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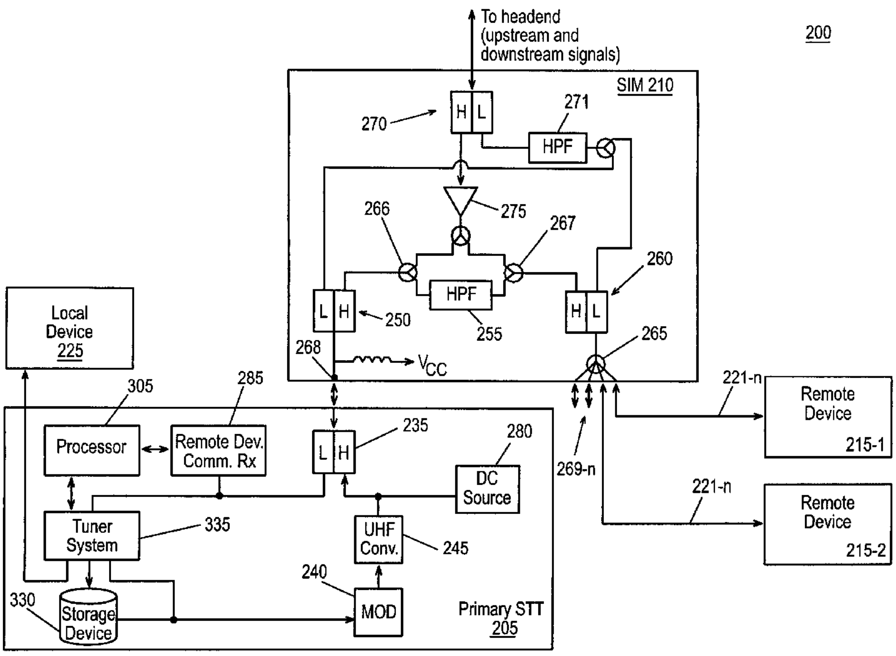

(57) Abstract: Systems and methods are disclosed for providing downstream signals to a plurality of receiver networks. A receiver network (i.e., a networked multimedia system) includes a splitter/isolation module (SIM), a primary set-top terminal (STT), and at least one remote device. The remote devices communicate with the primary STT via the SIM over coaxial cable. Accordingly, the remote devices utilize some or all of the features including hardware and software that are included in the the primary STT via the networked multimedia system.

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NETWORKED MULTIMEDIA SYSTEM

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CROSS-REFERENCE TO RELATED PATENT APPLICATIONS

The present application incorporates by reference in its entirety herein copending U.S. application having serial no.: 10/342,670, which was filed on January 15, 2003; copending U.S. provisional application having serial no.: 60/416,155, which was filed on October 4, 2002; and U.S. provisional application having serial no.: 60/424,269, which was filed on November 6, 2002. Also, the present application is a continuation-in-part of copending U.S. patent applications having serial nos.: 10/263,160, 10/263,449, and 10/263,270, which were filed on October 2, 2002 and are assigned to a common assignee, the teachings of which are hereby incorporated by reference.

FIELD OF THE INVENTION

This invention relates in general to broadband communications systems, and more particularly, to the field of set-top terminals and a networked multimedia system.

DESCRIPTION OF THE RELATED ART

Broadband communications systems, such as satellite and cable television systems, are now capable of providing many services in addition to analog broadcast video. In implementing enhanced programming, the set-top terminal (STT), otherwise known as the set-top box, has become an important computing device for accessing various video services. In addition to supporting traditional analog broadcast video functionality, many STTs now also provide other functionality, such as, for example, an interactive program guide (IPG), video-on-demand (VOD), subscription video-on-demand (SVOD) and functionality traditionally associated with a conventional computer, such as e-mail. Recently new functionality has been added to conventional STTs – namely the ability to video record an incoming video stream in digitized form onto a mass storage device such as a hard dish drive, and playback that recorded video as desired by the user. This functionality has become known as a "digital video recorder" (DVR) or personal video recorder (PVR) and is viewed as a superior alternative to conventional video tape recorders for capture and subsequent playback of programming content.

An STT is typically connected to a communications network (*e.g.*, a cable or satellite television network) and includes hardware and software necessary to provide various services and functionality. Preferably, some of the software executed by an STT is downloaded and/or updated via the communications network. Each STT also typically includes a processor, communication components, and memory, and is connected to a television or other display device. While many conventional STTs are stand-alone devices that are externally connected to a television, an STT and/or its functionality may be integrated into a television or other device, as will be appreciated by those of ordinary skill in the art.

An STT is typically connected to a television set and located at the home of the cable or satellite system subscriber. Since the STT is located in the subscriber's premises, it typically may be used by two or more users (*e.g.*, household members). Television has become so prevalent in the United States, however, that the typical household may have two or more television sets, each television set requiring its own STT if the subscriber wishes to have access to enhanced functionality. However, STTs can be expensive and users may not be willing to purchase additional expensive STTs. This is particularly true of STTs incorporating PVR functionality since such devices require not only the addition of a hard disk drive but also additional processing components and software.

Therefore, there exists a need for systems and methods for addressing these and/or other problems associated with STTs. Specifically, there exists a need for systems and methods that allow multiple subscribers operating discrete STTs within a subscriber premises or other local area to have access to programming and content received by and/or stored in another STT.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention can be better understood with reference to the following drawings. The components in the drawings are not necessarily drawn to scale, emphasis instead being placed upon clearly illustrating the principles of the invention. In the drawings, like reference numerals designate corresponding parts throughout the several views.

FIG. 1 is a simplified block diagram depicting a non-limiting example of a conventional broadband communications system.

FIG. 2 is a block diagram illustrating one preferred embodiment of a networked multimedia system (NMS) in accordance with the present invention.

FIG. 3 is a simplified, non-limiting block diagram illustrating selected components of a primary STT in accordance with one preferred embodiment of the present invention.

FIG. 4 illustrates an example of a graph of the frequencies of the downstream broadband signals and the predetermined frequencies of the up-converted selected signals.

FIG. 5 is a simplified diagram of one preferred embodiment of a remote STT device.

FIG. 6 is a block diagram illustrating one preferred embodiment of a QPSK transmitter that converts user input command signals into FSK signals for transmission to the splitter/isolation module (SIM).

FIG. 7 illustrates generation of an FSK signal for input serial data x(n) = [10010].

FIG. 8 illustrates a second embodiment of the present invention for transmitting reverse command signals as OOK signals over the coaxial cable to the SIM.

FIG. 9 illustrates a block diagram of a second embodiment of the SIM 210 comprising passive splitter/isolation components in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Preferred embodiments of the invention can be understood in the context of a broadband communications system and a local network. Note, however, that the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. For example, transmitted broadband signals include at least one of video/audio, telephony, data, or Internet Protocol (IP) signals, to name but a few. Furthermore, remote devices included in the broadband communications system receiving the transmitted broadband signals may include a remote set-top terminal, a television, a consumer electronics device such as a DVD player/recorder, a computer, a personal digital assistant (PDA), or other device. All examples given herein, therefore, are intended to be non-limiting and are provided in order to help clarify the description of the invention.

The present invention is directed towards a networked multimedia system (NMS) that is suitable for use in a broadband communications system. The NMS is typically located within a subscriber premise. It will be appreciated, however, that the NMS can also be used in a multi-unit dwelling, business, school, hotel, or hospital, among others. Advantageously, the NMS allows the premise to be locally networked (i.e., home-networked). In accordance with the present invention a primary set-top terminal (STT) typically receives and forwards broadband multimedia content signals (e.g., digital or analog cable television channels (i.e., audio/video signals), IP signals, VOD signals, software application signals, administrative signals, etc.) throughout the local network to a plurality of remote devices. Additionally, the remote devices are each capable of requesting from the primary STT and seamlessly receiving, for example, a cable channel, a stored or recorded presentation, a VOD movie, or the interactive program guide, just as if the remote devices were equipped with the primary STT functionality. In other words, the remote devices may be simplified, less-costly versions of the primary STT but are capable of utilizing, via the local network, some or all of the advanced hardware and software features, such as memory, a mass storage device, or software applications, that are available in the primary STT. A broadband communications system that is suitable in implementing a preferred embodiment of the present invention is described hereinbelow.

<u>An Example of a Broadband Communications System</u>

FIG. 1 is a simplified block diagram depicting a non-limiting example of a conventional broadband communications system 100. In this example, the communications system 100 includes a headend 110 that is coupled to a local network (LN) 101 via a communications network (CN) 130. The CN 130 may be any network that is suitable for transmitting preferably downstream and upstream broadband multimedia signals, such as audio/video signals, IP signals, telephony signals, or data signals to name but a few. The CN 130 may be, for example, a hybrid fiber/coax (HFC) network, a fiber-to-the-home (FTTH) network, a satellite network, or a fixed wireless network (e.g., MMDS), among others.

The LN 101 includes a set-top terminal (STT) 105 that provides the broadband signals to the remote devices 140-1 and 140-2, and, optionally, to additional remote devices including, for example, remote device 140-3. The STT 105 may be coupled to the remote devices either directly or via one or more other devices. It will be appreciated that the STT 105 may be a stand-alone unit or may be integrated into another device, such as, for example, a television or a computer. Additionally, the remote devices may be located in different rooms than where the STT 105 is located. Further information regarding the LN 101 is provided in copending U.S. Patent Application Nos.: 10/263,160; 10/263,270; and 10/263,449, which were filed on October 2, 2002, the disclosure and teachings of which are hereby incorporated in their entirety by reference.

The headend 110 may include one or more server devices (not shown) for providing video, audio, and/or data signals to the STT 105 via the CN 130. The headend 110 and the STT 105 cooperate to provide a user with a variety of services via the remote devices 140-i (e.g., 140-1, 140-2, and/or 140-3). The services may include, for example, analog or digital television services and channels, video-on-demand (VOD) services, and/or pay-per-view (PPV) services, among others. Each broadcast television channel typically provides a sequence of television presentations corresponding to a television station (e.g., ABC, NBC, CBS, or FNN, to name a few) and is typically identified by a channel number (e.g., channel 2, channel 3, channel 4, etc.). Additionally, a television station (e.g., the Fox News Network) that is identified by a certain channel number (e.g., channel 84) to viewers served by a first service provider may be identified by another channel number (e.g., channel 45) to viewers served by a second service provider.

A preferred embodiment of the present invention may be implemented in addition to or replacement of the local network 101 of FIG. 1. The present invention will now be described in detail.

FIG. 2 is a block diagram illustrating one preferred embodiment of a networked multimedia system (NMS) 200 in accordance with the present invention. The NMS 200 includes a master or primary STT 205, a splitter/isolation module (SIM) 210, and a plurality of remote devices, e.g., 215-1, 215-2, 215-n. It is to be noted that while the embodiment of FIG. 2 illustrates an NMS having but two remote devices, the invention is not so limited. Indeed, any number of such remote devices may be employed, consistent with the requirements and capabilities of the NMS, as described herein. Briefly, the SIM 210 receives downstream broadband signals from, for example, the headend or satellite and subsequently provides the downstream signals to the primary STT 205 or to both the primary STT 205 and any one or all of the plurality of remote devices 215-n depending on the implementation. Upon command, the primary STT 205 may also forward selected real-time downstream signals or stored signals to one or all of the remote devices 215-n via the SIM 210. More specifically, the plurality of remote devices 215-n communicates with the primary STT 205 by sending reverse control/command signals via coaxial cable 220, 221-n requesting stored presentations or real-time signals. It will be appreciated that other wired mediums, such as telephone lines or data cables, may be used so long as the transport format accommodates the desired transmission medium. Advantageously, in accordance with the present invention, the plurality of remote devices 215-n have access to all of the primary STT's hardware and software functionality, along with receiving downstream signals directly from the headend via the SIM 210. In this manner, the remote devices 215-n may have limited functionality, thereby decreasing the overall costs to the service provider and the subscriber while offering advanced services to all of the remote devices that are networked.

Furthermore, the primary STT 205 may also directly provide broadband signals to a coupled local device 225, which may be, for example, a television, computer, or PDA. It will be appreciated that the primary STT 205 may transmit signals to and receive control signals from the local device 225 via wireless devices (e.g., RF or IR devices) or a wired medium (e.g., coaxial cable, power lines, or telephone lines). It will also be appreciated that the primary STT 205 may be incorporated in the local device 225. The primary STT 205 optionally includes, for example, an IR receiver 368 (FIG. 3) for receiving user input control signals (e.g., signals indicating a channel change, IPG display, volume control, or administrative signals) that are encoded in an IR signal. Those of ordinary skill in the art would understand elements and operation of a typical IR receiver 368. Further information regarding the transmitting and receiving of signals between the primary STT and the coupled local device via wireless devices or a wired medium can be found in copending U.S. Patent Application No.: 10/008,581, the teachings of which are hereby incorporated by reference.

A Preferred Embodiment of the Primary STT 205

FIG. 3 is a simplified, non-limiting block diagram illustrating selected components of a primary STT 205 in accordance with one preferred embodiment of the present invention. In other embodiments, a primary STT 205 may include only some of the components shown in FIG. 3, in addition to other components that are not shown in

FIG. 3. The primary STT 205 has electronic components (e.g., processor 305, memory 310, etc.) that are coupled to a local interface 315, which can include, for example, one or more buses or other wired or wireless connections. The processor 305 is a hardware device for executing software, particularly that stored in memory 310. The processor 305 can be a custom-made or commercially available processor for executing software instructions. When the primary STT 205 is in operation, the processor 305 is configured to execute software stored within the memory 310, to communicate data to and from the memory 310, and to generally control operations of the primary STT 205 according to the software.

The memory system 310 may include any one or combination of volatile memory elements (e.g., random access memory (RAM), dynamic RAM (DRAM), static RAM (SRAM), synchronous DRAM (SDRAM), magnetic RAM (MRAM), etc.) and nonvolatile memory elements (e.g., read only memory (ROM), hard drive, tape, compact disc ROM (CD-ROM), etc.). Moreover, the memory system 310 may incorporate electronic, magnetic, optical and/or other types of storage multimedia. Note that the memory system 310 can have a distributed architecture, where various memory components are situated remotely from one another, but can be accessed by the processor 305.

The software in memory 310 may include one or more separate programs, each of which comprises executable instructions for implementing logical functions. In the example of FIG. 3, the software in memory 310 includes an operating system (OS) 320, a WatchTV application 321, a navigator application 322, a personal video recorder (PVR)/digital video recorder (DVR) application 323, a driver 324, a VOD application 325, and an IPG application 326, among others. The OS 320 controls the execution of other software and provides management and control services including, for example, scheduling, input-output control, file and data management, memory management, and communication control. The WatchTV application 321 is used to help provide a user with a requested broadcast television channel. The IPG application 326 provides an interactive program guide that mainly includes listings of television channels provided by the primary STT 205, but may also present additional services, such as an NMS interactive guide. The navigator application 322 is used to route user input commands to respective software applications that have registered with the navigator application 322 to receive the respective commands. The VOD application 325 provides a user with video-on-demand presentations, such as, for example, movies that are selected via an on-screen movie catalog. The PVR application 323 may provide user interface (UI) screens that can be used to manage (e.g., record, playback, and delete) the content of a storage device 330. Accordingly, the PVR application 323 may record or delete data from the storage device 330 with the help of a software driver 324, which controls read and write operations performed on the storage device 330. In one preferred embodiment, the storage device 330 includes a hard drive that reads from and writes to a hard disk. It will be appreciated that other software applications may be included in memory 310.

A tuner system 335 includes, in one implementation, an out-of-band tuner (not shown) for receiving out-of-band signals (e.g., administrative signals that were modulated using quadrature phase shift keying (QPSK)), and a plurality of in-band tuners 340-n (e.g., quadrature amplitude modulation (QAM)/analog tuners) for receiving analog and/or digital in-band television channels. Alternatively, the tuner system 335 may only include one in-band tuner depending on a desired implementation. A signal processing system 345 may be capable of demodulating, demultiplexing, decrypting, and decoding signals that are tuned to by the tuner system 335. Although shown as one module, the signal processing system may comprise multiple modules that are located in different parts of the primary STT 205. It will be appreciated that in the preferred embodiment of the present invention the number of tuners 340-n typically corresponds to at least the optional coupled local device(s) 225 and the storage device 330. Further information regarding adding additional tuners can be found in copending U.S. patent application serial no. 10/263,449, which was filed on October 2, 2002, the teachings of which are hereby incorporated by reference.

The primary STT 205 also includes an upstream transmitter 350 and a local transmitter 355. The upstream transmitter 350, which may alternatively be included in the tuner system 335, preferably includes a QPSK/QAM modulator (not shown) that is used to transmit the upstream data to the CN 130 (FIG. 1). The local transmitter 355 preferably includes a UHF (ultra high frequency) modulator for modulating, for example, a television channel that is output to the local device 255 (FIG. 2) through an optional interface 365, such as for example an Ethernet wireless device, depending on a desired implementation.

The primary STT 205 may also include an IR receiver 368, a remote device command receiver 285, and/or an RF receiver 375, which detect respective signals (IR, electric, or wireless RF) having encoded remote control commands requesting television services, channels, or other NMS services. In one embodiment, the remote device command receiver 285 may forward received remote control signals from the plurality of remote devices 215-n to the processor 305, which then, for example, routes the commands to respective applications for processing.

An output system 380 may be used to encode television services that are to be output to, for example, local device 225 (FIG. 2), which may be a television or computer, via the connection 111. The output system 380 may provide a television 225 with signals that are in, for example, NTSC (National Television Standard Committee) format. In another embodiment, if the television 225 is a digital television, for example, a high definition television (HDTV), then the output system may include an MPEG (Motion Picture Expert Group) encoder for encoding television service signals in an MPEG-2 format. It will be appreciated that the primary STT 205 may also provide multimedia content signals to other remote devices (e.g., a computer, a remote set-top terminal, or a PDA) located in the network, such as illustrated in FIG. 1.

Referring to FIG. 2 in conjunction with FIG. 3, the primary STT 205 receives via the SIM 210 downstream broadband signals (i.e., signals that are typically in the range from 45 MHz to 870 MHz). A low pass filter in diplex filter 235 provides the downstream signals to the tuner system 335 and the remote device command receiver 285. Upon command from the processor 305, the tuner system 335 may send the downstream signals to any local devices 225, the storage device 330 for optional storage, and additionally to a modulator 240. More specifically, the processor 305 instructs the tuner system 335 to extract specified content signals from the downstream signals. By way of example, a tuner 340 responsive to the coupled local device 225 provides selected content signals directly to the local device 225. The tuner 340 or a plurality of tuners 340-n that are responsive to a remote device 215-n via the processor 305 may forward selected real-time presentations directly to the modulator 240 for transmission to the plurality of remote devices 215-n. Furthermore, upon user input from the primary STT 205 or any one of the remote devices 215-n, the processor 305 may instruct the tuner system 335 to provide content presentations to the storage device 330 for storage. The stored presentations are subsequently available for forwarding to any of the remote devices 215-n and/or the local device 255 upon instruction from the processor 305. User input signals will be discussed in further detail hereinbelow relating with a preferred embodiment of the remote devices 215-n.

In accordance with the present invention, the modulator 240 modulates the selected content signals (i.e., NMS presentations) provided from either the tuner system

335 or the storage device 330 prior to forwarding to the SIM 210. For example, a preferred embodiment of the present invention uses a QAM modulator, which may be used for effectively transmitting signals over coaxial cable in a cable television environment. Other embodiments may include a QPSK modulator in a satellite environment, an 8VSB (8-vestigial sideband) modulator in a digital terrestrial environment in the U.S., and a COFDM (coded orthogonal frequency division multiplexing) modulator in a digital terrestrial environment in Europe, or alternatively an analog modulator. The modulator 240 converts the signals to a predetermined intermediate frequency. Subsequently, the modulated presentations are up-converted to a predetermined higher frequency that is preferably greater than the highest frequency used in the system with, for example, a UHF converter 245. FIG. 4 illustrates an example of a graph of the conventional frequencies of the downstream broadband signals 403 and the predetermined frequencies of the up-converted NMS presentations 405. A preferred embodiment of the present invention is to up-convert the NMS presentations to an available high frequency channel, for example, channel 134, which may have a frequency range from 852 MHz to 858 MHz. The service provider, therefore, would provide downstream signals in the range from 45 MHz to approximately 840 MHz, thereby leaving frequencies greater than 840 MHz available for the transmission of NMS presentations. Accordingly, the NMS presentations 405 do not interfere with the downstream signals that may be concurrently provided via the common coax 220, 221-n to the primary STT 205 and the remote devices 215-n. It will be appreciated that other frequency ranges can be used that are either in-band (e.g., from 45MHz to 860 MHz) or out-of-band (e.g., from 865 MHz to 1 GHz) so long as the predetermined frequency range is not used for transmission of the downstream signals or is within the range that is tunable by the plurality of remote devices 215-n. The up-converted NMS presentations are subsequently provided to the SIM 210 via a high pass filter in the diplex filter 235.

Furthermore, the remote device command receiver 285 is included in the primary STT 205 for receiving reverse NMS command signals from the plurality of remote devices 215-n. Command signals will be discussed further hereinbelow; however, the command signals can be transmitted in the form of on-off keying (OOK) signals, frequency shift keying (FSK) signals, or serial data transmissions, among others. The remote device command receiver 285, therefore, includes the respective demodulator, such as an OOK demodulator or an FSK demodulator that demodulates the signals as known to one skilled in the art.

Additionally, an optional DC source 280, which may supply, for example, 12 to 15 volts (V) and 200 milliamps (mA), may be provided to power an amplifier 275 located the SIM 210, if necessary. If required, the amplifier 275 amplifies the downstream signals received from the CN 130. It will be appreciated that if the SIM 210 is a passive splitter/isolation module, the DC source 280 is not necessary.

Preferred Embodiments of the SIM 210

Referring again to FIG. 2, the selected NMS presentations are provided by the primary STT 205 to the SIM 210 via the coaxial cable 220. In a first embodiment of the SIM 210, the selected NMS presentations are routed to the plurality of remote devices 215-n via a diplex filter 250. A splitter 266 provides the NMS presentations to HPF 255, which subsequently provides the filtered NMS presentations to splitter 267, diplex filter 260, and splitter 265. The high pass filter (HPF) 255 has low attenuation at the frequencies of the NMS presentation and high isolation at lower frequencies, and thus, provides high isolation between port 268 and ports 269-n at these lower frequencies. It will be appreciated that a bandpass filter (BPF) can alternatively be used depending on the transmission frequencies of the NMS presentations. Splitter 265 provides the NMS presentations to the plurality of remote devices 215-n. It will be appreciated that, at the frequencies of the NMS presentations, splitters 266 and 267 provide low insertion loss between port 268 and the splitter 265, thereby ensuring the NMS presentations are routed to the plurality of remote devices 215-n. Additionally, in an active SIM 210, the amplifier 275 further prevents the NMS presentations from reaching the CN 130.

Moreover, diplex filters 250 and 270 provide a path for upstream signals from the primary STT 205 to the headend. Similarly, diplex filters 260 and 270 provide a path for upstream signals from the plurality of remote devices 215-n to the headend. A high pass filter 271 allows any upstream signals (e.g., signals ranging from 5 MHz to 45 MHz) to pass through to the diplex filter 270 on to the CN 130. It will be appreciated that the reverse signals intended to remain in the NMS 200, such as reverse command signals from the remote devices 215-n, are reflected back and routed to the primary STT 205. Furthermore, the SIM 210 receives the downstream broadband signals from the headend 110 at diplex filter 270, which provides the downstream signals to the primary STT 205 or, alternatively, to both the primary STT 205 and the plurality of remote devices 215-n.

FIG. 9 illustrates a block diagram of a second embodiment of a SIM 210 comprising passive splitter/isolation components in accordance with the present invention. More specifically, the NMS presentations from the primary STT 205 are provided to SIM 210 via port 268. A band reject filter (BRF) 910 rejects the frequencies of the selected NMS presentations (e.g., from 852 MHz to 858 MHz), thereby not allowing the presentations to leave the network 200. It will be appreciated that the NMS presentations are reflected off the BRF 910 and routed to the splitter 265 for transmission to the plurality of remote devices 215-n. It will be appreciated that there is a high insertion loss between a SIM port 269-n and the primary STT input port 268 at all other frequencies. A high pass filter (HPF) 915 is included to ensure that the reverse command signals provided by the plurality of remote devices 215-n are reflected and routed to the primary STT 205 and not transmitted to the CN 130.

Notably, the preferred embodiments of the SIM 210 provide protection against any of the reverse command signals from leaving the NMS 200, thereby ensuring proper delivery to the primary STT 205 while also avoiding any interference with separate networked multimedia systems that may be in close proximity. A further advantage is that the SIM 210 enhances privacy and security by making the NMS 200 unobservable to any upstream devices in the CN 130.

A Preferred Embodiment of a Remote Device 215-n

FIG. 5 is a simplified diagram of one preferred embodiment of a remote STT device 215-n. It will be appreciated that the remote devices 215-n may be identical to the primary STT 205 and just share the storage device contents of the primary STT 205. Alternatively, the remote devices 215-n may be a simplified or conventional version of the primary STT 205. A processor 305 and a tuner system 335, which may be a simplified processor and only one tuner, may be included to extract channels from the received downstream broadband signals. Additionally, decryptors and decoders (not shown) may be included to decode encoded signals for proper processing and display. Furthermore, the remote devices 215-n may or may not include memory. Preferably, the remote devices 215-n include a user input receiver 368, such as an IR receiver or an RF receiver, that receives signals from a remote control, such as an IR remote control or an RF remote control. It will be appreciated that the remote control 505 is not required, and any user input device could be incorporated in the remote devices 215-n.

As mentioned, the reverse command signals, which typically originate from user input signals (e.g., tuned channels, NMS functions, or IPG display) or generated administrative signals (e.g., turn-on signals), could be processed using various methods depending upon the type of remote control used. By way of example, if an RF remote control is used, the RF signals could be modulated to a desired frequency that does not interfere with any downstream or upstream signals that are transmitted via the common coaxial cable 221-n. There may be, however, RF interference issues between the remote control and other RF devices in the area. Alternatively, if an IR remote control device is used, RF interference is not an issue. The IR signals do, however, require modulation with a carrier frequency and subsequently multiplexed onto the coaxial cable 221-n. Accordingly, this will prevent the requirement of running separate reverse command transmission media to accommodate the serial data streams, such as twisted pair cable, from each remote device 215-n to the SIM 210. It will be appreciated that if the user input signals indicate non-NMS signals, for example, a channel change or volume change, the remote device 215-n processes and performs the operation internally. In other words, these types of user input signals are not routed throughout the NMS 200.

Notably, in accordance with the present invention, the reverse command signals are transmitted via the coaxial cable 221-n that is routed between each remote device 215-n and the SIM 210. A preferred embodiment of the present invention processes and transmits the reverse command signals that are indicative of user input commands using frequency shift keying (FSK) and utilizes existing components that are typically included in a conventional remote set-top terminal. As mentioned, a QPSK modulator is typically included in the upstream transmitter 350 for modulating conventional upstream signals, which are signals ranging from 5 MHz to 40 MHz, for transmission to the headend and, in accordance with the present invention, for modulating the reverse command signals that are routed throughout the NMS 200. Preferably, the existing QPSK modulator modulates the reverse command signals to an FSK signal at a frequency that is below the conventional upstream signals (i.e., below 5 MHz). In this manner, the reverse command signals do not interfere with conventionally transmitted upstream signals that may be provided from the remote devices 215-n.

FIG. 6 is a block diagram illustrating one preferred embodiment of a QPSK transmitter 600 that converts user input command signals into FSK signals for transmission to the SIM 210. The user input command signals, such as a channel change, request for an IPG display, request for a stored presentation, etc., are presented from the user input receiver 368 to the QPSK transmitter 600 as serial data. In conventional QPSK transmitters, the input serial data is converted to parallel signals (A, B), and the parallel signals are subsequently mapped directly to a phase change $\Delta\varphi$ by a differential encoder. An example is shown in Table 1.

Input Serial Data A B	$\Delta\varphi$
0 0	0
0 1	$+\pi/2$
1 0	$-\pi/2$
1 1	π

Table 1

The output of the conventional QPSK transmitter is, therefore, a QPSK modulated output signal. Disadvantageously, however, the receiving equipment, such as would be required in the primary STT 205, is complex and expensive. On the other hand, the present invention includes a precoder 605 that precodes the input serial data to generate a frequency shift keyed signal, thereby requiring a less complex, inexpensive receiver in the primary STT 205.

In accordance with the present invention, the precoder 605 operates on the input serial data to produce, for example, 2 symbols for each input bit. By way of example, the input serial data, x(n), may be changed to output serial data, x'(n), as follows:

when x(n) = 1: x'(n) = [01 01]; and

when x(n) = 0: x'(n) = [10 10],

where the sample time of the input x is, in this example, 4 times that of the output x'. For x(n) = 1, therefore, the precoder 605 generates two symbols with each symbol producing a phase change of $+\pi/2$ (as shown in Table 1), and a total phase change of π. Similarly, for x(n) = 0, the precoder 605 generates two symbols with each symbol producing a phase change of $-\pi/2$, and a total phase change of $-\pi$. It will be appreciated that the output serial data, x'(n), may be any arbitrary number of symbols, such as four symbols for an input bit, and the phase changes may be different than shown in Table 1 so long as the change is significant enough that the FSK demodulator in the command receiver 285 in the primary STT 205 can detect the change in frequency. Additionally, the precoder 605 does not have to be a dedicated piece of hardware; the precoder 605 can be used elsewhere within the remote terminal 215-n. Furthermore, the precoder 605 can be, for example, a look-up table that is stored in memory, or it can be hardware, such as logic gates. The precoded signals are provided to a serial-to-parallel (S/P) converter 610 for providing parallel signals (A, B). A differential encoder 615 receives the A and B bits and encodes them according to the phase changes shown in the example Table 1 to provide mapped I and Q bits. An optional filter 620 may be used to shape the I/Q pulse. A carrier frequency is modulated by the I and Q bits via a QPSK modulator 625 to provide the FSK output signals at a desired frequency, such as, for example, in the range from 2 MHz to 4.5 MHz.

It will be appreciated that the QPSK transmitter 600 may be enabled only when there are reverse command signals being transmitted, thereby enabling a way of preventing collisions between remote devices 215-n. Further embodiments of collision avoidance will be discussed further below. Additionally, the remote command signals may be encrypted and, therefore, decrypted accordingly in the command receiver 285. Further information regarding encryption/decryption can be found in copending U.S. patent application 10/154,495, which was filed on May 24, 2002 and is assigned to a common assignee, the teachings of which are hereby incorporated by reference.

FIG. 7 illustrates generation of an FSK signal for input serial data x(n) = [10010]. Graph 7(a) illustrates the phase vs. the time over the duration of each symbol, which is shown to be linear, however, this is not required. As per the previous example, x(1) = [01 01], which corresponds to a total phase change of $+\pi$. The next input serial bit, x(0), is converted to [10 10], which corresponds to a total phase change of $-\pi$. Similarly, the next input serial bit, x(0), corresponds to a total phase change of $-\pi$, and so forth. As can be seen, graph 7(b) illustrates a single positive value when x(n) = 1, and a single negative value when x(n) = 0. This constitutes the FSK signal. Note that, since the phase of the signal is continuous, the FSK signal generated may be designated as a continuous-phase FSK signal (CPFSK). It will be appreciated that there are further embodiments of an FSK transmitter. By way of example, an FSK transmitter could include a direct digital frequency synthesizer with two selectable frequency words.

FIG. 8 illustrates a second embodiment of the present invention for transmitting reverse command signals as OOK signals over the coaxial cable 221-n to the SIM 210. An on-off keying (OOK) inserter device 805 is either internally or externally added to the conventional remote device 215 for producing a modulated serial data stream that is suitable for transmission over coaxial cable. A logic gate 810 receives the serial data stream, which is indicative of the user input command signals, and an oscillator 815 provides an oscillated input signal at a specified frequency, such as 2 MHz. The logic gate 810 essentially gates the serial data stream to provide a modulated signal according to the user input signals for transmission over the coaxial cable 221-n.

Referring again to FIG. 2, the reverse command signals from each of the plurality of remote devices 215-n are provided to the primary STT 205 via the diplex filters 260, 250 in the SIM 210. The remote device command receiver 285 receives the reverse command signals and instructs the primary STT 205 to provide return NMS presentations accordingly. A preferred embodiment of the command receiver 285 includes an FSK demodulator. It will be appreciated, however, that the receiver 285 can include any demodulator that is in accordance with the reverse command signal transmission technique.

After processing, the command receiver 285 sends signals indicative of the reverse command signal to the processor 305. By way of example, if a remote device 215-n requests the latest IPG or a list of the stored presentations, the processor 305 accesses the IPG display or the list via the navigational interface 322, which subsequently forwards the IPG or the list to the requesting remote device 215-n. The remote device 215-n may then, upon user input, select a presentation from the IPG or the stored presentations. For example, upon receipt of the reverse command signals indicative of a selected stored presentation, the processor 305 extracts the selected presentation from the storage device 330 and transmits the presentation to the remote device 215-n via the modulator 240. The remote device 215-n tunes to the modulator frequency and waits for the response (i.e., the stored presentation). Notably, in accordance with the present invention a remote device 215-n that views a stored presentation is capable of utilizing advanced features via the primary STT 205, such as play, pause, fast-forward, or rewind functions, with the selected presentation. More specifically, a remote device 215-n receives user input indicating one of the play, pause, fast-forward, or rewind signals and forwards the reverse command signals indicative of the user input signals to the primary STT 205. The processor 305 subsequently performs the function relating to the user input signals on the stored presentation that is being viewed, such as, for example, pausing transmission of the stored presentation until further commands are received.

A further example is a remote device 215-n that requests a video-on-demand (VOD) presentation from a headend server via the primary STT 205. It will be appreciated that if the remote device 215-n is a broadcast-only device, it is incapable of transmitting upstream signals to the headend. In this case and in accordance with the present invention, the broadcast-only device 215-n may transmit reverse command signals to the primary STT 205, which acts as a gateway device. Subsequent to processing the command signals, the primary STT 205 may transmit upstream signals that are indicative of the command signals to the headend server. For instance, the remote device 215-n selects a presentation from a displayed VOD list and transmits the reverse command signals to the primary STT 205. The primary STT 205 processes the signals and subsequently transmits upstream signals to the headend server requesting the particular VOD presentation. The VOD presentation is then transmitted along with the downstream signals to the primary STT 205, which may optionally store the presentation on the storage device 330, and, either concurrently or subsequently, forward the VOD presentation to the requesting broadcast-only remote device 215-n. Alternatively, the requesting remote device 215-n can extract the VOD presentation with an included tuner from the downstream signals using, for example, a predetermined channel frequency or other identifying convention.

Collision avoidance between the remote devices 215-n can be significantly improved in several ways. A preferred embodiment of the present invention, however, utilizes the asynchronous input data bits as an inexpensive way to transmit the reverse command signals from the plurality of remote devices 215-n to the primary STT 205. More specifically, the user input data is a sequence of asynchronous characters called a cell. Each cell contains a preamble, which is followed by several characters. The characters include, for example, one start bit, eight data bits, and one stop bit. An example may be that a low logical level represents a start bit or a data bit 0; a high logical level represents a stop bit or data bit 1. The eight data bits are the reverse command signals. After modulation by the QPSK transmitter 600, the FSK asynchronous signals are provided to the primary STT 205. A demodulator (not shown) included in the command receiver 285 demodulates the signals and provides the demodulated signals to a universal asynchronous receiver/transmitter (UART) (not shown) for framing into data bytes using the asynchronous characters. Advantageously, by using the asynchronous data, the command receiver 285 does not need time to synchronize with a remote device's reference clock. It will be appreciated that other collision avoidance and collision recovery methods exist and can replace or further enhance the above-described embodiment of the present invention. These methods are known to one skilled in the art.

It should be emphasized that the above-described embodiments of the invention are merely possible examples, among others, of the implementations, setting forth a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiments of the invention without departing substantially from the principles of the invention. All such modifications and variations are intended to be included herein within the scope of the disclosure and invention and protected by the following claims. In addition, the scope of the invention includes embodying the functionality of the preferred embodiments of the invention in logic embodied in hardware and/or software-configured mediums.

What is claimed is:

CLAIMS

1. A network system, comprising:

a primary set-top terminal (STT) for receiving downstream signals from a communications network and for selectively storing presentations included in the downstream signals, the primary STT comprising:

a tuner system for providing tuned signals;

a modulator for modulating the tuned signals to a predetermined frequency and for providing modulated signals; and

a plurality of remote devices coupled to the primary STT, each remote device for receiving the downstream signals and for selecting and receiving a tuned modulated signal,

wherein the tuner system is responsive to a processor, and wherein the processor is responsive to one of the plurality of remote devices.

2. The network system of claim 1, wherein the primary STT further includes a storage device for storing the presentations, and wherein the tuned modulated signal includes a stored presentation.

3. The network system of claim 1, wherein the modulator is one of a QAM modulator, a QPSK modulator, a 8VSB modulator, and a COFDM modulator.

4. The network system of claim 1, further comprising a splitter/isolation module (SIM) for receiving the downstream signals and for providing the downstream signals to at least one of the primary STT and the plurality of remote devices, and for receiving upstream signals from at least one of the primary STT and the plurality of remote devices and providing the upstream signals to the communications network.

5. The network system of claim 4, wherein the SIM receives the tuned modulated signal and provides the tuned modulated signal to the plurality of remote devices, and wherein the SIM receives at least one reverse command signal provided by the plurality of remote devices and provides the at least one reverse command signal to the primary STT.

6. The network system of claim 5, wherein the upstream signals are transmitted in a plurality of upstream frequencies, and wherein a reverse frequency of the at least one reverse command signal is excluded from the plurality of upstream frequencies.

7. The network system of claim 1, wherein each of the plurality of remote devices communicates with the primary STT by transmitting at least one reverse command signal via coaxial cable.

8. The network system of claim 7, wherein the at least one reverse command signal is transmitted in an OOK format.

9. The network system of claim 7, wherein the at least one reverse command signal is transmitted in an FSK format.

10. The network system of claim 9, wherein a QPSK transmitter transmits the at least one reverse command signal in the FSK format, the QPSK transmitter comprises:

a precoder for precoding the at least one reverse command signal,

a serial-to-parallel converter for providing a parallel precoded signal,

an encoder for encoding the parallel precoded signal into I and Q bits, and

a QPSK modulator for modulating the I and Q bits into the FSK format.

11. The network system of claim 1, wherein the downstream signals are transmitted in a plurality of downstream frequencies, and wherein the predetermined frequency of the tuned modulated signal is excluded from the plurality of downstream frequencies.

12. The network system of claim 1, wherein the tuned modulated signal is one of a stored presentation, a VOD presentation, an IPG application, an NMS application, and a television channel.

13. The network system of claim 1, wherein a remote device includes at least one tuner for tuning to a presentation included in the downstream signals.

14. A broadband communications system for transmitting downstream signals having a downstream frequency range and upstream signals having an upstream frequency range, the broadband communications system including a headend, a communications network, and a plurality of receiver networks, a receiver network comprising:

a splitter/isolation module (SIM) having an input port and a plurality of output ports, the SIM for receiving downstream signals at the input port and for outputting the downstream signals to at least one of the plurality of output ports, and for receiving at the plurality of output ports a plurality of upstream signals and for outputting the plurality of upstream signals at the input port ;

a primary set-top terminal (STT) coupled to one of the plurality of output ports for receiving the downstream signals, and for providing one of the plurality of upstream signals, the primary STT including a tuner system for providing at least one tuned presentation; and

at least one remote device coupled to another of the plurality of output ports, the at least one remote device in communication with the primary STT, the at least one remote device for receiving the downstream signals, the at least one remote device for selecting and receiving the at least one tuned presentation.

15. The broadband communications system of claim 14, the receiver network further including a local device coupled to the primary STT for receiving the tuned presentation, wherein the local device provides the tuned presentation to a viewing display.

16. The broadband communications system of claim 14, the primary STT further including a modulator coupled to the tuner system, the modulator for modulating the at least one tuned presentation to a predetermined frequency.

17. The broadband communications system of claim 16, wherein the primary STT further includes a storage device for storing the at least one tuned presentation.

18. The broadband communications system of claim 17, wherein the storage device, upon command from a processor, provides a stored presentation to the modulator for modulation and transmission to the at least one remote device.

19. The broadband communications system of claim 18, wherein the at least one remote device can perform, via the primary STT, play, pause, fast-forward, rewind, and stop functions on the received stored presentation.

20. The broadband communication system of claim 16, wherein the predetermined frequency is excluded from the downstream frequency range.

21. The broadband communications system of claim 14, wherein the at least one remote device provides reverse command signals having a reverse frequency requesting the tuned presentation, and wherein the reverse frequency is excluded from the upstream frequency range.

22. The broadband communications system of claim 17, wherein the primary STT further includes a processor for controlling the tuner system and the storage device.

23. A method for providing a networked multimedia system comprising the steps of:

receiving downstream signals having a downstream frequency range at a primary STT and a plurality of remote devices;

providing the downstream signals via a tuning system located in the primary STT to at least one of a coupled local device, a storage device, and a modulator;

receiving a reverse command signal having a reverse frequency at the primary STT provided by at least one of the plurality of remote devices;

processing the reverse command signal and extracting a presentation indicative of the reverse command signal from one of the downstream signals and the storage device;

modulating the extracted presentation to a modulation frequency; and

transmitting the modulated presentation to the at least one of the plurality of remote devices.

24. The method of claim 23, further comprising the step of providing upstream signals having an upstream frequency range to a headend via a communications network provided by the primary STT, wherein the reverse frequency of the reverse command signal is excluded from the upstream frequency range.

25. The method of claim 24, wherein the modulation frequency is excluded from the downstream frequency range.

26. The method of claim 23, wherein the reverse command signal is transmitted in an FSK format.

27. The method of claim 23, wherein the reverse command signal is transmitted in an OOK format.

28. A method for providing a networked multimedia system, the networked multimedia system including a primary STT, a splitter/isolation module (SIM), and a plurality of remote devices, the method comprising the steps of:

at at least one of the plurality of remote devices,

receiving user input signals that are indicative of a selected presentation;

processing the user input signals to determine whether the selected presentation is indicative of one of a downstream signal and a stored presentation; and

transmitting the user input signals that are indicative of the stored presentation to the primary STT via the SIM; and

at the primary STT,

processing the user input signals;

extracting the stored presentation;

modulating the extracted stored presentation to a predetermined frequency; and

transmitting the stored presentation to the at least one of the plurality of remote devices.

29. The method of claim 28, further comprising the steps of:

at the primary STT,

receiving the downstream signal; and

storing presentations included in the downstream signal in a storage device.

30. A method for providing an interactive network, the interactive network including a headend facility for transmitting and receiving interactive signals over a communications network to a network multimedia system, the network multimedia system including a gateway device, a splitter/isolation module (SIM), and a plurality of client devices, the method comprising the steps of:

at at least one of the plurality of client devices,

receiving user input signals that are indicative of a selected presentation;

processing the user input signals to determine whether the selected presentation is indicative of one of a broadcast content, a stored presentation, and a headend server presentation; and

transmitting reverse command signals indicative of one of the stored presentation and the headend server presentation to the gateway device via the SIM;

at the gateway device,

processing the reverse command signals to determine whether the selected presentation is one of the stored presentation and the headend server presentation; and

transmitting the processed headend server presentation to the headend facility via the communications network; and

at the headend facility,

processing and extracting the content presentation that is indicative of the headend server presentation; and

forwarding the content presentation to the at least one of the plurality of client devices.

31. The method of claim 30, further comprising the steps of:

subsequent to determining the selected presentation is the stored presentation,

extracting the stored presentation from a storage device;

modulating the stored presentation at a predetermined frequency; and

transmitting the modulated stored presentation to the plurality of client devices via the SIM.

32. The method of claim 30, further comprising the steps of:

at the gateway device,

receiving the broadcast content;

upon input, tuning a selected presentation included in the broadcast content; and

providing the tuned presentation to one of a local device, a storage device, and a modulator.

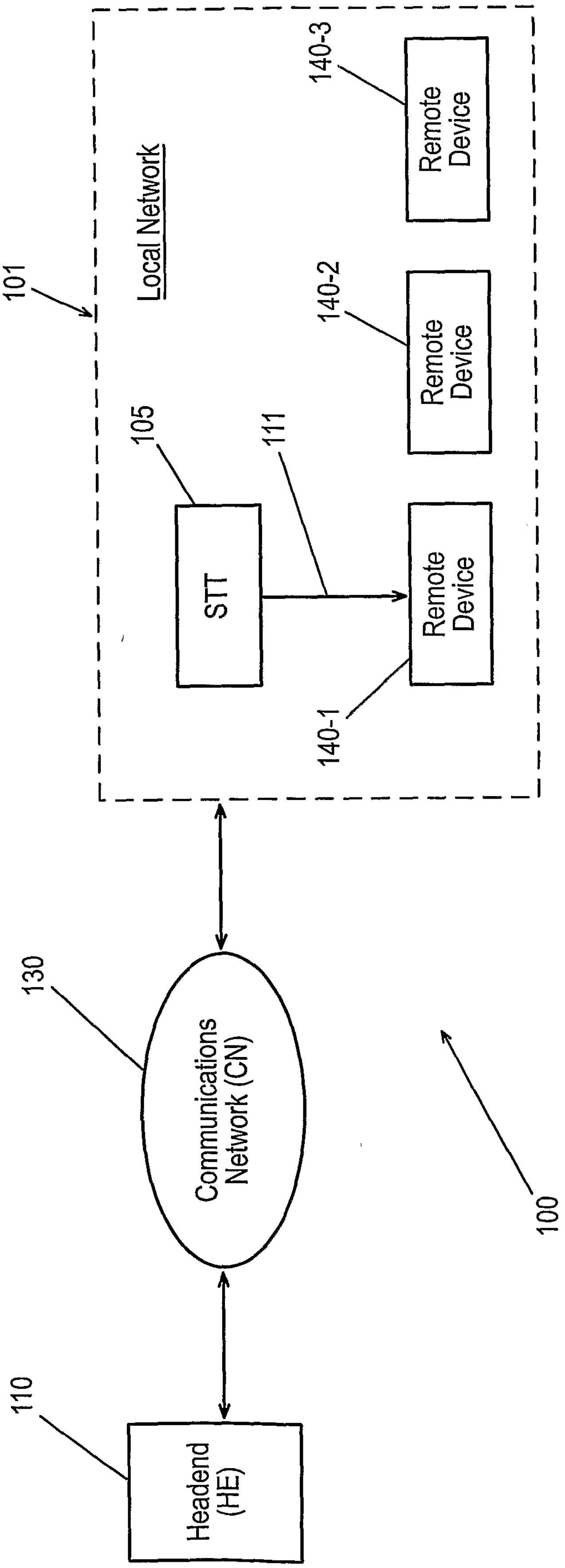

Fig. 1
(Prior Art)

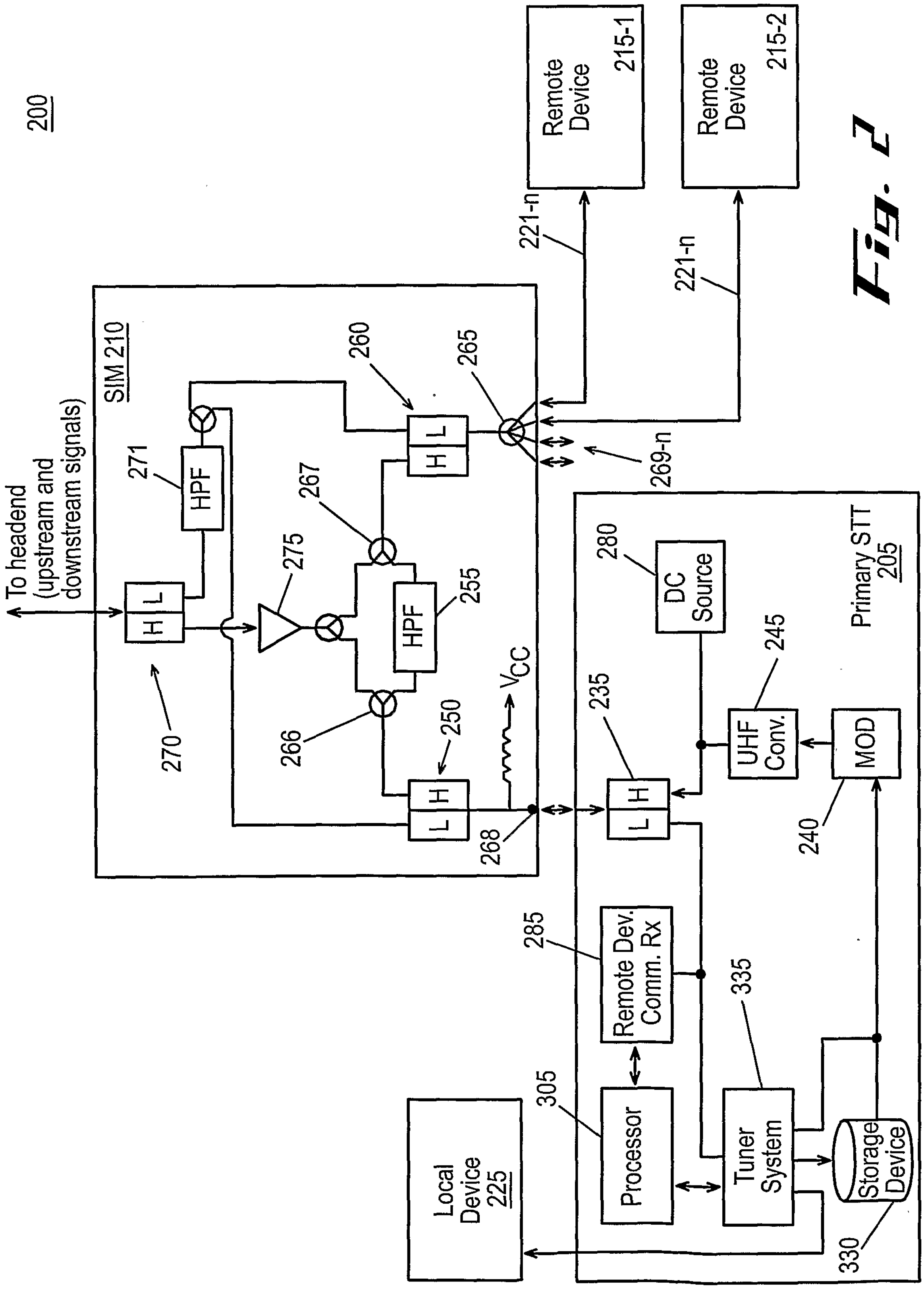
200
To headend (upstream and downstream signals)
SIM 210
H L
HPF
271
270
275
HPF
255
266
267
260
265
250
Vcc
268
269-n
221-n
221-n
Remote Device 215-1
Remote Device 215-2
Primary STT 205
DC Source
280
UHF Conv.
245
MOD
240
235
Remote Dev. Comm. Rx
285
335
Processor
305
Tuner System
Storage Device
330
Local Device 225

Fig. 2

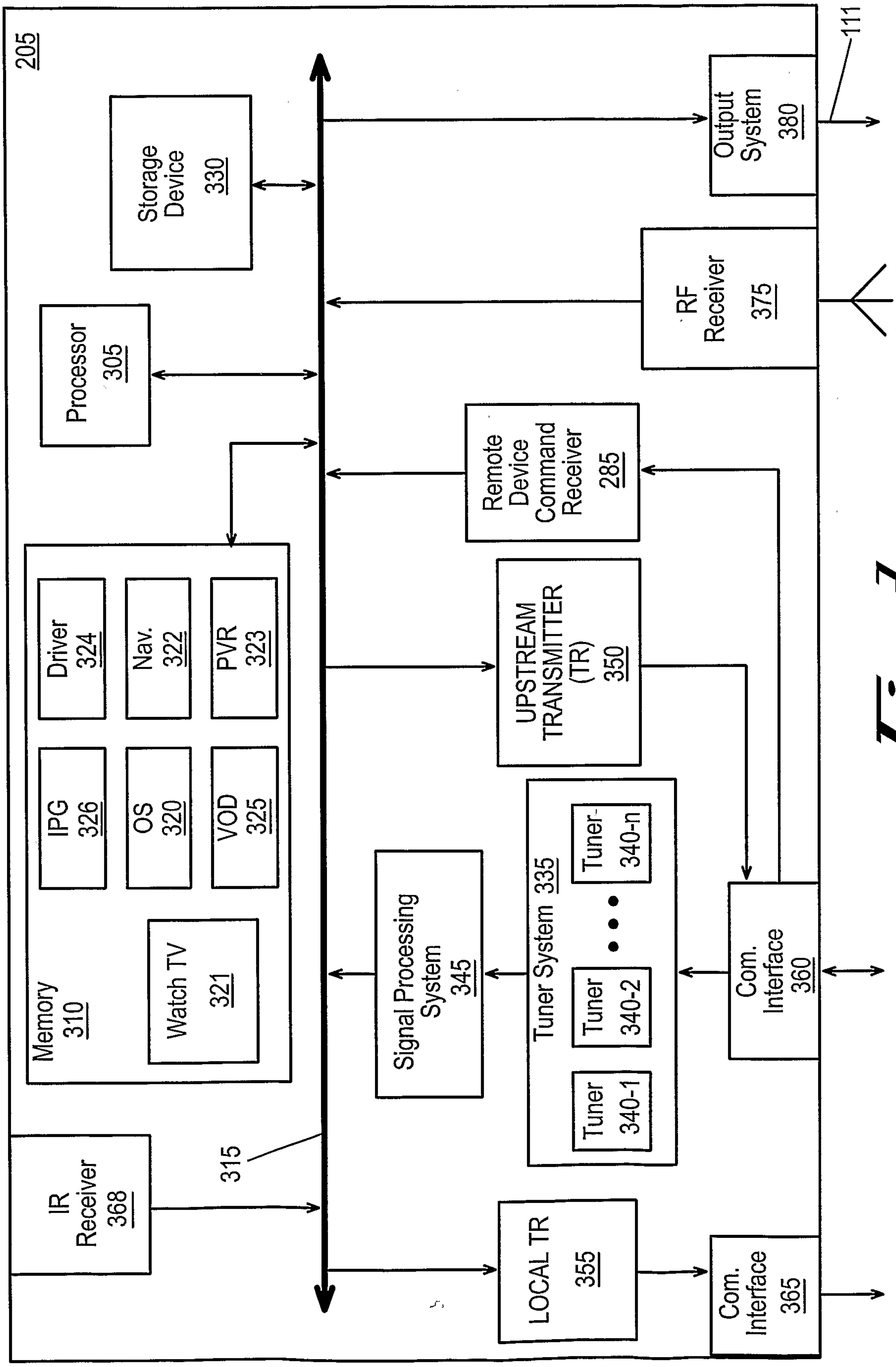
205
Storage Device 330
Processor 305
Memory 310
Driver 324
Nav. 322
PVR 323
IPG 326
OS 320
VOD 325
Watch TV 321
IR Receiver 368
315
Output System 380
111
RF Receiver 375
Remote Device Command Receiver 285
UPSTREAM TRANSMITTER (TR) 350
Signal Processing System 345
Tuner System 335
Tuner-340-n
Tuner 340-2
Tuner 340-1
Com. Interface 360
LOCAL TR 355
Com. Interface 365

Fig. 3

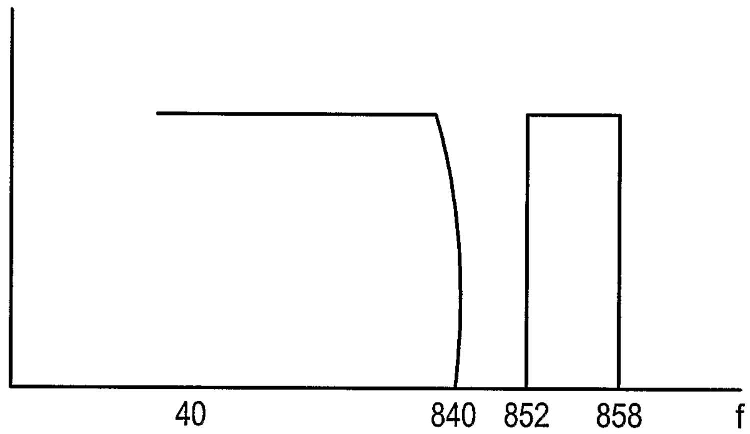

Fig. 4

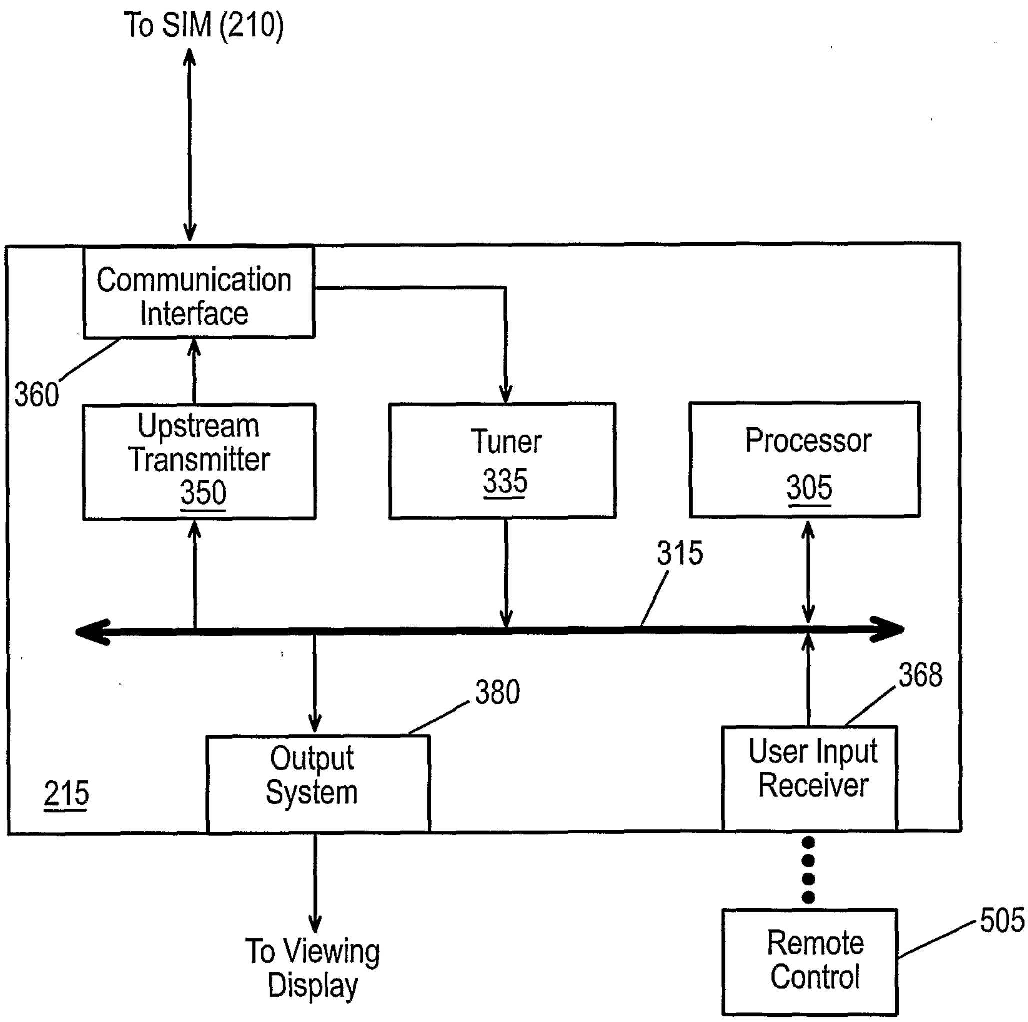
To SIM (210)
Communication Interface
360
Upstream Transmitter 350
Tuner 335
Processor 305
315
380
368
Output System
User Input Receiver
215
To Viewing Display
Remote Control
505

Fig. 5

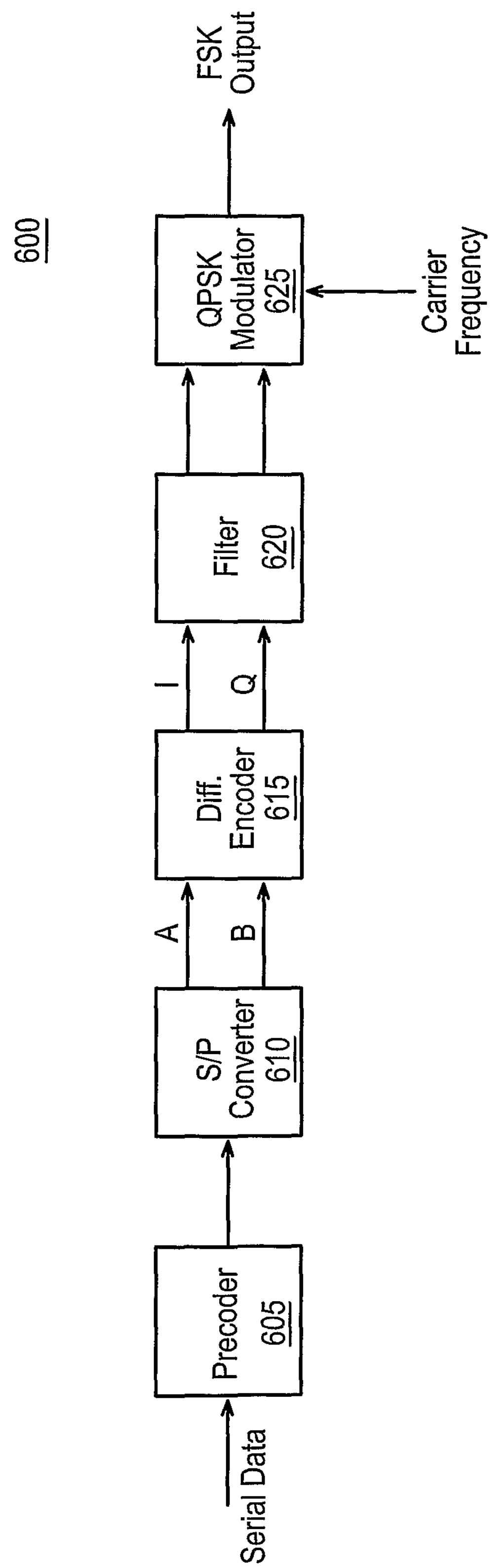
600
Serial Data
Precoder
605
S/P
Converter
610
A
B
Diff.
Encoder
615
I
Q
Filter
620
QPSK
Modulator
625
Carrier
Frequency
FSK
Output

Fig. 6

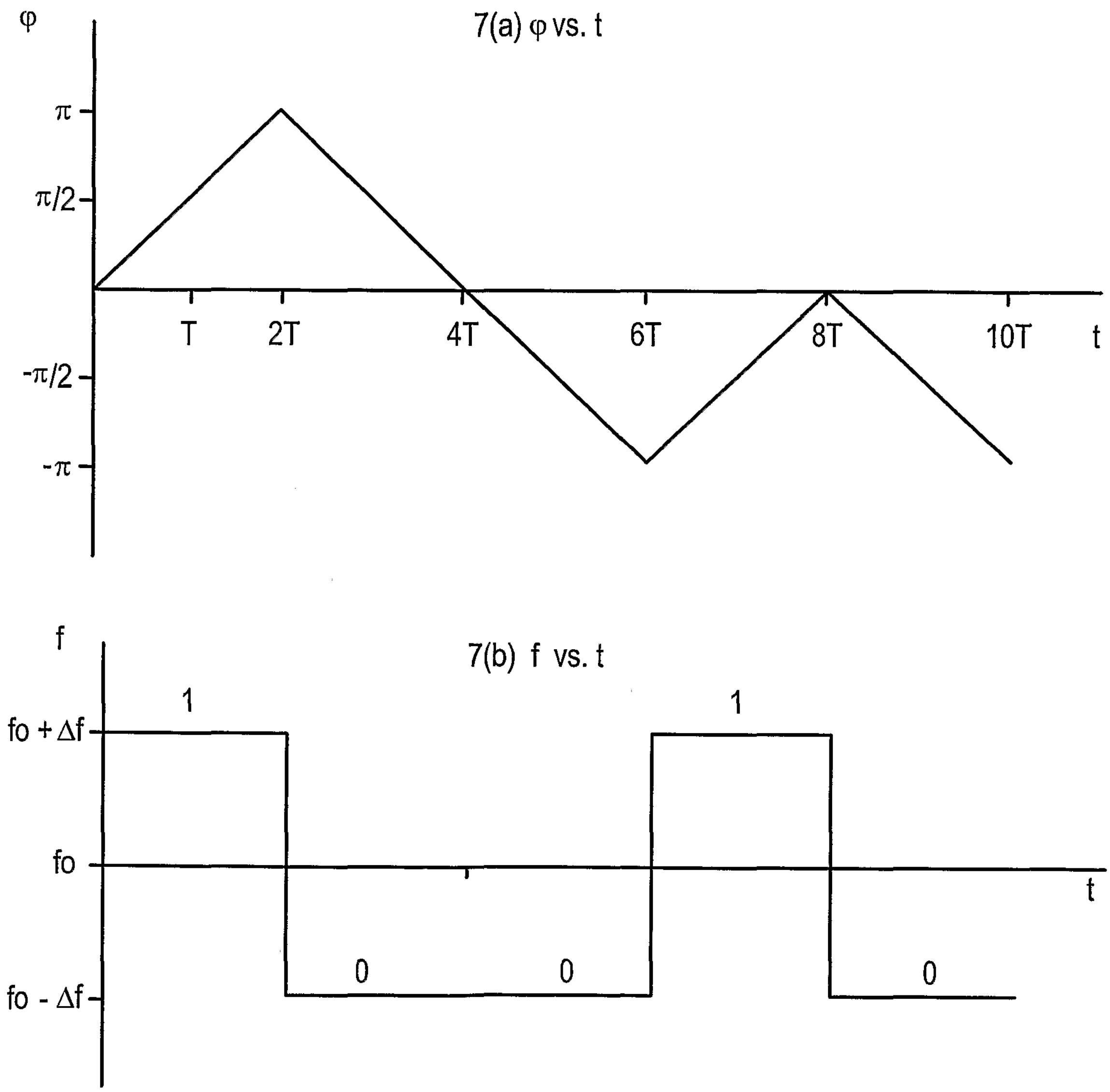

Fig. 7

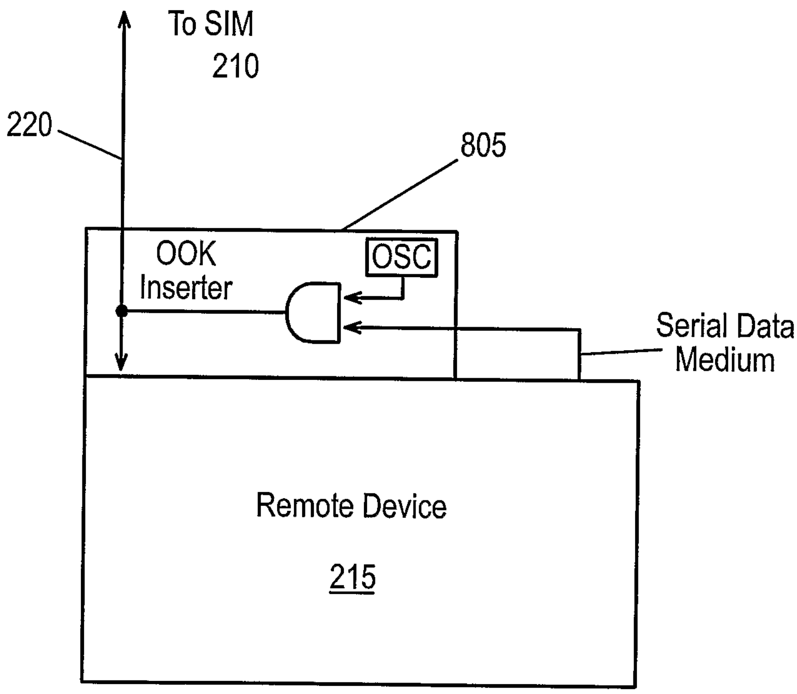
To SIM
210
220
805
OOK
Inserter
OSC
Serial Data
Medium
Remote Device
215

Fig. 8

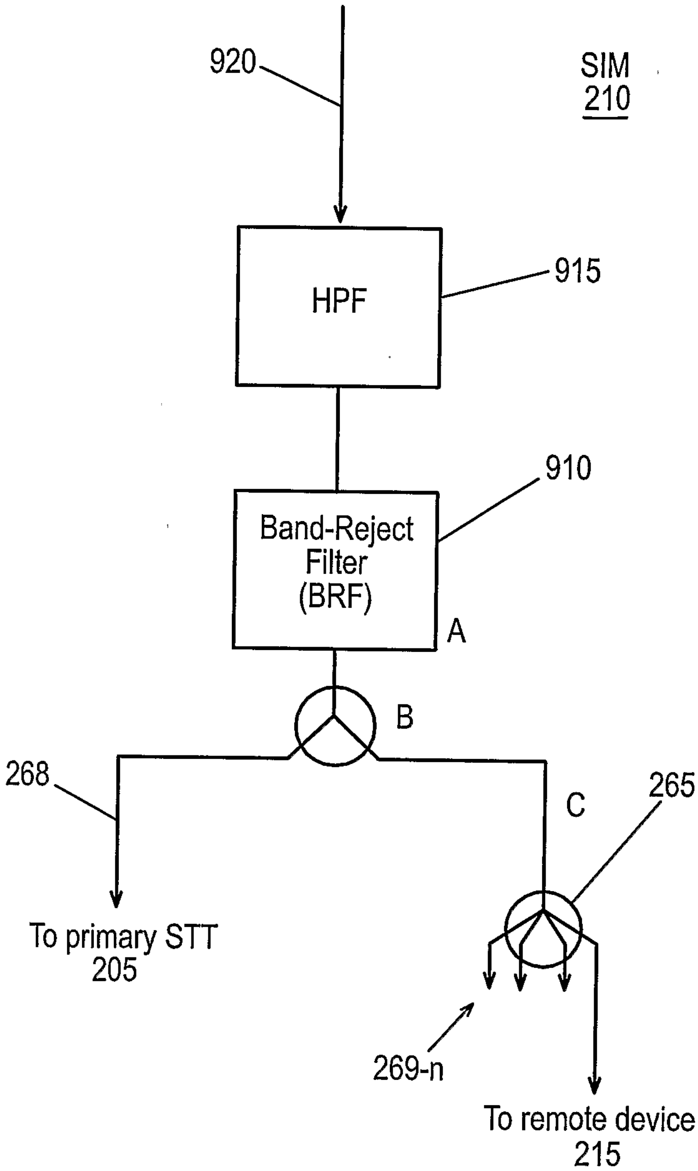
920
SIM
210
HPF
915
910
Band-Reject
Filter
(BRF)
A
B
268
C
265
To primary STT
205
269-n
To remote device
215

Fig. 9