



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
07.06.2023 Bulletin 2023/23

(51) International Patent Classification (IPC):
H04H 20/24 (2008.01)

(21) Application number: **21212598.3**

(52) Cooperative Patent Classification (CPC):
H04H 20/24

(22) Date of filing: **06.12.2021**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(54) **APPARATUSES AND METHODS FOR PROVIDING HYBRID TELEVISION (TV) SERVICE WITH SMART SOURCE SWITCHING**

(57) A method for providing hybrid TV service with smart source switching is proposed. The method includes the following steps. A TV receiver determines whether a particular channel supports hybrid TV service over a plurality of communication media. If the channel supports hybrid TV service, the TV receiver determines the availabilities or indicators of data signals over the

communication media. The TV receiver selects one of the communication media based on the availabilities or the indicators of the data signals over the communication media. After that, the TV receiver displays multimedia content carried in the data signals over the selected communication medium.

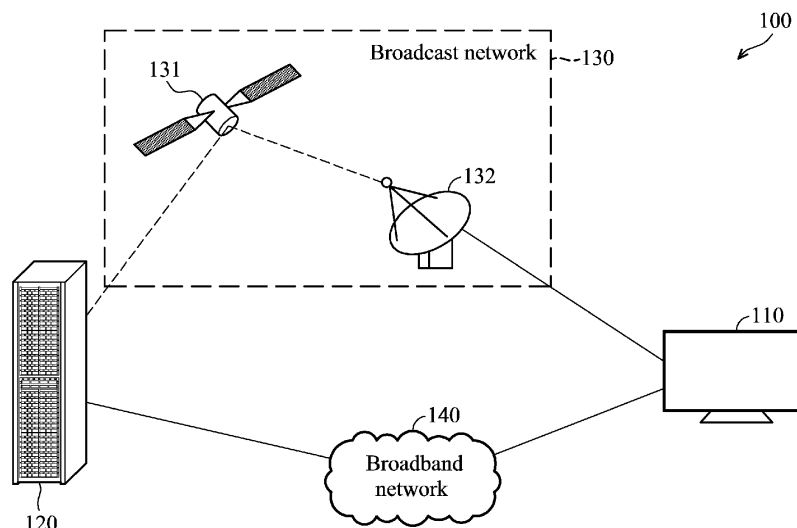


FIG. 1

Description

BACKGROUND OF THE APPLICATION

Field of the Application

[0001] The application generally relates to television (TV) broadcast communications and, more particularly, to apparatuses and methods for providing hybrid TV service with smart source switching.

Description of the Related Art

[0002] As the age of analog broadcasting comes to an end, various technologies for digital broadcasting have been developed in the field of broadcast-content reproduction. Generally, digital broadcast technologies can deliver more video and/or audio data than analog broadcasts, and they may also be able to deliver various types of additional data, in addition to just the video and/or audio data. For example, a digital broadcast system supporting hybrid television (TV) service may provide High Definition (HD) images, multi-channel audio, and various additional services over different communication media, such as a satellite/cable/terrestrial broadcast network (also referred to as a broadcast network), and a broadband network (e.g., any wired or wireless communication network that can provide Internet access). However, in conventional applications of hybrid TV service, a TV set is commonly designed to display content according to the preconfigured or default setting of broadcast/broadband priority. When the current source (i.e., either broadcast or broadband) of content is off or unstable, the TV set still keeps displaying content from the non-ideal source and a black screen (or called a blank screen) may appear. As a result, user experience with hybrid TV service may be affected.

BRIEF SUMMARY OF THE APPLICATION

[0003] In order to solve the aforementioned problem, the present application proposes to enable a TV receiver to dynamically switch between the broadcast input source and the broadband input source of a TV channel, thereby avoiding the occurrence of a black screen (or called a blank screen) while the user is watching or listening to the TV channel, thereby improving the overall user experience.

[0004] In one aspect of the application, a method is provided. The method comprises the following steps: determining, by a television, TV, receiver, whether a channel supports hybrid TV service over a plurality of communication media; determining, by the TV receiver, availabilities or indicators of data signals over the communication media in response to the channel supporting hybrid TV service; selecting, by the TV receiver, one of the communication media based on the availabilities or the indicators of the data signals over the communication

media; and displaying, by the TV receiver, multimedia content carried in the data signals over the selected communication medium.

[0005] In another aspect of the application, a TV receiver comprising a receiving circuit and a control circuit is provided. The receiving circuit is configured to receive data signals of a channel via a plurality of communication media. The control circuit is configured to determine whether the channel supports hybrid TV service over the communication media, determine availabilities or indicators of the data signals over the communication media in response to the channel supporting hybrid TV service, select one of the communication media based on the availabilities or the indicators of the data signals over the communication media, and display multimedia content carried in the data signals over the selected communication medium.

[0006] In yet another aspect of the application, an audio or video reproduction apparatus comprising a display device, and a TV receiver is provided. The TV receiver is configured to determine whether a channel supports hybrid TV service over a plurality of communication media, determine availabilities or indicators of the data signals over the communication media in response to the channel supporting hybrid TV service, select one of the communication media based on the availabilities or the indicators of the data signals over the communication media, and display multimedia content carried in the data signals over the selected communication medium on the display device.

[0007] In one example, the communication media comprise a broadcast network and a broadband network.

[0008] In one example, the indicators of the data signals over the broadcast network comprise a signal quality indicator and/or a resolution indicator. The indicators of the data signals over the broadband network comprise the data rate and/or the buffering rate.

[0009] In one example, the TV receiver is further configured to update the availabilities or the indicators of the data signals over the communication media during the displaying of the multimedia content carried in the data signals over the selected communication medium, and to switch between the communication media for displaying the data signals received therethrough based on the updated availabilities or indicators of the data signals over the communication media.

[0010] In one example, the TV receiver is installed in an audio or video reproduction apparatus comprising a TV set, a Personal Computer, PC, a smartphone, a tablet PC, or a gaming console.

[0011] Other aspects and features of the present application will become apparent to those with ordinary skill in the art upon review of the following descriptions of specific embodiments of the apparatuses and methods for providing hybrid TV service with smart source switching.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] The present application can be more fully understood by reading the subsequent detailed description and examples with references made to the accompanying drawings, wherein:

Fig. 1 is a block diagram of a hybrid TV service environment according to an embodiment of the application;

Fig. 2 is a block diagram illustrating the audio/video reproduction apparatus 110 according to an embodiment of the application;

Fig. 3 is a flow chart illustrating the method for providing hybrid TV service with smart source switching according to an embodiment of the application; and Fig. 4 is a flow chart illustrating the method for providing hybrid TV service with smart source switching according to another embodiment of the application.

DETAILED DESCRIPTION OF THE APPLICATION

[0013] The following description is made for the purpose of illustrating the general principles of the application and should not be taken in a limiting sense. It should be understood that the embodiments may be realized in software, hardware, firmware, or any combination thereof. The terms "comprises", "comprising", "includes", and/or "including" when used herein, specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[0014] Fig. 1 is a block diagram of a hybrid TV service environment according to an embodiment of the application.

[0015] As shown in Fig. 1, the hybrid TV service environment 100 may include an audio/video reproduction apparatus 110, a content provider (also called an operator) 120, a broadcast network 130, and a broadband network 140.

[0016] The audio/video reproduction apparatus 110 may be a TV set, a Personal Computer (PC), a smartphone, a tablet PC, or a gaming console, which at least includes a TV receiver (e.g., a Hybrid Broadcast Broadband TV (HbbTV)) supporting hybrid TV service to receive data signals from the content provider 120 over one or both of the broadcast network 130 and the broadband network 140. That is, the audio/video reproduction apparatus 110 may be connected to the broadcast network 130 and the broadband network 140 in parallel, and receives data signals from the content provider 120 on a broadcast channel or a broadband channel.

[0017] The content provider 120 may produce the digital content of one or more TV channels, and embed the digital content in data signals to be distributed over both the broadcast network 130 and the broadband network

140. That is, the TV channels created by the content provider 120 support hybrid TV service. Specifically, the digital content at least includes multimedia content, such as audio/video content (e.g., TV shows, advertisements, or games), and/or textual/graphical content.

[0018] The broadcast network 130 may be a cable TV network or a Digital Video Broadcasting (DVB) network (e.g., a DVB-Terrestrial (DVB-T) system, a DVB-Satellite (DVB-S) system, or a DVB-Cable (DVB-C) system). Specifically, the broadcast network 130 may include a satellite network 131 and a terrestrial network 132. Although not shown, the broadcast network 130 may further include a cable network to connect the terrestrial network 132 and the audio/video reproduction apparatus 110.

[0019] The broadband network 140 may be any wired or wireless communication network that can provide access to the Internet. For example, the broadband network 140 may be an Asymmetric Digital Subscriber Line (ADSL) network, a fiber optic network, an Ethernet network, a Global System for Mobile communications (GSM) network, a General Packet Radio Service (GPRS) network, an Enhanced Data rates for Global Evolution (EDGE) network, a Wideband Code Division Multiple Access (WCDMA) network, a Code Division Multiple Access 2000 (CDMA-2000) network, a Time Division-Synchronous Code Division Multiple Access (TD-SCDMA) network, a Worldwide Interoperability for Microwave Access (WiMAX) network, a Long Term Evolution (LTE) network, an LTE-Advanced (LTE-A) network, or a 5G New Radio (NR) network, etc., depending on the wired/wireless communication technology in use.

[0020] Fig. 2 is a block diagram illustrating the audio/video reproduction apparatus 110 according to an embodiment of the application.

[0021] As shown in Fig. 2, the audio/video reproduction apparatus 110 may include a TV receiver 10, a decoder 20, and a display device 30, and an Input/Output (I/O) device 40.

[0022] The TV receiver 10 at least includes a receiving circuit 11 and a control circuit 12. The receiving circuit 11 is configured to receive data signals of a TV channel via a plurality of communication media. The communication media may include the broadcast network 130 and the broadband network 140. For example, the receiving circuit 11 may include a broadcast communication interface and a broadband communication interface. The broadcast communication interface may include an antenna and a tuner for receiving data signals over the broadcast network 130. The broadband communication interface may include a wired/wireless transceiver for receiving data signals over the broadband network 140. For example, a wired transceiver may include an ADSL modem, a fiber optic card, or an Ethernet card, while a wireless transceiver may include an antenna, a Radio Frequency (RF) device, and a baseband processing device. The control circuit 12 is configured to provide hybrid TV service with smart source switching. Specifically, the control circuit 12 determines whether the channel sup-

ports hybrid TV service over the communication media, and determines availabilities or indicators of the data signals over the communication media in response to the channel supporting hybrid TV service. Also, the control circuit 12 selects one of the communication media based on the availabilities or the indicators of the data signals over the communication media, and displays multimedia content carried in the data signals over the selected communication medium on the display device 30. In one example, the control circuit 12 may be part of a processor, such as a general-purpose processor, a Micro Control Unit (MCU), an application processor, a Digital Signal Processor (DSP), a Graphics Processing Unit (GPU), a Holographic Processing Unit (HPU), a Neural Processing Unit (NPU), or the like, which includes various circuits for providing the functions of data processing and computing.

[0023] As will be appreciated by persons skilled in the art, the circuits of the processor may include transistors that are configured in such a way as to control the operation of the circuits in accordance with the functions and operations described herein. As will be further appreciated, the specific structure or interconnections of the transistors may be determined by a compiler, such as a Register Transfer Language (RTL) compiler. RTL compilers may be operated by a processor upon scripts that closely resemble assembly language code, to compile the script into a form that is used for the layout or fabrication of the ultimate circuitry. Indeed, RTL is well known for its role and use in the facilitation of the design process of electronic and digital systems.

[0024] The decoder 20 is responsible for decoding the multimedia content carried in the data signals. For example, the decoder 20 may include an audio decoder and a video decoder. The audio decoder is configured to decode the audio content carried in the received data signals to generate an audio signal, and outputs the generated audio signal to the display device 30. The video decoder is configured to decode the video content carried in the received data signals to generate a video signal, and outputs the generated video signal to the display device 30.

[0025] The display device 30 is configured to display multimedia content based on the audio/video signal outputted by the decoder 20. In one example, the display device may include a Liquid-Crystal Display (LCD), a Light-Emitting Diode (LED) display, an Organic LED (OLED) display, or an Electronic Paper Display (EPD), etc., for providing a visual display function, and a speaker for providing an audio display function.

[0026] In another embodiment, the decoder 20 and/or the display device 30 may be incorporated into the TV receiver 10.

[0027] The I/O device 40 may include one or more buttons, a keyboard, a mouse, a touch pad, a video camera, a microphone, and/or an Infrared (IR) receiver to serve as the Man-Machine Interface (MMI) for interaction with users.

[0028] It should be understood that the components described in the embodiment of Fig. 2 are for illustrative purposes only and are not intended to limit the scope of the application. For example, the audio/video reproduction apparatus 110 may include more components, such as a non-transitory machine-readable storage medium (e.g., a NonVolatile Random Access Memory (NVRAM)) for storing data (e.g., the received data signals or decoded audio/video signals), instructions, and/or program code of applications, communication protocols, and/or the method of the present application. Alternatively, the audio/video reproduction apparatus 110 may include fewer components. For example, the audio/video reproduction apparatus 110 may not include the display device 30 (e.g., the display device 30 may be an external device coupled to the audio/video reproduction apparatus 110).

[0029] Fig. 3 is a flow chart illustrating the method for providing hybrid TV service with smart source switching according to an embodiment of the application.

[0030] In this embodiment, the method for providing hybrid TV service with smart source switching may be applied to and executed by a TV receiver supporting hybrid TV service with a preconfigured broadcast/broadband priority.

[0031] In step S310, the TV receiver determines whether the current channel supports hybrid TV service over a plurality of communication media. In one example, the plurality of communication media may include at least a broadcast network and a broadband network. The TV receiver may perform a channel scanning procedure to search for available TV channels, and during the channel scanning procedure, channel information, such as information indicating whether each channel supports hybrid TV service, can be acquired by the TV receiver. In one example, the channel scanning procedure can be performed only once when the TV receiver is used for the first time, and the channel information may apply in each time the method is executed.

[0032] Subsequent to step S310, if the current channel does not support hybrid TV service, the method proceeds to step S320. Otherwise, if the current channel supports hybrid TV service, the method proceeds to step S330.

[0033] In step S320, the TV receiver continues using the current communication medium as the input source of data signals carrying the multimedia content of the channel (regardless of whether data signals over the current communication medium are available). For example, the current communication medium is a broadcast network if the preconfigured broadcast/broadband priority indicates the source preference being "broadcast", or is a broadband network if the preconfigured broadcast/broadband priority indicates the source preference being "broadband".

[0034] In step S330, the TV receiver determines whether data signals over the current communication medium are available (i.e., detectable). In one example, if the current communication medium is a broadcast network, the TV receiver may determine that data signals

over the broadcast network are available in response to a cable connector to the broadcast network being attached to the TV receiver and a valid smartcard being inserted into the Conditional Access Module (CAM) slot or Common Interface (CI) slot of a TV set where the TV receiver is installed. In another example, if the current communication medium is a broadband network, the TV receiver may determine that data signals over the current communication medium are available in response to the broadcast network being capable of providing normal connection service to the Internet.

[0035] Subsequent to step S330, if data signals over the current communication medium are available, the method proceeds to step S340. Otherwise, if data signals over the current communication medium are unavailable (i.e., undetectable), the method returns to step S320.

[0036] In step S340, the TV receiver determines whether the indicator of the data signals over the current communication medium meets a predetermined condition.

[0037] In one embodiment, the indicator may include a signal quality indicator and/or a resolution indicator if the current communication medium is a broadcast network. The signal quality indicator may be a Signal Strength Indicator (SSI), or a Signal Quality Indicator (SQI), etc., which may be acquired from the tuner. The resolution indicator may indicate the resolution, such as Standard Definition (SD), High Definition (HD), Full-HD, Ultra-HD (UHD), 4K (also called Hi-Vision (HV)), or 8K (also called Super Hi-Vision (SHV)), of the multimedia content carried in the data signals. For example, the predetermined condition may be that the SSI/SQI is less than a threshold, and/or the indication of the applied resolution is lower than the default resolution setting of the display device.

[0038] In another embodiment, the indicator may include a data rate and/or a buffering rate if the current communication medium is a broadband network. The data rate may be defined as the number of bits that are conveyed or processed per unit of time, while the buffering rate may be defined as the percentage of the waiting time to the total time of an audio/video stream. For example, the predetermined condition may be that the data rate is below a threshold, and/or the buffering rate is above a threshold.

[0039] Subsequent to step S340, if the indicator of the data signals over the current communication medium meets the predetermined condition, the method proceeds to step S350. Otherwise, if the indicator of the data signals over the current communication medium does not meet the predetermined condition, the method returns to step S320.

[0040] In step S350, the TV receiver switches the input source to another communication medium for receiving data signals carrying the multimedia content of the channel. For example, if the current communication medium is a broadcast network, the TV receiver may switch the input source from the broadcast network to a broadband

network. Otherwise, if the current communication medium is a broadband network, the TV receiver may switch the input source from the broadband network to a broadcast network.

[0041] Subsequent to step S350, the method ends (as shown in Fig. 3), or alternatively, the method may return to step S330. That is, the TV receiver may keep monitoring the availabilities and indicators of the data signals over the communication media, and switch between the communication media for displaying the data signals received therethrough based on the updated availabilities or indicators of the data signals over the communication media.

[0042] Fig. 4 is a flow chart illustrating the method for providing hybrid TV service with smart source switching according to another embodiment of the application.

[0043] In this embodiment, the method for providing hybrid TV service with smart source switching may be applied to and executed by a TV receiver supporting hybrid TV service without a preconfigured broadcast/broadband priority.

[0044] In step S410, the TV receiver determines whether the current channel supports hybrid TV service over a plurality of communication media. In one example, the plurality of communication media may include at least a broadcast network and a broadband network. The TV receiver may acquire the channel information, such as information indicating whether each channel supports hybrid TV service, during the channel scanning procedure.

[0045] Subsequent to step S410, if the current channel does not support hybrid TV service, the method proceeds to step S420. Otherwise, if the current channel supports hybrid TV service, the method proceeds to step S430.

[0046] In step S420, the TV receiver selects the only communication medium supported by the current channel as the input source of data signals carrying the multimedia content of the current channel.

[0047] In step S430, the TV receiver displays (e.g., on a display device) the multimedia content carried in the data signals over the selected communication medium.

[0048] In step S440, the TV receiver determines the availabilities of data signals over the plurality of communication media.

[0049] In step S450, the TV receiver determines the indicators of data signals over the plurality of communication media.

[0050] In step S460, the TV receiver compares the indicator of data signals over one of the communication media with the indicator of data signals over the other of the communication media, to see which indicator (better) meets the predetermined condition.

[0051] In step S470, based on the comparison result, the TV receiver selects the communication medium with data signal indicator (better) meeting the predetermined condition as the input source of data signals carrying the multimedia content of the current channel, and the method proceeds to step S430.

[0052] Subsequent to step S430, the method ends (as shown in Fig. 4), or alternatively, the method may return to step S440 if the current channel supports hybrid TV service. That is, for the case where the current channel supports hybrid TV service, the TV receiver may keep monitoring the availabilities and indicators of the data signals over the communication media, and switch between the communication media for displaying the data signals received therethrough based on the updated availabilities or indicators of the data signals over the communication media.

[0053] In view of the forgoing embodiments, it will be appreciated that the present application realizes the provision of hybrid TV service with smart source switching. Advantageously, the occurrence of a black screen (or called a blank screen) may be avoided while a TV channel is being viewed or listened to, by enabling a TV receiver to dynamically switch between the broadcast input source and the broadband input source of that TV channel.

[0054] While the application has been described by way of example and in terms of preferred embodiment, it should be understood that the application is not limited thereto. Those who are skilled in this technology can still make various alterations and modifications without departing from the scope and spirit of this application. Therefore, the scope of the present application shall be defined and protected by the following claims and their equivalents.

Claims

1. A method, comprising:

determining, by a television (TV), receiver, whether a channel supports hybrid TV service over a plurality of communication media;
determining, by the TV receiver, availabilities or indicators of data signals over the communication media in response to the channel supporting hybrid TV service;
selecting, by the TV receiver, one of the communication media based on the availabilities or the indicators of the data signals over the communication media; and
displaying, by the TV receiver, multimedia content carried in the data signals over the selected communication medium.

2. The method as claimed in claim 1, wherein the communication media comprise a broadcast network and a broadband network.

3. The method as claimed in claim 2, wherein the indicators of the data signals over the broadcast network comprise at least one of the following:

a signal quality indicator; and
a resolution indicator; and

wherein the indicators of the data signals over the broadband network comprise at least one of the following:

a data rate; and
a buffering rate.

4. The method as claimed in claim 1, further comprising:

updating the availabilities or the indicators of the data signals over the communication media during the displaying of the multimedia content carried in the data signals over the selected communication medium; and
switching between the communication media for displaying the data signals received therethrough based on the updated availabilities or indicators of the data signals over the communication media.

5. The method as claimed in claim 1, wherein the TV receiver is installed in an audio or video reproduction apparatus comprising a TV set, a Personal Computer (PC), a smartphone, a tablet PC, or a gaming console.

6. A television (TV) receiver, comprising:

a receiving circuit, configured to receive data signals of a channel via a plurality of communication media;
a control circuit, configured to determine whether the channel supports hybrid TV service over the communication media, determine availabilities or indicators of the data signals over the communication media in response to the channel supporting hybrid TV service, select one of the communication media based on the availabilities or the indicators of the data signals over the communication media, and display multimedia content carried in the data signals over the selected communication medium.

7. The TV receiver as claimed in claim 6, wherein the communication media comprise a broadcast network and a broadband network.

8. The TV receiver as claimed in claim 7, wherein the indicators of the data signals over the broadcast network comprise at least one of the following:

a signal quality indicator; and
a resolution indicator; and

wherein the indicators of the data signals over the broadband network comprise at least one of the following:

a data rate; and
a buffering rate.

9. The TV receiver as claimed in claim 6, wherein the control circuit is further configured to update the availabilities or the indicators of the data signals over the communication media during the displaying of the multimedia content carried in the data signals over the selected communication medium, and switch between the communication media for displaying the data signals received therethrough based on the updated availabilities or indicators of the data signals over the communication media. 10
10. The TV receiver as claimed in claim 6, wherein the TV receiver is installed in an audio or video reproduction apparatus comprising a TV set, a Personal Computer (PC), a smartphone, a tablet PC, or a gaming console. 20
11. An audio or video reproduction apparatus, comprising: 25
 - a display device; and
 - a television (TV) receiver, configured to determine whether a channel supports hybrid TV service over a plurality of communication media, determine availabilities or indicators of the data signals over the communication media in response to the channel supporting hybrid TV service, select one of the communication media based on the availabilities or the indicators of the data signals over the communication media, and display multimedia content carried in the data signals over the selected communication medium on the display device. 30 35 40
12. The audio or video reproduction apparatus as claimed in claim 11, wherein the communication media comprise a broadcast network and a broadband network. 45
13. The audio or video reproduction apparatus as claimed in claim 12, wherein the indicators of the data signals over the broadcast network comprise at least one of the following: 50
 - a signal quality indicator; and
 - a resolution indicator; andwherein the indicators of the data signals over the broadband network comprise at least one of the following: 55

a data rate; and
a buffering rate.

14. The audio or video reproduction apparatus as claimed in claim 11, wherein the TV receiver is further configured to update the availabilities or the indicators of the data signals over the communication media during the displaying of the multimedia content carried in the data signals over the selected communication medium, and switch between the communication media for displaying the data signals received therethrough based on the updated availabilities or indicators of the data signals over the communication media.
15. The audio or video reproduction apparatus as claimed in claim 11, wherein the audio or video reproduction apparatus is a TV set, a Personal Computer (PC), a smartphone, a tablet PC, or a gaming console.

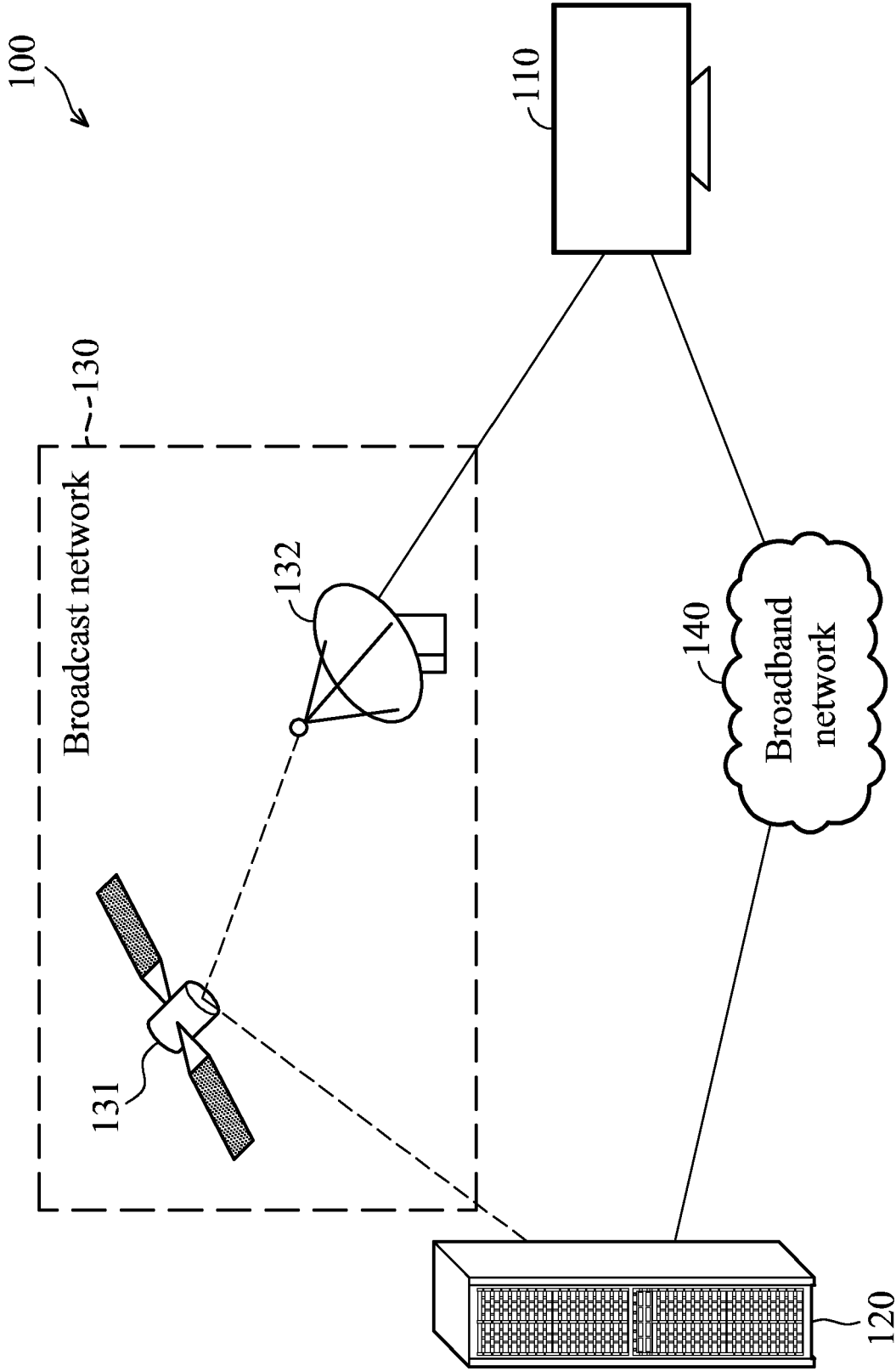


FIG. 1

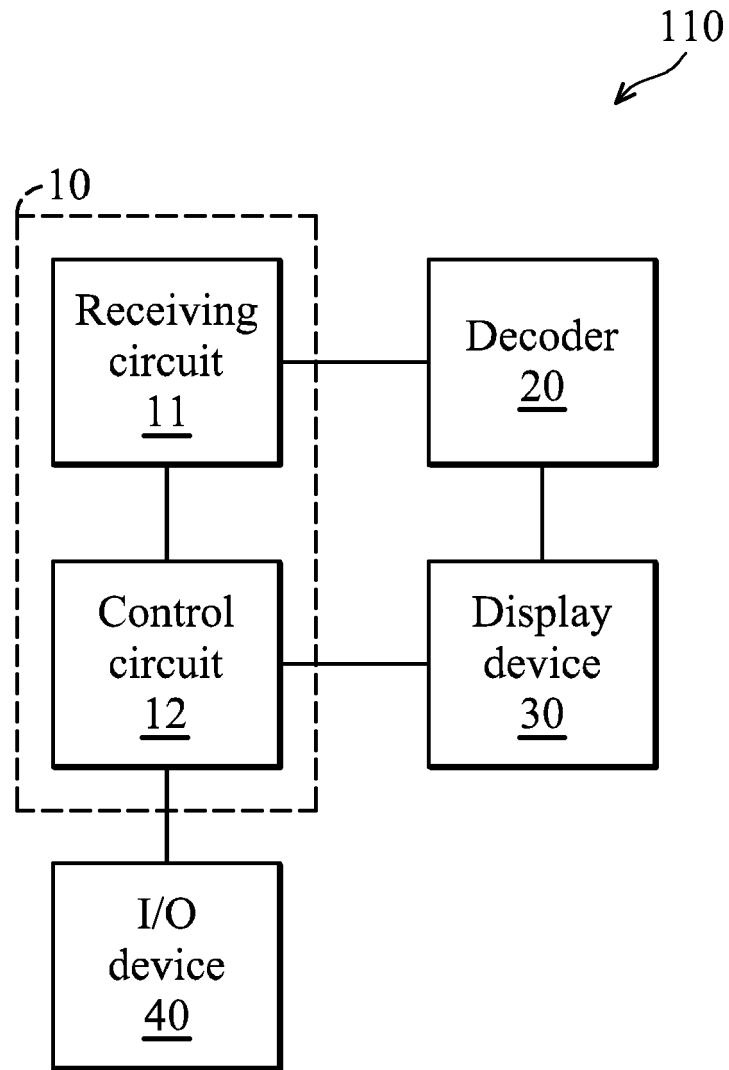


FIG. 2

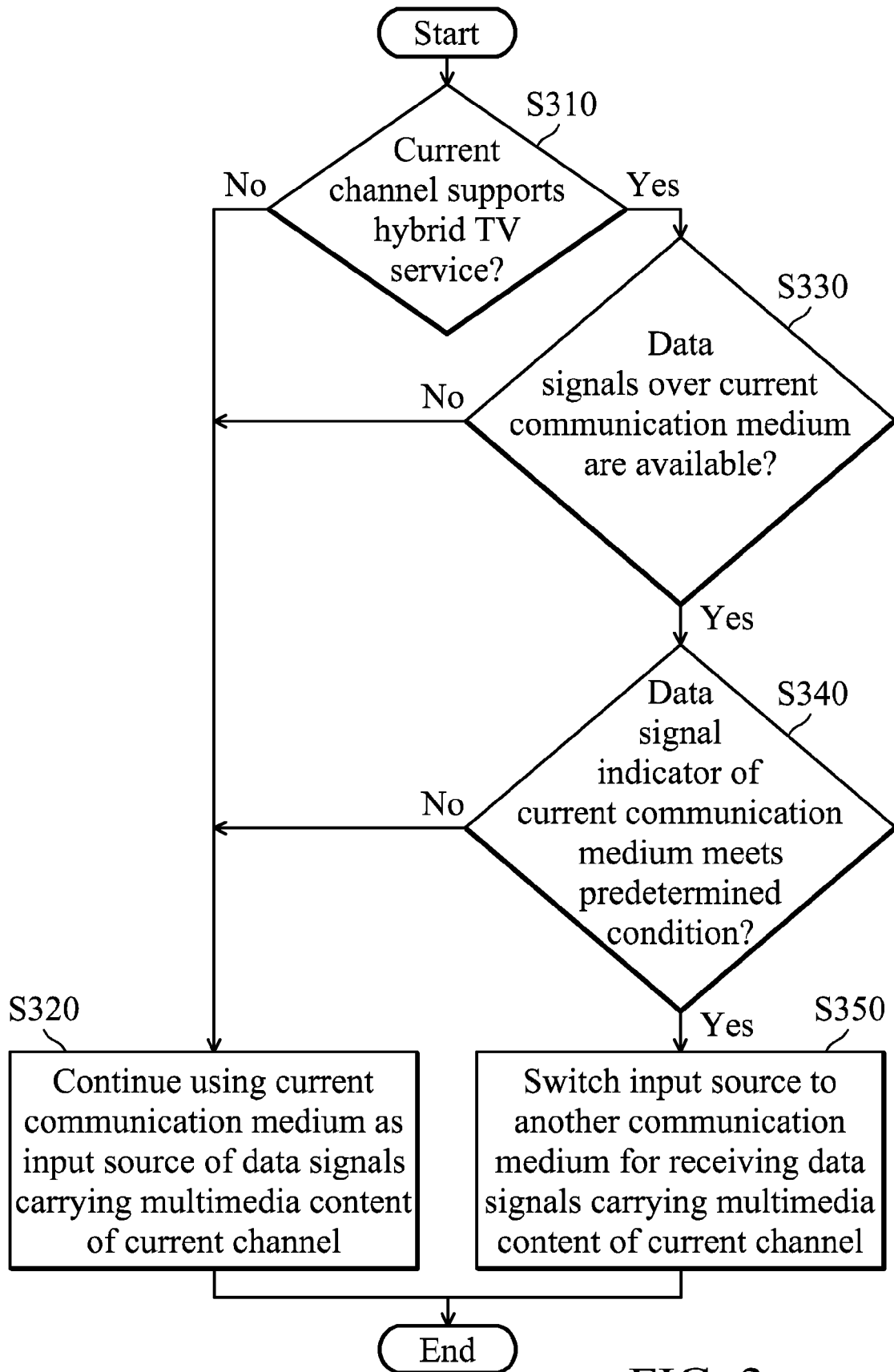


FIG. 3

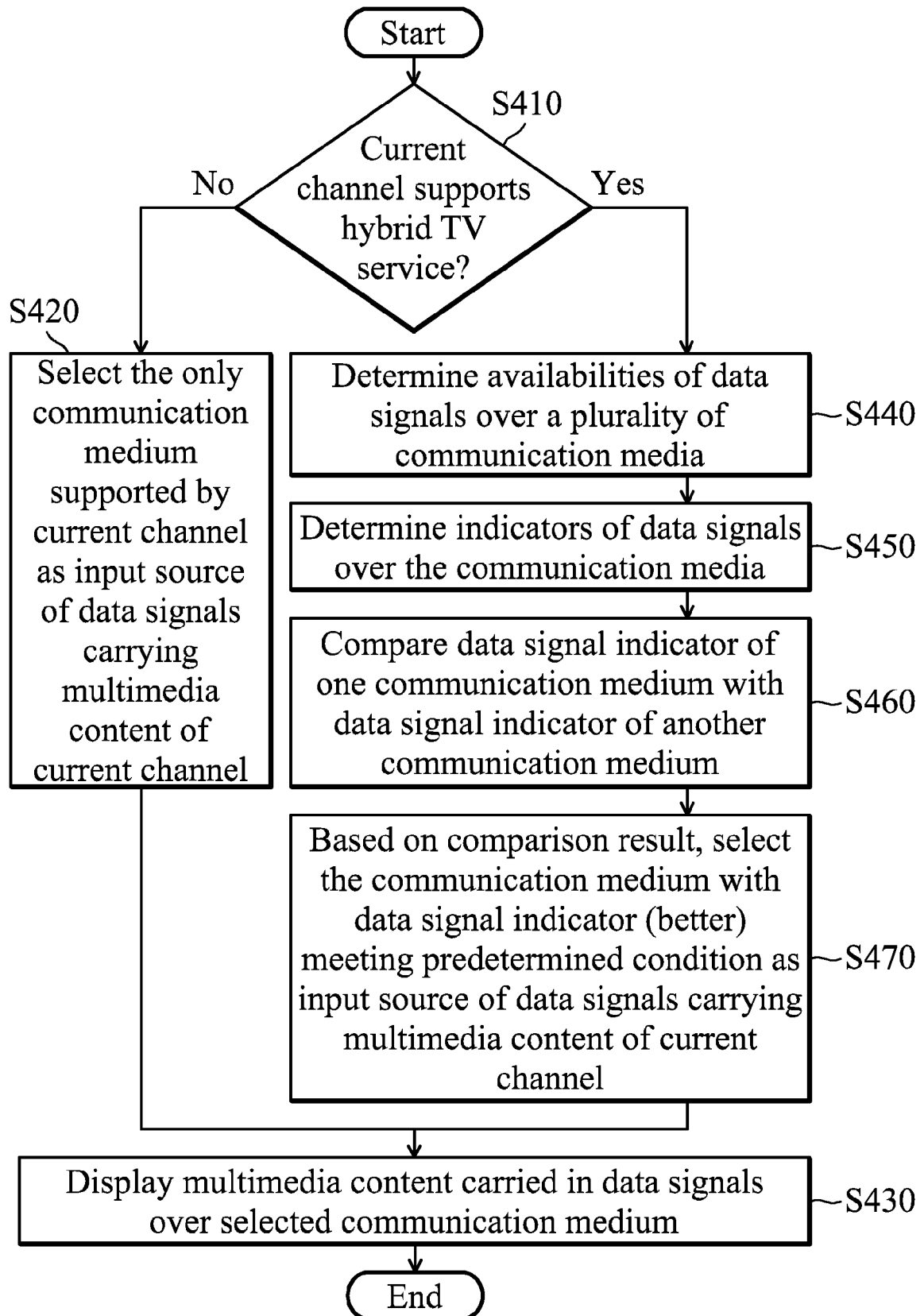


FIG. 4



EUROPEAN SEARCH REPORT

Application Number

EP 21 21 2598

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The present search report has been drawn up for all claims			

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EPO FORM 1503 03.82 (P04C01)

Place of search	Date of completion of the search	Examiner
The Hague	19 May 2022	Van Hoorick, Jan
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		

**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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