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(71) Applicant *(for all designated States except US)*: **NIELSEN MEDIA RESEARCH, INC.** [US/US]; 770 Broadway, New York, NY 10003 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **RAMASWAMY, Arun** [US/US]; 10710 Tavistock Drive, Tampa, FL 33626 (US). **CAVE, Mark Richard** [GB/US]; 1216 Omaha Street, Palm Harbor, FL 34683 (US).

(74) Agent: **HO, Frankie**; Grossman & Flight, LLC, 20 N. Wacker Drive, Suite 4220, Chicago, IL 60606 (US).

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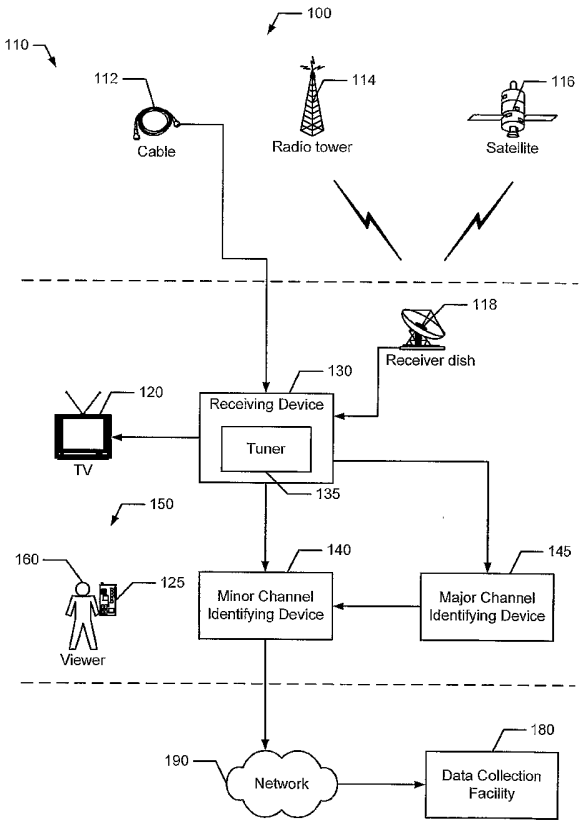
(54) Title: METHODS AND APPARATUS TO IDENTIFY A TUNED DIGITAL TELEVISION CHANNEL



(57) Abstract: Methods and apparatus to identify a tuned digital television channel are described herein (FIG. 1). In an example method, a tuned major channel is identified (510). Program identifiers (PIDs) associated with the tuned major channel are identified (520). Packets of minor channels associated with the tuned major channel from a multiplexed digital stream of major channels are extracted (530). At least one of the major channels includes minor channels. An audio stream from a digital audio output is extracted (540). Accordingly, a digital signature associated with the extracted audio stream is compared to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel to identify a tuned digital television channel (550).

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METHODS AND APPARATUS TO IDENTIFY A TUNED DIGITAL TELEVISION CHANNEL

TECHNICAL FIELD

[0001] The present disclosure relates generally to media measurement, and more particularly, to methods and apparatus to identify a tuned digital television (DTV) channel.

BACKGROUND

[0002] Companies that rely on broadcast video and/or audio programs for revenue, such as advertisers, television networks and content providers, wish to know the size and demographic composition of the audience(s) that consume their program(s). Audience measurement companies may address this need by measuring the demographic composition of a set of statistically selected households and the program consumption habits of the member(s) of those households. For example, audience measurement companies may collect viewing data on a selected household by monitoring the content displayed on that household's television(s) and by identifying which household member(s) are watching that content.

[0003] Digital television is expected to supplant analog television in the near future. Although the technology used to broadcast and receive television signals is changing, the need to monitor the size and demographic composition of the viewing audience is not changing. Faced with this continuing need and with changing technology, audience measurement companies must develop new ways to efficiently and accurately gather the desired audience composition data.

[0004] Digital television systems broadcast programs by modulating one or more streams of digital packets on a single carrier frequency. Because multiple streams of data

packets can be multiplexed on a single carrier frequency, multiple programs can be carried by that single frequency. As is well known to persons of ordinary skill in the art, each of the packets in the broadcast data streams typically include headers containing various administrative data as well as payloads carrying content data. For example, each of the headers may include a program identifier (a PID) which identifies the corresponding packets as being associated with a specific one of the programs carried on the frequency. The headers may also identify the type of payload carried by their corresponding packets. For example, the headers may contain a code identifying their corresponding payload as audio data, video data, or other data.

[0005] Because of this ability to multiplex multiple programs on a single carrier frequency, digital television channels are classified as major channels and minor channels. Major channels are analogous to the analog channels which, as is well known, have traditionally only carried one program on a single carrier frequency. Thus, a major channel refers to all of the content carried by a single transmission frequency. Minor channels, on the other hand, refer to the individual programs multiplexed within a major channel. It is possible for a major channel to carry only one program (i.e., to use only one minor channel), or to carry multiple programs (i.e., to have two or more minor channels).

[0006] To identify a program tuned by a digital television and/or a set top box (STB), it is necessary to identify the tuned major channel and one or more tuned minor channel associated with the tuned major channel. Identifying the frequency tuned by the tuner of the digital television and/or the STB identifies the major channel, but, unless the major channel carries only one minor channel, the identification of the major channel does not identify which of the minor channels are being tuned. Therefore, there is a need to efficiently and accurately identify both the major and minor channels tuned by a digital television and/or an STB.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a block diagram representation of an example media monitoring system.

[0008] FIG. 2 is a block diagram representation of an example channel identifying device.

[0009] FIG. 3 is an example lookup table of program identifiers (PIDs) that may be used to implement the example channel identifying device of FIG. 2.

[0010] FIG. 4 is an example lookup table of digital signatures that may be used to implement the example channel identifying device of FIG. 2.

[0011] FIG. 5 is a flow diagram depicting one manner in which the example channel identifying device of FIG. 2 may be configured to identify a tuned digital television channel.

[0012] FIG. 6 is a block diagram representation of an example processor system that may be used to implement the example channel identifying device of FIG. 2.

DETAILED DESCRIPTION

[0013] In general, methods and apparatus for identifying a tuned digital television channel are disclosed herein. The methods and apparatus disclosed herein may be used to identify a tuned minor channel without implementing either a bit stream decoding algorithm or an audio correlation algorithm. In addition to identifying the tuned minor channel, the methods and apparatus disclosed herein may also identify program names, metadata associated with the other minor channels, and/or name and language type of a program associated with the tuned minor channel.

[0014] Traditionally, television signals are broadcasted as analog signals. The Federal Communications Commission (FCC) allocated six megahertz (MHz) of bandwidth for each analog television channel in three bands of frequencies in the radio spectrum (e.g., frequencies ranging from 54 to 88 MHz for analog television channels 2 to 6, frequencies ranging 174 to 216 MHz for analog television channels 7 through 13, and frequencies 470 to 880 MHz for analog television channels 14 to 83). To improve quality by providing greater resolution, television signals may be broadcasted as digital signals. For example, a digital signal may include metadata, synchronization information, audio and/or video streams, channel information (e.g., PSIP information and/or PMT/PAT information as described in detail below), etc. Accordingly, the FCC allocated new frequencies to broadcasters for transmitting digital signals to provide digital television channels. As a result, some television broadcasters may have an analog television channel and a digital television channel corresponding to the analog television channel. In particular, digital television channels may carry a 19.39 megabit- per-second (Mbps) data stream. Further, digital television channels are classified as major channels and minor channels. Major channels may correspond to the analog channels that have traditionally carried only one program on a single carrier frequency (also known as "branded" channels). For example, a broadcaster may transmit a single television program at a frequency bandwidth ranging from 54 to 60 MHz (e.g., channel 2). Thus, a major channel refers to all of the content carried by a single transmission frequency. Minor channels, on the other hand, refer to the individual programs multiplexed within a major channel. It is possible for a major channel to carry only one program (i.e., to use only one minor channel), or to carry multiple programs (i.e., to have two or more minor channels). Alternatively, the broadcaster may divide the digital television channel into two or more data streams. For example, the broadcaster may divide branded channel no.

4 into three streams with each stream having a frequency of 6.46333 Mbps. Each of the divided data streams may correspond to a minor channel (e.g., 4.1, 4.2, and 4.3 of FIG. 4) carrying a different program.

[0015] While many television broadcasters may broadcast on both analog television channels and corresponding digital television channels during the gradual transition from analog broadcasting to digital broadcasting, other television broadcasters may broadcast solely on digital television channels (e.g., also known as "carrier channels"). In particular, carrier channels do not correspond to analog television channels (i.e., carrier channels are not "branded" to traditional analog channels). In this case, a tuned major channel refers to all of the content carried by a single transmission frequency bandwidth ranging, for example, from 54 to 60 MHz (i.e., a carrier channel). For example, a broadcaster may transmit digital signals only on carrier channel no. 99 because the carrier channel no. 99 is outside of the three bands of frequencies allocated to analog television channels. As a result, traditional methods to identify tuning information are outdated because a channel may include multiple data streams that are multiplexed in a particular bandwidth. Thus, the methods and apparatus described herein are necessary to identify tuning information as more and more broadcasters begin to transmit digital signals in addition to or instead of analog signals.

[0016] In the example of FIG. 1, an example media monitoring system 100 including a television service provider 110, a media delivery device 120, a remote control device 125, and a receiving device 130 is metered using an audience measurement system having a channel identifying device 140 and a major channel identifying device 145. The components of the system 100 may be coupled in any well known manner. For example, the media delivery device 120 may be a television such as a digital television (DTV) positioned in a viewing area 150. The receiving device 130 may be an STB, a video

cassette recorder, a digital video recorder, a personal video recorder, a personal computer, a digital video disc player, etc. coupled to the television 120. The viewing area 150 is located within a house occupied by one or more people, referred to as household members 160, whom may have agreed to participate in an audience measurement research study. In particular, the viewing area 150 includes the area in which the television 120 and/or the receiving device 130 is located and from which the television 120 may be viewed by one or more household members 160 located in the viewing area 150. The minor channel identifying device 140 and major channel identifying device 145 are configured to identify tuning information (i.e., minor and major channels tuned to by the household members 160). Further, the minor channel identifying device 140 is configured to send viewing data to a data collection facility 180 via a network 190. The data collection facility 180 is configured to process and store data received from the minor channel identifying device 140.

[0017] The television service providers 110 may be implemented by any television service provider such as, for example, a cable television service provider 112, a radio frequency (RF) television service provider 114, and/or a satellite television service provider 116. The television 120 and/or the receiving device 130 may be adapted to tune a television signal transmitted via one of a plurality of channels by the television service provider 110 and to process and display television signals provided in any format such as a high definition television (HDTV) signal format, an Advanced Television Systems Committee (ATSC) television signal format, a digital video broadcasting (DVB) television signal format, an Association of Radio Industries and Businesses (ARIB) television signal format, a digital cable-based Moving Picture Experts Group (MPEG) format, etc. The user-operated remote control device 125 allows a user to cause the television 120 and/or the receiving device 130 to tune to and receive signals transmitted

on a desired major/minor channel, and to cause the television 120 and/or the receiving device 130 to process and present the programming content contained in the signals transmitted on the desired major/minor channel. The processing performed by the television 120 and/or the receiving device 130 may include, for example, extracting a video component delivered via the received signal and an audio component delivered via the received signal, causing the video component to be displayed on a screen/display associated with the television 120, and causing the audio component to be emitted by speakers associated with the television 120. The programming content contained in the television signal may include, for example, a television program, a movie, an advertisement, a video game, and/or preview of other programming that is currently offered or will be offered in future by the television service provider 110.

[0018] While the components shown in FIG. 1 are depicted as separate functional blocks within the media monitoring system 100, the functions performed by some of these blocks may be integrated within a single unit or may be implemented using two or more separate components. For example, although the television 120 and the receiving device 130 are depicted as separate blocks, persons of ordinary skill in the art will readily appreciate that the television 120 and the receiving device 130 may be integrated within a single unit. The minor channel identifying device 140 and the major channel identifying device 145 may also be integrated into a single unit as well. Further, the minor channel identifying device 140 and/or the major channel identifying device 145 may be integrated into the television 120 and/or the receiving device 130.

[0019] The tuned major channel of the television 120 and/or the receiving device 130 may be identified by the major channel identifying device 145 as described in, for example, U.S. Patent No. 5,488,408 entitled "Serial Data Channel Metering Attachment for Metering Channels to which a Receiver is Tuned" and issued on January 30, 1996.

The subject matter of U.S. Patent No. 5,488,408 is hereby incorporated by reference. For example, the major channel identifying device 145 may be directly wired to the tuner 135 of the receiving device 130 (i.e., a hardwire link) to receive the tuned major channel. In another example, the major channel identifying device 145 may communicate with the tuner 135 via a wireless link such as radio frequency (RF) link or an infrared link. Alternatively, the minor channel identifying device 140 may be configured to identify the tuned major channel so that a separate component such as the major channel identifying device 145 is unnecessary.

[0020] In the example of FIG. 2, the illustrated minor channel identifying device 200 includes a demodulator 210, a demultiplexer 220, a digital audio interface 230, a digital signature matcher 240, and a communication interface 250. The demodulator 210 is operatively coupled to the demultiplexer 220, which includes a program identifier (PID) filter 260 and a parser 270. The demultiplexer 220 and the digital audio interface 230 are operatively coupled to the digital signature matcher 240, which in turn, is operatively coupled to the communication interface 250. While the components shown in FIG. 2 are depicted as separate blocks within the minor channel identifying device 200, the functions performed by some of these blocks may be integrated within a single semiconductor circuit or may be implemented using two or more separate integrated circuits.

[0021] The receiving device 130 is tuned to a particular channel for viewing on the TV 120 by the viewer 160 via the remote control device 125. In particular, the receiving device 130 receives a TV signal from the broadcast source 110. For example, the TV signal may be a digital TV signal including a plurality of programs. Typically, each of the plurality of programs corresponds to a major channel. The major channel may include at least one minor channel having an audio signal, a video signal, etc. For example, a program may be viewed in different languages such as English or Spanish.

The English version and the Spanish version of the program may be part of the same minor channel but correspond to separate audio PIDs as described in detail below (i.e., the English version is associated with one audio PID and the Spanish version is associated with another audio PID). Alternatively, the minor channels carried by a major channel may carry unrelated programs.

[0022] To identify a tuned minor channel, the demodulator 210 of the minor channel identifying device 200 receives an intermediate frequency (IF) signal from the tuner 135 of the television 120 to produce a digital bit stream corresponding to the tuned major channel (e.g., an ATSC digital bit stream). For example, the IF signal may be a signal modulated 45.75 megahertz (MHz) with a six MHz bandwidth. The IF signal may represent the modulated broadcast carrier tuned to by the receiving device 130.

[0023] The demodulator 210 provides the digital bit stream to the demultiplexer 220 to determine PIDs of minor channels corresponding to the tuned major channel. The demultiplexer 220 also extracts packets corresponding to the minor channels from the digital bit stream. In particular, the parser 270 extracts program and system information protocol (PSIP) information, and uses the tuned major channel to derive the PIDs of minor channels corresponding to the tuned major channel. While the parser 270 is described herein to extract PSIP information, the parser 270 may be configured to extract other type of information from packets corresponding to the minor channels. For example, the parser 270 may be configured to extract program map table (PMT) information or program association table (PAT) information from an MPEG bit stream. In particular, the PMT information may provide a link of a video component and/or an audio component and associated PIDs for each minor channel. The PAT information may provide a list of PIDs associated with the minor channels within the digital bit stream.

[0024] Based on the PIDs, the PID filter 260 extracts packets of minor channels from the multiplexed digital bit stream of major channels from the demodulator 210. For example, the PID filter 260 may be a transport stream parser configured to extract packets having a particular PID from the multiplexed digital stream. The extracted packets of the minor channels then enter the digital signature matcher 240 as described below.

[0025] Referring to FIG. 3, for example, the digital bit stream from the demodulator 210 may include three programs, and each program may include an audio signal and a video signal. The parser 270 of the demultiplexer 220 stores a PID for each signal. For example, the audio signal of Minor Channel No. 1 associated with Major Channel No. 4 has a PID of 411 and the video signal of Minor Channel No. 1 associated with Major Channel No. 4 has a PID of 412. For Minor Channel No. 2 associated with Major Channel No. 4, as another example, the audio signal has a PID of 421, and the video signal has a PID of 122. As another yet example, the audio signal of Minor Channel No. 2 associated with Major Channel 7 has a PID of 721, and the video signal has a PID of 722. Based on the PIDs from the parser 270, the PID filter 260 extracts the packets of minor channels corresponding to the PIDs from the digital bit stream.

[0026] In another example, a program may be broadcasted in different languages (e.g., English, Spanish, French, Japanese, Chinese, etc.). Accordingly, the program may include multiple audio signals. The parser 270 may extract PSIP information to derive a PID associated with each of the multiple audio signals. For example, a program may be broadcasted in English and Spanish on Minor Channel No. 1 associated with Major Channel No. 12 (i.e., two audio signals of the program). The parser 270 may extract PSIP information to derive a PID associated with the English version of the program (e.g., PID 1211) and a PID associated with the Spanish version of the program (e.g., PID 1231). Further, the parser 270 may also identify the name of the program (e.g., program call

letters) and other metadata associated with the program such as language type of the PIDs associated with each of the minor channels (e.g., English version, Spanish version, etc.).

[0027] The digital audio interface 230 receives a digital audio signal from the receiving device 130. For example, the digital audio interface 230 may be a Sony and Philips Digital Interconnect Format (SP-DIF) interface and/or any other suitable audio interface. To extract an audio stream from the digital audio signal, the digital audio interface 230 removes a digital header from the digital audio signal as persons of ordinary skill in the art will readily recognize. As noted above, the digital header may include various administrative data as well as payloads carrying content data. Accordingly, the audio stream enters the digital signature matcher 240.

[0028] The digital signature matcher 240 extracts and compares digital signatures of the packets from the demultiplexer 220 and the digital signature of the audio stream from the digital audio interface 230. The digital signatures may be cyclical redundancy code (CRC) bytes associated with the packets from the demultiplexer 220 and the audio stream from the digital audio interface 230 or bytes associated with a fixed location in an audio packet or frame of the audio stream. In one manner, the digital signature matcher 240 may use a lookup table 400 to compare the digital signature of the audio stream from the digital audio interface 230 to the digital signatures of the extracted packets of the minor channels from the demultiplexer 220. For example, the digital signature of the audio stream may match the digital signature of Minor Channel No. 1 (i.e., "a") for packet n. Accordingly, the digital signature matcher 240 identifies the tuned minor channel as Minor Channel No. 1. In another example, the digital signature of the audio stream may match the digital signature of Minor Channel 2 (i.e., "c") for packet n+1. Thus, the digital signature matcher 240 identifies the tuned minor channel as Minor Channel No. 2. In yet another example, the digital signature matcher 240 identifies the tuned minor

channel as Minor Channel No. 3 for packet n+2 because the digital signature of the audio stream matches the digital signature of Minor Channel No. 3.

[0029] By taking advantage of the digital interface provided by the tuner 135 of the receiving device 130, the minor channel identifying device 200 may identify the tuned minor channel without decoding the minor channels of the digital bit stream from the demodulator 210 to uncompressed audio and/or video signals. In addition to identifying the tuned minor channel, the minor channel identifying device 200 may also identify program names, metadata associated with the other minor channels, and/or name and language type of a program associated with the tuned minor channel. Further, the minor channel identifying device 200 identifies the tuned minor channel without converting the IF signal to a baseband signal so that baseband audio correlation may be performed (i.e., comparing either temporal or spectral fingerprints or signatures of two audio signals). Existing techniques identify the tuned minor channel by implementing baseband audio correlation that may require comparison of audio signals in a round-robin manner (i.e., compare a reference audio signal with a number of known audio signals). In contrast, the minor channel identifying device 200 simply uses the lookup table 400 as described above.

[0030] The minor channel identifying device 200 may use the communication interface 250 to transmit the identified tuned minor channel to the data collection facility 180 to process and/or store. Further, the minor channel identifying device 200 may also transmit the name of the program, the language type of the program, and/or other metadata associated with the identified tuned minor channel. The communication interface 250 may be implemented using any communication interface configured to enable communication the data collection facility 180 via, for example, an Ethernet card, a digital subscriber line (DSL), a coaxial cable, or any wireless connection.

[0031] FIG. 5 depicts one manner in which the example channel identifying device 200 of FIG. 2 may be configured to identify a tuned digital television channel. Persons of ordinary skill in the art will appreciate that the example process of FIG. 5 may be implemented as machine accessible instructions utilizing any of many different programming codes stored on any combination of computer-accessible media such as a volatile or nonvolatile memory or other mass storage device (e.g., a floppy disk, a CD, and a DVD). For example, the machine accessible instructions may be embodied in a machine-accessible medium such as a programmable gate array, an application specific integrated circuit (ASIC), an erasable programmable read only memory (EPROM), a read only memory (ROM), a random access memory (RAM), a magnetic media, an optical media, and/or any other suitable type of medium. Further, although a particular order of actions is illustrated in FIG. 5, persons of ordinary skill in the art will appreciate that these actions can be performed in other temporal sequences. Again, the process 500 is merely provided as an example of one way to configure a system to identify a tuned digital television channel.

[0032] In the example of FIG. 5, the process 500 begins with the minor channel identifying device 200 identifies a tuned major channel of a television (block 510). For example, the minor channel identifying device 200 may receive the frequency of the tuned major channel from another channel identifying device configured to identify the tuned major channel of the television (e.g., the major channel identifying device 145 of FIG. 1). Alternatively, the minor channel identifying device 200 and the major channel identifying device 145 may be integrated into a single unit to identify both the tuned major channel and the tuned minor channel of the television. The tuned major channel may include at least one minor channel. Accordingly, the minor channel identifying device 200 identifies PIDs of minor channels associated with the tuned major channel

(block 520). Based on the PIDs, the minor channel identifying device 200 extracts packets of minor channels from a multiplexed digital bit stream of major channels (block 530). The minor channel identifying device 200 may generate the multiplexed digital bit stream of major channels based on an IF signal from the tuner 135 of the receiving device 130.

[0033] Further, the minor channel identifying device 200 may extract an audio stream from a digital audio output from the receiving device 130 (block 540). To identify a tuned minor channel, the minor channel identifying device 200 compares a digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel (block 550). For example, the minor channel identifying device 200 may compare CRC bytes of the extracted audio stream and of the extracted packets of minor channels. Upon a match of digital signatures, the minor channel identifying device 200 identifies the tuned minor channel of the digital bit stream. As a result, the minor channel identifying device 200 may identify the tuned minor channel without implementing either a bit stream decoding algorithm or an audio correlation algorithm.

[0034] FIG. 6 is a block diagram of an example processor system 1000 adapted to implement the methods and apparatus disclosed herein. The processor system 1000 may be a desktop computer, a laptop computer, a notebook computer, a personal digital assistant (PDA), a server, an Internet appliance or any other type of computing device.

[0035] The processor system 1000 illustrated in FIG. 6 includes a chipset 1010, which includes a memory controller 1012 and an input/output (I/O) controller 1014. As is well known, a chipset typically provides memory and I/O management functions, as well as a plurality of general purpose and/or special purpose registers, timers, etc. that are accessible or used by a processor 1020. The processor 1020 is implemented using one or

more processors. The processor 1020 includes a cache 1022, which may be implemented using a first-level unified cache (L1), a second-level unified cache (L2), a third-level unified cache (L3), and/or any other suitable structures to store data as persons of ordinary skill in the art will readily recognize.

[0036] As is conventional, the memory controller 1012 performs functions that enable the processor 1020 to access and communicate with a main memory 1030 including a volatile memory 1032 and a non-volatile memory 1034 via a bus 1040. The volatile memory 132 may be implemented by Synchronous Dynamic Random Access Memory (SDRAM), Dynamic Random Access Memory (DRAM), RAMBUS Dynamic Random Access Memory (RDRAM), and/or any other type of random access memory device. The non-volatile memory 1034 may be implemented using flash memory, Read Only Memory (ROM), Electrically Erasable Programmable Read Only Memory (EEPROM), and/or any other desired type of memory device.

[0037] The processor system 1000 also includes an interface circuit 1050 that is coupled to the bus 1040. The interface circuit 1050 may be implemented using any type of well known interface standard such as an Ethernet interface, a universal serial bus (USB), a third generation input/output interface (3GIO) interface, and/or any other suitable type of interface.

[0038] One or more input devices 1060 are connected to the interface circuit 1050. The input device(s) 1060 permit a user to enter data and commands into the processor 1020. For example, the input device(s) 1060 may be implemented by a keyboard, a mouse, a touch-sensitive display, a track pad, a track ball, an isopoint, and/or a voice recognition system.

[0039] One or more output devices 1070 are also connected to the interface circuit 1050. For example, the output device(s) 1070 may be implemented by display devices

(e.g., a light emitting display (LED), a liquid crystal display (LCD), a cathode ray tube (CRT) display, a printer and/or speakers). The interface circuit 1050, thus, typically includes, among other things, a graphics driver card.

[0040] The processor system 1000 also includes one or more mass storage devices 1080 configured to store software and data. Examples of such mass storage device(s) 1080 include floppy disks and drives, hard disk drives, compact disks and drives, and digital versatile disks (DVD) and drives.

[0041] The interface circuit 1050 also includes a communication device such as a modem or a network interface card to facilitate exchange of data with external computers via a network. The communication link between the processor system 1000 and the network may be any type of network connection such as an Ethernet connection, a digital subscriber line (DSL), a telephone line, a cellular telephone system, a coaxial cable, etc.

[0042] Access to the input device(s) 1060, the output device(s) 1070, the mass storage device(s) 1080 and/or the network is typically controlled by the I/O controller 1014 in a conventional manner. In particular, the I/O controller 1014 performs functions that enable the processor 1020 to communicate with the input device(s) 1060, the output device(s) 1070, the mass storage device(s) 1080 and/or the network via the bus 1040 and the interface circuit 1050.

[0043] While the components shown in FIG. 6 are depicted as separate blocks within the processor system 1000, the functions performed by some of these blocks may be integrated within a single semiconductor circuit or may be implemented using two or more separate integrated circuits. For example, although the memory controller 1012 and the I/O controller 1014 are depicted as separate blocks within the chipset 1010, persons of ordinary skill in the art will readily appreciate that the memory controller 1012 and the I/O controller 1014 may be integrated within a single semiconductor circuit.

[0044] Although certain example methods, apparatus, and articles of manufacture have been described herein, the scope of coverage of this patent is not limited thereto. On the contrary, this patent covers all methods, apparatus, and articles of manufacture fairly falling within the scope of the appended claims either literally or under the doctrine of equivalents.

[0045] In addition, while this disclosure is made with respect to example television systems, it should be understood that the disclosed system is readily applicable to many other media systems. Accordingly, while this disclosure describes example systems and processes, persons of ordinary skill in the art will readily appreciate that the disclosed examples are not the only way to implement such systems.

[0046] Further, although this disclosure describes example systems including, among other components, software executed on hardware, it should be noted that such systems are merely illustrative and should not be considered as limiting. In particular, it is contemplated that any or all of the disclosed hardware and software components could be embodied exclusively in dedicated hardware, exclusively in firmware, exclusively in software or in some combination of hardware, firmware, and/or software.

What is claimed is:

1. A method to identify a tuned minor channel comprising:

identifying a tuned major channel;

identifying program identifiers (PIDs) associated with the tuned major channel;

extracting packets of minor channels associated with the tuned major channel from a multiplexed digital stream of major channels, at least one of the major channels including minor channels;

extracting an audio stream from a digital audio output; and

comparing a digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel.

2. A method as defined in claim 1, wherein extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels comprises extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without demultiplexing the multiplexed digital stream of major channels.

3. A method as defined in claim 1, wherein extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels comprises extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without decompressing the packets of minor channels from the multiplexed digital stream.

4. A method as defined in claim 1, wherein extracting the audio stream from the digital audio output comprises extracting the audio stream from a digital audio output associated with one of a set-top box (STB) and a television.

5. A method as defined in claim 1, wherein comparing the digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel comprises matching the digital signature associated with the extracted audio stream to one of the digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel based on a look-up table.

6. A method as defined in claim 1, wherein comparing the digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel comprises comparing a cyclical redundancy code (CRC) byte associated with the extracted audio stream to CRC bytes associated with the extracted packets of the minor channels.

7. A method as defined in claim 1, wherein comparing the digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel comprises comparing a byte associated with a fixed location of the extracted audio stream to bytes associated with fixed locations of the extracted packets of the minor channels.

8. A method as defined in claim 1 further comprising generating the multiplexed digital stream of major channels based on an intermediate frequency (IF) signal from one of a set-top box and a television.

9. A method as defined in claim 1 further comprising transmitting information associated with the tuned minor channel to a data collection facility.

10. A method as defined in claim 9, wherein the information associated with the tuned minor channel comprises at least one of a name and a language type of a program.

11. A method as defined in claim 1, wherein the tuned major channel comprises at least one of an analog television channel and a digital television channel.

12. An apparatus to identify a tuned minor channel comprising:

a demultiplexer configured to identify program identifiers (PIDs) associated with a tuned major channel, and to extract packets of minor channels associated with the tuned major channel from a multiplexed digital stream of major channels, at least one of the major channels including minor channels;

a digital audio interface configured to extract an audio stream from a digital audio output; and

a digital signature matcher operatively coupled to the demultiplexer and the digital audio interface, the digital signature matcher being configured to compare a digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel.

13. An apparatus as defined in claim 12, wherein the demultiplexer is configured to extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without demultiplexing the multiplexed digital stream of major channels.

14. An apparatus as defined in claim 12, wherein the demultiplexer is configured to extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without decompressing the packets of minor channels from the multiplexed digital stream.

15. An apparatus as defined in claim 12, wherein the demultiplexer comprises a parser configured to identify program identifiers (PIDs) associated with the tuned major channel.

16. An apparatus as defined in claim 12, wherein the demultiplexer comprises a PID filter configured to extract packets of minor channels associated with the tuned major channel from a multiplexed digital stream of major channels.

17. An apparatus as defined in claim 12, wherein the digital audio interface is configured to extract the audio stream from a digital audio output of one of a set-top box (STB) and a television.

18. An apparatus as defined in claim 12, wherein the digital signature comprises at least one of a cyclical redundancy code (CRC) byte and a byte associated with a fixed location of the audio stream.

19. An apparatus as defined in claim 12 comprises a demodulator operatively coupled to the demultiplexer, the demodulator being configured to generate the multiplexed digital stream of major channels based on an intermediate frequency (IF) signal from one of a set-top box (STB) and a television.

20. An apparatus as defined in claim 12 comprises a communication interface configured to transmit information associated with the tuned minor channel to a data collection facility.

21. An apparatus as defined in claim 20, wherein the information associated with the tuned minor channel comprises at least one of a name and a language type of a program.

22. An apparatus as defined in claim 12, wherein the tuned major channel comprises at least one of an analog television channel and a digital television channel.

23. A machine accessible medium storing instructions, the instructions being structured to cause a machine to:

identify a tuned major channel;

identify program identifiers (PIDs) associated with the tuned major channel;

extract packets of minor channels associated with the tuned major channel from a multiplexed digital stream of major channels, at least one of the major channels including minor channels;

extract an audio stream from a digital audio output; and

compare a digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel to identify a tuned minor channel.

24. A machine accessible medium as defined in claim 23, wherein the instructions cause the machine to extract packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels by extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without demultiplexing the multiplexed digital stream of major channels.

25. A machine accessible medium as defined in claim 23, wherein the instructions cause the machine to extract packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels by extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without decompressing the packets of minor channels from the multiplexed digital stream.

26. A machine accessible medium as defined in claim 23, wherein the instructions cause the machine to extract the audio stream from the digital audio output by extracting the audio stream from a digital audio output of one of a set-top box (STB) and a television.

27. A machine accessible medium as defined in claim 23, wherein the instructions cause the machine to compare the digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel by matching the digital signature associated with the extracted audio stream to one of the digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel based on a look-up table.

28. A machine accessible medium as defined in claim 23, wherein the instructions cause the machine to compare a digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel by comparing a cyclical redundancy code (CRC) byte associated with the extracted audio stream to CRC bytes associated with the extracted packets of the minor channels associated with the tuned major channel to identify the tuned minor channel.

29. A machine accessible medium as defined in claim 23, wherein the instructions cause the machine to compare a digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel by comparing a byte associated with a fixed location of the extracted audio stream to bytes associated with fixed locations of the extracted packets of the minor channels.

30. A machine accessible medium as defined in claim 23 further comprising instructions to cause the machine to generate the multiplexed digital stream of major channels based on an intermediate frequency (IF) signal from one of a set-top box and a television.

31. A machine accessible medium as defined in claim 23 further comprising instructions to cause the machine to transmit information associated with the tuned minor channel to a data collection facility.

32. A machine accessible medium as defined in claim 31, wherein the information associated with the tuned minor channel comprises at least one of a name and a language type of a program.

33. A machine accessible medium as defined in claim 23, wherein the tuned major channel comprises at least one of an analog television channel and a digital television channel.

34. A machine accessible medium as defined in claim 23 is one of a programmable gate array, application specific integrated circuit, erasable programmable read only memory, read only memory, random access memory, magnetic media, optical media, and a semiconductor-based storage media.

35. An audience measurement system to identify a tuned minor channel comprising:

a major channel identifying device configured to identify a tuned major channel; and

a minor channel identifying device operatively coupled to the major channel identifying device, the minor channel identifying device being configured to identify program identifiers (PIDs) associated with the tuned major channel, to extract packets of minor channels associated with the tuned major channel from a multiplexed digital stream of major channels with at least one of the major channels including minor channels, to extract an audio stream from a digital audio output, and to compare a digital signature associated with the extracted audio stream to digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel.

36. A system as defined in claim 35, wherein the minor channel identifying device is configured to extracting packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without demultiplexing the multiplexed digital stream of major channels.

37. A system as defined in claim 35, wherein the minor channel identifying device is configured to extract packets of minor channels associated with the tuned major channel from the multiplexed digital stream of major channels without decompressing the packets of minor channels from the multiplexed digital stream.

38. A system as defined in claim 35, wherein the minor channel identifying device is configured to extract an audio stream from a digital audio output of one of a set-top box (STB) and a television.

39. A system as defined in claim 35, wherein the minor channel identifying device is configured to match the digital signature associated with the extracted audio stream to one of the digital signatures associated with the extracted packets of the minor channels associated with the tuned major channel based on a look-up table.

40. A system as defined in claim 35, wherein the digital signature comprises at least one of a cyclical redundancy code (CRC) byte and a byte associated with a fixed location of an audio stream.

41. A system as defined in claim 35, wherein the minor channel identifying device is configured to generate the multiplexed digital stream of major channels based on an intermediate frequency (IF) signal from one of a set-top box and a television.

42. A system as defined in claim 35, wherein the minor channel identifying device comprises a communication interface configured to transmit the information associated with the tuned minor channel to a data collection facility.

43. A system as defined in claim 42, wherein the information associated with the tuned minor channel comprises at least one of a name and a language type of a program.

44. A system as defined in claim 35, wherein the tuned major channel comprises at least one of an analog television channel and a digital television channel.

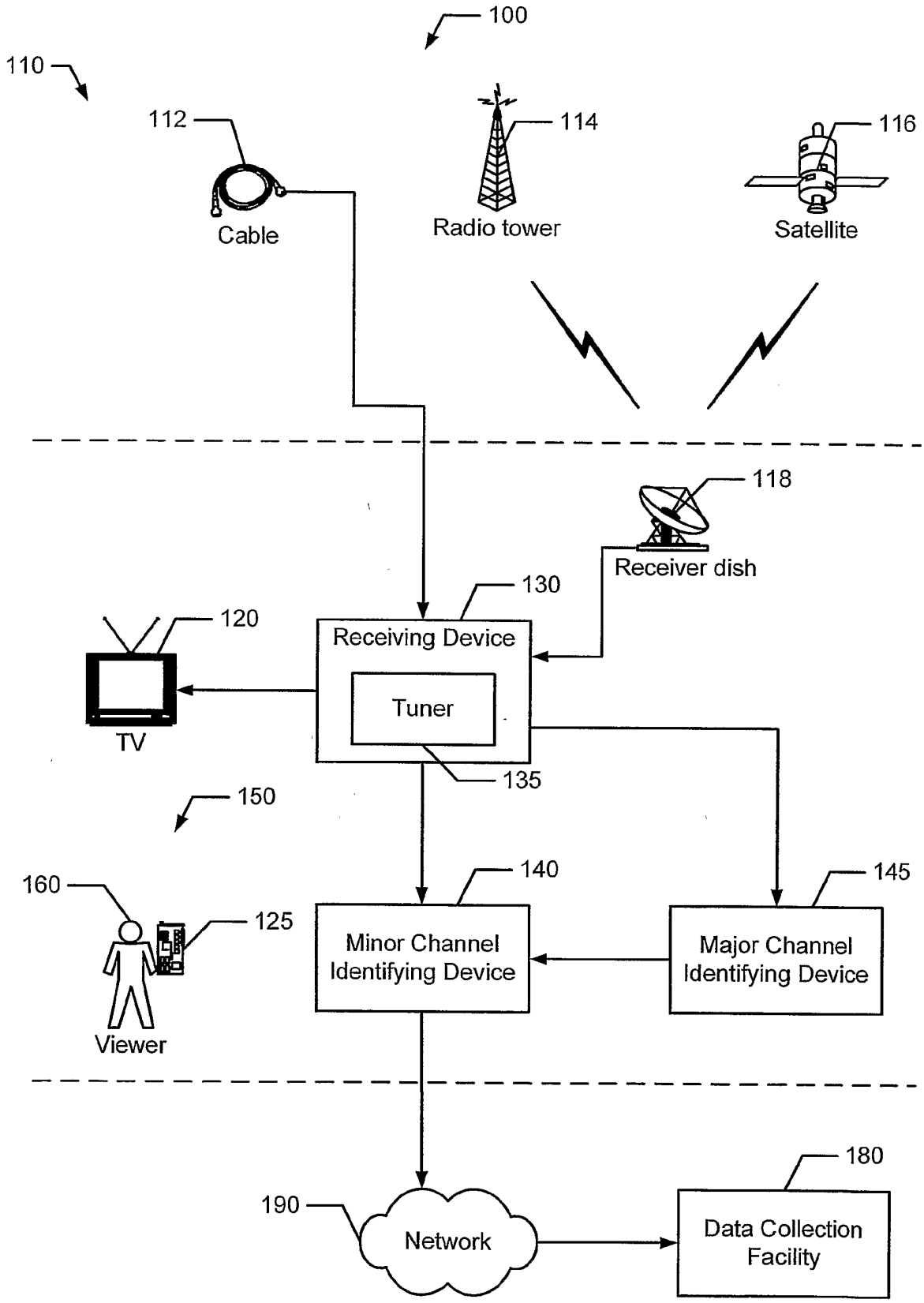
100
110
112
Cable
114
Radio tower
116
Satellite
118
Receiver dish
130
Receiving Device
Tuner
120
TV
135
150
160
125
Viewer
140
Minor Channel Identifying Device
145
Major Channel Identifying Device
180
190
Network
Data Collection Facility

FIG. 1

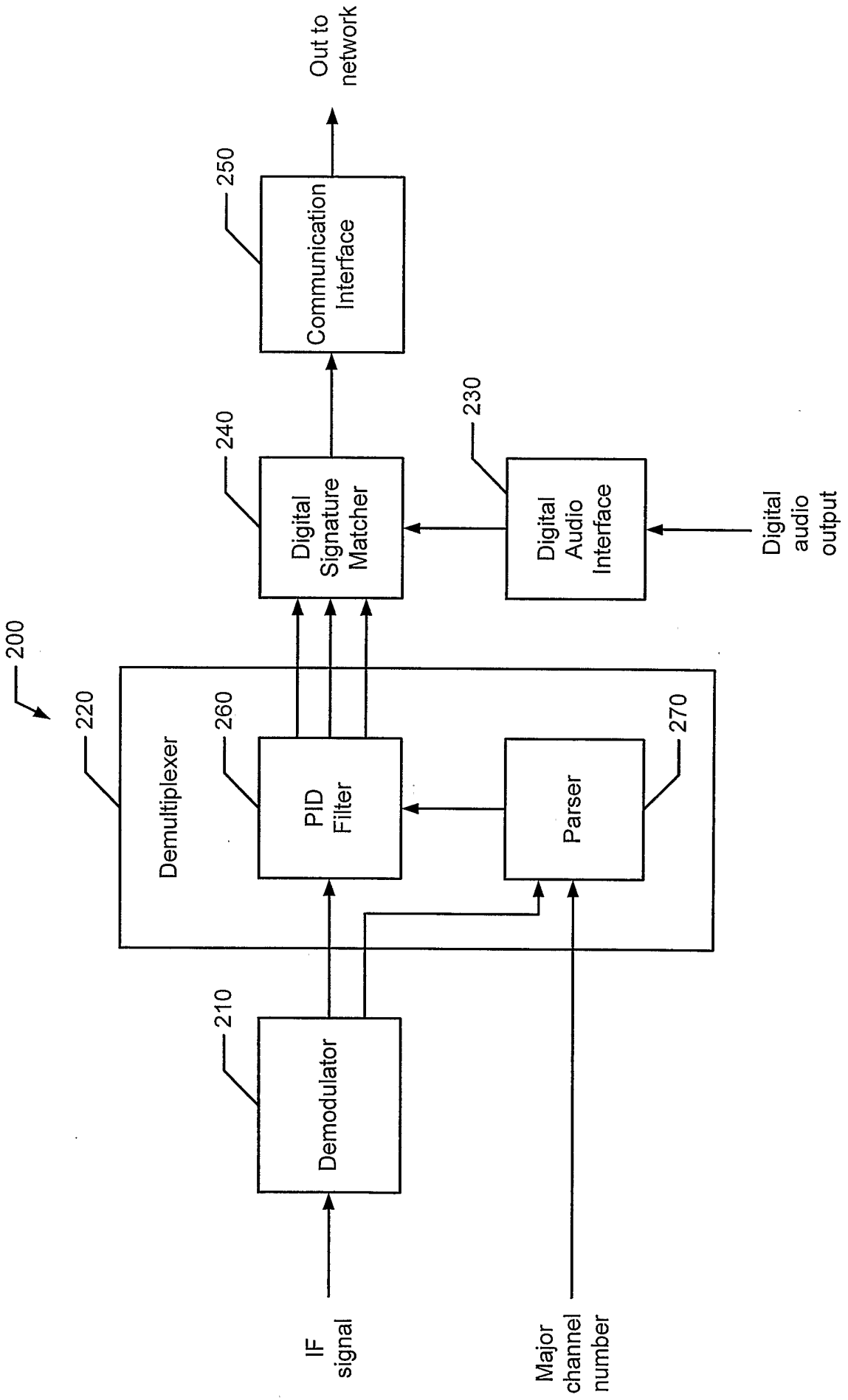
200
220
Demultiplexer
260
PID Filter
270
Parser
210
Demodulator
IF signal
Major channel number
240
Digital Signature Matcher
230
Digital Audio Interface
Digital audio output
250
Communication Interface
Out to network

FIG. 2

300

Major Channel No.	Minor Channel No.	PID(s) of Audio Signal(s)	PID(s) of Video Signal(s)
4	1	411	412
	2	421	422
	3	431	432
7	1	711	712
	2	721	722
	3	731	732
	4	741	742
12	1	1211, 1231	1212, 1232
	2	1221, 1241	1222, 1242

FIG. 3

400

Packets	Signature of audio stream	Signature of minor channel 1	Signature of minor channel 2	Signature of minor channel 3
n	a	a	b	c
n + 1	c	d	c	a
n + 2	b	c	a	b

FIG. 4

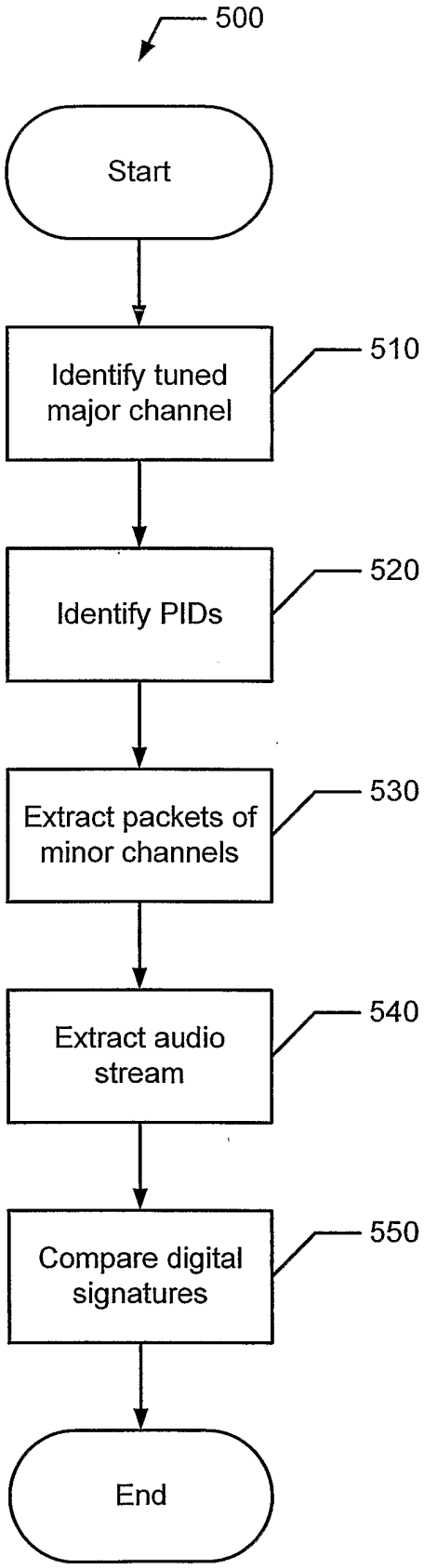
500
Start
Identify tuned major channel
510
Identify PIDs
520
Extract packets of minor channels
530
Extract audio stream
540
Compare digital signatures
550
End

FIG. 5

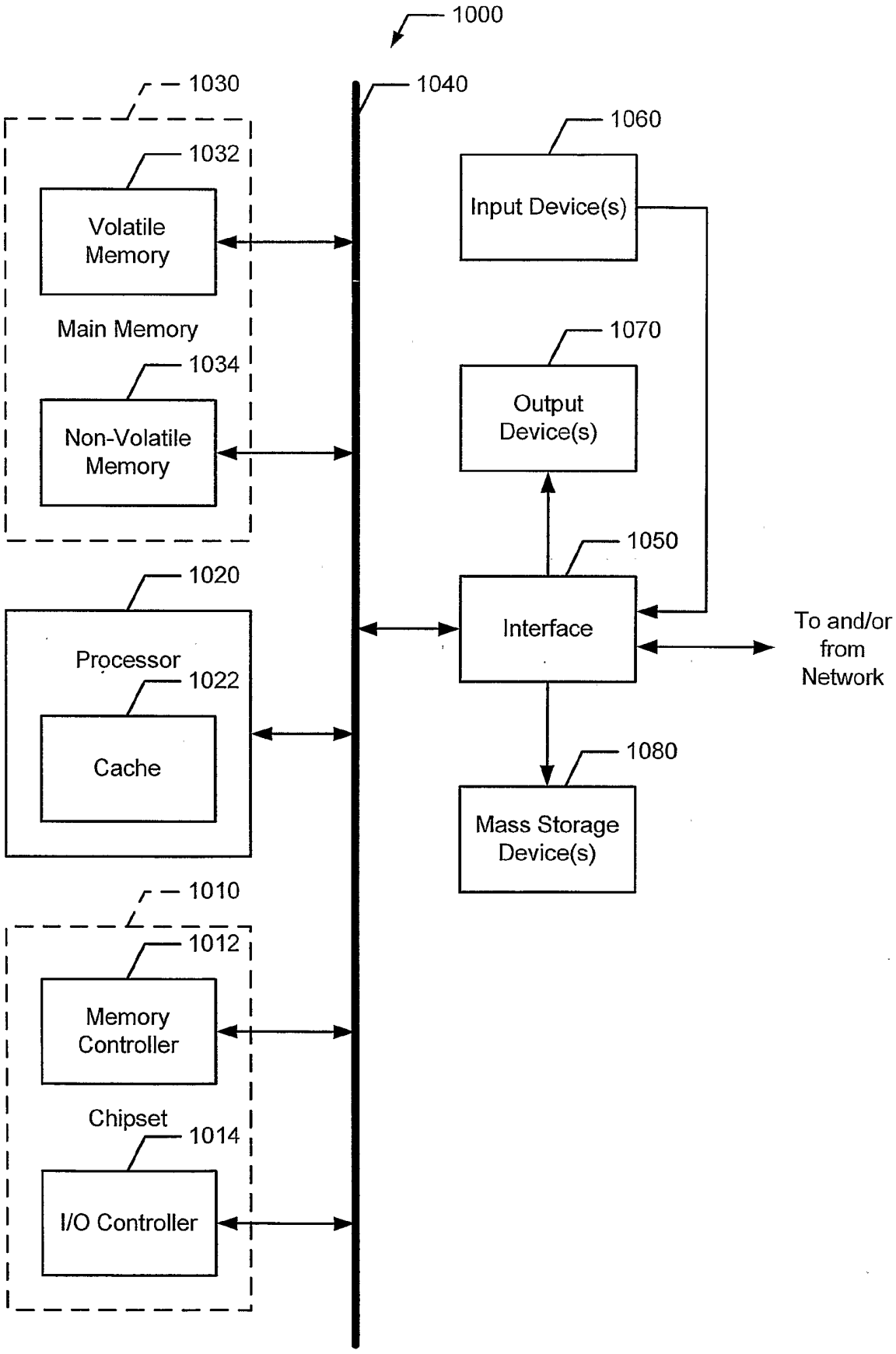
1000
1030
1040
1060
1032
Volatile Memory
Input Device(s)
Main Memory
1070
1034
Output Device(s)
Non-Volatile Memory
1050
1020
Interface
To and/or from Network
Processor
1022
Cache
1080
Mass Storage Device(s)
1010
1012
Memory Controller
Chipset
1014
I/O Controller

FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US04/13472

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : H04J 1/04
US CL : 370/431, 486, 487, 535; 348/405
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. : 370/431, 486, 487, 535; 348/405

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)
Please See Continuation Sheet

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,621,528 B1 (KESSLER et al) 16 September 2003 (16.09.2003), see the entire document.	1-44
Y	US 5,974,299 A (MASSETTI) 26 October 1999 (26.10.1999), see the entire document.	1-44
Y,E	US 6,763,522 B1 (KONDO et al) 13 July 2004 (13.07.2004), see the entire document.	1-44

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
24 August 2004 (24.08.2004)

Date of mailing of the international search report
08 OCT 2004

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (703)305-3230

Authorized officer
Toan Nguyen
Telephone No. 703-305-9600

Form PCT/ISA/210 (second sheet) (January 2004)

Continuation of B. FIELDS SEARCHED Item 3:
EAST

tun$4 near4 channel
((program near4 identifier) or PID)
extract$3 same multiplex$3 near4 digital
compar$3 same signatur$3