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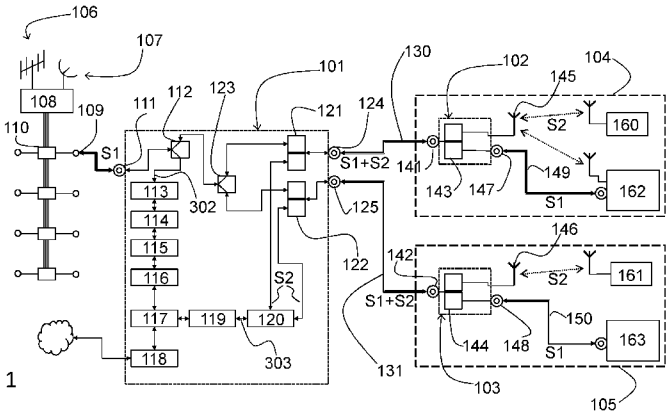

FIG. 1

(57) Abstract: The present invention relates to a distribution system (101; 201) for audiovisual contents, comprising at least one input interface (111) adapted to receive (801) at least one first radioelectric signal (S1) in a first frequency band, containing at least one video stream comprising at least one audiovisual content; at least one tuner (113) operatively associated with the input interface (111) and adapted to select the video stream from the first radioelectric signal (S1) in the first frequency band; at least one demultiplexer (114) operatively associated with the tuner (113) and adapted to extract an audiovisual content from the video stream; at least one IP encapsulator (116) operatively associated with the demultiplexer (114) and adapted to encapsulate the extracted audiovisual content into a packet data stream coded according to an IP protocol; at least one radiofrequency transceiver (119, 219, 319) configured to generate a second radioelectric signal (S2; S2') containing the IP data stream; and at least one coaxial interface (124, 125) for a coaxial cable (130, 131), operatively connected to the transceiver (119, 219, 319) and configured to emit the second radioelectric signal (S2; S2') on the coaxial cable (130, 131); at least one splitter (112) operatively connected to the input interface (111) and configured to receive the first radioelectric signal (S1) and split it so as to send it on one side to the coaxial interface (124, 125) and on another side to said tuner (113); at least one diplexer (121, 122) configured to receive the first radioelectric signal (S1) from the splitter (112) and send it to the coaxial interface (124, 125) for emitting a third radioelectric signal (802; 803) comprising the first radioelectric signal (S1) on the coaxial cable (130, 131) in the first frequency band, and further configured to receive the second radioelectric signal (S2; S2') from the transceiver (119, 219, 319) and send it to the coaxial interface (124, 125) for emitting

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the third radioelectric signal (802; 803) comprising the second radioelectric signal (S2; S2') on the coaxial cable (130, 131) in a second frequency band (816, 817; 818, 819), which is different from the first frequency band (811, 812, 813, 814, 815). The present invention also relates to an associated transceiving system (102, 103, 202, 203, 501) for transmission/reception of audi - ovisual contents in an environment.

DISTRIBUTION SYSTEM AND TRANSCEIVING SYSTEM FOR AUDIOVISUAL CONTENTS

DESCRIPTION

[TECHNICAL FIELD]

The present invention relates to a distribution system for audiovisual contents and to a transceiving system for transmission/reception of audiovisual contents in an environment.

In general, the present invention concerns systems and devices for distributing audiovisual contents transported by video streams distributed to one or more reproduction apparatuses by means of coaxial-cable or radio technologies.

[PRIOR ART]

Radioelectric signals of television channels, which carry audiovisual information pertaining to so-called "television programs", i.e. particular audiovisual contents, are transmitted via radio by satellite or terrestrial broadcasting by using technologies that once were analog but now are typically digital.

After having been received by suitable antennae, the signals of television channels are typically distributed by means of wired systems (typically a coaxial cable), whether individual or communitarian, to reach the reproduction apparatuses located, for example, in various places of a building or an environment.

For the distribution of "terrestrial" television signals via coaxial cable systems the same radiofrequency channels are typically used as those through which the signals are broadcast over the air, within the frequency spectrum referred to as "VHF Band" (Very High Frequency Band) and "UHF Band" (Ultra High Frequency Band).

As an alternative, for coaxial-cable distribution of "satellite" television signals, the signals received from the satellite are converted from the 11-12GHz band into the band of the first intermediate frequency, called "1st IF" (1st Intermediate Frequency), comprised between 950 MHz and 2,150 MHz, in which the signals can be distributed via cable without undergoing excessive attenuation.

As aforementioned, the radioelectric signals of television broadcasting are received by means of a suitable system of antennae, and are then sent, by means of said cable distribution systems, to the "user's socket", i.e. the socket to which terminal apparatuses

designed for reproducing audiovisual contents are connected (typically television sets or set-top boxes).

Modern television sets or television receivers are internally equipped with at least one tuner for the frequency bands of digital television (iDTV: integrated Digital TeleVision). Set-top boxes, instead, are used in association with old analog television sets, or in order to receive digital television signals in association with display apparatuses (e.g. TV monitors) not equipped with suitable tuning, demodulating and decoding means.

Terminal TV apparatuses are therefore equipped with means for tuning and demodulating radioelectric signals of television channels received via terrestrial and satellite broadcasting according to their radiofrequency, modulation and decoding capability characteristics.

With the advent of new apparatuses such as PCs, smartphones and tablet PCs, which can reproduce audiovisual contents and can also easily connect to the Internet via wired networks (balanced cables) or wireless networks (WLAN or Wi-Fi), has led to the development of solutions alternative to terrestrial and satellite radio broadcasting.

It is known that television programs can be directly broadcast over the Internet network, in particular for distribution via wired or wireless domestic networks (WLAN or Wi-Fi). With this solution, television programs can also be watched on a PC, a smartphone and/or a tablet PC, without such devices having to be equipped with a suitable television tuner for radiofrequency television signals, e.g. terrestrial or satellite ones. By way of example, we can mention the protocol for IPTV ("Internet Protocol Television") distribution according to the CENELEC (EN 50585) specification.

This known solution, however, has some drawbacks. For example, in many household environments a (balanced) network cable may not be available for distributing contents in IP format over an Ethernet network; moreover, many widespread devices, such as smartphones or tablet PCs, cannot be connected to a (balanced) network cable because they lack a network port, e.g. an Ethernet port, with an input for a (balanced) cable. Furthermore, for example, in many household environments it is difficult to distribute an Internet signal via radio, i.e. via a wireless network (WLAN o Wi-Fi), because of attenuation or noise affecting the radio signal and preventing a television content from being enjoyed without interruptions and/or errors, especially if it is a high-definition (HDTV) or stereoscopic (3DTV) content. Finally, current Wi-Fi standards only allow

for the transmission of a very limited number of high-quality and high-resolution audiovisual contents (e.g. Full HD or higher) over the same ad hoc network to cover a wide domestic environment characterized by the presence of physical obstacles (such as walls, pillars, metal surfaces) and/or sources of interference (such as nearby Wi-Fi networks, microwave ovens, Bluetooth connections).

It is also known that television programs from terrestrial and/or satellite broadcasting can be converted into signals to be distributed over an IP (Internet Protocol) network. Also this solution has the drawback that it potentially limits the number of television programs receivable by the users, especially if inside the building there is not a sufficient number of receiving apparatuses capable of tuning to the desired television channels and convert them into the IP format. As a matter of fact, one may want to record a television program being distributed over an IP network while at the same time watching a different television program on the same playing/recording apparatus connected to the IP network. Or, more often, two or more users connected to the same IP network may want to watch at the same time different television programs originating from different terrestrial and/or satellite broadcasting channels.

It is also known that television signals received via satellite can be distributed in IP format through the domestic electric network. These solutions ensure a high transmission speed, up to 200-500 Mbit/s. However, also these known systems have one drawback, in that the distribution of television signals over the domestic electric network does not allow using reproduction devices that can only connect via radio (WLAN or Wi-Fi wireless network), thus de facto leaving out smartphones and tablet PCs, which are now widespread in household environments.

It must be pointed out that the terms "television signal" or "radio-television signal" refer herein to a signal comprising a content consisting of an audio stream (e.g. a radio program) or comprising any combination of audio and video or any combination of audio, video and ancillary data (such as teletext, subtitles, EPG, MHP, HbbTV, etc.), transmitted by – and under the control of – a radio television broadcaster, e.g. in accordance with a DVB technical specification. Likewise, the terms "video stream" or "audiovisual content" refer herein to an audiovisual stream or content that may contain one or more audio streams, or a combination of one or more audio tracks and at least one video stream, or a combination of audio, video and ancillary data, which may be

formatted, for example, according to any MPEG or IP specification, coming from one or more TV broadcasters or from any other multimedia stream provider.

In general, the term "frequency band" refers to a frequency range comprised between a minimum frequency and a maximum frequency, wherein the minimum frequency is lower, in a strict sense, than the maximum one. Within this description, the term "frequency band" indicates such a frequency range even when the two ends thereof coincide; it may additionally indicate a contiguous or non-contiguous set of different frequency bands, in the usual sense thereof.

For distributing television signals to a plurality of reproduction apparatuses, a technology called RVU has been created upon proposal from the "*RVU Alliance*", composed of operators in the telecommunications and television field. According to the RVU system, TV signals are sent to all devices ("*RVU Clients*") within an environment, chosen among those connected to a central unit ("*RVU Server*"), which tunes to the satellite or terrestrial broadcast television signals or obtains the television signals from centralized Audio/Video sources. Distribution of the television signals according to the RVU protocol takes place by utilizing data channels operating according to an IP protocol within the apartment. The connection allowed by the RVU protocol is bidirectional, in order to allow choosing the desired TV program by means of a remote control.

The main drawback of the RVU distribution system is the quality of the connection between the RVU Server and the RVU Clients (television sets), in that the connection between these devices may be difficult to implement and/or may be affected by errors, as aforementioned in regard to distribution systems that use Internet protocols. Moreover, this system is not backward-compatible with existing reproduction apparatuses, since it requires compatibility with its protocol of transmission between the Clients and the Server.

It is also known from document EP2525572A1 to receive satellite television signals, to make a downconversion of the satellite signals by means of a Low Noise Block (LNB) downconverter in order to generate an intermediate frequency (IF) signal, to convert the intermediate frequency (IF) signal, to demodulate it in order to obtain the useful television information consisting of digital data; and to encapsulate the digital data into IP packets, which are then communicated to external devices.

According to one embodiment of EP2525572A1, the IP digital signal is transmitted over a wired network, such as a television network using a coaxial cable, so as to be able to use the existing system of coaxial cables in the household environment for IP signal communication.

For example, according to EP2525572A1 said wired network with coaxial cables can be operated by using a specific protocol called "Multimedia over Coax Alliance" (MoCA).

However, the distribution system known from document EP2525572A1 has the drawback that it disturbs the coaxial cable network by inserting television signal transmissions in a manner such that they are potentially in conflict with the television signal distribution with the above-mentioned known technique, in the "VHF Band" or "UHF Band" or "Satellite Band".

Besides, the distribution system known from document EP2525572A1 has the drawback that it uses proprietary distribution protocols that limit the flexibility of the user, who is compelled to implement solutions comprising apparatuses and devices exclusively complying with the "Multimedia over Coax Alliance" (MoCA) protocol. In addition, said system cannot ensure that the existing reception and reproduction apparatuses (television sets, set-top boxes, smartphones, tablet PCs, etc.) will still operate correctly after the installation of the apparatuses and devices that support the new protocol.

[OBJECTS AND SUMMARY OF THE INVENTION]

It is one object of the present invention to provide a solution that allows distributing audiovisual contents to reproduction apparatuses located, for example, in various places of a residential environment, building or apartment and in areas adjacent thereto, such as a garden or a terrace, which could ideally be reached from a wireless "access point" (WLAN), the nominal coverage radius of which does not exceed one hundred metres.

It is also a particular object of the present invention to provide a solution for distributing audiovisual contents that effectively exploits commonly used transmission systems already present in a domestic environment in the form of a coaxial cable, without requiring the laying of new cables.

It is another object of the present invention to provide a solution for distributing audiovisual contents that ensures high flexibility in the user's choices, with the possibility of using both the existing television receiving apparatuses, connected via coaxial cable, and new apparatuses such as tablet PCs and smartphones, which require

access to a WLAN or Wi-Fi network, for displaying audiovisual contents of interest for a wide audience located in any area of the household environment and simultaneously connected to enjoy different contents.

It is a further object of the present invention to provide a solution for distributing high-quality audiovisual contents with essentially no transmission or decoding errors, in order to ensure that they will be optimally reproduced when presented to the user.

It is yet another object of the present invention to provide a solution for distributing audiovisual contents that can be effectively integrated with television signal receivers, in particular in the "VHF Band" or "UHF band" or "Satellite Band", also of different types according to the prior art, which are already available in a household environment, thus improving the backward compatibility of the solution, in that continuity is ensured in the operation of all existing apparatuses for receiving and reproducing radio-television contents.

These and other objects are achieved through a distribution system for audiovisual contents and a transceiving system for transmitting/receiving audiovisual contents in an environment according to the appended claims, which are an integral part of the present description.

The basic idea of the present invention is to provide a distribution system for audiovisual contents incorporating the technical features set out in the independent claim 1.

Advantageously, this solution allows using the coaxial cables already present in the environment, e.g. an apartment, for both distributing audiovisual contents of television signals in the format directly received from the antenna (whether a terrestrial or satellite one) and delivering the same television signals converted and transmitted according to an IP protocol, in order to make them available in proximity to one or more receiving devices that are present in the environment (e.g. a particular room of the apartment), particularly in frequencies for wireless IP transmission (such as WLAN or Wi-Fi), receivable by currently widespread reproduction devices, e.g. PCs, smartphones and Tablet PCs.

According to a further aspect of the present invention, a transceiving system for transmission/reception of audiovisual contents in an environment is provided, which incorporates the technical features set out in the independent claim 16.

The solution proposed herein is advantageous because it allows fruition of audiovisual contents, such as TV programs, via widespread receiving terminals using wireless IP protocols, such as PCs, smartphones, tablet PCs, etc., without any loss of quality of the audiovisual content and without any interruptions or issues during reproduction, caused by bad propagation of wireless IP signals within the environment.

Furthermore, such solutions are advantageous in that they allow distributing and reproducing desired and selected audiovisual television contents, converted into the IP format, via the same coaxial cables that are typically already present in every home. Besides, they also allow distributing the audiovisual television contents received from the antenna system, which are delivered with no further processing via splitters on the coaxial cable.

In this manner, the signals containing the television video stream become available on a coaxial cable for reception by the user's devices, without creating any conflict with the data stream in IP format carried on the same coaxial cable, and without disturbing any radio broadcast signals that may be present in the environment, which transport multimedia contents of radio-television origin or coming from the Internet.

Other advantageous technical features of an apparatus according to the present invention will become apparent below.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Some preferred and advantageous embodiments will now be described by way of non-limiting example with reference to the annexed drawings, wherein:

- Figure 1 shows a first embodiment of a distribution system for audiovisual contents and a transceiving system for transmission/reception of audiovisual contents in an environment according to the present invention, wherein, in particular, TV signals in IP format are preferably distributed in WLAN frequency bands (typically 2.4-2.5 GHz and 5.0-6.0 GHz).
- Figure 2 shows a second embodiment of a distribution system for audiovisual contents and a transceiving system for transmission/reception of audiovisual contents in an environment according to the present invention, wherein, in particular, TV signals in IP format are preferably distributed in the 230-470MHz band or in other UHF or VHF frequency bands not in use, in the wired distribution network, by signals containing audiovisual contents received from the antenna system (106, 107)

and available at the user's socket (109).

- Figure 3 shows a further embodiment of a distribution system for audiovisual contents, i.e. a domestic distributor adapted to receive television signals and distribute them in IP format.
- Figure 4 shows an example of a radiofrequency transceiver adapted to transmit audiovisual contents in IP format over the coaxial cables for domestic television distribution, included in a distribution system for audiovisual contents according to the present invention.
- Figure 5 shows an example of a radiofrequency receiver adapted to receive audiovisual contents in IP format via coaxial cables, and to further distribute them for display of the audiovisual contents, included in a transceiving system for transmission/reception of audiovisual contents in an environment according to the present invention.
- Figure 6 shows an embodiment of a mixer/demixer network.
- Figure 7 illustrates the allocation of the WLAN channels in the 2.400-2.483GHz band.
- Figures 8a, 8b, 8c and 8d illustrate the frequency allocation of signals transported on coaxial cables according to various embodiments of the present invention.

The drawings show different aspects and embodiments of the present invention and, where appropriate, similar structures, components, materials and/or elements are designated in the various drawings by the same reference numerals.

[DETAILED DESCRIPTION OF THE INVENTION]

Within the context of the present description, the term "environment" will refer to a space delimited by boundaries, typically walls, the dimensions of which are such that it is covered by propagation of television signals by means of coaxial cables (without the attenuation occurring therein necessarily implying the necessity of using intermediate stations for signal amplification), i.e. such that it is covered by propagation of wireless radioelectric signals, preferably according to the Wi-Fi protocol described in the IEEE 802.11.x series standards.

Within the context of the present description, the terms "building" or "residential environment" (also called, for brevity, "environment") will be used to indicate an environment as specified above, having the characteristics of a building, preferably a

domestic building inhabited by people, e.g. an apartment, without however excluding other types of environments, such as restaurants, shopping centres, hotels or the like.

Figure 1 shows a first embodiment of a distribution system for audiovisual contents 101 and of transceiving systems for transmission/reception of audiovisual contents 102 and 103 in an environment 104 and 105 according to the present invention.

The distribution system 101 is adapted to receive at least one video stream that comprises audiovisual contents; for this purpose, it is operatively connected to one or more sources of audiovisual contents, represented by the terrestrial antenna 106, which is adapted to receive, for example, channels of digital terrestrial television, and by the satellite antenna 107, which is adapted to receive, for example, channels of digital satellite television.

The antennae 106 and 107 are connected to a header terminal 108 of a known type, which is adapted to distribute the signals containing the video streams to one or more apartment interfaces 109, connected to the distribution cables coming from the header terminal 108, preferably via one or more multiswitches 110.

In the antenna system for television signals shown in Figure 1, the technique with four drop cables is used, which cables run from the header terminal 108 to the multiswitches 110, usually installed at the level of each floor of a joint-ownership multifloor building, this structure being merely exemplificative in the present description, since the actual structure will depend on the type of installation employed; said antenna system allows the (terrestrial and satellite) television signals to be distributed to each apartment interface 109.

The apartment interface 109 is preferably configured for connection to a coaxial cable transporting the television signals within the apartment.

According to the invention, the distribution system 101 comprises an input interface 111, preferably for a coaxial cable, in particular comprising a connector compliant with the IEC 60169-2 technical specification, or an F-type connector compliant with the IEC 60169-24 technical specification.

Through the input interface 111, the distribution system is adapted to receive a first radioelectric signal S1 comprising the television video stream; said first radioelectric signal S1 has frequencies comprised in a first band, e.g. occupied by a transmission channel (Multiplex) of terrestrial or satellite digital television broadcasting.

The terrestrial broadcasting bands comprising radioelectric signals S1 received by the antenna 106, occupied by transmission channels of terrestrial digital television and available on the interfaces 109, are currently the VHF band (47-230 MHz), divided into Band I 811 (47-68 MHz), Band II 813 (88-108 MHz) (FM Radio) and Band III 812 (174-230 MHz), and the UHF Band 814 (470-790 MHz), divided into Band IV (470-606 MHz) and Band V (606-790 MHz) (see Figure 8a).

Other radioelectric signals S1 present in the satellite broadcasting band (11-12 GHz), received by the satellite antenna 107, are converted by the header terminal 108, for distribution over coaxial cables to the interfaces 109, into the band of the 1st intermediate frequency 815 (1st IF: 950-2,150 MHz, Figure 8a).

At least one first radioelectric signal S1 is thus received by the distribution system 101 and is transmitted, through a splitter 112, the function of which will be better described below, to the tuner 113 that is operatively associated with the input interface 111.

In particular, the tuner 113 is operatively associated with the input interface 111 through the coaxial interface 302, which will be described in detail below.

The tuner 113 is adapted to select at least one video stream among those carried by the first radioelectric signal S1, and to transfer it to a demultiplexer 114. The demultiplexer 114 is operatively associated with the tuner 113, and is further adapted to extract a particular audiovisual content from the selected video stream.

The distribution system 101 further comprises, in a preferred and optional embodiment, a decoder 115 adapted to decode the extracted audiovisual content.

The distribution system 101 further comprises an IP encapsulator 116, operatively associated with the demultiplexer 114 (and possibly with the decoder 115) in order to encapsulate the extracted audiovisual content into a packet data stream coded in accordance with an IP protocol.

The term "IP encapsulator" refers to a device adapted to process the data of the selected video stream in accordance with the IP protocol. The IP protocol is based on TCP ("Transmission Control Protocol"), also referred to as TCP/IP, or on UDP ("User Datagram Protocol"), and requires the transmission of packets or blocks of data called "segments" or "datagrams".

The IP encapsulator 116 receives a digital data stream relating to a selected audiovisual content (typically an MPEG transport stream with only one service), splits it into

packets and encapsulates (or envelopes) them into (TCP) segments or (UDP) datagrams compliant with the IP protocol, adding protocol information (header, checksum, etc.) to the input payload.

The IP encapsulator thus generates a packet-type IP data stream containing the selected audiovisual content, which is preferably delivered to an IP combiner 117.

The IP combiner 117 is further adapted to connect, via an IP protocol, to an Internet router or modem 118 in order to exchange packet data, both inbound and outbound, with the Internet network.

In a preferred embodiment, the IP combiner 117 is further adapted to combine the IP encapsulated audiovisual content together with the Internet packet data, allowing the transmission of both types of data over the system of coaxial cables, as will be better described below.

According to the invention, the distribution system 101 further comprises a radiofrequency transceiver 119 operatively connected to the IP encapsulator 116 and configured to generate a second radioelectric signal S2 containing the IP data stream in a second frequency band.

The transceiver 119 is also operatively connected to a coaxial interface 303, which will be described in detail below.

Preferably, the second radioelectric signal S2 corresponds to an IP WLAN signal.

In particular, the second frequency band corresponds to frequencies that are not used in terrestrial or satellite television transmission, i.e. frequencies that are typically free from television signals but may contain other types of signals, such as IP WLAN signals.

In the embodiment exemplified in Figure 1, the second radioelectric signal S2 thus generated is preferably sent to a power divider 120 to be then delivered to the diplexer 121 and the diplexer 122. The diplexers 121 and 122 are also sent, in the embodiment exemplified herein, the first radioelectric signal S1 received by the distribution system 101, through the aforementioned splitter 112 and an additional splitter 123 that distributes the first radioelectric signal S1 to both diplexers 121 and 122.

In particular, the splitter 112 is operatively connected to the input interface 111 and is configured to receive the first radioelectric signal S1 and split it between the output interface, as will be better described below, and the tuner 113.

It is apparent that other different solutions may be conceived by increasing the number

of diplexers; it is also apparent that an embodiment may be conceived which lacks the power divider 120 and has just one diplexer.

The distribution system 101 further comprises an output interface 124 and an additional output interface 125 operatively connected, respectively, to the diplexers 121 and 122, and hence configured to emit the second radioelectric signal S2 on the coaxial cables 130 and 131 typically running in the building, allowing radio-television signals to be distributed within that environment.

In other words, the diplexer is configured to receive the second radioelectric signal S2 from the transceiver 119 and send it to the output interface 124 and/or 125 for emitting the second radioelectric signal S2 on the coaxial cable 130, 131. The sum signal of S1 and S2, obtained by mixing the two radioelectric signals S1 and S2, is called third radioelectric signal 802 (see Fig. 8b).

Preferably, the interfaces 124 and 125 for coaxial cable comprise each a connector compliant with the IEC 60169-2 technical specification, or an F-type connector compliant with the IEC 60169-24 technical specification, or another equivalent type.

The distribution system 101, therefore, allows distributing desired and selected audiovisual contents, converted into the IP format, by means of the coaxial cables 130 and 131, which are typically already present in every home for the distribution of radiofrequency radio-television signals.

Moreover, the distribution system 101 also allows distributing the television audiovisual contents received by the antenna system 106 and/or 107, which are made available to the apartment interface 109 and then delivered without any further processing, through the splitters 112 and 123, to the interface 124 and an additional interface 125 for coaxial cable operatively connected to the diplexers 121 and 122.

In this manner, the signal S1 containing the television video stream becomes available on the coaxial cables 130 and 131 for reception by the user's devices, without creating any conflict with the data stream in IP format carried by the signal S2 on the said coaxial cable 130 and 131.

The distribution system 101 is placed in a predetermined location within the environment, typically near the apartment interface 109, for receiving audiovisual contents of interest and then distributing them over coaxial cables, via the IP protocol, to all rooms 104 and 105 of interest for the user, as well as for continuing the distribution

of terrestrial and/or satellite radio-television signals to the existing radio-television receivers 162 and 163.

In the embodiment of Figures 1 and 8b, the distribution system 101 is adapted to distribute to the interfaces 124 and 125 the first radioelectric signal S1, received in a first frequency band corresponding to frequencies used for television transmission over coaxial cable, both directly, as a signal S1 with unchanged frequency and format, and after transforming it into a second signal S2 in a second frequency band 816 or 817, preferably corresponding to frequencies used for transmission of wireless IP signals, i.e. comprised between 2.4 GHz and 2.5 GHz or between 5.0 GHz and 6.0 GHz; the power of the second radioelectric signal S2 is preferably 10 mW in the former case and 200 mW in the latter case. In this manner, the second radioelectric signal S2 in the coaxial cables 130 and 131 corresponds to a Wi-Fi modulated signal according to the IEEE 802.11.x standard, which can be easily received by commercial devices, as will be described more in detail below.

Furthermore, the diplexers 121, 122 and the splitter 112 are configured for bidirectional transmission of control signals 810 between the input interface 111 and the interface 124 and/or 125. In this manner, control signals can be sent which comprise a direct voltage (13/18V) and the 22kHz tone according to the DiSEqC protocol, running over the coaxial cables for controlling devices such as the multiswitches (110) situated in the distribution network of the centralized antenna system or directly on the parabolic antenna, in case of an individual antenna system. Therefore, in the terminology used herein the first radioelectric signal S1 may be or may comprise not only a radio-television signal being sent from one of the receiving antennae 106 and 107 to the receiving terminals 162 and 163, but also a control and/or signalling signal having a null bandwidth (13/18V direct voltage) or a very narrow one (22kHz tone) running in the opposite direction, from the receiving terminals 162 and 163 to the multiswitches (110) in a centralized system, or directly to the parabolic antenna 107 in an individual system.

The distribution system 101 is adapted, in fact, to cooperate with one or, advantageously, more transceiving systems for transmission/reception of audiovisual contents in an environment according to the present invention.

In an advantageous embodiment of the invention, the diplexers 121 and 122 can receive IP packets coming from the interfaces 124 or 125 in the frequency band 816, 817

occupied by the second radioelectric signal S2, and can make them available at their interface connected to the power divider 120, if present, or directly at the interface connected to the transceiver 119. The latter, just like any other Wi-Fi access point of this kind, can transmit said IP packets over the interface connected to the IP combiner 117 in a form which is suitable for transmission over the Internet via the Internet router or modem 118.

As will become apparent at the end of the description of Figure 1, this embodiment allows the distribution system 101 to be also used as a remote Wi-Fi modem o router for all IP terminals that are present in the residential environment, so that no additional Wi-Fi modem or router is necessary, in this case, in order to provide IP terminals with wireless Internet connectivity, save for an indispensable Internet line, e.g. a DSL one, to which said modem or router will have to be connected. Actually, as will be clear at the end of the description, such a distribution system 101 may, in addition to working as an IP distribution system for terrestrial and/or satellite television contents, also act as a Wi-Fi modem or router, thus becoming a real control unit allowing access to TV or Internet multimedia contents and Internet navigation in general from any IP terminal or computer equipped with a WLAN network card.

The system 101 may additionally be equipped with network ports, e.g. of the RJ-11 type, connected to an external modem for connecting to a WAN Internet line, and/or with one or more RJ-45 ports, connected internally to the router 118, for connecting the system 101 to PCs or other devices equipped with a wired IP Ethernet network card.

Note that, in spite of what is shown in Figure 1, in another embodiment of the invention the modem or router may be external to the system 101: in such a case, the system may be equipped with an Ethernet network interface towards the Internet, and the system may be included in a LAN network and connected to an external router or modem.

In a variant of the invention, the functions carried out by the units 117, 118 and 119 may be performed by a single functional block. The same is true in the presence of an external modem or router and an Ethernet network interface, which interface may be incorporated into said functional block.

The transceiving systems 102 and 103 are adapted to process a third radioelectric signal available via the coaxial cables 130 and 131, which in the present context will contain the above-described second radioelectric signal S2, save for any attenuation or distortion

that may occur along the path of the coaxial cables 130 and 131.

The transceiving systems 102 and 103 comprise respective coaxial inputs 141 and 142, to which the coaxial cables 130 and 131 are connected, preferably by means of a connector compliant with the IEC 60169-2 technical specification, or an F-type connector compliant with the IEC 60169-24 technical specification.

As already described with reference to the second radioelectric signal S2, the third signal (802, Figure 8b) inputted to the systems 102 and 103 comprises components (S2) in a frequency band that also includes frequencies used for transmission of wireless signals, i.e. comprised between 2.4 GHz and 2.5 GHz, or between 5.0 GHz and 6.0 GHz, while however travelling on the coaxial cable 130 or 131.

In other words, the third signal 802 inputted to the systems 102 and 103 comprises both a video content encapsulated in an IP data stream (in the component S2) and a radio-television video stream in the frequencies typically used for terrestrial or satellite radio-television transmission over coaxial cable (in the component S1).

The transceiving systems 102 and 103 comprise respective diplexers 143 and 144 for extracting from the third signal any traditional radio-television signals (S1) (whether terrestrial or satellite ones) travelling on the coaxial cables 130 and 131, with which the second component signal S2 generates no interference.

The diplexers 143 and 144 are adapted to separately send the components S1 and S2 that constitute the above-described third signal (802) to the irradiation means, ideally schematized by means of the antennae 145 and 146, which are optimized for the frequencies (S2) of Wi-Fi wireless transmission, and to the receiving apparatuses 162 and 163, which are adapted to tune to signals in the bands S1 (Figure 8b). The third signal, as aforesaid, comprises the selected audiovisual content encapsulated in IP format.

The diplexers 143 and 144 are therefore configured to process the third radioelectric signal, i.e. to treat the audiovisual content encapsulated in the IP data stream together with the above-mentioned radio-television video stream.

In other words, with reference to the signals S1 and S2 respectively transporting a radio-television stream received by the antennae 106 or 107 and an audiovisual content encapsulated in the IP data stream, the third signal (802 in Figure 8b) is composed of the sum of the two signals S1 and S2 ("S1+S2", see Figures 1 and 8b). These two signals

are processed by the diplexers 143 and 144, which will treat the two components S1 and S2 (combining or separating them, depending on the direction of the signals therein); the second signal S2 will form a fourth signal, which thus corresponds to S2.

The transceiving systems 102 and 103 are therefore adapted to irradiate a fourth signal within the environments 104 and 105; said fourth signal preferably occupies the frequencies used for wireless signal transmission, i.e. comprised between 2.4 GHz and 2.5 GHz, or between 5.0 GHz and 6.0 GHz, and coincides, save for any transmission or separation errors and/or any undesired attenuation introduced by the cable 130, 131 and/or by the diplexer, with the signal S2 that is present at the interfaces 124 and 125 of the system 101. Hence this fourth signal can be immediately applied to a suitable radiating antenna 145 or 146, as will be explained more in detail below, in order to feed the wireless IP terminals 160 and 161, as well as a Wi-Fi transceiver associated with a radio-television receiver 162.

In its turn, the fourth signal carries the selected audiovisual content encapsulated in IP format, in a form that this time can be received by devices equipped with wireless transceiving means of the Wi-Fi type, preferably in compliance with one of the IEEE 802.11.x standards, such as widespread PCs or personal digital assistants or tablet PCs or smartphones. In particular, the fourth signal is preferably an IP WLAN signal.

Preferably, the audiovisual content encapsulated in an IP data stream in both the third signal 802 and the fourth signal occupies the same frequency band, thus not requiring any frequency conversion at the level of the devices 102 and 103.

The user can therefore receive the audiovisual content thus distributed by the distribution system 101 and transceived by the systems 102 and 103, e.g. by means of portable devices commonly referred to as "second screen", such as the tablet 160 or the smartphone 161, or by means of the "connected TV" 162 equipped with Wi-Fi connection means, possibly subject to installation of a suitable additional wireless transceiver module (e.g. a Wi-Fi transceiver with a USB or HDMI interface).

It must be pointed out, in particular, that the audiovisual content encapsulated in the IP data stream occupies in the third signal a frequency band (S2) which is different from the frequency band (S1) of the radio-television video stream in the same third signal, which is used for terrestrial or satellite television broadcasting via coaxial cable; in order to highlight this circumstance, Figure 8b shows all the frequency bands that compose the

third signal 802, clearly distinguishing between the bands 810-815 that can be occupied by the radioelectric signals S1 comprising the above-mentioned radio-television streams and the bands 816-817 that compose the signal S2, which transports the IP data stream.

Both types of reproduction terminals can be made capable of interacting with the distribution system 101 of the present invention by installing suitable application software, which will take care of establishing a connection at application level with said system 101 and managing the delivery of requests for reproduction and control of the stream of audiovisual contents emitted by the system 101.

In brief, a first technique for the distribution of audiovisual contents originated by television signals according to the present invention, as exemplified in Figure 1, in IP format utilizes, along the stretches of coaxial cable that connect the distribution system 101 to the transceiving systems 102 and 103, the same (radio) bands as those of WLAN networks, in accordance with the IEEE 802.11.x family of technical specifications (2.4-2.5 GHz and/or 5.0-6.0 GHz).

The first stretch of the connection to the user's terminal to be served (in a room of the apartment) is created by using the coaxial cable for domestic distribution of television signals that connects the domestic distribution system 101 to the user's socket 141. From there, the signal is then irradiated over the air via the suitable antenna of the transceiving system 102 or 103. Therefore, transmission along the second stretch towards the mobile terminal 160 or 161 adapted to receive radio waves of WLAN (Wi-Fi) networks takes place via radio, as schematized by the dashed bidirectional arrow in Figure 1.

Downstream of the diplexers 143 and 144, the transceiving systems 102 and 103 further comprise respective outputs 147 and 148 for a coaxial cable, configured to transfer signals, in particular radio-television ones, which are present at the input, thus allowing traditional radio-television signals of terrestrial and satellite broadcasting travelling on the coaxial cables 130 and 131 to be also transmitted over the coaxial cables 149 and 150, respectively.

The transceiving systems 102 and 103 can deliver to the interfaces 147 and 148 the DiSEqC control signals for satellite reception via multiswitch, in particular the continuous component thereof (13/18V and the 22kHz tone).

In particular, the interfaces 147 and 148 are operatively connected to the diplexers 143

and 144, respectively, for transferring the radio-television video stream of the third radioelectric signal available at the input.

In this manner, the "connected TV" 162 and also the traditional television set 163 can receive television signals over the coaxial cable lines 149 and 150, just as it happens when using a common system for television signal distribution, with the advantageous addition, however, that in the same environment the Wi-Fi devices 160 and 161 can also receive the desired audiovisual contents via the IP protocol.

In a preferred embodiment of the distribution system, the interface 111, the tuner 113, the demultiplexer 114, the IP encapsulator 116, the radiofrequency transceiver 119 and the interface 124, 125 are integrated into a single apparatus 101.

Figure 2 shows a second embodiment of a distribution system for audiovisual contents 201 and a transceiving system for transmission/reception of audiovisual contents 202 and 203 in the environments 104 and 105. The same reference numerals are used in different Figures to designate identical or equivalent elements.

After the IP encapsulator 116 has encapsulated the extracted audiovisual content into the IP packet data stream, the radiofrequency transceiver 219, which is operatively connected to the IP encapsulator 116 (preferably via the IP combiner 117), is configured to generate a second radioelectric signal S2' containing the IP data stream in a second frequency band, and is operatively connected to the coaxial interface 303. Unlike the transceiver 119 of the first embodiment, the unit 219 emits and receives the IP stream, still in Wi-Fi format, at the interfaces that connect it to the diplexers 121 and 122, operating in frequency bands which are different from the one dedicated to communications in accordance with the Wi-Fi standard.

In the embodiment of Figure 2, the distribution system 201 is adapted to transmit the IP data stream in a second signal S2' in a second frequency band that preferably corresponds to frequencies not used for transmission of television signals over coaxial cables, while still being close to frequencies actually in use, and being preferably lower than other frequencies used for Wi-Fi wireless transmission; the power of the second radioelectric signal S2' is preferably 10 mW. Note that the signals S2 of the first embodiment and S2' of this second embodiment are indistinguishable from each other (i.e. they have the same modulation and bandwidth characteristics), except for the fact that they occupy two different frequency bands.

Preferably, the frequencies of said second band are television bands that are already available (e.g. the 230-470MHz band or the 790-862MHz band, freed by the first digital dividend) or that will become available in the future (the 694-790MHz band, so-called "700MHz band", which will be the subject of the second digital dividend), which do not contain any broadcast television channels that may potentially be interfered or interfering.

One important and interesting advantage of using the 230-470MHz or 790-862MHz or 694-790MHz bands over the WLAN bands is the lower attenuation undergone in that frequency band by coaxial cables for domestic distribution. The 230-470MHz band is almost universally dedicated to other services, different from television broadcasting. Therefore, it is free from potential interference from television signals.

The third radioelectric signal 803, received by the transceiving systems 202 and 203, corresponds (always, save for any undesired attenuations introduced by the cable and/or other undesired alterations introduced by the diplexers 121 and 122) to the one emitted by the distribution system 201, and therefore it comprises the above-described second radioelectric signal S2' (see Figure 8c). This received component S2' is still a signal in a Wi-Fi format according to the IEEE 802.11.x standard, but in a different frequency band, so that it is necessary to take the following measure.

In order to exploit wireless communication between the transceiving device 202 and 203 and the reproduction devices 160, 161 and 162, it is necessary to convert the frequency of the radioelectric signal S2' received at the user's socket 141 or 142 from the free television bands to the bands of WLAN networks (2.4-2.5 GHz and/or 5.0-6.0 GHz), before it is applied to a suitable antenna 145 or 146, so that it is fully compatible with the Wi-Fi terminals in the environment.

To this end, the transceiving systems 202 and 203 further comprise respective conversion means 270 and 271, which are adapted to convert the cable frequencies (S2') of the third radioelectric signal 803 (whatever they are) into frequencies of the fourth frequency band (which frequencies are suitable for Wi-Fi wireless transmission and are higher than those of the third frequency band) in order to generate the fourth radioelectric signal to be irradiated.

Thus, the transceiving systems 202 and 203 comprise irradiation means 145 and 146 adapted to irradiate in the environment 104 and 105 a fourth radioelectric signal in a

fourth frequency band dedicated to wireless communications according to an IP protocol, wherein the fourth radioelectric signal is encapsulated into a signal that uses an IP protocol for transmitting the audiovisual content to at least one wireless receiving terminal 160, 161 or 162.

The transceiving systems 202 and 203 can deliver, through the interfaces 147 and 148 (on one side) and the interfaces 141 and 142 (on the other side) of the coaxial cables 130 and 131, DiSEqC control signals for satellite reception directed towards the multiswitch, in particular the continuous component thereof (13/18V and the 22kHz tone), coming from the terminals 162 and/or 163, in the event that they are satellite TV receivers.

Therefore, in the apartment room 104 or 105 where the user is located, the signal is present as a WLAN network signal that can be received by the desired apparatus 160, 161 or 162, whether it is a PC, a smartphone or a tablet PC.

Note that, unless otherwise specified, all that has been said herein about the devices of the first embodiment of the invention shown in Figure 1 also applies to the same devices of the second embodiment of the invention shown in Figure 2. Therefore, such common considerations will not be repeated for the embodiment of the invention of Figure 2.

In the embodiments described so far, the second radioelectric signal S2 or S2' transmitted over the coaxial cable by the distribution system 101 or 201 is in a predetermined second frequency band, which can be established when manufacturing the apparatus or set via a user interface by an operator, e.g. the user or a service technician.

Another preferred and advantageous embodiment of the present invention utilizes a detector device (not shown) adapted to check for the presence of radioelectric signals on the coaxial cable connected to the interface 124 or 125 in the frequency band that will be used by the transceiver as a second frequency band for the second radioelectric signal S2 or S2'.

In this manner, it will be possible to use television channels of the VHF/UHF bands, assigned to television broadcasting, that may be available at a given moment, or channels previously assigned to television broadcasting and now used, or usable in the future, by the new mobile telephony services (such as, for example, LTE terminals). In this case, a detector device is used for verifying that the channel is really available, so as to avoid any undesired interference to and from that service, since said channels are

present in the cables that distribute radiofrequency TV signals (i.e. signals that are not in IP format) within the environment.

According to this embodiment, the choice of the second frequency band of the second electric signal S2 or S2' requires, in the apparatuses of the domestic distribution system 101 or 201, the execution of a search process of the type used for "cognitive radio", in order to search for frequencies that are free from any radioelectric signal, for the purpose of finding a vacant channel.

In a preferred embodiment, the channel used for the distribution of audiovisual contents in IP format is managed by means of normal protocols of the IEEE 802.11.x specification, so as to allow every apparatus equipped with a Wi-Fi connection to connect to the domestic distribution network that is distributing such signals in IP format in order to reproduce audiovisual contents.

The band of the Wi-Fi network channel is generally sufficient (bit rate of at least 54 Mbit/s) to handle television signals in the SD (Standard Definition) format, which require approx. 2 Mbit/s each, and in the HD (High Definition) or 3D formats, which require 8-12 Mbit/s each.

In principle, it would not be strictly necessary to adopt the Wi-Fi protocol of the IEEE 802.11.x specification to exchange data between the transceiving system 102, 103, 202, 203 and the mobile terminals 160, 161 and 162, since any communication protocol (e.g. a proprietary one) could be used which allows the domestic distributor and the user's terminals to exchange data and accomplish the distribution of TV signals in IP format over the mixed communication channel (coaxial cable and radio waves).

The choice of the Wi-Fi protocol of the IEEE 802.11.x specification is however particularly advantageous because it ensures compatibility with the numerous Wi-Fi terminals already available on the market.

Furthermore, the techniques described above for the distribution of audiovisual contents of television signals in IP format can also be used, as aforementioned, for distributing the Internet connection.

In a preferred embodiment, the distribution system 101 or 201 and the transceiving systems 102, 103, 202, 203 cooperate in the selection of the audiovisual content of interest by the user.

In particular, the distribution system 101 or 201 is equipped with a control unit (not

shown), which is operatively connected to the output interface 124 or 125 (which therefore also acts as an input interface for the selection signals) and is adapted to receive, from the reproduction terminals connected to the transceiving systems 160, 161 and 162, at least one selection signal indicating a specific audiovisual content.

Said selection signal is received over the coaxial cable, preferably in the second frequency band, and the transceiver 119 or 219 is further configured to receive the selection signal and send it to the control unit, which then commands the tuner 113 to make the appropriate selection of the video stream comprising the requested audiovisual content. In other words, the selection signal travels over the air or over a cable in the same frequency bands as those used by the television signals along their path from the distribution system 101 or 201 to the reproduction terminals, which path is made up of the coaxial-cable connection lines 130 and 131 and the over-the-air links between the antenna of the apparatus 102, 202 and those of the apparatuses 160 and 162, or between the antenna of the apparatus 103, 203 and the one of the apparatus 161.

The selection signal can be provided by the user through a suitable user interface (not shown), which can preferably be displayed on the reproduction terminals 160, 161 or 162, preferably as a software application. In other words, the transceiving system 102, 103, 202 or 203 comprises a receiver adapted to receive a radioelectric selection signal, preferably using an IP protocol, in particular in the fourth frequency band; the selection signal indicates the specific audiovisual content requested. The transceiving system 102, 103, 202 or 203 is then configured to deliver the radiofrequency signal comprising the radioelectric selection signal emitted by the user apparatus 160, 161 or 162, to be transmitted over the coaxial cable 130 and 131, to the input interface 141 and 142 in the third frequency band; in this case, the input interface 141 and 142 also performs additional functions as an output interface for the radioelectric selection signal emitted.

The selection signal is preferably sent by means of a radioelectric signal in the same frequency band as the second signal S2 or S2' transmitted over the coaxial cable, whether such frequencies are "vacant" television frequencies or frequencies comprised between 2.4 GHz and 2.5 GHz or between 5.0 GHz and 6.0 GHz, so that the radioelectric selection signal will be compliant with an IEEE 802.11.x standard.

In reply to the selection signal received, the control unit is configured to: identify a video stream that comprises that specific audiovisual content selected by the user; cause

the tuner 113 to select the identified video stream; cause the demultiplexer 114 to extract the audiovisual content from the selected video stream; and cause the IP encapsulator 116 to encapsulate the extracted audiovisual content into the IP data stream.

If there is more than one user simultaneously using the same coaxial-cable distribution lines, e.g. users of the terminals 160 and 162, both of which are located within the environment 104, the distribution system 101 will allow the use of multiple channels (e.g. two or three) in IP format, in order to provide the requested bit rate.

The system for distributing audiovisual contents in IP format can also manage the case wherein a mobile user terminal, e.g. 160 or 161, is moved from one room 104 to the other room 105 of the apartment and/or there is not sufficient insulation between the signals irradiated in different rooms 104 and 105, by using known mechanisms for handling such situations, already provided for by the Wi-Fi standard.

Note that in the embodiments of the invention described in Figures 1 and 2 reference is made to the case of a hybrid terrestrial and satellite reception system: it is clear the this is not limiting in nature, but is useful for describing the invention by taking into account the most general and complex situation. The invention can also be implemented in the presence of just a terrestrial reception system or just a satellite reception system, with the obvious simplifications implied by these two cases as regards the first radioelectric signal S1, which will occupy a frequency band composed of, respectively, only the channels reserved for digital terrestrial television 810-814 or those reserved for satellite television 815.

It is also apparent that the invention is still applicable if there is a cable TV reception system in the place of a terrestrial reception system: in such a case, in addition to the type of modulation of the received signal (DVB-C/C2 instead of DVB-T/T2), also the frequency bands occupied by the radioelectric signal S1 will change, leading to a variation of the frequency band available to the system 101 or 201 for outputting the radioelectric signal S2 or S2' via the third radioelectric signal 802 or 803 emitted.

Figure 3 shows a further advantageous and preferred embodiment of a distribution system according to the present invention.

The video stream processing system 301 refers to an embodiment that allows the distribution system to simultaneously provide a plurality of different audiovisual contents to a respective plurality of players; the distribution systems 101 and 201

previously described, instead, allow distributing one same audiovisual content to a plurality of multimedia players. This system can therefore be implemented as a substitute for what is included in the embodiments of the invention of Figures 1 or 2 between the terminals 302 e 303, in order to make the systems 101 or 201 suitable for said multiple provision.

In order to be able to handle a plurality of different audiovisual contents, the processing system 301 comprises a plurality of tuners 113a, 113b, 113c operatively associated with the coaxial interface 302 by means of a multiple splitter 312; each tuner 113a, 113b, 113c is adapted to select and output a respective digital video stream, typically as an MPEG transport stream, obtained from the signals in the first frequency band of the first radioelectric signal S1 received at the coaxial interface 302.

The distribution system 301 comprises an equal plurality of demultiplexers 114a, 114b, 114c, each one operatively associated with a respective apparatus consisting of one of the tuners 113a, 113b, 113c, and is therefore adapted to extract from the video stream a respective audiovisual content, e.g. a digital television service (such as "RAIUNO", "RAIDUE", "RAITRE", ...), inclusive of video, audio, teletext, EPG, service name, television broadcaster name ("RAI" in this example), MHP application (e.g. "Telecomando RAI"), etc.

The distribution system 301 comprises an equal plurality of IP encapsulators 116a, 116b, 116c, each one operatively associated with a respective apparatus consisting of one of the demultiplexers 114a, 114b, 114c and adapted to encapsulate the extracted respective audiovisual content into a respective data stream coded according to an IP protocol.

The distribution system 301 comprises a control unit 310 (not shown in Figures 1 and 2 for the distribution system 101 or 201), configured to control the IP combiner 317 (which essentially performs the same functions as the IP combiner 117 of Figures 1 and 2) so as to multiplex the plurality of data streams generated by the IP encapsulators 116a, 116b, 116c into a single IP data stream. The signal thus generated, representative of the IP data stream, is subsequently sent to the transceiver 319 (which essentially performs the same functions as the transceivers 119 and 219 of Figures 1 and 2, respectively) and is then applied to the coaxial interface 303 and transmitted over a coaxial cable as previously described.

In this manner, the plurality of audiovisual contents are distributed incorporated in the second radioelectric signal S2 o S2'.

In an advantageous embodiment of the invention, the IP combiner is connected to a modem or router 318 performing the same functions as an Internet access gateway as the similar block 118 of Figures 1 and 2. Just like the functional blocks 117, 118 and 119 of said Figures, the blocks 317, 318 and 319 can be configured in such a way as to allow access to the Internet to IP terminals connected downstream of the interface 303. The same options also apply to these blocks as those concerning the block 118 being either integrated or external and/or the presence of any RJ-45 and/or RJ-11 Ethernet connection interfaces.

In a preferred embodiment, the functional groups 310a, 310b, 310c are further adapted to decode the selected audiovisual content, i.e. the single elementary video and/or audio streams included in the selected audiovisual content extracted from the Transport Stream (TS), which contains the (multiplexed) television programs in MPEG format. Such decoding may be useful, for example, in order to carry out a transcoding, i.e. a conversion of the compression format of the video and/or audio signal, in the event that the target reproduction terminal cannot decode that particular video or audio in the coded form received at the input of the distribution system 301. In another typical example, after such decoding it is conceivable to code again and further compress the audiovisual content (e.g. in high video definition and with multichannel audio) being transmitted to the reproduction terminal, so as to comply with the maximum transmission capacity of the available channel. This can be done by adopting a more advanced coding standard, e.g. by replacing MPEG4 AVC with HEVC for video, and MPEG Audio 1 layer 3 (called "mp3") with AAC+ for audio. As a first transcoding step, it is necessary to decode the input audiovisual content.

According to one variant, a video stream received in a more advanced standard may be decoded and then re-coded into a standard different from the initial one and accessible to the television reproduction means available at the user's premises.

A suitable encoder (not shown in Figure 3) is adapted to code the audio and/or video of said decoded content in order to compress it according to the desired standard and output it to the IP encapsulator 116, as previously described.

The control unit 310 is further adapted to receive, by means of an operative connection

to the transceiver 319 and by using a suitable application program (AP), the requests received from the users, e.g. via the return 2.4-2.5GHz WLAN connection in the coaxial cable, in order to select the desired television program among those receivable by the distribution system 301 via the coaxial interface 302. Similar functions can be executed also in the event that the connection to the users is established in frequency bands other than the 2.4-2.5GHz one, e.g. in the 230-470MHz band or in channels available in the VHF/UHF bands, as previously described.

The user terminals equipped with a WLAN network connection (smartphones, tablet PCs, etc.) are adapted to communicate at physical level with the distribution system 101, 201 or 301 by means of the above-described transceiving systems both in order to obtain the desired audiovisual contents and to possibly cause the execution of the application program (AP) necessary for communicating with said system 101, 201 or 301 at logic-application level.

Aiming at ensuring the utmost flexibility of the system, television channels in IP format can be managed by means of tables taking into account the single users' preferences.

The solution described herein is applicable to signals of terrestrial and satellite television broadcasting, in that the origin of the radioelectric signals implies no modifications in the distribution of the same in the IP format, since it only requires the presence of suitable reception, decoding (optional) and demultiplexing means 310a, 310b, 310c in the distribution system 301.

The number of means 310a, 310b, 310c and of the respective IP encapsulators 116a, 116b e 116c may be changed (in particular, increased) after the first installation in a modular manner, in order to expand the system according to the user's requirements. The transceiver 319 must have sufficient output power to serve different rooms in the apartment.

In particular, one embodiment of the distribution system comprises:

- a plurality of tuners 113a, 113b, 113c, operatively associated with the coaxial interface 302, each one adapted to select a respective video stream in the first frequency band;
- an equal plurality of demultiplexers 114a, 114b, 114c, each one operatively associated with a respective one of said tuners 113a, 113b, 113c and adapted to extract a respective audiovisual content from the video stream;
- an equal plurality of IP encapsulators 116a, 116b, 116c, each one operatively

associated with a respective one of said demultiplexers 114a, 114b, 114c and adapted to encapsulate the extracted respective audiovisual content into a respective data stream coded according to an IP protocol;

the control unit 310 is configured to multiplex the plurality of said data streams generated by said IP encapsulators 116a, 116b, 116c into a single IP data stream comprising a plurality of audiovisual contents, and is further configured to supply said single IP data stream, incorporated in said second radioelectric signal S2 or S2', to said transceiver 319 connected to said coaxial interface 303.

Figure 4 shows an example of an apparatus 401 with bidirectional function, to be used in the base station for the 230-470MHz band.

Said apparatus comprises an IP separator/combiner 402, a demodulator 403 and a modulator 404, operatively connected to the diplexer 405.

In order to obtain the necessary separation between the delivery and return ways, two separate channels may be used in the 230-470MHz band for the modulator 403 and the demodulator 404; for example, the modulator 404 is assigned a channel around 250 MHz, and the demodulator 403 is assigned a channel around 440 MHz.

Figure 5 shows an example of an apparatus 501 with bidirectional function, also acting as a frequency converter from the 230-470MHz band to the WLAN band (e.g.: 2.4-2.5 GHz), to be used downstream of the user's socket 141 or 142 and of the respective diplexer 143 or 144. In this respect, the apparatus 501 performs some functions that are substantially equivalent to the functions carried out by the transceiving systems 102 and 103 of Figures 1 and 2.

The user's socket 141 or 142 is preferably fitted with suitable male or female connectors of the 75Ω IEC coaxial type, commonly referred to as "IEC connector" and defined in the IEC 60169-2 specification, for the normal connection to the domestic television receiver or set-top box in the VHF/UHF bands, or of the type commonly referred to as F-type, whether male or female, as defined in the IEC 60169-24 specification, in the satellite 1st IF band.

The apparatus 501 comprises a modulator 502, a demodulator 503, an IP separator/combiner 504, a WLAN transceiver 505, and a diplexer 506.

In order to obtain the necessary separation between the delivery and return ways, two separate channels may be used in the 230-470MHz band, e.g. the channel around 250

MHz for the demodulator 503 and the channel around 440 MHz for the modulator 502, of course selected for compatibility with the channels used in the base station, which have been described herein with reference to Figure 4.

Figure 6 shows an example of a mixer/demixer network (diplexer), formed by a high-pass filter (C1, C2, L1) coupled to a low-pass filter (L2, L3, C3). When the network is used as a mixer, the signals are applied to the ends (V1 and V2). Signals having a higher frequency are applied to V1, whereas signals having a lower frequency are applied to V2: the mixed output signal is obtained at V3. When, on the contrary, the network is used as a demixer, the signal is applied to V3 and the demixed output signal is obtained at the ends (V1 and V2). Signals having a higher frequency are obtained at V1, whereas signals having a lower frequency are obtained at V2:

depending on the difference in frequency between the high-frequency signals and the low-frequency signals to be mixed or demixed, the low-pass and high-pass cells may be designed with a complexity of degree 3, like those shown in the example, or of a higher degree.

When designing equipment that uses the 230-470MHz band, it is necessary to take into account the characteristics of the 2.4-2.483GHz and 5.150-5.875GHz WLAN bands in which the 22MHz channels are allocated, with QPSK, 16 QAM or 64 QAM modulation, depending on the desired bit rate (6-54 Mbit/s) and on the interferential situations encountered.

It is advantageous that the distribution system 101, 201 can detect, at the installation stage, the situation of the frequency ranges (S2') in the domestic environment, in order to monitor the situation in terms of signal-to-noise (S/N) ratio of the Wi-Fi channels and then select the proper modulation based on the situation detected.

In order to select the channel to be used, exploration signals can be sent to the WLAN terminal for finding a vacant channel and for sizing the most appropriate type of modulation. One may also change the power supplied into the coaxial cable and the irradiated electric field by adjusting the gain of antenna amplifiers and/or the power divider included in the distributor.

Figure 7 illustrates the 2.4-2.483 GHz band, in which at most 3 independent channels can be allocated of the 13 channels virtually available, but partially overlapping, in the 83MHz-wide band. The independent channels are the channels number 1, 6 and 11, or 2,

7 and 12, or 3, 8 and 13.

Since the 230-470MHz band has an extension of 240 MHz, the number of channels that can be allocated therein is three times higher (max. 9 channels), which are then re-converted into the 2.4-2.483 GHz band depending on the user's request.

Of course, if the 5.150-5.875GHz band, which is 725 MHz wide, is used for the re-conversion, the channels distributed in the 230-470MHz band, which is 240 MHz wide, can be converted in bulk, without requiring a selection of the channels to be converted, provided that there is no interference.

The prescriptions that must be complied with for signals in the 2.4-2.5GHz and 5.0-6.0GHz WLAN bands are those of the IEC 60728-1-1 specification (par. 6.6), concerning radio distribution of signals received by means of a wired modem.

To be precise, the so-called 5GHz band used for WLAN networks comprises a series of 20/40MHz radio channels between 4,915 and 5,850 MHz. The radio channels actually available for Wi-Fi transmission depend on the region (Europe) or country of installation, which impose their own regulations as to the available spectrum and maximum transmission power, in addition to other restrictions and rules of use, such as, for example, the possibility of using certain channels in indoor environments only, the mandatory use of automatic mechanisms for limiting the maximum emission power, and so on.

Europe, for example, has adopted a 20/40MHz channelling that extends from 5,150 to 5,725 MHz, in accordance with the EN 301 893 standard. The band from 5,150 to 5,725 MHz is divided into two sub-bands: 5,150-5,350 MHz and 5,470-5,725 MHz, which respectively are 200 MHz and 255 MHz wide. In the United States, on the other hand, a total band extending from 5,150 to 5,835 GHz is available for Wi-Fi transmission; other situations are encountered, for example, in China, India, Japan, Brazil, Australia, etc. For simplicity, in Figure 8b said band is generically indicated as extending from 5.0 to 6.0 GHZ, it being understood that it is actually slightly different and country-dependent.

In order to comply with these local regulations, the system 101 or 201 may acquire from the user during installation, through a suitable procedure, the country where the transceiver 119 of the system will have to operate and then generate the second radioelectric signal S2 in the second frequency band as permitted by the competent authorities.

Figure 8a illustrates the frequency allocation of a signal 801 running in the coaxial cable that connects the apartment interface 109 to the input interface 111.

Said signal 801 comprises a first radioelectric signal S1 in the frequencies typically used for terrestrial or satellite television broadcasting.

For example, said signal S1 comprises the continuous component (13/18V) and the 22kHz tone (810) of the DiSEqC protocol, if there is a satellite reception system.

Said signal S1 comprises also the allocation of the channels of terrestrial television broadcasting, which comprises the VHF Band I, designated 811, the VHF Band III, designated 812, the FM radio band, designated 813, the VHF Bands IV and V, designated 814.

Said signal S1 further comprises the allocation of the channels of satellite television broadcasting, which comprises the 1st intermediate frequency band (1st IF), designated 815.

Figure 8b illustrates a first embodiment of the frequency allocation of a signal 802 running in the coaxial cable 130 or 131 that connects the interface 124 or 125 to the interface 141 or 142 of the transceiving systems 102 and 103.

Said signal 802 comprises the above-described typical components of the signal S1.

In addition, said signal 802 comprises a second radioelectric signal S2 in frequencies that are not used for television broadcasting, in particular in frequencies that are typically used by other types of signals.

Preferably, the signal S2 occupies the 2.4-2.483GHz and/or 5.0-6.0GHz WLAN or Wi-Fi bands, respectively designated 816 and 817, in which the television signals encapsulated in an IP data stream are transmitted, as previously described.

Figure 8c illustrates a second embodiment of the frequency allocation of a signal 803 running in the coaxial cable 130 or 131 that connects the interface 124 or 125 to the interface 141 or 142 of the transceiving systems 102 and 103.

Said signal 803 comprises the above-described typical components of the signal S1.

In addition, said signal 803 comprises a second radioelectric signal S2, in particular in the 230-470MHz second band and in the 790-862MHz third band, respectively designated 818 and 819, in which the television signals encapsulated in an IP data stream are transmitted, as previously described.

Figure 8d illustrates the frequency allocation of a signal 804 running in the coaxial

cables 149 or 150 that connect the interfaces 147 and 148 of the transceiving systems 102 and 103, respectively, to the coaxial-cable inputs of the user's apparatuses 162 and 163.

Said signal 804 essentially corresponds to the signal S1 originally received by the apartment interface 109, i.e. a signal that is perfectly acceptable at the input of any user's receiving apparatuses, even those already existing prior to the installation of the distribution system 101 or 201.

This signal 804 is accompanied with a fourth radioelectric signal irradiated in a fourth frequency band, which carries the audiovisual content encapsulated in an IP data stream. Preferably, the fourth radioelectric signal corresponds to the signal S2 and comprises the 2.400-2.483GHz and/or 5.0-6.0GHz WLAN or Wi-Fi bands, respectively designated 816 and 817, in which the television signals encapsulated in an IP data stream are transmitted, as previously described.

The invention has been described herein with reference to terrestrial television bands and to the satellite intermediate frequency band that are in use and available in Italy or, more in general, in Europe; actually, however, the invention is also applicable, with appropriate adaptations, in countries or continents wherein the frequency bands available for terrestrial or satellite television are different from those presented herein.

[INDUSTRIAL APPLICABILITY]

The distribution system and the transceiving system according to the present invention are effectively backward-compatible and allow the new communication functionalities for Wi-Fi terminals to be added to the domestic system without in the least disturbing the operation of any pre-existent apparatuses, such as television sets, LNB satellite or terrestrial digital reception system, terrestrial, satellite or hybrid set-top boxes, etc. In this regard, through the use apparatuses according to the present invention, the user will not have to substitute any radio-television apparatuses already in place prior to the installation of the new distribution system and of one or more transceiving systems according to the present invention, nor to purchase any new radio-television receiving apparatuses, such as a proprietary set-top box capable of utilizing the new frequency bands over a coaxial cable.

The distribution system and the transceiving system according to the present invention, therefore, minimize the impact on the existing system and apparatuses, and allow

keeping pre-existent apparatuses, which will continue to work properly and hence will not have to be replaced, leading to considerable economical savings and less discomfort for the user.

In addition, the distribution system and the transceiving system according to the present invention get round the lack of access points in every room or environment where audiovisual contents, especially high or ultra high resolution ones, are to be distributed in wireless mode to mobile (and fixed) terminals equipped with an IEEE 802.11.x WLAN/Wi-Fi interface, which are now pervasive (smartphones, tablets, smart TVs, etc.). It must be pointed out that the invention can be implemented by using any one of the present or future Wi-Fi standards of the 802.11x family, e.g. in the 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac, etc. versions.

The distribution system and the transceiving system according to the present invention also ensure better exploitation of the vacant frequency bands of the pre-existent coaxial-cable distribution system, which do not require a license and can be used for distributing audiovisual contents in a safe and secure manner towards environments that, for example, are not easily reachable via wireless transmission because of the presence of insurmountable obstacles to radio waves and/or because of interferences caused by existing WLAN networks (e.g. a densely populated city block with many WLAN networks), microwave ovens, or other unlicensed ISM radio connections.

The distribution system and the transceiving system according to the present invention also allow delivering audiovisual contents to "WLAN enabled" devices, by sending a signal already compliant with the Wi-Fi protocol; furthermore, in a preferred embodiment, wherein the frequency band in use is compliant with the 802.11.x standard, it will be sufficient to add to the user's socket a special apparatus 102 (202) or 103 (203) containing an antenna 145, 146 to directly irradiate the signal over the air, ready for use by the served WLAN terminals, without requiring the use of new, dedicated set-top boxes.

Likewise, the WLAN terminals 160, 161 and 162 can send commands and signalling to the distribution system 101 or 201 through the antenna 145, 146 over the coaxial-cable connections 130, 131, since said connections are bidirectional.

It must be remarked that, regardless of the teachings of the present invention, there is a technical prejudice in using a wireless communication protocol like those of the IEEE

802.11.x series on an I/O interface of a wired apparatus. This family of Wi-Fi standards has been specifically conceived for use in wireless communication networks, and their use in a wired communication network would certainly not be intuitive for the man skilled in the art. In fact, cable and radio are, in principle, communication channels with totally different characteristics as regards attenuation, passband, interference sensitivity, presence of reflections, variability or stability over time, presence of noise, and so on; these substantial differences induce a man skilled in the art to exclude right away the possibility of using a communication protocol optimized for a wireless radio channel in a communication network over coaxial cable.

In light of the present description, further variants and modifications of the present invention will be apparent to those skilled in the art, without however departing from the protection scope defined by the following claims.

CLAIMS

1. **Distribution system** (101; 201) for audiovisual contents, comprising:

- at least one input interface (111) adapted to receive at least one first radioelectric signal (S1) in a first frequency band, said first radioelectric signal containing at least one video stream comprising at least one audiovisual content;

- at least one tuner (113) operatively associated with said input interface (111) and adapted to select said at least one video stream from said first radioelectric signal (S1) in said first frequency band;

– at least one demultiplexer (114) operatively associated with said tuner (113) and adapted to extract said at least one audiovisual content from said video stream;

- at least one IP encapsulator (116) operatively associated with said demultiplexer (114) and adapted to encapsulate said extracted audiovisual content into a packet data stream coded according to an IP protocol;

- at least one radiofrequency transceiver (119, 219, 319) configured to generate a second radioelectric signal (S2; S2') containing said IP data stream; and

- at least one coaxial interface (124, 125) for a coaxial cable (130, 131), operatively connected to said transceiver (119, 219, 319) and configured to emit said second radioelectric signal (S2; S2') on said coaxial cable (130, 131);

said distribution system (101; 201) being **characterized in that** it further comprises at least one splitter (112) operatively connected to said input interface (111) and configured to receive said first radioelectric signal (S1) and split it so as to send it on one side to said coaxial interface (124, 125) and on another side to said tuner (113),

and in that it further comprises at least one diplexer (121, 122) configured to receive said first radioelectric signal (S1) from said splitter (112) and send it to said at least one coaxial interface (124, 125) for emitting a third radioelectric signal (802; 803) comprising said first radioelectric signal (S1) on said coaxial cable (130, 131) in said first frequency band, and further configured to receive said second radioelectric signal (S2; S2') from said transceiver (119, 219, 319) and send it to said at least one coaxial interface (124, 125) for emitting said third radioelectric signal (802; 803) comprising said second radioelectric signal (S2; S2') on said coaxial cable (130, 131) in a second frequency band (816, 817; 818, 819), which is different from said first frequency band (811, 812, 813, 814, 815).

2. Distribution system according to claim 1, wherein said first frequency band corresponds to frequencies (811, 812, 813, 814, 815) used in satellite or terrestrial television transmission on coaxial cable, and wherein said second frequency band (816, 817; 818, 819) corresponds to frequencies not used in satellite or terrestrial television transmission on coaxial cable.

3. Distribution system according to claim 2, wherein said second radioelectric signal (S2; S2') comprises an IP WLAN signal, preferably according to an IEEE 802.11.x standard, in said second frequency band (816, 817; 818, 819).

4. Distribution system according to claim 3, wherein said second frequency band (816, 817) is comprised between 2.4 GHz and 2.5 GHz, or between 5.0 GHz and 6.0 GHz.

5. Distribution system according to claim 2, wherein said second frequency band (818, 819) is comprised between 230 MHz and 470 MHz, or between 790 and 862 MHz, or between 694 and 790 MHz, or between 694 and 862 MHz.

6. Distribution system according to any one of claims 2 to 5, wherein said first frequency band (811, 812, 813, 814, 815) comprises at least one of the following: VHF band between 47 MHz and 230 MHz, UHF band between 470 MHz and 862 MHz, UHF band between 470 MHz and 790 MHz, UHF band between 470 MHz and 694 MHz, intermediate satellite band between 950 MHz and 2,150 MHz.

7. Distribution system according to any one of claims 1 to 6, wherein said at least one diplexer (121, 122) and said at least one splitter (112) are further configured for bidirectional transmission of control signals (810) between said input interface (111) and said coaxial interface (124, 125).

8. Distribution system according to claim 7, wherein said control signals (810) comprise a continuous component (13/18V) and a 22kHz tone in accordance with the DiSEqC protocol.

9. Distribution system according to any one of claims 1 or 2, further comprising a detector device adapted to check for the presence of radioelectric signals in frequency bands on said coaxial cable (130, 131) connected to said coaxial interface (124, 125), wherein said detector device is operatively associated with said transceiver (119, 219, 319), and wherein said transceiver (119, 219, 319) is further configured to select said second frequency band according to the result of the inspection carried out by said

detector device.

10. Distribution system according to any one of claims 1 to 9, further comprising a control unit (310) operatively connected to said coaxial interface (303) and adapted to receive at least one selection signal indicating at least one piece of information associated with a specific audiovisual content, said selection signal being received on said coaxial cable (130, 131), said transceiver (319) being further configured to receive at least said selection signal and send it to said control unit (310), said control unit (310) being further configured to, in reply to said selection signal received:

- identify a video stream comprising said specific audiovisual content;
- cause said tuner (113) to select said video stream comprising said specific audiovisual content;
– cause said demultiplexer (114) to extract said specific audiovisual content from said selected video stream, and
- cause said IP encapsulator (116) to encapsulate said extracted specific audiovisual content into said IP data stream.

11. System according to any one of claims 1 to 10, further comprising at least one decoder (115) operatively associated with said at least one demultiplexer (114) and adapted to decode said at least one audiovisual content following said extraction, wherein said at least one IP encapsulator (116) is operatively associated with said at least one decoder (115) and is adapted to generate said IP data stream starting from said decoded audiovisual content.

12. Distribution system according to any one of claims 1 to 11, further comprising Internet connection means (118), wherein said transceiver (119, 219) is further configured to transmit over said coaxial interface (124, 125), in addition to said second radioelectric signal, a data signal received through said Internet connection means, by using said second frequency band (816, 817; 818, 819).

13. Distribution system according to any one of claims 1 to 12, wherein said coaxial interface (124, 125) for a coaxial cable comprises a connector compliant with the IEC 60169-2 technical specification, or an F-type connector compliant with the IEC 60169-24 technical specification, or another equivalent type.

14. Distribution system according to claim 1, wherein said at least one diplexer (121, 122) is configured for receiving IP data packets through said at least one coaxial

interface (124, 125) in said second frequency band (816, 817; 818, 819) and for routing said IP packets towards said at least one transceiver (119, 219), which will convert them into a format that can be transmitted through the Internet from an Internet modem or router (118).

15. Distribution system according to any one of claims 1 to 14, wherein said video stream is received in a first coding standard, and wherein said system further comprises at least one encoder adapted to re-code said received video stream into a second coding standard, different from said first coding standard.

16. **Transceiving system** (102, 103, 202, 203, 501) for transmission/reception of audiovisual contents in an environment (104, 105), comprising:

- at least one first coaxial interface (141, 142) for a coaxial cable (130, 131);
- an apparatus connected to said first interface (141, 142) and adapted to receive from said coaxial cable (130, 131) at least one third radioelectric signal (802; 803) in a third frequency band, said third radioelectric signal (802; 803) comprising a television video stream transported by a first radioelectric signal (S1) in a first frequency band (811, 812, 813, 814, 815) used in satellite or terrestrial television transmission on coaxial cable, said third signal (802; 803) further comprising at least on audiovisual content encapsulated in an IP data stream transported by a second radioelectric signal (S2; S2') in a second frequency band (816, 817; 818, 819), which is different from said first frequency band;
- at least one diplexer (143, 144) configured to process said third radioelectric signal (802; 803) and separate said audiovisual content encapsulated in an IP data stream from said television video stream;
- at least one second interface (147, 148) for a coaxial cable (149, 150) operatively connected to said diplexer (143, 144) and configured to transfer said television video stream comprised in said third radioelectric signal (802; 803);
- and further comprising irradiation means (145, 146, 505) operatively connected to said diplexer (143, 144) and adapted to irradiate in said environment (104, 105) a fourth radioelectric signal in a fourth frequency band dedicated to wireless communications according to an IP protocol, said fourth radioelectric signal comprising said audiovisual content encapsulated in an IP data stream for transmitting said audiovisual content to at least one wireless receiving terminal (160, 161, 162).

17. Transceiving system according to claim 16, wherein said fourth radioelectric signal corresponds to an IP WLAN signal, being preferably compliant with an IEEE 802.11.x standard.

18. Transceiving system according to claim 17, wherein said fourth frequency band is comprised between 2.4 GHz and 2.5 GHz, or between 5.0 GHz and 6.0 GHz.

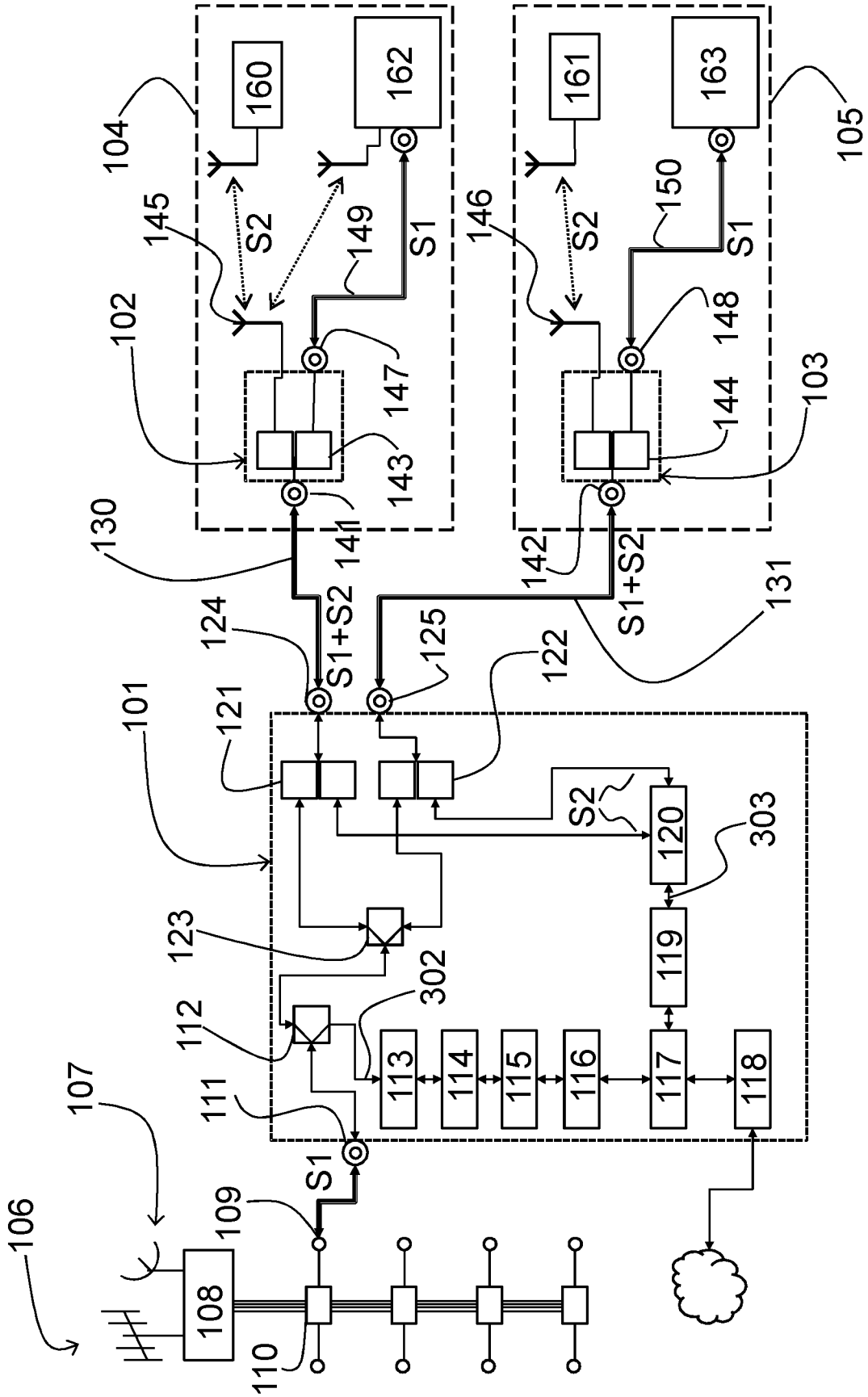
19. Transceiving system according to any one of claims 16 to 18, wherein said audiovisual content encapsulated in an IP data stream transported by said second radioelectric signal (S2; S2') occupies in said third radioelectric signal (802; 803) a frequency band which is the same as said fourth frequency band.

20. Transceiving system according to any one of claims 16 to 19, wherein said audiovisual content encapsulated in an IP data stream comprised in said third radioelectric signal (802; 803) corresponds to the audiovisual content encapsulated in an IP data stream comprised in said fourth radioelectric signal.

21. Transceiving system according to claim 16 or 17, wherein said transceiving system (202, 203, 501) further comprises conversion means (270, 271; 502, 503, 504) adapted to convert said second frequency band of said second radioelectric signal (S2; S2') comprising said audiovisual content encapsulated in an IP data stream into a fourth frequency band of said fourth radioelectric signal, said fourth frequency band being different from said second frequency band.

22. Transceiving system according to any one of claims 16 to 21, further comprising a second receiver adapted to receive at least one radioelectric selection signal according to an IP protocol, received in said fourth frequency band and indicating at least one piece of information associated with a specific audiovisual content, and further comprising means for emitting a radiofrequency signal comprising said radioelectric selection signal, said radiofrequency signal being transmitted over said coaxial cable (130, 131) through said first interface (141, 142) in said third frequency band of said third radioelectric signal (802; 803).

23. Transceiving system according to any one of claims 16 to 22, wherein said first interface (141, 142) for a coaxial cable comprises a connector compliant with the IEC 60169-2 technical specification, or an F-type connector compliant with the IEC 60169-24 technical specification, or another equivalent type.


160
162
161
163
104
105
145
S2
149
S1
146
S2
150
S1
102
148
147
144
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143
130
141
142
S1+S2
131
124
125
122
S1+S2
101
121
S2
120
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114
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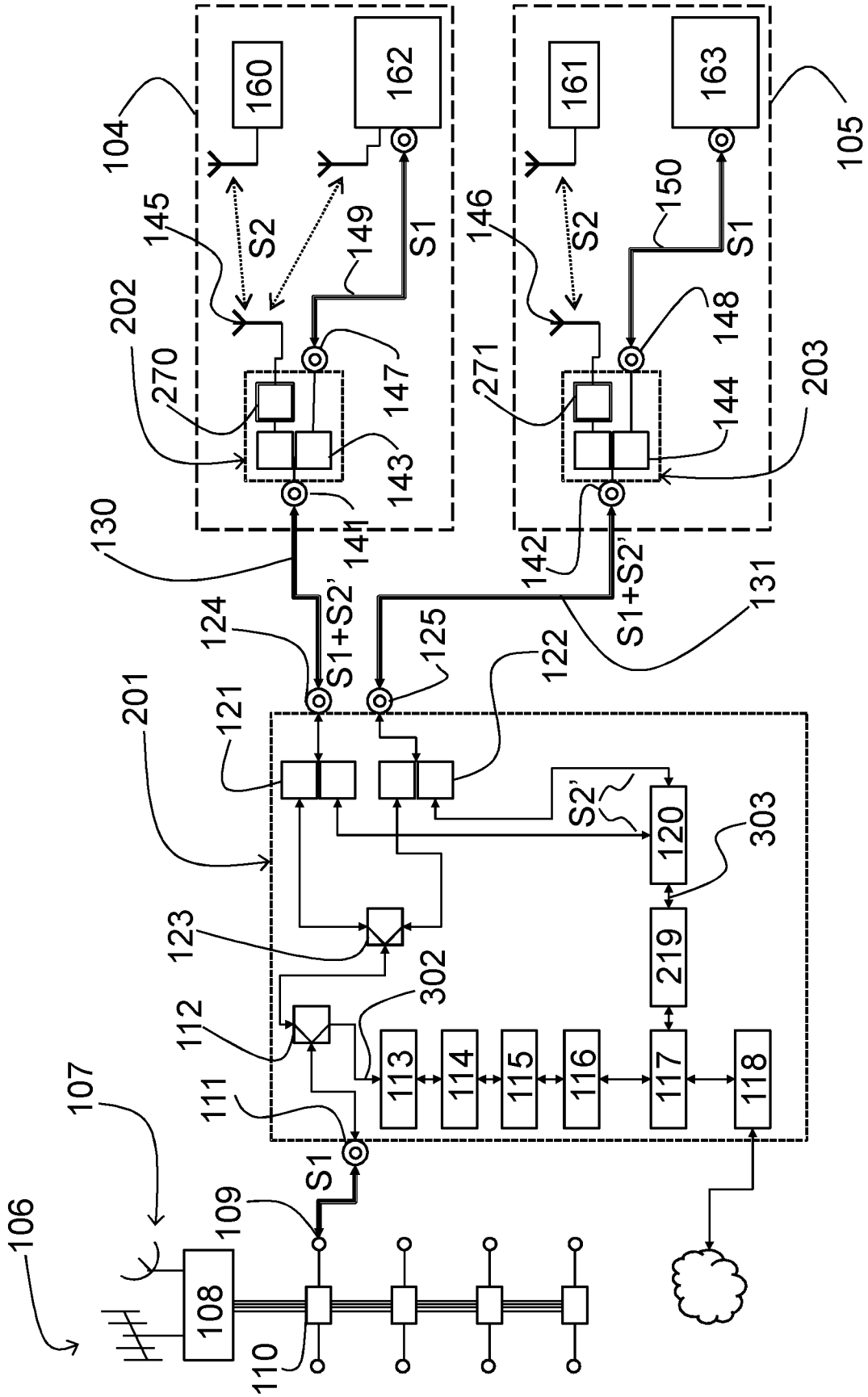
117
118
111
107
S1
109
106
108
110

FIG. 1


104
105
160
161
162
163
145
146
149
150
S2
S1
202
203
270
271
147
148
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144
130
141
142
131
S1+S2'
124
125
122
201
121
S2'
120
303
123
219
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112
113
114
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111
107
S1
109
106
108
110

FIG. 2

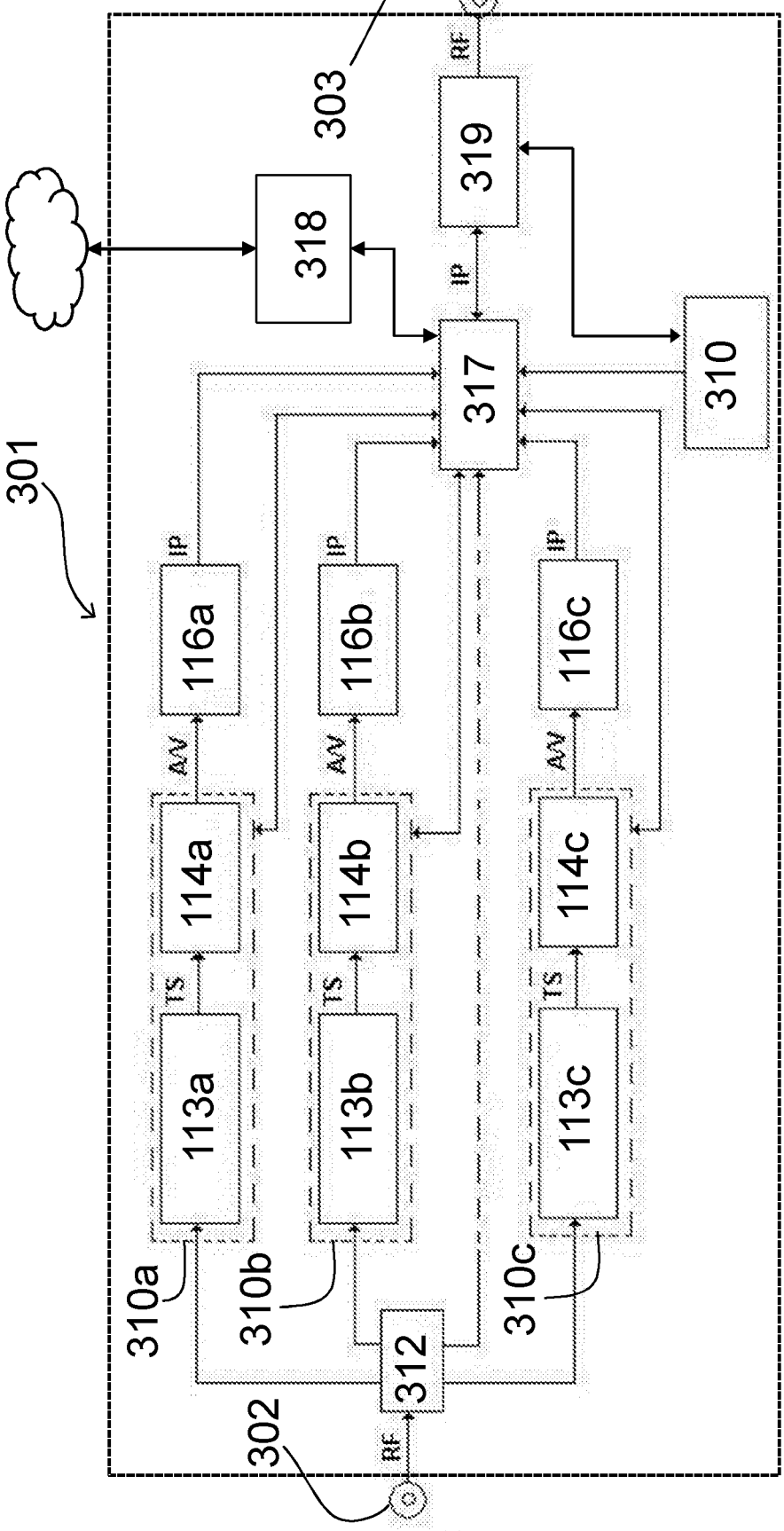
303
RF
319
318
IP
317
310
301
IP
116a
116b
116c
A/V
114a
114b
114c
TS
113a
113b
113c
310a
310b
310c
312
302
RF

FIG. 3

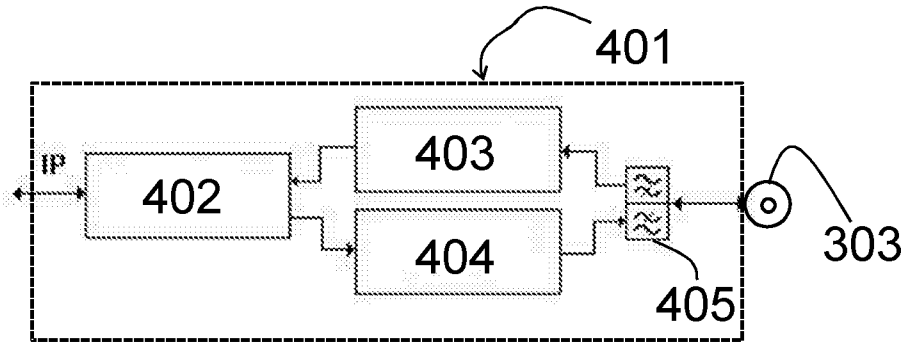

FIG. 4

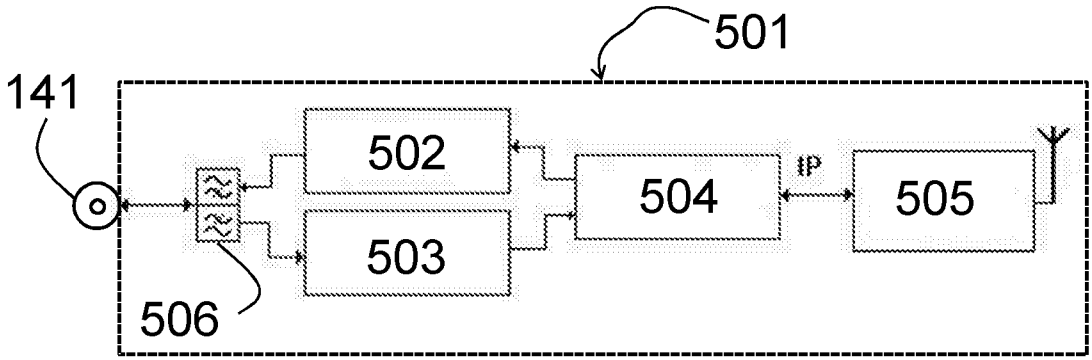

FIG. 5

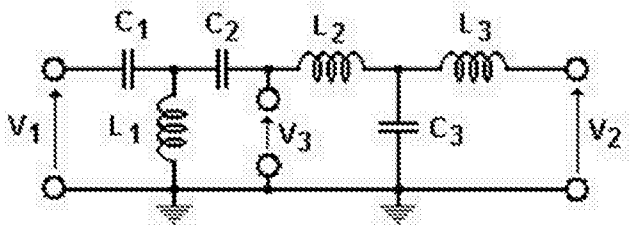

FIG. 6

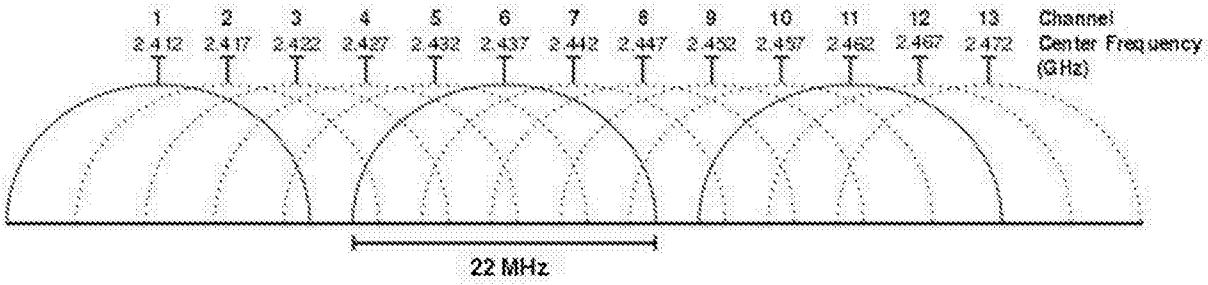

FIG. 7

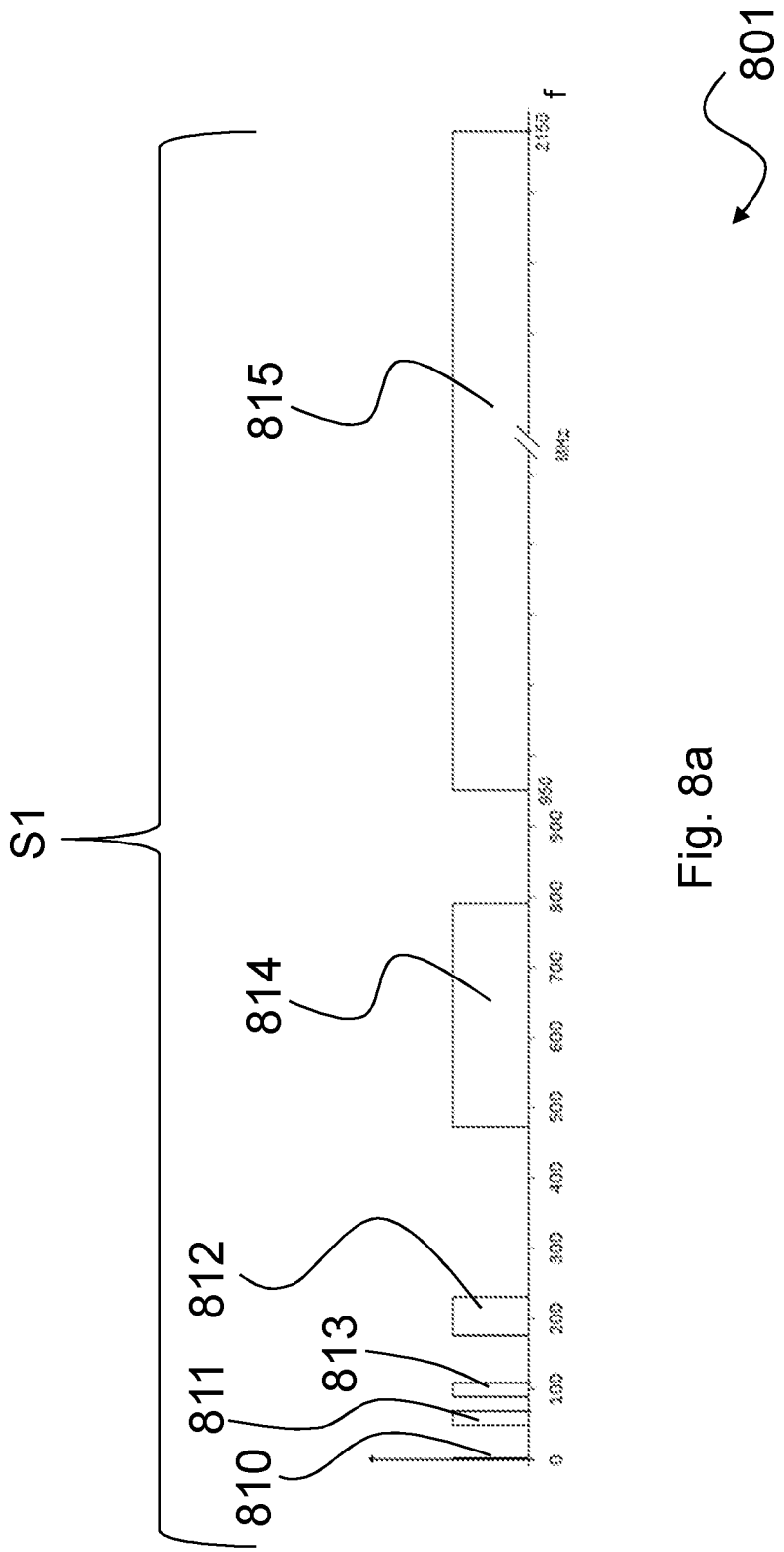
801
S1
815
814
812
813
811
810
f
0
100
200
300
400
500
600
700
800
900
2155

Fig. 8a

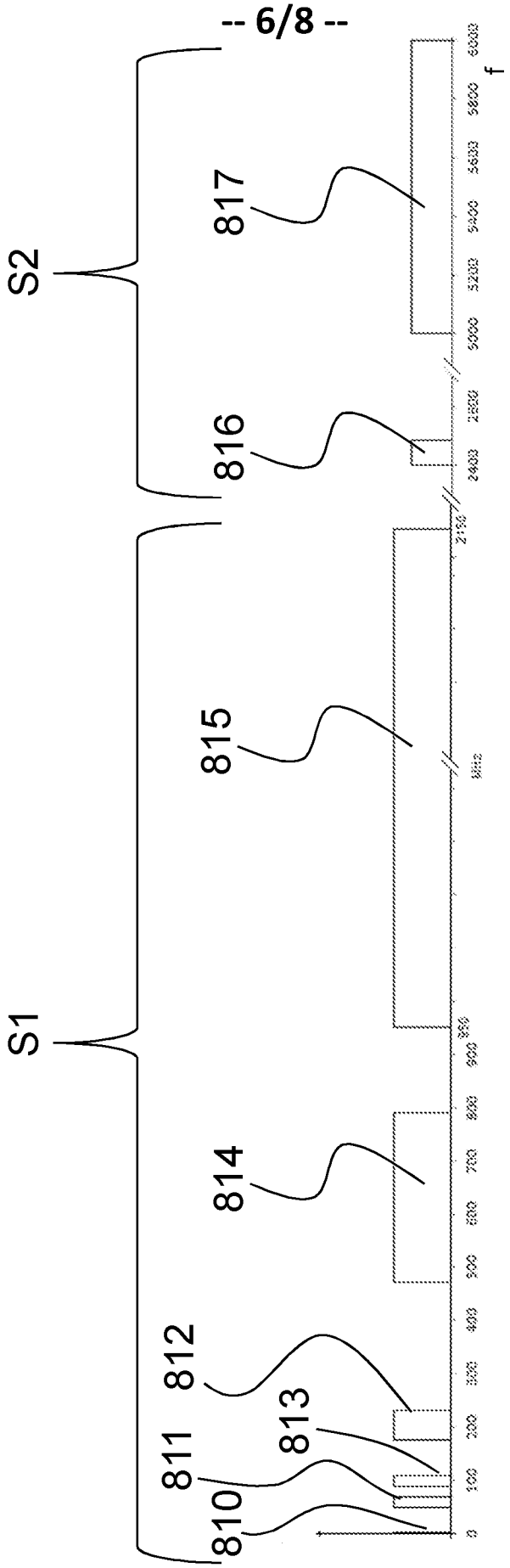

Fig. 8b

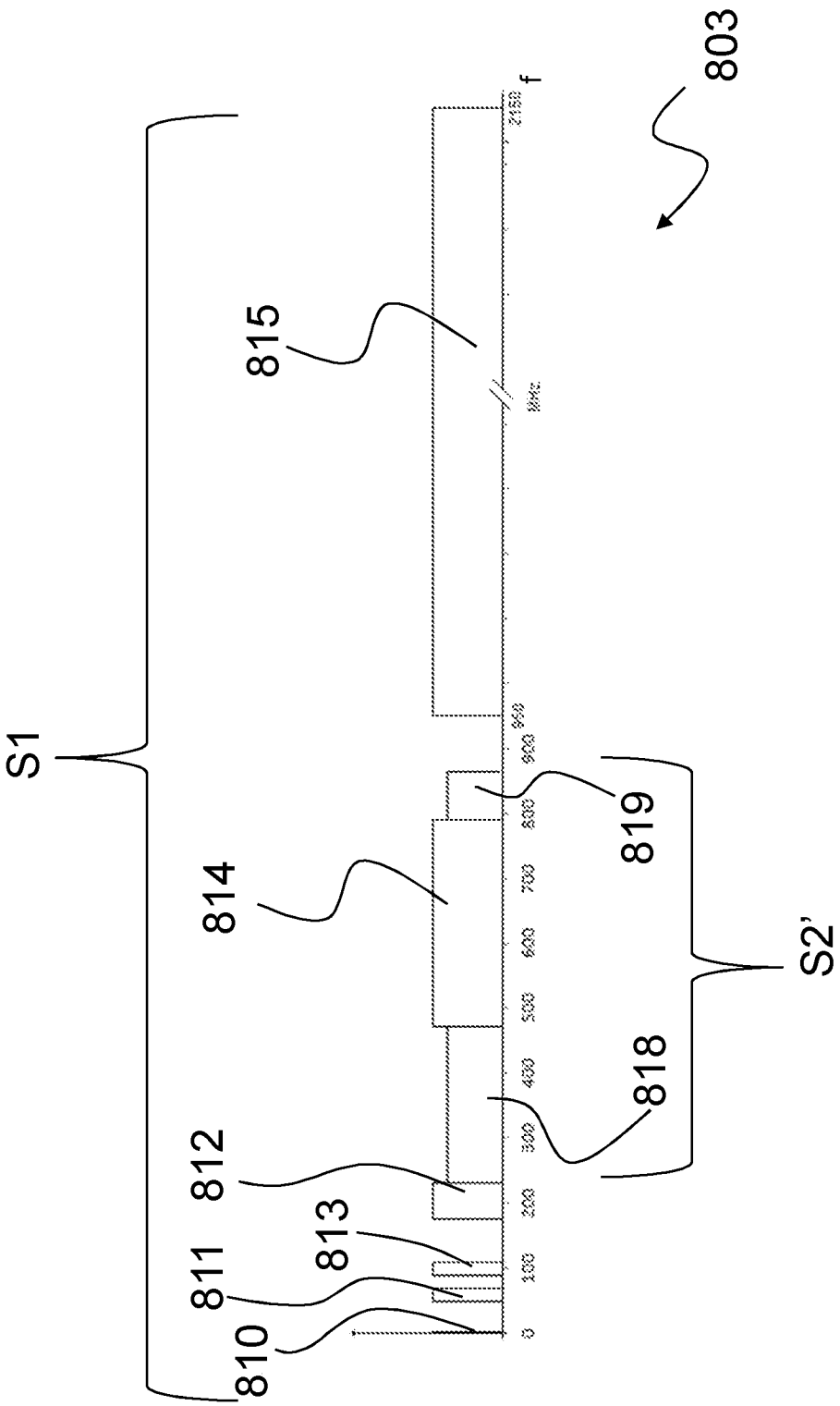
803
f
815
S1
814
819
S2'
818
812
813
811
810
0
100
200
300
400
500
600
700
800
900

Fig. 8c

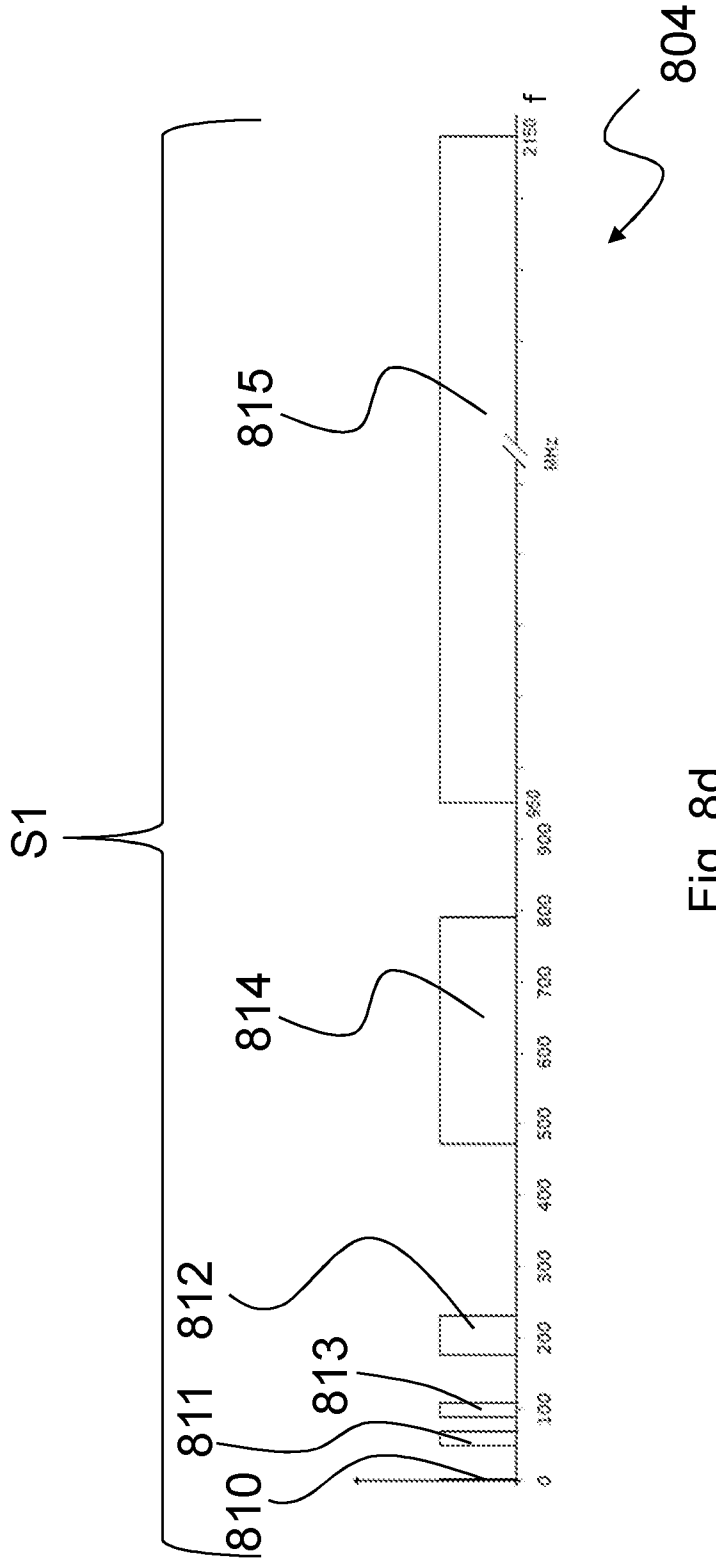
804
f
815
814
812
813
811
810
S1
0
100
200
300
400
500
600
700
800
900
1000

Fig. 8d

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2014/063682

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04N21/4363 H04N7/10
ADD.

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)
H04N H04H

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)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 2 525 572 A1 (MAXLINEAR INC [US]) 21 November 2012 (2012-11-21) the whole document -----	1-6,10, 13,16-23 9,15
X Y	WO 2010/147806 A1 (ECHOSTAR TECHNOLOGIES LLC [US]; STRONG STEPHEN [US]; TUCK FREDERICK R) 23 December 2010 (2010-12-23) abstract; claims 1-4 page 5, line 16 - line 18 page 10, line 1 - line 15 -----	1-6, 10-14 9,15
X Y	US 2009/113492 A1 (NORIN JOHN L [US] ET AL) 30 April 2009 (2009-04-30) abstract; figures 2,4 paragraphs [0008], [0050] paragraph [0026] - paragraph [0038] -----	1-8,10, 11,13 9,15
	-/--	

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

[X] See patent family annex.

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation 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 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	Date of mailing of the international search report
16 December 2014	23/12/2014

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Brans, Tim

INTERNATIONAL SEARCH REPORT

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2007/256094 A1 (PUGEL MICHAEL A [US] ET AL) 1 November 2007 (2007-11-01) abstract; figure 6 paragraph [0044] -----	9,15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2014/063682

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2525572 A1	21-11-2012	NONE	
WO 2010147806 A1	23-12-2010	CA 2761347 A1	23-12-2010
		CN 102450008 A	09-05-2012
		EP 2443829 A1	25-04-2012
		US 2010325670 A1	23-12-2010
		US 2014033259 A1	30-01-2014
		WO 2010147806 A1	23-12-2010
US 2009113492 A1	30-04-2009	CN 101861733 A	13-10-2010
		EP 2208348 A2	21-07-2010
		EP 2521355 A1	07-11-2012
		KR 20100094483 A	26-08-2010
		KR 20120113278 A	12-10-2012
		US 2009113492 A1	30-04-2009
		WO 2009059241 A2	07-05-2009
US 2007256094 A1	01-11-2007	NONE	