METHOD AND APPARATUS FOR TRANSMITTING WIRELESS SIGNALS OVER MEDIA

A residential gateway (RG) (200) for distributing video, data and telephony services to multiple devices within a residence is disclosed. The RG (200) receives signals from a telecommunications network, converts the signals to formats compatible with the multiple devices, and transmits the appropriate signals to the appropriate devices. Wireless remote control devices associated with the remotely located televisions (TVs) (199) transmit channel select commands as wireless signals to the RG (200). The wireless signals are received by a Remote Antennae Package (RAP) (900) that transmits the wireless signal over cable. A remote Antennae Module (RAM) (920) receives the wireless signal and extracts the channel select command.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
TITLE

Method and Apparatus for Transmitting Wireless Signals over Media

Background of the Invention

Advances in the field of telecommunications allow large amounts of digital information to be delivered to a residence. Digital telecommunications networks (access systems), such as Hybrid-Fiber-Coax (HFC), Fiber-to-the-Curb (FTTC), and Digital Subscriber Line (DSL), can provide both traditional telecommunications services such as Plain Old Telephone Service (POTS) as well as advanced services such as Switched Digital Video (SDV) and high-speed data access. Devices inside the residence, will be connected to the network by twisted wire pairs which provide telephone services today, or by coaxial cable similar to that used by cable operators to provide cable TV services. Because of this range of services, it is likely that digital networks will be widely deployed. In a widespread deployment of digital networks, millions of homes will connect to the digital network.

Because the majority of new video services will be digital, and because existing televisions (TVs) are analog, there is a requirement for a device which converts the digital signals supplied by the network to analog signals compatible with existing TVs. Presently available STBs can perform this function, but are expensive. Moreover, many homes have more than one TV, and would therefore require multiple STBs to receive and convert the digital signals at each location within the home. Furthermore, there is a need for an interface subsystem for each device connected to the digital network. For example, a Premises Interface Device (PID) to extract time division multiplexed information and generate a telephone signal, and an Ethernet Bridge or Router (EBR) to generate a signal compatible with a computer.
For the foregoing reasons, there is a need for a centralized unit in the residence that can provide: a central connectivity point to the digital network; digital to analog conversion; and supporting communications with multiple locations within the home (e.g., telephone, computer, TV). A centrally located in-home device is usually referred to as a residential gateway (RG).

Transmission of channel select commands associated with remotely located TVs may encounter problems related to the distance to the RG and possible obstacles therebetween. Thus, there is a need for a method and apparatus for ensuring the RG receives the channel select commands from remotely located TVs. Numerous connectors may be required as multiple devices are connected to the RG and will transmit signals to and from the RG. Thus, there is a need for an apparatus that combines multiple devices and connections into a single device so as to simplify the installation of the RG.

Summary Of The Invention

The present invention discloses a method and apparatus for transmitting wireless signals over a media. In a preferred embodiment, the wireless signals are channel change commands received from a wireless remote control device. The wireless signals are then transmitted over a media to a central processing device. In one embodiment, the central processing device is a device that communicates with a television network by sending channel change commands to the television network and receives and forwards programming in response. In another embodiment, the central processing unit communicates with a telecommunications network and provides video, data and telephony service. In a preferred embodiment, the central processing device is the residential gateway (RG) produced by the assignee, Next Level Communications (NLC) of Rohnert Park, California.
The RG is capable of receiving signals from a telecommunications network, decoding the signals, and transmitting the decoded signals to a plurality of devices. In a preferred embodiment, the telecommunications network is a digital network and the signals include video signals, and may possibly include telephone signals, computer signals, and signals for other devices. In a preferred embodiment, the plurality of devices includes multiple televisions (TVs) and may possibly include telephones, computers and other devices.

The RG is capable of connecting to TVs in close proximity as well as TVs that are remotely located. As the RG is the central point of communications for the TVs, channel select commands need to be received by the RG. This includes the channel select commands from remotely located TVs. These remotely located TVs will use a wireless remote control to communicate with the RG.

According to one embodiment of the invention, the remotely located televisions use a UHF remote control unit. The channel change commands are received by a remote antennae package (RAP) that receives the signal and modulates the signal over the media, such as coaxial cable, toward the RG. The channel change commands are extracted from the media with a remote antennae module (RAM) and transmitted to the RG therefrom.

According to one embodiment, the remotely located televisions use an IR remote control unit. The channel change commands are received by an optical receiver that converts the signals to a pulse train and transmits the pulse train to an RF transmitter. The RF transmitter converts the pulse train to an RF signal that is modulated over the media toward the RG. The channel select commands are extracted from the media with the RAM. According to an alternative embodiment, the optical receiver and the RF transmitter are integrated together in an optical conversion device.

According to one embodiment, the communications between the RG and the TVs as well as the communications between the RG
and the telecom network will be transmitted over the same media. As such, a media interface device is disclosed for enabling multiple TV channels and telecom data to be transmitted over the same media. The MID includes a splitter, balun, diplexer and RAM. The MID can be used with either IR or UHF remote control devices. The MID reduces the amount of connections necessary to perform these operations.

These and other features and objects of the invention will be more fully understood from the following detailed description of the preferred embodiments that should be read in light of the accompanying drawings.

**Brief Description Of The Drawings**

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the embodiments of the present invention and, together with the description serve to explain the principles of the invention.

In the drawings:

Fig. 1 illustrates a hybrid-fiber-coax (HFC) access system;

Fig. 2 illustrates a fiber-to-the-curb (FTTC) access system;

Fig. 3 illustrates an FTTC access system including a residential gateway (RG), according to one embodiment;

Fig. 4 illustrates a Digital Subscriber Line (DSL) access system including an RG, according to one embodiment;

Fig. 5 illustrates a RG architecture, according to one embodiment;

Fig. 6 illustrates the use of the RG with the residence, according to one embodiment;

Fig. 7 illustrates the use of the RG with the residence, according to one embodiment;
Fig. 8 illustrates a RG architecture, according to one embodiment;

Fig. 9 illustrates a schematic of the RG configuration of Fig. 7;

Fig. 10 illustrates a schematic of the Remote Antennae Package (RAP), according to one embodiment;

Fig. 11 illustrates a schematic of the Remote Antennae Module (RAM), according to one embodiment;

Fig. 12 illustrates the use of the RG with the residence, according to one embodiment;

Fig. 13 illustrates the components of an RF transmitter, according to one embodiment;

Figs. 14A and 14B illustrate a circuit diagram of the RF transmitter, according to one embodiment;

Fig. 15 illustrates the connections between the RG and various other components, according to one embodiment;

Fig. 16 illustrates the components of a Media Interface Device (MID), according to one embodiment; and

Fig. 17 illustrates the housing of the MID, according to one embodiment.

**Detailed Description**

**Of The Preferred Embodiments**

In describing a preferred embodiment of the invention illustrated in the drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents which operate in a similar manner to accomplish a similar purpose.
With reference to the drawings, in general, and Figs. 1 through 17 in particular, the method and apparatus of the present invention are disclosed.

Fig. 1 illustrates a Hybrid-Fiber-Coax (HFC) digital network in which various devices within a residence 190 are connected to a Video Network (VN) 408 or a data and voice network (DVN) 404. The devices in the residence 190 can include a Premises Interface Device (PID) 196 connected to a telephone 194, a television (TV) set top-converter (STB) 198 connected to a TV 199, an Ethernet Bridge or Router (EBR) 191 connected to a computer 193, or other devices.

The HFC network illustrated in Fig. 1 works by connecting a cable headend (HE) 400 to the DVN 404 and the VN 408. The physical interface to the DVN 404 may be copper wire pairs carrying either DS-1 or DS-3 signals. The physical interface to the VN 408 may be via a wide area network (WAN).

The Cable HE 400 is connected to a plurality of optical to electrical (O/E) nodes 410 (only one illustrated) with fiber optic cables 160. The O/E nodes 410 are located within the communities serviced by the HFC network. Each O/E node 410 provides service for up to 500 residences within the given community. Since such a large number of users are being serviced by one O/E node 410, amplifiers 420 are required. The O/E node 410 connects to the residence 190 via coaxial cable 170. The coaxial cable 170 is received by a splitter 177 within the residence 190 so that internal coaxial wiring 171 can route the data being transmitted to the various devices. Each device connected to the internal coaxial wiring 171 will require an interface sub-system which can convert the current format of the signal being transmitted over the internal coaxial wiring 171 to the service interface required by the devices (i.e., telephone, TV, computer, or other devices). In a preferred embodiment, the PID 196 extracts time division multiplexed information carried on the internal coaxial wiring and generates a telephone signal compatible with the telephone
194. Similarly, the STB 198 converts digital video signals to
analog signals compatible with the TV 199. Likewise, the EBR
191 generates a signal compatible with the computer 193.

Fig. 2 illustrates a Fiber-to-the-Curb (FTTC) network in
which various devices in the residence 190 are connected to a
Public Switched Telecommunications Network (PSTN) 100 or an
Asynchronous Transfer Mode (ATM) network 110. The devices in
the residence 190 can include telephones 194 (with or without a
PID 196), a TV 199 with a STB 198, and a computer 193 with an
EBR 191.

The FTTC network illustrated in Fig. 2 works by connecting
a Host Digital Terminal (HDT) 130 to the PSTN 100 and the ATM
network 110. A PSTN-HDT interface 103 is specified by
standards bodies, and in the U.S. is specified by Bellcore
specifications TR-TSY-000008, TR-NWT-000057 or GR-NWT-000303,
which are incorporated herein by reference. The HDT 130 can
also receive special service signals from private or non-
switched public networks. The physical interface to the PSTN
100 may be twisted wire pairs carrying DS-1 signals, or optical
fibers carrying Optical Carrier (OC)-3 optical signals.

An ATM network-HDT interface 113 can be realized using an
OC-3 or OC-12c optical interface carrying ATM cells. In a
preferred embodiment, the HDT 130 has three OC-12c broadcast
ports, which receive signals carrying ATM cells, and one OC-12c
interactive port which receives and transmits signals.

An element management system (EMS) 150 is connected to the
HDT 130 and forms part of an Element Management Layer (EML)
which is used to provision services and equipment on the FTTC
network, in the central office where the HDT 130 is located, in
the field, or in the residences 190. The EMS 150 is software
based and can be run on a personal computer in which case it
will support one HDT 130 and the associated digital network
equipment connected to it, or can be run on a workstation to
support multiple HDTs 130 and the associated digital network
equipment.
Optical Network Units (ONUs) 140 are located in the serving area and are connected to the HDT 130 via optical fiber 160. Digital signals, having a format which is similar to the Synchronous Digital Hierarchy (SDH) format, are transmitted to and from each ONU 140 over the optical fiber 160 at a rate of at least 155 Mb/s, and preferably 622 Mb/s. In a preferred embodiment, the optical fiber 160 is a single-mode fiber and a dual wavelength transmission scheme is used to communicate between the ONU 140 and the HDT 130. In an alternate embodiment, a single wavelength scheme is used in which low reflectivity components are used to permit transmission and reception on one fiber.

A Telephony Interface Unit (TIU) 145 in the ONU 140 generates an analog Plain Old Telephone signal (POTS) which is transported to the residence 190 via a twisted wire pair, drop line cable 180. At the residence 190 a Network Interface Device (NID) 183 provides for high-voltage protection and serves as the interface and demarcation point between the twisted wire pair, drop line cable 180 and the twisted wire pairs 181 internal to the residence 190. In a preferred embodiment, the TIU 145 generates POTS signals for six residences 190, each having a separate twisted wire pair, drop line cable 180 connected to the ONU 140.

As shown in Fig. 2, a Broadband Interface Unit (BIU) 152 is located in the ONU 140 and generates broadband signals which contain video, data and voice information. The BIU 152 modulates data onto a RF carrier and transmits the data to the residence 190 over media 170, such as a coaxial, drop line cable or a twisted wire pair, drop line cable. The media 170 connects to the residence 190 at a splitter 177. The data then travels from the splitter 177 to the devices within the residence 190 over coaxial wiring 171 internal to the residence 190.
In one embodiment, 64 ONUs 140 are served by each HDT 130 and each ONU 140 serves 8 residences 190. In an alternate embodiment, each ONU 140 serves 16 residences 190.

As shown in Fig. 2, each device connected to the internal coaxial wiring 171 will require an interface sub-system which can convert the current format of the signal being transmitted over the internal coaxial wiring 171 to the service interface required by the devices (i.e., telephone 194, TV 199, computer, or other devices). In a preferred embodiment, the PID 196 extracts time division multiplexed information carried on the internal coaxial wiring 171 and generates a telephone signal compatible with the telephone 194. Similarly, the STB 198 converts digital video signals to analog signals compatible with the TV 199. Likewise, the EBR 191 generates a signal compatible with the computer.

In the system illustrated in Fig. 2, the NID 183 is located external to the residence 190, at what is known in the industry as the network demarcation point. For the delivery of telephony services the NID 183 is a passive device whose principal functions are lightning protection and the ability to troubleshoot the network by allowing connection of a telephone 194 to the twisted wire pair, drop line cable 180 to determine if wiring problems exist on the internal twisted wire pairs 181.

Fig. 3 illustrates a residential gateway (RG) 200 located within the residence 190. In the embodiment illustrated, the digital network is an FTTC network and the media 170 is a coaxial, drop line cable for connecting to and communicating with the RG 200. The RG 200 generates signals compatible with the devices in the residence 190, thus reducing the number of interface sub-systems required in the residence 190 to interface between the FTTC network and the devices (i.e., telephone 194, TV 199, and the computer 193). The devices are connected either directly or indirectly to the RG 200 instead of to an interface sub-system. For example, the computer 193
and the telephone 194 may be directly connected to the RG 200 via internal twisted wire pairs 181. As one of ordinary skill in the art would know, multiple computers 193 or telephones 194 could be connected to the RG 200 by using a splitter external to the RG 200, or by having additional Ethernet ports for the computers 193 or telephone jacks for the telephones 194 in the housing of the RG 200.

The TV 199 may be connected directly to the RG 200 via video cables 205. In a preferred embodiment, the video cables 205 used for the direct RG-TV connection 205 are a four-conductor cable carrying S-video signals. As one of ordinary skill in the art would know, additional TVs 199 could be directly connected to the RG 200 by using a splitter or additional S-video connectors in the housing of the RG 200.

The preferred embodiment would be to have additional S-video connectors so that the quality of the video signals would be maintained. Moreover, the TVs 199 directly connected to the RG 200 would have to be within close proximity to the RG 200 as S-video signals can only maintain their quality for a limited distance.

Additional devices 192, such as additional TVs 199, which are remotely located from the RG 200 (hereinafter referred to as remotely located TVs 199) may be connected to the RG 200. One embodiment connects the additional devices 192 to the RG 200 via media 210, such as internal coaxial cable wiring, and the splitter 177. That is, one port, such as a coaxial connector, on the RG 200 can connect multiple additional devices 192 to the RG 200. This type of connection is known as a point-to-multipoint connection. Alternatively, each additional device 192 could be directly connected to the RG 200 using the single media 210, the splitter 177 is not used. This type of connection is known as a point-to-point connection and would require the RG 200 to have multiple ports, such as coaxial connectors.
It would be obvious to one of ordinary skill in the art that any of the devices (TVs 199, telephones 194, computers 193, etc.) could be connected to the RG 200 with any type of cable that can transmit signals compatible with the particular device. Moreover, the RG 200 can include any type of ports that can receive signals compatible with a particular device.

Fig. 4 illustrates an embodiment, in which the digital network is a Digital Subscriber Line (DSL) network. In this embodiment, the DSL network replaces the ONU 140 with a Universal Service Access Multiplexer (USAM) 340. The USAM 340 is located in the serving area, and is connected to the HDT 130 via optical fiber 160. A twisted wire pair, drop line cable 180 to provide communications to and from the RG 200.

The USAM 340 includes an xDSL modem 350 which provides for the transmission of high-speed digital data to and from the residence 190, over the twisted wire pair, drop line cable 180. When used herein, the term xDSL refers to any one of the twisted wire pair digital subscriber loop transmission techniques including High Speed Digital Subscriber Loop, Asymmetric Digital Subscriber Loop, Very high speed Digital Subscriber Loop, Rate Adaptive Digital Subscriber Loop, or other similar twisted wire pair transmission techniques. Such transmission techniques are known to those of ordinary skill in the art. The xDSL modem 350 contains the circuitry and software to generate a signal which can be transmitted over the twisted wire pair, drop line cable 180, and which can receive high speed digital signals transmitted from the RG 200 or other devices connected to the subscriber network.

Traditional analog telephone signals are combined with the digital signals for transmission to the residence 190. A NID/filter 360 replaces the NID 183 of Figs. 2 and 3, and is used to separate the analog telephone signals from the digital signals. The majority of xDSL transmission techniques leave the analog voice portion of the spectrum (from approximately 400 Hz to 4,000 Hz) undisturbed. The analog telephone signal,
once separated from any digital data signals in the spectrum, is sent to the telephone 194 over the internal twisted wire pairs 181. The digital signals that are separated at the NID/filter 360 are sent from a separate port on the NID/filter 360 to the RG 200. The RG 200 serves as the interface to the other devices (TVs 199, computers 193, and additional telephones 194) in the residence 190. The connection of the devices within the residence 190 to the RG 200 is the same as described above with respect to Fig. 3.

The embodiment illustrated in Fig. 4 is a central office configuration, which includes a USAM Central Office Terminal (COT) 324 connected to the HDT 130. A USAM COT-HDT connection 325, is a twisted wire pair which transmits a STS3c signal in a preferred embodiment. A PSTN-USAM COT interface 303 is one of the Bellcore specified interfaces including TR-TSY-000008, TR-NWT-000057 or TR-NWT-000303, which are all incorporated herein by reference. The USAM COT 324 has the same mechanical configuration as the USAM 340 in terms of power supplies and common control cards, but has line cards which support twisted wire pair interfaces to the PSTN 100 (including DS-1 interfaces) and cards which support STS3c transmission over the twisted wire pair of the USAM COT-HDT connection 325.

The embodiment illustrated in Fig. 4, also includes a Channel Bank (CB) 322 in the central office. The CB 322 is used to connect special networks 310, comprised of signals from special private or public networks, to the DSL network via a special networks-CB interface 313. In a preferred embodiment, a CB-USAM COT connection 320 includes DS1 signals over twisted wire pairs.

The RG 200 can be located anywhere within the residence 190 (i.e., in any of the living spaces, in the basement, in the garage, in a wiring closet, in the attic), or external to the residence (i.e., on an external wall). For external locations, the RG 200 will require a hardened enclosure and components which work over a larger temperature range than those used for
the RG 200 located internal to the residence 190. Techniques for developing hardened enclosures and selecting temperature tolerant components are known to those of ordinary skill in the art.

Fig. 5 illustrates one embodiment of the RG 200. The RG 200 includes a network connection 460 for connecting to the digital network. The network connection 460 will vary depending on the digital network that the RG is connecting to. That is, the network connection 460 will depend on whether the digital network for the area the residence 190 is located within is an FTTC network, a DSL network, or other type of digital network. For example, if the drop line from the digital network to the RG 200 is a coaxial cable (i.e., the FTTC network of Fig. 3) the network connection 460 should be a coaxial cable connector. If the drop line from the digital network to the RG 200 is twisted wire pair cable (i.e., the DSL network of Fig. 4) the network connection 460 should be a connector capable of receiving twisted wire pairs, such as a telephone jack. As one of ordinary skill in the art would know, the network connection 460 could be various different types of connectors as long as the connector is capable of receiving the signals being transmitted over the drop line from the digital network.

The network connection 460 is connected to a Network Interface Module (NIM) 410. The NIM 410 receives all data from and transmits all data to the digital network and thus contains the appropriate modem technology. As with the network connection 460, the type of NIM 410 utilized depends on the type of digital network that the RG 200 is connected to. In a preferred embodiment, different types of NIMs 410 are utilized for digital networks having coaxial drop line cables (i.e., the FTTC network of Fig. 3) than for digital networks having twisted wire pair drop line cables (i.e., the DSL network of Fig. 4).
Regardless of the type of NIM 410 utilized, the NIM 410 interfaces to a motherboard 414 which provides the basic functionality of the RG 200. The motherboard 414 may contain a microprocessor 434, memory 436, a power supply 440, a main MPEG processor 430, an Ethernet processor 438, and a Remote Control (RC) processor 442. As one of ordinary skill in the art would recognize, the motherboard 414 could contain additional components, or some of the components illustrated as being part of the motherboard 414 could removed from or located elsewhere within the RG 200, without departing from the scope of the current invention.

The RG 200 receives power from a power source, which in a preferred embodiment is an AC outlet, via a plug 476, which in a preferred embodiment is an AC plug. The power supply 440 converts the voltage from the AC outlet, for example 120 volts AC in a typical residence 190, to the voltages necessary for each of the components of the RG 200 to operate. The power supply 440 is illustrated as being an element of the motherboard 414, but as one of ordinary skill in the art would know, the power supply 440 could be a separate component within the RG 200.

The microprocessor 434 controls the operation of the RG 200. For example, the microprocessor 434 may control the transfer of data between each of the elements of the RG 200. The memory 436 may store operating programs required by the microprocessor 434, data received from the digital network or any of the devices in the residence 190 connected to the RG 200, or other data or programs required by the RG 200.

The Ethernet processor 438 converts ATM cells received by the NIM 410 into the appropriate form for transmission to the devices, such as the computers 193. The computers 193 are connected to the RG 200 via an Ethernet connector 478 located in the housing of the RG 200. As illustrated in Fig. 5, the RG 200 has only one Ethernet connector 478. This would seem to infer that only one computer could be connected to the RG 200.
However, as one of ordinary skill in the art would know, a splitter could be used to connect additional computers 193 to the RG 200. Furthermore, an alternative embodiment could include additional Ethernet connectors 478 located in the housing of the RG 200 so that additional computers 193 could be connected to the RG 200.

Within the main MPEG processor 430 there is a Video Segmentation and Re-assembly (VSAR) module 432 which constructs Motion Picture Experts Group (MPEG) packets from an ATM stream received from the NIM 410. In addition to constructing the MPEG packets, the VSAR module 432 can reduce jitter in the MPEG packets which arises from transmission of those packets over the ATM network 110, as well as constructing a useable MPEG stream in spite of lost ATM cells which contain partial MPEG packets. It would be obvious to one of ordinary skill in the art that the VSAR module 432 does not have to be part of the main MPEG processor 430. For example, the VSAR module 432 could be its own module on the mother board 414, could be its own subassembly, or could be part of another processor, such as the NIM 410.

While the VSAR module 432 has been described as constructing MPEG packets from received ATM streams, this is in no way intended to limit the scope of the invention. Rather, this is simply the current preferred embodiment. That is, digital data is currently transmitted over the digital network in ATM streams and digital video data is currently compressed according to an MPEG standard (currently the MPEG-2 standard). It is within the scope of the current invention to receive digital data from a digital network in any format and for the video data to be compressed in any format. That is, one of ordinary skill in the art could modify the VSAR module 432 to handle new transmission or compression formats without departing from the scope of the current invention.

The main MPEG processor 430 can also decompress the MPEG packets, which are constructed by the VSAR module 432, to
generate video signal(s) compatible with present TVs 199. In
one embodiment, the main MPEG processor 430 generates video
signal(s) having an S-video format. The S-video signal(s) can
be transmitted over an S-video connector 474 to a TV 199 having
an S-video port via an S-video cable 205. As one of ordinary
skill in the art knows, S-video signals are a higher quality
video signal because the chrominance and luminance information
are separated. The TV 199 receiving the S-video signals should
be located in close proximity to the RG 200 to ensure the
quality of the S-video signal. As illustrated, there is only
one TV 199 connected to the RG 200 with the S-video cable 205
and only one S-video connector 474. However, this is not
intended to limit the scope of the invention as it would be
possible to have multiple TVs 199 (assuming they are located in
close proximity to the RG 200) receive S-video signals from the
RG 200 by splitting the signal transmitted from the single S-
video connector 474 or by providing multiple S-video connectors
in the housing of the RG 200.

In one embodiment, the main MPEG processor 430 may
decompress multiple MPEG packets corresponding to multiple TV
channel selections to generate video signal(s) compatible with
the current TV format, which in the U.S. is currently the
National TV System Committee (NTSC) format. The invention
however is not limited to the NTSC format. It is well within
the scope of the current invention for the TV signals to be
generated in accordance with the current standard for the time,
whether it be the NTSC format or a new format. For example,
the main MPEG processor 430 may decompress three video streams
simultaneously to generate three video signals associated with
three TV channel selections. The TV signals may be transmitted
to the TVs 199 by either combining and modulating each TV
signal over one media or by modulating each TV signal over a
separate media.

The RC processor 442 is capable of processing RC signals
received by the RG 200. For example, in the embodiment
illustrated in Fig. 5, the RC processor 442 receives optical
signals, such as infrared (IR) signals, from an optical receiver 472, such as an IR receiver, and wireless signals, such as UHF signals, from a wireless receiver 470, such as a UHF receiver. One of ordinary skill in the art would recognize that the RC processor 442 could be designed to handle any type of channel select signals that were received from a variety of different RC devices. Moreover, one of ordinary skill in the art would recognize that the RC processor 442 is not limited to the illustrated configuration of being a module located on the motherboard 414. For example, the RC processor 442 could be located on another board or could be incorporated as part of another module.

The embodiment of the RG 200 illustrated in Fig. 5, further includes the optical receiver 472. The optical receiver 472 receives channel select commands for the TV 199 that is directly connected to the RG 200, preferably via the S-video port 474. As stated earlier, this TV 199 will be in close proximity to the RG. In a preferred embodiment, the RG 200 would be located in a stereo cabinet with the TV 199 or on top of the TV 199, much like a VCR. As with a VCR, the TV 199 would be set to a particular channel, for example channel 3 or 4 just like a VCR, and the control of the channel selection for the TV 199 would then be controlled by the optical RC sending channel select commands to the RG 200 directly. While the illustrated embodiment is the preferred embodiment, the current invention is not limited to using an optical RC to control the TV 199 directly connected to the RG 200. For example, the RC could be a wireless RC or a hard wired RC device.

The RG 200 illustrated in Fig. 5, further includes the wireless receiver 470 for receiving channel select signals from the remotely located TVs 199 that are connected to the RG 200 and are located in separate rooms or even separate floors of the residence 190. As with the TV 199 directly connected to the and located in close proximity to the RG 200, the remotely located TVs 199 would be set to a particular channel, for example channel 3 or 4 just like a VCR, and the control of the...
channel selection for the remotely located TVs 199 would then be controlled by a wireless RC associated with each TV 199. The wireless RC transmits the channel select commands to the RG 200 directly.

5 The RG 200 also includes a set of buses 429 used to route information within the RG 200. As illustrated in Fig. 5, the set of buses 429 includes a Time Division Multiplexing (TDM) bus 420, a control bus 422, a MPEG bus 424, and an ATM bus 428.

10 The RG 200 may also include a number of optional modules which can be inserted into the RG 200. The optional modules include MPEG modules 450, a Digital Audio Visual Council (DAVIC) module 452, and a telephony module 454. All of the optional modules are connected to the control bus 422 in addition to being connected to at least one other bus which provides those modules with the appropriate types of data for the services supported by the module.

15 The MPEG modules 450 provide for decompression of MPEG packets which are constructed by the VSAR processor 432. The MPEG modules are associated with remotely located TVs 199. As with the output of the main MPEG processor 430, the output of the MPEG modules 450 is a signal having a format compatible with present TVs 199. The MPEG modules 450 can modulate the decompressed analog format video signal onto an available channel for transmission to the remotely located TVs 199 in the residence 190. In a preferred embodiment, the MPEG modules 450 are insertable cards. Thus, the cards could be added after an initial installation to handle additional TVs 199. For example, in one embodiment the main MPEG processor 430 may be capable of generating three TV signals so that the RG 200 can accommodate three TVs 199 without the need for any MPEG modules 450. If a fourth TV 199 was added, or one of the TVs 199 had picture-in-picture, a MPEG module 450 would be required to generate a fourth TV signal.

20 The DAVIC module 452 is for communicating with devices that have a signal format that is compatible with a signal
format received from the digital network. That is, the DAVIC module transmits ATM signals to and receives ATM signals from these devices. Thus, the DAVIC module 452 allows the RG 200 to act as a pass through for these devices. These devices may include the interface sub-systems illustrated in Figs. 1 and 2. This is beneficial because the RG 200 can be used in conjunction with previously purchased interface sub-systems if required or desired.

As illustrated in Fig. 5, the MPEG modules 450 and the DAVIC module 452 are connected to a combiner 418 which combines the RF signals from those modules. It should be noted that this embodiment has only one RF connector 466 so that the combiner 418 is necessary to combine all the TV signals and ATM signals so they can be transmitted over a single media 210 connected to the RF connector 466. If multiple RF connectors 466 were provided, it is possible that the combiner 418 would not be required or could be externally located. However, the combiner 418 can also add other RF signals, such as off-air broadcast TV signals or Community Antenna TV (CATV) signals supplied by a cable TV company. Signals from the antenna or cable system are coupled to the RF pass-through 464, which in a preferred embodiment is an F-connector. A low pass filter 482 is used in the combiner 418 to insure that the frequencies used by MPEG modules 450 are available. The output of the combiner 418 is connected to the RF connector 466, which in a preferred embodiment is an F-connector. An optional CATV module 480 can be inserted into the RG 200 to allow for mapping of off-air or cable video channels from their original frequencies to new frequencies for in-home distribution. The RC processor 442 can control the channel selection and mapping via the control bus 422 which is connected to the CATV module 480. Either a handheld optical RC or a wireless RC can be used to change the channel mapping of the CATV module 480.

The RG 200 includes a front panel interface 462, which provides for connectivity between the front panel controls (buttons) and the microprocessor 434. Through the front panel
controls, the user can make channel changes as well as changing the configuration of the channels transmitted on the in-home coaxial network.

The RG 200 also includes a telephony module 454, which transmits and receives information from the TDM bus 420 and produces an analog telephone signal which is compatible with telephones 194. The interface for the telephones 194 is a telephone jack 468, which in a preferred embodiment is an RJ-11 jack.

Fig. 6 illustrates one embodiment of how the RG 200 could be configured within the residence 190. As illustrated, the remotely located TVs 199 use a wireless RC 500 to transmit channel select commands to the RG 200. In particular, TVs 1 and 2 are located on a second floor while the RG 200 and TV3, which is directly connected to the RG 200 via the S-video connector 474, are located on a first floor of the residence 190. Wireless RCs 1 and 2 are associated with TVs 1 and 2 and transmit channel select commands for the associated TVs to the RG 200 as wireless signals. The wireless channel select commands are received by the RG 200 via the wireless receiver 470. The channel select commands for TV 3 are transmitted using an optical RC 510. The optical channel select command is received by the optical receiver 472 within the RG 200.

This embodiment illustrates TVs 1 and 2 being connected to the RG 200 via a splitter 177. This is in no way intended to limit the scope of the invention. Rather, as previously discussed it is within the scope of this invention to have multiple coaxial connectors within the housing of the RG 200 so that each remotely located TV 199 can be directly connected to the RG 200. As one of ordinary skill in the art would know, there is a limit to how many ports can be added to the housing so there is a limit to how many separate remotely located TVs 199 can be connected directly to the RG 200. Thus, it possible to have some of the remotely located TVs 199 connected directly
to a port in the RG 200 and others that are connected to a port via the splitter 177.

One drawback to the embodiment of Fig. 6 that utilizes wireless RCs 500 and the wireless receiver 470 (Fig. 5) within the RG 200 (as illustrated in Fig. 5), is that the further the wireless signals have to be transmitted and the more obstacles, such as walls, that the signals have to navigate around, the weaker the signal at the wireless receiver 470, and the more likely that the channel select command is lost or distorted. Moreover, the average consumer will more than likely point the wireless RC 500 at the TV 199, which is more than likely away from the RG 200 and the wireless receiver 470.

An alternative embodiment, for transmitting channel select commands from the remotely located TVs 199 to the RG 200 is illustrated in Fig. 7. In this embodiment, a Remote Antennae Package (RAP) 900 is connected to each remotely located TV 199. The RAP 900 is a passive device for receiving and transmitting the wireless signals. The RAP 900 includes an antenna 910, such as a ¼ wave dipole antenna, located in close proximity to the TV 199, and preferably mounted to the TV 199. A wireless RC 500 is used to select a channel. The wireless RC 500 transmits a channel select command at one of the common wireless frequencies known to those of ordinary skill in the art. In a preferred embodiment, the wireless signal is transmitted at a frequency of approximately 433 MHz. The FCC regulations for wireless RCs imposes a maximum transmit power of 80.5 dbu V/m at a distance of 3 meters. One such wireless RC 500 that can be used along with the current invention is the RCK-431N manufactured by DAE-Ryung. The antenna 910 receives the channel select command and the RAP 900 transmits the wireless signal over the media 210 (i.e., coaxial cable) or the media 210 and the splitter 177.

A Remote Antenna Module (RAM) 920 which is located near, and preferably connected to the RG 200, receives the wireless signal. The RAM 920 demodulates the wireless signal and
extracts the channel select command therefrom. In a preferred embodiment, the channel select command is extracted as an approximately 1 KHz audio signal. The RAM 920 then transmits the channel select command to the RG 200 for processing. The RAM 920 may be connected to the RG 200 with, for example audio wire better known as "speaker wire". In an alternative embodiment, the RAM 920 may be directly mounted on the RG 200. In another alternative embodiment, the RAM 920 may be an integral part of the RG 200.

Fig. 8 illustrates an embodiment of the RG 200 that includes a port 750 for receiving channel select commands from the RAM 920. The channel select commands are provided directly to the RC processor 442. In this embodiment, a wireless antennae is not required to receive the wireless signals. Moreover, this embodiment includes multiple ports 630, such as TV connectors. Thus, the combiner 418 of Fig. 5 is not required. Rather, this embodiment illustrates TV modules 654 for modulating the appropriate video channel over the appropriate port 630.

Fig. 9 illustrates a schematic diagram of an RG system utilizing the RAP 900 and the RAM 920 for communications between the RG 200 and the remotely located TVs 199. As illustrated, the RAM 920 is connected to the RG 200 with both speaker wire 990 and coaxial cable 210. The RAM 920 is further connected to a splitter 177 that in turn connects to two RAPs 900. The RAPs 900 are connected to the remotely located TVs 199. Channel select commands are received by the antennae 910 as wireless signals and the RAP 900 transmits the wireless signals over coaxial cable 210 to the RAM 920. The RAM 920 extracts the channel select commands and transmits them to the RG 200 over the speaker wire 990. TV signals are transmitted from the RG 200 to the TVs 199. As illustrated, the RAM 920 is connected to the RG 200 and thus receives the TV signals. However, the RAM 920 simply forwards the TV signals. The splitter 177 splits the TV signals so as to provide the TV
signals to the two TVs 199. The TV signals simply pass through the RAP 900 in this direction.

Fig. 10 illustrates one embodiment of the RAP 900. In addition to the antenna 910, the RAP 900 includes a combination of inductors and capacitors. Fig. 11 illustrates one embodiment of the RAM 920 that includes a combination of inductors and capacitors. Figs. 10 and 11 depict values associated with each of the components, however, this is only an example and should not be construed as limiting the scope of this invention. Rather, as one of ordinary skill in the art would know, different components, configurations of components, and/or values of components could be used to accomplish the same or a similar purpose and would thus be well within the scope of the current invention.

Fig. 12 illustrates an alternative embodiment in which each remotely located TV 199 has an optical receiver 710, such as an IR receiver, connected to and located on or within close proximity to the TV 199. A user selects a channel by using an optical RC 700, such as an IR RC, associated with the optical receiver 710 to select a channel for the respective TV 199. The optical RC 700 transmits the channel select commands as optical signals to the optical receiver 710. The optical receiver 710 converts the optical signal to a pulse train. This type of optical receiver 710 is well known to those of ordinary skill in the art. The pulse train from the optical receiver 710 is then provided to a RF transmitter 720. The RF transmitter 720 converts the pulse train into a RF signal having a standard wireless frequency, which would be known to those of ordinary skill in the art. In a preferred embodiment, the frequency of the RF signal is approximately 433 MHz. The RF transmitter 720 then transmits the RF signal to the RG 200 over the media 210.

Fig. 13 illustrates one embodiment of the RF transmitter 720. The RF transmitter 720 requires power in order to operate and is therefore provided with a plug that can plug into a
standard outlet. As one of ordinary skill in the art would know, the RF transmitter 720 could include a battery that would provide the necessary power in lieu of the plug. The RF transmitter 720 includes a power regulator 725 which converts the received power to the power necessary to operate the RF transmitter 720, for example 5V. The RF transmitter 720 receives the pulse train from the optical receiver 710 and the necessary power from the power regulator 725 at a bias switch 730. The pulse train controls the operation of the bias switch 730. That is, the pulse train controls when the bias switch 730 is on and when it is off. An oscillator 740, such as a SAW resonator stabilized oscillator, is coupled to the bias switch 730. As such, the bias switch 730 controls when power is provided to the oscillator 740 and thus controls the generation of the RF signal by the oscillator 740.

An attenuator 750 is connected to the output of the oscillator 740 for reducing the amplitude of the RF signal to an appropriate level. The output of the attenuator 750 is connected to a diplexer 760 for directionally inserting the RF signal onto the media. That is, the diplexer 760 ensures that the RF signal is transmitted over the media to the RG 200 and not toward the remotely located TV 199 that is also connected to the RF transmitter 720. The diplexer 760 may consist of several filters such as a band pass filter (BPF) 770 and a band reject filter (BRF) 780. In the downstream direction, the BPF 770 allows the RF signal to pass through and be transmitted in the direction of the RG 200, while the BRF 780 ensures that the RF signal is not provided to the TV 199. In the upstream direction, the BRF 780 allows the TV signal to pass through and be transmitted to the TV 199, while the BPF 770 ensures that the TV signal is not provided to the rest of the RF transmitter 720 or the optical receiver 710.

As illustrated, the optical receiver 710 and the RF transmitter 720 are separate components. However, as one of ordinary skill in the art would recognize it is well within the scope of the current invention to combine the optical receiver
710 and the RF transmitter 720 into a single device. That is, an optical conversion device (OCD) 790, such as optical to RF conversion device, could include the optical receiver 710, the power regulator 725, the bias switch 730, the oscillator 740, the attenuator 750 and the diplexer 760. While the OCD 790 was just described as a combined unit, it is also intended to be a generic name that identifies the process being performed, whether it is the combined embodiment, the embodiment where the optical receiver 710 and RF transmitter 720 are separate, or an equivalent embodiment.

Figs. 14A and 14B illustrate a circuit diagram of one possible embodiment of the RF transmitter 720. It should be noted that this is simply one embodiment and is in no way intended to limit the scope of the invention.

The RF transmitter 720 (or OCD 790) transmits the RF signal over the media 210, such as coaxial cable. The RF signal is received by the RAM 920 (previously described with respect to Fig. 7) which is connected to the RG 200. The RAM 920 demodulates the RF signal and extracts the portion of the signal corresponding to the channel select commands. For example, the RAM may extract the 1 KHz signal (i.e., audio signal) from the RF signal, wherein the 1 KHz signal corresponds to the channel select commands. The RAM 920 provides the channel select commands to the RG 200. The RAM 920 may transmit the channel select commands to the RG 200 over audio cables (i.e. speaker wire). Other alternatives include directly connecting the RAM 920 to the RG 200 or incorporating the RAM 920 into the RG 200.

Fig. 15 illustrates one embodiment of a RG system utilizing the RAM 920 for communications between the RG 200 and the remotely located TVs 199 in addition to the use of diplexers and baluns to transmit network signals over the media 210. As illustrated, the channel select commands are UHF signals that are transmitted over media 210 using the RAP 900 (as disclosed in Fig. 7). The channel change commands could
also be IR signals that are transmitted over the media 210 using the RF transmitter 720 or the OCD 790 (as disclosed in Fig. 13).

As illustrated in Fig. 15, three TV signals are modulated over three separate channels via three separate ports in the RG 200. The three TV signals are combined into one combined TV signal by using a combiner 802. The combined TV signal is then split into two signals by splitter 804 so that the combined TV signal can be transmitted to a TV 199 in close proximity to the RG 200 and to the remotely located TVs 199. In this embodiment, the combined TV signal is transmitted to a VCR connected to the TV 199 in close proximity to the RG 200. As illustrated, the TV 199 located in close proximity to the RG 200 is not receiving S-video signals, but instead is receiving the same format of signals as the remotely located TVs 199. As discussed earlier, the format of these TV signals may be the NTSC format currently used in the U.S. As would be obvious to those of ordinary skill in the art, if the TV 199 located in close proximity to the RG 200 was receiving the TV signals as an S-video signal out of the S-video port, the splitter 804 would not be required.

The combined TV signal being transmitted to the remotely located TVs 199 may be passed through the RAM 920. The RAM 920 will not perform any processing on the combined TV signals. The combined TV signal may then connect to a diplexer 806 located in close proximity to the RG 200. Thus, the other signals, such as VDSL signals from the telecommunications network, may be transmitted over the same media 210 that connects the RG 200 to the remotely located TVs 199. The media 210 is illustrated as coaxial cable 210 in Fig. 15. In order for the other signals to be transmitted over the same media 210, the other signals need to be passed through a balun 808 located in close proximity to the RG 200. The balun 808 adjusts the impedance of the other signals so that it can be transmitted over the same media 210. For example, as illustrated the digital signals being transmitted between the
telecommunications network and the RG 200 are transmitted over twisted wire pair cables. Thus in this embodiment, the balun 808 provides the necessary impedance matching to allow the 100 ohm VDSL signal received from the digital network to be carried over the existing 75 ohm in home coaxial cable 210.

The combined TV signal and the other signals are then transmitted over the common media 210, such as in-home coaxial cable, to a remote location within the residence 190. A diplexer 810 is located at the remote location to remove the other signals from the media. A balun 812 is used to adjust the impedance of the other signals so that they can be transmitted over the twisted wire pair cables to the telecommunications network. The combined TV signal is then split by the splitter 177 so that it can be provided to multiple remotely located TVs 199. As illustrated the combined TV signal is provided to the RAP 900. However, the RAP 900 does not perform any processing on the combined TV signal. Each of the remotely located TVs 199 then displays the TV signal for the channel that was selected for viewing.

When the viewer of one of the remotely located TVs 199 decides to change channels, the viewer programs a wireless RC which transmits wireless signals, such as UHF signals, to the RAP 900. The RAP 900 receives the wireless signal, which includes the channel select command, and transmits the wireless signal downstream over the media 210 (i.e., coaxial cable). The wireless signals received from the multiple remotely located TVs 199 are combined at the splitter 177 onto the media 210. Downstream signals from the telecommunications network may be transmitted over the same media 210 using the balun 812 to adjust the impedance of the signals and the diplexer 810 to transmit the signals over the media 210. When the downstream signals are in the vicinity of the RG 200, the diplexer 806 removes the other signals from the media 210 and provides them to the balun 808 so that the impedance can be adjusted and the other signals can be provided to a network input of the RG 200. The wireless signals are provided from the diplexer 806 to the
RAM 920 where the channel select command is extracted and modulated to the RG 200. As illustrated the channel select commands are modulated to the RG 200 over speaker wire 922. The channel select commands are not provided to the splitter 804.

As should be apparent, numerous connections are required to install the configuration of Fig. 15. That is, the combiner 802 needs to be connected to the RG 200, the splitter 804 needs to be connected to the combiner 802, the RAM 920 needs to be connected to the splitter 804, the diplexer 806 needs to be connected to the RAM 920, the RAM 920 needs to be connected to the RG 200, the balun 808 needs to be connected to the RG 200, and the diplexer 806 needs to be connected to the balun 808. The dotted line on Fig. 15 illustrates the components that can be replaced by a single device, in an alternative embodiment. The alternative embodiment utilizes a Media Interface Device (MID) 800, such as a coaxial interface device, that includes the combiner 802, the splitter 804, the diplexer 806, the balun 808, and the RAM 920 and can be mounted directly on the RG 200. Utilizing the MID 800 reduces the number of independent devices and the number of cables required for installation of the configuration illustrated in Fig. 15.

Fig. 16 illustrates a schematic of the MID 800. The MID 800 includes multiple connectors, a 2x3 RF splitter 803, a RAM 920, a diplexer 806, a balun 808, and associated connections between the devices as illustrated. The MID 800 performs all the functions previously described above for each of the individual components. The multiple connectors include five connectors for connecting to the RG 200: three video connectors 850, such as coaxial connectors; a connector 852 for the channel select command, such as an audio pendant; and a connector 864 for connecting the telecommunications network to the RG 200, such as a RJ-45 pendant. The multiple connectors also include two connectors for connecting to other devices: a connector 860, such as coaxial connector, for the local TV 199;
and a connector 862, such as a coaxial connector, for the remote devices.

The channel numbers illustrated in Fig. 16 are examples of the channels that are assigned to each TV. The TV signals associated with each TV being modulated onto the coaxial cable at the frequency of the assigned channel. As illustrated the assigned channels are 3, 8 and 11. These channels are simply for illustrative purposes and are not intended to limit the scope of the invention.

Fig. 17 illustrates one embodiment of the housing of the MID 800. As illustrated the MID 800 includes three video connectors 850 which would be adequately spaced so that the MID 800 could be directly attached to the connectors on the RG 200. The MID 800 also includes the two connectors 860, 862 for the local TV 199 and the remotely located devices, as well as a pendant 864 for connecting the MID 800 to the network input of the RG 200 and a pendant 852 for connecting to the channel select command port, audio port, of the RG 200. The MID 800 may have a die cast housing, and is preferably die cast from tin plated zinc. The MID 800 should be produced so as to shield the various modules within the MID 800 from each other and external radiation. All of the coaxial connectors should be built into the housing.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those of ordinary skill in the art that various changes and modifications may be made which clearly fall within the scope of the present invention. The invention is intended to be protected broadly within the spirit and scope of the appended claims.
Claims

What is claimed is:

1. In a residential environment having a plurality of televisions locatable in at least two separate locations, a method of distributing video signals from a residential gateway, the method comprising:

   receiving at least one channel select command from one of a plurality of remote control devices associated with a respective one of the plurality of televisions, wherein at least a first one of the plurality of remote control devices is a wireless remote control device that transmits the channel select command as a wireless signal;

   receiving a video signal from a telecommunications network in response to the at least one channel select command;

   constructing, from the video signal, at least one series of video packets corresponding to the at least one channel select command;

   transporting the at least one series of video packets over a video packet bus to a plurality of video decoders; and

   decoding the at least one series of video packets to produce at least one television signal, the decoding performed by at least one of the plurality of video decoders.

2. The method of claim 1, further comprising:
receiving the wireless signal from the first one of the
plurality of remote control devices at a remote antennae
package connected to the first one of the plurality of
televisions; and

transmitting the wireless signal from the remote antennae
package over media.

3. The method of claim 2, further comprising:

receiving the wireless signal from the media at a remote
antennae module located in close proximity to the residential
gateway;

demodulating the wireless signal and extracting the
portion corresponding to the channel select command; and

transmitting the channel select command to the residential
gateway.

4. The method of claim 3, wherein said receiving the
wireless signal includes receiving an approximately 433 MHz
wireless signal from the first one of the plurality of remote
control devices at a remote antennae package connected to first
one of the plurality of televisions.

5. The method of claim 4, wherein said demodulating the
wireless signal includes demodulating the wireless signal and
extracting therefrom the channel select command as an approximately 1 KHz signal.

6. The method of claim 1, wherein at least a second one of the plurality of remote control devices is an optical remote control device that transmits the channel select command directly to the residential gateway as an optical signal.

7. The method of claim 6, wherein the optical signal is received by an optical receiver which is an integral part of the residential gateway.

8. The method of claim 1, wherein the wireless signal is an optical signal and the wireless remote control device is an optical remote control device, the method further comprising:

   transmitting the optical signal from the optical remote control device to an optical receiver located in close proximity to and coupled to the associated television;

   detecting the optical signal and generating corresponding demodulated pulse trains at the optical receiver;

   transmitting the pulse trains to a RF transmitter;

   receiving the pulse train and generating corresponding RF signals at the RF transmitter; and

   transmitting the RF signals from the RF transmitter to the residential gateway over media.
9. The method of claim 8, wherein said transmitting the RF signals from the RF transmitters includes:

transmitting the RF signals from the RF transmitters to a remote antennae module over the media, the media connecting the remotely located televisions to the remote antennae module;

receiving the RF signals at the remote antennae module;

extracting the channel select commands from the RF signals received at the remote antennae module; and

transmitting the channel select commands from the remote antennae module to the residential gateway.

10. The method of claim 9, wherein the media is a coaxial cable.

11. The method of claim 8, wherein said transmitting the RF signals from the RF transmitters includes:

transmitting the RF signals from the RF transmitters to a media interface device over the media, the media connecting the remotely located televisions to the media interface device;

receiving the RF signals at the media interface device;

extracting the channel select commands from the RF signals received at the media interface device; and
transmitting the channel select commands from the media interface device to the residential gateway.

12. The method of claim 8, wherein the optical remote control devices are infrared remote control devices and the optical signals are infrared signals.

13. A residential gateway for distributing video signals to a plurality of televisions locatable within at least two separate locations in a residential environment, said residential gateway comprising:

a plurality of remote control devices associated with a respective one of the plurality of televisions for transmitting channel select commands, wherein at least a first one of the plurality of remote control devices is a wireless remote control device that transmits the channel select command as a wireless signal;

a network interface module for receiving signals including video signals from a telecommunications network, wherein the received video signals correspond to the channel select commands;

means for constructing at least one series of video packets from the received video signals;

a plurality of video processors for decoding the at least one series of video packets to produce at least one television signal; and
a video packet bus for transporting the at least one series of video packets to said plurality of video processors.

14. The residential gateway of claim 13, further comprising a remote antennae package connected to the first one of the plurality of televisions associated with the first one of the plurality of remote control devices, the remote antennae package receiving the wireless signal and transmitting the wireless signal over media.

15. The residential gateway of claim 14, further comprising a remote antennae module for receiving the wireless signal from the remote antennae package, demodulating the wireless signal, extracting the portion corresponding to the channel select command, and transmitting the channel select command to the residential gateway.

16. The residential gateway of claim 15, wherein the remote antennae module is in close proximity to the residential gateway.

17. The residential gateway of claim 15, wherein the remote antennae module is connected to the residential gateway.
18. The residential gateway of claim 15, wherein the remote antennae module is an integral part of the residential gateway.

19. The residential gateway of claim 15, wherein the wireless signal has a frequency of approximately 433 MHz.

20. The residential gateway of claim 15, wherein the channel select command is extracted from the wireless signal as an approximately 1 KHz signal.

21. The residential gateway of claim 13, wherein at least a second one of the plurality of remote control devices is an optical remote control device that transmits the channel select command directly to the residential gateway as an optical signal.

22. The residential gateway of claim 21, further comprising an optical receiver for receiving the optical signal from the optical remote control device.

23. The residential gateway of claim 13, wherein the wireless signal is an optical signal and the wireless remote control device is an optical remote control device, the residential gateway further comprising an optical conversion
device in close proximity to the respective television, said optical conversion device

receiving optical signals, including channel select commands, from optical remote control devices associated with the remotely located televisions;

converting the optical signals to RF signals; and

transmitting the RF signals to the residential gateway over media.

24. The residential gateway of claim 23, wherein said optical conversion device includes:

an optical receiver for detecting the optical signal and generating a corresponding pulse train;

a bias switch connected to said optical receiver, said bias switch turning on and off in response to the pulse train;

an oscillator connected to said bias switch for producing a modulated RF signal, the modulated RF signal being produced by said oscillator turning on and off in response to said bias switch; and

a diplexer filter for injecting the RF signal onto the media in the direction of the residential gateway.

25. The residential gateway of claim 24, wherein said optical conversion device further includes an attenuator
connected between said oscillator and said diplexer for reducing the amplitude of the RF signal.

26. The residential gateway of claim 23, further comprising a remote antennae module coupled to said optical conversion device with the media, said remote antennae module receiving the RF signals and extracting the channel select commands from the RF signals.

27. The residential gateway of claim 26, wherein the media is a coaxial cable.

28. The residential gateway of claim 26, wherein said remote antennae module extracts the channel select commands from the RF signal as a 1 KHz signal.

29. The residential gateway of claim 23, further comprising a media interface device coupled to said optical conversion device with the media, said media interface device receiving the RF signals and extracting the channel select commands from the RF signals.

30. The residential gateway of claim 29, wherein said media interface device includes a diplexer for extracting other
signals from the media, the other signals having been transported over the same media as the channel select commands.

31. The residential gateway of claim 30, wherein said media interface device further includes a balun so that the impedance of a subset of the other signals can be adjusted so that the subset of the other signals can be processed by the residential gateway.

32. The residential gateway of claim 29, wherein said media interface device is directly connected to the residential gateway.

33. A method for receiving and decoding signals from a telecommunications network at a residential gateway, and transmitting the decoded signals from the residential gateway to a plurality of devices including multiple televisions, the method comprising:

connecting the residential gateway to the telecommunications network and to at least one television that is remotely located from the residential gateway;

selecting a television channel to view for the at least one television by programming an associated wireless remote control device, wherein the wireless remote control device transmits a channel select command as a wireless signal to a remote antennae package connected to the television, the remote
antennae package receives the wireless signal and transmits the wireless signal over a media to a remote antennae module which demodulates the wireless signal and extracts the portion corresponding to the channel select command;

transmitting the channel select command to the telecommunications network;

receiving a video signal from the telecommunications network corresponding to the channel select command;

decoding the video signal into a television signal, the decoding performed by one of multiple video decoders associated with the multiple televisions; and

transmitting the television signal to the at least one television.

34. A residential gateway for receiving and decoding signals from a telecommunications network and transmitting the decoded signals to a plurality of devices including multiple televisions, the residential gateway comprising:

a network interface module for transmitting upstream signals, including channel select commands, to the telecommunications network and receiving downstream signals, including video signals, from the telecommunications network;

a plurality of video decoders for decoding the video signals into at least one television signal corresponding to at least one channel select command, and transmitting the at least one television signal to the corresponding television;
a remote control module for processing the channel select commands, wherein at least one of the channel select commands is extracted from a wireless signal, the wireless signal being transmitted from a wireless remote control device to a remote antennae package connected to the associated television, the remote antennae package transmitting the wireless signal over media to a remote antennae module which demodulates the wireless signal and extracts the portion corresponding to the channel select command.

35. A residential gateway for receiving and decoding signals from a telecommunications network and transmitting the decoded signals to a plurality of devices including multiple televisions, the residential gateway comprising:

a network interface module for transmitting upstream signals, including channel select commands, to the telecommunications network and receiving downstream signals, including video signals, from the telecommunications network;

a plurality of video decoders for decoding the video signals into at least one television signal corresponding to at least one channel select command, and transmitting the at least one television signal to the corresponding television;

a remote antennae package located in close proximity to and connected to a remotely located television, said remote antennae package receiving a wireless signal, including a channel select command, from a wireless remote control device
associated with the remotely located television and modulating the wireless signal over media; and

a remote antennae module connected to the media and the residential gateway, said remote antennae module demodulating the wireless signal, extracting the portion corresponding to the channel select command, and transmitting the channel select command to the residential gateway.

36. A method for receiving signals from a telecommunications network, decoding the signals, and transmitting the decoded signals from a residential gateway to a plurality of devices including multiple televisions, the method comprising:

connecting the residential gateway to the telecommunications network and to at least one television that is remotely located from the residential gateway;

selecting a television channel to view for the at least one television by programming associated optical remote control devices, wherein the optical remote control devices transmit channel select commands as optical signals to optical conversion devices connected to the at least one television, the optical conversion devices receive the optical signals, convert the optical signals to RF signals and transmit the RF signals over media to a remote antennae module which demodulates the RF signals and extracts the portion corresponding to the channel select commands;
transmitting the channel select commands to the telecommunications network;

receiving a video signal from the telecommunications network;

processing the video signal to produce television signals corresponding to the channel select commands, wherein the processing is performed by a video processor; and

transmitting the television signals to the at least one television.

37. A residential gateway for receiving and decoding signals from a telecommunications network and transmitting the decoded signals to a plurality of devices including multiple televisions, the residential gateway comprising:

a network interface module for transmitting upstream signals, including channel select commands, to the telecommunications network and receiving downstream signals, including video signals, from the telecommunications network;

a video processor for processing the video signals into at least one television signal corresponding to at least one channel select command, and transmitting the at least one television signal to the corresponding television;

a remote control module for processing the channel select commands, wherein at least one of the channel select commands is extracted from a RF signal received from an optical conversion device connected to a remotely located television.
38. The residential gateway of claim 37, wherein the RF signal is generated by the optical conversion device in response to an optical signal received from an optical remote control device, the optical conversion device transmitting the RF signal over cable to a remote antennae module which demodulates the RF signal and extracts the portion corresponding to the channel select command.

39. A residential gateway for receiving and decoding signals from a telecommunications network and transmitting the decoded signals to a plurality of devices including multiple televisions, the residential gateway comprising:

   a network interface module for transmitting upstream signals, including channel select commands, to the telecommunications network and receiving downstream signals, including video signals, from the telecommunications network;
   a video processor for processing the video signals to generate television signals corresponding to channel select commands, and transmitting the television signals to the corresponding televisions;

   an optical conversion device located in close proximity to and connected to a remotely located television, said optical conversion device receiving an optical signal, including a channel select command, from an optical remote control device associated with the remotely located television, converting the
optical signal to an RF signal, and modulating the RF signal over media; and

a remote antennae module, connected to the media and the residential gateway, for demodulating the RF signal, extracting the portion corresponding to the channel select command, and transmitting the channel select command to the residential gateway.

40. The residential gateway of claim 39, wherein said optical conversion device includes:

an optical receiver for detecting the optical signal and generating a corresponding pulse train;

a bias switch connected to said optical receiver, said bias switch turning on and off in response to the pulse train;

an oscillator connected to said bias switch for producing a modulated RF signal in response to said bias switch turning on and off said oscillator; and

a diplexer filter for injecting the RF signal onto the media in the direction of the residential gateway.

41. The residential gateway of claim 40, wherein said optical conversion device further includes an attenuator connected between said oscillator and said diplexer for reducing the amplitude of the RF signal.
42. The residential gateway of claim 39, wherein said remote antennae module is an integral part of a media interface device.

5 43. The residential gateway of claim 39, wherein the remote antennae module is part of a media interface device, the media interface device further includes a diplexer for extracting other signals from the media, the other signals having been transported over the same media as the channel select commands.

44. The residential gateway of claim 43, wherein the media interface device further includes a balun so that the impedance of a subset of the other signals can be adjusted so that the subset of the other signals can be processed by the residential gateway.

45. An optical conversion device for receiving optical signals, converting the optical signals to RF signals, and transmitting the RF signals over media, the optical conversion device comprising:

an optical receiver for detecting the optical signal and generating a corresponding pulse train;

a bias switch connected to said optical receiver, said bias switch turning on and off in response to the pulse train;
an oscillator connected to said bias switch for producing a modulated RF signal, the modulated RF signal being produced by said oscillator turning on and off in response to said bias switch; and

5 a diplexer filter for directionally injecting the RF signal onto the media.

46. The optical conversion device of claim 45, further comprising an attenuator connected between said oscillator and said diplexer for reducing the amplitude of the RF signal.

47. The optical conversion device of claim 45, wherein the optical conversion device is connected to a TV and receives optical signals corresponding to channel select commands associated with the TV from a corresponding remote control device.

48. The optical conversion device of claim 47, wherein said diplexer filter injects the RF signal onto the media in the direction of a residential gateway that controls communications between the TV and a telecommunications network.

49. The optical conversion device of claim 45, wherein the media is a coaxial cable.
50. An optical conversion device for receiving optical signals representing channel select commands from an optical remote control device associated with a TV, converting the optical signal to an RF signal, and transmitting the RF signal over media to a residential gateway, the optical conversion device comprising:

an optical receiver for detecting the optical signal and generating a corresponding pulse train;

a bias switch connected to said optical receiver, said bias switch turning on and off in response to the pulse train;

an oscillator connected to said bias switch for producing a modulated RF signal, the modulated RF signal being produced by said oscillator turning on and off in response to said bias switch; and

a diplexer filter for injecting the RF signal onto the media in the direction of the residential gateway.

51. The optical conversion device of claim 50, further comprising an attenuator connected between said oscillator and said diplexer for reducing the amplitude of the RF signal.

52. A method for receiving and decoding signals from a telecommunications network at a residential gateway, and transmitting the decoded signals from the residential gateway to a plurality of devices including multiple televisions, the method comprising:
connecting the residential gateway to the telecommunications network and to at least one television that is remotely located from the residential gateway;

selecting a television channel to view for the at least one television by programming associated wireless remote control devices, wherein the wireless remote control devices transmit channel select commands as wireless signals to remote antennae packages connected to the at least one television, the remote antennae packages receive the wireless signals and transmit the wireless signals over media to a media interface device which demodulates the wireless signals and extracts the portion corresponding to the channel select commands;

transmitting the channel select commands to the telecommunications network;

receiving a video signal from the telecommunications network;

processing the video signal to produce television signals corresponding to the channel select commands, wherein the processing is performed by a video processor; and

transmitting the television signals to the at least one television.

53. A residential gateway for receiving and decoding signals from a telecommunications network and transmitting the decoded signals to a plurality of devices including multiple televisions, the residential gateway comprising:
a network interface module for transmitting upstream signals, including channel select commands, to the telecommunications network and receiving downstream signals, including video signals, from the telecommunications network;

a video processor for processing the video signals into at least one television signal corresponding to at least one channel select command, and transmitting the at least one television signal to the corresponding television;

a remote control module for processing the channel select commands, wherein at least one of the channel select commands is extracted from a wireless signal, the wireless signal being transmitted from a wireless remote control device to a remote antennae package connected to the associated television, the remote antennae package transmitting the wireless signal over media to a media interface device which demodulates the wireless signal and extracts the portion corresponding to the channel select command.

54. A residential gateway for receiving and decoding signals from a telecommunications network and transmitting the decoded signals to a plurality of devices including multiple televisions, the residential gateway comprising:

a network interface module for transmitting upstream signals, including channel select commands, to the telecommunications network and receiving downstream signals, including video signals, from the telecommunications network;
a video processor for decoding the video signals into at least one television signal corresponding to at least one channel select command, and transmitting the at least one television signal to the corresponding television;

5 a remote antennae package located in close proximity to and connected to a remotely located television, said remote antennae package receiving a wireless signal, including a channel select command, from a wireless remote control device associated with the remotely located television and modulating the wireless signal over media; and

10 a media interface device connected to the media and the residential gateway for demodulating the wireless signal, extracting the portion corresponding to the channel select command, and transmitting the channel select command to the residential gateway.

54. The residential gateway of claim 53, wherein said media interface device includes:

a remote antennae module for extracting the channel select commands from the wireless signal;

20 a splitter for splitting the at least one TV signal, so that the at least one TV signal can be provided to multiple locations;

a balun for adjusting the impedance of network signals to and from the telecommunications network so that they can be transmitted over the media; and
a diplexer for extracting from the media network signals from the telecommunications network and inserting onto the media network signals from the residential gateway.

55. The residential gateway of claim 54, wherein said media interface device further includes a combiner for combining the at least one TV signal into a combined TV signal and said splitter splits the combined TV signal.

56. A media interface device for directional distribution of signals to multiple devices over a media, the media interface comprising:

   a first connector for receiving a first signal in a first direction;

   a second connector for receiving a second signal in the first direction and transmitting a third signal in a second direction;

   a third connector for transmitting the first signal and the second signal over the media in the first direction and receiving the third signal and a fourth signal over the media in the second direction;

   a diplexer for extracting the third signal from the media in the second direction and inserting the second signal onto the media in the first direction;
a remote antennae module for receiving the fourth signal
and extracting a fifth signal therefrom; and

a fourth connector for transmitting the fifth signal in
the second direction.

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57. The media interface device of claim 56, further
comprising a balun for adjusting the impedance of the second
signal so that it can be inserted onto the media by said
diplexer, and adjusting the impedance of the third signal
extracted from the media by said diplexer so it can be
transmitted over said connector.

58. The media interface device of claim 56, further
comprising:

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a splitter for splitting the first signal into two
identical first signals; and

a fifth connector for transmitting one of the two
identical first signals in the first direction.

59. The media interface device of claim 56, further
comprising a combiner, wherein said first connector includes
multiple connectors and the first signal includes multiple
signals, each multiple signal associated with a respective one
of the multiple connectors, and said combiner combines each of
the multiple signals together to form a combined signal, and
said third connector transmits the combined signal and the second signal over the media in the first direction.

60. The media interface device of claim 56, further comprising an X by Y splitter and additional connectors, wherein X and Y are integers, said first connector includes Y connectors and the first signal includes Y signals, each Y signal associated with a respective Y connector, and said X by Y splitter combines the Y signals to form a combined signal and splits the combined signal into X identical combined signals, said third connector transmits the combined signal and the second signal over the media in the first direction, and said additional connectors transmit the combined signal in the first direction.

61. The media interface device of claim 56, wherein the media interface device connects directly to a residential gateway and distributes signals between the residential gateway, a telecommunications network, and multiple devices communicating with the telecommunications network via the residential gateway.

62. The media interface device of claim 61, wherein the first signal is a TV signal, the second signal is an upstream network signal, the third signal is a downstream network signal, the fourth signal is a wireless signal, the fifth
signal is a channel select command, the first direction is away from the residential gateway, and the second direction is toward the residential gateway.

63. A media interface device for connecting to a residential gateway and distributing signals to and from the residential gateway over a media, the media interface comprising:

  a first connector for receiving and transmitting signals over a media, the received signals including wireless signals from wireless remote control devices associated with remotely located TVs and downstream network signals from a telecommunications network, the transmitted signals including TV signals and upstream network signals;

  a second connector for receiving the TV signals from the residential gateway;

  a third connector for receiving the upstream network signals from the residential gateway and transmitting the downstream network signals to the residential gateway;

  a diplexer, connected to said first connector, for extracting the downstream network signals from the media and inserting the upstream network signals onto the media;

  a balun, connected to said diplexer, for adjusting the impedance of the upstream network signals so they can be inserted onto the media by said diplexer, and for adjusting the
impedance of the downstream network signals so they can be processed by the residential gateway; and

a remote antennae module, connected to said diplexer, for extracting the channel select commands from the wireless signals and transmitting the channel select commands to the residential gateway.

64. The media interface device of claim 63, further comprising an X by Y splitter and X-1 additional connectors, wherein X and Y are integers, said second connector includes Y connectors each receiving a respective TV signal, said X by Y splitter combines the respective TV signals to form a combined TV signal and splits the combined signal into X identical combined TV signals, said diplexer inserts the upstream network signals onto the media with the combined TV signal, and said combined TV signal is provided to the X-1 additional connectors.
FIG. 7
FIG. 14B
FIG. 17
**INTERNATIONAL SEARCH REPORT**

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**A. CLASSIFICATION OF SUBJECT MATTER**
- IPC(7): H04N 7/18
- US CL: 725/81, 82, 120
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**
- Minimum documentation searched (classification system followed by classification symbols)
  - U.S.: 725/74, 78, 81, 82, 85, 120

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

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

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
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<tbody>
<tr>
<td>Y</td>
<td>US 5,701,152 A (CHEN) 23 December 1997, see whole document.</td>
<td>1-64</td>
</tr>
<tr>
<td>Y</td>
<td>US 5,708,961 A (HYLTON et al) 13 January 1998, see whole document.</td>
<td>1-64</td>
</tr>
<tr>
<td>Y</td>
<td>US 5,953,045 A (TANISHIMA) 14 September 1999, see whole document.</td>
<td>1-64</td>
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</table>

[] Further documents are listed in the continuation of Box C.  

See patent family annex.

- "A" Special categories of cited documents:
  - "A" Document defining the general state of the art which is not considered to be of particular relevance
  - "E" Earlier document published on or after the international filing data
  - "L" Document which may throw doubts on priority claim(s) or which is cited to establish the publication data of another application or other special reason (as specified)
  - "O" Document referring to an oral disclosure, use, exhibition or other means
  - "P" Document published prior to the international filing data but later than the priority data claimed

Date of the actual completion of the international search: 17 APRIL 2001

Date of mailing of the international search report: 31 MAY 2001

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<table>
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<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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</table>

Form PCT/ISA/210 (continuation of second sheet) (July 1998) ★
INTERNATIONAL SEARCH REPORT

Box I  Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.☐ Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2.☐ Claims Nos.:
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3.☐ Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II  Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2.☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3.☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4.☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest
☐ The additional search fees were accompanied by the applicant’s protest.
☐ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet(1)) (July 1998) •