless communication systems.

[0015] According to an aspect of the invention, there is provided a device to play back contents according to a reception sensitivity, the device including a communication unit receiving multimedia content through a wireless communication device selected from among one or more wireless communication devices on the basis of a selection instruction message input by a user; a reception sensitivity check unit checking the reception sensitivity of the received multimedia content; and an interface unit outputting the received multimedia content according to the reception sensitivity.

[0016] According to another aspect of the invention, there is provided a method of playing back contents according to a reception sensitivity, the method including receiving multimedia content through a wireless communication device selected from among one or more wireless communication devices on the basis of a selection instruction message input by a user; checking the reception sensitivity of the received multimedia content; and outputting the received multimedia content according to the reception sensitivity.

[0017] Additional aspects and/or advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] These and/or other aspects and advantages of the invention will become apparent and more readily appreciated from the following description of the embodiments, taken in conjunction with the accompanying drawings of which:

[0019] FIG. 1 is a block diagram illustrating a conventional wireless communication technique to provide multimedia content;

[0020] FIG. 2 is a block diagram illustrating a device to play back multimedia contents according to a reception sensitivity according to an embodiment of the present invention;

[0021] FIG. 3 is a diagram illustrating a selection instruction message according to an embodiment of the present invention;

[0022] FIG. 4 is a diagram illustrating the display of reception sensitivities according to an embodiment of the present invention;

[0023] FIG. 5 is a diagram illustrating multimedia content displayed according to priority according to an embodiment of the present invention;

[0024] FIG. 6 is a diagram illustrating an output of a message according to an embodiment of the present invention; and

[0025] FIG. 7 is a flow chart illustrating a process of playing back contents on the basis of a reception sensitivity according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0026] Reference will now be made in detail to the present embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

[0027] It is understood that blocks in the accompanying block diagrams and compositions of operations in flow charts can be performed by computer program instructions. These computer program instructions can be provided to processors of, for example, general-purpose computers, special-purpose computers, and programmable data processing apparatuses, although not limited thereto. Therefore, the instructions performed by, for example, the computer or the programmable data processing apparatus execute functions described in the blocks in the block diagrams or the operations in the flow charts. The computer program instructions can be stored in a computer usable memory or a computer readable memory of the computer or the programmable data processing apparatus in order to realize the functions in a specific manner. However, it is understood that the instructions may be stored in any computer-readable storage medium. Therefore, the instructions stored in, for example, the computer-usable memory or the computer-readable memory can perform the functions described in the blocks in the block diagrams or the operations in the flow charts. Also, the computer program instructions can, for example, be loaded onto the computer or the programmable data processing apparatus. Therefore, a series of operational steps are performed in the computer or the programmable data processing apparatus to generate a process executed by the computer, which makes it possible for the instructions performed on the computer or the programmable data processing apparatus to provide operations to execute the functions described in the blocks of the block diagrams or the operations of the flow charts.

[0028] Each block or each operation may indicate a portion of a code, a module, or a segment including one or more executable instructions to perform a specific logical function (or functions). It should be noted that, in some modifications of the invention, the functions described in the blocks or the operations may be executed in a different order. For example, two blocks or operations that are shown as being sequential can actually be performed at the same time, or they can be performed in reverse order depending on the functions of the blocks.

[0029] FIG. 2 is a block diagram illustrating a device to play back multimedia contents according to reception sensitivity according to an embodiment of the invention. A device 200 to play back multimedia contents according to reception sensitivity (hereinafter, referred to as a content playing device) includes a communication unit 210, a reception sensitivity check unit 220, a determining unit 230, a decoding unit 240, a control unit 250, and an interface unit 260, although not limited thereto.

[0030] The communication unit 210 includes a plurality of wireless communication units and receives multimedia con-

tents by using one of the plurality of wireless communication units corresponding to a selection instruction message input by a user. The selection instruction message includes information items, such as, although not necessarily and not limited to, a wireless-communication-system type field, a channel field, a reception sensitivity check field, a threshold reception sensitivity field, a priority field, a message field, and a reservation field. A detailed description of the selection instruction message is provided below with reference to FIG. 3.

[0031] Each of the wireless communication units included in the communication unit **210** can receive multimedia contents by using at least one of, although not limited to, an AirTV system, a digital multimedia broadcasting system, a wireless LAN system, and a wireless broadband system. However, it is understood that wireless communication units can use any wireless communication system to receive multimedia content, and are not limited to those systems listed above, in the prior art, or otherwise later developed.

[0032] The communication unit **210** shown in FIG. 2 includes N communication units therein (hereinafter, referred to as sub-communication units); that is, a first communication unit **211**, a second communication unit **212**, and through an N-th communication unit **213**. Each of the sub-communication units can receive multimedia contents by using one or more of the wireless communication systems as described above. While not required in all aspects, the communication unit **210** may include different types of wireless communication units, or may include wireless communication units of the same type in aspects of the invention.

[0033] For example, the first communication unit **211** may use the AirTV wireless communication system **12**, the second communication unit **212** may use the digital multimedia wireless broadcasting system **13**, and the N-th communication unit **213** may use the wireless LAN communication system **14**. Alternatively, the first and second communication units **211** and **212** may use the AirTV wireless communication system **12**, and the N-th communication unit **213** may use the digital multimedia wireless communication system **13**.

[0034] One or more of the sub-communication units **211**, **212**, **213** may, although not necessarily, each include a tuner and a demodulator. A multimedia content signal received by the tuner is demodulated by a demodulator corresponding to the tuner. The demodulator demodulates the original multimedia content signals from modulated wave signals. The demodulator in one or more of the sub-communication units may, although not necessarily and not limited to, include an automatic gain control amplifier, an oscillator, an analog-to-digital (A/D) converter, a symbol recovery unit, and a channel decoder. However, it is understood that the demodulators can be otherwise constructed.

[0035] The automatic gain control amplifier functions to compensate for a signal gain in order to convert received multimedia content signals to digital signals. That is, when a weak multimedia content signal is received, the automatic gain control amplifier amplifies the output of the received multimedia content signal such that an analog-to-digital conversion can be performed. The oscillator generates a sampling frequency to sample the received multimedia content signal. The A/D converter converts the multimedia

content signal amplified by the automatic gain control amplifier into a digital signal on the basis of the sampling frequency generated by the oscillator.

[0036] The converted digital multimedia content signal is transmitted to the symbol recovery unit. The symbol recovery unit receives timing errors of the current symbols obtained by processing baseband signals in a feedback manner, and reduces an error between the digital signals received from the A/D converter. Then, the symbol recovery unit removes phase noise and interference between symbols from the digital signal, and transmits the digital signal to the channel decoder. The channel decoder extracts synchronizing signals inserted at the time of transmission from the baseband signal, and decodes received data (that is, the multimedia content signal) by using the extracted synchronizing signal.

[0037] The demodulator may, although not necessarily, be an OFDM (orthogonal frequency division multiplex) demodulator. In this case, the demodulator divides one channel into a plurality of narrow-band sub-channels, allocates a plurality of sub-carrier waves orthogonal to each other to the narrow-band channels, modulates the sub-carrier waves, and multiplexes the sub-carrier waves.

[0038] The reception sensitivity check unit **220** checks the reception sensitivity of the received multimedia content signal. The reception sensitivity checked by the reception sensitivity check unit **220** may be the intensity of a radio wave, or an error rate included in the multimedia content signal, but is not limited thereto.

[0039] The determining unit **230** determines whether to output multimedia contents on the basis of the reception sensitivity checked by the reception sensitivity check unit **220**. That is, the determining unit **230** determines to output the received multimedia contents when the checked reception sensitivity exceeds a predetermined threshold value for the content received at the wireless sub-communication unit **211**, **212**, or **213**. When the reception sensitivity of the received multimedia content is lower than a predetermined threshold value of the wireless sub-communication unit **211**, **212**, or **213**, the determining unit **230** determines to output other multimedia content having a higher reception sensitivity than the threshold value set to correspond to a different wireless sub-communication unit **211**, **212**, or **213**.

[0040] For example, in the AirTV system **12**, when the reception sensitivity of the multimedia content received by the first communication unit **211** is lower than a threshold value set to the first communication unit **211**, the determining unit **230** may determine to output the multimedia content by the digital multimedia broadcasting system **13** or the wireless LAN system **14**, on the basis of the reception sensitivity of the multimedia content received by the second communication unit **212** according to the digital multimedia broadcasting system or by the N-th communication unit **213** according to the wireless LAN system. Alternatively, the determining unit **230** may determine to output multimedia content having a higher reception sensitivity than a threshold value set to correspond to the wireless communication device according to priority on the basis of the selection instruction message. Also, the priority can be pre-selected by default or by reception intensity. An example of the determination of output according to a priority will be described in detail below with reference to FIG. 5.

[0041] The decoding unit 240 decodes audio or video signals of the multimedia content output in response to the determination of the determining unit 230. A plurality of multimedia contents may be received from the determining unit 230. Therefore, the decoding unit 240 may include a plurality of decoders, and one of the plurality of decoders may decode the audio and video signals of the plurality of multimedia contents in the order in which the plurality of multimedia contents is transmitted. That is, the content playing device 200 may, although not necessarily, simultaneously play a plurality of multimedia contents in a picture-in-picture manner or by screen division. It is understood that the decoder 240 need not be used in all aspects, such as where the multimedia content is data or is to be stored in an encoded fashion.

[0042] The shown interface unit 260 includes an input unit and an output unit. The input unit receives a selection instruction message for multimedia contents from a user. The user may, although not necessarily, input the selection instruction message through the input unit, such as a button, a touch pad, or a touch screen, although not limited thereto. The output unit of the interface unit 260 outputs audio and/or video signals. When the multimedia content determined by the determining unit 230 is included in the multimedia contents selected by the selection instruction message input by the user, the output unit may, although not necessarily, output a message indicating that the multimedia content is included therein. While shown as combined, it is understood that the input unit can be separate from the output unit, and that one or more of the units can be interfaces and/or plugs connectable to external displays and/or speakers.

[0043] When the reception sensitivity of a first multimedia content that the user wants is lower than a threshold value, the user can view a second multimedia content through a different wireless sub-communication unit 211, 212, 213, with the first multimedia content set to a predetermined state. In this example, when the reception sensitivity of the first multimedia content becomes higher, the user can know the reception sensitivity of the first multimedia content through a message output from the output unit. Alternatively or in addition to the message, the apparatus can automatically switch back to the first multimedia content.

[0044] The output unit includes an audio output unit, such as a speaker, and/or a video output unit to display input image signals, such as, although not limited to, a cathode ray tube (CRT), a liquid crystal display (LCD), a light-emitting diode (LED), an organic light-emitting diode (OLED), or a plasma display panel (PDP).

[0045] The interface unit 260 can display the reception sensitivity of the multimedia content received by the wireless sub-communication unit corresponding to the selection instruction message in real time. An example of the display of reception sensitivity will be described in detail below with reference to FIG. 4.

[0046] The control unit 250 controls the communication unit 210, the reception sensitivity check unit 220, the determining unit 230, the decoding unit 240, the interface unit 260, and the content playing device 200 on the basis of the selection instruction message.

[0047] FIG. 3 is a diagram illustrating a selection instruction message 300 according to an embodiment of the present

invention. As shown in FIG. 3, a selection instruction message 300 includes information items, such as, although not necessarily and not limited to, a wireless-communication-system type field 310, a channel field 320, a reception sensitivity check field 330, a threshold reception sensitivity field 340, a priority field 350, a notification message field 360, and a reservation field 370. However, it is understood that ones of the fields need not be used, such as where the message 300 is part of a standard or where the message is predetermined. Also, additional fields can be included in the message 300.

[0048] The type of wireless communication system is input to the wireless-communication-system type field 310. That is, a type of wireless communication system (such as the AirTV system, the digital multimedia broadcasting system, the wireless LAN system, or the wireless broadcasting system) may be input to the wireless-communication-system type field 310.

[0049] One of a plurality of channels to be provided by the wireless communication system indicated in the wireless-communication-system type field 310 may be input to the channel field 320. A flag is input to the reception sensitivity check field 330 indicating whether the reception sensitivity of the multimedia content received through the channel of the wireless communication system input to the channel field 320 is checked. That is, when a value of 0 is input to the reception sensitivity check field 330, the reception sensitivity check unit 220 does not check the reception sensitivity of the corresponding multimedia content. When a value of 1 is input to the reception sensitivity check field 330, the reception sensitivity check unit 220 checks the reception sensitivity of the corresponding multimedia content.

[0050] When the value of 0 is input to the reception sensitivity check field 330, values input to the next fields (that is, the threshold reception sensitivity field 340, the priority field 350, the notification message field 360, and the reservation field 370) may be neglected.

[0051] A threshold value, that is, a threshold reception sensitivity, is input to the threshold reception sensitivity field 340. The threshold reception sensitivity is compared with the reception sensitivity of the multimedia content which is selected and received to determine whether to process the multimedia content (for example, to play or output a message). The priority of the selection instruction message 300 is input to the priority field 350. That is, the priority of the output of the multimedia content, which is received through a specific channel by the wireless communication system indicated in the wireless-communication-system type field 310 and the channel field 320, is input to the priority field 350.

[0052] For example, three selection instruction messages 300, a first priority selection instruction message, a second priority selection instruction message, and a third priority selection instruction message, are input in the messages, the reception sensitivities of the multimedia contents requested by the first and third priority selection instruction messages are lower than a threshold reception sensitivity, whereas the reception sensitivity of the multimedia content selected by the second selection instruction message is higher than the threshold reception sensitivity. In this case, the content playing device 200 plays back the multimedia content

requested by the second priority selection instruction message. According to an aspect of the present invention, even if the priority of the multimedia content requested by the third priority selection instruction message is higher than the threshold reception sensitivity, the content playing device 200 does not play back the multimedia content in response to the third priority selection instruction message as the reception sensitivity is below the threshold.

[0053] On the other hand, according to an aspect of the present invention, when the reception sensitivity of the multimedia content requested by the first priority selection instruction message is higher than the threshold reception sensitivity, the content playing device 200 stops playing back the multimedia content requested by the second priority selection instruction message, and plays back the multimedia content requested by the first priority selection instruction message.

[0054] In an aspect of the invention, switching between wireless communication systems can be performed in response to only pre-selected information (priority 350). Therefore, the content playing device 200 checks only the reception sensitivity of multimedia content having a higher priority than the multimedia content being currently played.

[0055] A flag indicating whether to output a message is input to the notification message field 360. When the reception sensitivity of the multimedia content that is selected and received is higher than the threshold reception sensitivity input to the threshold reception sensitivity field 340, a message is output to notify a user of this fact. A value of 0 or 1 can be input to the notification message field 360. When a value of 0 is input to the notification message field 360, the content playing device 200 outputs no message. When a value of 1 is input to the notification message field 360, the content playing device 200 outputs a message. However, it is understood that the field 360 can include a message text, or the text can be otherwise generated.

[0056] A reception sensitivity check time for multimedia contents whose reception sensitivity will be checked and a flag indicating whether to check the reception sensitivity of the multimedia contents are input to the reservation field 370. For example, a user can input a start time and an end time to the reservation field 370. When a reservation time is input to the reservation field 370, the content playing device 200 checks the reception sensitivity for only the reservation time. When the reservation time has elapsed, the content playing device 200 stops checking the reception sensitivity. As a result, the content playing device 200 does not perform unnecessary operations and the messages can expire.

[0057] FIG. 4 shows a diagram illustrating a display of the reception sensitivity according to an embodiment of the invention. One or more selection instruction messages 300 may be input to the content playing device 200. That is, the user may input one selection instruction message 300 in order to view the multimedia content provided through a specific channel by a specific wireless communication system, or the user may input more than one selection instruction messages 300 in order to view multimedia contents provided through channels of different wireless communication systems. Further, the user may input more than one selection instruction messages 300 in order to view different multimedia contents provided through different channels of the same wireless communication system.

[0058] According to an aspect of the present invention, the user may input values to the reception sensitivity check field 330, the threshold reception sensitivity field 340, the priority field 350, the notification message field 360, and the reservation field 370 included in the selection instruction message 300 to automatically play back multimedia contents that the user wants. According to another aspect, after checking the level of the reception sensitivity of the corresponding multimedia content, the user may manually play back the multimedia content.

[0059] In order for the user to play back multimedia contents, the content display device 200 displays reception sensitivities 450 of the multimedia contents corresponding to the selection instruction messages 300 input by the user.

[0060] FIG. 4 shows an example of the reception sensitivities 450 of the multimedia contents corresponding to four selection instruction messages 300 input by the user are displayed on a predetermined region of a screen. The level of the reception sensitivities may be displayed using a number of bars, as shown in FIG. 4, or it may be displayed using a predetermined icon color. However, it is understood that the level of the reception sensitivities can be displayed in any variety of ways that can indicate between different levels.

[0061] When the level of the reception sensitivity is displayed using a number of bars as shown in FIG. 4, the more the number of bars, the higher the level of the reception sensitivity. When the level of the reception sensitivity is displayed using the color of an icon, the levels of the reception sensitivities may, although not necessarily, be represented by red and blue or gradations therebetween. That is, when an icon is blue, the level of the reception sensitivity is high. When an icon is red, the level of the reception sensitivity is low. However, it is understood that other or more colors can be used, or that a single color can be used.

[0062] According to an aspect of the present invention, characters and figures displayed on the screen may indicate the type of wireless communication system and channels. That is, 'A1' indicates channel No. 1 of the AirTV system 12, and 'D3' indicates channel No. 3 of the digital multimedia broadcasting system 13. In addition, 'W2' indicates channel No. 2 of the wireless LAN system 14, and 'B2' indicates channel No. 2 of the wireless broadcasting system 15. The type of wireless communication system and channels may be set by the user. A reception sensitivity 451 corresponding to the multimedia content 410 being currently played may be prominently displayed such that the user can easily recognize the reception sensitivity 451. Alternatively, the sensitivities 450, 451 can be output on another display (not shown) so as to not take up space on the screen 410, 420.

[0063] The user can push directional buttons 491 provided in the content playing device 200 to move a cursor 452, and use a selection button 492 to display multimedia content 420 corresponding to a specific reception sensitivity icon selected by the cursor 452. That is, after checking the reception sensitivities 450 of the multimedia contents 420 corresponding to the selection instruction messages 300 input by the user, the user can use the directional buttons 491 and the selection button 492 of the content playing device 200 to play back a specific multimedia content. However, it

is understood that touch screen displays and/or a stylus can be used such that one or more of the buttons **491**, **492** need not be used, and that the buttons can be included on a keyboard of a telephone.

[0064] FIG. 5 shows that multimedia contents are displayed in a specific order according to an embodiment of the invention. As described above, when the user inputs a plurality of selection instruction messages **300** and priorities therefor, the content playing device **200** plays back multimedia contents in a sequence depending on the priorities of the selection instruction messages **300**.

[0065] FIG. 5 shows examples of priority tables **500** including priority, the type of wireless communication systems, channel, and reception sensitivities, and also shows that multimedia contents are displayed according to their priorities. The priority table **500** may be made by using the selection instruction message **300** input by the user, or it may be stored in a storage unit (not shown) of the content playing device **200**.

[0066] According to an aspect of the invention, a symbol '+' or '-' is input to a reception sensitivity field of the priority table **500**. The symbol '+' indicates that the reception sensitivity of the received multimedia content is higher than the corresponding threshold reception sensitivity, and the symbol '-' indicates that the reception sensitivity of the received multimedia content is lower than the corresponding threshold reception sensitivity. However, it is understood that any symbol or figure may be used to indicate whether the received reception sensitivity is higher than the threshold reception sensitivity.

[0067] In the first step **S5100**, the reception sensitivities of multimedia contents other than multimedia content having a second priority **520** are lower than the threshold reception sensitivity. Therefore, the content playing device **200** plays back the multimedia content **5150** provided through a channel No. 4 by the digital multimedia broadcasting system corresponding to the second priority **520**.

[0068] In the second step **S5200**, the reception sensitivity of multimedia content having a third priority **530** is higher than the threshold reception sensitivity while the multimedia content **5150** having the second priority **520** is being played. In this case, since the priority of the multimedia content **5150** being currently played is higher than the priority of the multimedia content having a higher reception sensitivity than the threshold reception sensitivity, the content playing device **200** does not play back the multimedia content having the third priority **530** and continues to play back the multimedia content **5150** having the second priority **520**.

[0069] In the third step **S5300**, the reception sensitivity of multimedia content **5250** having a first priority **510** is higher than the threshold reception sensitivity while the multimedia content having the second priority **520** is being played. In this case, since the priority of the multimedia content **5150** being currently played is lower than the priority of the multimedia content **5250** having a higher reception sensitivity than the threshold reception sensitivity, the content playing device **200** stops playing back the multimedia content **5150** having the second priority **520** and plays back the multimedia content **5250** having the first priority **510** provided through a channel No. 2 by the AirTV system **12**.

[0070] Playing the multimedia content according to priority may be automatically performed, or it may be manually

performed by the user. If the multimedia content is played automatically, as in the third step **S5300** shown in FIG. 5, the content playing device **200** may automatically stop playing back the multimedia content **5150** having the second priority **520** and automatically play back the multimedia content **5250** having the first priority **510**. If the multimedia content is played manually, the content playing device **200** may indicate to a user that the reception sensitivity of the multimedia content **5250** having the first priority **510** is higher than the threshold reception sensitivity, while playing back the multimedia content **5150** having the second priority **520**. The notification may be output in the form of an image or a sound, which will be described in detail below with reference to FIG. 6.

[0071] FIG. 6 is a diagram showing a process of outputting a message according to an embodiment of the invention. The content playing device **200** can receive one or more multimedia contents according to the selection instruction message **300** input by the user. FIG. 6 shows the content playing device **200** receiving two multimedia contents: a first content **610a** and a second content **620a**. In FIG. 6, the operation of the content playing device **200** is divided into two steps: a first step **S6100** and a second step **S6200**.

[0072] In the first step **S6100**, the content playing device **200** receives the first content **610a** and the second content **620a** according to the selection instruction message **300** input by the user. It is assumed that the second content **620** has a higher priority. In this case, since the reception sensitivity of the second content **620a** is lower than the threshold reception sensitivity, the content playing device **200** displays only the first content **610a** and checks the reception sensitivity of the second content **620a** in real time. When the reception sensitivity of the second content **620a** becomes higher than a predetermined threshold reception sensitivity, the second step **S6200** is performed. In the second step **S6200**, the content playing device **200** outputs a message **6210** or **6220** by using an output unit provided therein, while displaying a first content **610b**. That is, the content playing device **200** outputs a message indicating that the reception sensitivity of a second content **620b** is good in the form of a sound **6220** or an image **6210**. Then, the user can determine whether to switch the screen to the multimedia content **620b** that is selected as the best, while viewing the multimedia content **610b** that is selected as the second best.

[0073] FIG. 7 is a flow chart illustrating a process of playing back multimedia contents according to the reception sensitivity, according to an embodiment of the invention. In order to play back received multimedia contents according to the reception sensitivities, the content playing device **200** receives one or more selection instruction messages **300** from the user (**S710**). The one or more selection instruction messages **300** may include information items, such as the wireless-communication-system type field **310**, the channel field **320**, the reception sensitivity check field **330**, the threshold reception sensitivity field **340**, the priority field **350**, the notification message field **360**, and the reservation field **370**. Since the selection instruction message **300** has been described above with reference to FIG. 3, a detailed description thereof will be omitted herein. Alternatively or in addition to receiving input from the user, the selection

instruction message can be a default setting or can be received from an external device, such as from a computer networked to the device 200.

[0074] The selection instruction message 300 is transmitted to the control unit 250 through the interface unit 260. The control unit 250 controls the communication unit 210, the reception sensitivity check unit 220, the determining unit 230, the decoding unit 240, the interface unit 260, and the content playing device 200 on the basis of the one or more received selection instruction messages 300. The control unit 250 transmits the type of wireless communication system and channels included in the selection instruction message 300 to the communication unit 210. Then, the communication unit 210 receives multimedia contents from a wireless sub-communication unit corresponding to the selection instruction message 300 input by the user among one or more wireless sub-communication units provided in the communication unit 210 (S720).

[0075] Each of the wireless sub-communication devices unit in the communication unit 210 can receive multimedia contents by using at least one of, although not limited to, the AirTV system 12, the digital multimedia broadcasting system 13, the wireless LAN system, the wireless broadband system 15, or combinations thereof. However, it is understood that wireless communication units can use any wireless communication system to receive multimedia content, and are not limited to those systems listed above, otherwise existing or to be developed.

[0076] Sub-communication units 211, 212, 213 of the communication unit 210 may, although not necessarily, include different tuners and demodulators. The tuner receives multimedia content, and the demodulator demodulates the received multimedia content. The demodulated multimedia content is transmitted to the reception sensitivity check unit 220, and then the reception sensitivity check unit 220 checks the reception sensitivity of the received multimedia content (S730) received through corresponding sub-communication units 211, 212, 213.

[0077] The checked reception sensitivity is transmitted to the determining unit 230, and the determining unit 230 determines whether to output the corresponding multimedia content on the basis of the reception sensitivity. In this case, the determination of the determining unit 230 may be performed on the basis of the one or more selection instruction messages 300. That is, the determining unit 230 checks the reception sensitivity check field 330 of the selection instruction message 300 (S740). When the reception sensitivity check flag is set to zero, the determining unit 230 allows the received multimedia content to be played back regardless of the reception sensitivity transmitted from the reception sensitivity check unit 220. Then, audio or video multimedia content is transmitted to the decoding unit 240, and the decoding unit 240 decodes the audio and/or video multimedia content. The decoded multimedia content is output through the interface unit 260 (S790).

[0078] When the reception sensitivity check flag is set to 1, the determining unit 230 checks whether the reception sensitivity is higher than a predetermined threshold reception sensitivity (S750). That is, the determining unit 230 compares the threshold reception sensitivity included in the selection instruction message 300 with the reception sensitivity transmitted from the reception sensitivity check unit

220. As a result of the comparison, when the reception sensitivity transmitted from the reception sensitivity check unit 220 is higher than the threshold reception sensitivity included in the selection instruction message 300, the determining unit 230 checks the priority field 350 included in the selection instruction message 300 (S760).

[0079] When the priority of the received multimedia content is lower than the priority of the multimedia content being currently played, the determining unit 230 does not play back the received multimedia content, and continues to play back the current multimedia content. When the priority of the received multimedia content is higher than the priority of the multimedia content being currently played, the determining unit 230 checks the notification message field 360 included in the selection instruction message 300 (S770).

[0080] When a message flag is set to zero, the determining unit 230 determines to output the received multimedia content to allow the received multimedia content to be played back instead of the currently output content. Then, audio or video multimedia content is transmitted to the decoding unit 240, and the decoding unit 240 decodes the audio and/or video multimedia content. The decoded multimedia content is output through the interface unit 260 (S790).

[0081] On the other hand, when the message flag is set to 1, the determining unit 230 does not output the received multimedia content, and waits for the instruction of the control unit 250. The interface unit 260 outputs a message according to the instruction of the control unit 250 (S780). That is, the interface unit 260 outputs an audio or video message.

[0082] When the user inputs an instruction through the interface unit 260 to play back the multimedia content, the play instruction is transmitted to the determining unit 230 through the control unit 250. Then, the determining unit 230 stops playing back the current multimedia content, and allows the received multimedia content to be played back. Subsequently, the received multimedia content is transmitted to the decoding unit 240, and the decoding unit 240 performs audio and/or video decoding on the received multimedia content. The decoded multimedia content is output through the interface unit 260 (S790).

[0083] While not restricted thereto, it is understood that the device 200 to play back multimedia contents can be implemented using portable devices, such as telephones, personal digital assistants, and portable media players; non-portable devices such as displays, personal computers, audio and/or video recording and/or reproducing apparatuses, and digital video recorders; or combinations thereof.

[0084] As described above, according to a method and device to play back multimedia contents on the basis of the reception sensitivity of the multimedia content, it is possible for a user to view contents having a high reception sensitivity by selecting a wireless communication system according to the sensitivity of wireless signals and by playing back received contents. Furthermore, it is possible to prevent an increase in the number of switching operations between wireless communication systems and thus for contents to be stably displayed to a user.

[0085] Although a few embodiments of the present invention have been shown and described, it would be appreciated

by those skilled in the art that changes may be made in this embodiment without departing from the principles and spirit of the invention, the scope of which is defined in the claims and their equivalents.

What is claimed is:

1. A device to play back contents from one or more wireless communication systems according to a reception sensitivity, the device comprising:

a communication unit comprising one or more wireless sub-communication units, that receive corresponding multimedia content through using at least one of the one or more wireless communication systems selected on the basis of one or more selection instruction messages input by a user;

a reception sensitivity check unit to check the reception sensitivity of the received multimedia content received at the sub-communication units; and

an interface unit to output the received multimedia content according to the reception sensitivity and a priority indicated in the one or more selection instruction messages.

2. The device as claimed in claim 1, wherein the wireless sub-communication units receive the multimedia content by using at least one of an AirTV system, a digital multimedia broadcasting system, a wireless LAN system, a wireless broadcasting system, or combination thereof.

3. The device as claimed in claim 1, wherein each one of the one or more selection instruction messages comprises at least one of:

a wireless-communication-system type field, to correspond to a type of the wireless communication system;

a channel field, to correspond to one of a plurality of channels to be provided by the wireless communication system;

a reception sensitivity check field, to indicate whether the reception sensitivity of the multimedia content received through the channel of the wireless communication system input to the channel field is checked;

a threshold reception sensitivity field, to indicate a threshold reception sensitivity to be compared with the reception sensitivity of the multimedia content received through the channel of the wireless communication system input to the channel field;

a priority field, to indicate the priority of the output of the multimedia content as compared to other received multimedia content;

a message field, to indicate whether to output a message when the reception sensitivity of the multimedia content that is selected and received is higher than the threshold reception sensitivity; and

a reservation field, to indicate a reception sensitivity check time for multimedia contents whose reception sensitivity will be checked.

4. The device as claimed in claim 3, wherein if a first selection instruction message of the one or more selection instruction messages comprises the reception sensitivity check field and the reception sensitivity check field has a first value to indicate that received multimedia content is not to be checked, then the reception sensitivity of the multi-

media content received from the wireless sub-communication unit corresponding to the first selection instruction message is not checked and the received multimedia content is output by the interface unit.

5. The device as claimed in claim 1, further comprising:

a determining unit to determine whether to output the received multimedia content on the basis of the checked reception sensitivity and the one or more selection instruction messages.

6. The device as claimed in claim 5, wherein if the reception sensitivity of a first multimedia content that is received from a first wireless sub-communication unit of the one or more wireless sub-communication units is lower than a first threshold value set to correspond to the first wireless sub-communication unit, the determining unit determines to output a second multimedia content that is received from a second wireless sub-communication unit of the one or more wireless sub-communication units with the reception sensitivity higher than a second threshold value set to correspond to the second wireless sub-communication unit.

7. The device as claimed in claim 5, wherein each of the one or more wireless sub-communication units has a priority number assigned thereto in the corresponding one of the one or more selection instruction messages, wherein the determining unit determines to output the multimedia content that is received from a first wireless sub-communication unit, of the one or more wireless sub-communication units, with the reception sensitivity higher than a threshold value set to correspond to the first wireless sub-communication unit, wherein the first wireless sub-communication unit has a first priority number that is higher than the priority number of any other of the one or more wireless sub-communication units having the reception sensitivity higher than a corresponding threshold value.

8. The device as claimed in claim 7, wherein when the reception sensitivity of the multimedia content received from a second one of the wireless sub-communication units changes from a first level lower than the corresponding threshold value to a second level higher than or equal to the corresponding threshold value, and the second wireless sub-communication unit has a second priority number that is higher than the first priority number, the determining unit determines to output the multimedia content received from the second wireless sub-communication unit.

9. The device as claimed in claim 7, wherein when the reception sensitivity of the multimedia content received from a second one of the wireless sub-communication units changes from a first level lower than the corresponding threshold value to a second level higher than or equal to the corresponding threshold value, and the second wireless sub-communication unit has the priority number that is higher than the priority number of the first wireless sub-communication unit, the interface unit outputs a notification message to the user.

10. The device as claimed in claim 9, wherein the notification message is in a form of a sound and/or an image.

11. The device as claimed in claim 9, wherein the determining unit determines to output the multimedia content received from the second wireless sub-communication unit.

12. The device as claimed in claim 1, wherein the interface unit outputs a notification message to the user when the reception sensitivity of the multimedia content that is received from one of the one or more wireless sub-communication units changes from a first level lower than a

threshold value set to correspond to the one of the one or more wireless sub-communication units to a second level higher than or equal to the threshold value.

13. The device as claimed in claim 3, wherein if a first selection instruction message of the one or more selection instruction messages comprises the reservation field having a start time and an end time, the reception sensitivity check unit checks the reception sensitivity of the multimedia content received from the wireless sub-communication unit corresponding to the first selection instruction message during a time between the start time and the end time.

14. The device as claimed in claim 1, further comprising a decoding unit to decode an audio signal and/or a video signal of the multimedia content output according to the reception sensitivity and the one or more selection instruction messages.

15. The device as claimed in claim 1, wherein the interface unit receives the one or more selection instruction messages.

16. The device as claimed in claim 1, wherein the interface unit displays in real time the reception sensitivities of the multimedia content received from the one or more wireless sub-communication units corresponding to the one or more selection instruction messages.

17. The device as claimed in claim 16, wherein the real time display comprises bars and/or predetermined icon colors corresponding to different sensitivities.

18. The device as claimed in claim 1, wherein the interface unit displays in real time a list of the multimedia content being received by the one or more wireless sub-communication units, and the user selects from the displayed list the received multimedia content to be output.

19. The device as claimed in claim 18, wherein the list of the one or more wireless sub-communication units comprises characters and/or figures indicating a type of the wireless communication system and/or channels of the wireless communication system.

20. The device as claimed in claim 18, further comprising directional buttons and/or a selection button provided on an outside surface of the device, wherein the user selects from the list by using the directional buttons and/or the selection button.

21. A method of playing back contents from one or more wireless communication systems according to a reception sensitivity, the method comprising:

receiving multimedia content through a wireless sub-communication unit selected from among one or more wireless sub-communication units on the basis of one or more selection instruction messages input by a user;

checking the reception sensitivity of the received multimedia content; and

outputting the received multimedia content according to the reception sensitivity and a priority of multimedia contents is indicated in the one or more selection instruction messages.

22. The method as claimed in claim 21, wherein each one of the one or more selection instruction messages comprises at least one of:

a wireless-communication-system type field, to correspond to a type of the wireless communication system;

a channel field, to correspond to one of a plurality of channels to be provided by the wireless communication system;

a reception sensitivity check field, to indicate whether the reception sensitivity of the multimedia content received through the channel of the wireless communication system input to the channel field is checked;

a threshold reception sensitivity field, to indicate a threshold reception sensitivity to be compared with the reception sensitivity of the multimedia content received through the channel of the wireless communication system input to the channel field;

a priority field, to indicate the priority of the output of the multimedia content as compared to other received multimedia content;

a message field, to indicate whether to output a message when the reception sensitivity of the multimedia content that is selected and received is higher than the threshold reception sensitivity; and

a reservation field to indicate a reception sensitivity check time for multimedia contents whose reception sensitivity will be checked.

23. The method as claimed in claim 22, wherein the outputting of the received multimedia content comprises outputting the received multimedia content corresponding to a first selection instruction message of the one or more selection instruction messages, wherein the first selection instruction message comprises the reception sensitivity check field having a first value to indicate that the reception sensitivity of the received multimedia content is not to be checked.

24. The method as claimed in claim 21, wherein the determining of the output of the multimedia content further comprises determining to output the multimedia content received from a second one of the wireless sub-communication units when the reception sensitivity of the multimedia content received from the second wireless sub-communication unit changes from a first level lower than the corresponding threshold value to a second level higher than or equal to the corresponding threshold value, and the second wireless sub-communication unit has a second priority number that is higher than the first priority number.

25. The method as claimed in claim 21, further comprising outputting a notification message to the user if the reception sensitivity of the multimedia content received from a second one of the wireless sub-communication units changes from a first level lower than the corresponding threshold value to a second level higher than or equal to the corresponding threshold value, and the second wireless sub-communication unit has a second priority number that is higher than the first priority number.

26. The method as claimed in claim 25, further comprising determining to output the multimedia content received from the second wireless sub-communication unit.

27. The method as claimed in claim 25, wherein the determining of the output of the multimedia content further comprises receiving an instruction message from the user instructing whether to output the multimedia content received from the second wireless sub-communication unit.

28. The method as claimed in claim 21, further comprising outputting a notification message to a user when the reception sensitivity of the multimedia content that is

received from one of the one or more wireless sub-communication units changes from a first level lower than a threshold value set to correspond to the one of the one or more wireless sub-communication units to a second level higher than or equal to the threshold value.

29. The method as claimed in claim 22, wherein the checking of the reception sensitivity of the received multimedia content comprises checking the reception sensitivity of the received multimedia content received from the wireless sub-communication unit corresponding to a first selection instruction message during a time between a start time and an end time, wherein the first selection instruction message comprises the reservation field having the start time and the end time.

30. A computer-readable medium encoded with the method of claim 21 implemented by a computer.

31. A device to play back contents from one or more wireless communication systems according to a reception sensitivity, the device comprising:

- a first wireless sub-communication unit to receive a first content through using a first wireless communication system;
- a second wireless sub-communication unit to receive a second content through using a second wireless communication system;
- a reception sensitivity check unit to check corresponding reception sensitivities of the first content and the second content against a first threshold value and a second threshold value, respectively; and
- a control unit to, based upon the reception sensitivities and a priority between the first content and the second content:
 - prevent an output of the second content while the priority for the first content is greater than the priority of the second content and the reception sensitivity of the first content is greater than or equal to the first threshold value;
 - prevent the output of the second content while the reception sensitivity of the second content is lower than the second threshold value;

prevent an output of the first content while the priority of the second content is greater than the priority of the first content and the reception sensitivity of the second content is greater than or equal to the second threshold value; and

prevent the output of the first content while the reception sensitivity of the first content is lower than the first threshold value.

32. A method of playing back contents from one or more wireless communication systems according to a reception sensitivity, the method comprising:

receiving a first content from a first wireless communication system through a first wireless sub-communication unit having a first threshold value;

receiving a second content from a second wireless communication system through a second wireless sub-communication unit having a second threshold value;

comparing a reception sensitivity of the first content with the first threshold value;

comparing a reception sensitivity of the second content with the second threshold value;

preventing an output of the second content and allowing an output of the first content while a priority of the first content is greater than a priority of the second content and the reception sensitivity of the first content is greater than or equal to the first threshold value;

preventing the output of the second content while the reception sensitivity of the second content is lower than the second threshold value;

preventing the output of the first content and allowing the output of the second content while the priority of the second content is greater than the priority of the first content and the reception sensitivity of the second content is greater than or equal to the second threshold value; and

preventing the output of the first content while the reception sensitivity of the first content is lower than the first threshold value.

* * * * *

EXHIBIT 1032



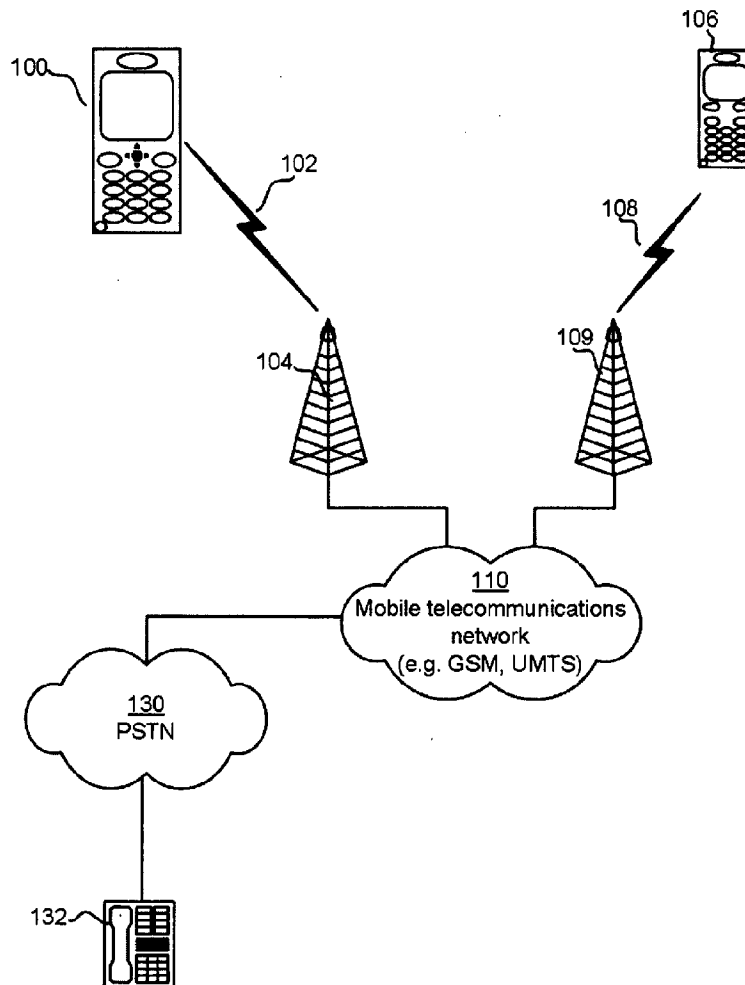
US 20070072642A1

(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2007/0072642 A1**
(43) **Pub. Date: Mar. 29, 2007**(54) **MOBILE COMMUNICATION TERMINAL
AND METHOD**(52) **U.S. Cl. 455/552.1**(76) **Inventors: Tita Kangas, Kaarina (FI); Teemu
Laaksonen, Turku (FI); Vesa Heikkola,
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(FI)**(57) **ABSTRACT**

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A method is presented for initiating communication in a mobile terminal capable of providing at least a first mode of communication and a second mode of communication, the mobile terminal comprising a communication initiation element. The method involves the steps of detecting a user actuation of the communication initiation element, discriminating between at least a first and a second type of the user actuation, and generating a control signal for initiating communication using the first mode of communication or the second mode of communication, depending on whether the user actuation is of the first type or the second type. A corresponding mobile terminal and a computer program are also presented.



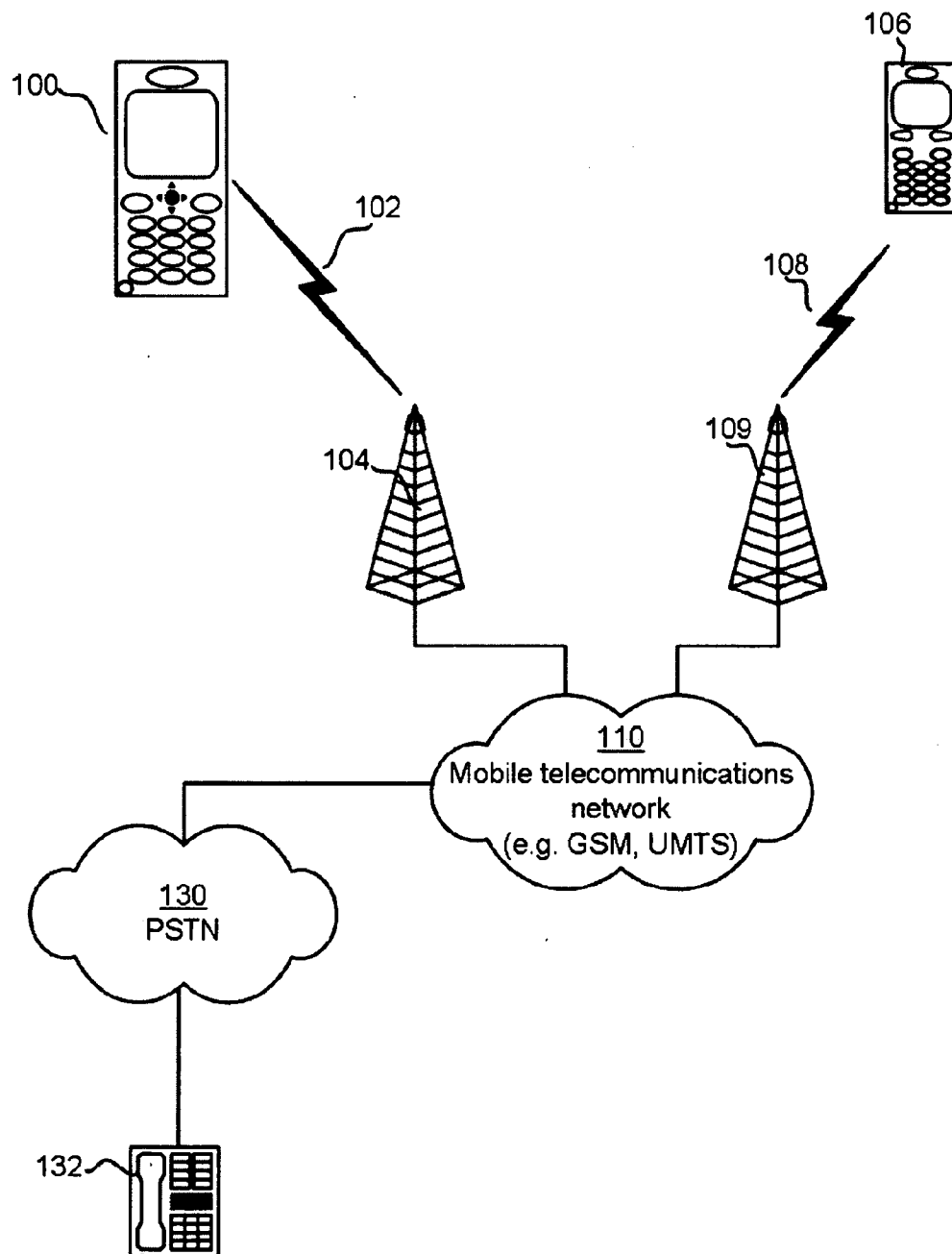


Fig 1

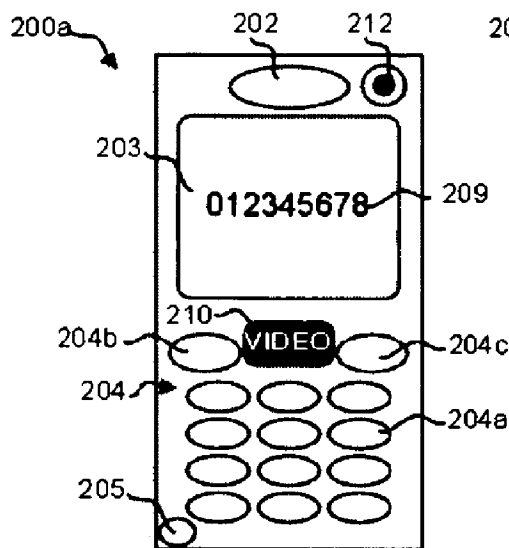


Fig 2A
Prior art

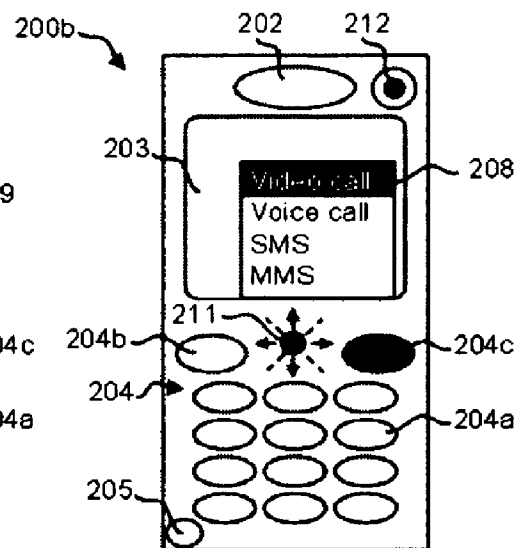


Fig 2B
Prior art

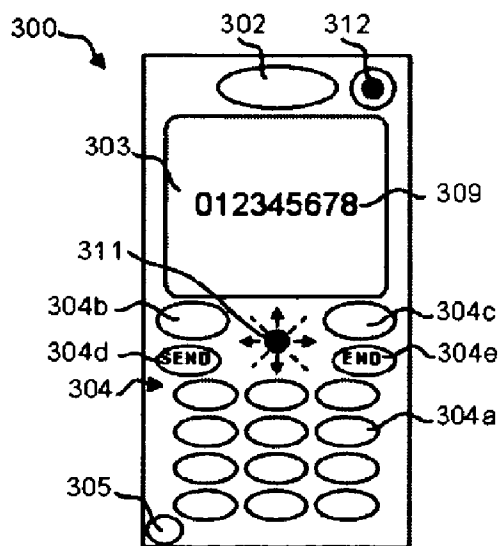


Fig 3

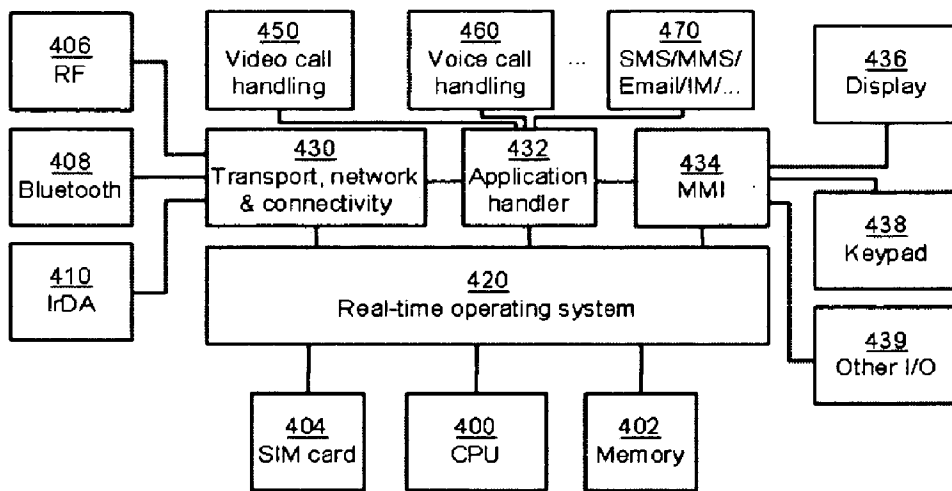
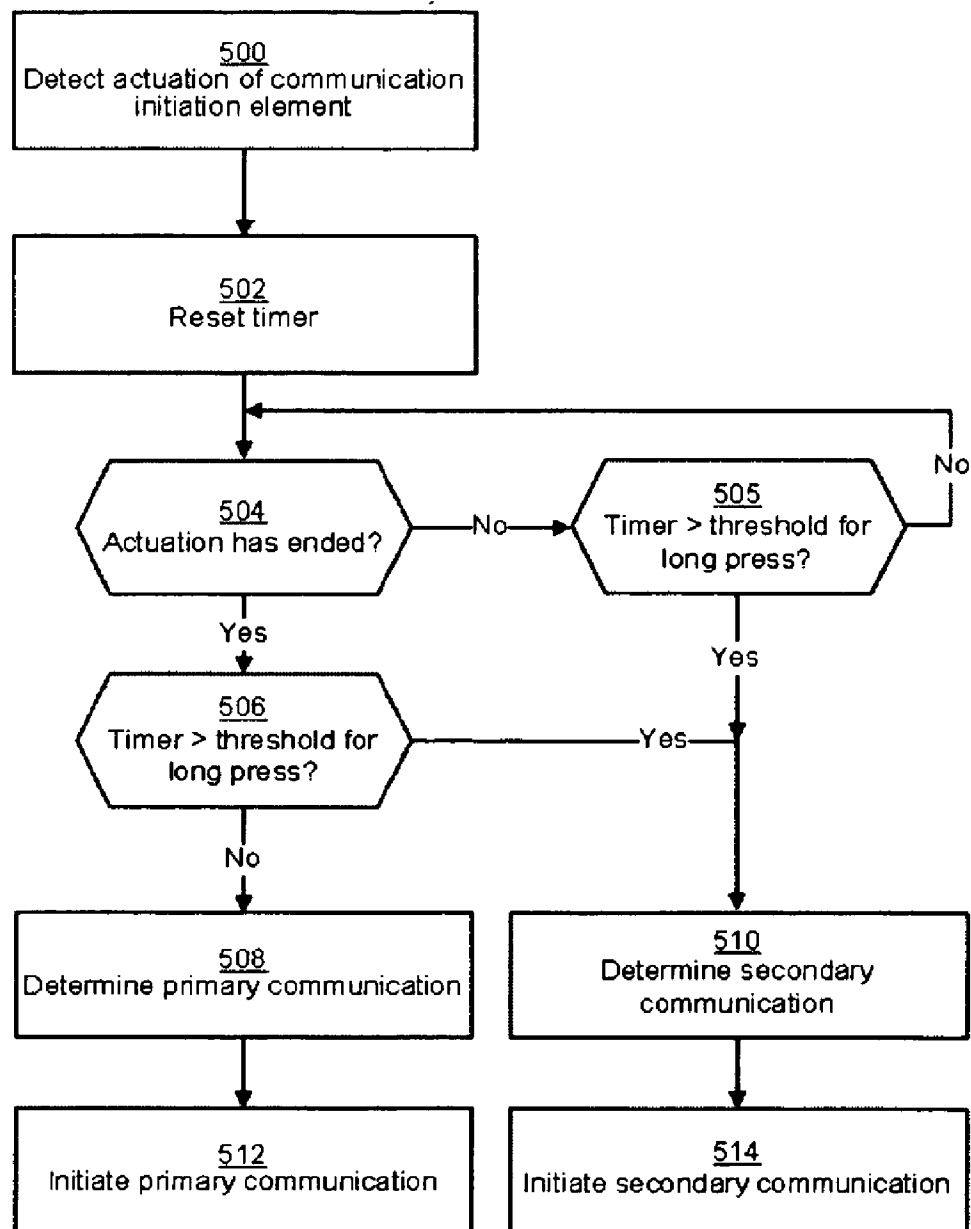


Fig 4

*Fig 5*

MOBILE COMMUNICATION TERMINAL AND METHOD

FIELD OF THE INVENTION

[0001] The present invention generally relates to mobile telecommunication and more particularly to initiating communication in a mobile terminal having several modes of communication.

BACKGROUND OF THE INVENTION

[0002] Mobile terminals, or mobile (cellular) telephones, for mobile telecommunications systems like GSM, UMTS, D-AMPS and CDMA2000 have been used for many years now. In the older days, mobile terminals were used almost only for voice communication with other mobile terminals or stationary telephones. More recently, the use of modern terminals has been broadened to include not just voice communication, but also various other services and applications such as video telephony, electronic messaging (e.g. SMS, MMS, email, instant messaging), digital image or video recording, FM radio, music playback, electronic games, calendar/organizer/time planner, word processing, WWW/WAP browser, etc.

[0003] Two mobile terminals **200a**, **200b** of the prior art with both voice and video telephony capability are shown in FIGS. 2A and 2B.

[0004] The mobile terminals **200a**, **200b** each have a user interface which typically includes a display **203** and a keypad **204**, the latter including a set of alpha-numeric (ITU-T type) keys **204a**. The user interface also comprises acoustic components for sound input and output. These components typically include a microphone **205** and a speaker **202**, and additionally often audio I/O ports in an accessories interface. The speaker **202** normally serves to provide acoustic output in the form of human speech, ring signals, music, etc.

[0005] As more functionality has been added to mobile terminals, additional input means have been provided for additional efficiency and functionality. For instance, modern mobile terminals are often provided, in addition to an ITU-T type keypad, with function keys/soft keys **204b**, **204c** (i.e. keys that have different functions in different contexts), a joystick **211** and a camera **212**.

[0006] With the introduction of third generation mobile communication systems (3G), video telephony has been provided to mobile terminal users. Video telephony may in rare cases only convey visual information, but most commonly video telephony includes both video and voice communication.

[0007] A first alternative to allow a user to initiate a video call is shown in FIG. 2A. The user may for example first dial a phone number **209** to an intended receiver of the video call, and then the user may press a dedicated video call key **210**. Using the dedicated (separate) video call key **210** to initiate a video call has a disadvantage in that it adds on to the total number of keys in the user interface. Not only will such a separate video call key require some additional space and therefore have negative implications for a mobile terminal designer that seeks to meet market demands for miniaturized terminals, but it will also add on to the total component cost for the user interface. Furthermore, a separate video call key

represents yet an additional key that the mobile terminal user must know the meaning and location of.

[0008] A second alternative to allow a user to initiate a video call is shown in FIG. 2B. Here, upon having entered an intended receiver's phone number, the user presses a soft key **204c** to display a menu **208**. From the menu **208** the user selects to initiate a video call. While this alternative allows a user to initiate a video call without requiring a dedicated video call key, the procedure requires several key presses and time to initiate a video call.

SUMMARY OF THE INVENTION

[0009] In view of the above, an objective of the invention is to solve or at least reduce the problems discussed above. The present invention particularly seeks to provide improvements to the user interface of a mobile terminal having multiple types of communication.

[0010] When the term "communication initiation element" is used herein, it denotes any input mechanism at the time configured to allow a user to indicate that communication is to be initiated. For example, the communication initiation element may be a dedicated call set-up key such as a "send" key or a "yes" key, a soft key, or a joystick or a multi-way navigation key which is depressible.

[0011] Generally, the above objectives are achieved by the attached independent patent claims.

[0012] A first aspect of the invention is a mobile terminal comprising:

[0013] first communication means capable of a first mode of communication;

[0014] second communication means capable of a second mode of communication;

[0015] a communication initiation element configured at least part of the time to accept input to initiate communication; and

[0016] a controller associated with said communication initiation element,

[0017] said controller being adapted to detect a user actuation of said communication initiation element and to discriminate between at least a first and a second type of said user actuation, and

[0018] said controller being further adapted to generate a control signal for initiating communication using said first communication means or said second communication means, depending on whether said user actuation is of said first type or said second type.

[0019] The controller may be adapted to discriminate between said first and said second type of said user actuation by determining whether or not a duration of said user actuation exceeds a predetermined time period.

[0020] Moreover, the controller may be adapted to determine whether to generate a control signal for initiating communication using said first communication means or said second communication means based on said user actuation type and a preferred mode of communication associated with an intended receiver of communication. Such a preferred mode of communication may be stored by a phone book application. If no preferred mode of communication is

associated with said intended receiver of communication, said mobile terminal may be adapted to generate a control signal to said first communication means if said first type of user actuation is determined, and to generate a control signal to said second communication means if said second type of user actuation is determined.

[0021] In different embodiments, said first communication means may be selected from a group consisting of means for providing voice communication, means for providing video communication, means for providing SMS communication, means for providing MMS communication, means for providing e-mail communication and means for providing instant messaging communication.

[0022] Correspondingly, in different embodiments, said second communication means may be selected from a group consisting of means for providing voice communication, means for providing video communication, means for providing SMS communication, means for providing MMS communication, means for providing e-mail communication and means for providing instant messaging communication.

[0023] Said communication initiation element may be an element selected from a group consisting of a dedicated send key, a soft key, a multi-way navigation key and a joystick.

[0024] In one embodiment of the present invention, said first and second modes of communication are voice communication and video communication, or vice versa; said communication initiation element is a send key; and said first and second types of said user actuation are short-press and long-press of said send key, or vice versa.

[0025] Said controller may be further adapted to determine an identifier of an intended receiver of communication, and include said identifier of said intended receiver in said control signal. The controller may be adapted to determine said identifier of said intended receiver of communication from a source selected from a group consisting of a directly entered phone number, a phone book application, an SMS, a MMS, a latest calls list, a call reminder from a calendar application, and a telephony URL.

[0026] A second aspect of the present invention is a method for initiating communication in a mobile terminal capable of providing at least a first mode of communication and a second mode of communication, said mobile terminal comprising a communication initiation element, said method involving the steps of:

[0027] detecting a user actuation of said communication initiation element;

[0028] discriminating between at least a first and a second type of said user actuation; and

[0029] generating a control signal for initiating communication using said first mode of communication or said second mode of communication, depending on whether said user actuation is of said first type or said second type.

[0030] A third aspect of the present invention is a computer program comprising software instructions that, when executed in a mobile terminal, performs the method according to the second aspect of the present invention.

[0031] The second and third aspects may generally have the same or corresponding features as those that have been described above for the first aspect.

[0032] The invention is advantageous for several reasons. For instance, for an embodiment capable of initiating voice calls and video calls, not only are the problems referred to in the first alternative in the background section of this document alleviated by reducing the need for a separate, dedicated video call key, but it also represents an efficient and intuitive way for a user to initiate a video call. Reducing the need for a separate video call key keeps space requirements low, facilitating keeping the size of the mobile terminal attractively small, and also gives the benefit of lower component costs. Additionally, the user may use the same familiar keys and procedures normally used to initiate a voice call, whereby the simple act of holding down the key to initiate the voice call for a longer period of time will instead initiate a video call. No video call specific key sequences are required to initiate the video call, whereby the time required to initiate a video call is conveniently short.

[0033] Other objectives, features and advantages of the present invention will appear from the following detailed disclosure, from the attached dependent claims as well as from the drawings.

[0034] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, step, etc]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, step, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0035] Embodiments of the present invention will now be described in more detail, reference being made to the enclosed drawings, in which:

[0036] FIG. 1 is a schematic illustration of a cellular telecommunication system in which different modes of communication may be performed between different mobile terminals, as an example of an environment in which the present invention may be applied.

[0037] FIGS. 2A and B are schematic front views illustrating two mobile terminals capable of several modes of communication according to the prior art.

[0038] FIG. 3 is a schematic front view illustrating a mobile terminal capable of several modes of communication according to an embodiment of the present invention.

[0039] FIG. 4 is a schematic block diagram representing an internal component, software and protocol structure of the mobile terminal shown in FIG. 3.

[0040] FIG. 5 is a flowchart diagram that illustrates the operation of the mobile terminal shown in FIG. 3 to select a mode of communication.

DETAILED DESCRIPTION OF THE INVENTION

[0041] FIG. 1 illustrates an example of a cellular telecommunication system in which the invention may be applied. In the telecommunication system of FIG. 1, various telecommunication services such as cellular voice calls, cellular video calls, data calls, facsimile transmissions, music

transmissions, still image transmissions, video transmissions, electronic message transmissions and electronic commerce may be performed between a mobile terminal **100** according to the present invention and other devices, such as another mobile terminal **106** or a stationary telephone **132**. It is to be noted that for different embodiments of the mobile terminal **100** and in different situations, different ones of the telecommunications services referred to above may or may not be available; the invention is not limited to any particular set of services in this respect.

[0042] The mobile terminals **100**, **106** are connected to a mobile telecommunications network **110** through RF links **102**, **108** via base stations **104**, **109**. The mobile telecommunications network **110** may be in compliance with any commercially available mobile telecommunications standard, such as GSM, UMTS, D-AMPS, CDMA2000, FOMA and TD-SCDMA.

[0043] A public switched telephone network (PSTN) **130** is connected to the mobile telecommunications network **110** in a familiar manner. Various telephone terminals, including the stationary telephone **132**, are connected to the PSTN **130**.

[0044] Preferably, the mobile terminal **100** has video telephony functionality and may thus perform video calls with another video telephony enabled mobile terminal **106** over the mobile telecommunications network **110**. In the illustrated example of FIG. 1, video telephony may for example be implemented according to 3GPP standards available on the world wide web under the address of <http://www.3gpp.org>.

[0045] An embodiment **300** of the mobile terminal **100** is illustrated in more detail in FIG. 3. The mobile terminal **300** comprises a speaker or earphone **302**, a microphone **305**, a display **303**, a camera **312** and a set of keys **304** which may include a keypad **304a** of common ITU-T type (alphanumeric keypad representing characters "0"-"9", "*", and "#") and certain other keys such as a "Send" key **304d**, an "End" key **304e**, soft keys **304b**, **304c** and a joystick **311**. Just like the prior art terminal **200** of FIGS. 2A and 2B, the mobile terminal **300** has video telephony functionality, but it has no dedicated video call key (like key **210** in the prior art terminal **200** of FIG. 2a). Instead, video telephony functionality is selected in this embodiment by long pressing a communication initiation element before calling a receiver. The communication initiation element is the input element that the user may use to set up communication with a remote receiver.

[0046] For example, when a user has completed entering a phone number **309** using the keypad **304**, the user may short-press on the send key **304d** to initiate a voice call to the entered phone number **309**. In this case, the communication initiation element is the send key **304d**. Similarly, a short press on the joystick **311** may also initiate a call. Correspondingly, a long press on the send key **304d** or the joystick **311** will instead result in a video call being initiated.

[0047] In another example, the user may use a phone book (contacts) application in the mobile terminal to locate somebody the user wishes to call. A short press on the send key **304d** or the joystick **311** will result in a voice call, while a long press on the send button **304d** or the joystick **311** will result in a video call. In one embodiment, the user may

configure a primary and secondary mode of communication per contact, wherein a short press on the communication initiation element will result in communication by a first communication means using the primary mode of communication and a long press will result in communication by a second communication means using the secondary mode of communication. In this embodiment, if the primary and secondary modes of communication are not configured for a contact, the default primary mode of communication is preferably voice telephony and the default secondary mode of communication is preferably video telephony. Note that not just voice or video communication, but any type of communication, including SMS, MMS, email and instant messaging, could potentially be configured as a primary or secondary mode of communication. Specifically, the present invention may be embodied in a mobile terminal which does not support video telephony.

[0048] In one embodiment, the left soft key **304b** (or right soft key **304c**) may be used as the communication initiation element, whereby a short-press and a long-press of the left soft key **304b** (or right soft key **304c**) may initiate two different modes of communication, such as voice communication and video communication.

[0049] The internal component and software structure of the mobile terminal **300** will now be described with reference to FIG. 4. The mobile terminal has a controller **400** which is responsible for the overall operation of the mobile terminal and is preferably implemented by any commercially available CPU ("Central Processing Unit"), DSP ("Digital Signal Processor") or any other electronic programmable logic device. The controller **400** has associated electronic memory **402** such as RAM memory, ROM memory, EEPROM memory, flash memory, or any combination thereof. The memory **402** is used for various purposes by the controller **400**, one of them being for storing data and program instructions for various software in the mobile terminal. The software includes a real-time operating system **420**, drivers for a man-machine interface (MMI) **434**, an application handler **432** as well as various applications. The applications include a video call handling application **450**, a conventional voice call handling application **460** as well as various other applications **470**, such as applications for sending SMS, MMS or email, an instant messaging application, a phone book (contacts) application, a calendar application, a control panel application, a camera application, a media player, one or more video games, a notepad application, etc.

[0050] The MMI **434** also includes one or more hardware controllers, which together with the MMI drivers cooperate with the display **436/303**, keypad **438/304** as well as various other I/O devices such as microphone, speaker, vibrator, ringtone generator, LED indicator, etc. As is commonly known, the user may operate the mobile terminal through the man-machine interface thus formed.

[0051] The software also includes various modules, protocol stacks, drivers, etc., which are commonly designated as **430** and which provide communication services (such as transport, network and connectivity) for an RF interface **406**, and optionally a Bluetooth interface **408** and/or an IrDA interface **410**. The RF interface **406** comprises an internal or external antenna as well as appropriate radio circuitry for establishing and maintaining a wireless link to a base station

(e.g. the link 102 and base station 104 in FIG. 1). As is well known to a man skilled in the art, the radio circuitry comprises a series of analogue and digital electronic components, together forming a radio receiver and transmitter. These components include, i.a., band pass filters, amplifiers, mixers, local oscillators, low pass filters, AD/DA converters, etc.

[0052] The mobile terminal also has a SIM card 404 and an associated reader. As is commonly known, the SIM card 404 comprises a processor as well as local work and data memory.

[0053] With reference to FIG. 5, the operation of the mobile terminal 300 for selecting a mode of communication by detecting actuation of the communication initiation element will now be described. In FIG. 5, it is assumed that the user has previously indicated, directly or indirectly, an identifier of an intended receiver such as a phone number with which to establish communication. For example, this may have been performed by entering the phone number directly, using the phone book (contacts) application, locating a phone number in an SMS or MMS message, browsing through a latest calls list, a call reminder from the calendar application, selecting a telephony URL in a browser, etc.

[0054] An input element controller, which is either a separate controller or part of a more general MMI controller in MMI module 434, detects in step 500 that the user has depressed the communication initiation element. In step 502, a timer is reset and started. In step 504 it is determined whether the communication initiation element is still depressed. If it is found that the actuation of the element has not ended, it is checked in step 505 if the current duration of the actuation, as given by the timer, exceeds a predetermined threshold or time period. In the described embodiment, the predetermined threshold is 400 milliseconds; in other embodiments it may preferably, but not necessarily, be set to a value between about 100 milliseconds and about 2 seconds. If the predetermined threshold is exceeded, the execution proceeds to step 510, which is described in more detail below.

[0055] If it is determined in step 505 that the current duration of the actuation of the communication initiation element not yet exceeds the predetermined threshold, the control is returned to step 504 to continue monitoring the actuation of the element.

[0056] If it is found in step 504 that the actuation of the communication initiation element has in fact ended, it is checked in step 506 if the duration of the now-ended actuation exceeds the predetermined threshold. If so, control is passed to step 510 (this is a rare situation which might occur if the user releases the element almost exactly after the lapse of the predetermined time period). Otherwise, the control is passed to step 508, in which the actuation of the communication initiation element is handled as a short-press.

[0057] In step 508, the primary mode of communication is determined. As explained in conjunction with FIG. 3 above, the primary (and secondary) modes of communication may preferably be stored in the phone book (contacts) application. Consequently, in this step it is performed a look-up in the phone book using the phone number provided by the user. If no primary mode of communication is found, either

because there is no contact with the provided phone number or because the matched contact has no primary mode of communication configured, the primary mode of communication is as a default set to be a voice call. As explained above, the primary mode of communication may be a voice call, a video call, an SMS, an MMS, an email, an instant message or any other form of communication supported by the mobile terminal.

[0058] Once the primary mode of communication has been determined, the application, or functionality within an application, responsible for that mode of communication is initiated in step 512 and the phone number is communicated to the application.

[0059] In step 510, the actuation of the communication initiation element is handled as a long-press, as determined in step 505, and the secondary mode of communication is determined. This is done in the same manner that the primary mode of communication is determined in step 508, with the difference that the default mode of communication for the secondary mode of communication is preferably a video call. In other words, if a secondary mode of communication is configured for the phone number in question, the configured mode of communication is used, otherwise a video call is considered to be the secondary mode of communication.

[0060] Once the secondary mode of communication has been determined, the application, or functionality within an application, responsible for that mode of communication is initiated in step 514 and the phone number is communicated to the application.

[0061] The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended patent claims.

1. A mobile terminal comprising:

first communication means capable of a first mode of communication;

second communication means capable of a second mode of communication;

a communication initiation element configured at least part of the time to accept input to initiate communication; and

a controller associated with said communication initiation element,

said controller being adapted to detect a user actuation of said communication initiation element and to discriminate between at least a first and a second type of said user actuation, and

said controller being further adapted to generate a control signal for initiating communication using said first communication means or said second communication means, depending on whether said user actuation is of said first type or said second type.

2. A mobile terminal as defined in claim 1, wherein said controller is adapted to discriminate between said first and

said second type of said user actuation by determining whether or not a duration of said user actuation exceeds a predetermined time period.

3. A mobile terminal as defined in claim 1, wherein said controller is further adapted to determine whether to generate a control signal for initiating communication using said first communication means or said second communication means based on said user actuation type and a preferred mode of communication associated with an intended receiver of communication.

4. A mobile terminal as defined in claim 3, wherein said preferred mode of communication is stored by a phone book application.

5. A mobile terminal as defined in claim 1, wherein said first communication means is selected from a group consisting of means for providing voice communication, means for providing video communication, means for providing SMS communication, means for providing MMS communication, means for providing e-mail communication and means for providing instant messaging communication.

6. A mobile terminal as defined in claim 1, wherein said second communication means is selected from a group consisting of means for providing voice communication, means for providing video communication, means for providing SMS communication, means for providing MMS communication, means for providing e-mail communication and means for providing instant messaging communication.

7. A mobile terminal as defined in claim 3, wherein if no preferred mode of communication is associated with said intended receiver of communication, said mobile terminal is adapted to generate a control signal to said first communication means if said first type of user actuation is determined, and to generate a control signal to said second communication means if said second type of user actuation is determined.

8. A mobile terminal as defined in claim 1, wherein said communication initiation element is an element selected from a group consisting of a dedicated send key, a soft key, a multi-way navigation key and a joystick.

9. A mobile terminal as defined in claim 1, wherein

said first and second modes of communication are voice communication and video communication, or vice versa;

said communication initiation element is a send key; and

said first and second types of said user actuation are short-press and long-press of said send key, or vice versa.

10. A mobile terminal as defined in claim 1, wherein said controller is further adapted to determine an identifier of an intended receiver of communication, and include said identifier of said intended receiver in said control signal.

11. A mobile terminal as defined in claim 10, wherein said controller is further adapted to determine said identifier of said intended receiver of communication from a source selected from a group consisting of a directly entered phone number, a phone book application, an SMS, a MMS, a latest calls list, a call reminder from a calendar application, and a telephony URL.

12. A method for initiating communication in a mobile terminal capable of providing at least a first mode of communication and a second mode of communication, said mobile terminal comprising a communication initiation element, said method involving the steps of:

detecting a user actuation of said communication initiation element;

discriminating between at least a first and a second type of said user actuation; and

generating a control signal for initiating communication using said first mode of communication or said second mode of communication, depending on whether said user actuation is of said first type or said second type.

13. A method as defined in claim 12, wherein said step of discriminating between at least a first and a second type of said user actuation involves determining whether or not a duration of said user actuation exceeds a predetermined time period.

14. A method as defined in claim 12, wherein said step of generating a control signal for initiating communication involves determining whether to generate a control signal for initiating communication using said first mode of communication or said second mode of communication based on said user actuation type and a preferred mode of communication associated with an intended receiver of communication.

15. A method as defined in claim 12, wherein said first mode of communication is a mode of communication selected from a group consisting of voice communication, video communication, SMS communication, MMS communication, e-mail communication and instant messaging communication.

16. A method as defined in claim 12, wherein said second mode of communication is a mode of communication selected from a group consisting of voice communication, video communication, SMS communication, MMS communication, e-mail communication and instant messaging communication.

17. A method as defined in claim 14, wherein if it is determined that no preferred mode of communication is associated with said intended receiver of communication, said mobile terminal generates a control signal for initiating communication using said first mode of communication if said first type of user actuation is detected and generates a control signal for initiating communication using said second mode of communication if said second type of user actuation is detected.

18. A method as defined in claim 12, wherein said first and second modes of communication are voice communication and video communication, or vice versa; said communication initiation element is a send key; and said first and second types of said user actuation are short-press and long-press of said send key, or vice versa.

19. A method as defined in claim 12, involving the steps of:

determining an identifier of an intended receiver of communication; and

including said identifier of said intended receiver in said control signal.

20. A method as defined in claim 19, wherein said

step of determining an identifier involves determining said identifier of said intended receiver of communication from a source selected from a group consisting of a directly entered phone number, a phone book

application, an SMS, a MMS, a latest calls list, a call reminder from a calendar application, and a telephony URL.

21. A computer program comprising software instructions that, when executed in a mobile terminal, performs the method according to claim 12.

* * * * *

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(54) **WIRELESS COMMUNICATIONS CIRCUITRY
WITH SIMULTANEOUS RECEIVE
CAPABILITIES FOR HANDLED
ELECTRONIC DEVICES**

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(57) **ABSTRACT**

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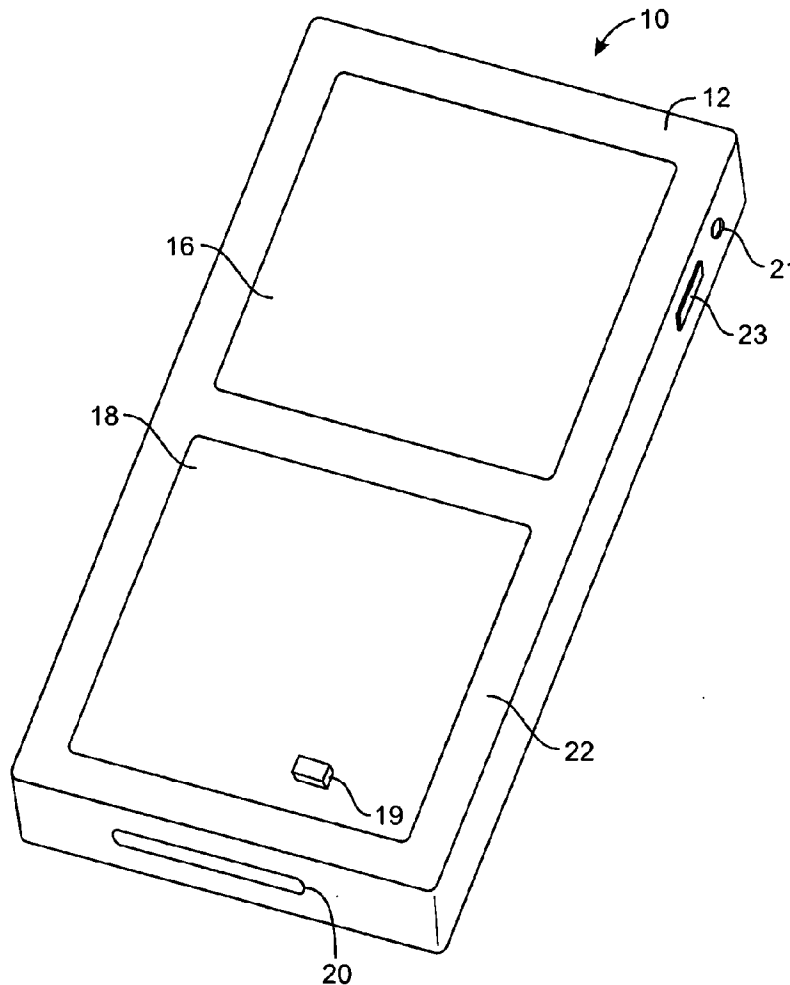
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Handheld electronic devices are provided that contain wireless communications circuitry. The wireless communications circuitry has simultaneous reception functions that allow the handheld devices to simultaneously receive multiple communications signals in a single communications band. The handheld electronic devices may include cellular telephones with music player functionality or other portable devices. The handheld electronic devices may have local wireless communications capabilities for supporting local wireless links such as WiFi and Bluetooth links. Using the simultaneous reception functions of the wireless communications circuitry, users of the handheld electronic devices can simultaneously receive signals such as WiFi and Bluetooth signals.



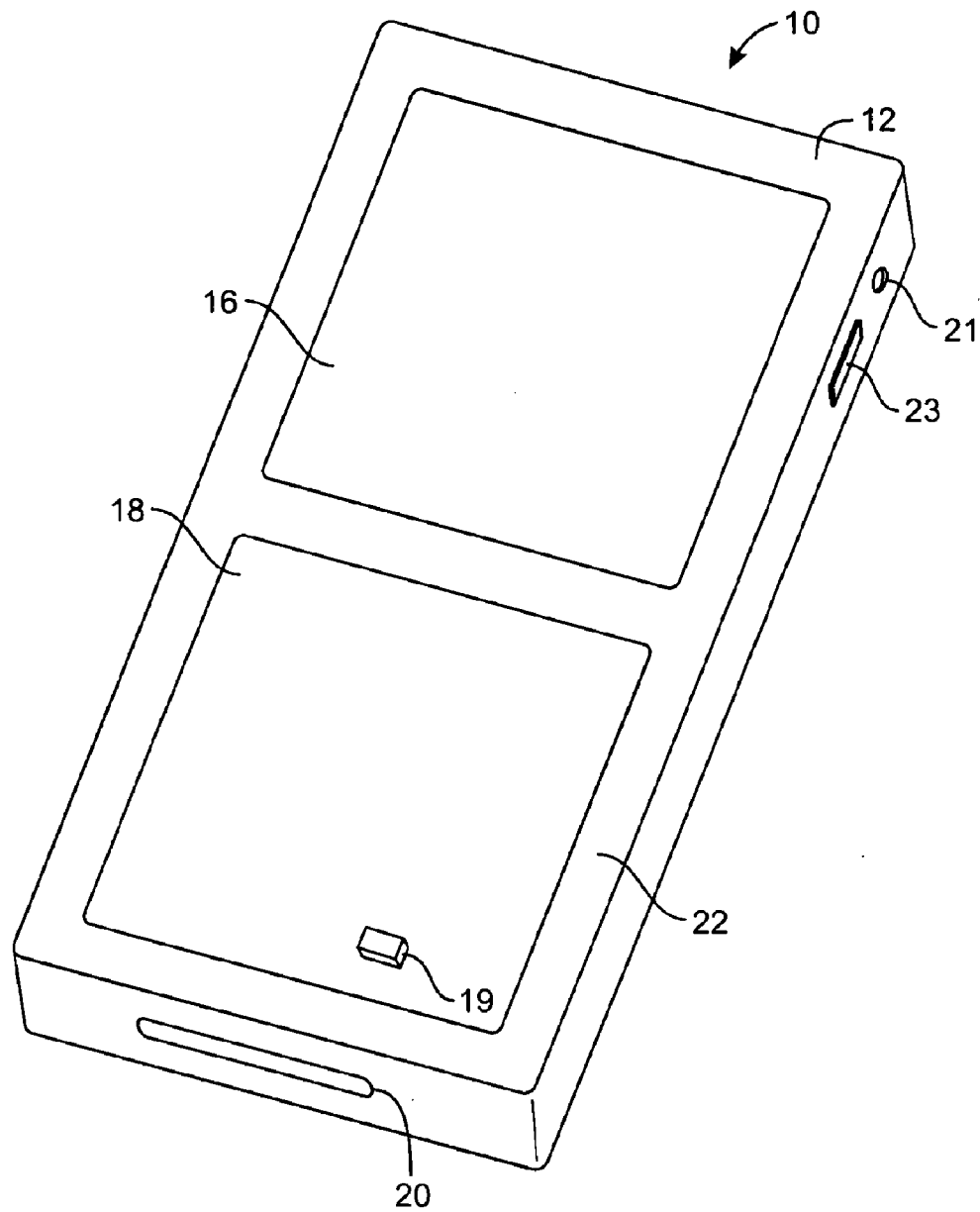


FIG. 1

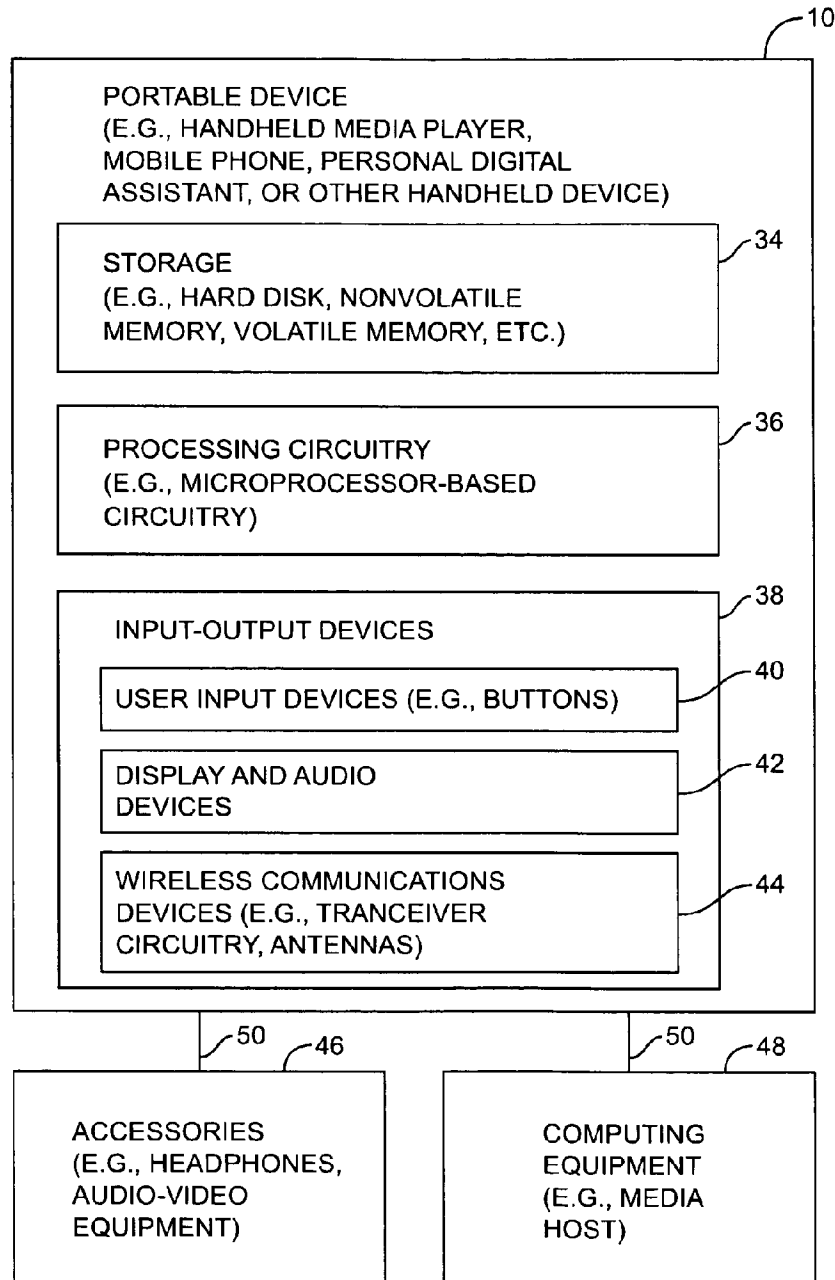
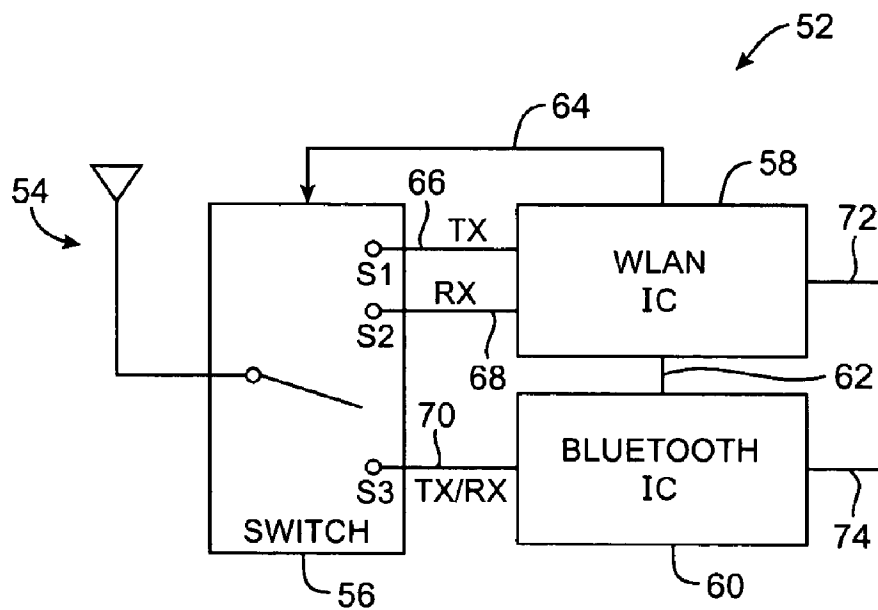


FIG. 2



(PRIOR ART)

FIG. 3

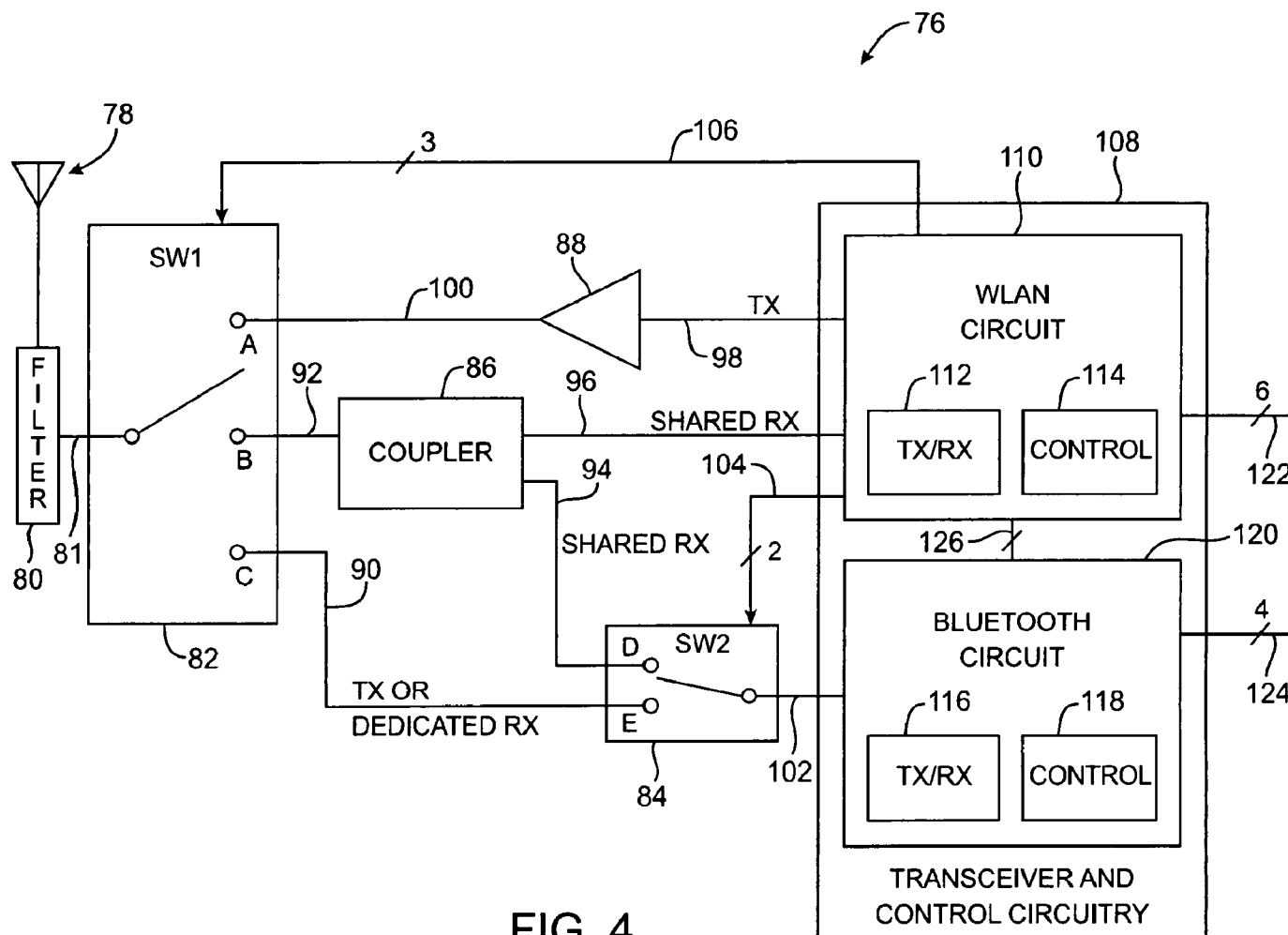


FIG. 4

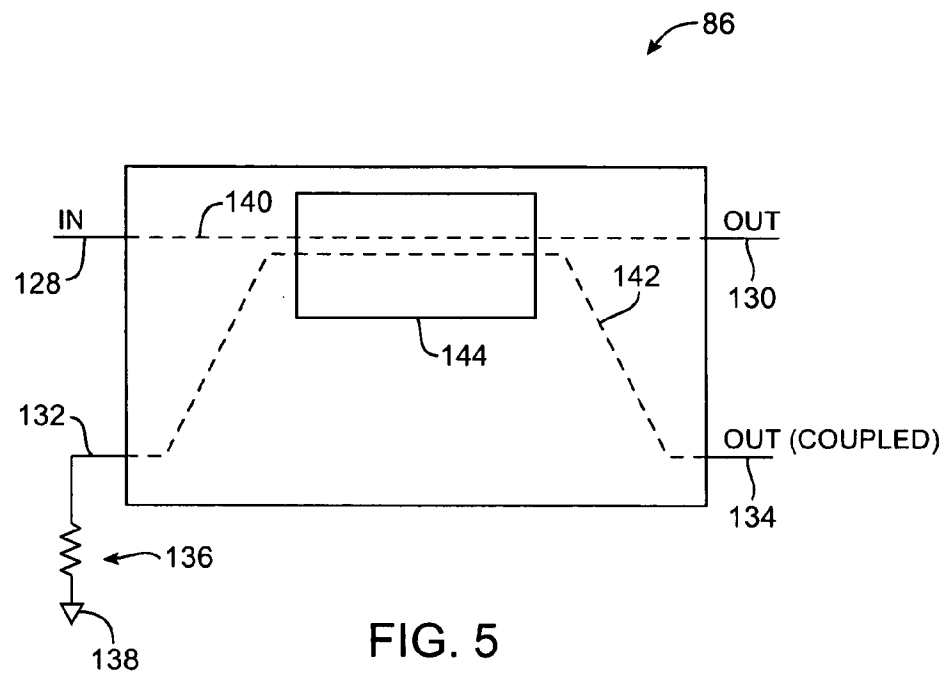


FIG. 5

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SW1			SW2		MODE
A	B	C	D	E	
1	0	0	X	X	WLAN TX
0	1	0	1	0	SHARED RX
0	0	1	0	1	BLUETOOTH TX OR DEDICATED RX

FIG. 6

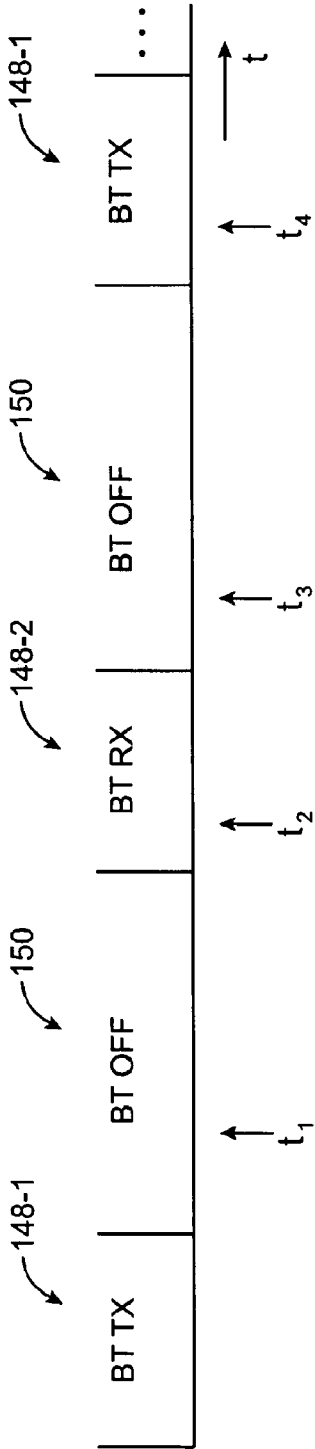


FIG. 7

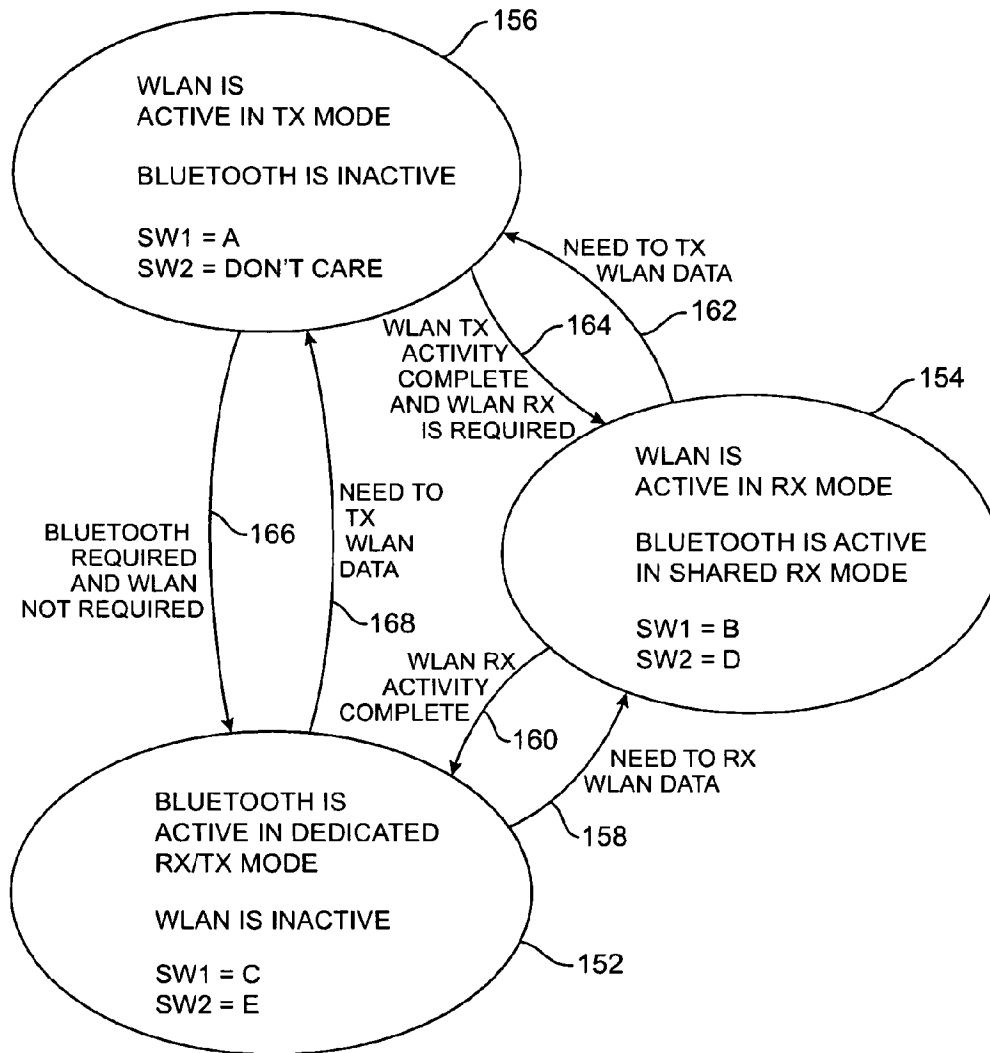


FIG. 8

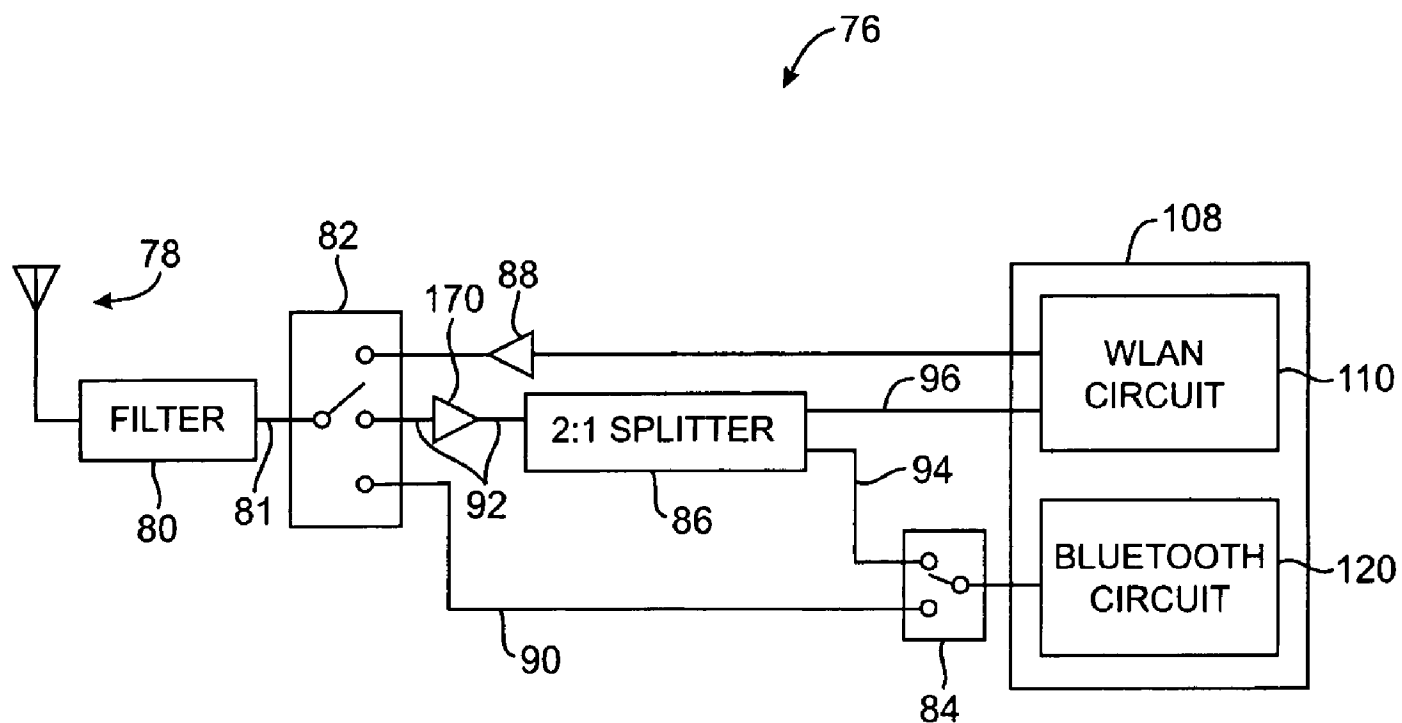


FIG. 9

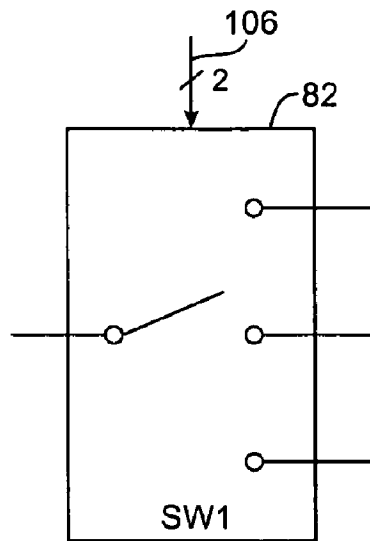


FIG. 10

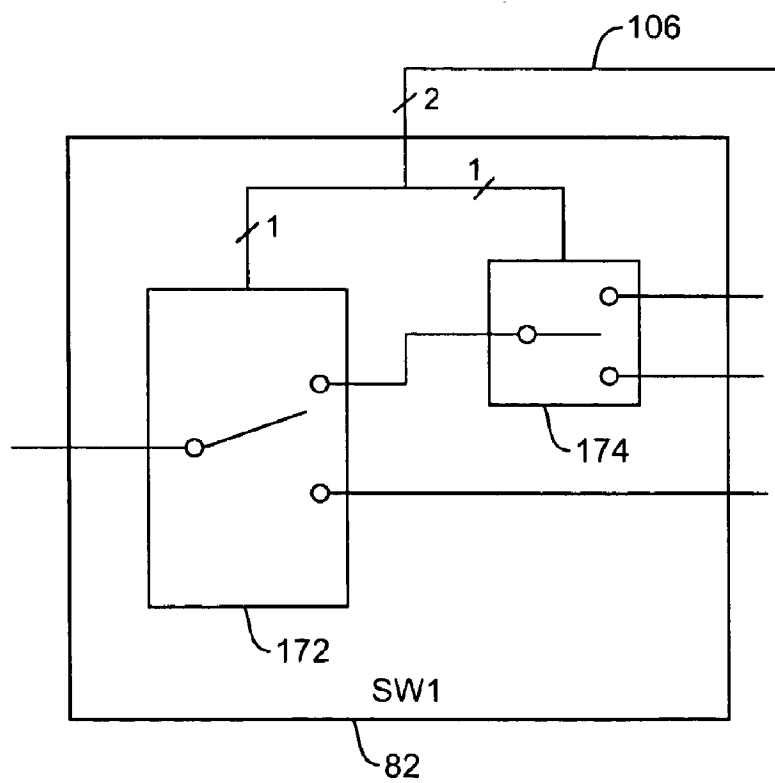


FIG. 11

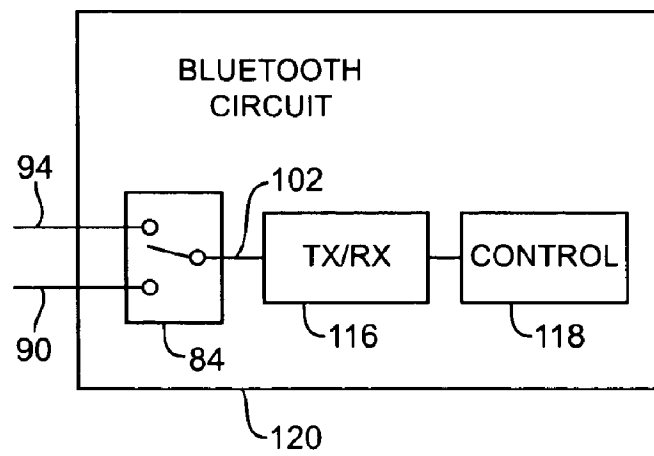


FIG. 12

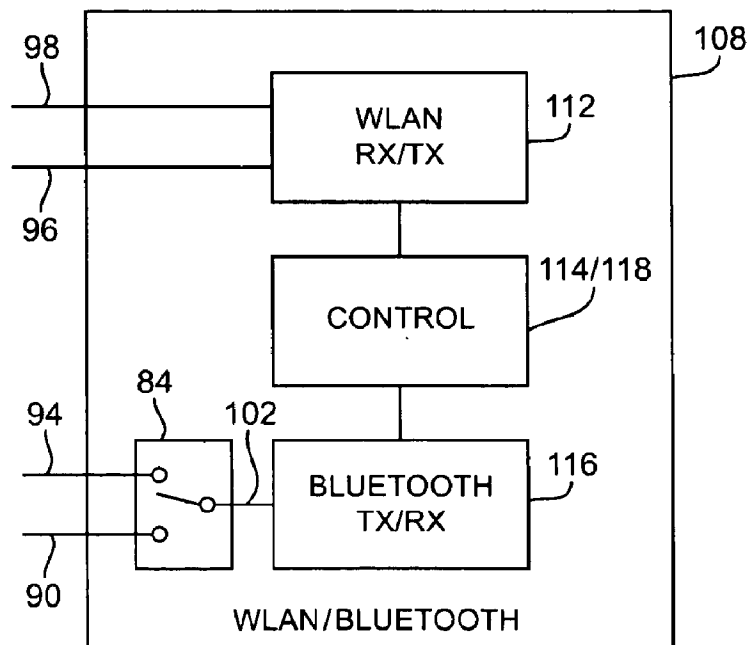


FIG. 13

WIRELESS COMMUNICATIONS CIRCUITRY WITH SIMULTANEOUS RECEIVE CAPABILITIES FOR HANDLED ELECTRONIC DEVICES

BACKGROUND

[0001] This invention relates generally to wireless communications circuitry, and more particularly, to wireless communications circuitry with simultaneous receive capabilities for handheld electronic devices.

[0002] Handheld electronic devices are becoming increasingly popular. Examples of handheld devices include handheld computers, cellular telephones, media players, and hybrid devices that include the functionality of multiple devices of this type.

[0003] Due in part to their mobile nature, handheld electronic devices are often provided with wireless communications capabilities. Handheld electronic devices may use long-range wireless communications to communicate with wireless base stations. For example, cellular telephones may communicate using cellular telephone bands at 850 MHz, 900 MHz, 1800 MHz, and 1900 MHz (e.g., the main Global System for Mobile Communications or GSM cellular telephone bands). Handheld electronic devices may also use short-range wireless communications links. For example, handheld electronic devices may communicate using the WiFi® (IEEE 802.11) band at 2.4 GHz and the Bluetooth® band at 2.4 GHz.

[0004] To satisfy consumer demand for small form factor wireless devices, manufacturers are continually striving to reduce the number of components that are used. For example, in some wireless designs a single antenna is shared by two transceivers. Because there is only a single antenna with this type of approach, device size is minimized.

[0005] It is not always desirable to share an antenna in a wireless device. In conventional shared antenna arrangements with two transceivers operating on a shared communications frequency, the two transceivers compete with each other for use of the antenna. If, for example, data is being received by one of the transceivers, data cannot be received by the other transceiver. This may lead to dropped data packets and service interruptions.

[0006] It would therefore be desirable to be able to provide improved wireless communications circuitry for wireless handheld electronic devices.

SUMMARY

[0007] In accordance with an embodiment of the present invention, a handheld electronic device with wireless communications circuitry is provided. The handheld electronic device may have cellular telephone, music player, or handheld computer functionality. The wireless communications circuitry may have multiple transceivers that share an antenna.

[0008] With one suitable arrangement, the wireless communications circuitry has first and second transceivers. The first transceiver may be, for example, a wireless local area network (WLAN) transceiver integrated circuit that handles IEEE 802.11 traffic. The second transceiver may be a Bluetooth transceiver. The first transceiver and second transceiver may operate in a common frequency band (e.g., a 2.4 GHz communications frequency band).

[0009] The wireless communications circuitry may have a radio-frequency coupler and switching circuitry. When it is desired to simultaneously receive incoming radio-frequency signals from the antenna with both the first transceiver and the second transceiver, the coupler is used to divide the incoming radio-frequency signals into first and second identical power-reduced versions of the incoming radio-frequency signals. These signals are simultaneously provided to the first and second transceivers in parallel.

[0010] The first and second versions of the incoming signals that are produced by the coupler may have the same signal power or may have different signal powers. With one suitable arrangement, the coupler is asymmetric, so that the signal that is diverted to the wireless local area network transceiver circuit has a relatively larger power than the signal that is diverted to the Bluetooth transceiver.

[0011] When it is desired to transmit WLAN data, the switching circuitry is adjusted appropriately and the WLAN transceiver is made active while the Bluetooth transceiver is made inactive. A power amplifier may be used to amplify outgoing transmitted WLAN data.

[0012] When it is desired to use the Bluetooth transceiver without using the WLAN transceiver, the WLAN transceiver is placed in an inactive state. When the WLAN transceiver is inactive, it is not necessary to receive data simultaneously with both the WLAN and Bluetooth circuits. As a result, the switching circuitry can be adjusted to bypass the coupler. With the coupler bypassed, Bluetooth data can be transmitted or Bluetooth data can be received. When receiving Bluetooth data in this way, there is a relatively larger signal strength, because the insertion loss of the coupler is avoided. If desired, an input amplifier may be placed upstream from the coupler to compensate for the coupler's insertion loss.

[0013] Further features of the invention, its nature and various advantages will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a perspective view of an illustrative handheld electronic device with wireless communications circuitry in accordance with an embodiment of the present invention.

[0015] FIG. 2 is a schematic diagram of an illustrative handheld electronic device with wireless communications circuitry in accordance with an embodiment of the present invention.

[0016] FIG. 3 is a schematic diagram of conventional wireless communications circuitry for a wireless electronic device.

[0017] FIG. 4 is a schematic diagram of illustrative wireless communications circuitry for a handheld electronic device in accordance with an embodiment of the present invention.

[0018] FIG. 5 is a schematic diagram of an illustrative coupler that may be used in wireless communications circuitry for a handheld electronic device in accordance with an embodiment of the present invention.

[0019] FIG. 6 is a table showing illustrative switch settings that may be used with wireless communications circuitry of the type shown in FIG. 4 in accordance with an embodiment of the present invention.

[0020] FIG. 7 is a timing diagram that illustrates wireless activity associated with using communications circuitry such

as the illustrative wireless communications circuitry of FIG. 4 in accordance with an embodiment of the present invention.

[0021] FIG. 8 is an illustrative state diagram showing how wireless communications circuitry in a handheld electronic device such as the wireless communications circuitry of FIG. 4 may be used to handle wireless data traffic associated with two different transceivers in accordance with an embodiment of the present invention.

[0022] FIG. 9 is a schematic diagram of illustrative wireless communications circuitry using a 2:1 splitter and low noise amplifier in an input data path in accordance with an embodiment of the present invention.

[0023] FIG. 10 is a schematic diagram of an illustrative three-way switch that may be used in wireless communications circuitry of the type shown in FIG. 4 in accordance with an embodiment of the present invention.

[0024] FIG. 11 is a schematic diagram of an illustrative three-way switch that has been implemented using two two-way switches and that may be used in wireless communications circuitry of the type shown in FIG. 4 in accordance with an embodiment of the present invention.

[0025] FIG. 12 is a schematic diagram of an illustrative Bluetooth transceiver and control circuit having an integrated two-way switch that may be used in wireless communications circuitry for a handheld electronic device in accordance with an embodiment of the present invention.

[0026] FIG. 13 is a schematic diagram of an illustrative wireless local area network (WLAN) and Bluetooth transceiver and control circuit that may be used in wireless communications circuitry for a handheld electronic device in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION

[0027] The present invention relates generally to wireless communications and more particularly, to wireless communications circuitry that supports antenna sharing in electronic devices such as portable electronic devices.

[0028] An illustrative portable electronic device in accordance with an embodiment of the present invention is shown in FIG. 1. Portable electronic devices such as illustrative portable electronic device 10 may be laptop computers or small portable computers such as those sometimes referred to as ultraportables. Portable electronic devices may also be somewhat smaller devices. Examples of smaller portable electronic devices include wrist-watch devices, pendant devices, headphone and earpiece devices, and other wearable and miniature devices.

[0029] With one suitable arrangement, the portable electronic devices are handheld electronic devices. Space is at a premium in handheld electronic devices, so antenna-sharing arrangements for handheld electronic devices can be particularly advantageous. The use of handheld devices is therefore generally described herein as an example, although any suitable electronic device may be used with the wireless communications functions of the present invention, if desired.

[0030] Handheld devices may be, for example, cellular telephones, media players with wireless communications capabilities, handheld computers (also sometimes called personal digital assistants), remote controllers, global positioning system (GPS) devices, and handheld gaming devices. The handheld devices of the invention may also be hybrid devices that combine the functionality of multiple conventional devices. Examples of hybrid handheld devices include a cellular telephone that includes media player functionality, a

gaming device that includes a wireless communications capability, a cellular telephone that includes game and email functions, and a handheld device that receives email, supports mobile telephone calls, and supports web browsing. These are merely illustrative examples. Device 10 may be any suitable portable or handheld electronic device.

[0031] Device 10 includes housing 12 and includes at least one antenna for handling wireless communications. Housing 12, which is sometimes referred to as a case, may be formed of any suitable materials including, plastic, wood, glass, ceramics, metal, or other suitable materials, or a combination of these materials. In some situations, case 12 may be a dielectric or other low-conductivity material, so that the operation of conductive antenna elements that are located in proximity to case 12 is not disrupted. In other situations, case 12 may be formed from metal elements. In scenarios in which case 12 is formed from metal elements, one or more of the metal elements may be used as part of the antenna(s) in device 10.

[0032] Any suitable type of antenna may be used to support wireless communications in device 10. Examples of suitable antenna types include antennas with resonating elements that are formed from a patch antenna structure, a planar inverted-F antenna structure, a helical antenna structure, etc. To minimize device volume, at least one of the antennas in device 10 may be shared between two transceiver circuits.

[0033] Handheld electronic device 10 may have input-output devices such as a display screen 16, buttons such as button 23, user input control devices 18 such as button 19, and input-output components such as port 20 and input-output jack 21. Display screen 16 may be, for example, a liquid crystal display (LCD), an organic light-emitting diode (OLED) display, a plasma display, or multiple displays that use one or more different display technologies. As shown in the example of FIG. 1, display screens such as display screen 16 can be mounted on front face 22 of handheld electronic device 10. If desired, displays such as display 16 can be mounted on the rear face of handheld electronic device 10, on a side of device 10, on a flip-up portion of device 10 that is attached to a main body portion of device 10 by a hinge (for example), or using any other suitable mounting arrangement.

[0034] A user of handheld device 10 may supply input commands using user input interface 18. User input interface 18 may include buttons (e.g., alphanumeric keys, power on-off, power-on, power-off, and other specialized buttons, etc.), a touch pad, pointing stick, or other cursor control device, a touch screen (e.g., a touch screen implemented as part of screen 16), or any other suitable interface for controlling device 10. Although shown schematically as being formed on the top face 22 of handheld electronic device 10 in the example of FIG. 1, user input interface 18 may generally be formed on any suitable portion of handheld electronic device 10. For example, a button such as button 23 (which may be considered to be part of input interface 18) or other user interface control may be formed on the side of handheld electronic device 10. Buttons and other user interface controls can also be located on the top face, rear face, or other portion of device 10. If desired, device 10 can be controlled remotely (e.g., using an infrared remote control, a radio-frequency remote control such as a Bluetooth remote control, etc.).

[0035] Handheld device 10 may have ports such as bus connector 20 and jack 21 that allow device 10 to interface with external components. Typical ports include power jacks to recharge a battery within device 10 or to operate device 10

from a direct current (DC) power supply, data ports to exchange data with external components such as a personal computer or peripheral, audio-visual jacks to drive headphones, a monitor, or other external audio-video equipment, etc. The functions of some or all of these devices and the internal circuitry of handheld electronic device can be controlled using input interface 18.

[0036] Components such as display 16 and user input interface 18 may cover most of the available surface area on the front face 22 of device 10 (as shown in the example of FIG. 1) or may occupy only a small portion of the front face 22. Because electronic components such as display 16 often contain large amounts of metal (e.g., as radio-frequency shielding), the location of these components relative to the antenna elements in device 10 should generally be taken into consideration. Suitably chosen locations for the antenna elements and electronic components of the device will allow the antenna of handheld electronic device 10 to function properly without being disrupted by the electronic components.

[0037] A schematic diagram of an embodiment of an illustrative handheld electronic device is shown in FIG. 2. Handheld device 10 may be a mobile telephone, a mobile telephone with media player capabilities, a handheld computer, a remote control, a game player, a global positioning system (GPS) device, a combination of such devices, or any other suitable portable electronic device.

[0038] As shown in FIG. 2, handheld device 10 may include storage 34. Storage 34 may include one or more different types of storage such as hard disk drive storage, nonvolatile memory (e.g., flash memory or other electrically-programmable-read-only memory), volatile memory (e.g., battery-based static or dynamic random-access-memory), etc.

[0039] Processing circuitry 36 may be used to control the operation of device 10. Processing circuitry 36 may be based on a processor such as a microprocessor and other suitable integrated circuits. With one suitable arrangement, processing circuitry 36 and storage 34 are used to run software on device 10, such as internet browsing applications, voice-over-internet-protocol (VOIP) telephone call applications, email applications, media playback applications, operating system functions, etc. Processing circuitry 36 and storage 34 may be used in implementing suitable communications protocols. Communications protocols that may be implemented using processing circuitry 36 and storage 34 include internet protocols, wireless local area network protocols (e.g., IEEE 802.11 protocols—sometimes referred to as WiFi®), protocols for other short-range wireless communications links such as the Bluetooth® protocol, etc.)

[0040] Input-output devices 38 may be used to allow data to be supplied to device 10 and to allow data to be provided from device 10 to external devices. Display screen 16 and user input interface 18 of FIG. 1 are examples of input-output devices 38.

[0041] Input-output devices 38 can include user input-output devices 40 such as buttons, touch screens, joysticks, click wheels, scrolling wheels, touch pads, key pads, keyboards, microphones, cameras, etc. A user can control the operation of device 10 by supplying commands through user input devices 40. Display and audio devices 42 may include liquid-crystal display (LCD) screens, light-emitting diodes (LEDs), and other components that present visual information and status data. Display and audio devices 42 may also include audio equipment such as speakers and other devices for cre-

ating sound. Display and audio devices 42 may contain audio-video interface equipment such as jacks and other connectors for external headphones and monitors.

[0042] Wireless communications devices 44 may include communications circuitry such as radio-frequency (RF) transceiver circuitry formed from one or more integrated circuits, power amplifier circuitry, passive RF components, one or more antennas, and other circuitry for handling RF wireless signals. Wireless signals can also be sent using light (e.g., using infrared communications).

[0043] Device 10 can communicate with external devices such as accessories 46 and computing equipment 48, as shown by paths 50. Paths 50 may include wired and wireless paths. Accessories 46 may include headphones (e.g., a wireless cellular headset or audio headphones) and audio-video equipment (e.g., wireless speakers, a game controller, or other equipment that receives and plays audio and video content). In one illustrative scenario, paths 50 may include a wireless Bluetooth path that is used to support communications between a Bluetooth headset (one of accessories 46) and device 10 and a wireless local area network (WLAN) path (e.g., a WiFi path) that is used to support communications between device 10 and computing equipment 48.

[0044] Computing equipment 48 may be any suitable computer. With one suitable arrangement, computing equipment 48 is a computer that has an associated wireless access point (router) or an internal or external wireless card that establishes a wireless connection with device 10. The computer may be a server (e.g., an internet server), a local area network computer with or without internet access, a user's own personal computer, a peer device (e.g., another handheld electronic device 10), or any other suitable computing equipment.

[0045] Wireless communications devices 44 may be used to support local and remote wireless links.

[0046] Examples of local wireless links include WiFi and Bluetooth links and wireless universal serial bus (USB) links. Because wireless WiFi links are typically used to establish data links with local area networks, links such as WiFi links are sometimes referred to as WLAN links. The local wireless links may operate in any suitable frequency band. For example, WLAN links may operate at 2.4 GHz or 5.6 GHz (as examples), whereas Bluetooth links may operate at 2.4 GHz. The frequencies that are used to support these local links in device 10 may depend on the country in which device 10 is being deployed (e.g., to comply with local regulations), the available hardware of the WLAN or other equipment with which device 10 is connecting, and other factors.

[0047] With one suitable arrangement, which is sometimes described herein as an example, device 10 communicates using both the popular 2.4 GHz WiFi bands (802.11(b) and/or 802.11(g)) and the 2.4 GHz Bluetooth band using the same antenna. In this type of configuration, the antenna is designed to operate at a frequency of 2.4 GHz, so the antenna is suitable for use with the 2.4 GHz radio-frequency signals that are used in connection with both the WiFi and Bluetooth communications protocols. Circuitry 44 may include a coupler and other suitable circuitry that allows WiFi and Bluetooth signals to be simultaneously received.

[0048] If desired, wireless communications devices 44 may include circuitry for communicating over remote communications links. Typical remote link communications frequency bands include the cellular telephone bands at 850 MHz, 900 MHz, 1800 MHz, and 1900 MHz, the global positioning system (GPS) band at 1575 MHz, and data service bands such

as the 3 G data communications band at 2170 MHz band (commonly referred to as UMTS or Universal Mobile Telecommunications System). In these illustrative remote communications links, data is transmitted over links 50 that are one or more miles long, whereas in short-range links 50, a wireless signal is typically used to convey data over tens or hundreds of feet.

[0049] These are merely illustrative communications bands over which wireless devices 44 may operate. Additional local and remote communications bands are expected to be deployed in the future as new wireless services are made available. Wireless devices 44 may be configured to operate over any suitable band or bands to cover any existing or new services of interest. If desired, multiple antennas and/or a broadband antenna may be provided in wireless devices 44 to allow coverage of more bands. At least one of the antennas (e.g., an antenna used for WiFi and Bluetooth communications at a common communications band frequency of 2.4 GHz) may be shared, as this helps reduce the size of wireless communications circuitry 44 and therefore reduces the size of device 10.

[0050] In conventional wireless electronic devices in which an antenna is shared between multiple communications bands, switching circuitry is used to switch between different transceiver modules. While this type of arrangement may be satisfactory in undemanding applications, a shared antenna arrangement that is based solely on switching circuitry can be inadequate in many contemporary situations.

[0051] Conventional wireless communications circuitry that is based on a traditional shared-antenna architecture is shown in FIG. 3. Wireless communications circuitry 52 includes antenna 54, which handles radio-frequency signals at a frequency of 2.4 GHz. Switch 56 selectively connects antenna 54 to switch port S1, S2, or S3. Ports S1 and S2 are connected to wireless local area network (WLAN) integrated circuit 58 by respective paths 66 and 68. Port S3 is connected to Bluetooth integrated circuit 66 by path 70. Wireless local-area-network integrated circuit 58 includes a WiFi transceiver and control circuitry. Bluetooth integrated circuit 66 includes a Bluetooth transceiver and control circuitry. WLAN circuit 58 and Bluetooth circuit 66 communicate with each other using handshaking path 62. Paths 72 and 74 are used to provide data and control signals to circuits 58 and 66.

[0052] WLAN circuit 58 controls the state of switch 56 using control path 64. When it is desired to transmit WLAN data, switch 56 is connected to position S1, so that data can be transmitted from WLAN integrated circuit 58 to antenna 54 over path 66. Switch 56 is connected to position S2 when it is desired to receive data with WLAN circuit 58. In position S2, signals from antenna 54 are conveyed through switch 56 and over path 68 to WLAN circuit 58. Switch 56 has a third position—S3—that is used when it is desired to transmit or receive Bluetooth signals. In transmit mode, Bluetooth signals are transmitted to antenna 54 via transmit/receive path 70 and switch 56. In receive mode, Bluetooth signals that have been received by antenna 54 are conveyed to Bluetooth integrated circuit 66 by switch 56 and path 70.

[0053] The conventional arrangement of FIG. 3 allows antenna 54 to be shared. WiFi traffic is handled by WLAN circuit 58 and Bluetooth traffic is handled by Bluetooth circuit 60. Switch 56 can be switched between WLAN circuit 58 and Bluetooth circuit 60, so that circuit 58 and 60 are able to take turns using antenna 54. Although WLAN circuit 58 and Bluetooth circuit 60 cannot be used at the same time, switch 56 can

be switched quickly, so that circuits 58 and 60 are able to use antenna 54 in rapid succession.

[0054] Because switch 56 cannot be connected to both WLAN circuit 58 and Bluetooth circuit 60 at the same time, it is necessary to prioritize. Consider, as an example, the situation in which a user of communications circuitry 52 is browsing the internet using WLAN circuit 58, while using Bluetooth connection 60 to control a wireless mouse. In this type of situation, circuits 58 and 60 can decide to favor the Bluetooth connection over the WiFi connection. Whenever it is desired to connect to both the WLAN circuit 58 and the Bluetooth circuit 60 at the same time, the Bluetooth circuit is favored.

[0055] With this type of prioritization scheme, the user of circuit 52 will be able to use the wireless mouse without noticeable interruption. However, because the Bluetooth connection is favored over the WLAN connection, WLAN data packets will occasionally be dropped.

[0056] For example, consider the situation in which Bluetooth activity arises while requested internet data is being transmitted to WLAN circuit 58. To handle the Bluetooth activity, switch 56 will be connected to switch position S3. Bluetooth data has priority over WLAN data, so the fact that WLAN circuit 58 is in the midst of receiving internet data is immaterial and switch 56 is switched to position S3 to ensure that the Bluetooth activity is handled properly.

[0057] Placing switch 56 in position S3 allows Bluetooth circuit 60 to transmit and receive Bluetooth data as needed. However, setting switch 56 to position S3 prevents WLAN circuit 58 from receiving the internet data that is being transmitted. As a result, some internet data packets will be at least temporarily lost.

[0058] Data interruptions such as these are unavoidable using the conventional wireless communications circuitry arrangement of FIG. 3, because it is not possible to set switch 56 to a position that allows simultaneous reception of WLAN and Bluetooth data. Although data interruptions such as these may be acceptable in noncritical applications, in some situations the impact of lost data may be severe. For example, a user might desire to use WLAN circuit 58 to support a voice-over-internet-protocol (VOIP) telephone call over the internet, while using a Bluetooth headset. In real-time audio applications such as these, a high quality connection is critical. Using conventional wireless communications circuit 52 of FIG. 3 may cause the VOIP voice signal to break up due to lost data packets.

[0059] Wireless communications circuitry 76 in accordance with an illustrative embodiment of the present invention is shown in FIG. 4. As shown in FIG. 4, wireless communications circuitry 76 has an antenna 78. A filter 80 and a direct current (DC) blocking capacitor (not shown) may be used to filter out spurious noise from received signals. Circuitry 76 includes switches 82 and 84 (labeled S1 and S2, respectively). Path 81 connects filter 80 and switch SW1.

[0060] Switch SW1 may be set to one of three positions, which are labeled A, B, and C in FIG. 4. Switch SW2 may be set to one of two positions, which are labeled D and E in FIG. 4.

[0061] The states of switches SW1 and SW2 are controlled by control signals provided on control lines 106 and 104, respectively. With one suitable arrangement, the control signals are generated by transceiver and control circuitry 108.

[0062] Transceiver and control circuitry 108 may contain two or more transceiver circuit such as wireless local-area-

network (WLAN) circuit 110 and Bluetooth circuit 120. For clarity, a two-transceiver-circuit embodiment is described herein.

[0063] WLAN transceiver circuit 110 may be, for example, an integrated circuit that handles IEEE 802.11(b) or 802.11(g) signals using WiFi transceiver 112 and control circuitry 114. Bluetooth transceiver circuit 120 may be, for example, an integrated circuit that handles Bluetooth signals using Bluetooth transceiver 116 and control circuitry 118. Circuits 110 and 120 may be provided as two separate integrated circuits that are mounted on a common circuit board, using a single integrated circuit, or using more than two integrated circuits. With one suitable arrangement, WLAN circuit 110 is an integrated circuit such as Part No. 88W8686 of Marvell Semiconductor, Inc. of Santa Clara, Calif. and Bluetooth circuit 120 is an integrated circuit such as a BlueCore4 device of CSR, Cambridge, England. Circuits 110 and 120 may communicate with each other over handshaking path 126.

[0064] Each transceiver circuit handles a different type of wireless data traffic. In the example of FIG. 4, WiFi traffic is handled using wireless local-area-network (WLAN) circuit 110 and Bluetooth traffic is handled using Bluetooth circuit 120. Each of these circuits interfaces with antenna 78 and with circuitry on the handheld electronic device in which wireless communications circuitry 76 is being used.

[0065] Data and control paths 122 and 124 may be used to form communications paths between transceiver and control circuitry 108 and other circuitry on device 10 such as processing circuitry 36 of FIG. 2. Paths 122 and 124 may be used to support any suitable type of data communications. As an example, path 122 may be used to convey control and user data using the so-called secure digital input/output (SDIO) protocol. Paths 124 and 122 may be formed of any suitable number of conductive lines. In the example of FIG. 4, path 122 has been formed from a six-line bus and path 124 has been formed from a four-line bus. This is merely illustrative. Paths such as paths 122 and 124 may be formed from single lines or using larger or smaller busses of multiple lines, if desired.

[0066] WLAN circuit 110 may transmit WLAN data wirelessly using data transmission path 98. With the illustrative configuration of FIG. 4, path 98 can be dedicated to conveying transmitted data for circuit 110. Transmitted data on path 98 may be amplified by power amplifier 88. Corresponding amplified versions of the transmitted data signals on path 98 may be provided to switch SW1 over path 100. To transmit data over antenna 78, control signals may be issued on path 106 that direct switch SW1 to connect path 100 to path 81 (switch position A). When switch SW1 has been placed in position A and WLAN data is being transmitted over path 98, wireless communications circuitry 76 of FIG. 4 may be referred to as operating in WLAN TX mode. In this mode of operation, Bluetooth operations are temporarily blocked, so the position of switch SW2 is immaterial.

[0067] Circuitry 76 may have a radio-frequency coupler 86. An illustrative coupler 86 is shown in FIG. 5. As shown in FIG. 5, coupler 86 may be implemented as a four-terminal device. Terminal 128 may be used to receive radio-frequency input signals. Termination resistor 136 may be coupled between ground 138 and termination resistor terminal 132. During operation, input signals that are provided to input terminal 128 are divided into two corresponding output signals on outputs 130 and 134. As shown by box 144, coupler 86 typically contains a network of components such as induc-

tors, capacitors, and resistors that cause input signals on path 140 to become coupled onto path 142. As a result, part of the input signal power to coupler 86 is diverted to output terminal 134, while part of the input signal power to coupler 86 passes through to output 130. The splitting ratio of the coupler 86 is typically fixed by the values of the components in network 144. With one suitable arrangement, the output signal on output terminal 130 is -1.8 dB lower in power than the power of the input signal on input terminal 128 and the power of the coupled output signal on output terminal 134 is -6.5 dB lower than the power of the input signal on terminal 128. As this example demonstrates, coupler 86 typically exhibits some internal loss.

[0068] In this example, the coupler produces output signals that differ by about 4.7 dB. One output signal, which represents a first power-reduced version of the received radio-frequency input signals to the coupler, has an output power that is 4.7 dB larger than the other output signal, which represents a second power-reduced version of the received radio-frequency input signals to the coupler. The use of a coupler that produces output signals with -1.8 dB and -6.5 dB outputs is, however, merely illustrative. For example, coupler 86 may produce output signals in which the power for output 130 is equal to the power of output 134 or output signals in which the power for output 130 is greater than the power of output 134. An advantage of using arrangements in which the output signal power for output 130 is greater than the output signal power for output 134 is that this may divert a relatively small amount of power away from WLAN circuit 110, thereby helping to preserve proper operation of WLAN circuit 110 under adverse conditions. In general, the power of the signal on output 130 may be any suitable amount greater than the power of the signal on output 134. For example, the power of the signal on output 130 may be 1 dB greater than the power of the signal on output 134 or more. As another example, the power of the signal on output 130 may be 2 dB or more greater than the power of the signal on output 134. As a further example, the power of the signal on output 130 may be 3 dB or more greater than the power of the signal on output 134.

[0069] As shown in FIG. 4, coupler 86 may be used to provide wireless communications circuitry 76 with support for a shared receive mode (shared RX mode). In shared RX mode, control signals may be issued on control path 106 that place switch SW1 in position B and control signals may be issued on control path 104 that place switch SW2 in position D. With switches SW1 and SW2 configured in this way, data that is received on antenna 78 and that is provided to coupler 86 via shared input path 92 is split into two identical parts, each having a potentially different signal power. A first part of the received data signal is passed to WLAN circuit 110 on shared received data path 96. A second part of the received data signal is passed to Bluetooth circuit 120 via shared receive data path 94, switch SW2, and path 102. The data of the signals provided to circuits 110 and 120 in the shared receive mode is the same, but the powers of the signals is dictated by the coupler 86 and may be different. For example, the power of the data signal on path 96 may be -1.8 dB with respect to the incoming data signal on path 92, whereas the power of the data signal on path 102 may be -6.5 dB with respect to the incoming data signal on path 92 (as an example).

[0070] During use of wireless communications circuitry 76 of FIG. 4 in simultaneous receive mode, WLAN circuit 110

and Bluetooth circuit 120 may be in simultaneous operation, each handle respective portions of the incoming data. For example, when incoming data is an internet protocol (IP) packet destined for WLAN circuit 110, that packet may be received and processed by WLAN circuit 110. When incoming data is Bluetooth data destined for Bluetooth circuit 120, Bluetooth circuit 120 may receive and process the incoming data. Circuits 110 and 120 may be presented with both types of data (WLAN and Bluetooth), but can digitally recognize which type of data is being received and can therefore respond only as appropriate. Although signal strengths are reduced somewhat by the presence of coupler 86, simultaneous data reception is supported, so that demanding applications such as VOIP calls and Bluetooth audio can be simultaneously supported, without concern for lost data packets.

[0071] When it is desired to transmit Bluetooth data or when it is desired to receive Bluetooth data on a dedicated path without using coupler 86 (i.e., to benefit from a higher Bluetooth input signal power when simultaneous reception of WLAN data is not required), control signals may be issued on control path 106 that place switch SW1 in position C and control signals may be issued on control path 104 that place switch SW2 into position E. In this configuration, which is sometimes referred to as Bluetooth TX or dedicated RX mode, path 90 may be used for Bluetooth data transmission or for dedicated Bluetooth data reception.

[0072] During Bluetooth transmission, transmitted Bluetooth data from Bluetooth circuit 120 is provided to switch SW2 over path 102. Switch SW2, which is set to position E, conveys the outgoing Bluetooth data to switch SW1 over path 90. Switch SW1, which is set to position C, conveys the outgoing Bluetooth data to antenna 78 over path 81 and filter 80.

[0073] During dedicated RX mode, received Bluetooth data from antenna 78 and filter 80 is received by switch SW1 over path 81. Switch SW1 is set to position C, so switch SW1 directs the incoming Bluetooth data to switch SW2 over dedicated RX path 90. Because coupler 86 is bypassed in this mode, the signal power on path 90 is larger than it would have been had the signal been split by coupler 86. Because the signal power of the incoming Bluetooth signal is relatively high, it may exhibit a good signal-to-noise ratio. Switch SW2 is set to position E during dedicated RX mode, so the incoming Bluetooth data is routed to Bluetooth circuit 120 via path 102.

[0074] FIG. 6 contains a table that illustrates switch settings involved during the operation of wireless communications circuitry 76 of FIG. 4. In table 146, an entry of "0" indicates that a corresponding switch position is not being used, an entry of "1" indicates that a corresponding switch position is being used, and an entry of "X" indicates a don't care bit (the position of the switch is immaterial).

[0075] As shown in table 146, during WLAN TX mode, switch SW1 is set to position A, whereas the setting of switch SW2 is immaterial. In WLAN TX mode, WLAN circuit 110 is active and transmits WLAN data using antenna 78.

[0076] During shared RX mode, WLAN circuit 110 and Bluetooth circuit 120 are active simultaneously. Switch SW1 is set to position B, whereas switch SW2 is set to position D. In shared RX mode, circuit 110 and circuit 120 receive signals with somewhat reduced powers, but because both circuits are simultaneously active, incoming data is not lost. The type of coupler 86 that is used in the shared RX path influences the signal powers received by WLAN circuit 110 and Bluetooth

circuit 120. In general, any suitable ratio of output powers may be produced by coupler 86.

[0077] An advantage to using a coupler arrangement in which relatively more of the outgoing signal power is directed to WLAN circuit 110 than to Bluetooth circuit 120 is that this type of arrangement favors the WLAN circuit over the Bluetooth circuit. WLAN links are often formed over larger distances than Bluetooth links and may therefore require more assistance in maintaining good signal quality. Bluetooth links are often formed with equipment that is in the immediate vicinity of device 10 and may therefore require relatively less assistance in maintaining good signal quality. On balance, it is therefore often preferred to use a coupler 86 that produces an output signal on path 96 that has more power than the corresponding output signal on path 94.

[0078] Transceiver circuits such as circuits 110 and 120 in transceiver and control circuitry 108 of FIG. 4 may be used to support any suitable protocols. The use of circuits that support WiFi and Bluetooth links are being described as an example. FIG. 7 illustrates how circuits such as circuits 110 and 120 may handle WLAN traffic and Bluetooth audio traffic. In the example of FIG. 7, time is plotted on the horizontal axis. According to Bluetooth audio protocol specifications, Bluetooth circuit 120 will be active in Bluetooth time slots 148-1 and 148-2. During Bluetooth operations, Bluetooth circuit 120 alternates between transmitting data and receiving data. The Bluetooth time slots are labeled "BT TX" (148-1) and "BT RX" (148-2) to indicate whether Bluetooth circuit 120 is transmitting or receiving Bluetooth data. During time slots 150, Bluetooth circuit 120 is inactive, as indicated by the labels "BT OFF" in time slots 150.

[0079] With conventional wireless communications circuitry of the type shown in FIG. 3, WLAN operations are blocked completely during the active Bluetooth time slots. As a result, with conventional circuitry 52 of FIG. 3, WLAN data that is sent to circuitry 52 at a time such as time t_2 or at a time such as time t_4 in FIG. 7 will be lost. Conventional circuitry 52 only allows WLAN data to be successfully transmitted or received at times such as time t_1 or time t_3 , when Bluetooth integrated circuit 60 of FIG. 3 is inactive. Particularly in environments in which a premium is placed on low-latency and negligible packet loss, such as when supporting VOIP telephone calls, conventional arrangements of the type shown in FIG. 3 can be disadvantageous.

[0080] Wireless communications circuitry 76 of the type shown in FIG. 4 can be used to support a simultaneous RX mode, which allows WLAN circuit 110 and Bluetooth circuit 120 to receive incoming data at the same time. Because both WLAN circuit 110 and Bluetooth circuit 120 can be active and receiving data at the same time, WLAN data can be received at times such as time t_2 in FIG. 7 as well as times such as times t_1 and t_3 . Unlike conventional circuitry that blocks WLAN data during BT RX time slots, wireless communications circuitry 76 can be used to receive WLAN data during BT RX time slots. As a result, the amount of WLAN data that is blocked due to simultaneous Bluetooth activity is minimized. In applications such as VOIP telephone calls, where it is desirable to minimize data packet loss, the quality of the VOIP service that device 10 can deliver may be improved significantly when using the simultaneous receive functions of wireless communications circuitry 76.

[0081] A state diagram illustrating modes in which device 10 and wireless communications circuitry 76 may operate is shown in FIG. 8. The embodiment of wireless communica-

tions circuitry 76 that is described in connection with the state diagram of FIG. 8 has a first transceiver that handles wireless local area network (WLAN) communications, also sometimes referred to as WiFi communications or IEEE 802.11 communications and has a second transceiver is used to handle Bluetooth communications. This type of arrangement is merely illustrative. In general, wireless communications circuitry 76 and transceiver and control circuitry 108 can be used to support any suitable communications protocols. The description of WLAN and Bluetooth communications protocols is an example.

[0082] As shown in FIG. 8, wireless communications circuitry 76 and device 10 may operate in at least three states, state 152, state 154, and state 156.

[0083] In state 152, Bluetooth circuit 120 is active in Bluetooth TX or dedicated RX mode, whereas WLAN circuit 110 is inactive. State 152 corresponds to the third row in table 146 of FIG. 6. In state 152, switch SW1 is in position C and switch SW2 is in position E. When Bluetooth circuit 120 is in transmit mode, a radio-frequency transmitter circuit in transceiver 116 is used to generate outgoing Bluetooth data (e.g., data that has been received via path 124). The transmitted Bluetooth data is conveyed to antenna 78 via path 102, switch SW2, path 90, switch SW1, path 81, filter 80, and antenna 78. An example of a time during which Bluetooth data is being transmitted by circuitry 76 is time t_4 in BT TX slot 148-1 of FIG. 7. When Bluetooth circuit 120 is in dedicated RX mode, Bluetooth that is received from antenna 78 is conveyed to a receiver in transceiver 116 via antenna 78, filter 80, path 81, switch SW1, path 90, switch SW2, and path 102. Bluetooth data may be received over the dedicated RX path 90 in this way at any suitable time (see, e.g., time t_2 in BT RX time slot 148-2 of FIG. 7).

[0084] Circuits such as circuit 108 and processing circuitry 36 may have one or more internal clocks. For example, Bluetooth circuit 120 and WLAN circuit 110 may have each have an internal clock or may access a shared system clock. Using timing information from the clock circuitry and protocols implemented in processing circuitry 36 and circuits 110 and 120, circuits 110 and 120 and processing circuitry 36 can make decisions on when to switch between different modes of operation in wireless communications circuitry 76. Consider, as an example, a situation in which WLAN circuit 110 is in a sleep state. At a particular time (or when a particular set of conditions are satisfied), the WLAN circuit 110 wakes up to check for incoming data (as an example). As indicated by line 158, when the WLAN circuit wakes up to receive WLAN data, wireless communications circuitry 76 transitions from state 152 to state 154.

[0085] During transition 158, WLAN circuit 110 issues control signals for switch SW1 on path 106 that set switch SW1 to position B. WLAN circuit 110 also issues control signals on path 104 that set switch SW2 to position D. Making these adjustments causes signals from antenna 78 to be diverted through coupler 86. Part of the incoming signal power is directed to WLAN circuit 110 over shared RX path 96 and part of the incoming signal power is directed to Bluetooth circuit 120 over shared RX path 94 and path 102. Because of the presence of coupler 86, the incoming signal power is reduced somewhat. However, both circuits 110 and 120 are able to receive the incoming signal at the same time. Because both WLAN circuit 110 and Bluetooth circuit 120 are able to simultaneously receive incoming radio-frequency signals, state 154 is sometimes referred to as shared RX

mode. State 154 corresponds to the second row of table 146 in FIG. 6. In the diagram of FIG. 7, time t_2 in BT RX slot 148-2 may be associated with state 154.

[0086] When wireless communications circuitry 76 and/or processor 36 determines that WLAN circuit 110 has completed its necessary WLAN receiving activities (i.e., when no data needs to be received or when receive operations are finished), wireless communications circuitry 76 can transition back to state 152, as indicated by arrow 160. During transition 160, WLAN circuit 110 issues control signals for switch SW1 on path 106 that set switch SW1 to position C and issues control signals on path 104 that set switch SW2 to position E. In state 152, WLAN circuit 110 is inactive and Bluetooth circuit 120 is either transmitting Bluetooth signals or is receiving signals over dedicated RX path 90. By switching the receive path from shared RX path 94 back to dedicated RX path 90, coupler 86 is bypassed and Bluetooth circuit 120 is assured of receiving high-quality incoming data.

[0087] During state 154, WLAN circuit 110 is active and Bluetooth circuit 120 is active in shared RX mode. In state 154, when wireless communications circuitry 76 determines that WLAN circuit 110 needs to transmit data, wireless communications circuitry 76 transitions to state 156, as indicated by transition line 162. As an example, WLAN circuit 110 may need to transmit an acknowledgement packet. To make this transmission, the WLAN circuit 110 may wait until Bluetooth receive operations have been completed (e.g., when a BT RX slot 148-2 has just finished). At this point, Bluetooth circuit 120 becomes inactive.

[0088] As shown in FIG. 8, in state 156, WLAN circuit 110 is active and is transmitting data. Bluetooth circuit 120 is inactive. During transition 162, control signals are issued on path 106 that set switch SW1 to position A. When switch SW1 is in position A, transmitted WLAN data from WLAN circuit 110 is passed to power amplifier 88 via TX path 98. Amplifier 88 amplifies the transmitted signal and provides the amplified version of the transmitted signal to switch SW1 over path 100. The signal passes through switch SW1, is filtered by filter 80, and is transmitted wirelessly over antenna 78.

[0089] The position of switch SW2 is generally not critical in state 156, because no signals can be received or transmitted through switch SW2 so long as switch SW1 is in position A. Nevertheless, it may be desirable to set switch SW2 to position E as a default. In this position, switch SW2 defines a low-loss path for transmitting and receiving data from Bluetooth circuit 120. By placing switch SW2 in position E in state 156, switch SW2 will be ready to use in the event that wireless communications circuitry 76 transitions back to state 152.

[0090] When in state 156, wireless communications circuitry 76 can transition back to state 154 once WLAN transmission activity is complete, as indicated by line 164. Wireless communications circuitry 76 makes transition 164 when WLAN circuit 120 is needed to receive data. In state 154, WLAN circuit 120 may be used to receive data while Bluetooth circuit 120 again becomes active in shared RX mode. During transition 164, control signals are issued on path 106 that place switch SW1 in state B and control signals are issued on path 104 that place switch SW2 in position D.

[0091] When in state 156, wireless communications circuitry 76 can also transition to state 152, as indicated by transition line 166. Wireless communications circuitry 76 makes transition 166 when Bluetooth operations are required, but WLAN operations are not required. For example, a clock in WLAN circuit 110 may be used to determine that BT OFF

slot 150 has expired. When a BT OFF slot expires, Bluetooth operations may be required. If WLAN circuit 110 is not needed for receiving data, wireless communications circuitry 76 can transition to state 152, as indicated by line 166.

[0092] During transition 166, control signals are issued for switch SW1 on path 106 that set switch SW1 to position C. Control signals are issued on path 104 that set switch SW2 to position E. In state 152, WLAN circuit 110 is inactive and Bluetooth circuit 120 is either transmitting Bluetooth signals or is receiving signals over dedicated RX path 90. By switching the receive path from shared RX path 94 back to dedicated RX path 90 during transition 166, coupler 86 is bypassed and Bluetooth circuit 120 is assured of receiving high-quality incoming data.

[0093] While in state 152, it may become necessary to use WLAN circuit 110 to transmit data. For example, processing circuitry 36 may have data that is to be transferred over a wireless local area network with which device 10 is in communication. To transmit the data using WLAN circuit 110, wireless communications circuitry 166 transitions to state 156, as indicated by line 168. During transition 168, control signals are issued that place switch SW1 in position A. This connects WLAN transmit path 100 to antenna 78 and allows WLAN circuit 110 to transmit the desired data. The state of switch SW2 in state 156 is immaterial to the operation of WLAN circuit 110, but, if desired, may be left in position E to facilitate a transition back to state 152 after the WLAN data has been transmitted.

[0094] FIG. 9 shows an embodiment of wireless communications circuitry 76 in which coupler 86 has been implemented using a coupler that has an even splitting ratio. With this type of arrangement, incoming signals on path 92 are divided into two parts for respective paths 94 and 96. Because the power of the divided input signals on paths 94 and 96 is equal, couplers of this type are sometimes referred to as 2:1 splitters. Although shown as a 2:1 splitter in FIG. 9, coupler 86 may produce any suitable ratio of output powers on its outputs, if desired.

[0095] In the embodiment of FIG. 9, wireless communications circuitry 76 has an input amplifier interposed in path 92. Input amplifier 170 may, for example, be a radio-frequency amplifier of the type that is sometimes referred to as a low noise amplifier (LNA). The gain of input amplifier 170 helps to offset the power loss that arises from the use of coupler 86. With one suitable arrangement, the gain of input amplifier 170 may be set to compensate almost exactly for the loss of coupler 86. With this type of arrangement, if the loss imposed by coupler 86 is -4 dB to -4.5 dB on each output path (as an example), the gain of input amplifier 170 may be set to +8-9 dB, so that amplifier 170 overcomes the insertion loss of coupler 86. This is merely an illustrative configuration for amplifier 170 and coupler 86. In general, coupler 86 may exhibit any suitable associated insertion loss and amplifier 170 may have any suitable gain level to mitigate the loss imposed by coupler 86. If desired, one or more input amplifiers such as amplifier 170 may be used in wireless communications circuitry 76 and such amplifiers may be placed in other suitable input paths (e.g., path 96).

[0096] Switches such as three-way switch SW1 and two-way switch SW2 may be implemented using any suitable switching hardware. With one suitable arrangement, switch SW1 may be implemented using a single pole three throw (SP3T) switch that is controlled by control signals provided on a two-line control bus as shown in FIG. 10. If desired,

three-way switch SW1 may be implemented using two two-way switches 172 and 174, as shown in FIG. 11.

[0097] FIG. 12 shows how switches may be incorporated into transceiver and control circuitry 108. In the example of FIG. 12, Bluetooth circuit 120 includes switching functionality in the form of two-way switch 84. Transceiver 116 and control circuitry 118 may be used to send and receive data. Signals may be conveyed between switch 84 and transceiver 116 over path 102.

[0098] Circuits such as WLAN circuit 110 and Bluetooth circuit 120 may be provided using one or more integrated circuits. With one suitable arrangement, WLAN circuit 110 is provided using one or more integrated circuits and Bluetooth circuit 120 is provided using one or more integrated circuits. With another suitable arrangement, which is illustrated in FIG. 13, the functions of WLAN circuit 110 and Bluetooth circuit 120 are integrated into a common integrated circuit (WLAN/Bluetooth transceiver and control circuit 108). When two transceivers are integrated in this fashion, a single control block may be used for processing and control. In the example of FIG. 13, WLAN/Bluetooth integrated circuit 108 includes WLAN transceiver 112 and Bluetooth transceiver 116, which are controlled by a common control block 114/118. This type of arrangement may be used with a separate two-way switch, such as switch SW2 of FIG. 4, or may be used with an integrated two-way switch, such as switch 84 of FIG. 13. If desired, the functionality of other components such as switch 82, coupler 86, and amplifiers 88 and 170 may be integrated with circuitry of the type shown in FIG. 13 in the form of one or more integrated circuits.

[0099] The foregoing is merely illustrative of the principles of this invention and various modifications can be made by those skilled in the art without departing from the scope and spirit of the invention.

What is claimed is:

1. Wireless communications circuitry comprising:

transceiver circuitry comprising a first transceiver circuit and a second transceiver circuit, wherein the first and second transceiver circuits communicate using different communications protocols and a common radio-frequency band;

an antenna that handles radio-frequency signals in the common radio-frequency band; and

a radio-frequency coupler comprising an input and first and second outputs, wherein when the wireless communications circuitry is operated in a first mode, the input receives radio-frequency signals from the antenna and simultaneously provides corresponding first and second reduced-power versions of the received radio-frequency signals to the first and second outputs, respectively, wherein the first reduced-power version of the received radio-frequency signals is received by the first transceiver circuit, and wherein the second reduced-power version of the received radio-frequency signals is received by the second transceiver circuit.

2. The wireless communications circuitry defined in claim 1, further comprising a switch that is connected to the antenna and that has at least first and second positions, wherein when the wireless communications circuitry is operated in the first mode, the switch is placed in the second position to route radio-frequency signals from the antenna to the input of the coupler and wherein when the wireless communications circuitry is operated in a second mode, the switch is placed in the

first position to route radio-frequency signals that have been transmitted from the first transceiver to the antenna.

3. The wireless communications circuitry defined in claim 1, further comprising a switch that is connected to the antenna and that has at least first, second, and third positions, wherein:

when the wireless communications circuitry is operated in the first mode, the switch is placed in the second position to route radio-frequency signals from the antenna to the input of the coupler;

when the wireless communications circuitry is operated in a second mode, the switch is placed in the first position to route radio-frequency signals that have been transmitted from the first transceiver to the antenna; and

when the wireless communications circuitry is operated in a third mode, the switch is placed in the third position so that the antenna is coupled to the second transceiver.

4. The wireless communications circuitry defined in claim 1, further comprising a first switch that is connected to the antenna and that has at least first, second, and third positions and a second switch that is connected to the second transceiver and that has at least first and second positions, wherein:

when the wireless communications circuitry is operated in the first mode, the first switch is placed in its second position to route radio-frequency signals from the antenna to the input of the coupler and the second switch is placed in its first position to route signals from the second output of the coupler to the second transceiver;

when the wireless communications circuitry is operated in a second mode, the first switch is placed in its first position to route radio-frequency signals that have been transmitted from the first transceiver to the antenna; and

when the wireless communications circuitry is operated in a third mode, the first switch is placed in its third position and the second switch is placed in its second position so that the antenna is coupled to the second transceiver through the first and second switches.

5. The wireless communications circuitry defined in claim 1, further comprising a power amplifier, a first switch that is connected to the antenna and that has at least first, second, and third positions, and a second switch that is connected to the second transceiver and that has at least first and second positions, wherein:

when the wireless communications circuitry is operated in the first mode, the first switch is placed in its second position to route radio-frequency signals from the antenna to the input of the coupler and the second switch is placed in its first position to route signals from the second output of the coupler to the second transceiver;

when the wireless communications circuitry is operated in a second mode, the first switch is placed in its first position to route radio-frequency signals that have been transmitted from the first transceiver to the antenna through the power amplifier; and

when the wireless communications circuitry is operated in a third mode, the first switch is placed in its third position and the second switch is placed in its second position so that the antenna is coupled to the second transceiver through the first and second switches.

6. A wireless handheld electronic wireless device comprising:

storage that stores data;

processing circuitry coupled to the storage that generates data for wireless transmission and that processes wirelessly received data; and

wireless communications circuitry, wherein the wireless communications circuitry comprises:

transceiver circuitry comprising a first transceiver circuit and a second transceiver circuit, wherein the first and second transceiver circuits communicate using different communications protocols and a common radio-frequency frequency band;

an antenna that handles radio-frequency signals in the common radio-frequency frequency band; and

a radio-frequency coupler comprising an input and first and second outputs, wherein when the wireless communications circuitry is operated in a first mode, the input receives radio-frequency signals from the antenna and simultaneously provides corresponding first and second versions of the received radio-frequency signals to the first and second outputs, respectively, wherein the first version of the received radio-frequency signals is received by the first transceiver circuit, and wherein the second version of the received radio-frequency signals is received by the second transceiver circuit.

7. The wireless handheld electronic wireless device defined in claim 6 wherein the first transceiver comprises a wireless local area network (WLAN) transceiver circuit.

8. The wireless handheld electronic wireless device defined in claim 6 wherein the second transceiver comprises a Bluetooth transceiver circuit.

9. The wireless handheld electronic wireless device defined in claim 6 wherein the first transceiver comprises a wireless local area network (WLAN) transceiver circuit and the second transceiver comprises a Bluetooth transceiver circuit.

10. The wireless handheld electronic wireless device defined in claim 6 further comprising a radio-frequency amplifier coupled between the antenna and the input of the coupler.

11. Wireless communications circuitry comprising:

a first wireless transceiver circuit that transmits and receives according to a first communications protocol in a given radio-frequency communications frequency band;

a second wireless transceiver circuit that transmits and receives according to a second communications protocol in the given radio-frequency communications frequency band, wherein the first and second communications protocols are different;

an antenna;

a radio-frequency coupler;

switching circuitry that is responsive to control signals and that routes radio-frequency signals to and from the antenna, wherein the wireless communications circuitry is operative in at least first, second, and third modes of operation, wherein:

in the first mode of operation, the first wireless transceiver circuit is active and transmits radio-frequency signals through the switching circuitry and the antenna without passing through the coupler;

in the second mode of operation, the first and second wireless transceiver circuit are both active and receive respective first and second versions of identical radio-frequency signals through the coupler; and

in the third mode of operation, the first wireless transceiver circuit is inactive and the second wireless transceiver is active.

12. The wireless communications circuitry defined in claim 11 wherein the switching circuitry comprises a switch having at least a first position in which the switch routes the radio-frequency signals transmitted from the first transceiver to the antenna in the first mode of operation and a second position in which the switch routes the radio-frequency signals from the antenna to the coupler in the second mode of operation.

13. The wireless communications circuitry defined in claim 11 wherein:

the switching circuitry comprises a switch having at least a first position in which the switch routes the radio-frequency signals transmitted from the first transceiver to the antenna in the first mode of operation and a second position in which the switch routes the radio-frequency signals from the antenna to the coupler in the second mode of operation;

the coupler has first and second outputs; and

during the second mode of operation, the first wireless transceiver circuit receives the first version of the radio-frequency signals from the first output of the coupler and the second wireless transceiver circuit receives the second version of the radio-frequency signals from the second output of the coupler.

14. The wireless communications circuitry defined in claim 11 wherein:

the switching circuitry comprises a switch having at least a first position in which the switch routes the radio-frequency signals transmitted from the first transceiver to the antenna in the first mode of operation and a second position in which the switch routes the radio-frequency signals from the antenna to the coupler in the second mode of operation;

the coupler has first and second outputs;

during the second mode of operation, the first wireless transceiver circuit receives the first version of the radio-frequency signals from the first output of the coupler and the second wireless transceiver circuit receives the second version of the radio-frequency signals from the second output of the coupler;

the first version and second version of the radio-frequency signals have respective first and second signal powers; and

the first signal power is greater than the second signal power.

15. The wireless communications circuitry defined in claim 11 wherein:

the switching circuitry comprises a switch having at least a first position in which the switch routes the radio-frequency signals transmitted from the first transceiver to the antenna in the first mode of operation and a second position in which the switch routes the radio-frequency signals from the antenna to the coupler in the second mode of operation;

the coupler has first and second outputs;

during the second mode of operation, the first wireless transceiver circuit receives the first version of the radio-frequency signals from the first output of the coupler and the second wireless transceiver circuit receives the second version of the radio-frequency signals from the second output of the coupler;

the first version and second version of the radio-frequency signals have respective first and second signal powers; and

the first signal power is greater than the second signal power by at least 3 dB.

16. Wireless communications circuitry comprising:

a first wireless transceiver circuit that transmits and receives according to a first communications protocol in a 2.4 GHz radio-frequency communications band;

a second wireless transceiver circuit that transmits and receives according to a second communications protocol in the 2.4 GHz radio-frequency communications band, wherein the first and second communications protocols are different;

an antenna that operates in the 2.4 GHz radio-frequency communications band;

a radio-frequency coupler;

switching circuitry that is responsive to control signals and that routes radio-frequency signals to and from the antenna, wherein the wireless communications circuitry is operative in at least first and second modes, wherein: in the first mode of operation, the first wireless transceiver circuit is active and transmits radio-frequency signals through the switching circuitry and the antenna without passing through the coupler; and in the second mode of operation, the first and second wireless transceiver circuit are both active and receive respective first and second versions of identical radio-frequency signals through the coupler.

17. The wireless communications circuitry defined in claim 16 further comprising a power amplifier that amplifies the signals that are transmitted by the first wireless transceiver circuit in the first mode of operation, wherein the wireless communications circuitry is operative in at least a third mode and wherein in the third mode of operation the first wireless transceiver circuit is inactive and the second wireless transceiver is active.

18. The wireless communications circuitry defined in claim 16 further comprising a power amplifier that amplifies the signals that are transmitted by the first wireless transceiver circuit in the first mode of operation, wherein the wireless communications circuitry is operative in at least a third mode, and wherein in the third mode of operation the first wireless transceiver circuit is inactive and the second wireless transceiver is active, and wherein the first wireless transceiver comprises a wireless local area network transceiver circuit.

19. The wireless communications circuitry defined in claim 16 further comprising:

a power amplifier that amplifies the signals that are transmitted by the first wireless transceiver circuit in the first mode of operation; and

a single pole three throw switch in the switching circuitry, wherein the wireless communications circuitry is operative in at least a third mode, wherein in the third mode of operation the first wireless transceiver circuit is inactive and the second wireless transceiver is active, and wherein the first wireless transceiver comprises a wireless local area network transceiver circuit.

20. The wireless communications circuitry defined in claim 16 wherein the switching circuitry comprises a first switch having at least first, second, and third positions and a second switch having at least first and second positions, the wireless communications circuitry further comprising:

a power amplifier that amplifies the signals that are transmitted by the first wireless transceiver circuit in the first mode of operation, wherein the wireless communications circuitry is operative in at least a third mode in

which the first wireless transceiver circuit is inactive and the second wireless transceiver is active, wherein in the first mode of operation the first switch is in its first position, wherein in the second mode of operation the first switch is in its second position and the second switch is in its first position, and wherein in the third mode of operation the first switch is in its third position and the second switch is in its second position.

21. A method for controlling a wireless handheld electronic device with wireless communications circuitry having a first wireless transceiver, a second wireless transceiver, an antenna, a radio-frequency coupler, and switching circuitry, comprising:

when it is desired to transmit wireless data through the antenna from the first wireless transceiver, placing the wireless communications circuitry in a first mode of operation in which the first wireless transceiver circuit is active and transmits radio-frequency signals through the switching circuitry and the antenna without passing through the coupler; and

when it is desired to simultaneously receive wireless data with both the first wireless transceiver and the second wireless transceiver, placing the wireless communications circuitry in a second mode of operation in which the first and second wireless transceiver circuit are both active and receive respective first and second versions of identical radio-frequency signals from the antenna through the coupler.

22. The method defined in claim 21, wherein the first wireless transceiver circuit and the second wireless transceiver circuit operate according to different communications protocols, the method further comprising:

amplifying the transmitted radio-frequency signals from the first wireless transceiver circuit through a power amplifier when the wireless communications circuitry is in the first mode.

23. The method defined in claim 21, the method further comprising:

when in the first mode, transmitting the wireless data from the first wireless transceiver circuit according to a wireless local area network protocol; and

when in a third mode of operation, transmitting wireless data from the second wireless transceiver circuit according to a protocol that is different than the wireless local area network protocol.

24. The method defined in claim 21 further comprising:

when it is desired to transmit data with the second wireless transceiver, placing the wireless communications circuitry in a third mode of operation in which the first wireless transceiver circuit is inactive and the second wireless transceiver is active and is transmitting data through the switching circuitry.

25. The method defined in claim 21 further comprising:

when it is desired to receive data with the second wireless transceiver while not receiving data with the first wireless transceiver, placing the wireless communications circuitry in a third mode of operation in which the first wireless transceiver circuit is inactive and the second wireless transceiver is active and is receiving data through the switching circuitry without passing through the coupler.

26. A method for using wireless communications circuitry in a handheld wireless device comprising:

storing data in storage on the portable wireless device; with processing circuitry that is coupled to the storage, generating data for wireless transmission and processing wirelessly received data;

with an antenna and a first transceiver circuit in the wireless communications circuitry, communicating wirelessly in a communications frequency band according to a first communications protocol;

with the antenna and a second transceiver circuit in the wireless communications circuitry, communicating wirelessly in the communications frequency band according to a second communications protocol that is different than the first communications protocol; and

when it is desired to simultaneously receive data with both the first and the second transceivers in a simultaneous receive mode, distributing radio-frequency signals from the antenna simultaneously to the first and second transceivers.

27. The method defined in claim 26 further comprising:

when it is desired to transmit wireless data through the antenna from the first transceiver, placing the wireless communications circuitry in a wireless local area network transmit mode of operation in which the first transceiver is active and transmits radio-frequency signals through the antenna.

28. The method defined in claim 26 further comprising:

when it is desired to receive wireless data through the antenna with only the second transceiver, placing the wireless communications circuitry in a dedicated receive mode of operation in which the first transceiver is inactive and the second transceiver is active and receiving radio-frequency signals through the antenna.

29. The method defined in claim 26 further comprising:

when it is desired to transmit wireless data through the antenna from the first transceiver, placing the wireless communications circuitry in a wireless local area network transmit mode of operation in which the first transceiver is active and transmits radio-frequency signals through the antenna; and

when it is desired to receive wireless data through the antenna with only the second transceiver, placing the wireless communications circuitry in a dedicated receive mode of operation in which the first transceiver is inactive and the second transceiver is active and receiving radio-frequency signals through the antenna.

30. The method defined in claim 26 further comprising:

when it is desired to transmit wireless data through the antenna from the first transceiver, placing the wireless communications circuitry in a wireless local area network transmit mode of operation in which the first transceiver is active and transmits radio-frequency signals through the antenna; and

when it is desired to transmit wireless data through the antenna with the second transceiver, placing the wireless communications circuitry in a Bluetooth transmission mode of operation in which the second transceiver is active and transmitting Bluetooth radio-frequency signals through the antenna.

* * * * *

EXHIBIT 1034



US 20050034169A1

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Maeda et al. (43) **Pub. Date: Feb. 10, 2005**(54) **INFORMATION PROCESSING SYSTEM,
INFORMATION PROCESSING APPARATUS
AND METHOD, RECORDING MEDIUM, AND
PROGRAM****Publication Classification**(76) Inventors: Satoru Maeda, Kanagawa (JP);
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Okazaki, Kanagawa (JP); Katsutoshi
Sakao, Kanagawa (JP)(51) **Int. Cl.⁷** H04N 7/173; H04N 7/00;
H04N 7/16; H04N 11/00;
H04N 5/44
(52) **U.S. Cl.** 725/131; 348/725; 725/151Correspondence Address:
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FROMMER LAWRENCE & HAUG LLP
745 Fifth Avenue
New York, NY 10151 (US)(57) **ABSTRACT**

The present invention propose an broadcast reception system, wherein a program reception control apparatus is connected to Internet via a network interface to which a terminal apparatus carrying by a user. The broadcast received at an antenna is selected by a tuner, A/D converted, compressed at a compression unit, and encrypted at an encryption unit. The encrypted data from the encryption unit changed to packets at packet creation unit, and transmitted to the terminal apparatus via the network interface. A User is able to view the program in real time before the end of the broadcast for the program by successively creating data based on the received data, and transmitting them.

(21) Appl. No.: 10/876,233

(22) Filed: Jun. 24, 2004

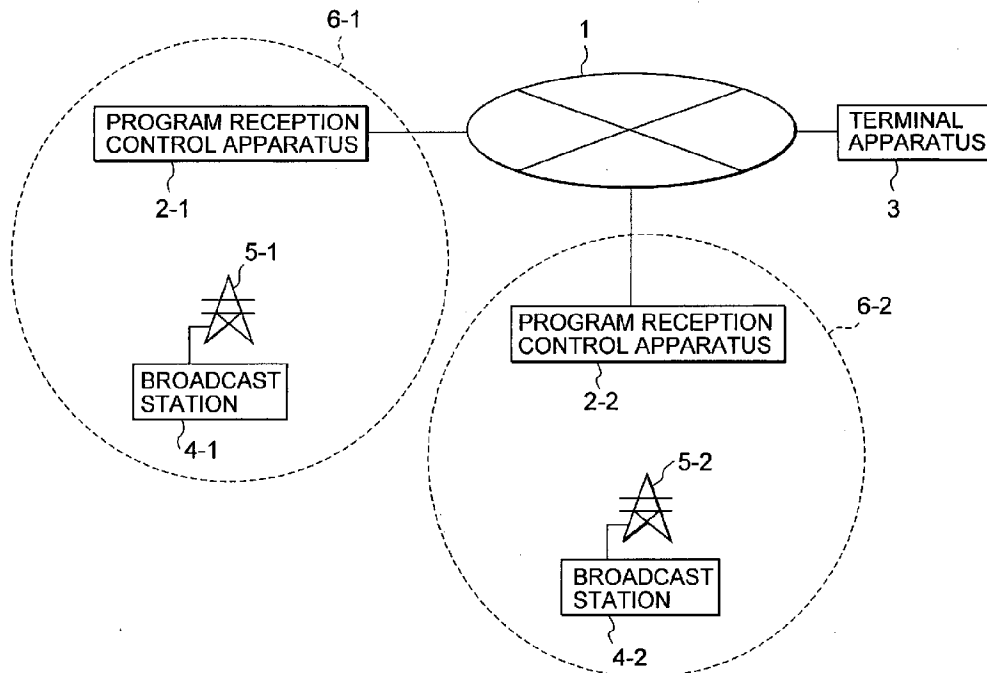
(30) **Foreign Application Priority Data**Jun. 26, 2003 (JP) 2003-183138
Apr. 13, 2004 (JP) 2004-118251

FIG. 1

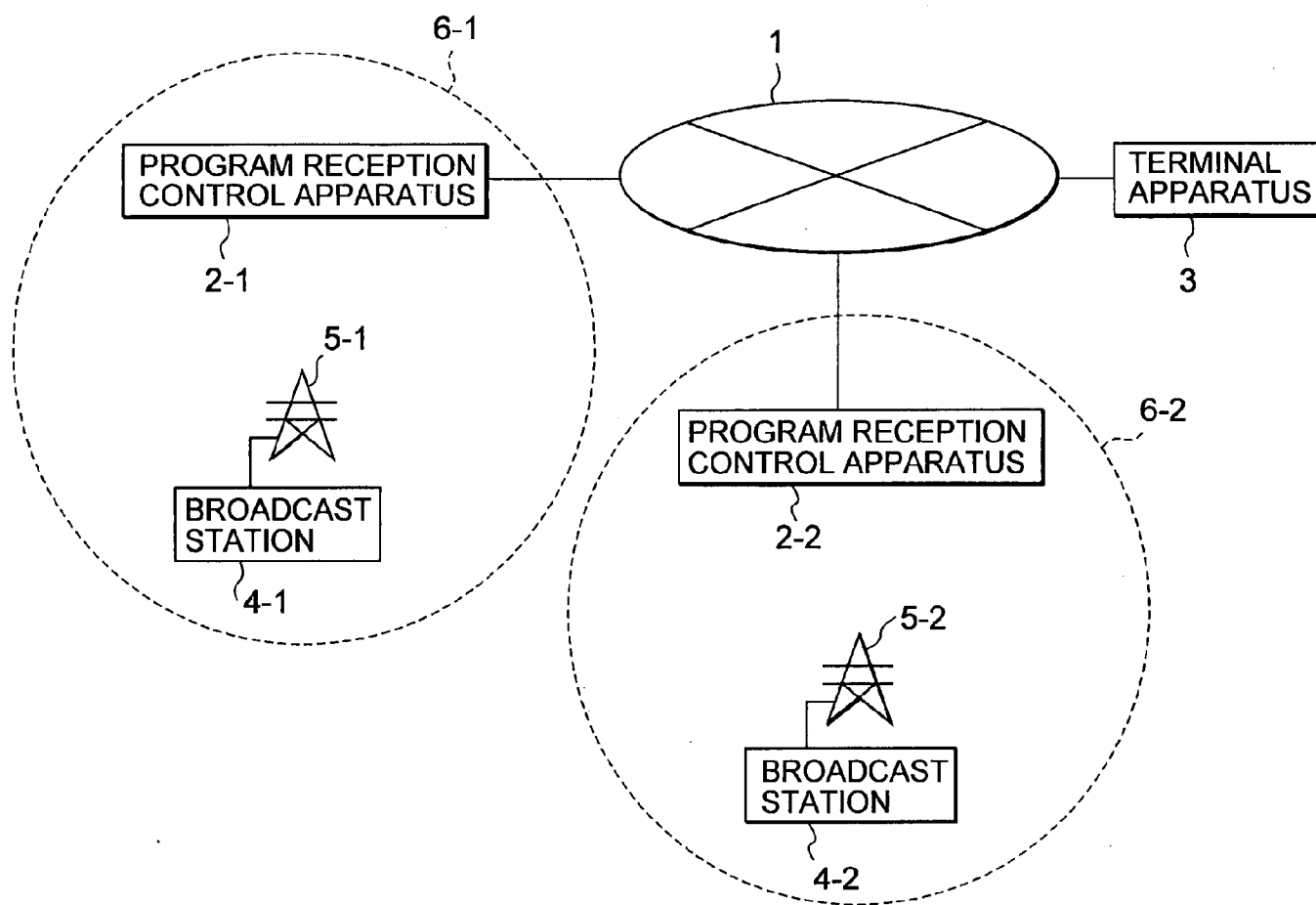


FIG. 2

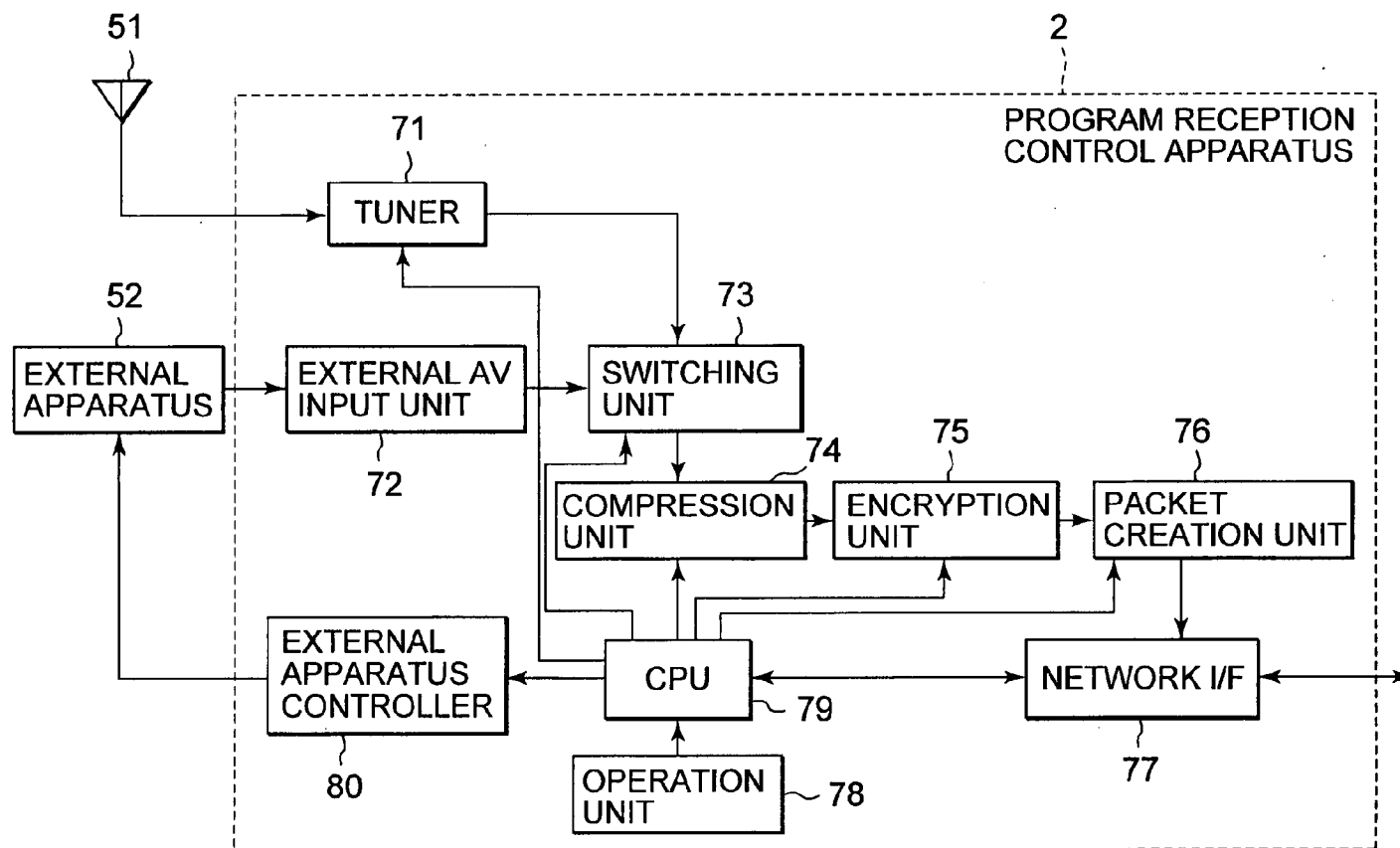


FIG. 3

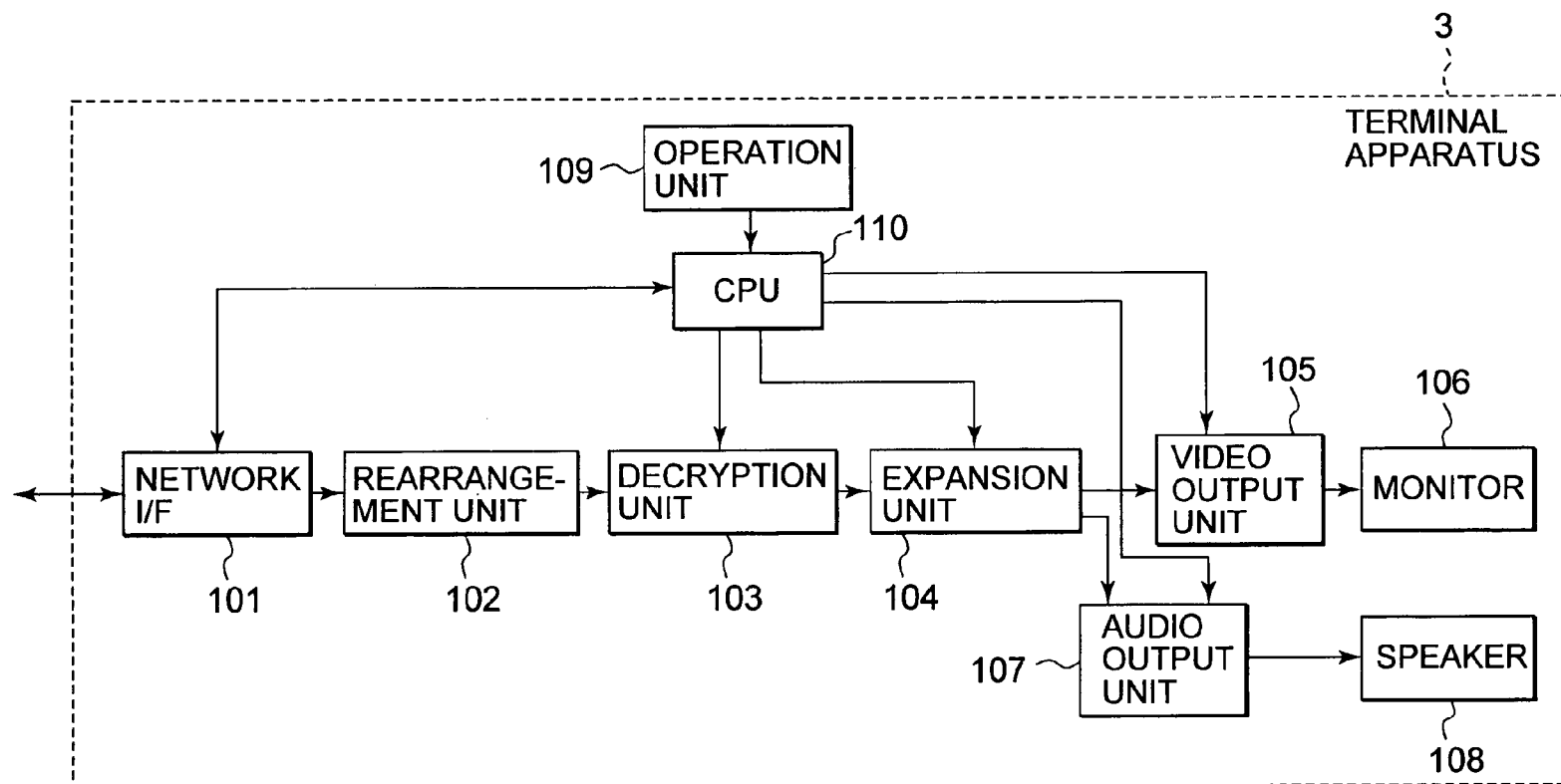


FIG. 4

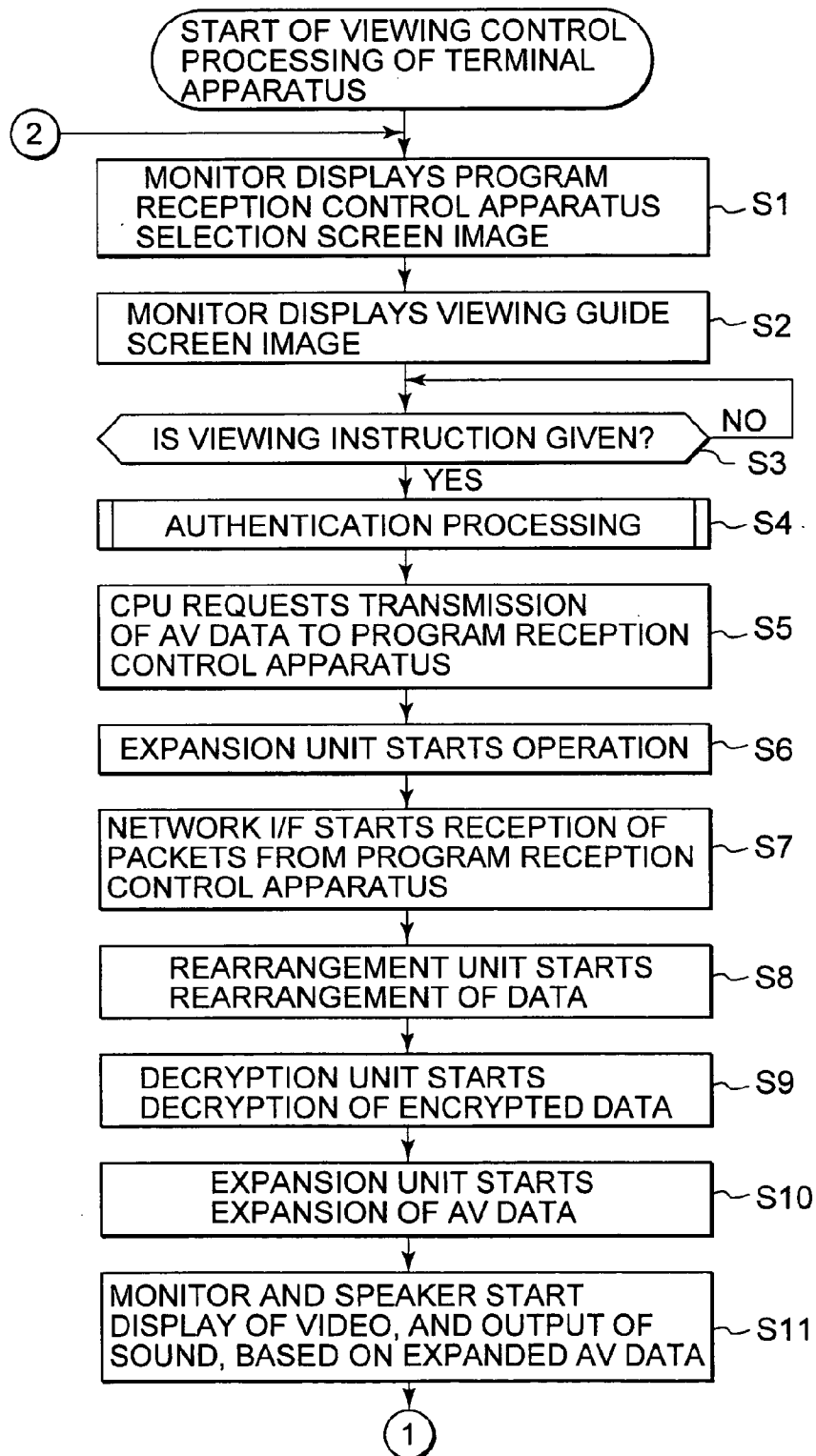


FIG. 5

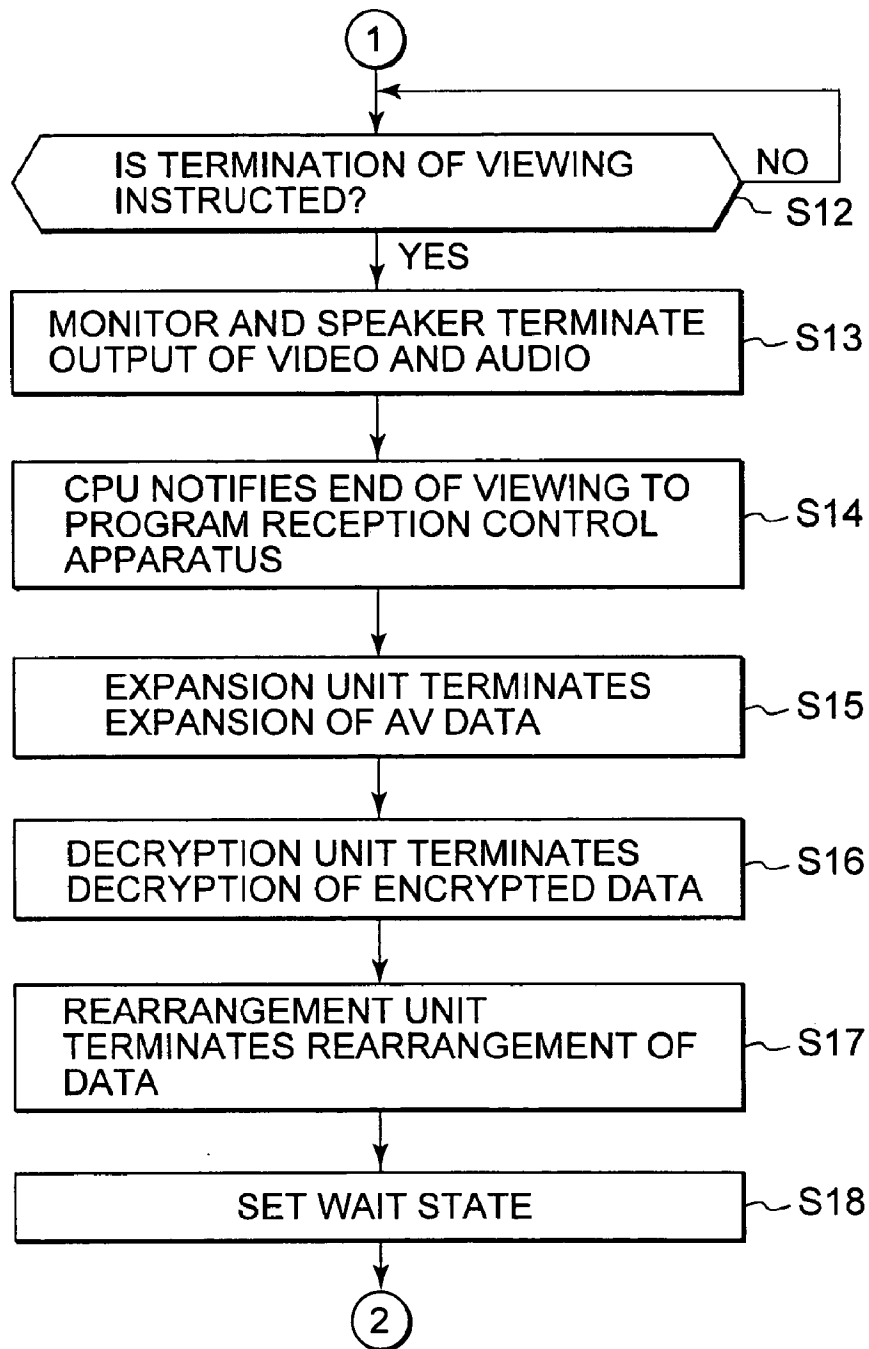


FIG. 6

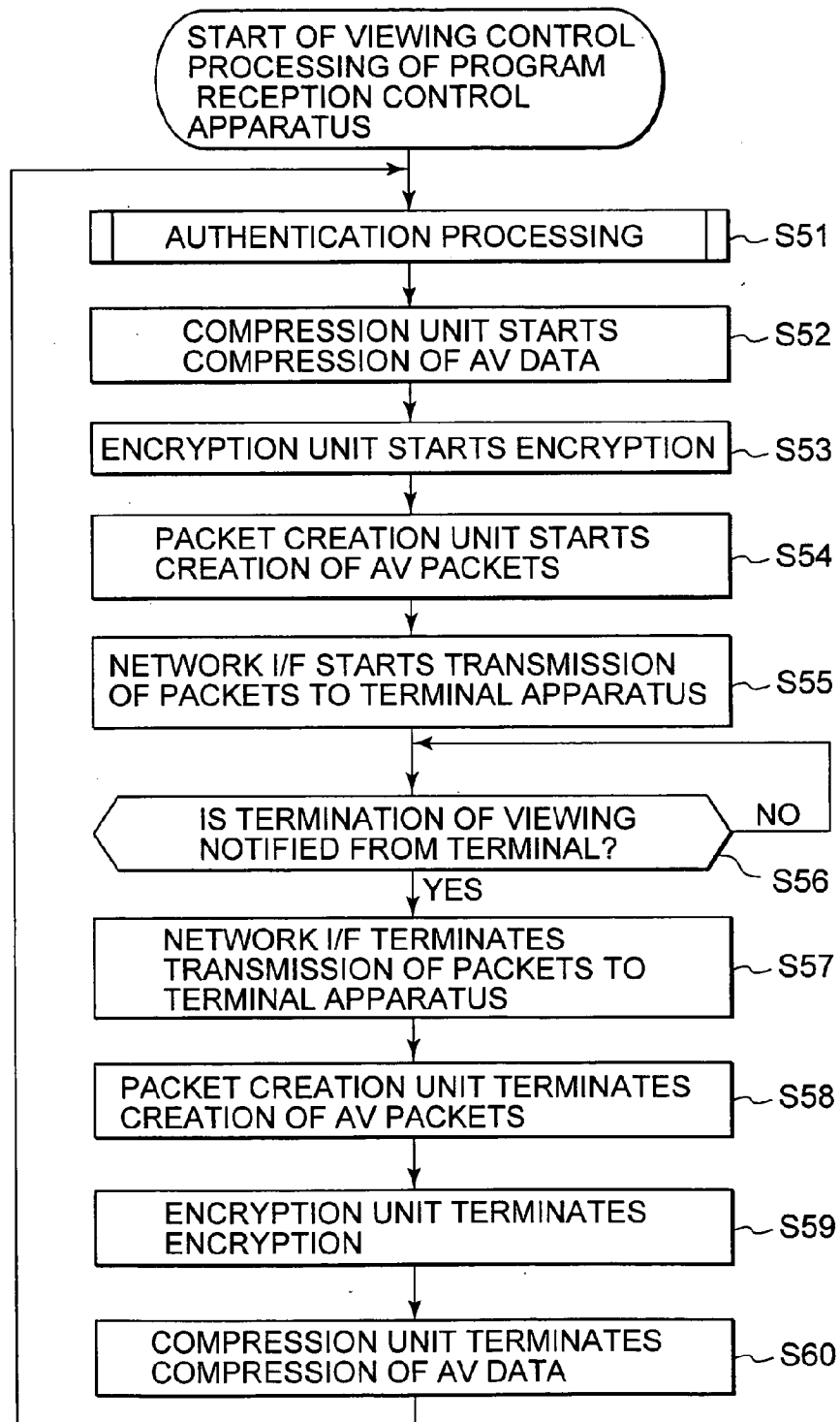


FIG. 7

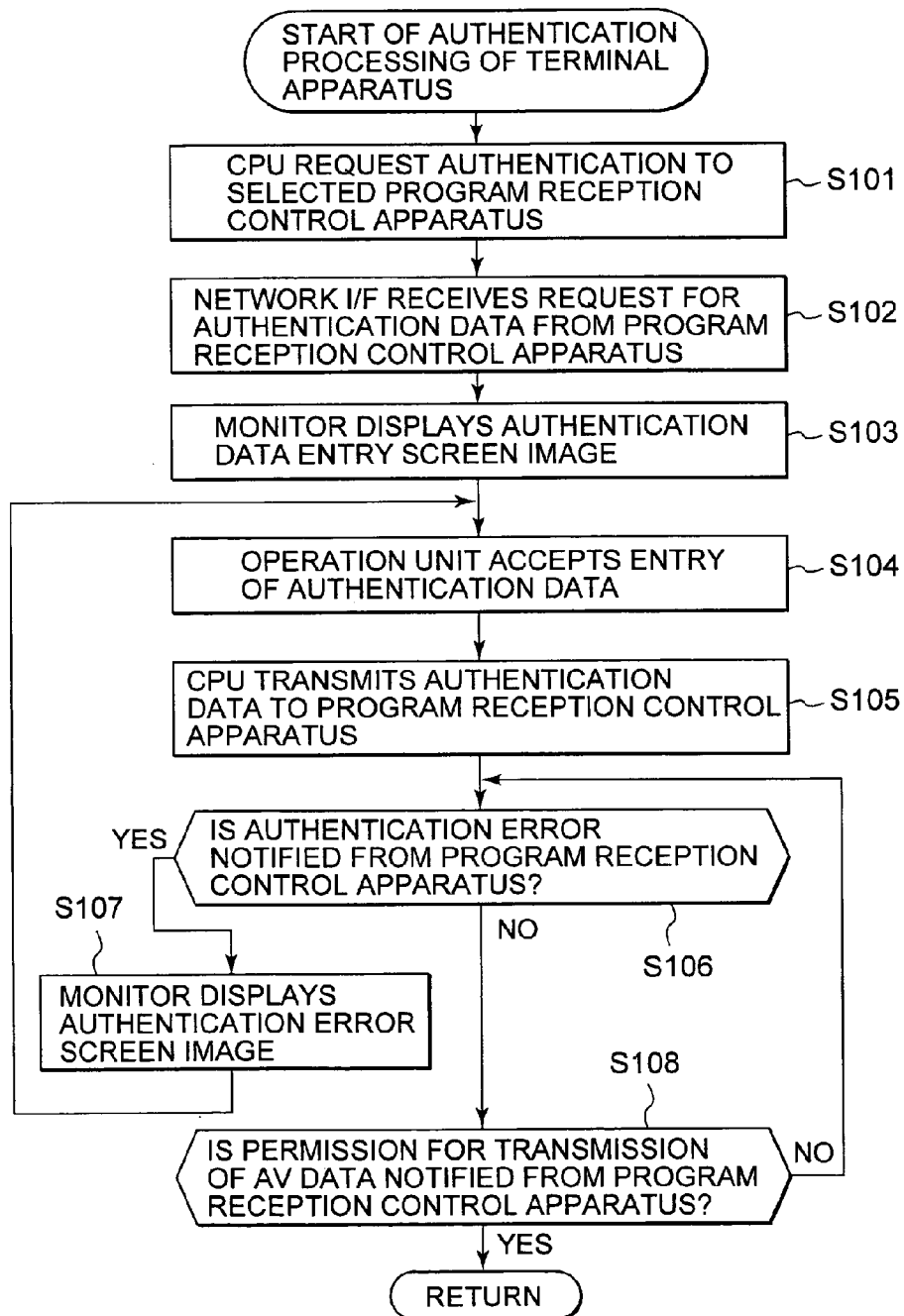


FIG. 8

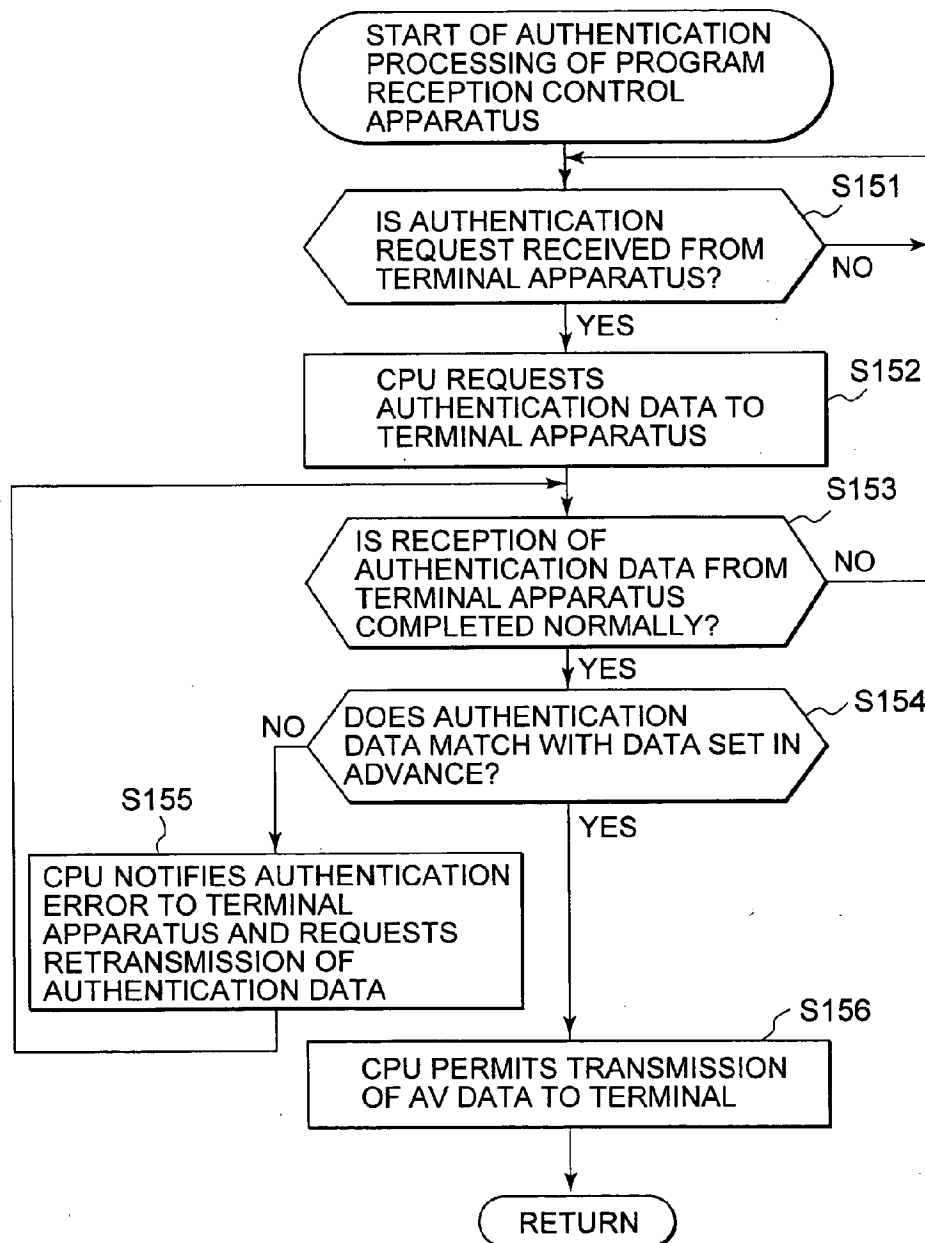


FIG. 9

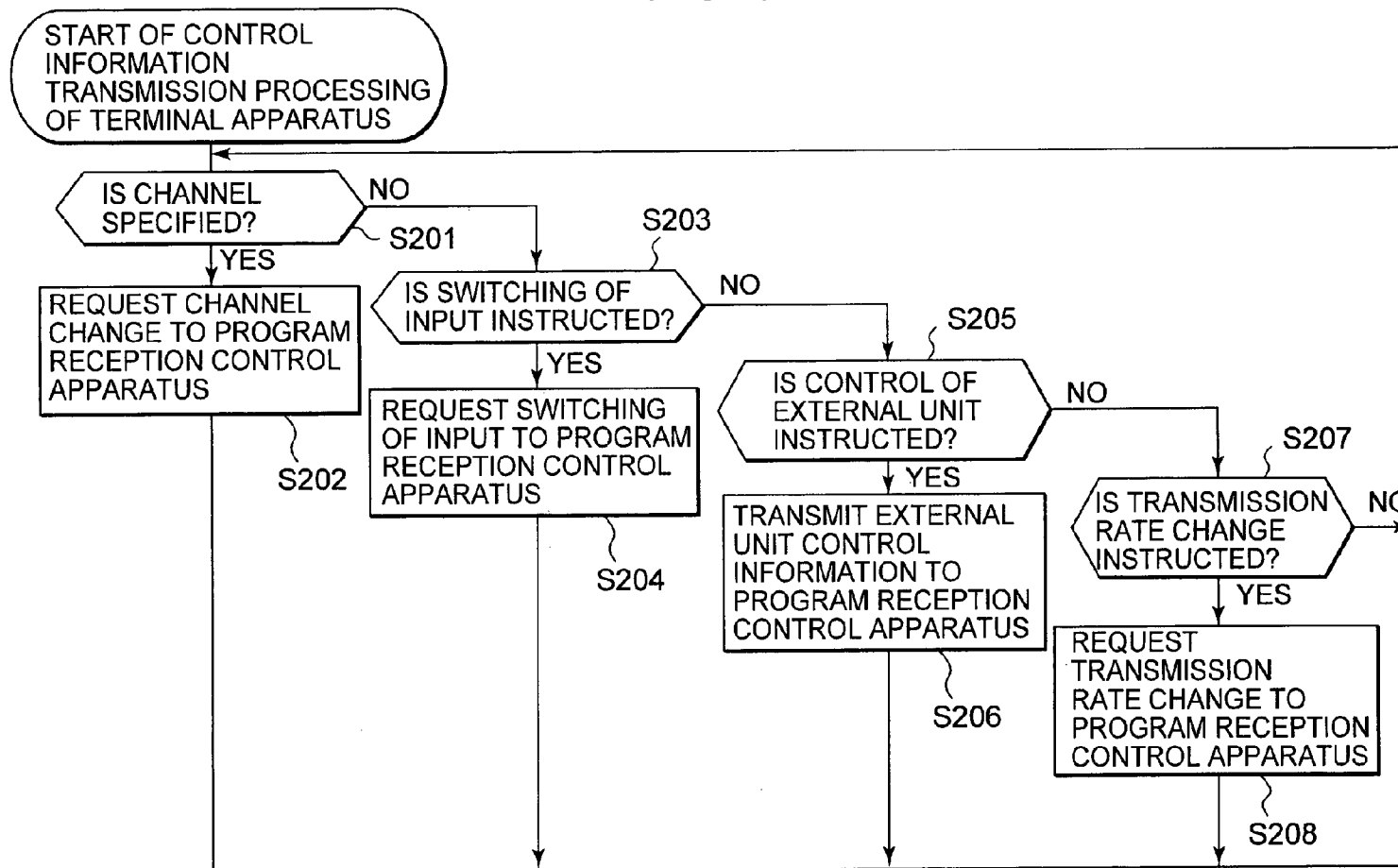


FIG. 10

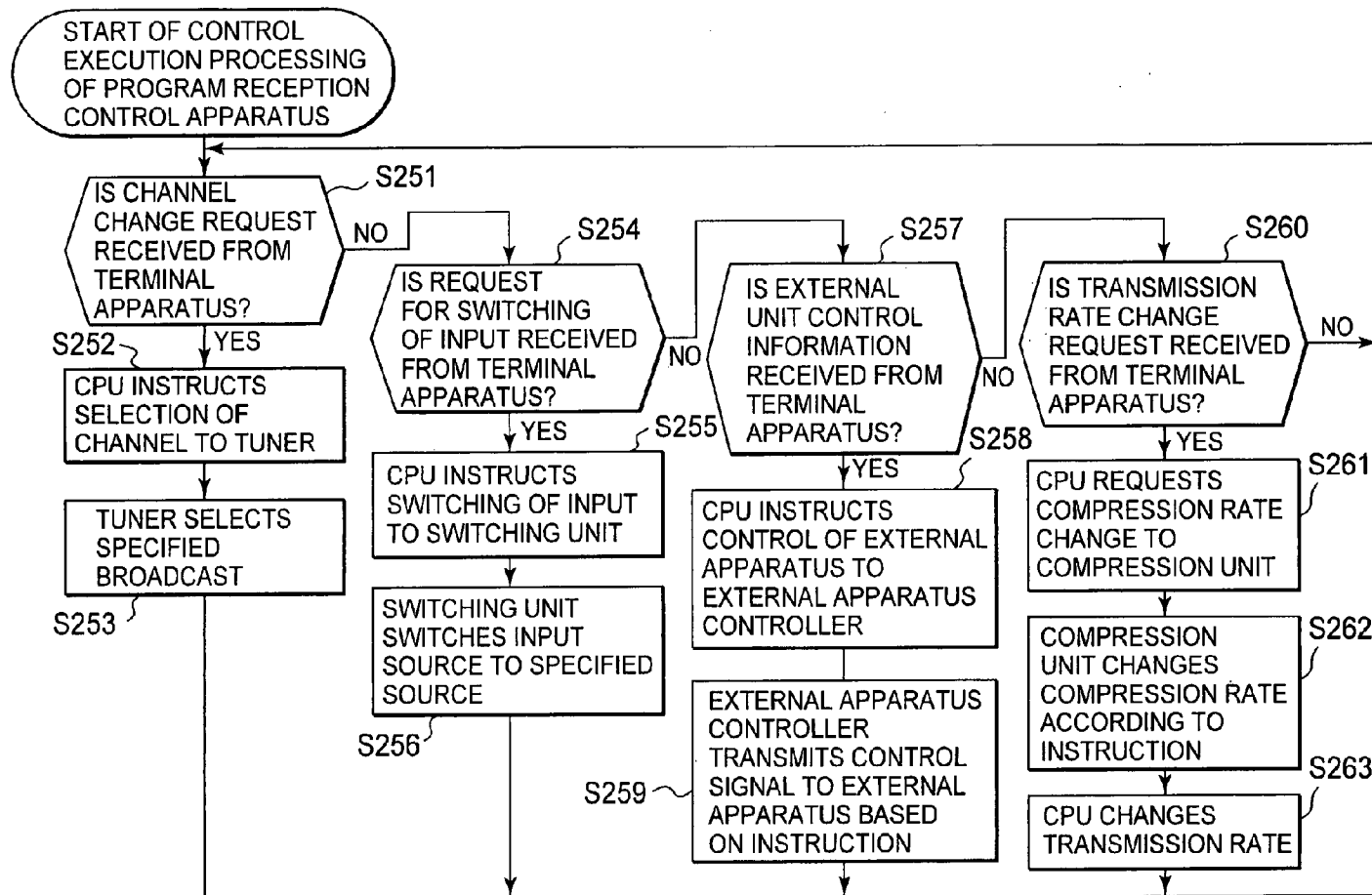


FIG. 11

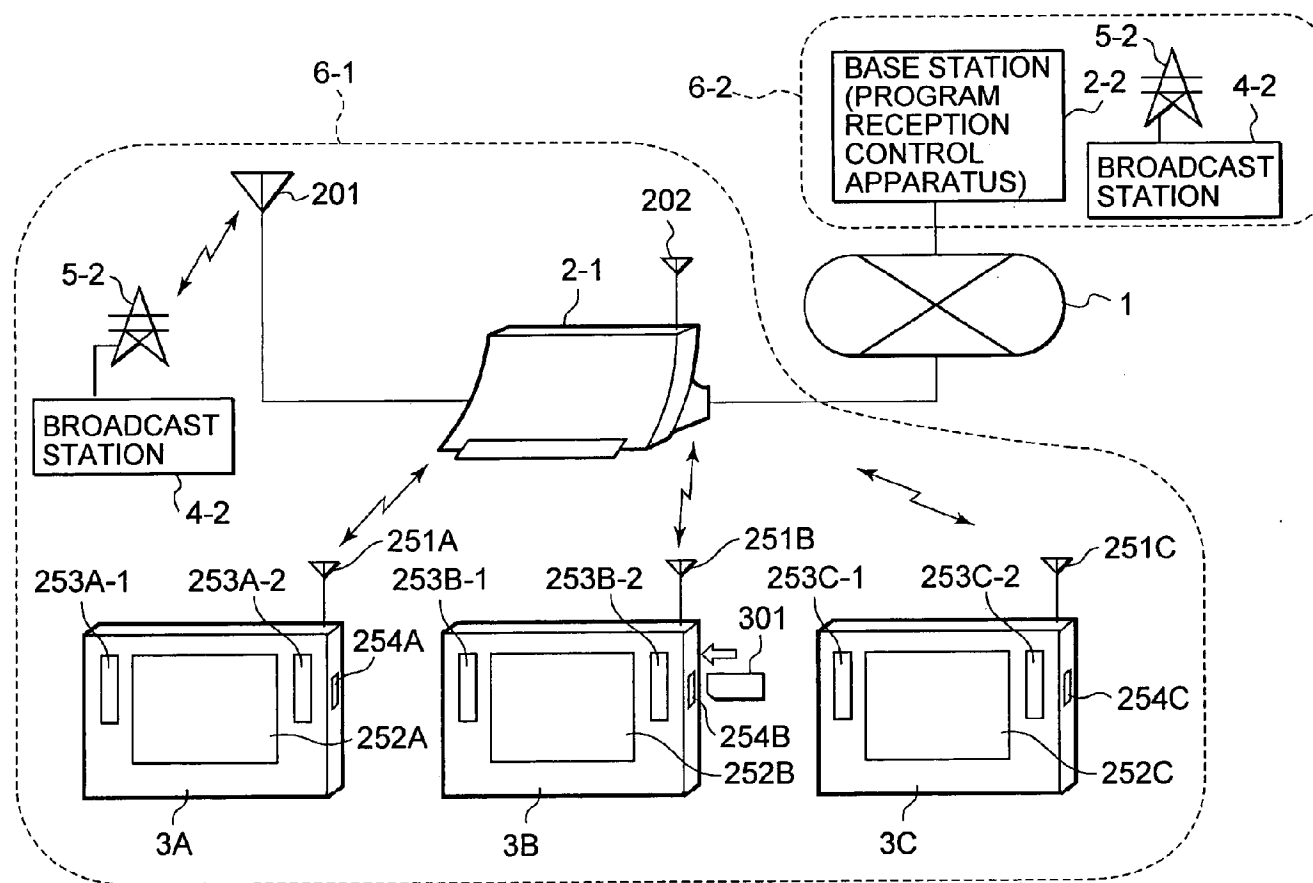


FIG. 12

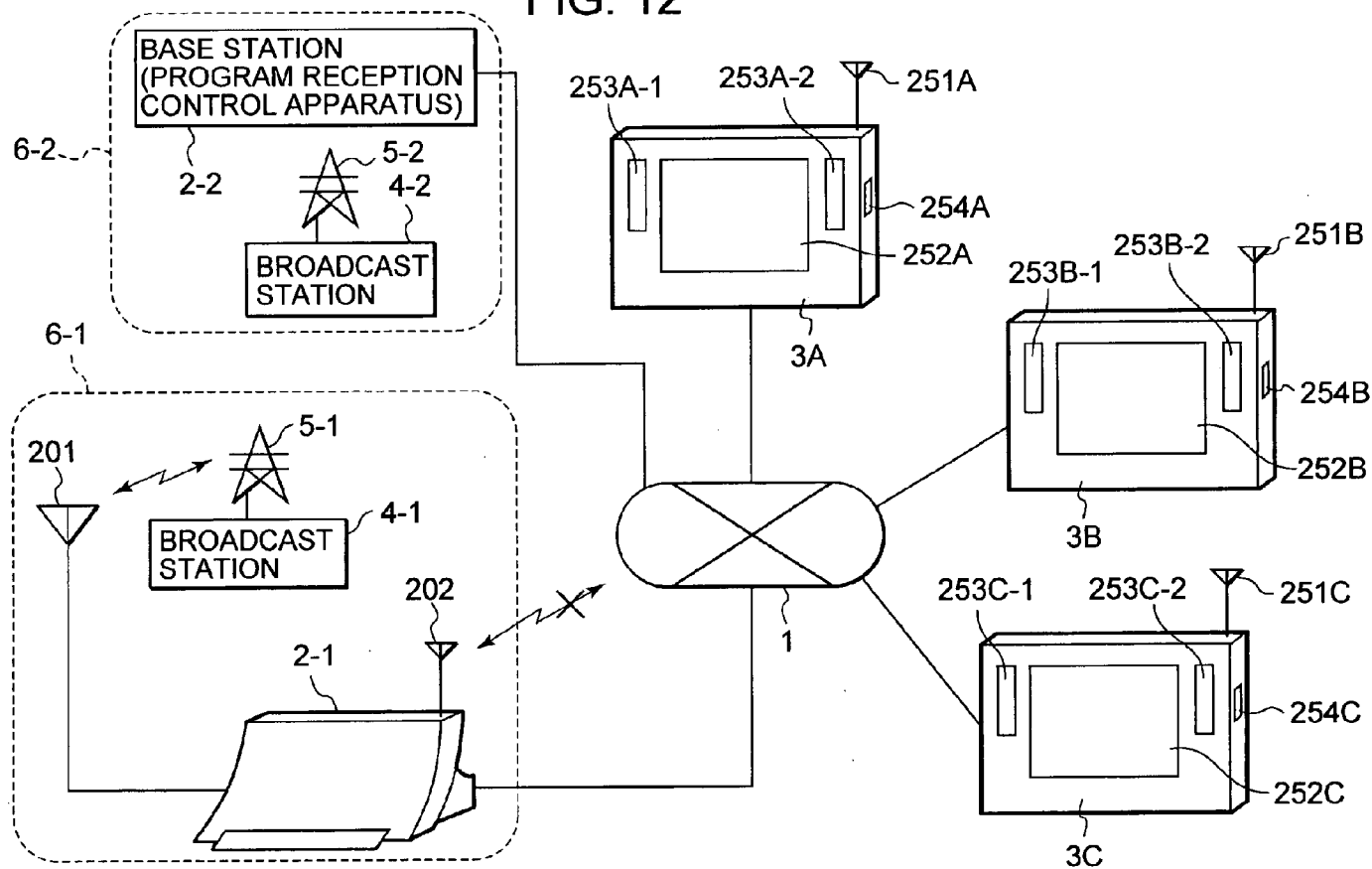


FIG. 13

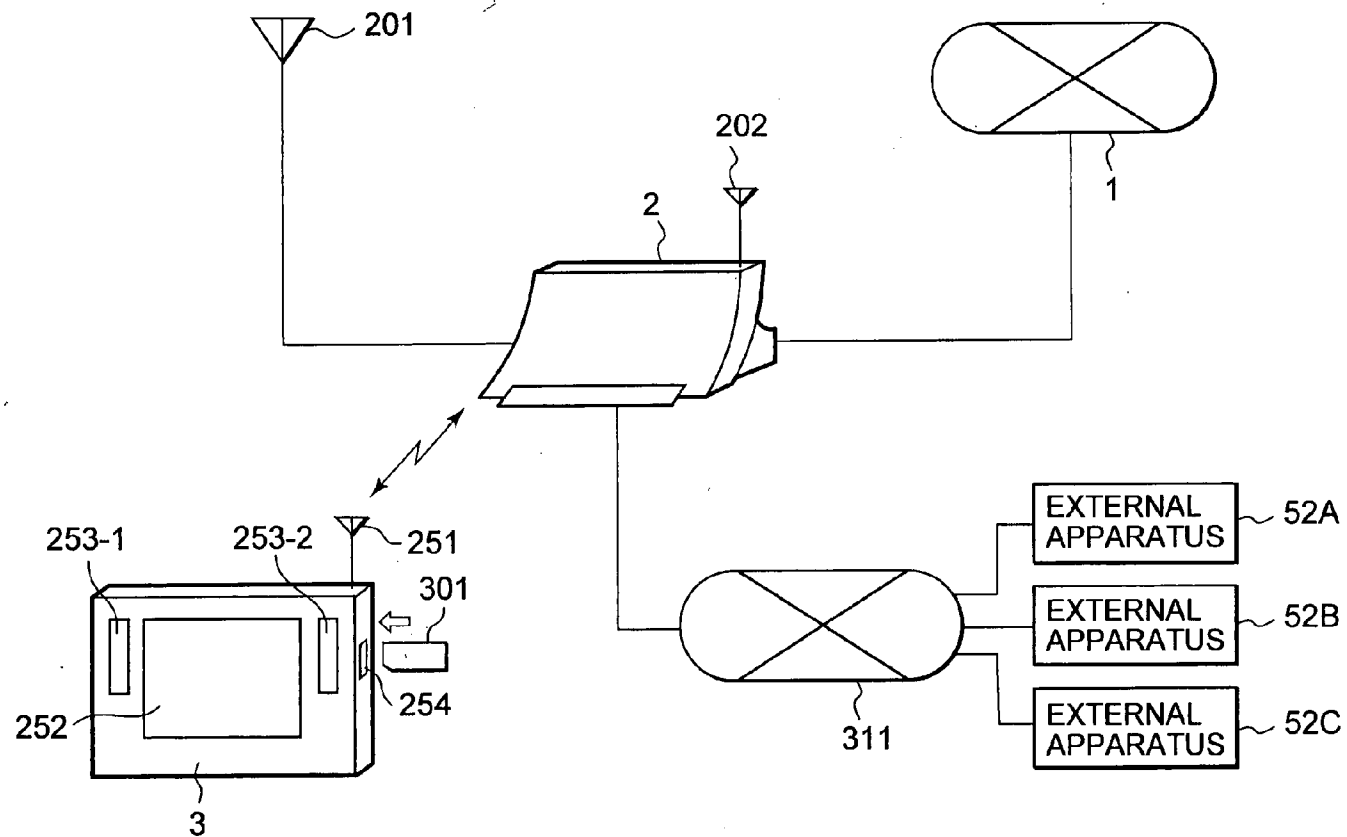


FIG. 14

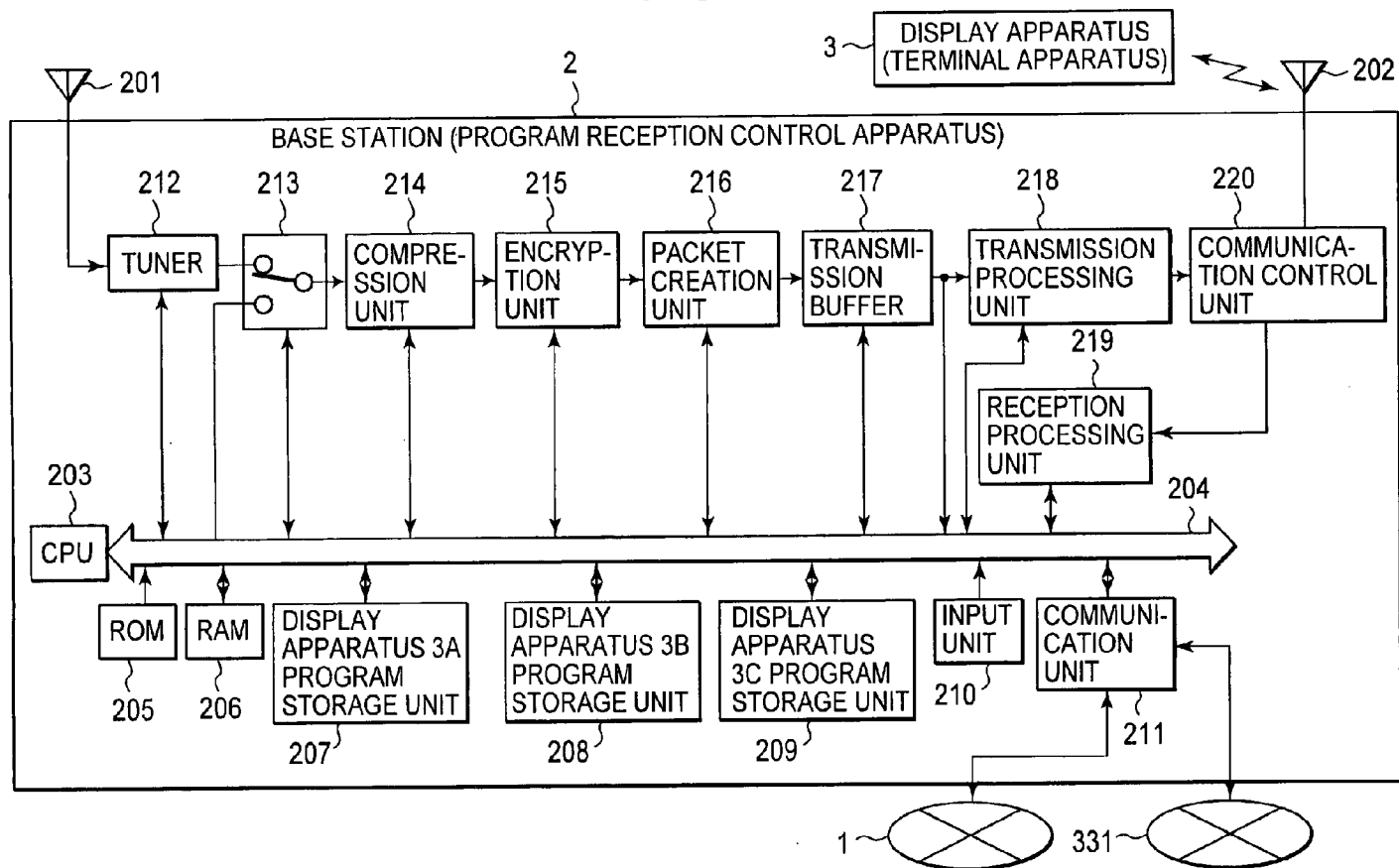


FIG. 15

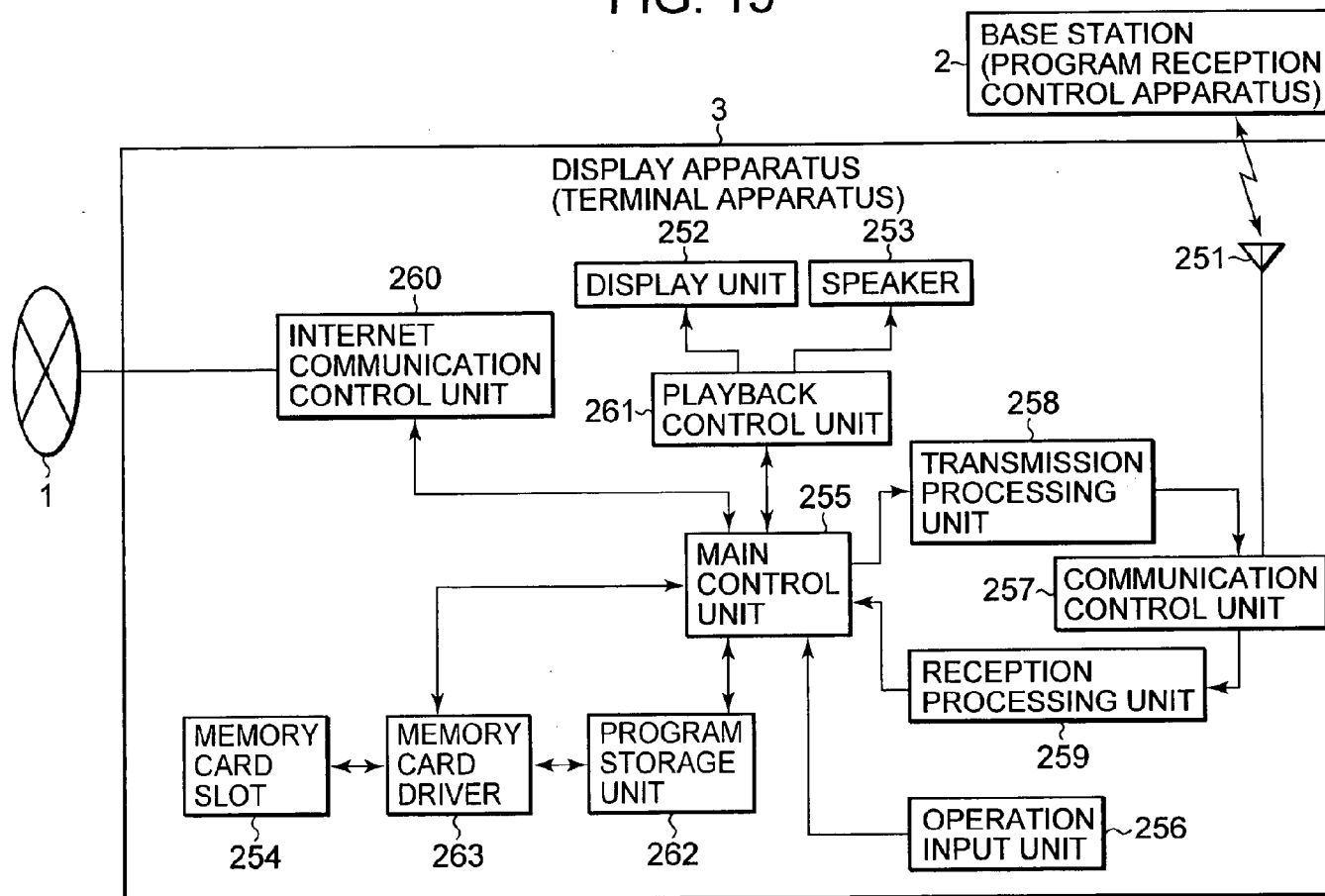
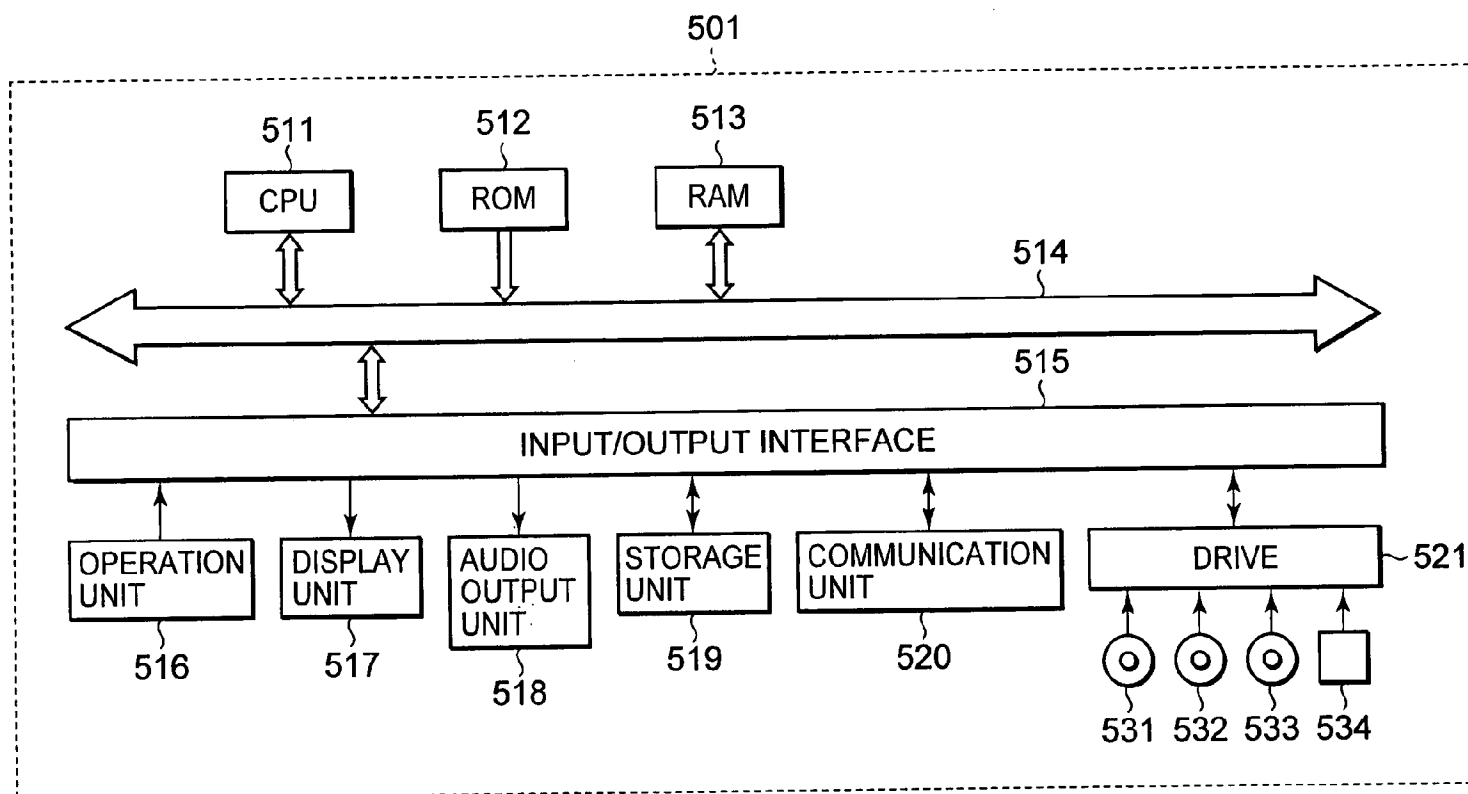


FIG. 16



INFORMATION PROCESSING SYSTEM, INFORMATION PROCESSING APPARATUS AND METHOD, RECORDING MEDIUM, AND PROGRAM

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to an information processing system, an information processing apparatus and method, a recording medium, and a program, and more particularly to an information processing system, an information processing apparatus and method, a recording medium, and a program that allow the user to view broadcast in real time even outside a reception coverage area.

[0003] 2. Description of the Related Art

[0004] Conventionally, there is a system that allows a user to view TV broadcast program produced in a foreign country in different countries by recording a TV program on a hard disk in a management server, transmitting the recorded data to a terminal apparatus via the Internet after completing the recording, and playing back the data on the terminal apparatus (For example, see Patent Document 1: Japanese Laid-Open Patent JP2003-18514A).

[0005] However, in the system as described in the above mentioned Patent Document 1, because the recorded data is transmitted to the terminal apparatus after completing the recording of the whole program in the management server, the problem is that the user who owns the terminal apparatus cannot view the program in real time while the program is being broadcast.

[0006] In view of this situation, the main aspect of the present invention is to enable the user to view a broadcast in real time on the terminal apparatus which the user owns.

SUMMARY OF THE INVENTION

[0007] An information processing system according to the present invention is characterized by comprising a first information processing apparatus and a second information processing apparatus, wherein the first information processing apparatus comprises receiving means for receiving a broadcast; creation means for creating data based on the broadcast received by the receiving means; first communication means for transmitting the data created by the creation means; and first control means for controlling the transmission of the data by said first communication means wirelessly or via a network, wherein the second information processing apparatus comprises second communication means for receiving data from the first information processing apparatus; and presentation means for presenting information based on the data received by the second communication means, and second control means for controlling the second information processing apparatus so that the second information processing apparatus receives the data wirelessly when wireless communication can be performed with the first information processing apparatus or receives the data via a network when the wireless communication cannot be performed.

[0008] The information processing system according to the present invention is characterized in that the second information processing apparatus further comprises input

means for inputting an operation signal generated through a user operation, wherein the second communication means transmits a viewing request based on the operation signal received from the input means, to the first communication means wirelessly or via the network, the first communication means receives this viewing request, and the receiving means receives a broadcast based on the viewing request.

[0009] The information processing system according to the present invention is characterized in that the second information processing apparatus further comprises authentication means for executing authentication processing, wherein user-entered authentication data or pre-stored authentication data is transmitted for use as authentication data requested by the first information processing apparatus in response to a connection request, wherein when a permission to connect to the first information processing apparatus is obtained through the authentication processing, the second communication means transmits viewing request to the first information processing apparatus.

[0010] The information processing system according to the present invention is characterized in that the first information processing apparatus further comprises encryption means for encrypting the data created by the creation means and the second information processing apparatus further comprises, decryption means for decrypting the encrypted data wherein after the authentication processing, the first communication means transmits the encrypted data to the second information processing apparatus and the second information processing apparatus receives the encrypted data transmitted from the first communication means via the second communication means and decrypts the encrypted data through the decryption means.

[0011] In the information processing system according to the present invention, in the first information processing apparatus, the authentication processing can be omitted when the viewing request from the second communication means is received wirelessly.

[0012] An information processing method according to the present invention is an information processing method for use by a first information processing apparatus that receives a broadcast for enabling a user to view a video and a sound and that transmits data based on a received signal to the second information processing apparatus. The method is characterized by comprising a receiving step for receiving the broadcast based on the viewing request from the second information processing apparatus; a creation step for creating data based on the received signal; and a transmission step for transmitting the data to the second information processing apparatus wirelessly when the second information processing apparatus is at a location where wireless communication is possible or via a network when the second information processing apparatus is at a location where wireless communication is impossible.

[0013] The information processing method according to the present invention is characterized by further comprising a communication step for receiving the viewing request from the second information processing apparatus wirelessly or via a network.

[0014] The information processing method according to the present invention is characterized by further comprising a requesting step for requesting authentication data in

response to the connection request from the second information processing apparatus; and an authentication step for authenticating the second information processing apparatus based on the authentication data from the second information processing apparatus, wherein the receiving step, the creation step, and the transmission step are executed after the authentication processing in this authentication step.

[0015] The information processing method according to the present invention is characterized in that the authentication processing in the authentication step checks if the authentication data transmitted from the second information processing apparatus matches pre-stored authentication data and permits the viewing request only when matched.

[0016] The information processing method according to the present invention is further characterized in which, the second information processing apparatus can decrypt encrypted data, and the information processing method further comprises an encryption step for encrypting the data created by the creation step after the authentication processing by the authentication step, wherein the transmission step transmits the data encrypted by the encryption step to the second information processing apparatus.

[0017] An information processing method according to the present invention for use by a second information processing apparatus, in which communicates with a first information processing apparatus which receives a broadcast and transmits data based on a received signal, is characterized by comprising a first transmission step for transmitting a connection request for requesting a viewing based on a user operation; a second transmission step for transmitting authentication data inputted by a user or pre-stored authentication data for use as authentication data requested by the first information processing apparatus in response to the connection request; a third transmission step for transmitting a transmission request which requests the transmission of data specified based on the connection request by the user operation after the authentication by the first information processing apparatus; a receiving step for receiving data transmitted from the first information processing apparatus in response to the third transmission step; and a presentation step for presenting a broadcast-based video or audio through the reception of the data, wherein the transmission and the reception in the first, second, third transmission steps and the receiving step are executed wirelessly or via a network.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

[0018] FIG. 1 is a block diagram showing an example of the configuration of an information processing system to which the present invention is applied;

[0019] FIG. 2 is a block diagram showing an example of the configuration of a program reception control apparatus in FIG. 1;

[0020] FIG. 3 is another block diagram showing an example of the configuration of a terminal apparatus in FIG. 1;

[0021] FIG. 4 is a flowchart showing the viewing control processing of the terminal apparatus;

[0022] FIG. 5 is a flowchart that continued from that in FIG. 4 showing the viewing control processing of the terminal apparatus;

[0023] FIG. 6 is a flowchart showing the viewing control processing of the program reception control apparatus;

[0024] FIG. 7 is a flowchart showing in detail the processing of step S4 in FIG. 4;

[0025] FIG. 8 is a flowchart showing in detail the processing of step S51 in FIG. 6;

[0026] FIG. 9 is a flowchart showing the control information transmission processing of the terminal apparatus;

[0027] FIG. 10 is a flowchart showing the control execution processing of the program reception control apparatus;

[0028] FIG. 11 is a schematic block diagram showing an example of another configuration of the information processing system to which the present invention is applied;

[0029] FIG. 12 is a schematic block diagram showing an example of another connection mode of the information processing system in FIG. 11;

[0030] FIG. 13 is a schematic block diagram showing an example of a still another configuration of the information processing system to which the present invention is applied;

[0031] FIG. 14 is a block diagram showing an example of the configuration of the base station (program reception control apparatus) in FIG. 11 to FIG. 13;

[0032] FIG. 15 is another block diagram showing an example of the configuration of a display apparatus (terminal apparatus) in FIG. 11 to FIG. 13; and

[0033] FIG. 16 is a block diagram showing an example of the configuration of a personal computer to which the present invention is applied.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0034] Preferred embodiments of the present invention will be described below. The correspondence between the constituent features described in the claims and the examples of the embodiments of the invention is exemplified as follows. This description is to confirm that the examples supporting the invention described in the claims are described in the embodiments. Therefore, even if there is an example that is described in the embodiments of the invention but is not described here as the one corresponding to a constituent feature, that does not mean that the example does not correspond to the constituent feature. Conversely, even if an example is described here as the one corresponding to a constituent feature, that does not mean that the example does not correspond to a constituent feature other than the constituent feature.

[0035] In addition, this description does not mean that the inventions corresponding to the examples described in the embodiments of the invention are all included in the claims. In other words, this description does not deny that there is an invention that corresponds to an example described in the embodiments of the invention and but is not described in the claims of this application, that is, does not deny there is an invention that will be applied as a divisional application or added as an amendment in future.

[0036] According to the present invention, an information processing system is provided. This information processing system is characterized in that a first information processing

apparatus (for example, program reception control apparatus 2 in FIG. 1 or in FIG. 11 and FIG. 12) comprises station selection means (for example, a tuner 71 in FIG. 2 or a tuner 212 in FIG. 14) for selecting a broadcast based on control information transmitted from a second information processing apparatus (for example, a terminal apparatus 3 in FIG. 1 or in FIG. 11 and FIG. 12) and which controls the operation of the first information processing apparatus; data creation means (for example, a compression unit 74 in FIG. 2 or a compression unit 214 in FIG. 14) for creating data, one by one, based on a broadcast selected and received by the selection means; first communication means (for example, a network I/F 77 in FIG. 2 or a communication control unit 220 and a communication unit 211 in FIG. 14) for transmitting data created by the creation means, to the second information processing apparatus and for receiving control information from the second information processing apparatus; and first control means (for example, a CPU 79 in FIG. 2 or a CPU 203 in FIG. 14) for causing the creation of data by the creation means and the transmission of data to the second information processing apparatus by the first communication means to be executed in parallel, wherein the second information processing apparatus comprises second communication means (for example, a network I/F 101 in FIG. 3 or a communication control unit 257 and an Internet communication control unit 260 in FIG. 15) for receiving broadcast-based data from the first information processing apparatus and for transmitting control information to the first information processing apparatus; presentation means (for example, a monitor 106 and a speaker 108 in FIG. 3 or a display unit 252 and a speaker 253 in FIG. 15) for presenting information based on data received by the second communication means; and second control means (for example, the CPU 110 in FIG. 3 or a main control unit 255 in FIG. 15) for causing the reception of data by the second communication means and the presentation of information by the presentation means to be executed in parallel, and wherein the first information processing apparatus is installed in a reception coverage area of a broadcast (for example, a reception coverage area 6 in FIG. 1 or in FIG. 11 and FIG. 12) and the second information processing apparatus is installed outside the reception coverage area of a broadcast.

[0037] In this information processing system, the first information processing apparatus further comprises authentication means (for example, a CPU 79 in FIG. 2 or a CPU 203 in FIG. 14) that executes authentication processing in FIG. 8) for authenticating the second information processing apparatus; and encryption means (for example, an encryption unit 75 in FIG. 2 or an encryption unit 215 in FIG. 14) for encrypting the data created by the creation means wherein, when the second information processing apparatus is authenticated by the authentication means, the first communication means transmits the data encrypted by the encryption means, to the second information processing apparatus and the first control means causes the creation of the data by the creation means and the transmission of the data to the second information processing apparatus by the first communication means as well as the authentication of the second information processing apparatus by the authentication means and the encryption of the data by the encryption means to be executed in parallel. The second information processing apparatus further comprises authentication means (for example, a CPU 110 in FIG. 3 or a main control

unit 255 in FIG. 15) that executes authentication processing in FIG. 7) for executing authentication processing required for authenticating itself by the authentication means of the first information processing apparatus; and decryption means (for example, a decryption unit 103 in FIG. 3 or a playback control unit 261 in FIG. 15) for decrypting the encrypted data when the data transmitted from the first communication means of the first information processing apparatus and received by the second communication means is encrypted, wherein the presentation means further presents information based on the data decrypted by the decryption means and the second control means causes the reception of the data by the second communication means and the presentation of the information by the presentation means as well as the authentication receiving processing by the authentication receiving means and the decryption of the data by the decryption means to be executed in parallel.

[0038] In this information processing system, the first communication means of the first information processing apparatus (for example, a program reception control apparatus 2 in FIG. 14) comprises first network communication means (for example, a communication unit 211 in FIG. 14) for communicating with the second information processing apparatus via a predetermined network (for example, Internet 1 in FIG. 11 and FIG. 12); and first wireless communication means (for example, a communication control unit 220 in FIG. 14) for communicating wirelessly with the second information processing apparatus, and the second communication means of the second information processing apparatus (for example, a terminal apparatus 3 in FIG. 15) comprises second network communication means (for example, an Internet communication control unit 260 in FIG. 15) for communicating with the first network communication means of the first information processing apparatus via the network; and second wireless communication means (for example, a communication control unit 257 in FIG. 15) for communicating wirelessly with the first wireless communication means of the first information processing apparatus. The second information processing apparatus can be installed also in the reception coverage area of the broadcast. When installed in a range where wireless communication is possible, each of the first information processing apparatus and the second information processing apparatus can receive and transmit the data or the control information using the first wireless communication means or the second wireless communication means. When installed outside the range where wireless communication is possible, each of the first information processing apparatus and the second information processing apparatus can receive and transmit the data or the control information using the first network communication means or the second network communication means.

[0039] According to the present invention, a first information processing apparatus is provided. This first information processing apparatus (for example, a program reception control apparatus 2 in FIG. 2 or in FIG. 11 and FIG. 12) is characterized by comprising station selection means (for example, a tuner 71 in FIG. 2 or a tuner 212 in FIG. 14) for selecting a broadcast based on control information from another information processing apparatus (for example, a terminal apparatus 3 in FIG. 1 or in FIG. 11 and FIG. 12) installed outside the reception coverage area of a broadcast (for example, a reception coverage area 6 in FIG. 1 or in FIG. 11 and FIG. 12); creation means (for example, a

compression unit 74 in FIG. 2 or a compression unit 214 in FIG. 14) for creating data, one by one, based on the broadcast selected and received by the station selection means; communication means (for example, a network I/F 77 in FIG. 2 or communication control unit 220 and a communication unit 211 in FIG. 14) for transmitting data created by the creation means to the other information processing apparatus and for receiving control information from the other information processing apparatus; and control means (for example, a CPU 79 in FIG. 2 or a CPU 203 in FIG. 14) for causing the creation of data by the creation means and the transmission of data to the other information processing apparatus by the communication means to be executed in parallel.

[0040] The first information processing apparatus further comprises authentication means (for example, a CPU 79 in FIG. 2 or a CPU 203 in FIG. 14) that executes authentication processing in FIG. 8) for authenticating the other information processing apparatus; and encryption means (for example, an encryption unit 75 in FIG. 2 or an encryption unit 215 in FIG. 14) for encrypting the data created by the creation means wherein, when the other information processing apparatus is authenticated by the authentication means, the communication means transmits the data, encrypted by the encryption means, to the other information processing apparatus and the control means causes the creation of the data by the creation means and the transmission of the data to the other information processing apparatus by the communication means as well as the authentication of the other information processing apparatus by the authentication means and the encryption of the data by the encryption means to be executed in parallel.

[0041] The communication means of this first information processing apparatus (for example, a program reception control apparatus 2 in FIG. 14) comprises network communication means (for example, a communication unit 211 in FIG. 14) for communicating with the other information processing apparatus via a predetermined network (for example, Internet 1 in FIG. 11 and FIG. 12); and wireless communication means (for example, a communication control unit 220 in FIG. 14) for communicating wirelessly with the other information processing apparatus. When the information processing apparatus itself is installed in a range where wireless communication with the other information processing apparatus is possible, the wireless communication means transmits the data and receives the control information. When the information processing apparatus itself is installed outside the range where wireless communication with the other information processing apparatus is possible, the network communication means transmits the data or receives the control information.

[0042] According to the present invention, a first information processing method is provided. This first information processing method is characterized by comprising a station selection step (for example, step S253 in FIG. 10) for selecting a broadcast based on control information from another information processing apparatus (for example, a terminal apparatus 3 in FIG. 1) installed outside a broadcast reception coverage area (for example, a reception coverage area 6 in FIG. 1); a creation step (for example, step S52 in FIG. 6) for creating data, one by one, based on the broadcast selected and received by the processing of the station selection step; and a transmission step (for example, step

S55 in FIG. 6) for transmitting the data, created by the processing of the creation step, to the other information processing apparatus, wherein the creation of data by the processing of the creation step and the transmission of data to another information processing apparatus by the processing of the transmission step are executed in parallel.

[0043] According to the present invention, a first recording medium is provided. A program on this first recording medium is characterized by comprising a station selection step (for example, step S253 in FIG. 10) for selecting a broadcast based on control information from another information processing apparatus (for example, a terminal apparatus 3 in FIG. 1) installed outside a broadcast reception coverage area (for example, a reception coverage area 6 in FIG. 1); a creation step (for example, step S52 in FIG. 6) for creating data, one by one, based on the broadcast selected and received by the processing of the station selection step; and a transmission control step (for example, step S55 in FIG. 6) for controlling the transmission of the data, created by the processing of the creation step, to the other information processing apparatus, wherein the creation of data by the processing of the creation step and the control of the transmission of data to another information processing apparatus by the processing of the transmission control step are executed in parallel.

[0044] According to the present invention, a first program is provided. Because an example of the constituent features of the first program is the same as that of the program on the first recording medium described above, the description is omitted.

[0045] According to the present invention, a second information processing apparatus is provided. This second information processing apparatus (for example, a terminal apparatus 3 in FIG. 1 or in FIG. 11 and FIG. 12) is characterized by comprising communication means (for example, a network I/F 101 in FIG. 3 or a communication control unit 257 and an Internet communication control unit 260 in FIG. 15) for receiving broadcast-based data from another information processing apparatus (for example, a program reception control apparatus 2 in FIG. 1 or in FIG. 11 and FIG. 12) installed in a broadcast reception coverage area (for example, a reception coverage area 6 in FIG. 1 or in FIG. 11 and FIG. 12) and for transmitting control information to the other information processing apparatus for controlling the operation of the other information processing apparatus; presentation means (for example, a monitor 106 and a speaker 108 in FIG. 3 or a display unit 252 and a speaker 253 in FIG. 15) for presenting information based on data received by the communication means; and control means (for example, a CPU 110 in FIG. 3 or a main control unit 255 in FIG. 15) for causing the reception of data by the communication means and the presentation of information by the presentation means to be executed in parallel, wherein the second information processing apparatus is installed outside the broadcast reception coverage area.

[0046] This second information processing apparatus is characterized by further comprising acceptance means (for example, an operation unit 109 in FIG. 3 or an operation input unit 256 in FIG. 15) for accepting the operation of selecting the station of the broadcast.

[0047] This second information processing apparatus is characterized by further comprising selection means (for

example, a CPU 110 in FIG. 3 or a main control unit 255 in FIG. 15 that executes the processing of step S1 in FIG. 4) for selecting the other information processing apparatus, with which communication is performed, from a plurality of the other information processing apparatuses (for example, program reception control apparatuses 2-1 and 2-2 in FIG. 1 or in FIG. 11 and FIG. 12), wherein the communication means receives the broadcast-based data from the other information processing apparatus, selected by the selection means, and transmits control information for controlling the operation of the other information processing apparatus to the other information processing apparatus selected by the selection means.

[0048] This second information processing apparatus further comprises authentication receiving means (for example, a CPU 110 in FIG. 3 or a main control unit 255 in FIG. 15 that executes authentication processing in FIG. 7) for executing authentication receiving processing required for authenticating the information processing apparatus itself by the other information processing apparatus; and decryption means (for example, a decryption unit 103 in FIG. 3 or a playback control unit 255 in FIG. 15) for decrypting the encrypted data when the data, which is transmitted from the other information processing apparatus and received by the communication means as a result of the authentication of the information processing apparatus itself by the other information processing apparatus through the execution of the authentication receiving processing by the authentication receiving means, is encrypted wherein the presentation means further presents information based on the data decrypted by the decryption means and the control means causes the reception of the data by the communication means and the presentation of the information by the presentation means as well as the authentication receiving processing by the authentication receiving means and the decryption of the data by the decryption means to be executed in parallel.

[0049] The communication means of this second information processing apparatus (for example, a terminal apparatus 3 in FIG. 15) comprises network communication means (for example, an Internet communication control unit 260 in FIG. 15) for communicating with the other information processing apparatus via a predetermined network; and wireless communication means (for example, a communication control unit 257 in FIG. 15) for communicating wirelessly with the other information processing apparatus. The information processing apparatus itself can be installed also in the reception coverage area of the broadcast. When the information processing apparatus itself is installed in a range where wireless communication with the other information processing apparatus is possible, the wireless communication means can receive the data or transmit the control information. When the information processing apparatus itself is installed outside the range where wireless communication with the other information processing apparatus is possible, the network communication means can receive the data or transmit the control information.

[0050] According to the present invention, a second information processing method is provided. This second information processing method is characterized by comprising a receiving step (for example, step S7 in FIG. 4) for receiving broadcast-based data from another information processing apparatus (for example, a program reception control appa-

ratus 2 in FIG. 1 or in FIG. 11 and FIG. 12) installed in the reception coverage area of a broadcast (for example, a reception coverage area 6 in FIG. 1 or in FIG. 11 and FIG. 12); a presentation step (for example, step S11 in FIG. 4) for presenting information based on the data received by the processing of the receiving step; and a transmission step (for example, step S202 in FIG. 9) for transmitting control information to the other information processing apparatus for controlling the operation of the other information processing apparatus, wherein the reception of data by the processing of the receiving step and the presentation of information by the processing of the presentation step are executed in parallel.

[0051] According to the present invention, a second recording medium is provided. A program on this second recording medium is characterized by comprising a receiving control step (for example, step S7 in FIG. 4) for controlling the reception of broadcast-based data from another information processing apparatus (for example, a program reception control apparatus 2 in FIG. 1 or in FIG. 11 and FIG. 12) installed in the reception coverage area of a broadcast (for example, a reception coverage area 6 in FIG. 1 or in FIG. 11 and FIG. 12); a presentation step (for example, step S11 in FIG. 4) for presenting information based on the data whose reception is controlled by the processing of the receiving control step; and a transmission control step (for example, step S202 in FIG. 9) for controlling the transmission of control information to the other information processing apparatus for controlling the operation of the other information processing apparatus, wherein the control of the reception of data by the processing of the receiving control step and the presentation of information by the processing of the presentation step are executed in parallel.

[0052] According to the present invention, a second program is provided. Because an example of the constituent features of the second program is the same as that of the program on the second recording medium described above, the description is omitted.

[0053] FIG. 1 shows the configuration of one embodiment of an information processing system to which the present invention is applied.

[0054] Referring to FIG. 1, a program reception control apparatuses 2-1 and 2-2 and a terminal apparatus 3 are connected to the Internet 1.

[0055] A broadcast station 4-1 broadcasts a program, which includes video signals and audio signals, from a broadcast antenna 5-1. A reception coverage area 6-1 surrounded by a dotted line indicates an area in which the audience can receive a program broadcasted from the broadcast antenna 5-1, via a reception unit to view the program.

[0056] The program reception control apparatus 2-1 installed within the reception coverage area 6-1 can receive a program broadcasted from the broadcast antenna 5-1 of the broadcast station 4-1. Although not shown in FIG. 1, an external apparatus 52 (see FIG. 2) is connected to the program reception control apparatus 2-1.

[0057] A broadcast station 4-2 broadcasts a program which includes video signals and audio signals, from a broadcast antenna 5-2. A reception coverage area 6-2 surrounded by a dotted line indicates an area in which the

audience can receive a program broadcasted from the broadcast antenna 5-2, via a reception unit to view the program.

[0058] The program reception control apparatus 2-2 installed within the reception coverage area 6-2, can receive a program broadcasted from the broadcast antenna 5-2 of the broadcast station 4-2. Although not shown in FIG. 1, an external apparatus is connected to the program reception control apparatus 2-2.

[0059] The program reception control apparatuses 2-1 and 2-2 are basically similar in configuration, and if it is not necessary to distinguish individually, they are collectively called as a program reception control apparatus 2. The same applies to the other configurations in the description below.

[0060] The terminal apparatus 3 is an apparatus which plays back and outputs a video and an audio, and is carried by a user, for example. Because the terminal apparatus 3 is installed outside the reception coverage area 6 in FIG. 1, the video and the audio of a program is not able to be outputted by directly receiving the program broadcasted from the broadcast antenna 5.

[0061] Next, FIG. 2 shows an example of the detailed configuration of the program reception control apparatus 2.

[0062] Referring to FIG. 2, a tuner 71 selects a broadcast instructed by a CPU 79, among the received electric waves by a reception antenna 51, converts the video signal and the audio signal of the selected broadcast from analog to digital, generates video data and audio data (hereinafter, video data and audio data are collectively called AV data), and outputs the generated AV data to a switching unit 73.

[0063] An external AV input unit 72 outputs AV data supplied from the external apparatus 52 to the switching unit 73.

[0064] The switching unit 73 selects only one of AV data supplied from the tuner 71 and AV data supplied from the external AV input unit 72 according to an instruction from the CPU 79, and outputs the selected AV data to a compression unit 74.

[0065] The compression unit 74 compresses the AV data supplied from the switching unit 73 using a standard specification such as MPEG (Moving Picture Experts Group) 2 or MPEG4, and outputs the compressed AV data (hereinafter called as compressed data) to an encryption unit 75. The compression unit 74 compresses the AV data at a compression rate instructed by the CPU 79.

[0066] The encryption unit 75 encrypts the compressed data supplied from the compression unit 74 based on a predetermined encryption method in accordance with the instruction from the CPU 79, and outputs the encrypted compressed data to a packet creation unit 76.

[0067] The packet creation unit 76 creates packets by segmenting the encrypted compressed data supplied from the encryption unit 75 into a predetermined size according to the instruction from the CPU 79 and by adding header information and so on, and then outputs the created packets to a network interface (I/F) 77.

[0068] The network interface 77 transmits the packets supplied from the packet creation unit 76 to the terminal apparatus 3 via the Internet 1. Also, when information is

received from the terminal apparatus 3, the network interface 77 supplies the received information to the CPU 79.

[0069] An operation unit 78 is configured to have, for example, a plurality of buttons and dials, accepts an operation input from the user, and outputs the operation signal based on the accepted operation to the CPU 79.

[0070] The CPU 79 controls the whole operation of the program reception control apparatus 2 based on the operation signal supplied from the operation unit 78 and based on the information supplied from the network interface 77 and received from the terminal apparatus 3. For example, the CPU 79 controls the selection of broadcast station by the tuner 71, the switching of AV data to be selected by the switching unit 73, the compression rate used when the AV data is compressed by the compression unit 74, and the operation of the encryption unit 75, packet creation unit 76, and network interface 77. When external apparatus control information for controlling the external apparatus 52 is received from the terminal apparatus 3, the CPU 79 supplies this information to an external apparatus controller 80.

[0071] The external apparatus controller 80 transmits a control signal for controlling the operation of the external apparatus 52 to the external apparatus 52 based on the external apparatus control information supplied from the CPU 79. This control signal may be transmitted via a cable or transmitted wirelessly. For example, when the external apparatus 52 is able to be controlled by a remote commander provided on the external apparatus 52 via infrared communication, the external apparatus controller 80 transmits the control signal to the external apparatus 52 via infrared communication that is the same as that used by the remote commander.

[0072] For example, if the external apparatus 52 is a video tape recorder, the control signal output from the external apparatus controller 80 can be a signal instructing playback, stop, fast-forward, or rewind to the external apparatus 52. If the external apparatus 52 is a TV game machine, the control signal can be a signal based on an operation that is input to the terminal apparatus 3 by the user.

[0073] The external apparatus 52 is an electronic unit connected to the program reception control apparatus 2. The external apparatus 52, for example, a video tape recorder, a DVD (Digital Versatile Disc) recorder, a hard disk recorder, or a TV game machine, controls its own operation based on the control signal from the external apparatus controller 80 and outputs AV data, as necessary to the external input unit 72. It is, of course, possible to connect a plurality of external apparatuses to the program reception control apparatus 2.

[0074] Next, FIG. 3 shows an example of the internal configuration of the terminal apparatus 3.

[0075] Referring to FIG. 3, a network interface (I/T) 101 receives packets from the program reception control apparatus 2 via the Internet 1, and supplies received packets to a rearrangement unit 102. When various instructions from the program reception control apparatus 2 are received, the network interface 101 notifies them to a CPU 110.

[0076] The rearrangement unit 102 extracts data, which is included in the packets supplied from the network interface 101 and segmented into a predetermined size, rearranges the data into a sequence of the original data, and outputs the

rearranged data to a decryption unit **103**. The rearranged data is the encrypted compressed data.

[0077] The decryption unit **103** decrypts the encrypted compressed data supplied from the rearrangement unit **102**, using the decryption method corresponding to the encryption method of the encryption unit **75**, and outputs thus decrypted compressed data to a expansion unit **104**.

[0078] The expansion unit **104** expands the compressed data supplied from the decryption unit **103** based on the compression (encoding) standard of the compression unit **74**, and outputs the expanded data, that is, the video data of the original AV data to a video output unit **105**, and the audio data to an audio output unit **107**.

[0079] The video output unit **105** outputs the video signal to a monitor **106** based on the video data supplied from the expansion unit **104**. The video output unit **105** also outputs the video signal such as a predetermined guide screen image to the monitor **106** according to an instruction from the CPU **110**. The monitor **106** is configured with a liquid crystal display, for example, and displays a video based on the video signal supplied from the video output unit **105**.

[0080] The audio output unit **107** supplies the audio signal to a speaker **108** based on the audio data supplied from the expansion unit **104**. The speaker **108** outputs an audio sound based on the audio signal supplied from the audio output unit **107**.

[0081] An operation unit **109** is configured with buttons, dials, a touch panel, and so on, accepts an operation input from the user, and outputs the operation signal to the CPU **110** based on the accepted operation.

[0082] The CPU **110** controls the whole operation of the terminal apparatus **3** based on the operation signal supplied from the operation unit **109**, and also based on the instructions from the program reception control apparatus **2**. The CPU **110** also creates control information for controlling the operation of the tuner **71**, the switching unit **73**, the compression unit **74**, and the external apparatus **52** of the program reception control apparatus **2**, for example, based on the operation signal from the operation unit **109**, and transmits the created control information through the network interface **10** to the program reception control apparatus **2**.

[0083] Note that the terminal apparatus **3** is not limited to the example shown in **FIG. 3** but may take various forms as long as the terminal apparatus is able to execute a sequence of processing that will be described later. For example, the terminal apparatus **3** may be a portable terminal apparatus or a cellular phone that the user can carry.

[0084] Next, the viewing control processing of the terminal apparatus **3** will be described with reference to the flowchart in **FIG. 4**.

[0085] In step S1, the CPU **110** instructs the display of the program reception control apparatus selection screen image on the monitor **106** to the video output unit **105**. The video output unit **105** causes the monitor **106** to display the program reception control apparatus selection screen image according to the instruction from the CPU **110**. The program reception control apparatus selection screen image is a guide screen image for allowing the user to select the program reception control apparatus of the communication opponent

among plural program reception control apparatuses (for example, program reception control apparatuses **2-1** and **2-2** in **FIG. 1**); for example, the screen has icons corresponding to the program reception control apparatuses **2-1** and **2-2**. The user can operate the operation unit **109** while watching this program reception control apparatus selection screen image in order to select a desired program reception control apparatus. When one program reception control apparatus is selected by the user, the processing goes to step S2.

[0086] In step S2, the CPU **110** instructs the display of the viewing guide screen image on the monitor **106** to the video output unit **105**. The video output unit **105** causes the monitor **106** to display the viewing guide screen image according to the instruction from the CPU **110**. The viewing guide screen image is a screen image for allowing the user to select a broadcast station (channel) or the external apparatus **52**; for example, an image imitating the buttons on the remote commander is displayed. The user can operate the operation unit **109** to give a program viewing instruction to select a broadcast station (channel) to be used for viewing, or to select the external apparatus **52** while watching this viewing guide screen image.

[0087] In step S3, the CPU **110** checks whether the user issues a viewing instruction based on the operation signal from the operation unit **109**, and remains in the wait state by repeating the processing of step S3 until a viewing instruction is given by the user. When a viewing instruction is given by the user, the processing goes to step S4.

[0088] In step S4, the CPU **110** accesses the program reception control apparatus **2** selected by the user in step S1 through the network interface **101** via the Internet **1** to execute authentication processing for connection to the program reception control apparatus **2**. If the authentication is successful, the processing goes to step 5. If the authentication is unsuccessful, the CPU **110** instructs the display of the authentication error guide on the monitor **106** to the video output unit **105**. The authentication processing in step S4 will be described in detail later with reference to the flowchart in **FIG. 7**.

[0089] In step S5, the CPU **110** requests the transmission of the AV data of a user-specified broadcast station or the external apparatus **52** to the program reception control apparatus **2** that authentication is completed, through the network interface **101** via the Internet **1**. The subsequent processing is performed to or from the program reception control apparatus **2** for which the authentication is completed in step S4. The communication between the program reception control apparatus **2** and the terminal apparatus **3** is performed via the Internet **1** and, therefore, the communication via the Internet **1** is not mentioned in the description below.

[0090] In step S6, the CPU **110** instructs the start of operation to the expansion unit **104**. The expansion unit **104** starts operation according to the instruction from the CPU **110**. The expansion unit **104** starts operation in step S6 and, after starting the operation, continues expansion processing until step S15 that will be described later is reached.

[0091] In response to the request from the terminal apparatus **3**, the program reception control apparatus **2** transmits packets including the AV data. Therefore, in step S7, the network interface **101** starts receiving the packets from the

program reception control apparatus 2. The network interface 101 supplies the received packets to the rearrangement unit 102.

[0092] In step S8, the rearrangement unit 102 extracts segmented data from the packets supplied from the network interface 101, and starts rearranging of the original data (encrypted compressed data). The rearrangement unit 102 supplies the rearranged data to the decryption unit 103. After starting the data rearrangement processing in step S8, the rearrangement unit 102 continues rearrangement processing until step S17 that will be described later is reached.

[0093] In step S9, the decryption unit 103 starts decrypting the encrypted compressed data supplied from the rearrangement unit 102 based on the encryption method. The decryption unit 103 supplies the decrypted data, that is, the compressed data to the expansion unit 104. The decryption unit 103 starts decryption processing in step S9 and then continues decryption processing until step S16 that will be described later is reached.

[0094] In step S10, the expansion unit 104 starts expanding the compressed data supplied from the decryption unit 103. The expansion unit 104 supplies the video data included in the expanded AV data to the video output unit 105, and supplies the audio data to the audio output unit 107. The expansion unit 104 starts expanding the compressed data in step S10 and then continues expansion processing until step S15 that will be described later is reached.

[0095] In step S1, the video output unit 105 starts supplying the video signal to the monitor 106 based on the video data supplied from the expansion unit 104. This enables the video to be displayed on the monitor 106 based on the video data supplied from the program reception control apparatus 2. Also, in step S11, the audio output unit 107 starts supplying the audio signal to the speaker 108 based on the audio data supplied from the expansion unit 104. This enables the sound to be output from the speaker 108 based on the audio data supplied from the program reception control apparatus 2. The video output unit 105 starts displaying the video on the monitor 106 in step S11 and then continues displaying the video on the monitor 106 until step S13 that will be described later is reached. The audio output unit 107 starts outputting the sound from the speaker 108 in step S11 and then continues outputting the sound from the speaker 108 until step S13 that will be described later is reached.

[0096] After the processing in step S11 in FIG. 4, the CPU 110 checks if the user issues a termination of viewing instruction based on the operation signal from the operation unit 109 in step S12 in FIG. 5 and, until the termination of viewing instruction is received, remains in the wait state by repeating the processing in step S12. During this time, too, the network interface 101 continues to receive packets, the rearrangement unit 102 continues to rearrange the original data, the decryption unit 103 continues to decrypt the encryption, the expansion unit 104 continues to expand the AV data, the video output unit 105 continues to display the video on the monitor 106, and the audio output unit 107 continues to output the sound from the speaker 108. Executing the processing of the network interface 101, the rearrangement unit 102, the decryption unit 103, the expansion unit 104, the video output unit 105, and the audio output unit 107 at the same time and in parallel as described above

allows the video to be displayed, and the sound to be output in real time based on the AV data received by the program reception control apparatus 2 so that the user can view it.

[0097] If the CPU 110 finds that a termination of viewing instruction is received from the operation unit 109 in step S12, the processing goes to step S13.

[0098] In step S13, the CPU 110 instructs the termination of the display of the video, received from the program reception control apparatus 2 onto the monitor 106 to the video output unit 105 and, at the same time, instructs the termination of the output of the sound, received from the program reception control apparatus 2 from the speaker 108 to the audio output unit 107. The video output unit 105 terminates the display of the video, received from the program reception control apparatus 2 onto the monitor 106 according to the instruction from the CPU 110. The audio output unit 107 terminates the output of the sound received from the program reception control apparatus 2 from the speaker 108 according to the instruction from the CPU 110.

[0099] In step S14, the CPU 110 transmits a termination of program viewing instruction from the network interface 101 to the program reception control apparatus 2 via the Internet 1.

[0100] In step S15, the CPU 110 instructs the termination of the expansion of the compressed data to the expansion unit 104. The expansion unit 104 terminates the expansion of the compressed data according to the instruction from the CPU 110.

[0101] In step S16, the CPU 110 instructs the termination of the decryption of the encrypted compressed data to the decryption unit 103. The decryption unit 103 terminates the decryption of the encrypted compressed data according to the instruction from the CPU 110.

[0102] In step S17, the CPU 110 instructs the termination of the rearrangement of the data segmented into packets to the rearrangement unit 102. The rearrangement unit 102 terminates the rearrangement of the data, segmented into packets according to the instruction from the CPU 110.

[0103] In step S18, the CPU 110 puts itself in the wait state. After that, the processing returns to step S1 to repeat the processing described above beginning with step S1.

[0104] As described above, the viewing control processing of the terminal apparatus 3 is executed.

[0105] Next, the viewing control processing of the program reception control apparatus 2 will be described with reference to the flowchart in FIG. 6.

[0106] In step S51, the CPU 79 performs authentication processing for authenticating the terminal apparatus 3 when the terminal apparatus 3 accesses the program reception control apparatus 2. If the terminal apparatus 3 is authenticated and the connection of the terminal apparatus 3 to the program reception control apparatus 2 is permitted as the result of authentication processing, the processing goes to step S52. If the connection from the terminal apparatus 3 to the program reception control apparatus 2 is not permitted as the result of the authentication processing, the processing does not go to step S52. The authentication processing in step S51 will be described in detail later with reference to the flowchart in FIG. 8.

[0107] The AV data is supplied from the tuner 71 and the external apparatus 52 to the switching unit 73. Thus, the compression unit 74 starts compressing the AV data supplied from the switching unit 73 in step S52. The compression unit 74 supplies the compressed data to the encryption unit 75. The compression unit 74 starts compression processing in step S52 and continues the compression processing until step 60 that will be described later is reached.

[0108] In step S53, the encryption unit 75 starts encrypting the compressed data supplied from the compression unit 74. The encryption unit 75 supplies the encrypted compressed data to the packet creation unit 76. The encryption unit 75 starts encrypting the compressed data in step S53, and continues the encryption processing until step S59 that will be described is reached.

[0109] In step S54, the packet creation unit 76 starts segmenting the encrypted compressed data supplied from the encryption unit 75 into plural packets. The packet creation unit 76 supplies the created packets to the network interface 77. The packet creation unit 76 starts packet creation in step S54 and then continues packet creation until step S58 that will be described later is reached.

[0110] In step S55, the network interface 77 starts transmitting the packets supplied from the packet creation unit 76, to the terminal apparatus 3 via the Internet 1. The network interface 77 starts packet transmission in step S55, and continues the packet transmission processing until step S57 that will be described later is reached.

[0111] In step S56, the CPU 79 checks if a termination of viewing notification is received from the terminal apparatus 3 via the network interface 77, and remains in the wait state by repeating the processing in step S5.6 until a viewing end notification is received from the terminal apparatus 3. During that time, too, the compression unit 74 continues to compress the AV data, the encryption unit 75 continues to encrypt the compressed data, the packet creation unit 76 continues to segment the encrypted compressed data into packets, and the network interface 77 continues to transmit the packets to the terminal apparatus 3. Executing the processing of the compression unit 74, the encryption unit 75, the packet creation unit 76, and the network interface 77 at the same time and in parallel as described above allows the video and the sound of the program being broadcasted to be converted to AV data in real time and to be transmitted to the terminal apparatus 3. Because the terminal apparatus 3 displays in real time the AV data (and outputs the sound) supplied from the program reception control apparatus 2, the user can view a program broadcasted by a broadcast station 4 in real time at the program broadcast time as if the user is a viewer in the reception coverage area 6.

[0112] If it is found that the CPU 79 receives a termination of viewing notification from the terminal apparatus 3 in step S56, the processing goes to step S57.

[0113] In step S57, the network interface 77 terminates the transmission of packets to the terminal apparatus 3.

[0114] In step S58, the packet creation unit 76 terminates the creation of packets.

[0115] In step S59, the encryption unit 75 terminates the encryption of the compressed data.

[0116] In step S60, the compression unit 74 terminates the compression of the AV data.

[0117] After that, the processing returns to step S51 and the processing of step S51 and the following steps described above is repeated.

[0118] The viewing control processing described above allows the user to view a broadcast program using the terminal apparatus 3 even if the user is outside the reception coverage area 6.

[0119] Next, the authentication processing in step S4 in FIG. 4 will be described with reference to the flowchart in FIG. 7.

[0120] In step S101 in FIG. 7, the CPU 110 issues an authentication request from the network interface 101 to the program reception control apparatus 2 selected in step S1 in FIG. 4.

[0121] The program reception control apparatus 2 requests the transmission of authentication data to the terminal apparatus 3 in step S152 in FIG. 8 that will be described later. Thus, in step S102, the network interface 101 receives the request for authentication data from the program reception control apparatus 2, and notifies the request to the CPU 110.

[0122] In step S103, the CPU 110 instructs the display of an authentication data entry screen image on the monitor 106 for receiving authentication data to the video output unit 105. The authentication data is, for example, a pre-set character string, and the user can enter the character string of authentication data by operating the operation unit 109.

[0123] Then, the operation unit 109 accepts the entry of authentication data from the user in step S104.

[0124] In step S105, the CPU 110 transmits the authentication data entered in step S104 from the network interface 101 to the program reception control apparatus 2.

[0125] After that, if the program reception control apparatus 2 succeeds in authenticating the terminal apparatus 3 and the transmission of AV data to the terminal apparatus 3 is permitted, a permission notification permitting the transmission of the AV data is transmitted from the program reception control apparatus 2 to the terminal apparatus 3. On the other hand, if the program reception control apparatus 2 does not succeed in authenticating the terminal apparatus 3, an authentication error notification is transmitted from the program reception control apparatus to the terminal apparatus 3.

[0126] So, in step S106, the CPU 110 checks if an authentication error is notified from the program reception control apparatus 2 and, if an authentication error is notified, the processing goes to step S107.

[0127] In step S107, the CPU 110 instructs the display of a guide on the monitor 106 to the video output unit 105 to indicate that the authentication fails. The monitor 106 displays this guide as well as a guide indicating that authentication data may be accepted again. The user can operate the operation unit 109 to enter authentication data again according to this guide. After the processing in step S107, the processing returns to step S104 and the processing of step S104 and the following steps described above is repeated.

[0128] If the CPU 110 finds that no authentication error is notified from the program reception control apparatus 2 in step S106, the processing goes to step S108.

[0129] The CPU 110 checks if the transmission permission of AV data is notified from the program reception control apparatus 2 via the network interface 101 in step S108. If the transmission permission of AV data is not notified from the program reception control apparatus 2, the processing returns to step S106 and the processing of step S106 and the following steps described above is repeated. If the CPU 110 finds that the transmission permission of AV data is notified in step S108, the authentication processing is terminated and the processing goes to step S5 in FIG. 4.

[0130] The authentication processing of the terminal apparatus 3 is executed as described above.

[0131] Although the entry of authentication data from the user is described as an example in the above description, it is also possible to store authentication data in advance in the terminal apparatus 3 and, when authentication data is requested from the program reception control apparatus 2, to transmit the authentication data, stored in advance, to the program reception control apparatus 2.

[0132] Next, the authentication processing in step S51 in FIG. 6 will be described in detail with reference to the flowchart in FIG. 8.

[0133] In step S151 in FIG. 8, the CPU 79 checks if an authentication request is received from the terminal apparatus 3, and remains in the wait state until the authentication request is received from the terminal apparatus 3 by repeating the processing in step S151. If an authentication request is received from the terminal apparatus 3 in step S101 in FIG. 7, the CPU 79 finds that the authentication request is received from terminal apparatus 3 in step S151 and the processing goes to step S152.

[0134] In step S152, the CPU 79 requests the transmission of authentication data to the terminal apparatus 3 via the network interface 77.

[0135] The terminal apparatus 3 transmits authentication data to the program reception control apparatus 2 in step S105 in FIG. 7. In step S153, the CPU 79 checks if the reception of the authentication data from the terminal apparatus 3 is completed normally. If the reception of the authentication data from the terminal apparatus 3 is not completed normally, the processing returns to step S151 and the processing of step S151 and the following steps described above is repeated.

[0136] If the CPU 79 finds that the reception of the authentication data from the terminal apparatus 3 is completed normally in step S153, the processing goes to step S154.

[0137] The program reception control apparatus 2 holds authentication data for authenticating the terminal apparatus 3, in advance, in advance. In step S154, the CPU 79 checks if the authentication data received from the terminal apparatus 3 matches the authentication data held in advance. If the authentication data received from the terminal apparatus 3 does not match the authentication data held in advance, the processing goes to step S155.

[0138] In step S155, the CPU 79 notifies an authentication error to the terminal apparatus 3 via the network interface

77, and requests the retransmission of the authentication data to the terminal apparatus 3.

[0139] In step S107 in FIG. 7, the terminal apparatus 3 causes the monitor 106 to display the guide of the authentication error, accepts the entry of authentication data again in step S104, and again transmits the authentication data to the program reception control apparatus 2 in step S105.

[0140] After step S155, the processing returns to step S153, and the processing in step S153 and the following steps described above are repeated. That is, the CPU 79 checks if the reception of the retransmitted authentication data is completed normally in step S153 and, if the reception of the authentication is completed normally, the CPU 79 checks if the authentication data received from the terminal apparatus 3 matches the authentication data held in advance in step S154.

[0141] As described above, the processing from step S153 to step S155 is repeated until the authentication data received from the terminal apparatus 3 matches the authentication data held in advance. If the CPU 79 finds that the authentication data received from the terminal apparatus 3 matches the authentication data held in advance in step S154, the processing goes to step S156.

[0142] In step S156, the CPU 79 transmits the notification for the permission of transmission of AV data to the terminal apparatus 3 to the terminal apparatus 3 via the network interface 77. After that, the processing goes to step S52 in FIG. 6.

[0143] The authentication processing of the program reception control apparatus 2 is performed as described above.

[0144] The authentication processing described above prevents others from illegally acquiring AV data from the program reception control apparatus 2 and viewing it.

[0145] An information processing system, to which the present invention is applied, allows the terminal apparatus 3 to control the operation of the tuner 71, the switching unit 73, and the compression unit 74 of the program reception control apparatus 2 and the external apparatus 52 after the transmission of AV data to the terminal apparatus is permitted through the authentication processing. In that case, control information for controlling the operation of the program reception control apparatus 2 or the external apparatus 52 is transmitted to the authenticated program reception control apparatus 2 from the terminal apparatus 3.

[0146] Next, the control information transmission processing of the terminal apparatus 3 will be described with reference to the flowchart in FIG. 9.

[0147] In step S201, the CPU 110 checks if the user specifies a channel based on the operation signal from the operation unit 109 and, if the user specifies a channel, the processing goes to step S202.

[0148] In step S202, the CPU 110 transmits control information which requests a channel change including channel information indicating a channel is specified, to the program reception control apparatus 2 via the network interface 101. After that, the processing returns to step S201, and the processing of step S201 and the following steps described above are repeated.

[0149] If the CPU 110 finds that the user does not specify a channel in step S201, the processing goes to step S203.

[0150] In step S203, the CPU 110 checks if the switching of input is instructed by the user based on the operation signal from the operation unit 109. If the switching of input is instructed by the user, the processing goes to step S204.

[0151] In step S204, the CPU 110 transmits control information which requests to switch the input to the program reception control apparatus 2 via the network interface 101. After that, the processing returns to step S201 and the processing of step S201 and the following steps described above are repeated.

[0152] If the CPU 110 finds that the switching of input is not instructed by the user in step S203, the processing goes to step S205.

[0153] In step S205, the CPU 110 checks if the operation of the external apparatus 52 is instructed by the user based on the operation signal from the operation unit 109. If the operation of the external apparatus 52 is instructed by the user, the processing goes to step S206.

[0154] In step S206, the CPU 110 transmits control information including operation information specifying the contents of operation (for example, playback, stop, fast forward, rewind, or the like) to be performed for the program reception control apparatus 2, to the external apparatus 52 via the network interface 101. After that, the processing returns to step S201 and the processing of step S201 and the following steps described above are repeated.

[0155] If the CPU 110 finds that the operation of the external apparatus 52 is not instructed by the user in step S205, the processing goes to step S207.

[0156] In step S207, the CPU 110 checks if a packet transmission rate change is instructed by the user based on the operation signal from the operation unit 109. If a packet transmission rate change is instructed by the user, the processing goes to step S208.

[0157] In step S208, the CPU 110 transmits control information including the user-specified transmission rate to the program reception control apparatus 2 via the network interface 101. After that, the processing returns to step S201 and the processing of step S201 and the following steps described above are repeated.

[0158] If the CPU 110 finds that the packet transmission rate change is not instructed in step S207, the processing returns to step S201 and the processing of step S201 and the following steps described above are repeated.

[0159] The control information transmission processing of the terminal apparatus 3 is executed as described above.

[0160] The program reception control apparatus 2, which receives the control information from the terminal apparatus 3, controls its own operation based on the received control information.

[0161] Next, the control execution processing of the program reception control apparatus 2 will be described with reference to the flowchart in FIG. 10.

[0162] In step S251, the CPU 79 checks if control information including a channel change request is received from

terminal apparatus 3. If control information including a channel change request is received, the processing goes to step S252.

[0163] In step S252, the CPU 79 identifies the channel to be selected based on the channel information included in the control information, and instructs the selection of the specified channel to the tuner 71.

[0164] In step S253, the tuner 71 selects the specified channel according to the instruction from the CPU 79. After that, the processing returns to step S251, and the processing of step S251 and the following steps described above are repeated.

[0165] If the CPU 79 finds that control information including a channel change request is not received from the terminal apparatus 3 in step S251, the processing goes to step S254.

[0166] In step S254, the CPU 79 checks if control information including an input switching request is received from the terminal apparatus 3. If control information including the input switching request is received, the processing goes to step S255.

[0167] In step S255, the CPU 79 requests the switching of the AV data to be output to the compression unit 74 to the switching unit 73.

[0168] In step S256, the switching unit 73 switches the AV data to be output to the compression unit 74 according to the instruction from the CPU 79. That is, if the AV data supplied originally from the tuner 71 is outputted to the compression unit 74, the switching unit 73 performs the processing of step S256 so that the AV data supplied from the external AV input unit 72 is switched and outputted to the compression unit 74. Conversely, if the AV data supplied originally from the external AV input unit 72 is outputted to the compression unit 74, the switching unit 73 performs the processing of step S256 so that the AV data supplied from the tuner 71 is switched and outputted to the compression unit 74. After the processing of step S256, the processing returns to step S251 and the processing of step S251 and the following steps described above are repeated.

[0169] If the CPU 79 finds that control information including an input switching request is not received from the terminal apparatus 3 in step S254, the processing goes to step S257.

[0170] In step S257, the CPU 79 checks if control information including operation information for operating the external apparatus 52 is received from the terminal apparatus 3. If the control information including operation information for operating the external apparatus 52 is received from the terminal apparatus 3, the processing goes to step S258.

[0171] In step S258, the CPU 79 supplies operation information which is included in the received control information and which includes the contents of operation on the external apparatus 52, to the external apparatus controller 80, and instructs the control of the external apparatus 52 based on the operation information to the external apparatus controller 80.

[0172] In step S259, the external apparatus controller 80 identifies the contents of operation on the external apparatus

52 based on the operation information supplied from the CPU **79**, generates the control signal for causing the external apparatus **52** to execute the identified contents of operation, and outputs the generated control signal (for example, control signal such as playback, stop, fast forward, rewind, or the like) to the external apparatus **52**. The external apparatus **52** controls its own operation based on the control signal supplied from the external apparatus controller **80**. For example, if the control signal for playback is received from the external apparatus controller **80**, the external apparatus **52** starts playing back the AV data. After the processing of step **S259**, the processing returns to step **S251** and the processing of step **S251** and the following steps described above are repeated.

[**0173**] If the CPU **79** finds that control information including operation information for operating the external apparatus **52** is not received from the terminal apparatus **3** in step **S257**, the processing goes to step **S260**.

[**0174**] In step **S260**, the CPU **79** checks if control information including a packet transmission rate change request is received from the terminal apparatus **3**. If the control information including a packet transmission rate change request is received from the terminal apparatus **3**, the processing goes to step **S261**.

[**0175**] In step **S261**, the CPU **79** instructs the change of the compression rate used to compress the AV data to the compression unit **74**.

[**0176**] In step **S262**, the compression unit **74** changes the compression rate used to compress the AV data according to the instruction from the CPU **79**.

[**0177**] In step **S263**, the CPU **79** changes the transmission rate by changing the size of a packet to be transmitted from the network interface **77** to the terminal apparatus **3**. After that, the processing returns to step **S251**, and the processing of step **S251** and the following steps described above are repeated.

[**0178**] If the CPU **79** finds that the control information including a packet transmission rate change request is not received from the terminal apparatus **3** in step **S260**, the processing returns to step **S251**, and the processing of step **S251** and the following steps described above are repeated.

[**0179**] As described above, the control execution processing of the program reception control apparatus **2** is executed.

[**0180**] The control information transmission processing and the control execution processing described above allow the user to remotely specify the operation of the program reception control apparatus **2** and the external apparatus **52**. In addition, the control signal that is outputted from the external apparatus controller **80** to the external apparatus **52** allows the user to utilize the external apparatus **52** originally owned by the user.

[**0181**] As described above, any broadcast can be viewed in real time even in an area other than reception coverage area **6** according to the present invention. In addition, the external apparatus **52** originally owned by the user can be utilized.

[**0182**] Although an information processing system to which the present invention is applied is described using the example in **FIG. 1**, the information processing system to

which the present invention is applied is not limited to the example in **FIG. 1**, but may take various forms.

[**0183**] More specifically, an information processing system to which the present invention is applied may also be configured, for example, as shown in **FIG. 11** and **FIG. 12**. That is, **FIG. 11** and **FIG. 12** are diagrams showing other configuration examples of an information processing system to which the present invention is applied.

[**0184**] In the information processing systems in **FIG. 11** and **FIG. 12**, base stations **2-1** and **2-2** are used as the program reception control apparatuses **2-1** and **2-2**. In addition, three display apparatuses **3A** to **3C** are used as the terminal apparatus **3**.

[**0185**] The base station **2-1**, which has a communication antenna **202**, can communicate wirelessly with each of the display apparatus **3A** that has a communication antenna **251A**, the display apparatus **3B** that has a communication antenna **251B**, and the display apparatus **3C** that has a communication antenna **251C**. (Hereinafter, if there is no need to distinguish among display apparatuses **3A** to **3C**, they are referred collectively to the display apparatus **3**. This applies to the various components included therein).

[**0186**] The base station **2-1** has a television broadcast receiving antenna **201**. The base station **2-1** is installed within the reception coverage area **6-1**. Therefore, the base station **2-1** can receive a program broadcast from the broadcast antenna **5-1** of the broadcast station **4-1**. That is, the base station **2-1** selects a predetermined broadcast from the received electric wave received via the television broadcast receiving antenna **201**, generate the AV data of the selected broadcast program, and compress the data according to a standard specification such as MPEG2 or MPEG4 to generate compressed data. In addition, the base station **2-1** can encrypt the compressed data, segment the data into packets, and transmit the packets via the communication antenna **202** to the display apparatus **3**.

[**0187**] The display apparatus **3** receives the compressed data via a communication antenna **251** and converts the data to the original AV data. More precisely, the display apparatus **3** that receives a plurality of packets extracts data included in each packet and segmented into a predetermined size, and rearranges the extracted data into the original sequence of data. Because the rearranged data is the encrypted compressed data, the display apparatus **3** decrypts the encrypted compressed data, and expands it according to the compression (encoding) standard of the base station **2-1**. This expanded data is the original AV data.

[**0188**] In addition, the display apparatus **3** converts the AV data into the video signal and the audio signal, displays the video corresponding to the video signal on a display unit **252**, and outputs the sound corresponding to the audio signal from speakers **253-1** and **253-2**.

[**0189**] In this way, the display apparatus **3** can receive a program broadcasted from the broadcast station **4-1**, via the base station **2-1**, and plays it back. This allows the user to view the program while freely moving around with the display apparatus **3**.

[**0190**] In other words, the base station **2-1** can execute each of the viewing control processing of the program reception control apparatus in **FIG. 6** as described above,

the authentication processing of the program reception control apparatus in FIG. 8 as described above, and the control execution processing of the program reception control apparatus in FIG. 10 as described above. Further, the display apparatus 3 can execute each of the viewing control processing of the terminal apparatus in FIG. 4 and FIG. 5 as described above, the authentication processing of the terminal apparatus in FIG. 7 as described above, and the control information transmission processing of the terminal apparatus in FIG. 9 as described above.

[0191] If the base station 2-1 and the display apparatus 3 transfer various information between them via wireless communication, not via the Internet 1, as shown in FIG. 11, the authentication processing in FIG. 7 and FIG. 8 may be omitted.

[0192] It should be noted that, as shown in FIG. 11, the base station 2-1 may also be connected to the Internet 1.

[0193] Another base station 2-2 may have the function and the configuration basically similar to that of the base station 2-1. That is, the other base station 2-2 can also execute each of the viewing control processing of the program reception control apparatus in FIG. 6 as described above, the authentication processing of the program reception control apparatus in FIG. 8 as described above, and the control execution processing of the program reception control apparatus in FIG. 10 as described above and, in addition, connect to the Internet 1.

[0194] Therefore, the display apparatus 3 can also transmit and receive various information to or from the other base station 2-2 via the base station 2-1 and the Internet 1.

[0195] This allows the user, who uses the display apparatus 3, to remotely specify the operation of the other base station 2-2. As a result, a broadcast from the broadcast station 4-2 can be viewed (can be played back on the display apparatus 3) in real time even when the user (display apparatus 3) is in an area other than the reception coverage area 6-2 of the broadcast station 4-2 as shown in FIG. 11.

[0196] In response to a URL (Uniform Resource Locator) entered from the display apparatus 3 by the user and notified via the communication antenna 202, the base station 2-1 can also access a WWW (World Wide Web) server, which is specified by the URL and connected to the Internet 1 but not shown in the figure, and obtain a Web page described, for example, in HTML (Hyper Text Markup Language) format. The obtained Web page is compressed by a predetermined compression method, transmitted via the communication antenna 202 to the display apparatus 3, and is displayed on the display unit 252 of the display apparatus 3. This allows the user to use various contents on the Internet 1, while freely moving around, by operating the display apparatus 3 in the same manner in which the user views a (television broadcast) program. In addition, the user can operate the display apparatus 3 to transmit and receive E-mails to or from another information processing apparatus, which is connected to the Internet 1 but not shown in the figure, for example, a personal computer owned by some other user.

[0197] Each of the display apparatuses 3 has a memory card slot 254 into which a removable memory card (trade-mark) 301 can be inserted. The memory card 301 contains a nonvolatile flash memory in which various information can be stored. For example, the user can store an image

(data) photographed by a digital still camera into the memory card 301, and insert the memory card 301 into the memory card slot 254 to display the photographed image on the display unit 252. The user can also take a favorite snap (still image or short moving image) of a program which is displayed on the display unit 252 into the memory card 301, and plays it back later on the display unit 252.

[0198] In addition, the user can use the memory card 301 to install various programs stored in that card into the display apparatus 3.

[0199] In the mean time, the display apparatus 3 can connect also to the Internet 1 directly as shown in FIG. 12. That is, the display apparatus 3 can also communicate (transmit and receive various information) with each of the base station 2-1 and the base station 2-2 via the Internet 1. In other words, the information processing system exactly similar to the mode (connection mode) shown in FIG. 1 can also be implemented easily by using the base station 2 and the display apparatus 3 as shown in FIG. 12.

[0200] Therefore, the user that uses the display apparatus 3 can remotely specify the operation of each of the base stations 2-1 and 2-2. As a result, even if the user (display apparatus 3) is outside the reception coverage area 6 of the broadcast station 4 as shown in FIG. 12, the user can view (play back on the display apparatus 3) a broadcast from the broadcast station 4 in real time.

[0201] In the description below, when the base stations 2-1 and 2-2 need not be distinguished individually, they are called collectively as the base station 2.

[0202] Furthermore, the base station 2 can be connected to a home network 311 built, for example, as a LAN (Local Area Network) as shown in FIG. 13. To this home network 311, the base station 2 as well as any number of external apparatuses 52 can be connected (In the example in FIG. 13, three external apparatuses 52A to 52C are connected. In the description below, they are collectively called as external apparatus 52 when they need not be distinguished individually). This allows the base station 2 to perform communication with, that is, to transmit and receive various information to or from, the external apparatuses 3 via the home network 311.

[0203] Therefore, the user can operate the display apparatus 3 to specify the operation of the external apparatus 52 connected to the home network 311 via the base station 2. The user can also utilize the originally owned external apparatus 52 by outputting the control signal from the base station 2 to the external apparatus 52.

[0204] Next, an example of the internal configuration of the base station 2 will be described with reference to FIG. 14. That is, FIG. 14 is a block diagram showing an example of the internal configuration of the base station 2.

[0205] A CPU 203 controls the operation of the components connected via a bus 204 in response to an instruction entered by the user through the operation of an input unit 210 and to an instruction transmitted from the display apparatus 3 via the communication antenna 202. That is, the CPU 203 corresponds to the CPU 79 in FIG. 2.

[0206] A ROM 205 stores the programs that are control programs used by the CPU 203 and that are programs for controlling the basic operation. A RAM 206 temporarily

stores the programs used by the CPU 203 and various data generated when processing is executed.

[0207] A program storage unit 207 for the display apparatus 3A stores the control program corresponding to the control program (control program stored in a program storage unit 262 in FIG. 15 that will be described later) of the display apparatus 3A. That is, for example, when the control program stored in the program storage unit 262 is started in the display apparatus 3A, the CPU 203 starts the control program stored in the display apparatus 3A program storage unit 207 for communication with the display apparatus 3A.

[0208] Similarly, a display apparatus 3B program storage unit 208 stores the control program corresponding to the control program of the display apparatus 3B, and a display apparatus 3C program storage unit 209 stores the control program corresponding to the control program of the display apparatus 3C.

[0209] The input unit 210 configured with a plurality of buttons or dials and so on accepts the input of a user operation, and outputs the operation signal generated based on the accepted operation to the CPU 203. That is, the input unit 210 corresponds to the operation unit 78 in FIG. 2.

[0210] A communication unit 211 configured with a MODEM, a terminal adapter, and so on transmits and receives various information to and from various information processing apparatuses connected to the Internet 1. For example, in the example in FIG. 11, the communication unit 211 of the base station 2-1 transmits and receives various information to and from the other base station 2-2 via the Internet 1. Also, in the example in FIG. 12, the communication unit 211 of the base station 2-1 transmits and receives various information to and from the other base station 2-2 and each of the display apparatuses 3A, 3B, and 3C via the Internet 1.

[0211] In addition, the communication unit 211 transmits and receives various information to and from various information processing apparatuses connected to the home network 311, for example, to and from each of the external apparatuses 52A, 52B, and 52C in the example in FIG. 13.

[0212] As described above, the communication unit 211 is thought of as a block having the functions of the external AV input unit 72, network I/F 77, and external apparatus controller 80 in FIG. 2. That is, the communication unit 211 corresponds to each of the external AV input unit 72, network I/F 77, and external apparatus controller 80 in FIG. 2.

[0213] A tuner 212 selects a broadcast instructed by the CPU 203 among the received electric waves received by the television broadcast receiving antenna 201, performs A/D conversion for the video signal and the audio signal of the selected broadcast to generate AV data, and outputs the generated AV data to a switching unit 213. That is, the tuner 212 corresponds to the tuner 71 in FIG. 2.

[0214] The switching unit 213 selects one of the AV data supplied from the tuner 212 and the AV data received by the communication unit 211 and supplied via the bus 204 according to the instruction from the CPU 203, and outputs it to a compression unit 214. That is, the switching unit 213 corresponds to the switching unit 73 in FIG. 2.

[0215] The compression unit 214 compresses the AV data supplied from the switching unit 213 using a standard specification such as MPEG2 or MPEG4, and outputs the resulting compressed data to an encryption unit 215. The compression unit 214 compresses the AV data at a compression rate instructed by the CPU 203. That is, the compression unit 214 corresponds to the compression unit 74 in FIG. 2.

[0216] The encryption unit 215 encrypts the compressed data supplied from the compression unit 214 based on a preset encryption method according to the instruction from the CPU 203, and outputs the encrypted compressed data to a packet creation unit 216. That is, the encryption unit 215 corresponds to the encryption unit 75 in FIG. 2.

[0217] The packet creation unit 216 segments the encrypted compressed data supplied from the encryption unit 215 into a predetermined size according to the instruction from the CPU 203, adds header information and so on to create a plurality of packets, and sequentially outputs each of the plurality of created packets to a transmission buffer 217. That is, the packet creation unit 216 corresponds to the packet creation unit 76 in FIG. 2.

[0218] The transmission buffer 217 holds the plurality of packets sequentially supplied from the packet creation unit 216, and sequentially supplies each the plurality of held packets to a transmission processing unit 218 or the communication unit 211 according to the timing instructed by the CPU 203. More precisely, when the mode of communication between the base station 2 and the display apparatus 3 is a wireless communication via the communication antenna 202 as shown in FIG. 11, the packets are supplied from the transmission buffer 217 to the transmission processing unit 218. On the other hand, when the mode of communication between the base station 2 and the display apparatus 3 is a communication via the Internet 1 as shown in FIG. 12, the packets are supplied from the transmission buffer 217 to the communication unit 211.

[0219] The transmission processing unit 218 performs modulation processing and D/A conversion processing (Digital/Analog conversion processing) for the data (packets) supplied from the transmission buffer 217, and supplies the resulting signal to a communication control unit 220.

[0220] The communication control unit 220 transmits the signal supplied from the transmission processing unit 218 via the communication antenna 202 to the display apparatus 3 that requests the signal (packets). The communication control unit 220 also receives the signal transmitted from the display apparatus 3 via the communication antenna 202, and supplies to a reception processing unit 219.

[0221] The reception processing unit 219 performs amplification processing, demodulation processing, A/D conversion processing, and so on for the signal supplied from the communication control unit 220, and supplies the resulting data to the CPU 203 and so on.

[0222] As described above, the base station 2 in FIG. 14 has the circuit blocks corresponding to each of all the components from the tuner 71 to the external apparatus controller 80 in FIG. 2. Therefore, as described above, the base station 2 in FIG. 14 can execute each of the viewing control processing of the program reception control apparatus in FIG. 6 as described above, the authentication

processing of the program reception control apparatus in FIG. 8 as described above, and the control execution processing of the program reception control apparatus in FIG. 10 as described above.

[0223] Next, an example of the internal configuration of the display apparatus 3 in FIG. 11 and FIG. 12 will be described with reference to FIG. 15. That is, FIG. 15 is a block diagram showing an example of the internal configuration of the display apparatus 3.

[0224] A main control unit 255 installs the control program stored in a built-in ROM, not shown, or stored in the program storage unit 262 into a RAM not shown based on the various instructions entered by the user through the operation of an operation input unit 256, and controls the whole operation of the display apparatus 3.

[0225] The main control unit 255 creates the control information for controlling the operation of the tuner 212, switching unit 213, and compression unit 214 of the base station 2 in FIG. 14 and the external apparatus 52 in FIG. 13, for example, based on the operation signal from the operation input unit 256, and transmits the created control information via the communication antenna 251 to the base station 2. Note that, when the display apparatus 3 is at a location where wireless communication cannot be made with the base station 2 and is connected to the Internet 1 as shown in FIG. 12 as described above, the main control unit 255 transmits the created control information from the Internet communication control unit 260 to the base station 2 via the Internet 1.

[0226] As described above, the main control unit 255 corresponds to the CPU 110 in FIG. 3.

[0227] The operation input unit 256 configured with buttons, dials, a touch panel, a touch pen, and so on, accepts the input of an operation from the user and, outputs the operation signal generated based on the accepted operation to the main control unit 255. That is, the operation input unit 256 corresponds to the operation unit 109 in FIG. 3.

[0228] The communication control unit 257 transmits the signal supplied from a transmission processing unit 258 to the base station 2 via the communication antenna 251. The communication control unit 257 receives the signal, transmitted from the base station 2, via the communication antenna 251, and supplies it to the reception processing unit 259.

[0229] The transmission processing unit 258 performs D/A conversion and modulation processing for data, for example, the control information supplied from the main control unit 255, and supplies the resulting signal to the communication control unit 257.

[0230] The reception processing unit 259 performs amplification processing, demodulation processing, A/D conversion processing, and so on for the signal supplied from the communication control unit 257, and supplies the resulting data to the main control unit 255. For example, the reception processing unit 259 performs various processing including the processing as described above for the television program signal supplied from the communication control unit 257, and supplies the resulting AV data (packets) to the main control unit 255.

[0231] The Internet communication control unit 260 configured with a MODEM, a terminal adapter, and so on, transmits and receives information to and from various information processing apparatuses connected to the Internet 1.

[0232] For example, if the display apparatus 3 is at a location where wireless communication cannot be made with the base station 2 as shown in FIG. 12 as described above and, at the same time, the Internet communication control unit 260 is connected to the Internet 1, the Internet communication control unit 260 transmits the control information supplied from the main control unit 255 to the base station 2 via the Internet 1. For example, if packets (AV data) are transmitted from the base station 2 via the Internet 1, the Internet communication control unit 260 receives them, and supplies them to the main control unit 255. In addition, if various instructions are transmitted from the base station 2 via the Internet 1, the Internet communication control unit 260 receives them, and supplies them to the main control unit 255.

[0233] As described above, the Internet communication control unit 260 corresponds to the network I/F 101 in FIG. 3.

[0234] A playback control unit 261 plays back AV data supplied from the main control unit 255. That is, the playback control unit 261 performs control processing for displaying the video corresponding to the AV data on the display unit 252, and for outputting the sound corresponding to the AV data from a speaker 253.

[0235] More in detail, the AV data supplied from the base station 2 are in the form of packets as described above. That is, through the base station 2, the AV data is compressed and encrypted, the resulting encrypted compressed data is divided (segmented into a predetermined size), and a plurality of packets containing each of the plurality of pieces of divided data are generated, and are transmitted to the display apparatus 3. The plurality of packets are accepted sequentially by the communication control unit 257 or the Internet communication control unit 260, and are supplied sequentially to the playback control unit 261 via the main control unit 255.

[0236] The playback control unit 261 extracts data from the plurality of packets sequentially supplied from the main control unit 255, and rearranges the extracted data into a sequence of data. The sequence of rearranged data is the encrypted compressed data.

[0237] Next, the playback control unit 261 decrypts the encrypted compressed data according to the decryption method corresponding to the encryption method of the encryption unit 215 (FIG. 14) of the base station 2 and, in addition, expands the data based on the compression (encoding) standard of the compression unit 214 (FIG. 14) of the base station 2. The data expanded in this way becomes the original AV data.

[0238] The playback control unit 261 supplies the video signal, which is the original AV data restored in this way and which is based on the video data, to the display unit 252. The playback control unit 261 sometimes supplies the video signal of a predetermined guide screen image and so on to the display unit 252 according to the instruction from the main control unit 255. In response, the display unit 252

displays the video based on the video signal supplied from the playback control unit 261.

[0239] The playback control unit 261 also supplies the audio signal, which is the original AV data restored in this way and which is based on the audio data, to the speaker 253. In response, the speaker 253 outputs the sound based on the audio signal supplied from the playback control unit 261.

[0240] As described above, the playback control unit 261 is thought of as a block having the functions of the components from the rearrangement unit 102 to the audio output unit 107 in FIG. 3. That is, the playback control unit 261 corresponds to each of the components from the rearrangement unit 102 to the audio output unit 107 in FIG. 3. Also, the display unit 252 corresponds to the monitor 106 in FIG. 3, and the speaker 253 corresponds to the speaker 108 in FIG. 3.

[0241] The program storage unit 262, in which the control program is stored as described above, is referenced as necessary by the main control unit 255.

[0242] A memory card driver 263 writes and reads various data to or from a memory card inserted into the memory card slot 254. For example, the memory card driver 263 reads the control program stored in the memory card based on an instruction from the main control unit 255, and stores in the program storage unit 262.

[0243] As described above, the display apparatus 3 in FIG. 15 has the circuit blocks corresponding to each of the components from network I/F 101 to the CPU 110 in FIG. 3. Therefore, the display apparatus 3 can perform each of the viewing control processing of the terminal apparatus in FIG. 4 and FIG. 5 as described above, the authentication processing of the terminal apparatus in FIG. 7 as described above, and the control information transmission processing of the terminal apparatus in FIG. 9 as described above.

[0244] Although there are two program reception control apparatuses 2-1 and 2-2, as shown in FIG. 1 or FIG. 11 and FIG. 12, the number of program reception control apparatuses may be one or three or more. If there are multiple program reception control apparatuses 2, it is possible that the tuners of the apparatuses receive different broadcasts. That is, it is possible, for example, that the tuner of the first program reception control apparatus is a tuner for a terrestrial analog broadcast, the tuner of the second program reception control apparatus is a tuner for a terrestrial digital broadcast, the tuner of the third program reception control apparatus is a tuner for a BS analog/digital broadcast, and the tuner of the fourth program reception control apparatus is a tuner for a CS broadcast. The ability to select a desired program reception control apparatus from multiple program reception control apparatuses with different tuners allows the user to have more choices of programs that can be viewed.

[0245] The sequence of processing described above can be executed by both hardware and software. In this case, each of the program reception control apparatus 2 and the terminal apparatus 3 can also be configured, for example, by a general-purpose personal computer 501 such as the one shown in FIG. 16.

[0246] In FIG. 16, a CPU 511 executes various processing according to the program stored in a ROM 512 or the

program loaded from a storage unit 519 to a RAM 513. Data required by the CPU 511 to execute various processing is also stored as necessary in the RAM 513.

[0247] The CPU 511, ROM 512, and RAM 513 are interconnected via a bus 514. An input/output interface 515 is also connected to this bus 514.

[0248] An operation unit 516 configured with a keyboard, a mouse and so on, a display unit 517 configured with a LCD, a CRT and so on, an audio output unit 518 configured with a speaker and so on for outputting a sound, the storage unit 519 configured with a hard disk and so on, and a communication unit 520 configured with a MODEM, terminal adapter and so on are connected to this input/output interface 515. The communication unit 520 performs communication processing via a network including the Internet 1 and the home network 311.

[0249] A drive 521 is also connected as necessary to the input/output interface 515. A magnetic disk 531, an optical disc 532, a magneto-optical disk 533, or a semiconductor memory 534 is mounted as necessary on the drive, and a computer program read from the medium is installed in the storage unit 519 as necessary.

[0250] To execute a sequence of operations through software, the programs of the software are installed from the network or from a recording medium into a computer in which the special hardware is built or into a computer, for example, a general-purpose personal computer that can execute various functions by having various programs installed therein.

[0251] As shown in FIG. 16, this recording medium is configured not only by a package medium such as the magnetic disk 531 (including a flexible disk), optical disc 532 (including a CD-ROM, a DVD), magneto-optical disk 533 (including an MD (Mini-Disk)), or semiconductor memory 534 which is distributed to the user separately from the main unit, for supplying a program and in which a program is stored but also by the ROM 512 or a hard disk included in the storage unit 519 which is built in the main unit, and is supplied to the user and in which a program is stored.

[0252] In this specification, the steps describing the program stored in a program storage medium include not only processing executed on a time-series basis according to the sequence in which the steps are executed but also processing executed not always on a time-series basis but in parallel or individually.

[0253] In this specification, the system refers to the whole of the apparatus comprising a plurality of units.

What is claimed is:

1. An information processing system including a first information processing apparatus installed in a reception coverage area for receiving broadcast, and a second information processing apparatus for viewing video/audio based on the broadcast received by the first information processing apparatus, wherein;

said first information processing apparatus comprises;

receiving means for receiving a broadcast;

creation means for creating data based on a received signal of the broadcast received by the receiving means;

first communication means for transmitting the data created by the creation means; and

first control means for controlling transmission of data by said first communication means wirelessly or via a network, and wherein;

said second information processing apparatus comprises;

second communication means for receiving the data from the first information processing apparatus; and

presentation means for presenting information based on the data received by said second communication means; and

second control means for controlling said second information processing apparatus so that said second information processing apparatus receives the data wirelessly if installed in a wireless communication coverage area; and said second information processing apparatus receives the data via a network if installed outside the wireless communication coverage area, wherein;

said second information processing apparatus enables to view the video/audio in real time by receiving data based on the broadcast.

2. The information processing system according to claim 1, wherein;

said second information processing apparatus further comprises input means for inputting an operation signal generated through a user operation;

said second communication means transmits a viewing request based on the operation signal received from the input means to said first information processing apparatus wirelessly or via the network;

said first communication means receives the viewing request from said second information processing apparatus in said first information processing apparatus; and

said receiving means receives the broadcast based on the viewing request.

3. The information processing system according to claim 1, wherein;

said second information processing apparatus further comprises;

input means for inputting operation signal by user operation; and

authentication means for executing authentication processing to transmit user-entered authentication data or pre-stored authentication data as authentication data requested from said first information processing apparatus with regard to the viewing request in response to a connection request based on the operation signal from the input means; and wherein;

said second information processing apparatus transmits the viewing request based on the operation signal to the first information processing apparatus if a permission to connect to the first information processing apparatus is obtained through the authentication processing.

4. The information processing system according to claim 3, wherein;

said first information processing apparatus further comprises authentication means for requesting authentication data with regard to the connection request from said second information processing apparatus, checking if the authentication data transmitted from said second information processing apparatus matches previously stored authentication data or not, and executing authentication processing only if they match.

5. The information processing system according to claim 4, wherein;

said first information processing apparatus further comprises encryption means for encrypting the data created by the creation means; and

said second information processing apparatus further comprises decryption means for decrypting the encrypted data, and wherein;

said first communication means transmits the encrypted data to the second information processing apparatus after the authentication processing; and

said second information processing apparatus receives the encrypted data transmitted from said first communication means via the second communication means, and decrypts the encrypted data through the decryption means.

6. The information processing system according to claim 4, wherein;

said first information processing apparatus omits the authentication processing when wirelessly receiving the connection request from the second communication means.

7. An information processing method for a first information processing apparatus that receives broadcast, and transmits the data based on the received signal to a second information processing apparatus, said method comprising:

a receiving step for receiving the broadcast based on a viewing request from said second information processing apparatus;

a creation step for creating the data based on the received signal; and

a transmission step for transmitting the data created by said creation step to the second information processing apparatus, wherein

said transmission step transmits wirelessly when the second information processing apparatus is at a location where wireless communication is possible; and transmits via a network when the second information processing apparatus is at a location where wireless communication is impossible.

8. The information processing method according to claim 7, further comprising:

a communication step for receiving the viewing request from the second information processing apparatus wirelessly or via a network.

9. The information processing method according to claim 7, further comprising:

a requesting step for requesting authentication data in response to the connection request from the second information processing apparatus; and

an authentication step for authenticating the second information processing apparatus based on the authentication data from the second information processing apparatus, wherein;

the receiving step, the creation step, and the transmission step are executed in response to the viewing request from said second information processing apparatus after the authentication processing in this authentication step.

10. The information processing method according to claim 9, wherein;

said authentication processing in the authentication step checks if the authentication data transmitted from the second information processing apparatus matches previously stored authentication data, and permits the viewing request only when they match.

11. The information processing method according to claim 9, further comprising:

an encryption step for encrypting the data created by the creation step by after being available the data for decryption, and the authentication processing by the authentication step, wherein;

said transmission step transmits the data encrypted by the encryption step to the second information processing apparatus.

12. An information processing method for use by a second information processing apparatus that communicates with a first information processing apparatus which receives a broadcast and transmits data based on a received signal, said method comprising the steps of:

a first transmission step for transmitting a connection request based on a user operation;

a second transmission step for transmitting authentication data inputted by a user or pre-stored authentication data for use as authentication data requested by the first information processing apparatus in response to the connection request;

a third transmission step for transmitting the viewing request by the user operation after the authentication by the first information processing apparatus;

a receiving step for receiving data transmitted from the first information processing apparatus in response to the third transmission step; and

a presentation step for presenting a broadcast-based video or audio through the reception of the data, wherein;

the transmission and the reception in the first, second, third transmission steps and the receiving step are executed wirelessly or via a network.

* * * * *

EXHIBIT 1035



US 20040193647A1

(19) **United States**(12) **Patent Application Publication** (10) **Pub. No.: US 2004/0193647 A1****Ueda et al.**(43) **Pub. Date: Sep. 30, 2004**(54) **AV DATA TRANSMITTER, AV DATA
RECEIVER, AND AV DATA
DISPLAYING/REPRODUCING APPARATUS**(30) **Foreign Application Priority Data**

Jul. 10, 2001 (JP) 2001-209787

(76) Inventors: **Toru Ueda**, Souraku-gun (JP); **Kazuya
Oyama**, Ikoma-shi (JP)**Publication Classification**(51) **Int. Cl.⁷** **G06F 17/00**(52) **U.S. Cl.** **707/104.1**

Correspondence Address:

**BIRCH STEWART KOLASCH & BIRCH
PO BOX 747****FALLS CHURCH, VA 22040-0747 (US)**(57) **ABSTRACT**

An AV data transmitter for transmitting AV data wirelessly and transmitting/receiving asynchronous data. The transmitter has a quality variation setting section for varying the compression ratio of the AV data and for changing the communication band for the AV data transmission or reliability of the communication. Further the transmitter has an AV data transmission switch for enabling switching even during communication.

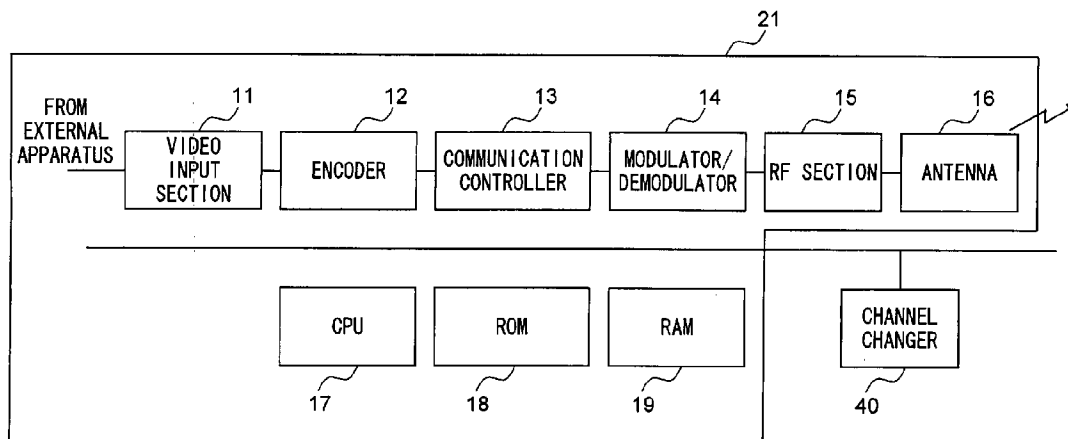
(21) Appl. No.: **10/482,800**(22) PCT Filed: **Jul. 4, 2002**(86) PCT No.: **PCT/JP02/06827**

FIG.1

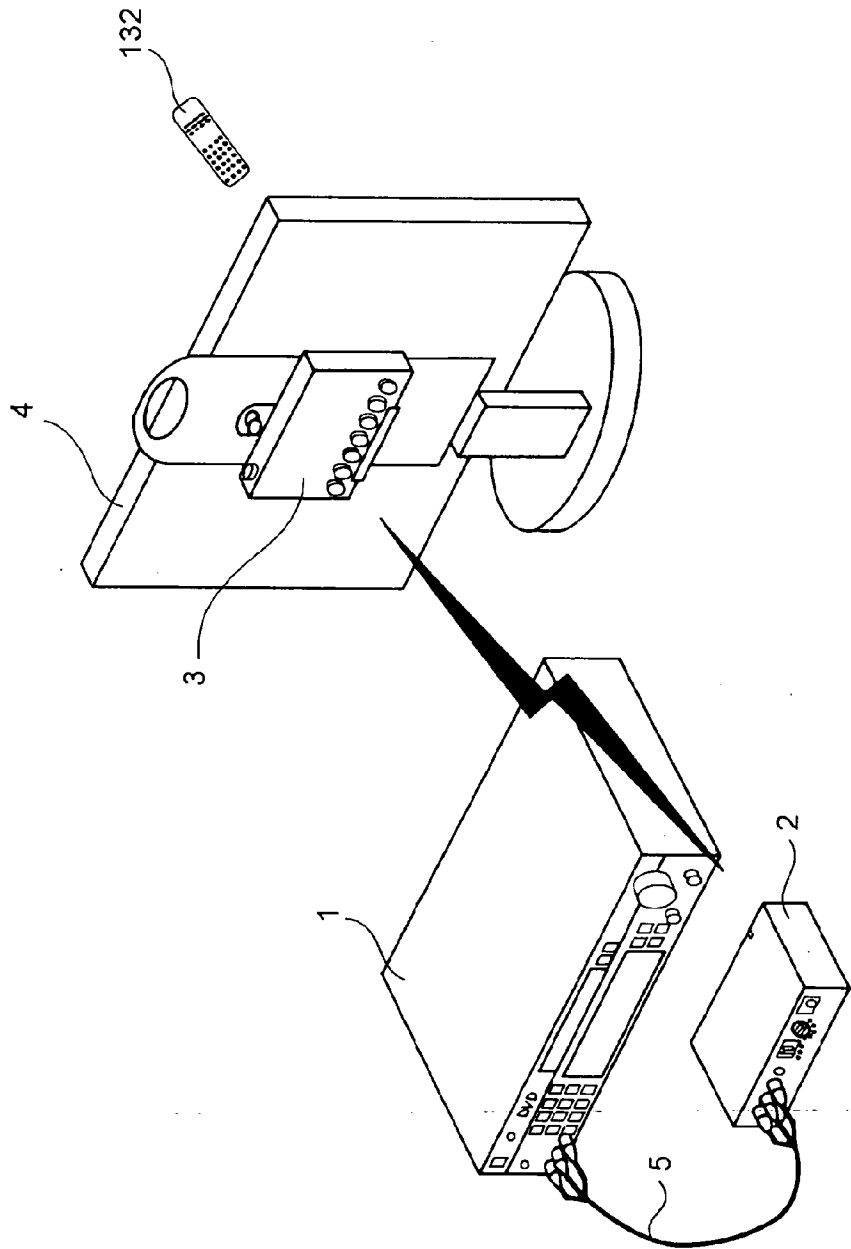


FIG.2

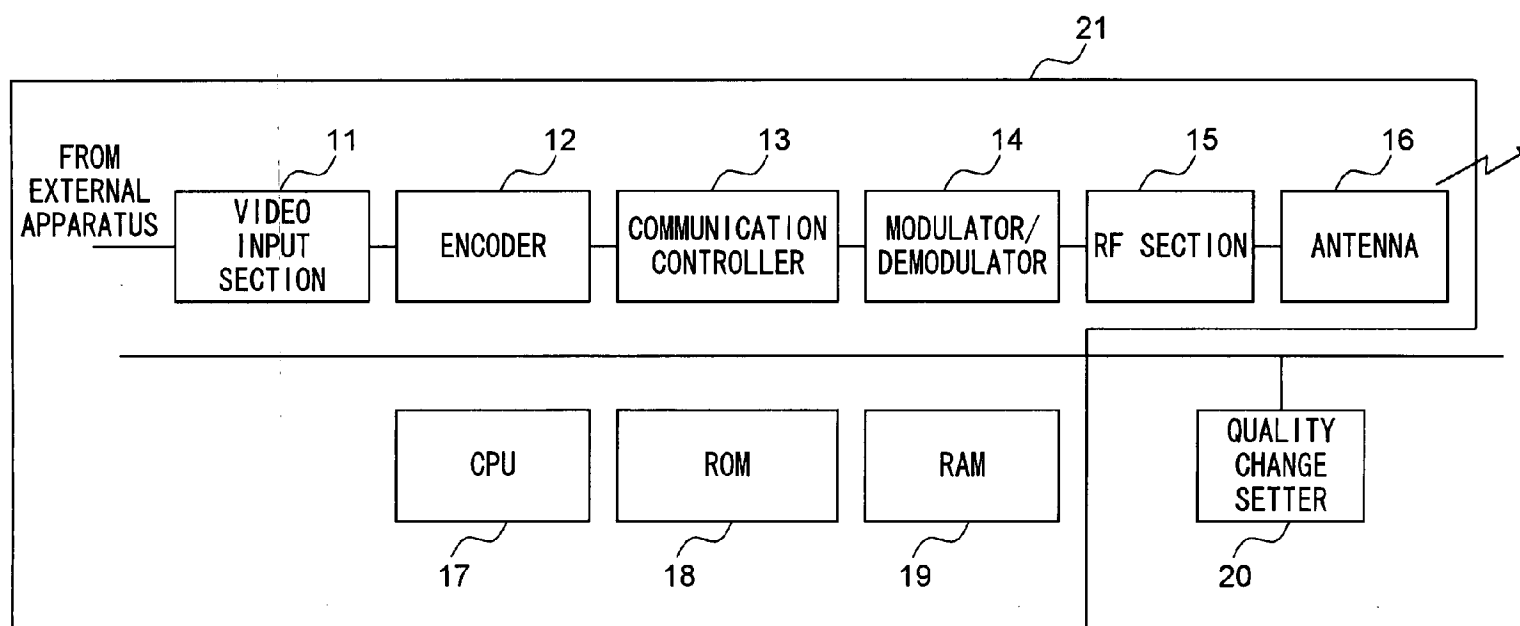


FIG. 3A

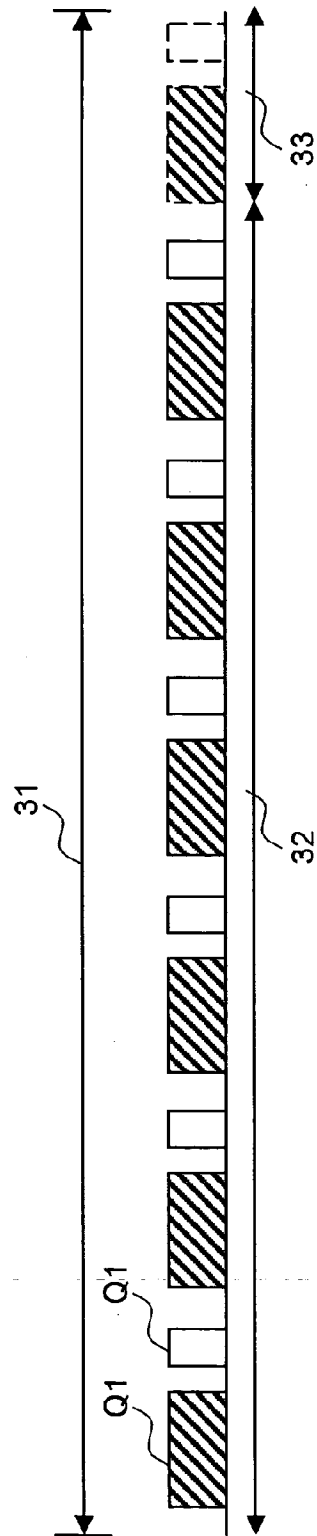


FIG. 3B

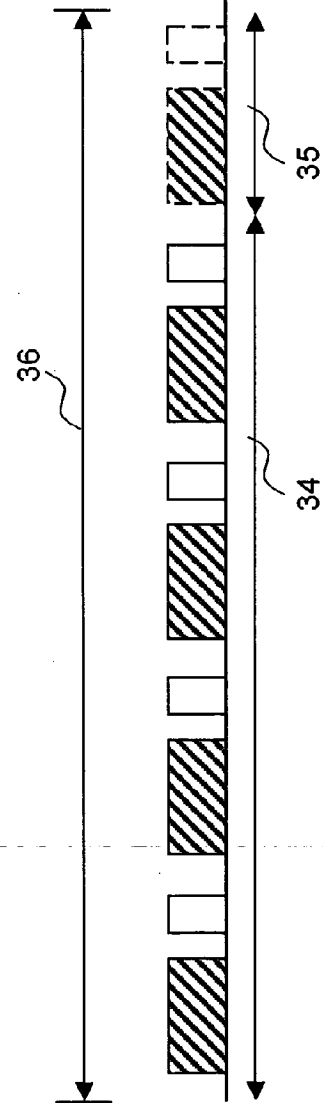


FIG. 4A

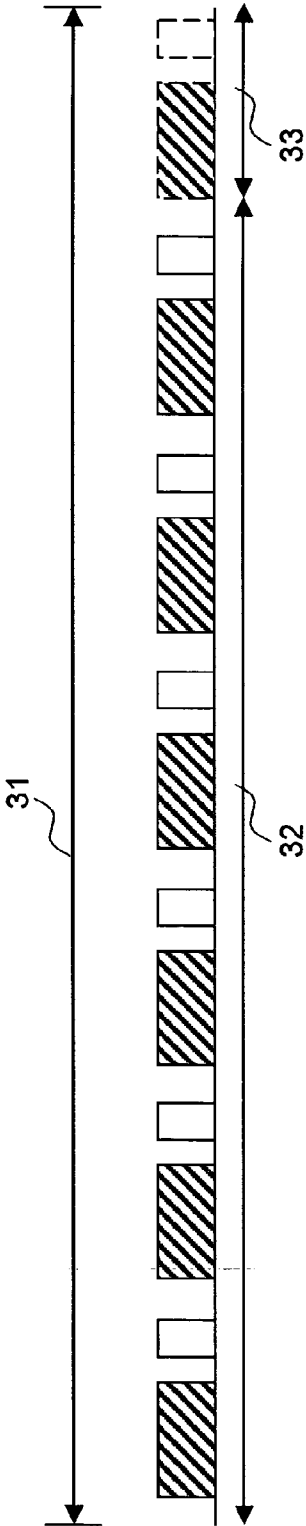


FIG. 4B

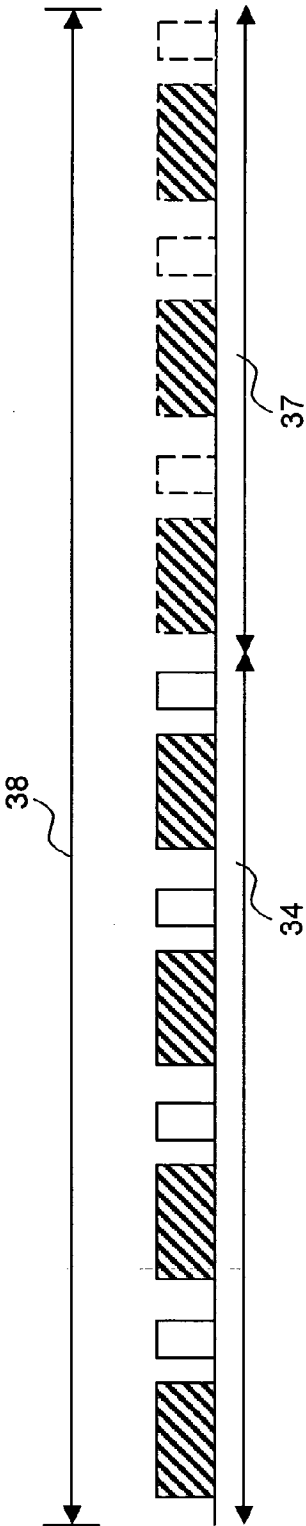


FIG.5

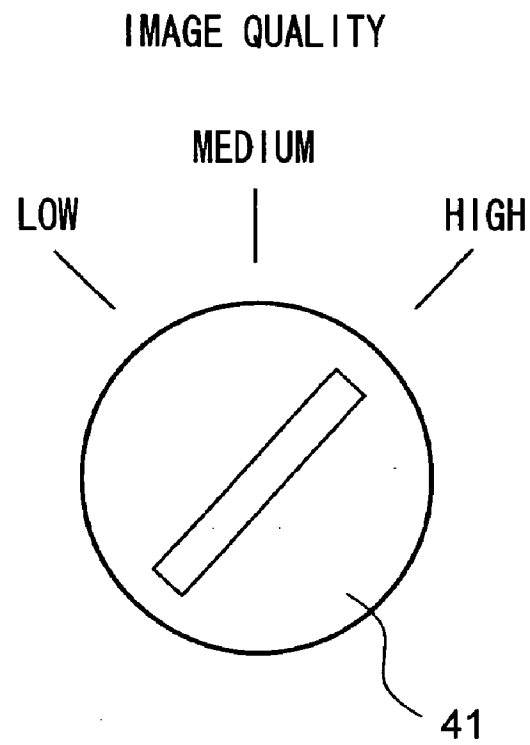


FIG.6

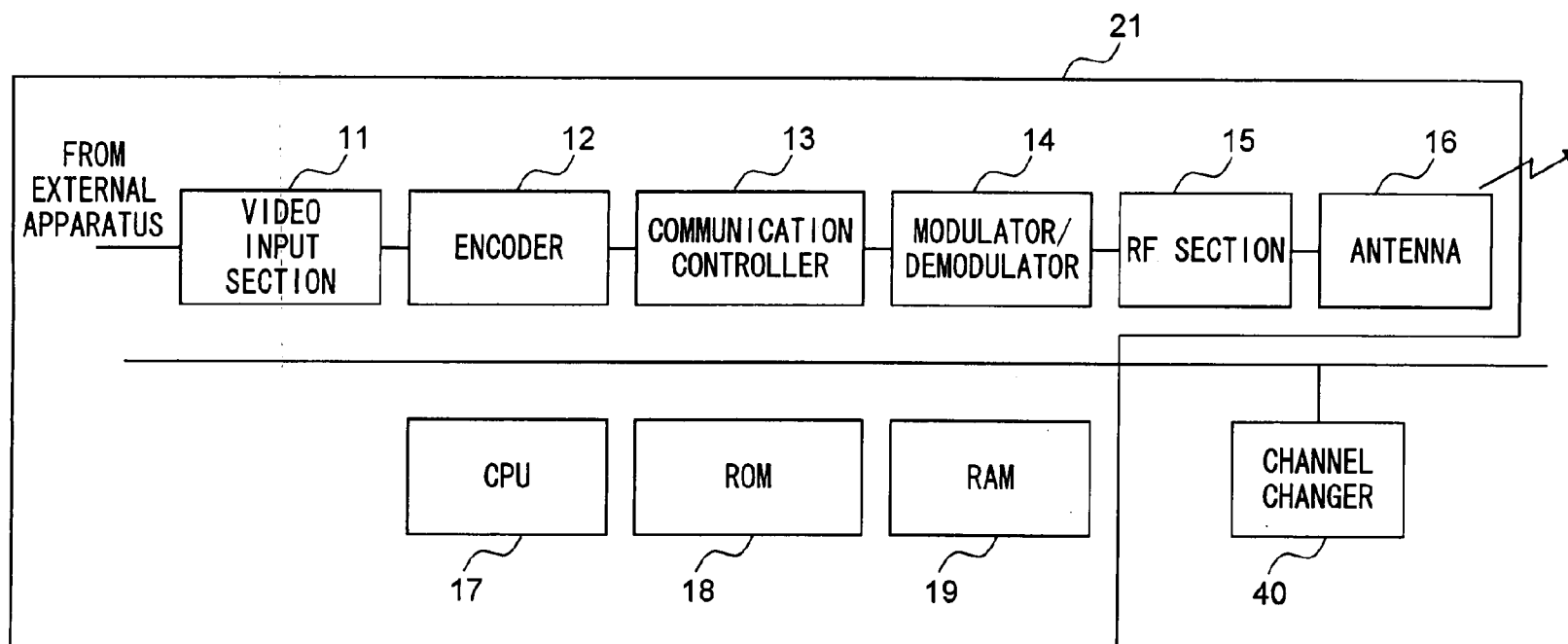


FIG. 7

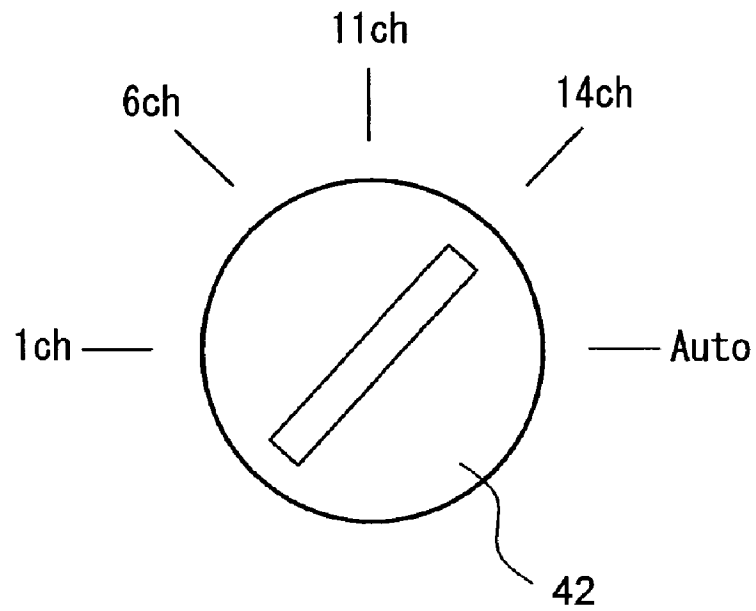


FIG.8

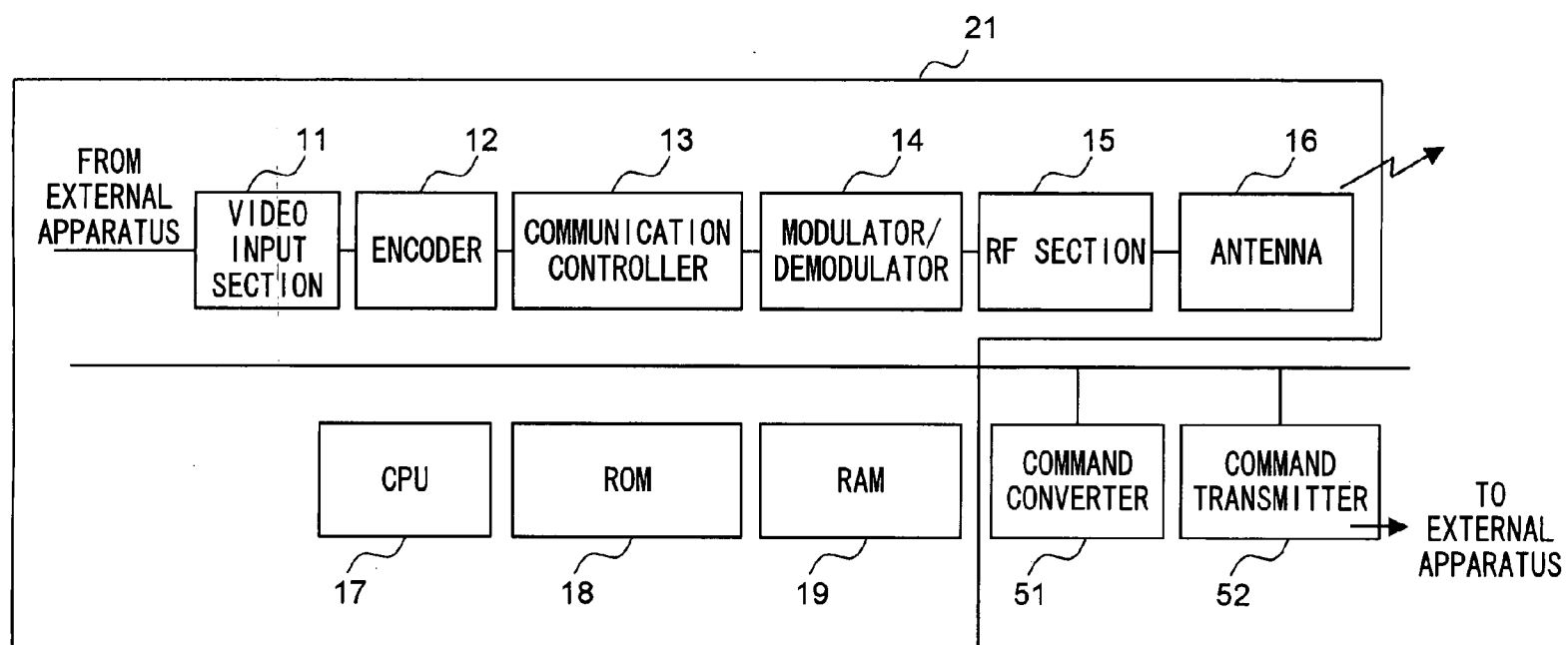


FIG.9

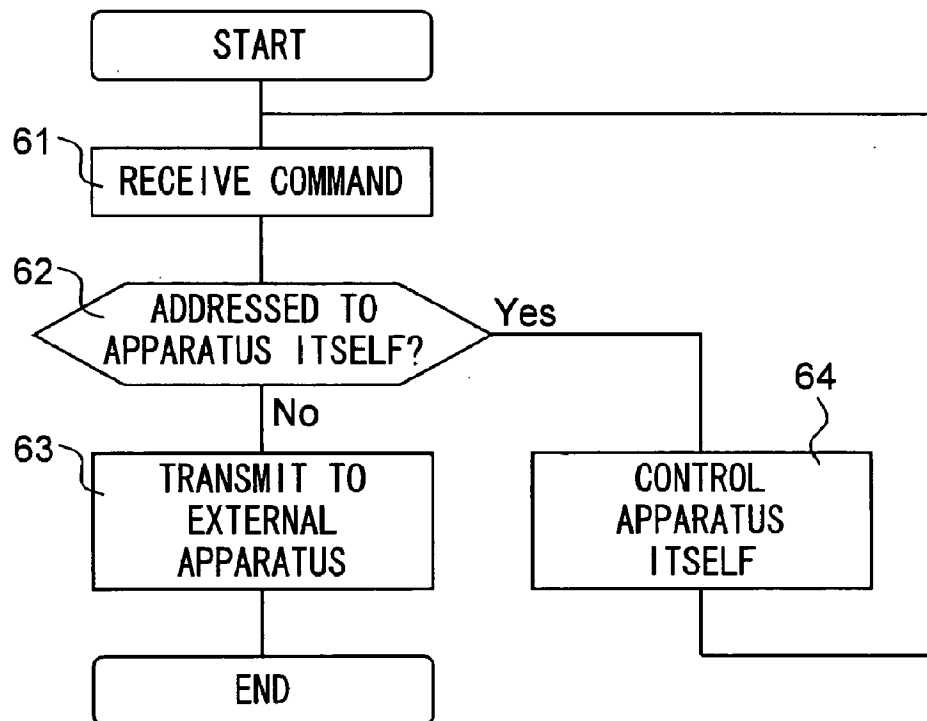


FIG. 10

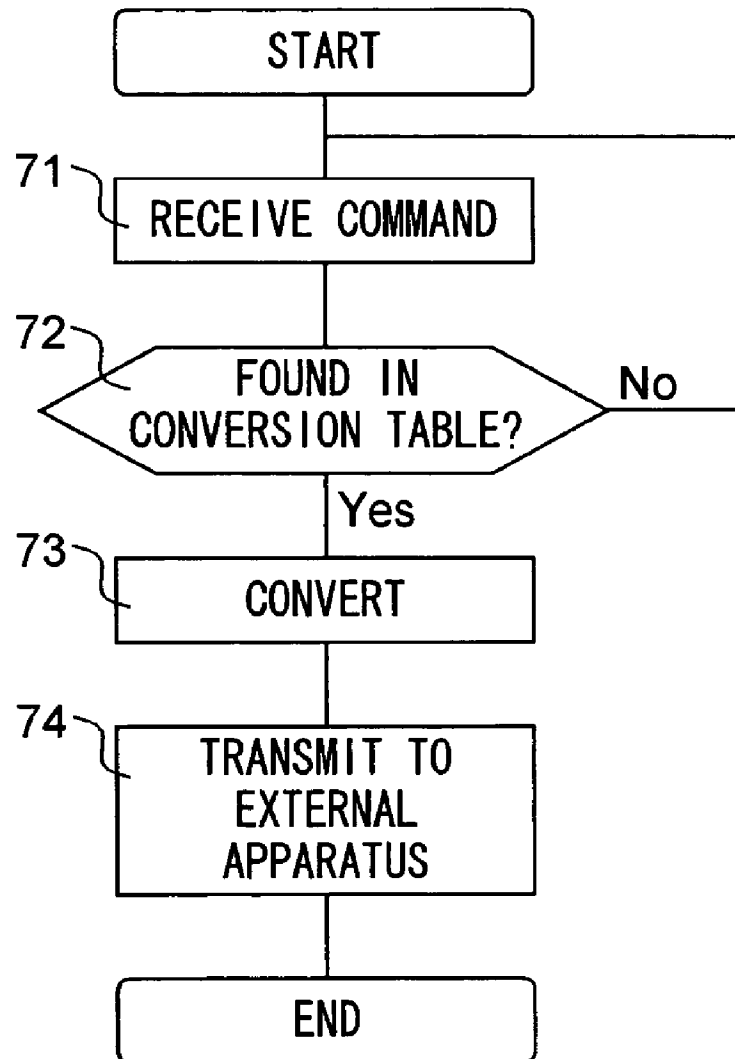


FIG.11

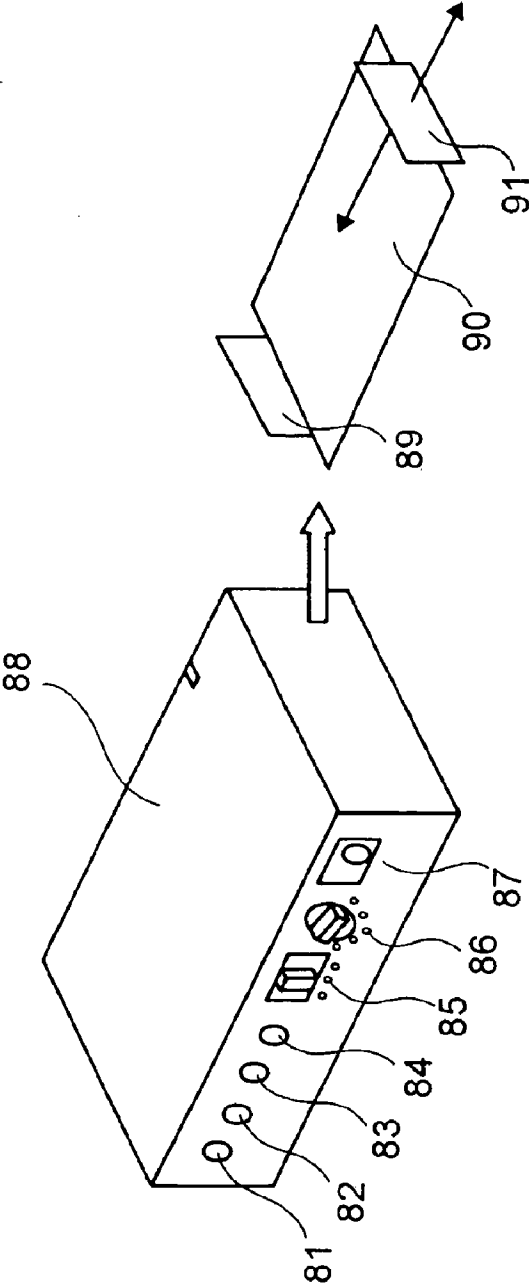


FIG.12

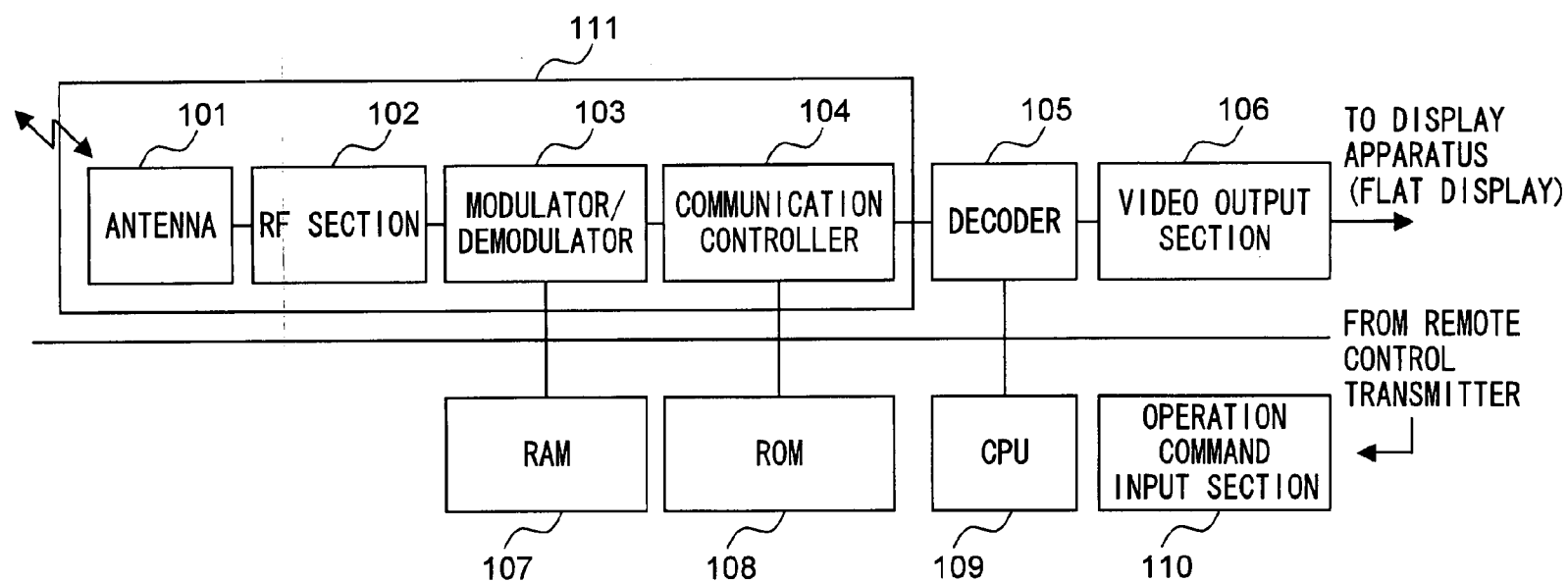


FIG.13

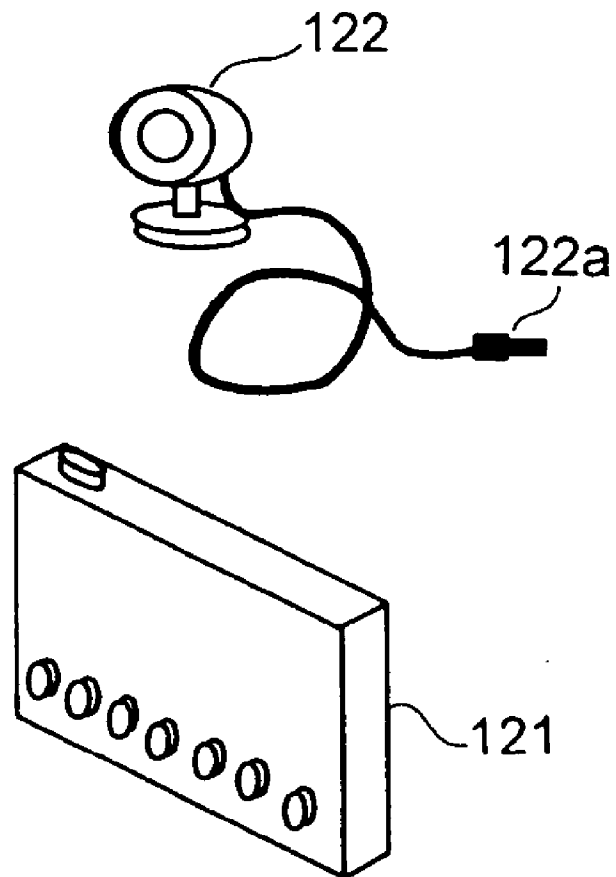


FIG. 14

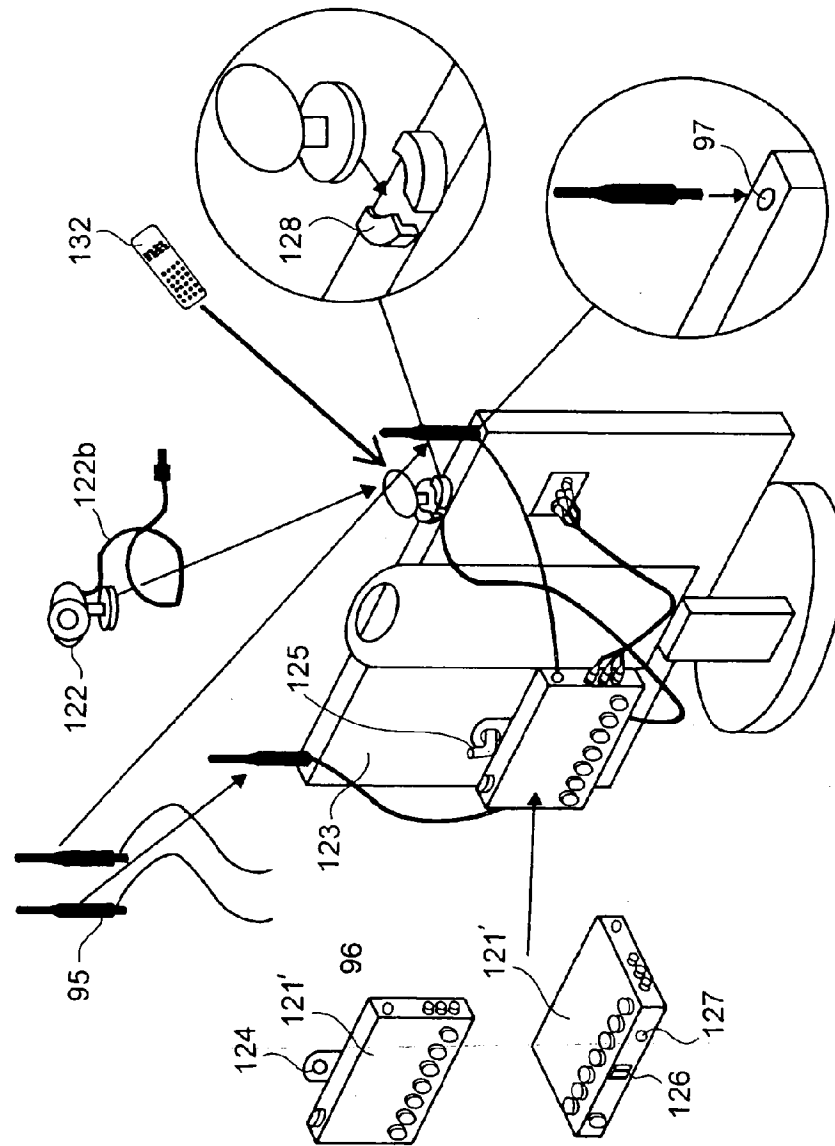


FIG. 15

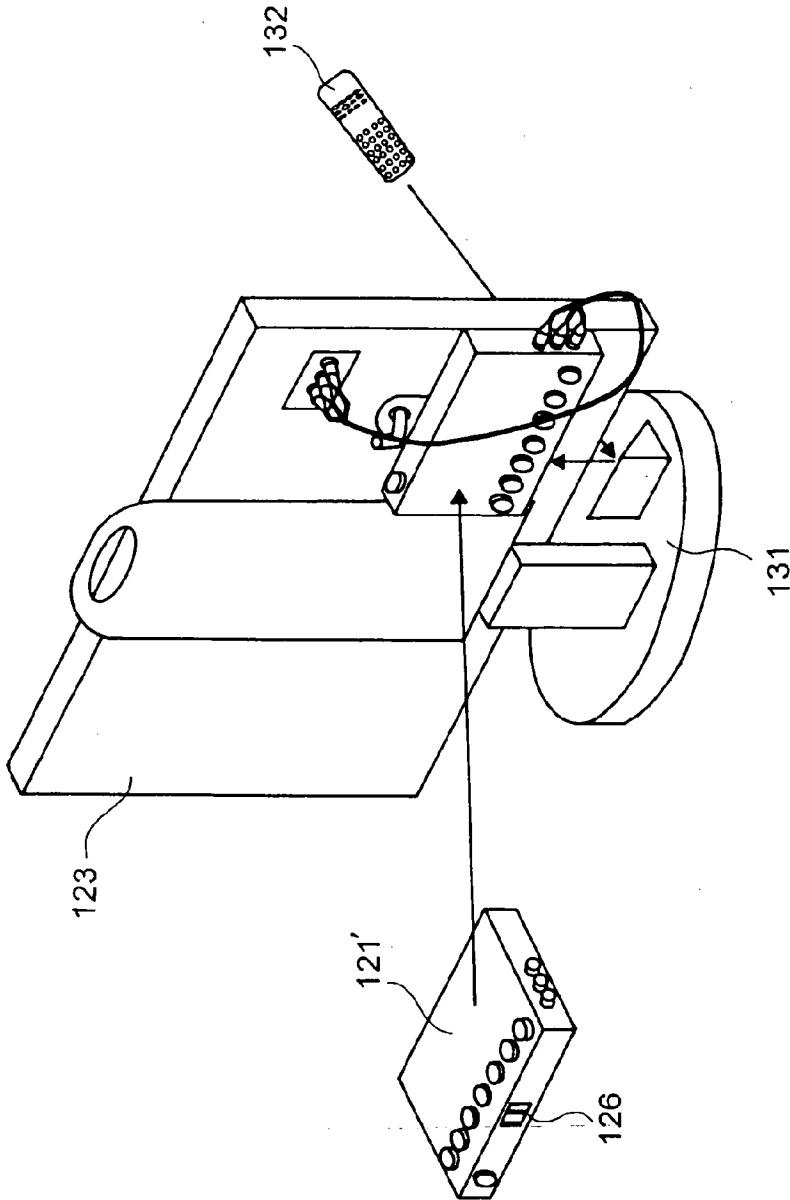


FIG. 16

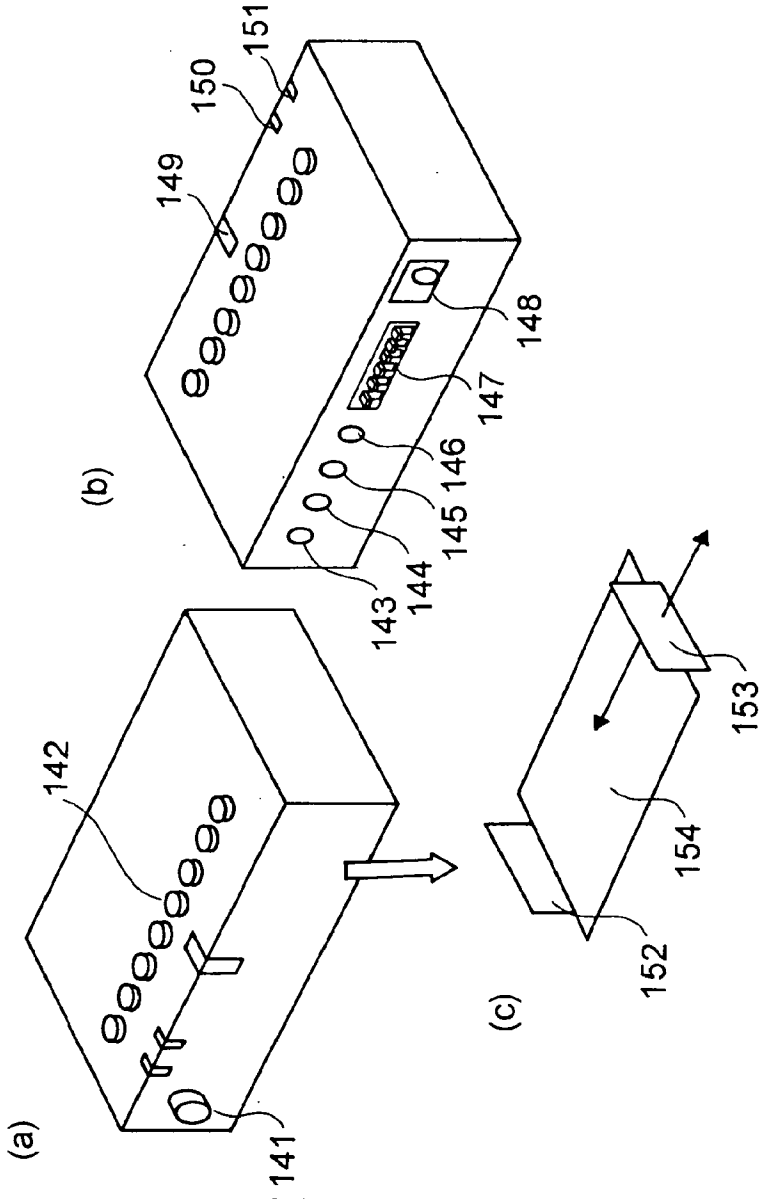


FIG.17

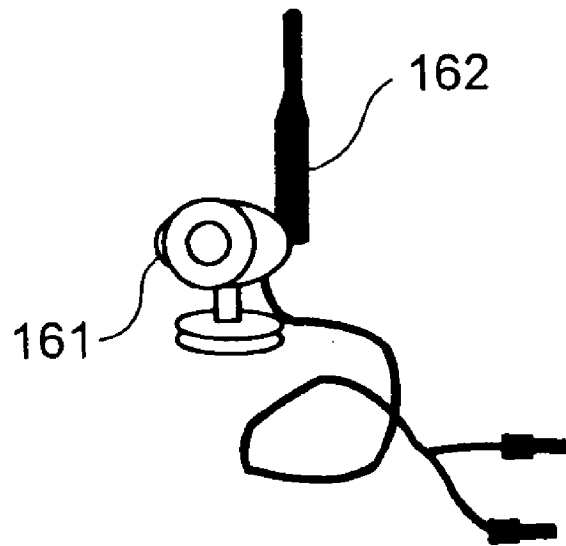


FIG.18

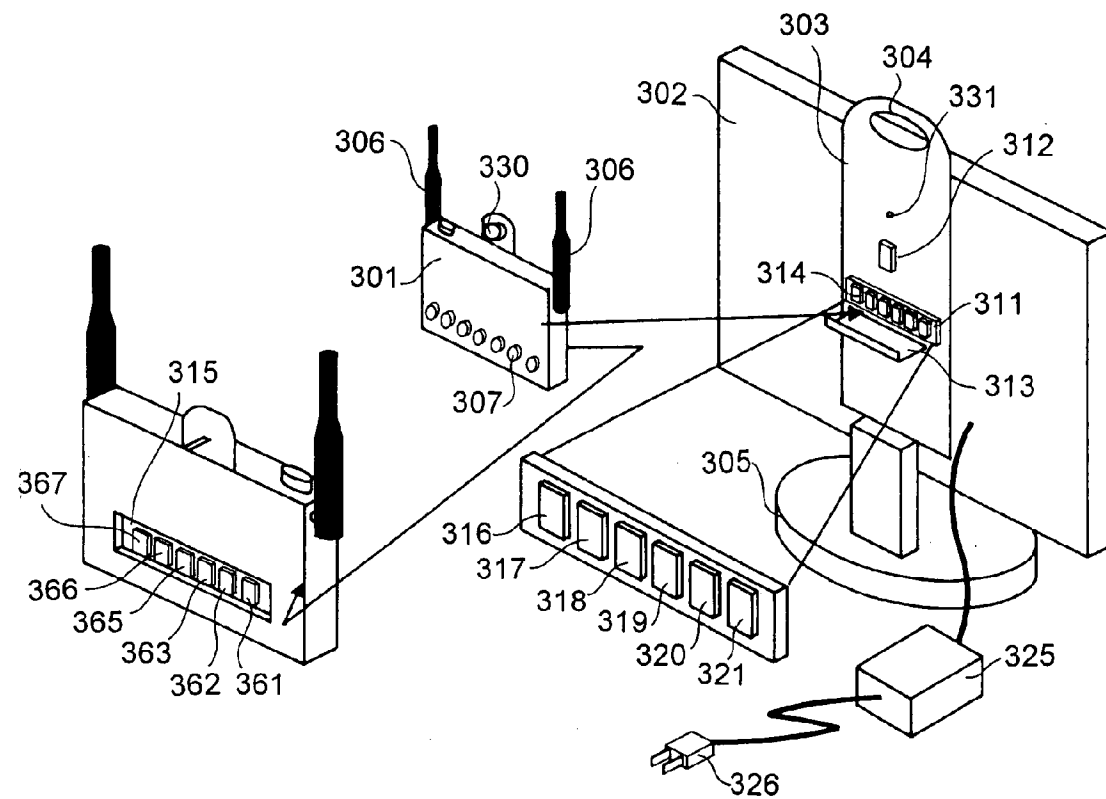


FIG. 19

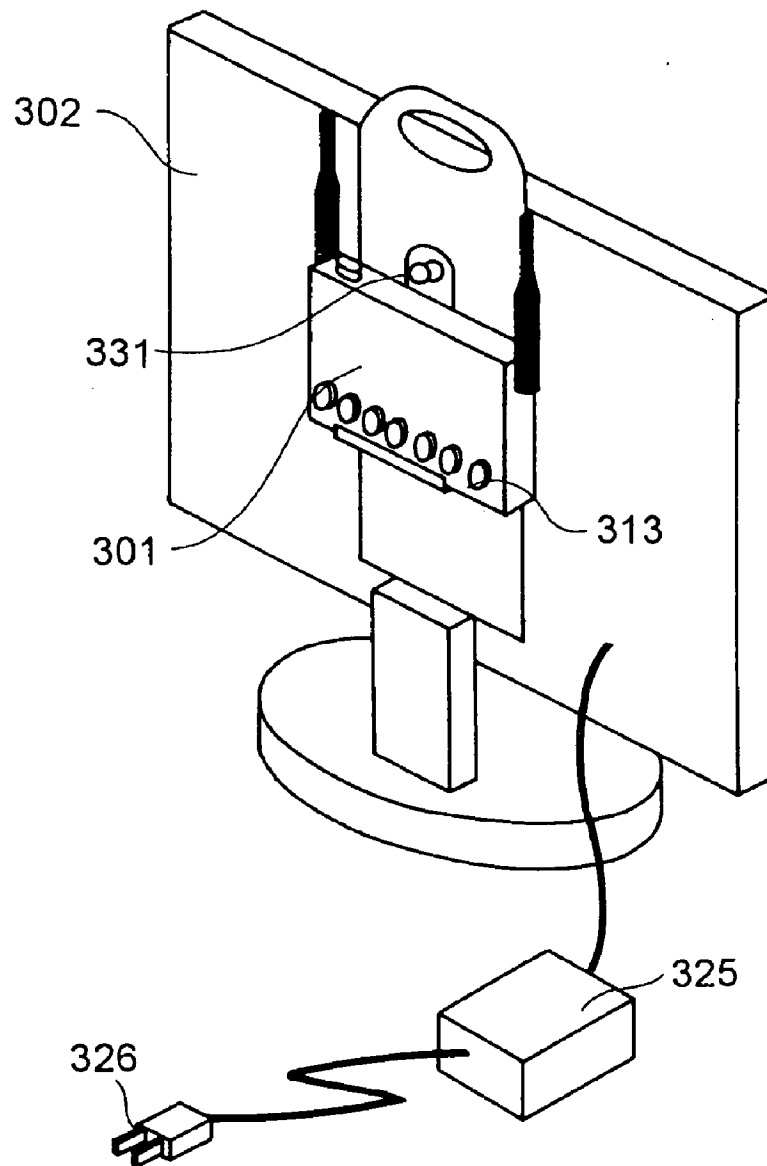


FIG.20

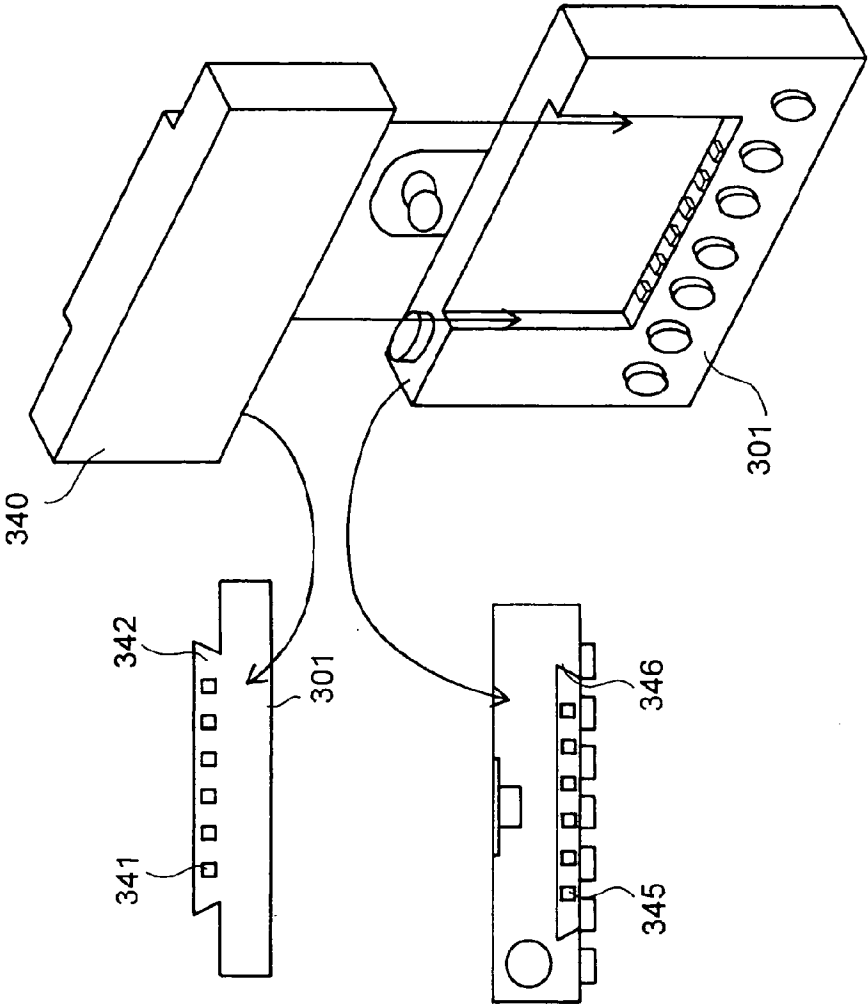


FIG.21

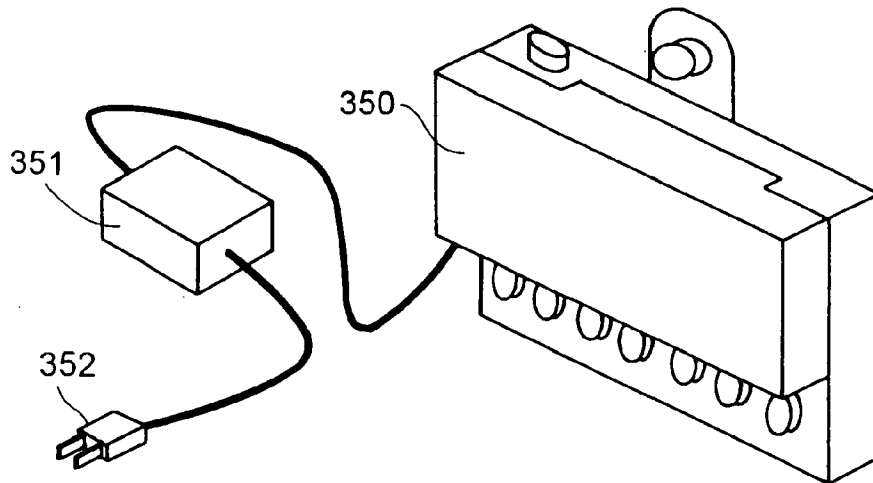


FIG. 22

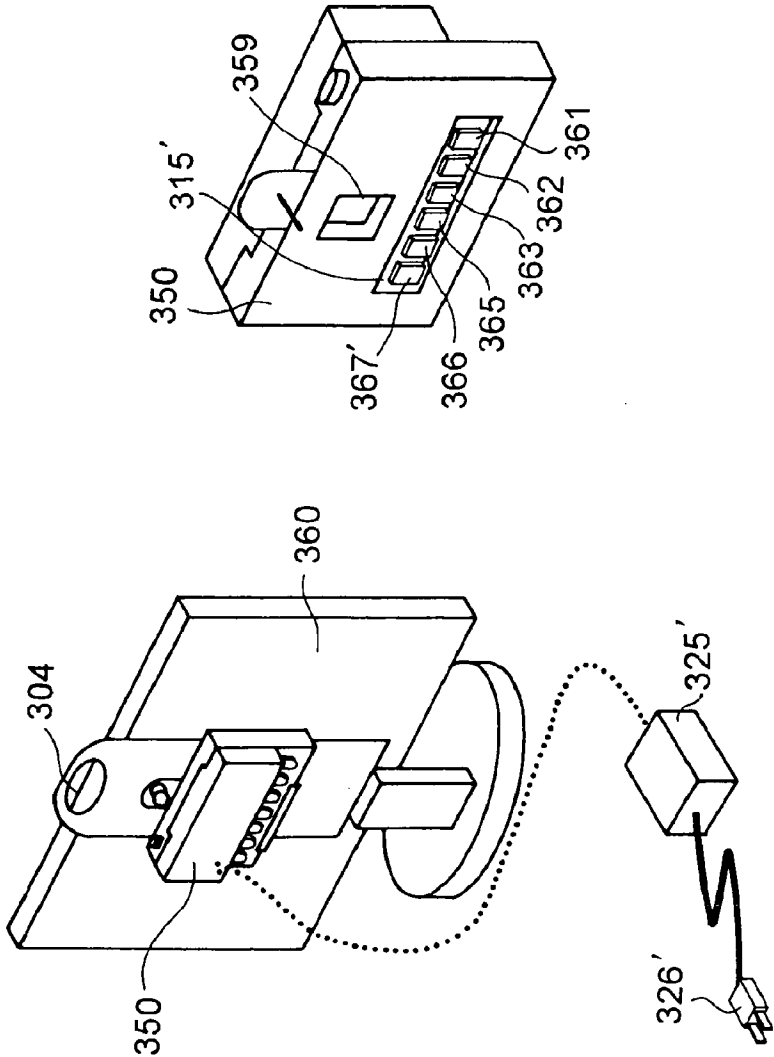


FIG. 23

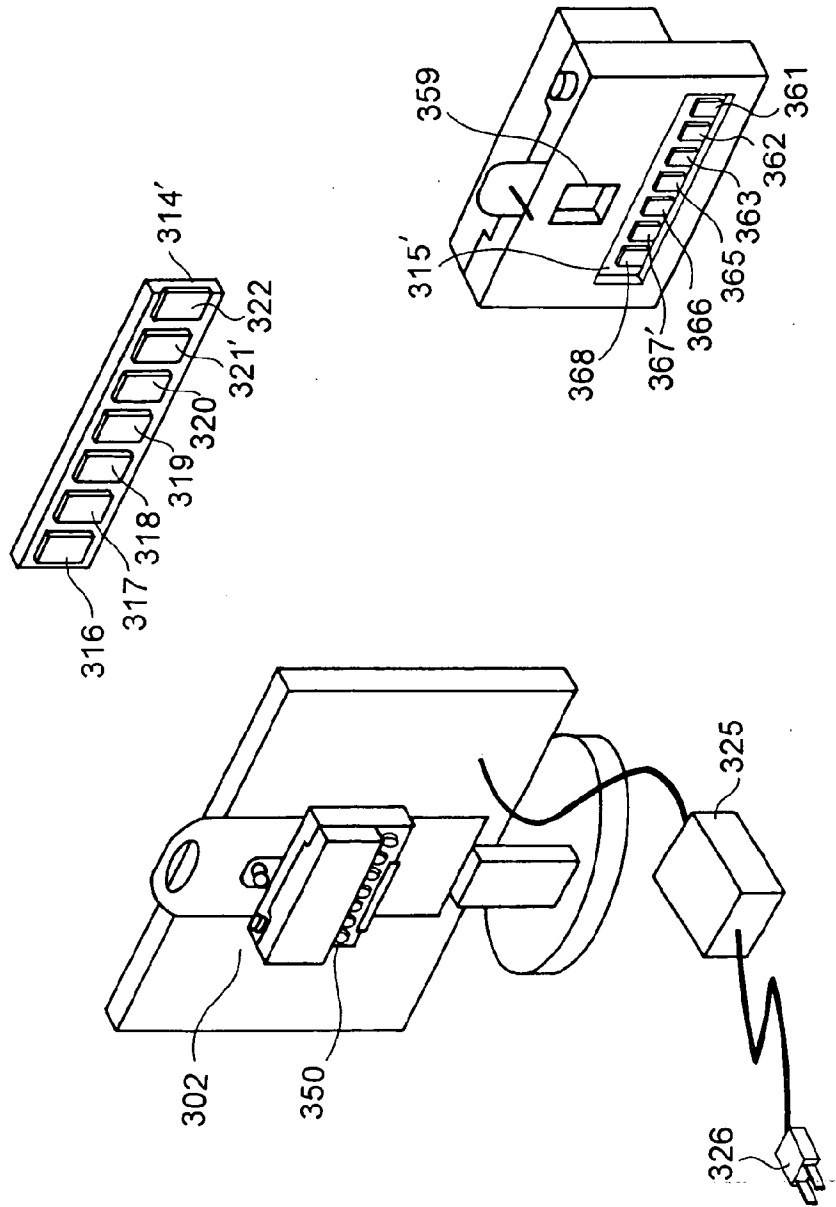


FIG.24

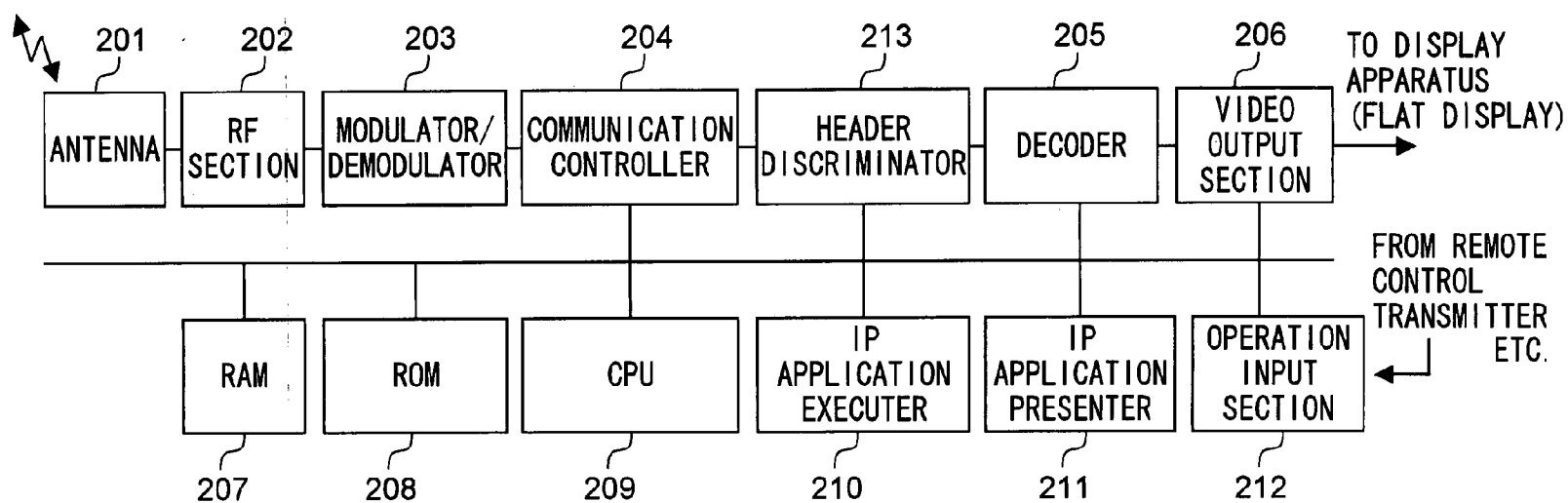


FIG.25A

IEEE802.2 LCC LAYER PACKET FORMAT
(GENERAL FORMAT) 4 BYTES

IEEE802.2 FORMAT PACKET

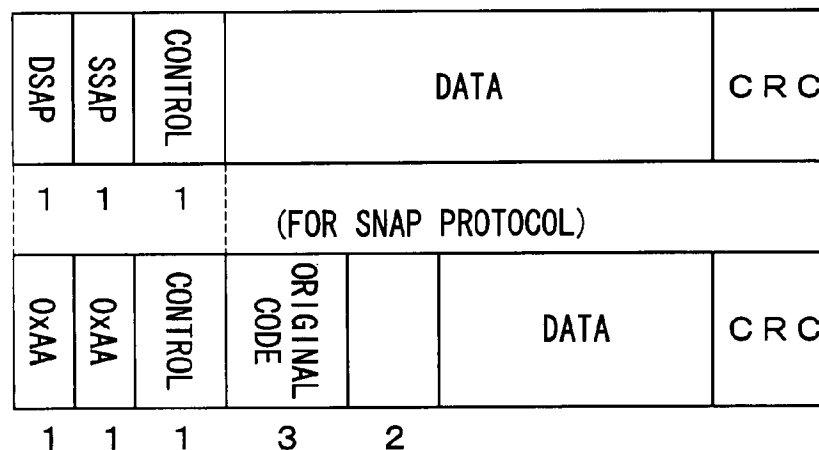
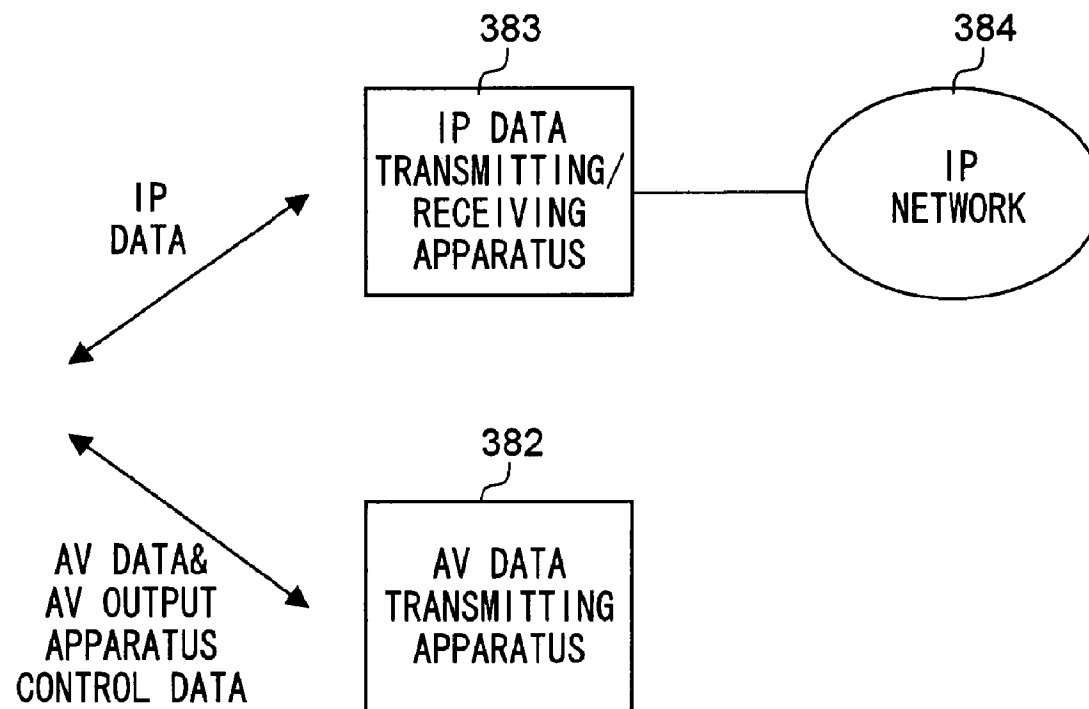


FIG.25B

SNAP PROTOCOL PACKET

DSAP (RECEIVER SAP)	RECEIVER NETWORK LAYER PROTOCOL ID
SSAP (TRANSMITTER SAP)	TRANSMITTER NETWORK LAYER PROTOCOL ID
CONTROL	FOR DATA LINK LAYER LEVEL CONNECTION/FLOW CONTROL
ORIGINAL CODE	FIXED (0x000000)
TYPE	PACKET TYPE

FIG. 26



AV DATA TRANSMITTER, AV DATA RECEIVER, AND AV DATA DISPLAYING/REPRODUCING APPARATUS

TECHNICAL FIELD

[0001] The present invention relates to an AV (audiovisual) data transmitting apparatus, AV data receiving apparatus, and AV data displaying/reproducing apparatus for displaying/reproducing images, music, and sounds.

BACKGROUND ART

[0002] Conventional apparatuses for receiving AV data and for transmitting control commands for controlling an image-source-side unit are disclosed, for example, in Japanese Patent Applications Laid-Open Nos. H9-74498 and 2000-251456. In the apparatuses disclosed in these publications, a sub AV unit is given capabilities of receiving AV data that is transmitted thereto wirelessly and of transmitting control commands that it receives from an infrared remote control transmitter to a main AV unit wirelessly.

[0003] The publications mentioned above disclose that such capabilities are achieved, for example, through wireless transmission based on the spread-spectrum principle in the 2.4 GHz band, but disclose nothing about how the image quality is controlled. Since only a limited amount of data (bandwidth) can be transmitted wirelessly per unit time, when a plurality of users attempt to transmit data simultaneously, if one of the users occupies a large part of the available bandwidth to transmit high-quality image data, the other users are not allowed satisfactorily high transmission rates. Moreover, when wireless reception is poor, data errors or data loss occurs, making proper reproduction of images impossible.

[0004] An AV data receiving apparatus exploits radio waves, which can be transmitted even by being reflected. Thus, the AV data receiving apparatus need not necessarily be placed in the range visible from the user. However, when infrared light is used, as in infrared remote control, an infrared receiver needs to be placed in the range visible from the remote control transmitter held by the user.

[0005] If all infrared commands are transmitted via a wireless route, the wrong units may be controlled on the command-receiving side. In a case where an AV data receiving apparatus alone is housed in a cabinet, and in addition it is used in combination with a portable AV data displaying/reproducing apparatus such as a flat display, when the AV data receiving apparatus is carried around, it needs to be carried separately from a liquid crystal television monitor.

[0006] In a case where an AV data receiving apparatus and an AV data displaying/reproducing apparatus are operated by infrared remote control, those apparatuses cannot be fully operated without the use of an infrared remote control transmitter. Accordingly, when the AV data receiving apparatus and the AV data displaying/reproducing apparatus are carried around, their infrared remote control transmitters need to be carried together therewith.

DISCLOSURE OF THE INVENTION

[0007] An object of the present invention is to provide an apparatus that permits easy and convenient use of an AV data

displaying/reproducing apparatus when it is controlled wirelessly via an AV data receiving apparatus by infrared remote control.

[0008] According to the present invention, when wireless reception is so poor that images cannot be reproduced properly, the image transfer rate is lowered so that more of the transfer capacity is allotted to re-transmission. This makes it possible to avoid data errors and data loss. A wireless system usually offers a plurality of transfer channels, and, if the user is permitted to change channels at will, even when a given channel is interfered by an interfering wave and images cannot be reproduced properly on that channel, the user can avoid the interference by changing channels.

[0009] According to the present invention, an AV data transmitting apparatus wirelessly transmits AV data in the form of digital data, and transmits and receives asynchronous data via a wireless route. The AV data transmitting apparatus is provided with a quality change setter for changing the compression ratio of the AV data, and the quality change setter permits the communication bandwidth for AV data transmission to be changed. The quality change setter permits not only the compression ratio of the AV data but also the reliability of communication to be changed. Thus, it is possible to change the quality of AV data, and as a result it is possible to change the bandwidth for AV data transfer or the reliability of communication. By changing the bandwidth for AV data transfer, it is possible to increase or decrease the bandwidth used by another application. Alternatively, the bandwidth freed by lowering the quality of AV data can be used to increase the reliability of communication and thereby reduce communication errors in AV data.

[0010] According to the present invention, an AV data transmitting apparatus is provided with a channel switcher. The channel switcher is added to the transmitting apparatus, and is switchable even during communication. This permits the user to change channels easily.

[0011] According to the present invention, an AV data transmitting apparatus uses, as a wireless route, the 2.4 GHz band (from 2 400 MHz to 2 497 MHz), and permits the user to use channels that include a part of the band above the 13th channel (with a central frequency of 2 472 MHz). In a wireless system that uses the 2.4 GHz band, by permitting the use of a channel in a part of the band above the 13th channel, it is possible to perform data transfer away from the 1st to 13th channels, which are used by the Bluetooth system, which also uses the 2.4 GHz band. When IEEE802.11b, a LAN technology that uses the 2.4 GHz band, is used, using channels outside the frequency shift range of the Bluetooth system makes it possible to reduce the effects thereof.

[0012] According to the present invention, an AV data transmitting apparatus wirelessly transmits AV data in the form of digital data, and transmits and receives asynchronous data via a wireless route. The AV data transmitting apparatus is provided with a command converter for selecting control data from the asynchronous data and converting the selected control data according to a predetermined rule, and a command transmitter for feeding the commands obtained through conversion by the command converter via an AV data receiving apparatus to an external apparatus such as a flat display or an AV data displaying/reproducing

apparatus such as a liquid crystal television monitor. The command transmitter may be built as an IR command transmitter.

[0013] This makes it possible to convert the control commands transmitted via the wireless route into a format that suits the external apparatus and then transmit them to the external apparatus. By making the conversion rule rewritable, it is possible to convert the control commands into different formats that suit different external apparatuses.

[0014] According to the present invention, an AV data receiving apparatus has a command receiver that is movable. Even in a case where the AV data receiving apparatus is fitted to the rear face of an AV data displaying/reproducing apparatus such as a flat display, a photoreceiver can be so placed as to permit the user to operate the AV data displaying/reproducing apparatus by remote control from in front thereof while viewing the image on the screen.

[0015] According to the present invention, an AV data receiving apparatus is provided with an external antenna interface and an infrared photoreceiver interface. This makes it possible to add an external antenna for more error-free communication. Arranging the external antenna interface and the infrared photoreceiver interface on the same face makes it easy for the user to plug in the connecting plugs for both the external antenna and the infrared photoreceiver.

[0016] According to the present invention, an AV data receiving apparatus is provided with a switch for generating operation commands. This makes it possible to control the AV data receiving apparatus and an AV data output apparatus from a distance without an infrared remote control transmitter.

[0017] According to the present invention, an AV data receiving apparatus has switches and connectors arranged so as not to obstruct the maximum gain plane of the antenna. This helps prevent the radio waves from being interfered by a switch or the like, and thus helps enhance communication performance.

[0018] According to the present invention, an AV data receiving apparatus is provided with a power supply interface for feeding electric power to an AV data displaying/reproducing apparatus. This makes it possible to display and reproduce AV data without connecting the AV data displaying/reproducing apparatus to an AC power source.

[0019] Additionally providing a mechanism that permits the AV data receiving apparatus to be fitted to the AV data displaying/reproducing apparatus makes it possible to carry around the AV data receiving apparatus together with the AV data displaying/reproducing apparatus as a single unit.

[0020] According to the present invention, an AV data receiving apparatus is provided with a header discriminator, an IP packet discriminator, and an IP application executor. This makes it possible to visually and acoustically enjoy both Internet applications and AV data.

BRIEF DESCRIPTION OF DRAWINGS

[0021] FIG. 1 is a diagram showing a system according to the invention as a whole.

[0022] FIG. 2 is a block diagram of a transmission-related principal portion of an AV data transmitting apparatus.

[0023] FIG. 3 is a conceptual diagram of a packet sequence.

[0024] FIG. 4 is a conceptual diagram of a packet sequence in another embodiment.

[0025] FIG. 5 is a diagram showing an image quality setting switch.

[0026] FIG. 6 is a block diagram of a transmission-related principal portion of an AV data transmitting apparatus in another embodiment.

[0027] FIG. 7 is a diagram showing a channel switch.

[0028] FIG. 8 is a block diagram of a transmission-related principal portion of an AV data transmitting apparatus in another embodiment.

[0029] FIG. 9 is a flow chart showing how the AV data transmitting apparatus shown in FIG. 8 transfers a control command to an AV data output apparatus.

[0030] FIG. 10 is another flow chart showing how the AV data transmitting apparatus transfers a control command to an AV data output apparatus.

[0031] FIG. 11 is a diagram showing an example of how the AV data transmitting apparatus is implemented.

[0032] FIG. 12 is a block diagram of an AV data receiving apparatus.

[0033] FIG. 13 is a diagram showing an AV data receiving apparatus and a photoreceiver.

[0034] FIG. 14 is a diagram showing how an AV data receiving apparatus is fitted on a rear face of a liquid crystal television monitor.

[0035] FIG. 15 is a diagram showing how an AV data receiving apparatus is fitted on a rear face of a display apparatus in another embodiment.

[0036] FIG. 16 is a diagram showing an outline of an AV data receiving apparatus.

[0037] FIG. 17 is a diagram showing an embodiment in which an infrared photoreceiver and an antenna are integrated together.

[0038] FIG. 18 is a diagram illustrating how an AV data receiving apparatus is connected to a display apparatus.

[0039] FIG. 19 is a diagram showing an AV data receiving apparatus connected to a display apparatus.

[0040] FIG. 20 is a diagram illustrating how an AV data receiving apparatus is connected to a battery.

[0041] FIG. 21 is a diagram showing an AV data receiving apparatus connected to a battery.

[0042] FIG. 22 is a diagram illustrating connection of an AV data receiving apparatus having a battery fitted thereto.

[0043] FIG. 23 is a diagram illustrating how an AV data receiving apparatus having a battery fitted thereto is connected to a display apparatus.

[0044] FIG. 24 is a block diagram of an apparatus that transmits AV data and IP data simultaneously.

[0045] FIG. 25 is a diagram showing the packet format conforming to IEEE802.2.

[0046] FIG. 26 is a diagram illustrating the relationship between an AV data receiving apparatus, an AV data transmitting apparatus, an IP data transmitting/receiving apparatus, and a network.

BEST MODE FOR CARRYING OUT THE INVENTION

[0047] Hereinafter, an example of embodiment of the present invention will be described in detail with reference to the drawings.

[0048] FIG. 1 is a diagram showing a system as a whole according to the present invention. Reference numeral 1 represents an AV data output apparatus such as a videocassette recorder, DVD player, tuner, stereo set, or personal computer; reference numeral 2 represents an AV data transmitting apparatus; reference numeral 3 represents an AV data receiving apparatus; reference numeral 4 represents an AV data displaying/reproducing apparatus such as a flat display like a liquid crystal television monitor, any other type of monitor, or personal computer; reference numeral 132 represents an infrared remote control transmitter. In the figure, the AV data output apparatus 1 and the AV data transmitting apparatus 2 are connected together with a cable 5, and likewise the AV data receiving apparatus 3 and the AV data displaying/reproducing apparatus 4 are connected together with a cable (not shown). These units, however, may be connected together in any other manner. For example, the AV data transmitting apparatus 2 or the AV data receiving apparatus 3 may be built in the form of a PCI board or a PCMCIA card so as to be connected via a PCI bus or the like. The AV data transmitting apparatus 2 and the AV data receiving apparatus 3 exchange AV data and asynchronous data by the use of a radio wave. The remote control transmitter 132 may use a radio wave; the AV data transmitting apparatus 2 and the AV data receiving apparatus 3 may exchange data by the use of infrared light.

[0049] FIG. 2 is a block diagram showing a transmission-related principal portion 21 of the AV data transmitting apparatus 2 which is so configured as to be able to change the quality of AV data. Reference numeral 11 represents a video input section to which AV data such as images (still and moving pictures), music, and sounds are fed from an external apparatus such as the AV data output apparatus 1. Reference numeral 12 represents an encoder that compresses the AV data fed to the video input section 11. In a case where AV data, namely images, music, and sounds, are transferred simultaneously, this encoder 12 typically uses the MPEG-2 format, in particular its TS (transport stream), which has a constant bit rate. The encoder 12, however, may use any other format. The encoder 12 may even simply have a capability of converting the bit rate or format of already encoded data.

[0050] Reference numeral 13 represents a communication controller that controls communication to transmit AV data and to transmit and receive control commands and asynchronous data. The communication controller 13 uses, for example, a communication control method based on a TDMA (time domain multiple duplex) technology, whereby transmission and reception is controlled separately on a time-division basis, or a CSMA/CA (carrier sense multiple access/collision avoidance) technology, whereby whether data is flowing via a wireless route or not is checked so that

communication is started when no data is flowing there. The communication controller 13, however, may use any other communication control method. Reference numeral 14 represents a modulator/demodulator that modulates and demodulates AV data. Wireless communication is achieved by the use of a radio wave in the 2.4 GHz, 5 GHz, 25 GHz, 60 GHz, or any other frequency band. Here, which frequency band the radio wave is in does not matter. Reference numeral 15 represents an RF section that performs up-conversion to the wireless frequency and down-conversion from the wireless frequency to the frequency that can be dealt with by digital circuitry. The RF section 15 includes an amplifier circuit and other circuits peculiar to wireless circuitry. Reference numeral 16 represents an output section that actually performs wireless transmission and reception, which is realized with an antenna when a radio wave is used. Reference numeral 17 represents a CPU that performs overall control. Reference numeral 18 represents a ROM in which programs and tables used by the CPU are stored. Reference numeral 19 represents a RAM that is used as a working area by the CPU. Depending on actual implementation, the RAM 19 may be used by the encoder or by the communication controller.

[0051] Reference numeral 20 represents a quality change setter that permits the user to set a change in the quality of AV data. The quality is selectable among, for example, three grades, namely high, medium, and low quality. The user selects one of these according to the condition at the moment. When the quality is set, the information is read by the CPU 17, which then feeds the result to the encoder 12 and, if necessary, also to the communication controller 13. For example, when the quality is changed from high to low, the amount of data output from the encoder 12 is reduced (for example, from 7 Mbps to 4 Mbps). As a result, the bandwidth used for communication is accordingly reduced, freeing a 3 Mbps bandwidth for use by another application (for example, for communication over the Internet).

[0052] Now, as an example of implementation, a description will be given of a case where the user changes the AV data quality and thereby changes the communication bandwidth. When a change in the quality is set in the quality change setter 20 shown in FIG. 2, the setting is read by the CPU 17, which then sets a new data rate in the encoder 12 and the communication controller 13. Here, the communication controller 13, according to the change in the data rate, changes the communication bandwidth. FIG. 3 is a conceptual diagram of a packet sequence. In this figure, the lapse of time is taken along the horizontal axis. In FIG. 3, at (a) is shown an example with high image quality (high data quality), and at (b) is shown an example with medium image quality (medium data quality). Reference numeral 31 represents a total AV data transmission period for transmitting AV data. This period occurs every predetermined length of time that depends on the AV data rate. Reference numeral 32 represents a main AV data transmission period for transmitting AV data. Unless an error occurs, image data can be transmitted by the use of all the main AV data transmission period 32. The hatched rectangulars Q1 represent packets of AV data, and the blank rectangulars Q2 represent Ack packets, which are sent for acknowledgment of receipt. Using Ack packets for acknowledgment of receipt is a mere example, and Nack packets may be used instead, which indicate failure of receipt.

[0053] Reference numeral 33 represents an AV data resend period for resending AV data. If an error occurs during the main AV data transmission period 32, AV data is resent during the AV data resend period 33. In the example being described, even when one among six packets contains an error, by resending the one packet containing the error, it is possible to avoid disturbance in the image. In the example with medium image quality shown at (b) in FIG. 3, a smaller bandwidth is used by transmitting ordinary AV data in four packets during a total AV data transmission period 36 for medium image quality. An AV data resend period 35 for medium image quality covers one packet. That is, by lowering the quality of AV data, it is possible to reduce the amount of data and thereby increase the wireless bandwidth for other communication. In the example being described, switching from the total AV data transmission period 31 to the total AV data transmission period 36 for medium image quality results in reducing the amount of transmitted data, and thus results in accordingly increasing the bandwidth for other communication. In this example, it is assumed that resending takes place; however, the same description applies even when no resending takes place. Although not illustrated, a total AV data transmission period for low image quality (low data quality) covers three packets, of which two are covered by a main AV data transmission period and of which one is covered by an AV data resend period.

[0054] Next, as another embodiment, a description will be given of a case where, at the same time that the AV data quality is changed, the reliability of communication is also changed. FIG. 4 is a conceptual diagram of a packet sequence observed in this case. In FIG. 4, at (a) is shown an example of transfer of high-quality AV data, and at (b) is shown an example of transfer of medium-quality AV data. In these examples, while the AV data resend period 33 permits resending only once, the AV data resend period 37 for medium image quality permits resending three times. In this case, even if up to three among the frames covered by the AV data transmission period 34 for medium image quality (which covers four frames) contain an error, the errors can be corrected.

[0055] In this embodiment, the total AV data transmission period 31 and the total AV data transmission period 38 are made equally long. Although not illustrated, an AV data resend period for low quality is so set as to permit resending four or five times. In this way, while the AV data quality is lowered, the incidence of errors is rapidly reduced as resending is permitted an increased number of times. Incidentally, the bandwidth may be controlled, instead of by controlling the number of packets as in these examples, by controlling the length of packets, or by any other method.

[0056] On the other hand, the reliability of communication may be changed, instead of by changing the number of times that resending is permitted, by adding or removing error correction codes. By changing the AV data quality and simultaneously changing the reliability in this way, even if errors occur during the communication period, it is possible to switch the AV data quality to a lower setting and thereby reduce communication errors. A change in the quality is set in the quality change setter 20 by the user operating the quality change setter 20. Alternatively, such a change may be set on the AV data receiving apparatus or on the AV data displaying/reproducing apparatus and the corresponding change command transmitted via a wireless route to the

transmitting apparatus so that the change is set in the quality change setter 20 of the transmitting apparatus.

[0057] In a case where, with respect to a change in the bandwidth or in the number of times of resending, a setting in the receiving apparatus needs to be changed, a command for such a change in the bandwidth or in the number of times of resending may be transmitted from the transmitting apparatus to the receiving apparatus so as to change the setting in the receiving apparatus. The different grades of quality are set in the following manner. The IEEE802.11b standard permits a maximum of 11 Mbps as a rate on a wireless route. In a case where MPEG-2 TS video or music is transmitted at this rate, it is advisable to set the high image quality (high data quality) at about 7 Mbps, the medium image quality (medium data quality) at about 5 Mbps, and the low image quality (low data quality) at about 4 Mbps. With the IEEE802.11a standard, which permits a maximum of 54 Mbps as a rate on a wireless route, to handle MPEG-2 video, it is preferable to increase the above AV data transmission rate by about 24 Mbps and 12 Mbps.

[0058] An example of the means for setting a change in the AV data quality according to the present invention is by realizing the quality change setter 20 with a switch. The user usually changes the AV data quality according to the communication condition while, for example, watching a movie. In such a case, it is undesirable to show the operation of making a change on the screen or indicate an image quality setting or the like on the screen being displayed. Instead, it is preferable to use a rotary switch, slide switch, or the like, because it permits the current AV data quality setting to be recognized at a glance and permits the image quality to be set elsewhere than on the screen. This permits easier setting of the image quality.

[0059] This quality setting switch may be provided in the AV data receiving apparatus so that a setting is transmitted as a control command wirelessly to the transmitting apparatus to make the quality change setter 20 of the transmitting apparatus set the AV data quality. FIG. 5 shows the quality setting switch 41. In this example, the image quality is selectable among high, medium, and low quality.

[0060] As another embodiment of the present invention, FIG. 6 shows a block diagram showing a case where the wireless channel is changed. Reference numeral 21 represents the same transmission-related principal portion 21 as the one used in the AV data transmitting apparatus shown in FIG. 2, and therefore its explanations will not be repeated. Reference numeral 40 represents a channel changer that changes the wireless channel. When a change is made in the setting of the channel changer, the information is read by the CPU 17, and the communication controller 13 is set for a new channel. Usually, a wireless system involves a plurality of channels that can be used simultaneously. The IEEE802.11b technology, which permits data transfer at 11 Mbps in the 2.4 GHz band, permits simultaneous use of three channels each having a 11 Mbps bandwidth, and permits selection of one among those three channels. The three channels offer different communication error rates depending on the condition of the apparatuses that are placed nearby and are radiating radio waves. By switching channels, it is possible to select a channel that offer a lower error rate.

[0061] According to the present invention, since the channel is switched with the switch, the user does not need to

check the current setting as by switching indications on the screen. That is, the user can confirm the currently set channel simply by visually checking the position in which the switch is currently in, and can change the setting without displaying an indication or the like on the screen. As another method for selecting a channel, it is also possible to previously prepare statistic information on communication quality (for example, information on the error rates on each channel that vary according to the month, day of the week, and hour) and switch the channel automatically within the transmitting apparatus on the basis of the information.

[0062] FIG. 7 shows the switch 42 for changing the channel. In this example, a rotary switch is used that permits selection among individual channels, namely 1ch, 6ch, 11ch, and 14ch, and an automatic mode in which the channel is automatically changed among 1ch, 6ch, and 11ch periodically. This switch may be provided in the AV data receiving apparatus 3 or in the AV data displaying/reproducing apparatus 4 so that the result set with the switch is sent as a control command wirelessly to the AV data transmitting apparatus 2 to make the channel changer of the AV data transmitting apparatus 2 operate. How the AV data receiving apparatus 3 reflects a change of the channel set on the AV data transmitting apparatus 2 may be switched by transmitting a channel change command from the AV data transmitting apparatus 2 to the AV data receiving apparatus 3. Alternatively, when the transmission channel is changed, the AV data receiving apparatus may automatically detect a channel on which AV data is flowing and automatically change channels.

[0063] As another embodiment of the present invention for changing the wireless channel, in particular in a case where the 2.4 GHz band (2 400 MHz to 2 497 MHz) is used, a part of the band above the 13th channel (with a central frequency of 2 472 MHz) is made usable (the band can thus be called the 14th channel). The 2.4 GHz band is used by the Bluetooth technology, which performs communication while going around a wide band in a short time. The Bluetooth technology performs communication while changing frequencies at a maximum rate of 1 600 times per second through the 1st to 13th channels, and thus increases noise on the 1st to 13th channels for wireless systems other than the Bluetooth technology. Thus, the part of the band above the 13th channel is less affected by the noise of the Bluetooth technology. Accordingly, by making that part of the band usable, it is possible to select a channel that offers less communication errors. Needless to say, a change to that channel may be achieved with a switch, or by the use of a remote control transmitter, or by displaying an indication on a channel change screen.

[0064] With respect to a change in the communication reliability (the number of times of resending) that accompanies a change in the AV data quality, checking may be performed automatically. If the AV data transmitting side adds error correction codes (for example, Reed-Solomon codes) to transmitted packets, the AV data receiving apparatus can not only correct errors but also obtain the number of corrected bytes. In addition, it is also possible to recognize a block (a unit of bytes, typically about 200 bytes, to which a Reed-Solomon code is applied) for which error correction has failed. Moreover, the AV data receiving apparatus 3 can recognize missing packets on the basis of the sequence numbers and time information added by the trans-

mitting side, and thus on the basis of the sequence numbers and time information of received packets (if packets with sequence numbers 5, 6, 7, and 9 are received, a packet with sequence number 8 is recognized to be missing). By the use of such information, the AV data receiving apparatus 3 can guess the incidence of errors on the currently selected channel, and thus, on the basis of the information, the AV data receiving apparatus 3 can transmit a command for changing the AV data quality or for changing the channel to the AV data transmitting apparatus 2 to effect the change.

[0065] FIG. 8 is a block diagram of a transmission-related principal portion of an AV data transmitting apparatus according to the present invention which is so configured as to receive a control command via a wireless route and then transmit the control command to an external apparatus by the use of, for example, infrared light. Reference numeral 21 represents the same transmission-related principal portion 21 as the one used in the AV data transmitting apparatus shown in FIG. 2, and therefore its explanations will not be repeated. Reference numeral 51 represents a command converter that converts a control command received via a wireless route to a format that suits an external apparatus. Reference numeral 52 represents an IR command transmitter that transmits a control command (for example, a control signal in the form of infrared light) to an external apparatus such as an AV data receiving apparatus (for example, a displaying apparatus). The IR command transmitter 52 is composed of, for example, an LED and a photodiode.

[0066] FIG. 9 is a flow chart of the operations that the AV data transmitting apparatus 2 shown in FIG. 8 performs to forward a control command transmitted wirelessly from the AV data receiving apparatus 3 to an external AV data output apparatus 1. Reference numeral 61 represents a step of receiving a control command transmitted as asynchronous data from the AV data receiving apparatus 3. Reference numeral 62 represents a step of checking whether or not the command is addressed to the transmitting apparatus itself. The command, if addressed to the transmitting apparatus itself, is, for example, one requesting a change in the transmission frequency or in the image quality. Whether or not the command is addressed to the transmitting apparatus itself is checked on the basis of an identification code that the command contains. In step 63, a control command that is not addressed to the transmitting apparatus itself is transmitted, through the IR command transmitter, to the external AV data output apparatus such as a videocassette recorder to control it. The control command, if addressed to a video cassette recorder, is, for example, one requesting fast forwarding, rewinding, stopping, or the like. In step 64, the transmitting apparatus itself is controlled according to the control command addressed thereto. The control command, if addressed to the transmitting apparatus itself, is, for example, one requesting a change in the AV data quality or in the wireless channel or one requesting starting or ending of AV data transmission, i.e., one according which the encoder, communication controller, modulator/demodulator, and RF section are controlled.

[0067] FIG. 10 is another flow chart of the operations that the AV data transmitting apparatus 2 performs to forward a control command transmitted wirelessly from the AV data receiving apparatus 3 to the AV data output apparatus 1. Reference numeral 71 represents a step, like step 61, of receiving a command transmitted via a wireless route.

Reference numeral **72** represents a step of referring to a conversion table stored in the ROM **18** or RAM **19** to check whether or not the command currently being processed is found in the conversion table. Reference numeral **73** represents a step of, if the command is found in the conversion table, converting the command. Reference numeral **74** represents a step of transmitting the converted command to the external apparatus, i.e., the AV data output apparatus **1**, by the use of, for example, infrared light. In this example, a command that is not found in the conversion table is ignored. Alternatively, a command that is not found in the conversion table may be transmitted without conversion, or a table other than a conversion table may be used with reference to which to determine whether or not to transmit such a command.

[0068] With the present invention, it is possible, for example, to convert a command received via a wireless route and requesting "video playback" into an infrared command requesting "video playback on an 'S Corporation'-made videocassette recorder," or to prohibit a command received via a wireless route and requesting "higher sound volume" on a television monitor from being transmitted to an external apparatus. For example, when the user operates a remote control transmitter on an AV data receiving apparatus, the command is sent to an AV data transmitting apparatus via a wireless route. In such a case, the user most probably wants to operate the volume of a television monitor located in front of him or her, and not of a television monitor located near an AV data transmitting apparatus that may be installed in another room.

[0069] In such a case, according to the present invention, with a conversion table so prepared that commands for controlling a television monitor are not transmitted to an external terminal, the AV data transmitting apparatus does not issue any command for controlling a television monitor. This helps prevent a television monitor located near the AV data transmitting apparatus from being erroneously controlled.

[0070] In another embodiment of the present invention, the command conversion table (conversion rules) provided in the command converter is made rewritable so that it can be changed from outside. By changing the command conversion table, it is possible to switch from a rule according to which a command received via a wireless route and requesting "video playback" is converted into an infrared command requesting "video playback on an 'S Corporation'-made videocassette recorder" to a rule according to which the command requesting "video playback" is converted into a command requesting "video playback on a 'P Corporation'-made DVD player." The present invention permits the user to issue control commands that suit the AV data output apparatus that he or she possesses.

[0071] FIG. 11 shows an example of implementation of the AV data transmitting apparatus. In the figure, reference numeral **81** represents a factory shipment terminal. Via this terminal **81**, the contents of the ROM can be changed, and internal diagnosis can be performed. Reference numeral **82** represents an AV output terminal. Reference numeral **83** represents an AV input terminal. AV data is fed in via the AV input terminal **83**, is then encoded within the AV data transmitting apparatus, and is then transmitted to the AV data receiving apparatus. Simultaneously, the same AV data is

output via the AV output terminal **82**. This is because the AV data transmitting apparatus is supposed to be connected, for example, between a videocassette recorder and a television monitor. In that case, the output from the AV output terminal **82** is coupled to the television monitor located near the videocassette recorder. In that case, it is preferable that the signal fed to the AV input terminal **83** be kept appearing at the AV output terminal **82** all the time even when the AV data transmitting apparatus is not turned on.

[0072] Reference numeral **84** represents a terminal to which an infrared light emitter is connected. This is to convert a wirelessly transmitted control command into an infrared command, then make the infrared light emitter connected to the terminal blink, and thereby control an apparatus (for example, a videocassette recorder) located in front of it. Reference numeral **85** represents an image quality switch. Reference numeral **86** represents a communication channel switch. Reference numeral **87** represents a power input terminal. Reference numeral **88** represents the casing of the AV data transmitting apparatus. Reference numerals **89** and **91** represent flat antennas that are fixed inside the casing, and reference numeral **90** represents a circuit board. This is illustrated at the same angle as the casing. The two flat antennas **89** and **91** are for diversity reception. It is, however, not absolutely necessary to provide two of them; there may be provided more than two antennas.

[0073] The circuit board **90** is covered with a conductive material, and thus shields radio waves. For this reason, the antennas are arranged at a substantially right angle to the surface of the circuit board so that the circuit board **90** does not obstruct the direction in which the antennas exhibit the maximum signal strength. Specifically, the flat antennas **89** and **91** illustrated are so arranged that the direction in which the radio wave travels, i.e., the direction indicated by arrows, is not obstructed by the circuit board. Likewise, the faces on which switches and connectors are arranged contain much conductive material, and therefore the antennas are so arranged that the direction indicated by arrows is not obstructed by those faces either. With respect to the arrangement of an antenna, the same principles apply with the AV data receiving apparatus; that is, it is preferable that an antenna be so arranged that the direction in which the antenna is effective is not obstructed by a circuit board, connector, or switch.

[0074] FIG. 12 shows an example of a block diagram of the AV data receiving apparatus according to the present inventions. Reference numeral **101** represents an antenna that actually transmits and receives a radio wave. Reference numeral **102** represents an RF section that performs up-conversion to the wireless frequency and down-conversion from the wireless frequency to the frequency that can be dealt with by digital circuitry. The RF section **102** includes an amplifier circuit and other circuits peculiar to wireless circuitry. Reference numeral **103** represents a modulator/demodulator that modulates and demodulates data. Reference numeral **104** represents a communication controller that controls communication to transmit AV data and to transmit and receive control commands and asynchronous data. The blocks **101** to **104** together constitute a wireless communication section **111**. Reference numeral **105** represents an encoder that decompresses the AV data fed thereto from the communication controller **104**. Reference numeral **106** represents a video output section that achieves connec-

tion to an unillustrated AV data displaying/reproducing apparatus, which may be an external apparatus, such as a display unit, image recording unit, or flat display such as a liquid crystal television monitor. Reference numeral 107 represents a RAM that is used as a working area by a CPU. Reference numeral 108 represents a ROM in which programs and tables used by the CPU are stored. Reference numeral 109 represents a CPU that performs overall control. Reference numeral 110 represents an IR command input section that receives optical operation commands sent from an external apparatus and from a remote control transmitter.

[0075] FIG. 13 shows an example of implementation of the AV data receiving apparatus according to the present invention. Reference numeral 121 represents the main unit of the AV data receiving apparatus, and reference numeral 122 represents an external infrared receiver that is movable. The external infrared receiver 122 has, at the other end of its connection line, a plug 122a, which is inserted into a connector (not illustrated) provided in the main unit of the AV data receiving apparatus.

[0076] FIG. 14 is a diagram showing how the main unit of the AV data receiving apparatus is fitted on the rear face of a display apparatus with a flat display, such as a liquid crystal television monitor. Reference numeral 123 represents a display apparatus built as a liquid crystal display monitor, and reference numeral 132 represents an infrared remote control transmitter. The fitting of the AV data receiving apparatus 121' is achieved by inserting a hook 125 provided on the rear face of the liquid crystal television monitor into a fitting hole 124. The fitting hole 124 and the hook 125 may be replaced with any other fitting mechanism. Here, the AV data receiving apparatus 121' is fitted on the rear face of the display apparatus 123, and thus cannot directly receive infrared commands from the remote control transmitter 132. However, by permitting the infrared receiver 122 to be moved to a position visible from the user as shown in the figure, it is possible to permit the AV data receiving apparatus 121' to receive commands from the remote control transmitter 132. The cable 122b of the external infrared receiver 122 is made 20 cm to 80 cm long so that the AV data receiving apparatus 121' fitted on the rear face of the display apparatus 123 can be connected to the external infrared receiver terminal 127.

[0077] When the AV data receiving apparatus 121' and the display apparatus 123 are connected together on a wired basis, and the infrared command signals received by the infrared receiver 122 are not only processed within the display apparatus 123 but also sent intact to the AV data receiving apparatus 121', it is possible, without separately providing an external infrared receiver, to receive remote control commands from the remote control transmitter operated by the user present in front of the display apparatus 123 and transmit them to the AV data transmitting apparatus.

[0078] FIG. 15 shows another embodiment in which the AV data receiving apparatus according to the present invention is fitted on the rear face of a display apparatus. Reference numeral 131 represents a reflective mirror that reflects infrared light. When the AV data receiving apparatus 121' is fitted on the rear face of the display apparatus 123, it cannot directly receive the infrared light from the front face of the display apparatus. However, by providing the reflective mirror 131, it is possible to make the infrared light reach the

AV data receiving apparatus main unit infrared receiver 126 fitted on the rear face of the display apparatus 123. This makes possible direct control from in front of the display apparatus 123 by the use of the remote control transmitter 132.

[0079] Back in FIG. 14, the display apparatus 123 has a holding mechanism, for removably holding the external infrared receiver 122, provided on the top face of the AV data displaying/reproducing apparatus (display apparatus) 123. This permits the user to easily and securely fit and remove the external infrared receiver to and from the AV data displaying/reproducing apparatus (display apparatus) 123.

[0080] As another embodiment, a description will be given of a case where the AV data receiving apparatus or the AV data transmitting apparatus is fitted with an antenna interface. When a high-performance external antenna is externally fitted to the apparatus, it is possible to perform communication over a wider range. In a case where both the AV data transmitting apparatus and the AV data receiving apparatus are used in fixed positions, by using external antennas with high directionality and properly adjusting their orientation, it is possible to transfer AV data even between remote rooms in a bigger house. On the other hand, in a case where radio waves do not reach far enough because of the presence of concrete walls or the like as in a reinforced concrete building or the like, by replacing the antennas with ones that offer a higher gain, it is possible to realize a high-performance AV data communication system (the combination shown in FIG. 1). The antenna interface then serves to disable the antenna 101 shown in FIG. 12 and enable an external antenna.

[0081] In FIG. 14, reference numeral 95 represents external antennas; reference numeral 96 represents external antenna connection terminals; and reference numeral 97 represents external antenna fitting portions provided in the display apparatus 123. This construction helps easily obtain reception performance that suits the radio wave condition at the user's site. The external antenna 95 may be provided on the AV data receiving apparatus 121'. The external antenna 95 may be placed separately away from the display apparatus 123 by the use of a stand or the like.

[0082] FIG. 16 shows an outline of the AV data receiving apparatus according to the present invention. FIG. 16(a) is a front outline view of the AV data receiving apparatus, FIG. 16(b) is a rear outline view thereof, and FIG. 16(c) is a diagram showing the circuit board and the antenna housed inside the AV data receiving apparatus. Reference numeral 141 represents a power button. Reference numeral 142 represents control buttons provided on the AV data receiving apparatus. These buttons correspond to, for example, power, input select, tune (forward and backward), rewind, fast forward, playback, stop, and other buttons. Reference numeral 143 represents a factory adjustment terminal that is used to rewrite the ROM, to perform self checks, and to monitor errors during reception.

[0083] Reference numeral 144 represents an AV output terminal, which is connected to the AV data displaying/reproducing apparatus. Reference numeral 145 represents an infrared receiver connection terminal, to which an externally fitted infrared receiver is connected. Reference numeral 146 represents an external antenna connection terminal. Refer-

ence numeral **147** represents a video controller setting switch. Reference numeral **148** represents a power connector, and reference numeral **149** represents an infrared receiver. Reference numeral **150** represents a reception level lamp, which is lit green when reception is normal and red when reception is abnormal. Whether reception is abnormal or not is checked, for example, by guessing the incidence of errors by counting, on the receiving side, the number of corrected errors on the basis of error correction codes (for example, Reed-Solomon codes) or the number of erroneous and thus resent packets. The reception level lamp **150** may be kept off when no AV data communication is taking place. Reference numeral **151** represents a power lamp, which is lit when the power is on.

[0084] Reference numerals **152**, **153**, and **154** show the circuit board and the antennas housed inside the casing of the AV data receiving apparatus. Reference numerals **152** and **153** represent antennas, and reference numeral **154** represents a circuit board. The antenna **153** is so arranged as to exhibit its maximum sensitivity in the direction indicated by arrows. As shown in FIG. 16, the infrared receiver connection terminal **145** and the external antenna connection terminal **146** are arranged in the vicinity of each other on the same face. This makes it easy to externally fit the two externally fitted units, namely the external antennas **95** and the external infrared receiver **122**.

[0085] FIG. 17 shows a structure in which an infrared receiver **161** and an external antenna **162** are integrated together. This permits the infrared receiver and the antenna to be fixed at the same time.

[0086] The switches **142** shown in FIG. 16 produce commands for controlling the AV data output apparatus connected on the AV data transmitting apparatus side. These commands are wirelessly transmitted to the AV data transmitting apparatus, which then converts them into control commands for the AV data output apparatus, which is an external apparatus, and then forwards them to the AV data output apparatus. These commands may be the same as those transmitted from the infrared remote control transmitter. Providing the switches **142** on the AV data receiving apparatus permits the user to control the functions of the AV data output apparatus by operating the switches **142** without carrying around the remote control transmitter.

[0087] The commands from the switches **142** and the control data from the remote control transmitter **132** may be interpreted within the apparatus so that, as necessary, the commands are converted or checks are made as to whether to forward the commands or not. This makes more flexible control of the image output apparatus possible. In that case, the control flows are basically the same as those shown in FIGS. 9 and 10, except that, in step **61** in FIG. 9 and in step **71** in FIG. 10, commands are received in the form of infrared light and, in step **63** in FIG. 9 and in step **74** in FIG. 10, commands are transmitted wirelessly.

[0088] It is preferable that the table used to convert commands or to make checks as to whether to forward them or not be settable from outside. Then, by changing the table, the user can set the commands output to the image output apparatus to those appropriate for the type and manufacturer of the output apparatus. When a conversion table is used, a command is converted by the following procedure:

[0089] 1. The remote control transmitter transmits a general command requesting "playback".

[0090] 2. In the AV data receiving apparatus, there is stored a conversion table for an 'S-Corporation'-made videocassette recorder as an image output apparatus.

[0091] 3. The "playback" command received in the form of infrared light is converted into a command requesting "playback on an 'S-Corporation'-made videocassette recorder," and is then wirelessly sent to the AV data transmitting apparatus.

[0092] 4. The AV data transmitting apparatus sends out the command requesting "playback on an 'S-Corporation'-made videocassette recorder" as an infrared command via the wireless route.

[0093] By changing the conversion table, it is possible to modify the rule according to which the "playback" command is converted into the "playback on an 'S-Corporation'-made videocassette recorder" command to a rule according to which the "playback" command is converted into a "playback on a 'P-Corporation'-made DVD player" command. Thus, when the user buys an AV data transmitting apparatus of a different manufacturer, he or she can change the control commands to those that suit it.

[0094] As shown in FIG. 16 as an embodiment of the present invention, the flat antennas **152** and **153** are so arranged that no switch, circuit board, or connector is located in the direction in which they exhibit the maximum gain. Moreover, in a case where the AV data receiving apparatus is fixed to a display apparatus, the flat antennas **152** and **153** are so arranged that none of the faces of the display apparatus casing is located in the direction in which they exhibit the maximum gain. This helps minimize the interference of conductive materials, which shield radio waves, and thereby achieve efficient transmission and reception of radio waves.

[0095] As shown in FIG. 16, the AV data receiving apparatus is installed with its face with the buttons **142** facing upward. In this state, the antenna plane is perpendicular to the floor, and the maximum gain plane is parallel to the floor. When this apparatus is mounted on a display apparatus, it is installed with its face with the power button **141** facing upward or downward. That is, even when fixed to a display apparatus, the AV data receiving apparatus is installed with the maximum gain plane parallel to the floor. In this way, it is possible to minimize degradation of antenna performance irrespective of whether the AV data receiving apparatus is installed independently or mounted on a display apparatus.

[0096] Next, with reference to FIGS. 18 to 23, an embodiment of the present invention which relates to supply of power will be described. In FIG. 18, reference numeral **302** represents a display apparatus (here, a flat panel display such as a liquid crystal television monitor). The display apparatus **302** is supported on a base **305** designed to well withstand the weight thereof, and is fitted to a fitting plate **303** designed to well withstand the weight of the display and an AV data receiving apparatus. These are firmly fixed together so that they can be easily carried around together with a grip **304** held in the hand.

[0097] The fitting plate **303** has a screw hole **331** formed therein so as to permit an AV data receiving apparatus fitting member **313** and an AV data receiving apparatus to be fixed

thereto. The fitting plate **303** also has an opening formed therein so as to expose projection-like display apparatus side power/signal relaying members **314** and a projection-like connection detecting member **312**, all provided on the display apparatus. On the other hand, the AV data receiving apparatus **301** is provided with antennas **306**, operation members **307**, and a fixing screw **330** with which the AV data receiving apparatus is fixed to the display apparatus. Moreover, on the rear face of the AV data receiving apparatus, there are provided recess-like AV data receiving apparatus side power/signal relaying members **315** so as to face away from the operation members **306**.

[0098] The display apparatus receives electric power from an AC power outlet by way of a power plug **326** and an AC adapter **325**. The display apparatus side power/signal relaying members **314** include a signal GND terminal **316**, a video signal terminal **317**, a left sound signal terminal **318**, a right sound signal terminal **319**, a power GND terminal **320**, and a power output terminal **321**. In corresponding order, the AV data receiving apparatus side power/signal relaying members **315** include a signal GND terminal **361**, a video signal terminal **362**, a left sound signal terminal **363**, a right sound signal terminal **365**, a power GND terminal **366**, and a power terminal **367**.

[0099] The AV data receiving apparatus **301** has its lower portion fixed by the AV data receiving apparatus fitting member **313**, and has its upper portion fixed to the screw hole **331** with the fixing screw **330**. In this state, the projection-like display apparatus side power/signal relaying members **314** fit into the recess-like AV data receiving apparatus side power/signal relaying members **315**, with the result that the display apparatus side signal/power terminals (**316** to **321**) are easily and accurately connected to the corresponding terminals (**361** to **367**) constituting the AV data receiving apparatus side power/signal relaying members **351**. In this way, the AV data receiving apparatus **301** can easily be fixed to the display apparatus **302**, and necessary wiring is finished simultaneously. This helps to reduce the time and trouble required for wiring, to prevent wrong and unnecessary wiring, and thereby to reduce the costs and to improve the outer appearance.

[0100] The AV data receiving apparatus **301** may be so configured as to receive electric power from an AC adapter or the like just as does the display apparatus **302**. However, using two AC adapters is inconvenient in that it requires more AC power outlets and more wiring, leading to an unsightly look and other problems.

[0101] In this embodiment, while the display apparatus side power/signal relaying members **314** include the power GND terminal **320** and the power input/output terminal **321**, the corresponding terminals, namely the power GND terminal **366** and power input terminal **367**, are provided on the AV data receiving apparatus side. Thus, via these terminals, electric power can be fed from the display apparatus **302** to the AV data receiving apparatus **301**, and therefore there is no need to separately provide a power supply such as an AC adapter on the AV data receiving apparatus side. FIG. 19 shows these apparatuses in the connected state.

[0102] Furthermore, in this embodiment, when the AV data receiving apparatus is fitted, only while the connection detecting member **312** is being pressed, electric power is output via the power input/output terminal **321**. This helps

prevent the power output from being short-circuited to, for example, ground as a result of a metal part touching the power input/output terminal **321** or the like when the AV data receiving apparatus **301** is not fitted. The other control, such as that for supplying electric power only when a detector has detected something, is conventionally well known, and therefore no detailed description thereof will be given. In this embodiment, the display apparatus **302** is a flat display. However, this is not to limit the present invention; that is, a CRT display or the like may be used instead.

[0103] FIG. 20 shows an embodiment in which a battery is used. Reference numeral **340** represents a battery, which has, on the bottom face thereof, connection terminals **341** for connection with an external apparatus, and has, on a side face thereof, a tenon-like engagement projection **342**. The AV data receiving apparatus **301'** is provided with connection terminals **345** for connection with the battery **340**, and has a mortise-like engagement recess **346**. The engagement projection **342** of the battery **340** engages with the engagement recess **346** of the AV data receiving apparatus **301'**, and thereby these are fixed together. The connection terminals **341** of the battery are connected to the connection terminals **345** of the battery, and thereby these are integrated together, resulting in the battery-equipped AV data receiving apparatus **350** shown in FIG. 21. The battery-equipped AV data receiving apparatus **350** can also be supplied with electric power from outside by way of a power plug **352** and an AC adapter **351**. This electric power is used as driving power for the battery-equipped AV data receiving apparatus. Thus, the battery-equipped AV data receiving apparatus **350** operates from both AC power and the battery. Moreover, when the battery is in a chargeable state, it can be charged with the electric power supplied from the AC power.

[0104] As shown in FIG. 22, the battery-equipped AV data receiving apparatus **350** has a recess **359** in the rear face thereof. Thus, even when it is fitted to the display apparatus **302**, the connection detecting member **312** is not pressed, and therefore no electric power is supplied. In this case, in this embodiment, the power input/output terminal **321** serves as a power input terminal. Accordingly, the terminal of the battery-equipped AV data receiving apparatus **350** which corresponds to the power input/output terminal **321** serves as a power output terminal, and thus the display apparatus is supplied with electric power.

[0105] In this way, the AV data receiving apparatus, display apparatus, and battery serving as a power source are integrated together, and operate without being supplied with electric power from outside. In addition, AV data is received wirelessly. Thus, the display apparatus **360** operates perfectly wirelessly without any connection to the outside world via an AC or DC power line or via an antenna line, and can readily be carried around with the grip **304** held in the hand.

[0106] Even in a case where no battery is provided, so long as the AV data receiving apparatus **301** is capable of feeding electric power to the display apparatus, electric power can be supplied to the AV data receiving apparatus and the display apparatus via the power plug **326'** and the AC adapter **325'**. That is, it is possible to eliminate the AV adapter or the like for the display apparatus and supply all the electric power needed via a single AC line.

[0107] As shown in FIG. 23, if the AV data receiving apparatus side power/signal relaying members **315'** include

a power/charge input terminal 368 and the display apparatus side power/signal relaying members 314' include a power/charge output terminal 322, it is possible to drive and charge the battery-equipped AV data receiving apparatus 350 by using the electric power supplied to the display apparatus 302 via the power plug 326 and the AC adapter 352. The technology used here to achieve charging is conventionally well known in the field of PCs (personal computers) and the like, and therefore no detailed description thereof will be given.

[0108] The perfectly wireless display apparatus 360 shown in FIG. 22 and the integrated system shown in FIG. 1, which is composed of the AV data receiving apparatus 3 and the AV data transmitting apparatus 4, are, in the respective embodiments, described as being completed by the user who assembles together a plurality of apparatuses. It is, however, also possible to previously incorporate an AV data receiving apparatus and a battery in a display apparatus. Likewise, the AV data transmitting apparatus shown in FIG. 1 may be an AV unit incorporated in a AV data displaying/reproducing apparatus.

[0109] FIG. 24 shows a block diagram of an example of the present invention. Reference numeral 201 represents an antenna that actually transmits and receives a radio wave. Reference numeral 202 represents an RF section that performs up-conversion to the wireless frequency and down-conversion from the wireless frequency to the frequency that can be dealt with by digital circuitry. The RF section 202 includes an amplifier circuit and other circuits peculiar to wireless circuitry. Reference numeral 203 represents a modulator/demodulator that modulates and demodulates data. Reference numeral 204 represents a communication controller that controls communication to transmit image data and to transmit and receive control commands and asynchronous data. Reference numeral 205 represents a decoder that decompresses the image data fed thereto from the communication controller 204. Reference numeral 206 represents a video output section that achieves connection to an unillustrated external unit (for example, a display unit or image recording unit). Reference numeral 207 represents a RAM that is used as a working area by a CPU.

[0110] Reference numeral 208 represents a ROM in which programs and tables used by the CPU are stored. Reference numeral 209 represents a CPU that performs overall control. Reference numeral 210 represents an IP application executer that processes protocols related to the Internet protocol and that executes Internet applications. Reference numeral 211 represents an IP application presenter that produces screens for Internet applications. The screens produced here are displayed on an external display unit through the video output section 205. Reference numeral 212 represents an operation input section, through which entry of both Internet applications and commands for controlling AV data transmitting apparatus side unit is performed.

[0111] The distinctive feature of the present invention is the provision of a header discriminator 213, of which a detailed description will be given below. Headers need to be discriminated to know whether transmitted and received data packets are AV data, control commands for AV-related units, or Internet protocol (IP) packets. This is because AV data needs to be sent to the decoder, control commands for AV apparatuses need to be interpreted and processed as

control commands, and IP-related packets (including address analysis protocols) need to be subjected to IP-related processing.

[0112] To achieve such discrimination, in the present invention, the packet format complying with IEEE802.2 is used. In FIG. 25, at (A) is shown the packet format complying with IEEE802.2, and at (B) is shown the SNAP protocol packet format that is generally used as a 802.2-complying format. The SNAP format is one method of implementing the 802.2 format. Here, IP has 0800 (hexadecimal) in the "TYPE" field. For example, "TYPE"=A000 (hexadecimal) for AV data, and "TYPE"=A001 (hexadecimal) for AV control data. AV control data may be AV/C commands that are used to control AV equipment according to IEEE1394, or may be commands in the format complying with Association for Electric Home Appliances which are used in infrared remote control in Japan. Different "TYPE" fields may be assigned to those two formats. AV data may be in the format formulated in IEC61883.

[0113] IEC61883 has an internal timer, and thus permits output synchronous with a clock at the output stage. Providing a packet header discriminator and using packet headers in the IEEE802.2 and SNAP protocol formats as in this embodiment permits even a PC software program that has conventionally been handling the IP protocol to distinguish among the IP protocol, AV data, and commands simply by discriminating the "TYPE" field. Thus, by providing the receiving side with a packet header discriminator that interprets those formats, it is possible to readily classify IP and AV data. This helps simplify the configuration of the receiving apparatus.

[0114] FIG. 26 shows an embodiment of the AV data receiving apparatus that connects to, as a destination of connection achieved by the Internet protocol, an access point (AP) from which IP packets are received, that negotiates with, as an image source, an AV data source about the rate, whether there has been any corrected error or not, whether there has been any delayed acknowledgement or not, etc., and that receives AV data from the AV data source.

[0115] Here, reference numeral 381 represents an AV data receiving apparatus, and reference numeral 382 represents an AV data transmitting apparatus. No AV data displaying/reproducing apparatus or AV data output apparatus is shown. Reference numeral 383 represents an IP data transmitting/receiving apparatus that transmits and receives Internet-related packets. The IP data transmitting/receiving apparatus 383 is connected to the Internet (IP network) 384. For example, with the wireless LAN protocol of IEEE802.11, in a wireless network that is connected via an access point to an outside-world network, an apparatus within the wireless network can exchange data only with the access point. This is not particularly inconvenient in the case of an IP network, because it is connected to the outside world via an AP.

[0116] However, in a case where the image source is based on a system other than an IP network (for example, a home videocassette recorder), the videocassette recorder is not connected to an AP, and thus cannot receive image data via an AP. In this case, the AV data receiving apparatus adjusts the band width with the image source or with a node for adjusting the band width, and exchanges AV data directly with the image source. Accordingly, the AV data receiving apparatus 381 transmits and receives Internet-related data to

and from an access point, and simultaneously connects to the AV data transmitting apparatus for images. Thus, the AV data receiving apparatus 381 achieves Internet and AV data applications simultaneously.

[0117] Although the AV data receiving apparatus and the AV data displaying/reproducing apparatus have been described as separate apparatuses, it is also possible to integrate together the AV data receiving apparatus and the AV data displaying/reproducing apparatus to realize a wireless AV data displaying/reproducing apparatus. This makes it possible to realize an apparatus that permits AV data to be enjoyed wirelessly at any time without requiring an AV data receiving apparatus to be connected later.

[0118] Likewise, although the AV data transmitting apparatus and the AV data output apparatus have been described as separate apparatuses, it is also possible to integrate together the AV data transmitting apparatus and the AV data output apparatus to realize a wireless AV data output apparatus. This makes it possible to realize an apparatus that permits AV data to be transmitted wirelessly at any time without requiring an AV data transmitting apparatus to be connected later.

[0119] Industrial Applicability

[0120] As described in detail hereinbefore, according to the present invention, it is possible to realize an AV data transmitting apparatus having an image quality switching capability which permits effective use of a radio wave band.

[0121] According to the present invention, it is possible to realize an AV data transmitting apparatus having an image quality switching capability which offers higher reliability in AV data transfer by controlling the image quality and number of times of resending.

[0122] According to the present invention, it is possible to realize an AV data transmitting apparatus having an image quality switching capability which permits confirmation of the currently set image quality level and which permits changing of the image quality at any time with no indication on the screen

[0123] According to the present invention, it is possible to realize an AV data transmitting apparatus that permits confirmation of the currently set frequency by the use of a frequency switch and permits changing of the transfer channel with no indication on the screen. According to the present invention, it is possible to realize an AV data transmitting apparatus that uses a part of the 2.4 GHz band around the 14th channel and that thereby achieves image transfer with less noise as a result of less interference from the Bluetooth system.

[0124] According to the present invention, it is possible to convert received control signals into commands that suit the connected AV unit. Thus, the remote control signals received by an AV data receiving apparatus do not need to be those for the connected AV unit. Moreover, the signals are checked so as not to send unnecessary remote control signals. This prevents other AV units from being erroneously controlled.

[0125] According to the present invention, by changing tables, it is possible to operate a number of AV units. It is possible to generate commands such as those requesting "video playback on an 'S Corporation'-made videocassette recorder" and "video playback on a 'P Corporation'-made

DVD player." Moreover, by making a setting such that television channel commands are not transmitted, it is possible to prevent a television monitor located near an AV data transmitting apparatus from being erroneously controlled.

[0126] According to the present invention, by making the operation command receiver movable, it is possible to permit the user to perform remote control operation from in front of a display apparatus. Moreover, even in a case where an AV data receiving apparatus is fitted on a rear face of a display apparatus such as a flat display so as not to spoil its slim design, the photoreceiver can be placed in such a position that the user of the display apparatus can easily perform remote control operation.

[0127] According to the present invention, the photoreceiver of a display apparatus can be shared by an AV data receiving apparatus. This makes it possible to transfer operation commands from the AV data receiving apparatus to the an AV data transmitting apparatus without providing an extra photoreceiver.

[0128] According to the present invention, by adding a reflective member, it is possible to control an AV data receiving apparatus by remote control without providing an extra photoreceiver or moving an existing photoreceiver.

[0129] According to the present invention, it is possible to fit the movable photoreceiver to the display apparatus. This makes it easy for the user to fix the photoreceiver.

[0130] According to the present invention, it is possible to select and add an antenna. This makes it possible to select perception performance that suits the radio wave condition at the user's site.

[0131] According to the present invention, the fitting portion for an external antenna and that for an infrared light-receiving element can be provided on the same face. This makes it easy for the user to connect the units together.

[0132] According to the present invention, an external antenna and an infrared light-receiving element are integrated together. This permits the antenna and the infrared light-receiving element to be fitted simultaneously. This reduces the work of the user.

[0133] According to the present invention, an AV data receiving apparatus is provided with operation switches. Thus, even without a remote control transmitter, it is possible to operate AV units connected to an AV data transmitting apparatus or AV data transmitting apparatus.

[0134] According to the present invention, an AV data receiving apparatus can kill signals that do not need to be wirelessly sent to an AV data transmitting apparatus. This permits effective use of a radio wave band, prevents unnecessary operation on the AV data transmitting apparatus, and prevents erroneous control of a unit that is located close to the AV data transmitting apparatus but is not supposed to be operated.

[0135] According to the present invention, an AV data receiving apparatus can convert commands. This makes it possible to switch and control, from the AV data receiving apparatus, a number of units located around an AV data transmitting apparatus. Moreover, by making it possible to convert the switching commands of the AV data receiving

apparatus itself, it is possible to perform a number of operations and operate a number of units with a few switches.

[0136] According to the present invention, an antenna, a circuit board, and other components are arranged in such a way as to minimize the obstruction of the radio wave received by the antenna. This makes it possible to transmit and receive the radio wave efficiently.

[0137] According to the present invention, it is possible to supply electric power from a display apparatus. This eliminates the need to provide an AV data receiving apparatus with a separate unit such as an AC adapter. This helps reduce costs, simplify the wiring, and improve the outer appearance.

[0138] According to the present invention, it is possible to supply electric power from an AV data receiving apparatus to a display apparatus. This eliminates the need to provide the display apparatus with a separate unit such as an AV adapter. This helps reduce costs, simplify the wiring, and improve the outer appearance.

[0139] According to the present invention, a battery is used as a power source. This makes it possible to realize a perfectly wireless television system.

[0140] According to the present invention, a display apparatus is provided with a mechanism for mounting an AV data receiving apparatus. This eliminates the need to secure an extra space for the AV data receiving apparatus, and thus makes it easy to install the AV data receiving apparatus.

[0141] According to the present invention, an AV data receiving apparatus is fitted on the rear face of a display apparatus. Thus, even with a flat display, it is possible to fit the AV data receiving apparatus without spoiling the neat design of the display apparatus having few components located on the front face.

[0142] According to the present invention, it is possible to carry an AV data receiving apparatus and a display apparatus simultaneously and easily with a single hand. When this is combined with the aforementioned construction, it is possible to carry an AV data receiving apparatus, a display apparatus, and a battery simultaneously and freely. Thus, it is possible to realize a perfectly wireless display apparatus that can be viewed anywhere, even while it is being carried around.

[0143] According to the present invention, the receiving side is provided with a packet header discriminator that interprets predetermined formats. This makes it possible to distinguish among the IP protocol, commands, and AV-related data. This helps easily realize a receiving apparatus that distinguishes between IP and AV data.

[0144] According to the present invention, connection is made to separate apparatuses for IP data and AV data. This makes it possible to exchange IP data and AV data simultaneously on the same channel of the same medium between a transmitting side and a receiving side. That is, connection can be made to two destinations simultaneously, namely an IP data provider and an AV data transmitting apparatus.

[0145] According to the present invention, an AV data receiving apparatus is previously incorporated in a receiving apparatus. This makes it possible to view information of an

AV unit located at a remote place without additional provision of an extra AV data receiving apparatus or the like.

[0146] According to the present invention, an AV data transmitting apparatus is previously incorporated in an AV unit or the like. This makes it possible to transfer AV data to an AV data receiving apparatus located at a remote place without additional provision of an extra AV data transmitting apparatus or the like.

1. An AV data transmitting apparatus that transmits AV data wirelessly and that transmits and receives asynchronous data containing control data,

wherein the AV data transmitting apparatus comprises

a quality change setter for changing a setting in a compression ratio of the AV data, the quality change setter being capable of changing a communication bandwidth with which the AV data is transmitted.

2. An AV data transmitting apparatus that transmits AV data wirelessly and that transmits and receives asynchronous data containing control data,

wherein the AV data transmitting apparatus comprises

a quality change setter for permitting a user to change a compression ratio of the AV data, the quality change setter being capable of changing not only a compression ratio with which the AV data is transmitted but also reliability of communication.

3. The AV data transmitting apparatus according to claim 1,

wherein the quality change setter is a switch added to the AV data transmitting apparatus, the switch being switchable even during communication.

4. An AV data transmitting apparatus that transmits AV data wirelessly and that transmits and receives asynchronous data,

wherein the AV data transmitting apparatus comprises

a channel switcher for switching channels used for wireless transmission.

5. The AV data transmitting apparatus according to claim 4,

wherein wireless transmission is performed in a 2.4 GHz band (from 2 400 MHz to 2 497 MHz), and channels switchable by a user include a part of the band above a 13th channel (with a central frequency of 2 472 MHz).

6. An AV data transmitting apparatus that transmits AV data wirelessly and that transmits and receives asynchronous data,

wherein the AV data transmitting apparatus comprises

a command converter for selecting control data from the asynchronous data and converting the control data according to a predetermined rule and

a command transmitter for feeding a command obtained through conversion by the command converter to an external apparatus.

7. The AV data transmitting apparatus according to claim 6,

wherein the command converter holds a rewritable conversion rule that can be changed from the external apparatus.

8. An AV data receiving apparatus that receives wirelessly transmitted AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus comprises

a command receiver for receiving an operation command, the command receiver being movable.

9. An AV data receiving apparatus that receives wirelessly transmitted AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus has a command receiver externally fitted thereto for receiving an operation command.

10. The AV data receiving apparatus according to claim 8,

wherein the movable command receiver can be placed in a position in which the command receiver can receive remote control operation signals from a front-face side of an AV data displaying/reproducing apparatus.

11. The AV data receiving apparatus according to claim 9,

wherein a movable command receiver can be placed in a position in which the command receiver can receive remote control operation signals from a front-face side of an AV data displaying/reproducing apparatus.

12. The AV data receiving apparatus according to claim 8,

wherein the AV data receiving apparatus is connected to an AV data displaying/reproducing apparatus via a signal line so that an operation command receiver of the AV data receiving apparatus is shared as a command receiver of the AV data displaying/reproducing apparatus.

13. The AV data receiving apparatus according to claim 9,

wherein the AV data receiving apparatus is connected to an AV data displaying/reproducing apparatus via a signal line so that an operation command receiver of the AV data receiving apparatus is shared as a command receiver of the AV data displaying/reproducing apparatus.

14. The AV data receiving apparatus according to claim 10,

wherein the AV data receiving apparatus is connected to an AV data displaying/reproducing apparatus via a signal line so that an operation command receiver of the AV data receiving apparatus is shared as a command receiver of the AV data displaying/reproducing apparatus.

15. The AV data receiving apparatus according to claim 11,

wherein the AV data receiving apparatus is connected to an AV data displaying/reproducing apparatus via a signal line so that an operation command receiver of the AV data receiving apparatus is shared as a command receiver of the AV data displaying/reproducing apparatus.

16. An AV data receiving apparatus that receives wirelessly transmitted AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus comprises

an operation command receiver and

a light reflector for feeding light to the operation command receiver by reflecting the light.

17. The AV data receiving apparatus according to claim 8,

wherein the AV data displaying/reproducing apparatus has a portion to which the operation command receiver is fitted.

18. An AV data receiving apparatus that receives wirelessly transmitted AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus has an external antenna data reception interface and a command reception interface arranged on a same face of the AV data receiving apparatus.

19. The AV data receiving apparatus according to claim 8,

wherein an external antenna and the command receiver are integrated together.

20. An AV data receiving apparatus that receives wirelessly transmitted AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus comprises

a command switch for generating an operation command.

21. An AV data receiving apparatus that receives wirelessly transmitted digital AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus comprises

an IR command receiver and a command converter.

22. The AV data receiving apparatus according to claim 21,

wherein the command converter is partially rewritable through setting from outside so as to be capable of being switched to a different function.

23. An AV data receiving apparatus that receives wirelessly transmitted AV data and that transmits and receives asynchronous data containing control data,

wherein an antenna is arranged with a maximum gain plane of the antenna kept at a substantially right angle to a surface of a circuit board provided inside the AV data receiving apparatus.

24. An AV data receiving apparatus that receives wirelessly transmitted digital AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus comprises

a power supply interface for feeding electric power to the AV data receiving apparatus.

25. An AV data receiving apparatus that receives wirelessly transmitted digital AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus comprises

a power supply for feeding electric power to the AV data receiving apparatus and

a power supply interface for feeding electric power to an AV data displaying/reproducing apparatus.

26. The AV data receiving apparatus according to claim 21,

wherein the AV data receiving apparatus operates from a battery as a power source so that the AV data receiving apparatus can be charged when the AV data displaying/reproducing apparatus is operating from another power source.

27. An AV data displaying/reproducing apparatus that permits the AV data receiving apparatus according to claim 8 to be fitted and fixed thereto.

28. The AV data displaying/reproducing apparatus according to claim 27,

wherein the AV data displaying/reproducing apparatus is a flat display apparatus having, on a rear face thereof, a mechanism that permits the AV data receiving apparatus to be fitted thereto so that a flat panel display and the AV data receiving apparatus can be carried around together.

29. The AV data displaying/reproducing apparatus according to claim 28,

wherein a flat panel display holder for holding the flat panel display upright has a mechanism that permits the AV data receiving apparatus to be fitted thereto so that the AV data receiving apparatus can be fitted to a portion of the AV data displaying/reproducing apparatus where a weight of the flat panel display can be supported.

30. An AV data receiving apparatus that receives wirelessly transmitted digital AV data and that transmits and receives asynchronous data containing control data,

wherein the AV data receiving apparatus comprises

a header discriminator for checking whether received data is image data, control data, or data relating to an Internet protocol,

an IP application executer for executing an Internet application, and

an IP application presenter for producing a IP application screen.

31. The AV data receiving apparatus according to claim 30,

wherein the AV data receiving apparatus connects to the Internet via an apparatus separate from an AV data transmitting apparatus.

32. An AV data receiving apparatus that receives AV data transmitted wirelessly from an AV data transmitting side and that transmits and receives asynchronous data containing control data wirelessly to and from the AV data transmitting side,

wherein the AV data receiving apparatus comprises

a command receiver of which a receiver section for receiving an optical signal carrying an operation command is movable.

33. An AV data receiving apparatus that receives AV data transmitted wirelessly from an AV data source side and that receives an operation command from a remote control transmitter to transmit asynchronous data containing control data wirelessly to the AV data source side,

wherein a command receiver for receiving the operation command is movable.

34. The AV data transmitting apparatus according to claim 1,

wherein the quality change setter changes the communication bandwidth by increasing or decreasing the communication bandwidth, and is capable of accordingly increasing or decreasing either a period for resending the AV data or a bandwidth for other communication.

35. The AV data transmitting apparatus according to claim 2,

wherein the quality change setter is a switch added to the AV data transmitting apparatus, the switch being switchable even during communication.

36. The AV data receiving apparatus according to claim 9,

wherein an external antenna and the command receiver are integrated together.

37. The AV data receiving apparatus according to claim 16,

wherein an external antenna and the command receiver are integrated together.

38. The AV data receiving apparatus according to claim 18,

wherein an external antenna and the command receiver are integrated together.

* * * * *

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re reexamination of: Kurita, et al.

Confirmation No.: *To Be Assigned*

U.S. Patent No. 10,129,590 B2

Art Unit: *To Be Assigned*

Issue Date: November 13, 2018

Examiner: *To Be Assigned*

Title: DISPLAY APPARATUS AND
VIDEO PROCESSING APPARATUS

Third Party Requester Docket No. 2638-19.08

Mail Stop *Ex Parte* Reexam

Attn: Central Reexamination Unit
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**REQUEST FOR *EX PARTE* REEXAMINATION OF U.S. PATENT NO. 10,129,590
UNDER 35 U.S.C. § 302 AND 37 C.F.R. § 1.510**

Requester submits this Request for *Ex Parte* Reexamination under 35 U.S.C. § 302 and 37 C.F.R. § 1.510 of U.S. Patent No. 10,129,590 to Kurita, et al., titled “DISPLAY APPARATUS AND VIDEO PROCESSING APPARATUS” (“the ’590 Patent”). In accordance with 37 C.F.R. § 1.510(b)(4), a copy of the ’590 Patent is attached hereto as Exhibit 1001. The ’590 Patent is assigned to Maxell, Ltd. (“*Maxell*”) according to United States Patent and Trademark Office (“USPTO”) records at the time of this request.

Pursuant to 37 C.F.R. § 1.510, this Request for *Ex Parte* Reexamination includes:

- 1) A statement pointing out each substantial new question of patentability based on prior art patents and printed publications;
- 2) An identification of every claim for which reexamination is requested and a detailed explanation of the pertinency and manner of applying the cited prior art to every claim for which reexamination is requested;

***Request for Reexamination of
U.S. Patent No. 10,129,590 B2***

- 3) A copy of every patent or printed publication relied upon or referred to herein, attached as Exhibits 1005–1006;
- 4) A copy of the entire U.S. Patent No. 10,129,590 for which re-examination is requested, including any disclaimer, certificate of correction, or reexamination certificate issued in the patent;
- 5) A certification that a copy of the request filed has been served in its entirety on the patent owner at the address as provided for in 37 C.F.R. § 1.33(c);
- 6) A certification that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) or 35 U.S.C. § 325(e)(1) do not prohibit the Requester from filing the *Ex Parte* Reexamination Request; and
- 7) The appropriate fee under 37 C.F.R. § 1.20(c).

The Commissioner is authorized to charge any additional fees, or to credit any overpayment, to Deposit Account No. 50-6159.

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LIST OF EXHIBITS

Exhibit No.	Exhibit Name
1001	U.S. Patent No. 10,129,590 (“’590 Patent”)
1002	Prosecution history for the ’590 Patent (“’590 File History”)
1003	Chuck Creusere Declaration (“ <i>Creusere Dec.</i> ”)
1004	Commission Investigative Staff’s Initial <i>Markman</i> Brief, <i>In the Matter of Certain Mobile Electronic Devices and Laptop Computers</i> , Investigation No. 337-TA-1215 (U.S. Int’l Trade Comm’n, January 5, 2021) “ITC Complaint” (“Staff’s <i>Markman</i> Brief”)
1005	U.S. Patent Application Publication No. 2006/0203758 A1 to Tee <i>et al.</i> (“ <i>Tee</i> ”)
1006	U.S. Patent Application Publication No. 2006/0135076 A1 to Honkanen <i>et al.</i> (“ <i>Honkanen</i> ”)
1007	U.S. Patent No. 9,420,212 (“’212 Patent”)
1008	Complaint for Patent Infringement, <i>Maxell. Ltd. v. Apple Inc.</i> , No. 6:20-cv-00646 (W.D. Tex. Jul 17, 2020), ECF No. 1 (“Apple Complaint”)
1009	Complainant Maxell, Ltd.’s Statement, <i>In the Matter of Certain Mobile Electronic Devices and Laptop Computers</i> , Investigation No. 337-TA-1215 (U.S. Int’l Trade Comm’n, July 16, 2020) “ITC Complaint”
1010	Intentionally Omitted
1011	Intentionally Omitted
1012	U.S. Patent Application Publication No. 2007/0109973 A1 to Trachewsky (“ <i>Trachewsky</i> ”)
1013	U.S. Patent Application Publication No. 2006/0258289 A1 to Dua (“ <i>Dua</i> ”)
1014	U.S. Patent Application Publication No. 2005/0136949 A1 to Barnes Jr. (“ <i>Barnes</i> ”)
1015	U.S. Patent Application Publication No. 2008/0101446 A1 to Gautier <i>et al.</i> (“ <i>Gautier</i> ”)
1016	International Publication No. WO 2005/060127 A1 to Sinivaara (“ <i>Sinivaara</i> ”)
1017	U.S. Patent Application Publication No. 2005/0215284 A1 to Su <i>et al.</i> (“ <i>Su</i> ”)

***Request for Reexamination of
U.S. Patent No. 10,129,590 B2***

1018	U.S. Patent Application Publication No. 2007/0238482 A1 to Rayzman et al. (“ <i>Rayzman</i> ”)
1019	U.S. Patent Application Publication No. 2007/0275746 A1 to Bitran (“ <i>Bitran</i> ”)
1020	U.S. Patent Application Publication No. 2008/0081663 A1 to Kasslin et al. (“ <i>Kasslin</i> ”)
1021	U.S. Patent Application Publication No. 2007/0165754 A1 to Kiukkonen et al. (“ <i>Kiukkonen</i> ”)
1022	U.S. Patent Application Publication No. 2005/0190747 A1 to Sindhvani et al. (“ <i>Sindhvani</i> ”)
1023	U.S. Patent Application Publication No. 2005/0249245 A1 to Hazani et al. (“ <i>Hazani</i> ”)
1024	U.S. Patent No. 8,625,547 to Miller, II (“ <i>Miller II</i> ”)
1025	Mobile and Wireless Design Essentials by Martyn Mallick
1026	U.S. Patent No. 7,233,359 to Yasuo Suda (“ <i>Suda</i> ”)
1027	Video Streaming: Concepts, Algorithms, and Systems by Apostolopoulos et al.
1028	Newton’s Telecom Dictionary 20 th Update and Expanded Edition by Harry Newton
1029	“A Flexible Decoder Buffer Model For JVT Video Coding” by Ribas-Corbera et al., IEEE ICIP 2002
1030	“A Buffer Allocation Mechanism for VBR Video Playback” by Sheu et al., IEEE
1031	U.S. Patent Application Publication No. 2007/0091835 A1 to Jo <i>et al.</i> (“ <i>Jo</i> ”)
1032	U.S. Patent Application Publication No. 2007/0072642 A1 to Kangas <i>et al.</i> (“ <i>Kangas</i> ”)
1033	U.S. Patent Application Publication No. 2008/0139118 A1 to Sanguinetti <i>et al.</i> (“ <i>Sanguinetti</i> ”)
1034	U.S. Patent Application Publication No. 2005/0034169 A1 to Maeda <i>et al.</i> (“ <i>Maeda</i> ”)
1035	U.S. Patent Application Publication No. 2004/0193647 A1 to Ueda <i>et al.</i> (“ <i>Ueda</i> ”)

I. IDENTIFICATION OF CLAIMS FOR WHICH REEXAMINATION IS REQUESTED

In accordance with 37 C.F.R. §1.510, reexamination of claims 1-10 of U. S. Patent No. 10,129,590 B2 is requested in view of the following references:

- U.S. Patent Application Publication No. 2006/0203758 A1 to Tee *et al.* (“*Tee*”)
- U.S. Patent Application Publication No. 2006/0135076 A1 to Honkanen *et al.* (“*Honkanen*”)

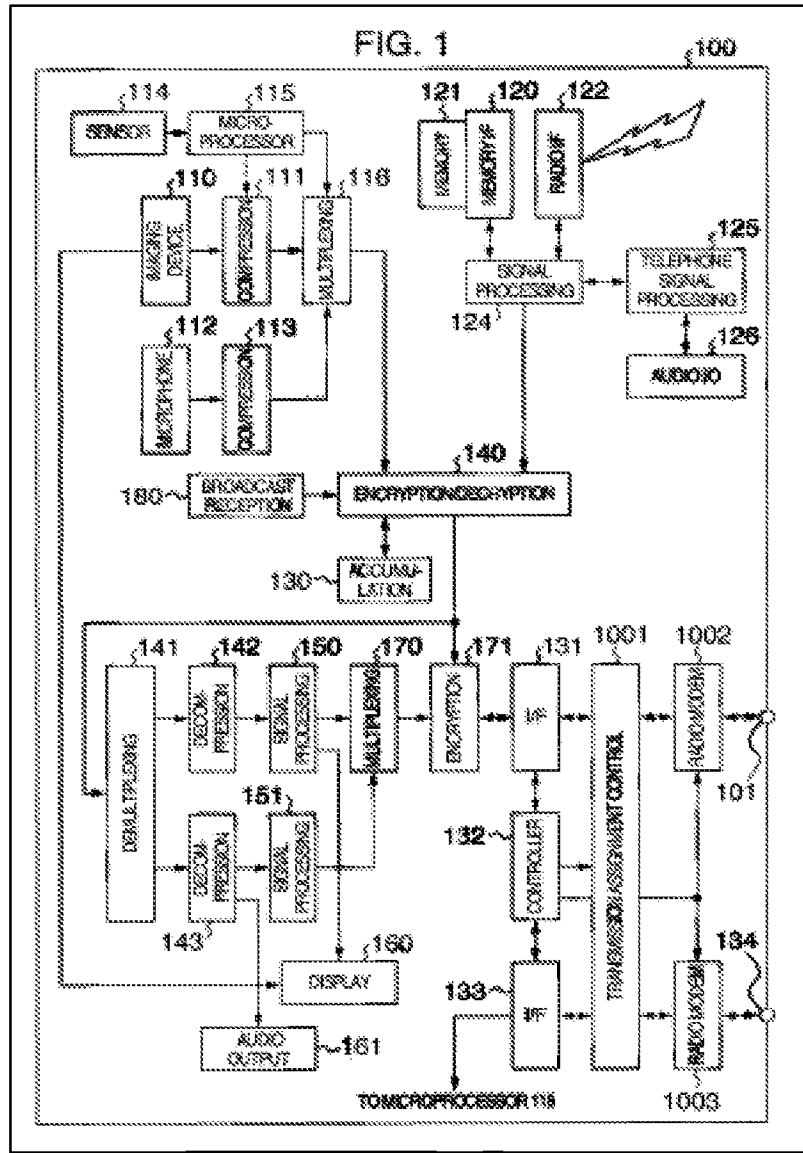
In particular, re-examination of claims 1 and 4-10 is requested under 35 U.S.C. § 103(a) as being unpatentable over *Tee* in view of the knowledge of a PHOSITA, and re-examination of claims 2-3 is requested under 35 U.S.C. § 103(a) as being unpatentable over *Tee* in view of *Honkanen*.

Pursuant to 37 C.F.R. § 1.510, *ex parte* reexamination is available “at any time during the period of enforceability of a patent.” Because U.S. Patent No. 10,129,590 is unexpired, it is enforceable and eligible for *ex parte* reexamination.

II. SUMMARY OF THE '590 PATENT

A. The '590 Patent's Alleged Invention

The '590 Patent generally describes a system wherein a display device that receives video via a first radio communication interface while simultaneously connected to the internet via a second radio communication interface. '590 Patent (Ex. 1001), 1:45–60. Examples of devices contemplated by the patent include a digital or video camera, a mobile phone, a gaming machine, or a personal media player. *Id.* at 3:43–46. Fig. 1 below illustrates one exemplary embodiment:



Id. at Fig. 1. As illustrated, the device includes a first radio communication circuit 1002 designed for video communications and a second radio communication circuit 1003 for Internet or home network communications. *Id.* at 6:58–7:61. The device also contains an imaging device 110 including an optical system for creating pictures or videos. *Id.* at 3:47–52. The videos are recorded and stored in storage 130 along with any videos the apparatus 100 receives. *Id.* at 4:10–14, 48–51.

B. Summary of the Prosecution History

The Application that resulted in the '590 Patent was filed on July 13, 2016 and claims priority to Japanese Application No. 2007-306750, dated Nov. 28, 2007. *Id.* For purposes of this request and without waiving its right to challenge priority in this or any other proceeding, Requester adopts Nov. 28, 2007 as the invention date for the Challenged Claims.

Eight originally filed claims were subject to a single office action. '590 *File History* (Ex. 1002) 143–49. The Examiner rejected proposed claims 1–4 as obvious over U.S. Patent Application Publication No. 2007/0091835 to Jo et al. (“Jo”) in view of U.S. Patent Application Publication No. 2007/0072642 to Kangas et al. (“Kangas”) and claims 5-8 as anticipated or rendered obvious by Jo. *Id.* In response, Applicant amended all claims to require the first radio communication circuit transmits or receives video information while the device is “simultaneously” connected to the internet or the home network via the second radio communication circuit. *Id.* at 162–72. Applicant also added independent method claims 9 and 10 that largely parallel independent apparatus claims 1 and 5, respectively. *Id.*

A Notice of Allowance issued on July 13, 2018. As the reasons for allowance, the Examiner identified a number of additional references that established the general idea of simultaneous connections existed in the prior art but concluded no art of record taught the specific simultaneity claimed. *Id.* at 184.

As shown below, the purportedly novel feature of transmitting/receiving video information using a first radio communication circuit while simultaneously connected to the internet via a second radio communication circuit was well known.

C. Level of Skill in the Art

A person having ordinary skill in the art (“PHOSITA”) at the time of the ’590 Patent would have had at least a bachelor’s degree in electrical engineering or equivalent with at least one year of experience in the field of wireless communications. Additional education or experience might substitute for the above requirements. *Creusere Dec.* (Ex. 1003), ¶¶ 25-27.

III. NOTIFICATION OF CONCURRENT PROCEEDINGS PURSUANT TO 37 C.F.R. § 1.565

The ’590 Patent is currently the subject of pending litigation: *Maxell Ltd. v. Apple Inc.*, No. 6:20-cv-00646 (W.D. Tex.). *Apple Complaint*, Dkt. No. 1 (Ex. 1008) (“*Complaint*”). The Requester is a Defendant in the Litigation. In view of this concurrent Litigation, it is respectfully urged that this Request be granted and reexamination be conducted not only with “special dispatch,” but also with “priority over all other cases” in accordance with M.P.E.P. § 2261.

Requester notes that trial in the Litigation is currently unscheduled. Therefore, there is currently no federal court decision affecting this reexamination. A final holding of claim invalidity or unenforceability (after all appeals) will likely not occur prior to a determination on the request for reexamination is made. Requester reminds the Office of M.P.E.P. § 2286(II) and treatment of federal court decisions, namely that “[a] non-final federal court decision concerning a patent under reexamination shall have no binding effect on a reexamination proceeding.” (M.P.E.P. § 2286(IV)) (emphasis in original).

The ’590 Patent is also currently the subject of pending litigation at the International Trade Commission: *In the Matter of Certain Mobile Elec. Devices & Laptop Computers*, USITC Inv. No. 337-TA-1215. *ITC Complaint* (Ex. 1009). The Requester is a Respondent in the litigation.

Requester has concurrently filed a petition for *Inter Partes* Review of the ’590 Patent (IPR2021-00400) that mirrors the grounds proposed herein. To avoid duplicating efforts,

Requester proposes the Patent Office stay this reexamination proceeding pursuant to 37 C.F.R. § 1.565 in the event the Board institutes the IPR.

IV. RELATED REEXAMINATION PROCEEDINGS

Requester is not aware of any reexamination proceeding related to the '590 Patent or any patent related to the '590 Patent.

V. STATEMENT POINTING OUT EACH SUBSTANTIAL NEW QUESTION OF PATENTABILITY

Requester respectfully submits that a substantial new question of patentability under § 103 exists with respect to each of claims 1-10 of U.S. Patent No. 10,129,590 based on Tee alone or Tee in view of Honkanen.

<u>Substantial New Questions of Patentability</u>	<u>Exhibits</u>
<u>SNQP 1:</u> Claims 1, and 4-10 are obvious under pre-AIA 35 U.S.C. § 103 over <i>Tee</i> in view of the knowledge of a PHOSITA	Ex. 1005
<u>SNQP 2:</u> Claims 2-3 are obvious under pre-AIA 35 U.S.C § 103 over <i>Tee</i> in view of <i>Honkanen</i>	Ex. 1005, Ex. 1006

A. Tee Alone or in Combination with Honkanen Presents a Substantial New Question of Patentability

Neither Tee nor Honkanen was cited or considered during the examination of the '590 Patent or the parent '212 Patent. *See '590 File History* (Ex. 1002). The only prior art rejections during the prosecution of the '590 Patent were based on *Jo* (Ex. 1031), alone or in combination with *Kangas* (Ex. 1032). *Jo* discloses a device and method to play back contents according to a reception sensitivity, and more specifically, a device and method to select a wireless communication system according to the reception sensitivity of wireless signals. *Jo* (Ex. 1031) at Abstract. Responsive to these rejections, then-Applicant Maxell amended the claim to recite “the

controller controls each of the first and second radio communication circuits, so that the first radio communication circuit receives [transmits] video information and the second radio communication circuit connects to the internet or the home network simultaneously” (hereinafter “simultaneous communication” for brevity).’590 *File History* (Ex. 1002) at 163-165. Responsive to this amendment, the Examiner performed an updated search, locating *Sanguinetti* (Ex. 1033), *Maeda* (Ex. 1034), and *Ueda* (Ex. 1035). *Id* at 184-187. The Examiner found that *Sanguinetti* and *Maeda* failed to teach the “simultaneous communication” limitation, and *Ueda*, while teaching “two communications devices simultaneously connecting generally,” did not teach “all of the claimed limitations of the currently presented invention.” *Id.* at 184. Therefore, there are *material differences* between the art of record, alone or in combination, and the present art, and the present art presents minimal overlap (generally a device communicating over multiple communications interfaces). Due to the material differences between the art of record and the present art, *Tee* and *Honkanen* are not cumulative over the art of record in the ’590 Patent.

Tee and Honkanen were not previously cited or used as the basis for any rejection. The Office did not have the benefit of these references in performing its original examination of the ’590 Patent. The new references, along with the evidence and opinions provided by Dr. Creusere (in the supporting declaration), warrant reconsideration.

VI. CLAIM CONSTRUCTION

In the context of reexamining patent claims, “the PTO must give claims their broadest reasonable construction consistent with the specification.” *In re Suitco Surface, Inc.*, 603 F.3d 1255, 1259 (Fed. Cir. 2010) (quoting *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007)) (citation omitted). During reexamination proceedings, the patent owner will be permitted to amend the claims. 35 U.S.C. § 305. “Further, as applicants may amend claims to

narrow their scope, a broad construction during prosecution creates no unfairness to the applicant or patentee.” *In re ICON Health & Fitness, Inc.*, 496 F.3d at 1379 (citing *In re Am. Acad. of Sci. Tech Ctr.*, 367 F.3d 1359, 1364 (Fed. Cir. 2004)). Thus, in the analysis and discussion presented below, the identified claims are given their broadest reasonable interpretation consistent with the ’590 Patent specification.

Claim 3 recites, “upon receiving an indication to transmit video information accumulated in the accumulation circuit via the first radio communication circuit while acquiring information from the internet via the second radio communication circuit, the controller assigns connection of the first radio communication circuit prior to connection of the second radio communication circuit.” In the ITC investigation, the parties have agreed to apply the following plain and ordinary meaning of this phrase: “upon receiving an instruction to transmit video information accumulated in the accumulation circuit via the first radio communication circuit while simultaneously acquiring information from the internet via the second radio communication circuit, the controller assigns connection of the first radio communication circuit before assigning connection of the second radio communication circuit.” *Staff’s Markman Brief* (Ex. 1004), 42–43. Requester submits that this plain and ordinary meaning falls within the broadest reasonable interpretation of claim 3, and this construction is applied below.

VII. DETAILED EXPLANATION UNDER 37 C.F.R. § 1.510(B)(2)

Requester respectfully submits that a substantial new question of patentability under § 103 exists with respect to claims 1 and 4-10 of U.S. Patent No. 10,129,590 B2 over Tee in view of the knowledge of a PHOSITA and with respect to claims 2-3 over Tee in view of Honkanen.

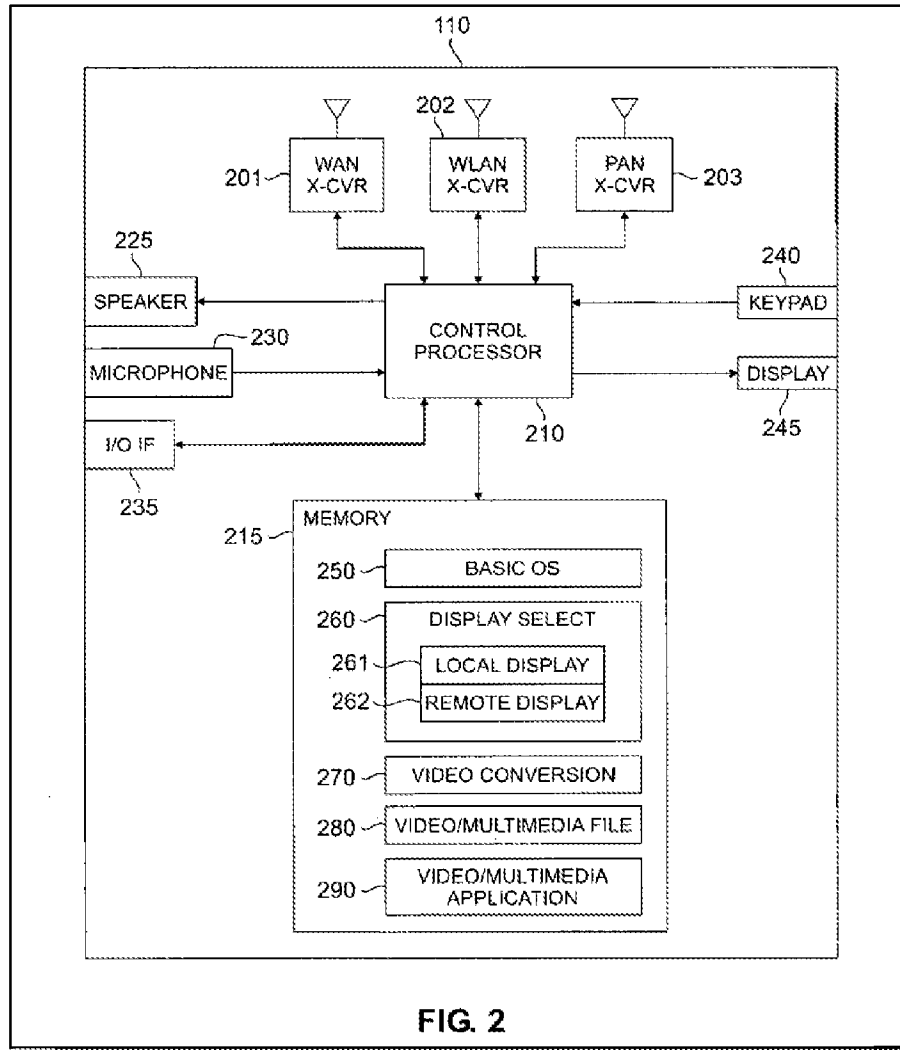
A. SNQP 1: Claims 1 and 4-10 are obvious over Tee in view of the knowledge of a PHOSITA

1. Overview of Tee

U.S. Patent Application Publication No. 2006/0203758 A1 to Tee et al. (“*Tee*”) (Ex. 1005) was published on Sep. 14, 2006 and is prior art to the ’590 Patent under at least 35 U.S.C. § 102(b) (pre-AIA). *Tee* was not cited or considered during prosecution of the ’590 Patent or its parent, U.S. Patent No. 9,420,212. ’590 Patent (Ex. 1001); ’212 Patent (Ex. 1007).

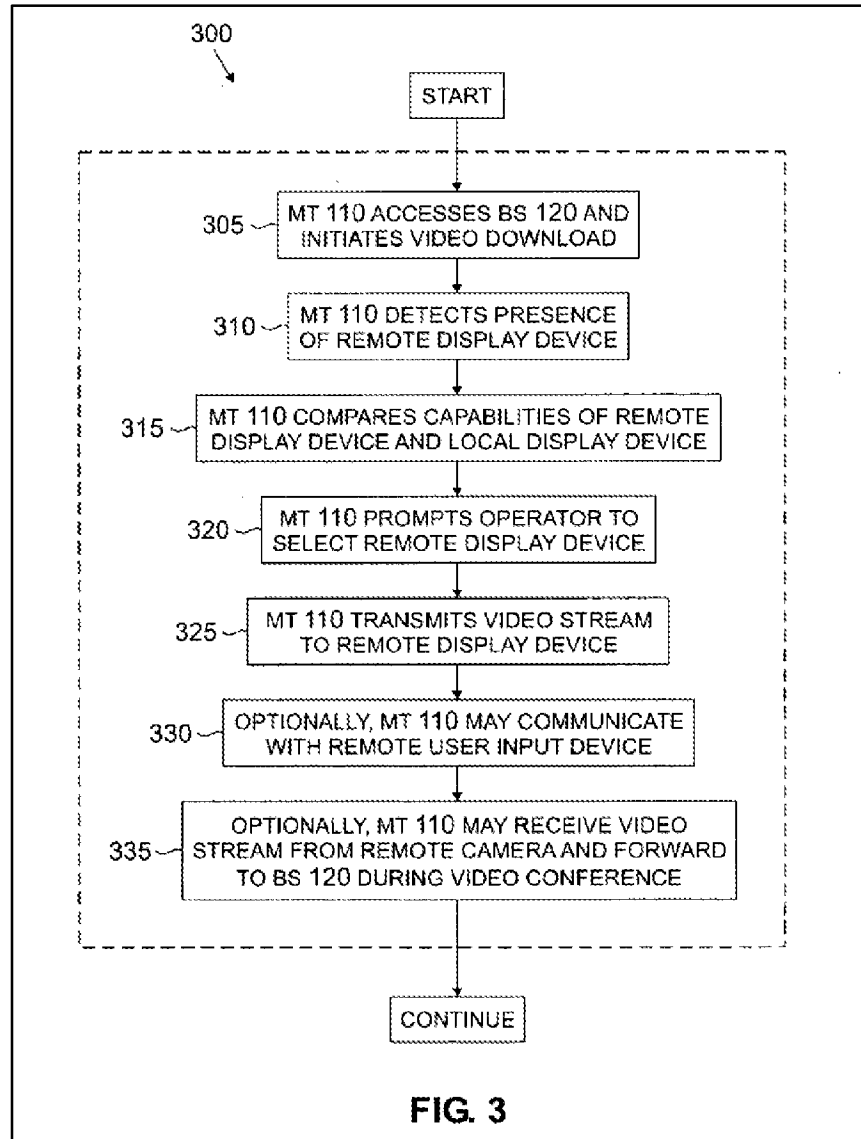
Tee discloses a mobile terminal 110 with its own display that receives multimedia data (e.g., video) “via a first wireless interface” and relays it to an external display “via a second wireless interface . . . if the mobile terminal determines the quality of the external display is superior to the quality of the local display. *Tee* (Ex. 1005), Abstract. Mobile terminal 110 includes three distinct wireless transceivers, including a wireless local area network (WLAN) transceiver 202 using an 802.11 protocol (e.g., a WiFi transceiver), a wide area network (WAN) transceiver 201 supporting such protocols as GSM/GPRS/EDGE, CDMA, or 802.16 (e.g., a cellular transceiver), and a personal area network (PAN) transceiver 203 supporting protocols such as Bluetooth. *Id.* at [0027].

The mobile terminal 110 is disclosed as “any type of mobile wireless device that uses a display” including a cellular phone, PDA, handheld computer, and laptop. *Id.* at [0019]. Fig. 2 below illustrates an exemplary embodiment:



Id. at Fig. 2.

Tee teaches that its mobile terminal may receive video from the internet via the WLAN or WAN transceiver and may also receive video from a remote camera via the PAN transceiver. *Id.* at [0022], [0038]. The videos are then simultaneously relayed to an external display via the WLAN or PAN transceiver. *Id.* at [0030], [0037]. In one example, illustrated below in Fig. 3, *Tee*'s mobile terminal streams a video from the Internet using the WLAN transceiver, determines that an external display has better capabilities than the mobile terminal's native display, and relays the streaming video feed to the external display using the PAN transceiver:



Id. at Fig. 3.; *see also id.* at [0037]–[0038] (describing the same).

Because *Tee*, like the '590 Patent, discloses a video device capable of supporting simultaneous wireless connections, *Tee* is in the same field of endeavor as the '590 Patent. *Compare* '590 Patent (Ex 1001), 1:47–51 (describing, as an object of the invention, “presenting on a display apparatus videos of high picture quality obtained from portable video processing apparatuses such as a camera” while communicating “with the internet and/or a home network”) *with Tee* (Ex. 1005), [0032] (“... mobile terminal 201 may receive a video stream from... a video

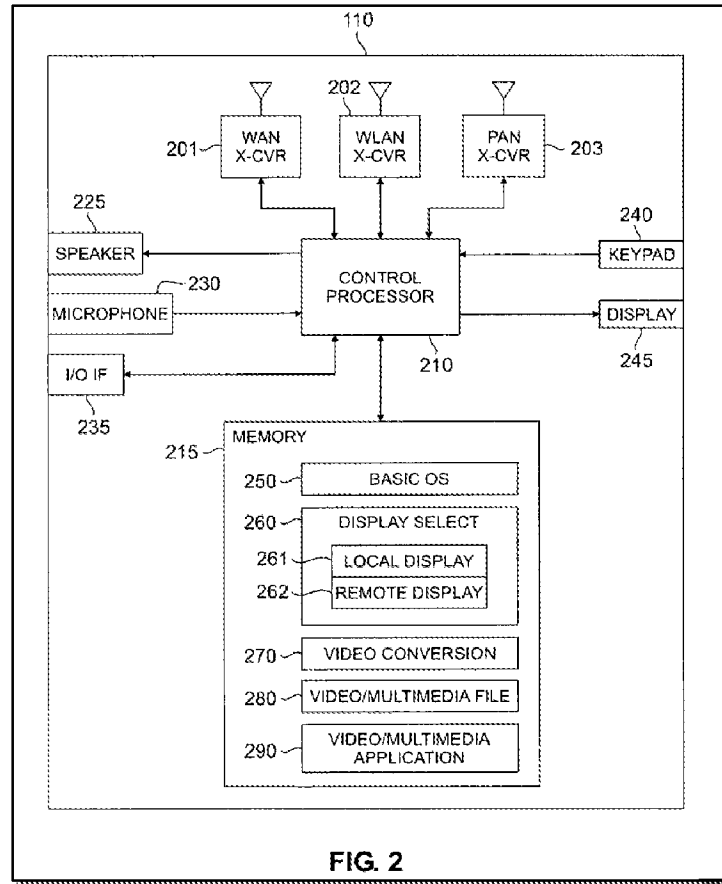
source device via PAN transceiver 203 and may relay the video stream” over the internet “via WLAN transceiver 202”). *Tee* is therefore analogous art to the ’590 Patent. *Creusere Dec.* (Ex. 1003), ¶¶ 35–38.

2. Claim 1.

1[P] A video processing apparatus, comprising:

To the extent the preamble is limiting, *Tee* teaches a video processing apparatus. In particular, *Tee* teaches a mobile terminal 110 that “may be any type of mobile wireless device” such as “**a cellular phone**, a PDA, a handheld computer (e.g. Pocket PC™), and even a laptop computer.” *Tee* (Ex. 1005), [0019]; *see* ’590 Patent (Ex. 1001), 1:49–50 (identifying a cellular phone as an exemplary video processing apparatus to which the invention is directed).

Mobile terminal 110 includes a video conversion program 270 that processes incoming video data and a video/multimedia application program 290 that supports “display[ing] video.” *Tee* (Ex. 1005), [0033]. Figure 2 below depicts these video subcomponents along with display 245 and speaker 225, which also support displaying video:



Id. at Fig. 2.

[1(a)] a first radio communication circuit capable of transmitting video information by radio or receiving information by radio;

Tee's mobile terminal includes a "PAN transceiver 203" that is capable of transmitting video information by radio and receiving information by radio. *Tee* explains that its PAN transceiver supports wireless communications in a "personal area network environment" using short range technologies such as Bluetooth:

Control processor 210 may use **PAN transceiver 203** to communicate in a personal area network (PAN) environment, such as a **Bluetooth or IEEE-802.15.3** communication link that may have a coverage area or range around 10-20 meters.

Tee (Ex. 1005), [0027] (emphasis added). Such short-range wireless communications were well known at the time, and a PHOSITA would have understood the PAN transceiver is a radio communication circuit. *Creusere Decl.* (Ex. 1003), ¶ 43.

PAN transceiver 203 is capable of both transmitting and receiving video information as claimed. For example, *Tee* teaches that PAN transceiver transmits a video stream to an external display device:

In another example, mobile terminal [110]¹ may receive a video stream from a base station or access point of a home or office WLAN via WLAN transceiver 202 and **may relay the video stream over a short distance to a remote display device via PAN transceiver 203.**

Tee (Ex. 1005), [0031] (emphasis added) (further noting “the remote display communicates with mobile terminal 110 using, for example, a high data rate Bluetooth transceiver”). PAN transceiver 203 can also receive video information:

In a third example, mobile terminal [110] **may receive a video stream** from a base station, an access point, **or a video source device via PAN transceiver 203** and may relay the video stream over a short distance to a remote display device via WLAN transceiver 202.

¹ *Tee* uses the reference number 201 for the WAN transceiver throughout its disclosure. At [0030]–[0032], *Tee* uses this same reference number for mobile terminal, which is referred to by the reference 110 throughout the remainder of the disclosure. This appears to be a clerical error, and Requester assumes these limited references to “mobile terminal 201” were intended to reference “mobile terminal 110.”

Id. at [0032] (emphasis added).

[1(b)] a second radio communication circuit capable of connecting by radio to an internet or a home network to transmit and receive information;

Tee’s mobile terminal includes a “WLAN transceiver 202” that is capable of connecting to an internet or home network to transmit and receive information:

Control processor 210 may use **WLAN transceiver 202 to communicate in a wireless local area network (WLAN) environment, such as an office WLAN** that may have a coverage area or range of several hundred feet. **By way of example, WLAN transceiver 202 may be an IEEE-802.11x transceiver.**

Tee (Ex. 1005), [0027] (emphasis added). IEEE-802.11x wireless standards, commonly referred to as “WiFi,” were well known at the time, and a PHOSITA would have understood that the WLAN transceiver is a radio communication circuit and that such local area networks are most commonly used to connect devices to each other within a home/office environment and to connect those devices to the Internet through an “access point.” *Creusere Decl.* (Ex. 1003), ¶¶ 44–45.

Expressly acknowledging that a WLAN provides Internet access through an “access point,” *Tee* explains that the mobile terminal may “receive a video stream from a base station or access point of a home or office WLAN via WLAN transceiver 202.” *Tee* (Ex. 1005), [0031]. In the context of the WAN cellular transceiver, *Tee* explains that “[b]ase station 120 provides mobile terminal 110 with access to . . . data networks, including, for example, the Internet.” *Id.* at [0020] (noting “BS 120 provides mobile terminal 110 with access to server 150 via IP network 140”). A PHOSITA would have understood that the described “access point” provides *Tee*’s WLAN transceiver with the same access to data networks such as the Internet. *Creusere Decl.* (Ex. 1003), ¶ 45.

Tee's WLAN transceiver is also capable of transmitting information within the described home network. For example, similar to the PAN transceiver embodiment discussed with reference to the prior limitation, the WLAN transceiver may also transmit video information to a display via WiFi:

In a third example, mobile terminal 201 may receive a video stream from a base station, an access point, or a video source device via PAN transceiver 203 and **may relay the video stream over a short distance to a remote display device via WLAN transceiver 202**. This may occur if the video source with wireless capability transmits a video stream to mobile terminal 110 using, for example, a high data rate Bluetooth transceiver and the **remote display communicates with mobile terminal 110 using, for example, an IEEE-802.11x transceiver**.

Tee (Ex. 1005), [0032] (emphasis added).

[1(c)] an imaging circuit capable of receiving video information via an optical system;

Tee teaches that the mobile terminal 110 may be a digital camera phone capable of capturing video and relaying said video to an external display, supporting a video conference application:

The mobile terminal may support a variety of mobile applications, including . . . **video conferencing** [W]hen the mobile terminal is near a higher quality display (e.g., a TV screen), **the mobile terminal relays its video data to the external display device** as well as to its internal display. **This enables the operator** of the mobile terminal to view the information on the higher quality display device, and **to share the displayed information with other people at the same location, e.g., in a video conference call[.]**

. . .

In the case of group video conferencing using, for example, a **digital camera phone**, it would be more practical and ergonomically correct to have the received

video data displayed on an external screen, while the **phone camera captures and transmits the local user images.**

Id. at [0018] (emphasis added). A PHOSITA would have understood that the described digital camera phone, in order to support a video conference application and to “capture[] and transmit[] the local user images,” as described, includes “an imaging circuit capable of receiving video information via an optical system.” *Creusere Dec.*(Ex. 1003), ¶ 46 (explaining that an imaging circuit (e.g., to convert captured video signal into a digital representation) in an optical system (e.g., lens, filters, etc. to capture a scene) is fundamental to all video capture systems that would have been part of a camera phone at the time).

[1(d)] an accumulation circuit capable of accumulating video information received by the imaging circuit; and

Tee’s mobile terminal includes “an accumulation circuit” in the form of memory 215 that stores “video/multimedia” files:

Memory 215 stores basic operating system (OS) program 250, display select program 260, video conversion program 270, **video/multimedia file 280**, and one or more video application programs 290.

Tee (Ex. 1005), [0025] (emphasis added). As discussed with reference to the preceding limitation, the mobile terminal may be a digital camera phone that “captures and transmits the local user images” in support of a videoconference application. *Id.* at [0018] (emphasis added).

A PHOSITA would have understood that capturing video from an internal camera module before transmitting the video via one of the wireless interfaces necessarily involves storing the video in memory, even if just temporarily, e.g., buffering the video in order to properly format the video data for a given wireless transmission. *Creusere Dec.* (Ex. 1003) ¶ 47. Confirming this

understanding, *Tee* explains that video to be transmitted wirelessly is retrieved from memory and/or reformatted for the chosen wireless interface:

Control processor 210 executes video conversion program 270 in order to **re-format** (if necessary) **the video data** downloaded from server 150 through the one wireless interface (e.g., WAN transceiver 201) **to a suitable format for re-transmission via another wireless interface** (e.g., WLAN transceiver 202 or PAN transceiver 203). **Additionally, video/multimedia application program 290 may retrieve video/multimedia data from video/multimedia file 280 and transmit a video stream to a remote device via a wireless interface.**

Tee (1005), [0033] (emphasis added).

[1(e)] a controller,

Tee's mobile terminal includes control processor 210, which “**function[s] as a controller that controls the overall operation of mobile terminal 110.**” *Id.* at [0026], Fig. 2, [0025] (describing Fig. 2).

[1(f)] wherein the first radio communication circuit can transmit video information accumulated in the accumulation circuit to an external device by radio,²

Tee's PAN transceiver 203 (first radio communication circuit) transmits video stored in video/multimedia file 280 (video information accumulated in the accumulation circuit) to an external device by radio:

[M]obile terminal 110 may play back video/multimedia data stored in video/multimedia file 280. At some point, mobile terminal 110 **detects the presence of a remote display device** (e.g., television 131) **via** another air interface (e.g., **transceiver 202 or 203**) **and establishes a wireless link** with the remote display device . . . **mobile terminal 110 then forwards** (or relays or re-transmits) the . . . **video/multimedia file 280[] to the remote display device[.]**

Tee (Ex. 1005), [0037]–[0038] (emphasis added), *see also id.* at [0031] (describing an embodiment in which mobile terminal “relay[s] the video stream over a short distance to a remote display device via PAN transceiver 203”), [0033] (teaching “video/multimedia application program 290 may retrieve video/multimedia data from video/multimedia file 280 and transmit a video stream to a remote device via a wireless interface”).

² The preceding limitations address capturing “video information” with an “imaging circuit” and storing said video information in an “accumulation circuit.” Although limitation [1(f)] require transmitting “video information accumulated in the accumulation circuit,” nothing in the claim language requires the transmitted video information be the same video information captured via the imaging circuit. In other words, the transmitted video information recited in limitation [1(f)] need not derive from any particular source.

As discussed above with reference to limitation [1(d)], a PHOSITA would have understood that obtaining video from an internal camera before transmitting the video via one of the wireless interfaces necessarily involves storing the video in memory, even if just temporarily, e.g., buffering the video in order to properly format the video data for a given wireless transmission. *Creusere Dec.* (Ex. 1003), ¶ 48. In addition to video captured from the internal camera, *Tee* explains that video received from external sources (e.g., server 150) is similarly retrieved from memory in order to be processed for transmission via a given wireless interface:

Control processor 210 executes video conversion program 270 in order to **re-format** (if necessary) **the video data** downloaded from server 150 through the one wireless interface (e.g., WAN transceiver 201) **to a suitable format for re-transmission via another wireless interface** (e.g., WLAN transceiver 202 or PAN transceiver 203). **Additionally, video/multimedia application program 290 may retrieve video/multimedia data from video/multimedia file 280 and transmit a video stream to a remote device via a wireless interface.**

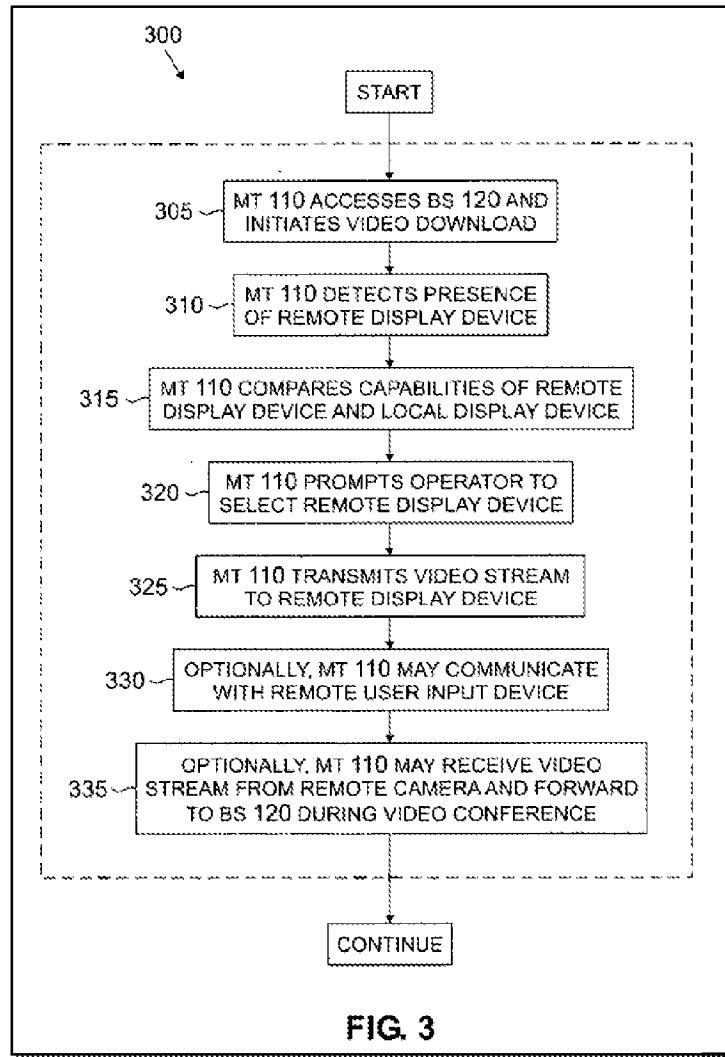
Tee (1005), [0033] (emphasis added). A PHOSITA would thus have understood that, in each of the described embodiments in which *Tee*'s PAN transceiver transmits video to an external display, the video information transmitted comes from memory (i.e., an accumulation circuit). *Creusere Dec.* (Ex. 1003), ¶ 48.

[1(g)] the controller controls assignment of connection for each of the first and second radio communication circuit in response to receiving an indication from a user; and

Tee's "control processor 210 **executes basic OS program 250 in order to control, among other things, transceivers 201, 202, and 203.**" *Tee* (Ex. 1005), [0026] (emphasis added). Specifically, for PAN transceiver 203, *Tee* teaches that "[c]ontrol processor 210 may use PAN transceiver 203 to communicate in a personal area network (PAN) environment, such as a Bluetooth." *Id.* at [0027]. Similarly, *Tee* teaches that "control processor 210 **may use WLAN**

transceiver 202 to communicate in a wireless local area network (WLAN).” *Id.* (emphasis added). Accordingly, a PHOSITA would have understood that control processor 210 assigns both the PAN transceiver and WLAN transceiver connections. *Creusere Dec.* (Ex. 1003), ¶¶ 49–50.

FIG. 3 below illustrates one specific embodiment in which both the first connection and second connection are assigned in response to user requests/indications:



Tee (Ex. 1005), Fig. 3. As depicted, the process begins with the mobile terminal accessing base station 120 using WLAN transceiver 202 (the “second radio communication circuit”) to initiate a video download from server 150. *Id.* at [0037] (“[M]obile terminal 110 **accesses base station 120**

via an air interface (e.g., **transceiver 201 or 202**) **and initiates a video/multimedia download** from server 150 (process step 305).”) (emphasis added). Although *Tee* does not expressly describe a user requesting the video download, a PHOSITA would have understood that such a request/indication would be part of the described process flow. *Creusere Dec.* (Ex. 1003), ¶ 51. Indeed, it would make little sense for the mobile terminal to initiate a video download other than at a user’s request. *Id.* Because such a connection must be assigned prior to downloading the requested video, the second radio connection for downloading a video from server 150 using the WLAN transceiver is assigned in response to receiving an indication from the user.

Turning to the first radio communication circuit assignment, steps 310–325 in Fig. 3 illustrate the process by which a local display device is located and a connection to that device is established using PAN transceiver 203 (“the first radio communication circuit”) such that video can be streamed to the display device in response to a user’s indication. At step 310, the mobile terminal “detects the presence of a remote display device.” *Tee* (Ex. 1005), Fig. 3, [0037] (noting the display device is detected using PAN transceiver 203). *Tee* explains that the display device can be detected either by (1) PAN transceiver 203 detecting a pilot signal sent by the display, (2) PAN transceiver 203 broadcasting its own signal to find a display, or (3) the user manually identifying a display. *Id.* at [0034]. After the display is detected, step 315 obtains the display capabilities of the display device, comparing them to the display capabilities of the mobile terminal’s native display, and step 320 “prompt[s] the operator to select the remote display device.” *Id.* at [0037]–[0038]. Finally, at step 325, “[a]ssuming the remote display device is selected, mobile terminal 110 then forwards (or relays or re-transmits) the video stream . . . to the remote display device.” *Id.* at [0038].

Although there is an interrogation of the remote display device to obtain its “capabilities,” a PHOSITA would have understood that separate resources would later be assigned the PAN transceiver to support video streaming after the user selects a particular remote display device for such purposes. *Creusere Dec.* (Ex. 1003), ¶ 52. Indeed, a video streaming connection using the PAN transceiver demands the system allocate significant resources to support such a high bandwidth transmission. *Id.* In contrast, the initial interrogation of the remote display device for its “capabilities” would have required only minimal resource allocation, i.e., enough to support a discrete transfer of a minimal amount of information. *Id.* In light of the significantly different requirements of the initial interrogation and the later video streaming connections, a PHOSITA would have understood that the controller assigns a video streaming connection using the PAN transceiver in response to the user selecting a remote display device for the video streaming. *Id.*

[1(h)] wherein the controller controls each of the first and second radio communication circuit, so that the first radio communication circuit transmits video information and the second radio communication circuit connects to the internet or the home network simultaneously.

As set forth above with reference to limitation [1(g)], *Tee* describes an embodiment in which video is downloaded from base station 120 using the WLAN transceiver³ (second radio

³ As discussed above with respect to limitation [1(b)], the WLAN connection to a base station 120 is both an Internet connection and a connection to a home network. In the expressly described implementation of the WLAN as an 802.11 (i.e., WiFi) transceiver, the WLAN transceiver connects to the home network via a wireless router and then to the Internet via an “access point.” *Creusere Dec.* (Ex. 1003), ¶¶ 44–45.

communication circuit) and the same video is streamed to a remote display device using the PAN transceiver (first radio communication circuits. *Tee* also teaches that these connections actively communicate information simultaneously. Namely, *Tee* teaches that the PAN transceiver “relays” the video received through the WLAN transceiver such that both connections are active simultaneously:

In another example, mobile terminal 201 may receive a video stream from a base station or access point of a home or office WLAN via WLAN transceiver 202 and may relay the video stream over a short distance to a remote display device via PAN transceiver 203.

Tee (Ex. 1005), [0031] (emphasis added). *Tee* makes clear that relaying a video stream to an external display is an alternative to viewing the video stream on the mobile terminal’s local display. *Id.* at [0022]–[0023]. The process of viewing a video *stream* is well understood to mean displaying the video as it is received from an external source. *Creusere Dec.* (Ex. 1003), ¶ 53. Accordingly, a PHOSITA would have understood that *relaying* a video *stream* to a remote display device would have involved actively receiving the video stream over the WLAN connection (i.e., receiving the stream) while simultaneously transmitting the video to a remote display device (i.e., relaying the video stream). *Id.*

3. Claim 4.

4[P] The video processing apparatus according to claim 1, further comprising

Tee teaches the video processing apparatus of claim 1. *See* § 2, *supra*.

4(a)] a radio interface capable of receiving video information by radio,

In addition to the WLAN and PAN transceivers discussion in the Claim 1 mapping above, *Tee*’s mobile terminal includes a WAN transceiver capable of connecting to base station 120 via a wireless cellular connection. *Tee* (Ex. 1005), [0020], [0027] (“For example, WAN transceiver 201

may be a GSM/GPRS/EDGE transceiver, a CDMA2000/1xEV-DO transceiver, or an IEEE-802.16x transceiver that communicates with base station 120 of a wide-area network”). *Tee* teaches that the WAN transceiver may receive video/multimedia from base station 120:

In one example, **mobile terminal [110] may receive a video stream from BS 120 via WAN transceiver 201** and may relay the video stream over a short distance to a remote display device via WLAN transceiver 202 or PAN transceiver 203.

Id. at [0030]; *see also id.* at [0037] (describing the mobile terminal downloading video/multimedia from a server 150 via the WAN transceiver 201).

[4(b)] wherein the accumulation circuit accumulates the video information received via the radio interface, and

Tee’s mobile terminal includes “an accumulation circuit” in the form of memory 215 that stores “video/multimedia” files:

Memory 215 stores basic operating system (OS) program 250, display select program 260, video conversion program 270, **video/multimedia file 280**, and one or more video application programs 290.

Id. at [0025] (emphasis added). In addition to its teaching that video is received via the WAN transceiver and “relayed” to a local display device, as discussed with reference to the preceding limitation, *Tee* teaches that video files may be *downloaded* via the WAN transceiver 201:

[M]obile terminal 110 accesses base station 120 via an air interface (e.g., transceiver 201 or 202) and initiates a video/multimedia download from server 150[.]

Id. at [0037]. A PHOSITA would have understood that downloading video from a server necessarily involves storing that video at the receiving device. *Creusere Dec.* (Ex. 1003) ¶ 54 (explaining that downloading connotes receiving from an external source and storing). Whether received and immediately “relayed” to another device or downloaded, video obtained via WAN

transceiver is necessarily stored in memory, even if just temporarily, e.g., buffering the video in order to properly format the video data for a given wireless transmission. *Id.* Confirming this understanding, *Tee* explains that video to be transmitted wirelessly is retrieved from memory and/or reformatted for the chosen wireless interface:

Control processor 210 executes video conversion program 270 in order to **re-format** (if necessary) **the video data** downloaded from server 150 through the one wireless interface (e.g., WAN transceiver 201) **to a suitable format for re-transmission via another wireless interface** (e.g., WLAN transceiver 202 or PAN transceiver 203). **Additionally, video/multimedia application program 290 may retrieve video/multimedia data from video/multimedia file 280 and transmit a video stream to a remote device via a wireless interface.**

Tee (Ex. 1005), [0033] (emphasis added).

[4(c)] the first radio communication circuit is further capable of transmitting the accumulated video information.

Tee teaches this limitation. *Tee*'s mobile terminal 110 is capable of transmitting, via the PAN transceiver (first radio communication circuit), the stored video content that was received via the WAN transceiver ("transmitting the accumulated video information"):

[M]obile terminal 110 accesses base station **120 via an air interface** (e.g., transceiver **201** or **202**) and **initiates a video/multimedia download** from server 150 (process step 305). Alternatively, mobile terminal 110 may play back video/multimedia data stored in video/multimedia file 280. At some point, **mobile terminal 110 detects the presence of a remote display device** (e.g., television 131) **via another air interface** (e.g., transceiver **202** or **203**) **and establishes a wireless link with the remote display device[.]**

...

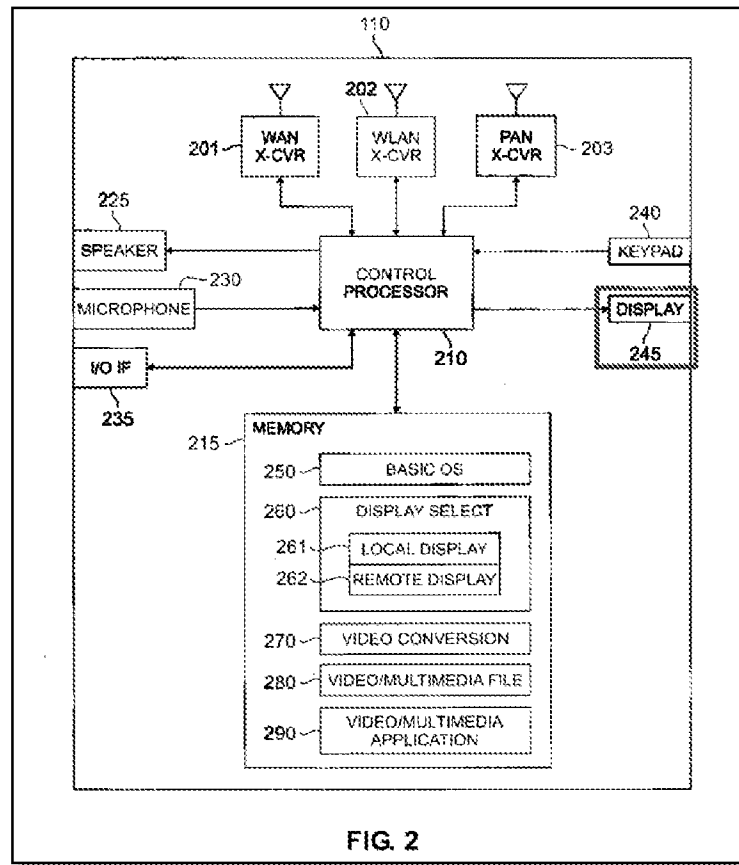
mobile terminal 110 then forwards (or relays or re-transmits) the video stream from base station 120 (or video/multimedia file 280) **to the remote display device[.]**

Id. at [0037]–[0038] (emphasis added); *see also id.* at [0030] (“mobile terminal 201 may receive a video stream from BS 120 via WAN transceiver 201 and may relay the video stream over a short distance to a remote display device via . . . PAN transceiver 203.”), [0033] (describing receiving video via WAN and re-transmitting to another device via PAN).

4. Claim 5.

5[P] A display apparatus, comprising:

To the extent the preamble is limiting, *Tee*’s mobile terminal is a “display apparatus.” For example, Fig. 2 below depicts display 245 in the mobile terminal:



Id. at FIG. 2. Indeed, one of the fundamental aspects of the *Tee* disclosures discussed above is that the mobile terminal can play back video on its native display or, if an available external display has better capabilities, can stream the video wirelessly to improve playback:

Control processor 210 executes display select program 260 in order to determine whether the quality of the display of the remote device (e.g., television 131) is superior to the quality of display 245 in mobile terminal 110.

...

control processor 210 compares the parameters in remote display parameters file 262 to the parameters in local display parameters file 261 and selects the display best suited to video/multimedia application program 290. If the display of the external device is selected, control processor 210 transfers the video/multimedia data to the appropriate one of transceivers 202 and 203.

Id. at [0034]–[0036] (emphasis added).

[5(a)] a first radio communication circuit capable of receiving video information by radio or transmitting information by radio;

Tee's mobile terminal includes a PAN transceiver (first radio communication circuit) capable of transmitting or receiving video information by radio. *See* limitation [1(a)], *supra*.

[5(b)] a second radio communication circuit capable of connecting by radio to an internet or a home network to transmit and receive information;

Tee's mobile terminal includes a WLAN transceiver (second radio communication circuit) capable of connecting by radio to an internet to transmit and receive information. *See* limitation [1(b)], *supra*.

[5(c)] a display capable of displaying the information received by the first radio communication circuit or the second radio communication circuit; and

As discussed above with reference to the Preamble, *Tee* teaches that video is displayed on local display 245 as a default and is wirelessly relayed to a more capable remote display *only* when such an external display is available. Based on this teaching, although many of *Tee's* specifically described scenarios contemplate receiving video from one of the wireless transceivers (e.g., PAN or WLAN) and relaying said video to an external display, a PHOSITA would have understood that the mobile terminal's display 245 is capable of displaying that same wirelessly received video, for

example, if no external display is available. *Creusere Dec.* (Ex. 1003), ¶ 55. Indeed, *Tee* confirms that “the mobile terminal relays its video data to the external display device as well as to its internal display.” *Tee* (Ex. 1005), [0018]. Supporting this local display, *Tee* teaches that “[c]ontrol processor 210 executes video/multimedia application program 290 in order to display video data on display 245.” *Id.* at [0033].

In terms of receiving video that may be displayed on the local display 245, *Tee* teaches that all three transceivers support such functionality, including the PAN and WLAN transceivers mapped herein to the first and second radio communication circuits:

Additionally, depending on the distances involved, **mobile terminal 110 may receive an incoming video and/or multimedia stream from any one of WAN transceiver 201, WLAN transceiver 202, and PAN transceiver 203[.]**

Id. at [0030] (emphasis added).

[5(d)] a controller,

Tee’s mobile terminal includes a controller. *See* element [1(e)], *supra*.

[5(e)] wherein the controller controls assignment of connection for each of the first and second radio communication circuits in response to receiving an indication from a user; and

As discussed above with reference to limitation [1(g)], a PHOSITA would have understood that *Tee*’s Fig. 3 embodiment—where video is received via the WLAN transceiver and relayed to an external display via the PAN transceiver—assigns resources to each of the wireless connections in response to receiving a user indication. *See* limitation [1(g)], *supra*. Namely, these assignments are made in response to a user requesting the video download/stream via the WLAN transceiver and selecting a particular external display to relay the video via the PAN transceiver. *Id.*

As mapped below with reference to limitation [5(f)], Fig. 3 and its corresponding description also teach a scenario in which video is received via the PAN transceiver from a local

video camera and relayed to the Internet via the WLAN transceiver in support of a videoconference application. For the same reasons outlined above in reference to limitation [1(g)], a PHOSITA would have understood that control processor 210 assigns both the PAN transceiver and WLAN transceiver connections in response to user indications. *Creusere Dec.* (Ex. 1003), ¶ 56. Namely, in response to a user selecting the external camera to supply a video input for the videoconference, control processor 210 would have assigned resources using PAN transceiver to support that connection. *Id.* Similarly, in response to a user choosing to supply the locally captured video to base station 120 in support of the videoconference application, control processor 210 would have assigned resources using WLAN transceiver to support that connection. *Id.*

[5(f)] wherein the controller controls each of the first and second radio communication circuits, so that the first radio communication circuit receives video information and the second radio communication circuit connects to the internet or the home network simultaneously.

As discussed above, *Tee* teaches numerous scenarios in which video is received using one wireless transceiver and relayed to an external device using a different wireless transceiver. One such scenario involves receiving a video stream via the PAN transceiver (first radio communication circuit) and relaying the video stream to an external device using the WLAN transceiver (second radio communication circuit):

[M]obile terminal 110 may **receive an incoming video and/or multimedia stream from** any one of WAN transceiver 201, WLAN transceiver 202, and **PAN transceiver 203 and may relay the video and/or multimedia stream to an external device using**, for example, **WLAN transceiver 202** or PAN transceiver 203.

Tee (Ex. 1005), [0029] (emphasis added); *see also id.* at [0032] (“[M]obile terminal [110] may receive . . . a video source device via PAN transceiver 203 and may relay the video stream over a short distance to a remote display device via WLAN transceiver 202.”). As discussed with

reference to limitation [1(h)], a PHOSITA would have understood that *relaying* a video *stream* to a remote display device would have involved actively receiving the video stream over a first connection (i.e., receiving the stream) while simultaneously transmitting the video over a second connection (i.e., relaying the video stream). *See* limitation [1(h)], *supra*. And, as discussed with reference to limitation [1(b)], WLAN transceiver is a WiFi transceiver, which a PHOSITA would have understood is most commonly used to connect devices to each other within a home/office environment and to connect those devices to the Internet through an “access point.” *Creusere Decl.* (Ex. 1003), ¶¶ 44–45. In the above-described scenario in which the WLAN transceiver is used to relay a video stream to a local display, a PHOSITA would have understood that the mobile terminal and display device would be connected using a “home network” as claimed (i.e., the home WiFi network). *Id.*

In addition to relaying video streams to an external device, *Tee* teaches a videoconference scenario in which video is received from a local camera via a short range connection, such as the PAN transceiver (first radio communication circuit), and is transmitted to base station 120 using, for example, the WLAN transceiver (second radio communication circuit):

[I]f video/multimedia application program 290 is a video conferencing application, **mobile terminal 110 receives via the short-range air interface video/multimedia data from a remote video camera and relays the camera video data to base station 120[.]**

Tee (Ex. 1005), [0038] (emphasis added); *see also id.* at [0017] (explaining its use of “short-range” is a reference to connections using the PAN transceiver), [0037] (explaining that “mobile terminal 110 accesses base station 120 via [WLAN] transceiver . . . 202”). As noted in the preceding paragraph, the WLAN connection is a WiFi connection to a home network that may also support accessing the Internet via an access point. In this video conference scenario, because the WLAN

connection is to base station 120, the WLAN transceiver not only provides a connection to the home network, but also to the Internet. *Id.* at [0020] (explaining that “[b]ase station 120 provides mobile terminal 110 with access to . . . the Internet”). Further, just as with the embodiment described in the preceding paragraph, a PHOSITA would have understood that *relaying* the camera video data via the Internet to support a videoconference application would have involved actively receiving the video data over a first connection while simultaneously relaying the video data. *Creusere Dec.* (Ex. 1003), ¶¶ 57–58. Indeed, the entire purpose of a videoconference application is to allow remote users to see each other live via video streams. *Id.* This is only possible if the video data captured by the local camera is relayed simultaneously to the Internet-based videoconference application. *Id.*

5. Claim 6.

6. The display apparatus according to claim 5, wherein, upon receiving an indication to receive the video information from an external device via the first radio communication circuit, the controller assigns connection of the first radio communication circuit prior to connection of the second radio communication circuit.

As described above, *Tee* teaches a videoconference scenario in which video is received from a local camera via a short-range connection, such as the PAN transceiver (first radio communication circuit) and is transmitted to base station 120 using, for example, the WLAN transceiver (second radio communication circuit). *See* limitation [5(f)], *supra*. A PHOSITA would have understood that the PAN connection should be provisioned before the WLAN connection. *Creusere Dec.* (Ex. 1003), ¶¶ 59. Indeed, the premise of the videoconference scenario is that a single video stream captured by a local camera is received via the PAN transceiver and relayed to base station 120 via the WLAN transceiver. *Id.* If there is no video data received by the PAN transceiver, there is nothing to relay via the WLAN transceiver. *Id.* Accordingly, a PHOSITA

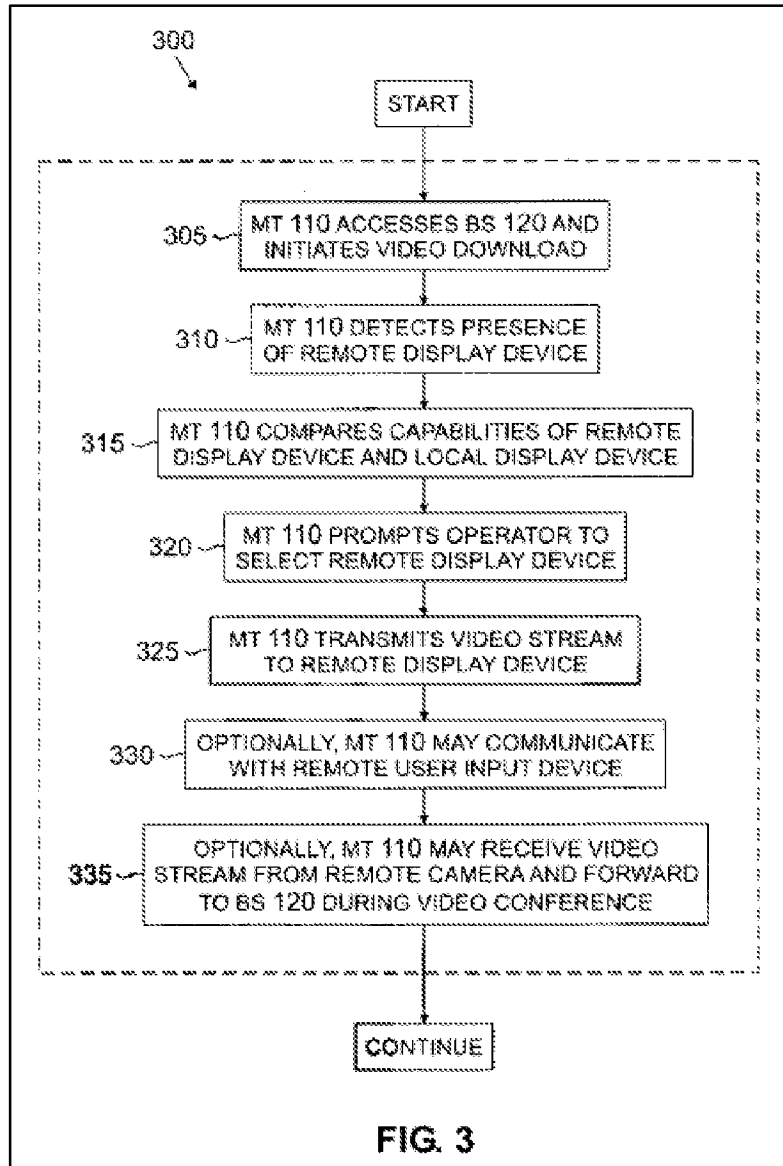
would have been motivated to establish the PAN connection (e.g., to ensure the video stream is being effectively received) before establishing the WLAN connection—after it is confirmed that a video stream exists to relay via the WLAN connection. *Id.*

6. Claim 7.

7. The display apparatus according to claim 5, wherein, upon receiving an indication to receive the video information via the first radio communication circuit while acquiring information from the internet via the second radio communication circuit, the controller assigns connection of the first radio communication circuit prior to connection of the second radio communication circuit.

As discussed above with respect to claim 6, a PHOSITA would have been motivated, in the videoconference scenario illustrated in Fig. 3 as step 335, to first establish the PAN transceiver connection (e.g., to ensure the video stream is being effectively received) and then establish the WLAN connection—after it is confirmed that a video stream exists to relay via the WLAN connection. *See Claim 6, supra.*

As depicted in Fig. 3, step 335 is an optional addition to the process flow that begins at step 305 with mobile terminal 110 initiating a video download from base station 120:



Tee (Ex. 1005), Fig. 3; *see also id.* at [0037]–[0038] (explaining that mobile terminal downloads a video through base station 120 (i.e., the Internet) at step 305 using WLAN transceiver 202, may relay that video to a local external display, and may optionally perform step 335 of receiving a video stream from a local camera via the PAN transceiver and relaying that video to base station 120). Accordingly, before the step 335 process occurs, there is an active Internet connection acquiring information via WLAN through base station 120.

This disclosed sequence of events satisfies Claim 7. Namely, “upon receiving an indication to receive the video information via the first radio communication circuit while acquiring information from the internet via the second radio communication circuit” is satisfied because (1) there is an active Internet connection via WLAN over which video information is received by the mobile terminal and, while that video reception is active, and (2) the user initiates step 335, requesting a video stream from a local camera via the PAN transceiver. The remainder of the claim, “the controller assigns connection of the first radio communication circuit prior to connection of the second radio communication circuit,” is satisfied as noted above regarding step 335. Namely, the PAN transceiver video connection is established first (e.g., to ensure the video stream is being effectively received) and the WLAN video connection is established second—after it is confirmed that a video stream exists to relay via the WLAN connection.

7. Claim 8.

8[P] The display apparatus according to claim 5,

Tee teaches the display apparatus of claim 5. *See* Claim 5, *supra*.

[8(a)] further comprising a radio interface capable of receiving video information by radio,

Tee teaches this limitation. *See* limitation [4(a)], *supra* (mapping *Tee*’s WAN transceiver).

[8(b)] wherein the display device is further capable of displaying the video information received via the radio interface.

As set forth above with reference to limitation [5(c)], a PHOSITA would have understood that the mobile terminal’s display 245 is capable of displaying wirelessly received video from any of the disclosed wireless interfaces, including the WAN transceiver. *See* limitation [5(c)], *supra*. Such local display is contemplated, for example, if no external display is available. *Id.*

8. Claim 9

9[P] A method for video processing, comprising:

To the extent the preamble is limiting, *Tee* teaches a method for video processing. See limitation 1[P] and the Claim 1 mapping, *supra*.

[9(a)] receiving video information via an optical system by an imaging circuit;

Tee teaches this claim limitation. See element [1(c)], *supra*.

[9(b)] accumulating video information received by the imaging circuit;

Tee teaches this claim limitation. See element [1(d)], *supra*.

[9(c)] transmitting the video information to an external device by radio, via a first radio communication circuit; and

Tee teaches this claim limitation. See elements [1(f)] and [1(a)], *supra*.

[9(d)] connecting, by radio, to an internet or a home network to transmit and receive information, via a second radio communication circuit;

Tee teaches this claim limitation. See element [1(b)], *supra*.

[9(e)] wherein assignment of connection for each of the first and second radio communication circuit is controlled in response to receiving an indication from a user; and

Tee teaches this claim limitation. See element [1(g)], *supra*.

[9(f)] wherein the transmitting and connecting is controlled so that the first radio communication circuit is configured to transmit video information and the second radio communication circuit is configured to connect to the internet or the home network simultaneously.

Tee teaches this claim limitation. See element [1(h)], *supra*.

9. Claim 10

10[P] A method, comprising:

To the extent the preamble is limiting, *Tee* teaches a method for video processing. See element 5[P] and the claim 5 mapping generally, *supra*.

[10(a)] receiving video information by radio, via a first radio communication circuit and connecting by radio to an internet or a home network to transmit and receive information, via a second radio communication circuit; and

Tee teaches this claim limitation. See elements [5(a)] and [5(b)], *supra*.

[10(b)] displaying, via a display circuit, information received by the first radio communication circuit or the second radio communication circuit;

Tee teaches this claim limitation. See element [5(c)], *supra*.

[10(c)] wherein assignment of connection for each of the first and second radio communication circuit is controlled in response to receiving an indication from a user; and

Tee teaches this claim limitation. See element [5(e)], *supra*.

[10(d)] wherein the receiving and connecting is controlled so that the first radio communication circuit is configured to receive video information and the second radio communication circuit is configured to connect to the internet or the home network simultaneously.

Tee teaches this claim limitation. See element [5(f)], *supra*.

B. SNQP 2: Claims 2-3 are obvious over Tee in view of Honkanen

1. Overview of Honkanen

U.S. Patent Application Publication No. 2006/0135076 A1 to Honkanen *et al.* (“*Honkanen*”) (Ex. 1006) was published on June 22, 2006 and is prior art to the ’590 Patent under at least 35 U.S.C. § 102(b) (pre-AIA). *Honkanen* was not cited or considered during prosecution of the ’590 Patent or the parent ’212 Patent. ’590 Patent (Ex. 1001); ’212 Patent (Ex. 1007).

Honkanen discloses a method of allocating radio resources for simultaneous radio connections to minimize interference. *Honkanen* (Ex. 1006), Abstract. Although *Honkanen*

addresses minimizing interference where there is direct frequency overlap, it also teaches that its methods are applicable to simultaneous connections that are not using the same frequencies. *Id.* at [0003]. *Honkanen* expressly identifies WLAN and Bluetooth (the technology implemented by *Tee's* PAN transceiver) interfaces as wireless connections of the type fit for its interference minimizing methods:

“In the example of FIG. 1 three communication interfaces 110 to 114 are provided in the communication device, these interfaces 110 to 114 providing the **Bluetooth® connection** 122, the GSM connection 116, and the **WLAN connection** 118, respectively.

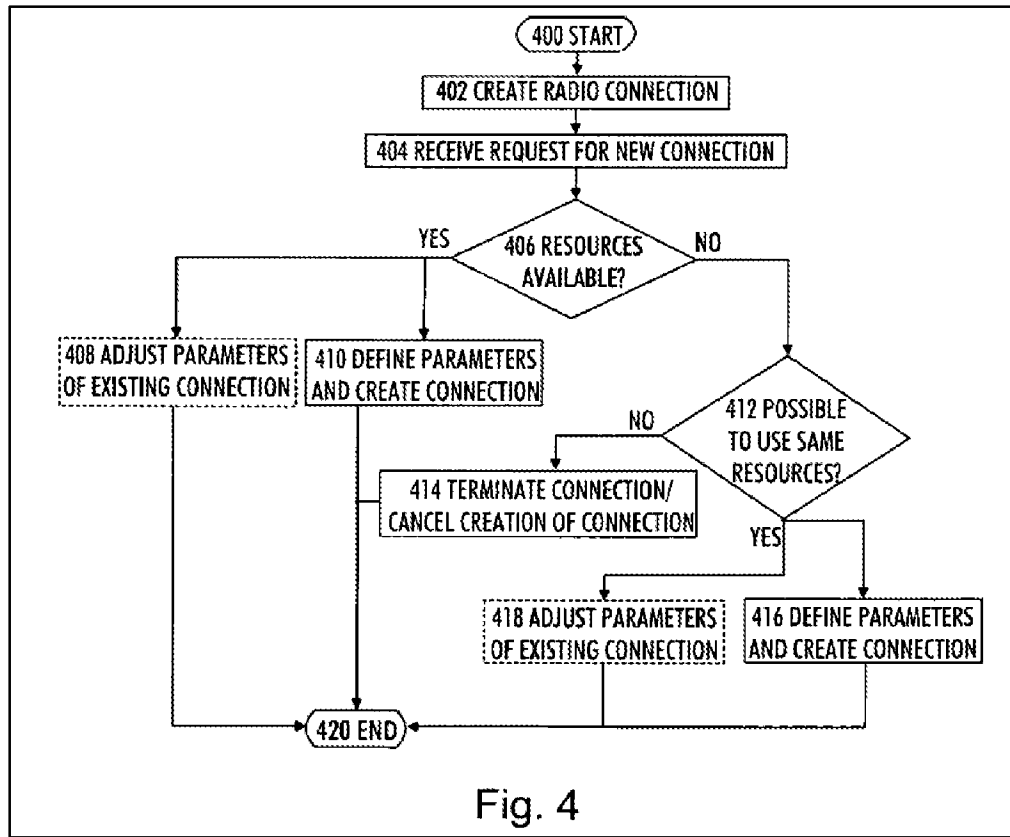
Id. at [0025] (emphasis added).

In one embodiment, *Honkanen* recognizes that WLAN and Bluetooth may operate partially on the same frequencies. To minimize interference between simultaneous WLAN and Bluetooth connections, *Honkanen* teaches configuring the resources allocated in a way to minimize overlap:

When creating a new radio connection, the connection parameter manager 308 may first check, whether existing connections exist that use the same frequency band as the requested new connection in creation would use. **If an existing connection on the same frequency band exists, the connection manager may (if possible) define the frequency parameters of the connection in creation so that the frequency bands of two connections do not overlap.** For example, a Bluetooth® connection and a WLAN connection operate partially on the same 2.4 Gigahertz ISM-band. **Let us assume that the connection in creation is a Bluetooth® connection, and a WLAN connection in operation exists.** The Bluetooth® connection is a frequency hopping spread spectrum connection. Thus, **the connection parameter manager 308 may prevent the Bluetooth® connection from hopping to the frequencies the WLAN connection is using.**

Id. at [0049] (emphasis added) (further noting this same technique applies where a WLAN connection is requested that may overlap with an existing Bluetooth connection).

Honkanen also recognizes that frequency overlap may be maintained and proposes adjusting other parameters, such as transmission power, in order to minimize interference. *Id.* at [0053]. The right branch of Figure 4, ending with steps 416 and 418, illustrates a method by which parameters of an existing connection are adjusted in order to support a new connection that uses some of the same resources:



Id. at Fig. 4. A first radio connection is created at step 402, and a request for a second connection is received at step 404. *Id.* at [0060]. At step 406 the system checks if resources are available to create both connections using unique resources. *Id.* at [0062]. If not, the system determines whether it's possible to share some resources at step 412. *Id.* at [0063]. Assuming resource sharing is possible, the process moves to steps 416 and 418 where connection parameters are allocated to accommodate simultaneous connections while minimizing interference by first establishing the

new connection at step 416 and then reassigning the original connection to use parameters that serve to minimize interference:

If it is possible in 412 to create another connection using the same radio resources as used for an existing connection or connections, the process proceeds to 416 and 418 (optional). The new connection with parameters that allow the connection to sustain interference to some degree is created in 416. The parameters of an existing connection or connections are adjusted accordingly, when necessary.

Id. at [0065].

Although *Honkanen* is not directed to a video-specific device and instead describes allocating wireless connection resources more generally, it is directed to methods for controlling simultaneous radio connections and is thus in the same field of endeavor as the '590 Patent. *Compare* '590 Patent (Ex. 1001), 13:58–14:3 with *Honkanen* (Ex. 1006), [0057]. Further, *Honkanen* is reasonably pertinent to a problem the '590 Patent sought to address—supporting a new and higher priority connection by re-allocating resources of a pre-existing connection to support simultaneous communications). *Compare* '590 Patent (Ex. 1001), 8:7–57 (describing reallocating an existing Internet connection from scheme 1 to scheme 2 and allocating the higher throughput scheme 1 to a new video connection) with *Honkanen* (Ex. 1006), [0065] (describing allocating a new connection and then adjusting the parameters of a pre-existing connection to minimize interference due to simultaneous communications. Therefore, *Honkanen* is analogous art to the '590 Patent. *Creusere Decl.* (Ex. 1003), ¶¶ 39–42.

2. Modifying Tee in view of Honkanen

As set forth above in Section VII.A, *Tee* describes an embodiment in which video is downloaded from base station 120 using the WLAN transceiver (second radio communication circuit) and the same video is streamed to a remote display device using the PAN (Bluetooth)

transceiver (first radio communication circuit) such that both connections are simultaneously active. *See* limitations [1(g)–1(h)], *supra*. Further, as set forth above, a request to relay the video to an external display via the PAN transceiver is assigned in response to a user request after the video streaming via WLAN has been initiated. *Id.* In other words, there is an active WLAN connection when the user asks to establish the simultaneous PAN (Bluetooth) connection. It was known in the art that simultaneous WLAN and Bluetooth connections use overlapping resources (i.e., frequencies) and that some form of interference mitigation should be used to avoid fidelity issues. *Creusere Dec.* (Ex. 1003), ¶ 60 (discussing state of the art, including widespread recognition of interference issues with Bluetooth and WLAN connections). Indeed, *Honkanen* expressly identifies Bluetooth and WLAN as two wireless technologies subject to potentially severe interference:

If there is a number of connections simultaneously operating on the same band, interference they cause to one another is much more severe than if they were operating on separate bands. Especially on the 2.4 GHz unlicensed Industrial, Scientific and Medical (ISM) band there may be several connections, for example **Bluetooth® and wireless local area network (WLAN) connections**, operating on the same band simultaneously. **These connections cause inter-system interference to one another, which may result in a degraded quality of service.**

Honkanen (Ex. 1006), [0004] (emphasis added). Accordingly, a PHOSITA would have been motivated to account for the potential interference that would have resulted from *Tee*'s simultaneous WLAN and PAN (Bluetooth) video streaming connections and would have looked to solutions in the art such as those disclosed by *Honkanen*. *Creusere Dec.* (Ex. 1003), ¶ 60.

Among *Honkanen*'s solutions, two are particularly suited to simultaneous Bluetooth and WLAN connections. First, *Honkanen* teaches that interference can be minimized when a Bluetooth

connection is added to existing WLAN connection by limiting the operational frequencies of the Bluetooth connection so as to “prevent the Bluetooth® connection from hopping to the frequencies the WLAN connection is using.” *Honkanen* (Ex. 1006), [0049]. It was, however, known in the art that limiting the operational frequencies of a Bluetooth connection may negatively impact the connection. *Creusere Dec.* (Ex. 1003), ¶ 61 (discussing recognition of performance degradation due to limiting Bluetooth operational frequencies, including one study that found a throughput decrease of 13%, resulting from such frequency limitations). A PHOSITA would have understood that the video streaming connections contemplated by *Tee* consume significant bandwidth and would have been motivated to avoid artificially limiting the bandwidth of these connections if at all possible. *Id.* at ¶ 62. Further, a PHOSITA would have understood that the Bluetooth connection should be prioritized because the mobile terminal has no ability to control the reception (e.g., buffering and processing) at the external display and must provide a consistent and high quality video stream in order to ensure proper video playback at the external display. *Id.* at ¶¶ 63–64 (explaining that the mobile terminal exerts control over the WiFi reception and Bluetooth transmission, but has no ability to control reception and video processing at the external display and, accordingly, must ensure it provides the external display a high fidelity video stream).

Honkanen’s second applicable solution sets forth a process to avoid interference that does not require artificially limiting the operational frequencies of the Bluetooth connection. Namely, *Honkanen* teaches that frequency overlap may be maintained by adjusting other parameters, such as transmission power, in order to minimize interference. *Honkanen* (Ex. 1006), [0053]. In this resource sharing solution, when a request for a resource-overlapping connection is received, the system first establishes the new connection (step 416) and then reassigns the original connection to use parameters that minimize interference:

If it is possible in 412 to create another connection using the same radio resources as used for an existing connection or connections, the process proceeds to 416 and 418 (optional). The new connection with parameters that allow the connection to sustain interference to some degree is created in 416. The parameters of an existing connection or connections are adjusted accordingly, when necessary.

Id. at [0065], [0058] (listing spreading code, channel code, modulation technique, power level, and/or timing parameters as adjustable parameters). Because a PHOSITA would have been motivated to minimize interference when establishing a Bluetooth (PAN) connection for simultaneous communications with the existing WiFi connection (WLAN) and would further have been motivated to ensure the Bluetooth connection takes priority, that PHOSITA would have been motivated to employ *Honkanen's* solution excerpted above by establishing the PAN/Bluetooth with parameters that ensure high fidelity and re-allocating the WiFi parameters in order to minimize interference. *Creusere Dec.* (Ex. 1003), ¶ 64. Of the adjustable parameters listed, a PHOSITA would have identified lowering the transmission power level of the WiFi connection as the most straightforward. *Id.* at ¶ 65. Indeed, where the WiFi connection is strong (e.g., experiences a high signal-to-noise ratio), its transmission power can be lowered to avoid interference without negatively impacting the fidelity of the WiFi connection itself. *Id.* But even if lowering the transmission power would negatively impact the WiFi connection, a PHOSITA would have understood that the reception buffer size could be increased to accommodate delays or other errors resulting from the adjustment. *Id.* (explaining that variable reception buffers were well known to accommodate unstable or otherwise poor channel conditions). In other words, the mobile terminal would adjust to collect more video data from the WiFi connection before relaying the video stream to the external display. *Id.* (explaining that the larger buffer permits the mobile terminal to correct for errors (e.g., retransmit missing packets) and to account for delays in the video data reception,

ensuring that a consistent video stream is relayed to the external display over the Bluetooth/PAN connection).

To be sure, this solution implicates a tradeoff. A larger reception buffer introduces a small delay between the reception of the video stream and relaying that video stream to the external display. But a PHOSITA would have understood that the benefit of ensuring a consistent and high-quality video stream is relayed to the external display is far more important to the user experience than a minimally increased delay. *Id.*

In addition to the transmission power, a PHOSITA would further have understood that the channel code for the WLAN connection could have been altered to minimize interference with the PAN connection. *Honkanen* specifically identifies channel codes as a parameter that can be altered to minimize interference. *Honkanen* (Ex. 1006), [0041], [0053], [0058]. Channel codes are designed to protect data streams from transmission errors, and a PHOSITA would have known that, by appropriately altering the channel code at the same time as the transmission power was reduced, one could maintain the channels transmission error rate at a constant level. *Creusere Dec.* (Ex. 1003), ¶ 66. Although altering channel codes to maintain a constant error rate might impose a computational cost, a PHOSITA would have expected that the endpoints of the WLAN connection (i.e., the server and mobile terminal) are more capable of incurring the additional computational load than an external display. *Id.*

A POSITA would thus have been motivated to modify *Tee*'s wireless mobile terminal by programming *Tee*'s control processor 210 to implement the functionality provided by *Honkanen*'s multi-radio controller. *Id.* at ¶ 67. Namely, when there is an active WLAN connection over which video is received and the user requests the video be relayed to an external display via the PAN transceiver, the system allocates the PAN connection and then re-allocates the WLAN connection

with parameters designed to minimize interference (e.g., lowering the WLAN transmission power). When necessary, the reception buffer for the WLAN connection may further be increased to accommodate fidelity issues resulting from the decreased transmit power.

Implementing *Honkanen*'s interference minimizing solution would benefit *Tee* in the same manner that it benefits *Honkanen*—limiting the detrimental impact of interference due to simultaneous WLAN and Bluetooth connections. *Id.* at ¶ 67. In both cases, adjustments are made to the connection priorities in order to improve fidelity by minimizing interference, and both expressly address the potential interference implicated by simultaneous Bluetooth and WLAN connections. *Id.* at ¶¶ 60, 67; *see also KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) (obvious to use known techniques to improve similar devices in the same way).

Such a modification to *Tee* would also have been straightforward, requiring only minor changes such as reprogramming *Tee*'s system to permit parameter adjustments, and would have, accordingly, yielded predictable results. *Creusere Dec.* (Ex. 1003), ¶ 68 (describing the proposed modification and concluding that such modifications would have been well within the capabilities of a PHOSITA); *see also KSR*, 550 U.S. at 416 (obvious to combine prior art elements according to known methods to yield predictable results). Indeed, *Tee* includes all the hardware infrastructure necessary. As set forth above, *Tee* expressly contemplates simultaneous Bluetooth and WLAN connections and would necessarily include all hardware infrastructure necessary to accommodate those connections. *Creusere Dec.* (Ex. 1003), ¶ 68. Additionally, *Tee*'s mobile terminal 110 includes control processor 210 for provisioning its wireless connections. *Id.* at ¶ 49 (noting *Tee*'s “[c]ontrol processor 210 executes basic OS program 250 in order to control, among other things, transceivers 201, 202, and 203” (citing *Tee* (Ex. 1005), [0026]) and concluding that such control includes provisioning the wireless connections using said transceivers).

3. Claim 2.

2. The video processing apparatus according to claim 1, wherein, upon receiving an indication to transmit video information accumulated in the accumulation circuit via the first radio communication circuit, the controller assigns connection of the first radio communication circuit prior to connection of the second radio communication circuit.

The '590 Patent does not describe the order in which connections should be established or any benefit to assigning one connection before another. It does, however, describe a scenario in which a user requests a video connection using a first radio communication circuit while a second radio communication circuit (e.g., Internet connection) is already active. To accommodate the request, the system assigns the first connection prior to re-assigning the second connection:

[I]n a situation wherein the user issues an indication to transmit video information by radio via the modem 1002 to the display apparatus 200 while acquiring information from the Internet according to scheme 1 of FIG. 9 by use of the modem 1003, the controller 132 outputs a control signal to the assignment controller 1001 such that the transmission scheme of the modem 1003 is changed from scheme 1 to scheme 2 of FIG. 9 and that of the modem 1002 is set to scheme 1 of FIG. 9 conduct communications.

'590 Patent (Ex. 1001), 8:35–47. Interpreting Claim 2 in view of this teaching, the limitation should at least capture a scenario in which the requested first radio communication circuit (video connection) is established prior to re-provisioning the second radio communication circuit.

As set forth above, it would have been obvious to implement *Honkanen's* interference mitigation process in *Tee's* mobile terminal such that, when there is an active WLAN connection over which video is received and the user requests the video be relayed to an external display via the PAN transceiver, the system first provisions the PAN connection and then re-provisions the WLAN connection with parameters designed to minimize interference (e.g., lowering the WLAN transmission power).

4. Claim 3.

3. The video processing apparatus according to claim 1, wherein, upon receiving an indication to transmit video information accumulated in the accumulation circuit via the first radio communication circuit while acquiring information from the internet via the second radio communication circuit, the controller assigns connection of the first radio communication circuit prior to connection of the second radio communication circuit.

As discussed in Section VI, this limitation should be construed as, “upon receiving an instruction to transmit video information accumulated in the accumulation circuit via the first radio communication circuit while simultaneously acquiring information from the internet via the second radio communication circuit, the controller assigns connection of the first radio communication circuit before assigning connection of the second radio communication circuit.” Based on Patent Owner’s infringement allegations in the parallel ITC investigation, there remains uncertainty as to precisely how Patent Owner is interpreting this agreed-upon language. As discussed above with reference to Claim 2, the sole disclosure in the ’590 Patent that addresses the order in which the connections are established describes a scenario in which a user requests a video connection using a first radio communication circuit while a second radio communication circuit (e.g., Internet connection) is already active and accommodates this request by first assigning the requested video connection and then re-assigning the second connection (i.e., re-allocating the second connection parameters). ’590 Patent (Ex. 1001), 8:35–47. Although Requester reserves its right to pursue invalidity in other proceedings based on a broader interpretation that Patent Owner may advance, Requester interprets the agreed-upon construction of Claim 3 consistent with the specific description in the ’590 Patent. Namely, for purposes of this mapping, Requester assumes the agreed-upon construction requires (1) receiving an “instruction to transmit video” over a first radio circuit while **simultaneously** acquiring information over the internet via the second radio

communication circuit, and (2) assigning the first radio communication circuit connection **before** re-assigning the second radio communication circuit connection.

As set forth above, it would have been obvious to implement *Honkanen's* interference mitigation process in *Tee's* mobile terminal such that, when there is an active WLAN connection over which video is received and the user requests the video be relayed to an external display via the PAN transceiver, the system first provisions the PAN connection and then re-provisions the WLAN connection with parameters designed to minimize interference (e.g., lowering the WLAN transmission power).

VIII. TIMING FOR REQUESTING EX PARTE REEXAMINATION UNDER 35 U.S.C. 302

The filing of this Request for *Ex Parte* Reexamination is timely. The '590 Patent is still enforceable as of the date of filing this Request for *Ex Parte* Reexamination. *See* M.P.E.P. § 2211; 35 U.S.C. § 286.

IX. COMMUNICATIONS TO THIRD PARTY REQUESTER

The Requester's correspondence address is:

ERISE IP, P.A.
7015 College Boulevard, Suite 700
Overland Park, Kansas 66211
Telephone: (913) 777-5600
Facsimile: (913) 777-5601

X. CERTIFICATION THAT REEXAMINATION IS NOT PROHIBITED

In accordance with 37 C.F.R. § 1.510(b)(6), the Third Party Requester hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) and 35 U.S.C. § 325(e)(1) do not prohibit the Requester from filing this *Ex Parte* Reexamination Request.

XI. CERTIFICATION OF SERVICE ON PATENT OWNER

In accordance with 37 C.F.R. § 1.510(b)(5), the Third Party Requester hereby certifies that the above captioned Request for *Ex Parte* Reexamination under 37 C.F.R. § 1.510 will be served upon:

MATTINGLY & MALUR, PC
1800 Diagonal Road
Suite 210
Alexandria, VA 22314

XII. CONCLUSION

For at least the forgoing reasons, Requester respectfully submits substantial new questions of patentability have been raised with respect to claims 1-10 of the '590 Patent. Accordingly, claims 1-10 of the '590 Patent are unpatentable over the prior art documents cited herein under 35 U.S.C. § 103.

Requester respectfully requests that this Request for *Ex Parte* Reexamination of the '590 Patent be granted by the U.S. Patent and Trademark Office, and that the reexamination be conducted with "special dispatch" pursuant to 35 U.S.C. § 314 and with "priority over all other cases" in accordance with M.P.E.P. § 2661.

Prompt and favorable consideration of this Request for *Ex Parte* Reexamination is respectfully requested.

Date: January 12, 2021

Respectfully submitted,

/Robin A. Snader/
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ATTORNEY FOR THIRD PARTY REQUESTER,
APPLE INC.

Electronic Patent Application Fee Transmittal

Application Number:				
Filing Date:				
Title of Invention:	DISPLAY APPARATUS AND VIDEO PROCESSING APPARATUS			
First Named Inventor/Applicant Name:	Toshiyuki Kurita			
Filer:	Robin A. Snader/Chalynda Giles			
Attorney Docket Number:	2638-19.08			
Filed as Large Entity				
Filing Fees for ex parte reexam				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
EX PARTE REEXAMINATION (1.510(A)) NON-STREAMLINED	1812	1	12600	12600
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				12600

Electronic Acknowledgement Receipt

EFS ID:	41613647
Application Number:	90014651
International Application Number:	
Confirmation Number:	7485
Title of Invention:	DISPLAY APPARATUS AND VIDEO PROCESSING APPARATUS
First Named Inventor/Applicant Name:	Toshiyuki Kurita
Customer Number:	118925
Filer:	Robin A. Snader/Chalynda Giles
Filer Authorized By:	Robin A. Snader
Attorney Docket Number:	2638-19.08
Receipt Date:	12-JAN-2021
Filing Date:	
Time Stamp:	12:25:22
Application Type:	Reexam (Third Party)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 12600
RAM confirmation Number	E20211BC26070281
Deposit Account	506159
Authorized User	Chalynda Giles

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)
37 CFR 1.20 (Post Issuance fees)
37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	01_Request_Reexamination_Transmittal.pdf	382922	no	4
			6c440cc1e01913618f6e4c10cb28152c48764ea9		
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	03_Information_Disclosure_Statement.pdf	127479	no	2
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Information:					
This is not an USPTO supplied IDS fillable form					
3	Copy of patent for which reexamination is requested	EX1001_10129590_Kurita.pdf	1911949	no	23
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4	Non Patent Literature	EX1002_590_FH_10129590_Final_Part1.pdf	18494743	no	224
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9	Reexam - Affidavit/Decl/Exhibit Filed by 3rd Party	EX1003_Creusere_Dec_590_Patent.pdf	3067909	no	65
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11	Other Reference-Patent/App/Search documents	EX1005_US20060203758A1_Technology.pdf	404785	no	11
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12	Other Reference-Patent/App/Search documents	EX1006_US20060135076A1_Honkanen.pdf	2260824	no	15
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14	Non Patent Literature	EX1008_Maxell_v_Apple_WDT EX_Complaint.pdf	869480	no	33
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31	Non Patent Literature	EX1027_Video_Streaming_Concepts_Algorithms_Networks.pdf	465924	no	36
			1f125ee4e4172deb1191dfbb6d272bdc1ecb291fe		
Warnings:					
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32	Non Patent Literature	EX1028_EXCERPT_Newtons_Telecom_Dictionary_20th_Edition.pdf	13281034	no	9
			415f35834797e6c8d4260b5f32c7fd33cd31d4f		
Warnings:					
Information:					
33	Non Patent Literature	EX1029_Flexible_Decoder_Buffer_Ribas_Corbera.pdf	7032	no	1
			c502123680c0a8c3cef1be187b552cf7b055fcd		
Warnings:					
Information:					
34	Non Patent Literature	EX1030_Buffer_Allocation_Mechanism_Sheu.pdf	695616	no	5
			664aaa4bb20f3989ed7968eff80d869277f81d7f		
Warnings:					
Information:					

35	Other Reference-Patent/App/Search documents	EX1031_US20070091835A1_Jo.pdf	2056582	no	19
			a373479a56202aae39bee5182292dea07ab3d8b9		
Warnings:					
Information:					
36	Other Reference-Patent/App/Search documents	EX1032_US20070072642A1_Kangas.pdf	1061637	no	12
			4544961134125bd7e6f5bf8fbcf0bed5d1915fc4		
Warnings:					
Information:					
37	Other Reference-Patent/App/Search documents	EX1033_US20080139118A1_Sanguinetti.pdf	2438073	no	24
			fe0ff749762a1a7b0c264ada7a721a4b8a1f0271		
Warnings:					
Information:					
38	Other Reference-Patent/App/Search documents	EX1034_US20050034169A1_Maeda.pdf	3976753	no	36
			63171ed33b1be1331769cde327e15d09dbab84ea		
Warnings:					
Information:					
39	Other Reference-Patent/App/Search documents	EX1035_US20040193647A1_Ueda.pdf	3446204	no	42
			0a21c11f95699ae7bfdf7777cfc166ac1cecc287		
Warnings:					
Information:					
40	Receipt of Orig. Ex Parte Request by Third Party	02_Request_Reexamination_10129590.pdf	1474448	no	53
			3e7561fbc5f417502213e3d0d2c9077e88d1b7e3		
Warnings:					
Information:					
41	Fee Worksheet (SB06)	fee-info.pdf	30207	no	2
			9da076a27e5cb7233d72b2583a9e26209e882b2e		
Warnings:					
Information:					
Total Files Size (in bytes):			166495471		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

(Also referred to as FORM PTO-1465)

REQUEST FOR *EX PARTE* REEXAMINATION TRANSMITTAL FORM

Address to:
Mail Stop *Ex Parte* Reexam
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attorney Docket No.: 2638-19.08

Date: January 12, 2021

1. ☒ This is a request for *ex parte* reexamination pursuant to 37 CFR 1.510 of patent number 10,129,590 issued November 13, 2018. The request is made by:
☐ patent owner. ☒ third party requester.
2. ☒ The name and address of the person requesting reexamination is:
Apple Inc.
One Apple Park Way
Cupertino, CA 95014
3. Requester ☐ asserts small entity status (37 CFR 1.27) or ☐ certifies micro entity status (37 CFR 1.29). Only a patent owner requester can certify micro entity status. Form PTO/SB/15A or B must be attached to certify micro entity status.
4. This request is accompanied by payment of the reexamination fee as set forth in:
☒ 37 CFR 1.20(c)(2); or
☐ 37 CFR 1.20(c)(1). In checking this box for payment of the fee set forth in 37 CFR 1.20(c)(1), requester asserts that this request has forty (40) or fewer pages and complies with all other requirements of 37 CFR 1.20(c)(1).
Payment of the reexamination fee is made by the method set forth below.
 - a. ☐ A check in the amount of \$_____ is enclosed to cover the reexamination fee;
 - b. ☒ The Director is hereby authorized to charge the reexamination fee to Deposit Account No. 50-6159;
 - c. ☐ Payment by credit card. Form PTO-2038 is attached; or
 - d. ☒ Payment made via EFS-Web.☒ In addition, the Director is hereby authorized to charge any fee deficiencies to Deposit Account No. 50-6159.
5. ☒ Any refund should be made by ☐ check or ☒ credit to Deposit Account No. 50-6159 37 CFR 1.26(c). If payment is made by credit card, refund must be to credit card account.
6. ☒ A copy of the patent to be reexamined having a double column format on one side of a separate paper is enclosed. 37 CFR 1.510(b)(4).
7. ☐ CD-ROM or CD-R in duplicate, Computer Program (Appendix) or large table
☐ Landscape Table on CD

[Page 1 of 3]

This collection of information is required by 37 CFR 1.510. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) a request for reexamination. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop *Ex Parte* Reexam, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

8. ☐ Nucleotide and/or Amino Acid Sequence Submission
If applicable, items a. – c. are required.
- a. ☐ Computer Readable Form (CRF)
- b. Specification Sequence Listing on:
- i. ☐ CD-ROM (2 copies) or CD-R (2 copies) **or**
- ii. ☐ paper
- c. ☐ Statements verifying identity of above copies.
9. ☒ A copy of any disclaimer, certificate of correction or reexamination certificate issued in the patent is included.
10. ☒ Reexamination of claim(s) 1-10 is requested.
11. ☒ A copy of every patent or printed publication relied upon is submitted herewith including a listing thereof on Form PTO/SB/08, PTO-1449, or equivalent.
12. ☐ An English language translation of all necessary and pertinent non-English language patents and/or printed publications is attached.
13. ☒ The attached detailed request includes at least the following items:
- a. A statement identifying each substantial new question of patentability based on prior patents and printed publications. 37 CFR 1.510(b)(1).
- b. An identification of every claim for which reexamination is requested, and a detailed explanation of the pertinency and manner of applying the cited art to every claim for which reexamination is requested. 37 CFR 1.510(b)(2).
14. ☐ A proposed amendment is included (only where the patent owner is the requester). 37 CFR 1.510(e).
15. ☒ It is certified that the statutory estoppel provisions of 35 U.S.C. 315(e)(1) or 35 U.S.C. 325(e)(1) do not prohibit requester from filing this *ex parte* reexamination request. 37 CFR 1.510(b)(6).
16. Service
- a. ☒ It is certified that a copy of this request (if filed by other than the patent owner) has been served in its entirety on the patent owner as provided in 37 CFR 1.33(c).
- The name and address of the party served are:
- MATTINGLY & MALUR, PC
- 1800 Diagonal Road, Suite 210
- Alexandria, VA 22314
- Date of Service: January 12, 2021
- OR**
- b. ☐ A duplicate copy is enclosed since service on patent owner was not possible. An explanation of the efforts made to serve patent owner is **attached**. See MPEP 2220.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

17. Correspondence Address: Direct all communication about the reexamination to:

☒ The address associated with Customer Number: **118925**

OR

☐ Firm or Individual Name _____
(at the address identified below)

Address

City

State

Zip

Country

Telephone

Email

18. ☒ The patent is currently the subject of the following concurrent proceeding(s):

- a. ☐ Copending reissue Application No. _____
- b. ☐ Copending reexamination Control No. _____
- c. ☐ Copending Interference No. _____
- d. ☒ Copending litigation styled:

Maxell Ltd. v. Apple Inc, No. 5:19-cv-0036-RWS (E.D. Tex.)In the Matter of Certain Mobile Elec. Devices & Laptop Computers, USITC Inv. No. 337-TA-1215**WARNING : Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.**/Robin A. Snader/

Authorized Signature

January 12, 2021

Date

Robin A. Snader

Typed/Printed Name

66085

Registration No.

☐ For Patent Owner Requester☒ For Third Party Requester

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.