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(71) Applicant: **Vestel Elektronik Sanayi ve Ticaret A.S.**
45030 Manisa (TR)

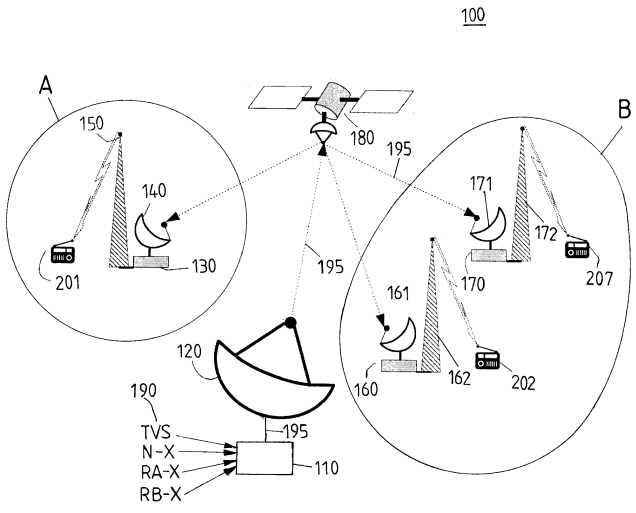
(72) Inventor: **Yüksel, Ulas**
45030 Manisa (TR)

(74) Representative: **Maikowski & Ninnemann**
Patentanwälte Partnerschaft mbB
Postfach 15 09 20
10671 Berlin (DE)

(54) PROVISION OF A REGIONAL RADIO PROGRAM

(57) A method performed by an apparatus (110) is disclosed. The method comprises initiating a generation of a digital signal (195), wherein, for at least one time frame, the digital signal comprises a plurality of radio program signals (N-X, RA-X, RB-X). Therein the plurality of radio program signals (N-X, RA-X, RB-X) comprises a first radio program signal (RA-X), which is a regional radio program signal for a first region (A), and a second radio program signal (N-X), which is a supra-regional radio program signal. The method further comprises initiating a transmission of the digital signal (195) by a head-end transmitter (120) towards a plurality of back-end transmitters (150, 162, 172), the plurality of back-end transmitters (150, 162, 172) including a first frequency modulation, FM, back-end transmitter (150) configured to broadcast a radio program in the first region (A). Further disclosed is another method performed by an apparatus (130). The method comprises obtaining such a digital signal (195). It further comprises initiating an FM transmission, for at least one time frame, of a first regional radio program encoded in the first radio program signal (RA-X) by an FM back-end transmitter (150) configured to broadcast a radio program in the first region (A). Further disclosed are computer programs comprising program code for performing the above methods, apparatuses (110, 130) configured to perform the above methods and a system (100) comprising these apparatuses (110, 130).

FIG 1



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Description

[0001] The invention relates to the provision of a regional radio program.

[0002] Nowadays, radio programs are in many cases transmitted as digital signals. For instance, radio programs are broadcast as digital signals or are made available via the Internet. However, frequency modulation (FM) radios are still widely used, e.g. in cars and at the countryside. FM broadcasting of radio programs requires geographically distributed FM transmitters, each transmitter having a specific coverage area.

[0003] Inter alia due to the complexity involved in the distribution of region-specific radio programs, in many cases, the same radio program is provided to FM transmitters broadcasting in different coverage areas, e.g. radio programs of radio channels that distribute their programs in a geographic area covering more than a single region, i.e. that are supra-regional radio channels, such as national radio channels distributing their program nationwide. Further, radio programs of particular relevance for listeners in a specific region, which these listeners will likely be interested in, is expected to be significantly less interesting for listeners outside that region. However, some radio channels that distribute their programs in a geographic area covering more than a single region, for certain time frames, focus on big cities within that area, e.g. provide city traffic news on a national channel that are not of interest to listeners from other regions of the country. Listeners from these other regions will likely switch channels for these time frames. Moreover, no radio program tailored to these other regions is broadcast.

[0004] It is an object of the present invention to provide improved techniques for providing a regional radio program.

[0005] According to a first aspect of the invention, a method performed by an apparatus is disclosed. The method comprises initiating a generation of a digital signal, wherein, for at least one time frame, the digital signal comprises a plurality of radio program signals. Therein, the plurality of radio program signals comprises a first radio program signal, which is a regional radio program signal for a first region, and a second radio program signal, which is a supra-regional radio program signal. The method further comprises initiating a transmission of the digital signal by a head-end transmitter towards a plurality of back-end transmitters, the plurality of back-end transmitters including a first frequency modulation (FM) back-end transmitter configured to broadcast a radio program in the first region.

[0006] According to a second aspect of the invention, a computer program is disclosed. The computer program comprises program code for performing the method according to the first aspect of the invention when the computer program is executed on a processor.

[0007] According to a third aspect of the invention, an apparatus is disclosed. The apparatus is configured to perform the method according to the first aspect of the invention. To this end, the apparatus may for instance comprise means for performing the method according to the first aspect of the invention. As an example, the apparatus may comprise at least one processor and at least one memory including computer program code, said at least one memory and said computer program code configured to, with said at least one processor, cause said apparatus at least to perform the method according to the first aspect of the invention.

[0008] According to a fourth aspect of the invention, a method performed by an apparatus is disclosed. The method comprises obtaining a digital signal, wherein, for at least one time frame, the digital signal comprises a plurality of radio program signals. Therein, the plurality of radio program signals comprises a first radio program signal, which is a regional radio program signal for a first region, and a second radio program signal, which is a supra-regional radio program signal. The method further comprises initiating a frequency modulation (FM) transmission, for the at least one time frame, of a first regional radio program encoded in the first radio program signal by an FM back-end transmitter configured to broadcast a radio program in the first region.

[0009] According to a fifth aspect of the invention, a computer program is disclosed. The computer program comprises program code for performing the method according to the fourth aspect of the invention when the computer program is executed on a processor.

[0010] According to a sixth aspect of the invention, an apparatus is disclosed. The apparatus is configured to perform the method according to the fourth aspect of the invention. To this end, the apparatus may for instance comprise means for performing the method according to the fourth aspect of the invention. As an example, the apparatus may comprise at least one processor and at least one memory including computer program code, said at least one memory and said computer program code configured to, with said at least one processor, cause said apparatus at least to perform the method according to the fourth aspect of the invention.

[0011] According to a seventh aspect of the invention, a system is disclosed. The system comprises an apparatus according to the third aspect of the invention and an apparatus according to the sixth aspect of the invention.

[0012] Each of the computer programs according to the second and fifth aspects of the invention may for instance be distributable via a network, such as for instance the Internet. The computer program may for instance be stored or be storable on a computer-readable medium. The computer program may for instance at least partially represent software and/or firmware of the processor.

[0013] The computer-readable medium may for instance be embodied as an electric, magnetic, electromagnetic, optic or other storage medium, and may either be a removable medium or a medium that is fixedly installed in an apparatus or device. Non-limiting examples of such a computer-readable medium are a random ac-

cess memory (RAM) or a read-only memory (ROM). The computer-readable medium may for instance be a tangible medium.

[0014] Any of the described apparatuses may be a module or a component for a device, for example a chip. Alternatively, any of the mentioned apparatuses may be a mobile or stationary device. In particular, the apparatus according to the third aspect of the invention may form part of the head-end transmitter. The apparatus according to the sixth aspect of the invention may form part of the back-end transmitter.

[0015] Any of the processors mentioned in this text may be a processor of any suitable type. Any processor may for instance comprise one or more microprocessors, one or more digital signal processors (DSPs), one or more special-purpose computer chips, one or more field-programmable gate arrays (FPGAs), one or more controllers or one or more application-specific integrated circuits (ASICs).

[0016] Any of the memories mentioned in this text may for instance be implemented as a ROM, a RAM, a flash memory or a hard disc drive memory etc.

[0017] In the following, some explanations on embodiments of the invention are provided. For reasons of conciseness, focus is put on the method according to the first aspect of the invention and the method according to the fourth aspect of the invention. The given explanations however correspondingly apply to other aspects of the invention. In particular, explanations relating to the first aspect of the invention apply mutatis mutandis to the second, third and seventh aspects of the invention and explanations relating to the fourth aspect of the invention apply mutatis mutandis to the fifth, sixth and seventh aspect of the invention. Furthermore, explanations provided in the context of discussing the first aspect of the invention but likewise relevant for the second aspect are to be understood as also relating to the second aspect of the invention and vice versa.

[0018] By initiating the generation of the digital signal comprising the plurality of radio program signals and by initiating the transmission of the digital signal by the head-end transmitter towards a plurality of back-end transmitters, the plurality of back-end transmitters may be provided with the plurality of radio program signals. Accordingly, the back-end transmitters may broadcast radio programs encoded in the plurality of radio program signals. Since the plurality of radio program signals comprises, for at least one time frame, the first radio program signal, which is a regional radio program signal for a first region, and the second radio program signal, which is a supra-regional radio program signal, inter alia provision of the first FM back-end transmitter, which is configured to broadcast a radio program in the first region, with the radio program signal for the first region is initiated. This provides a basis for the first FM back-end transmitter to broadcast a first regional radio program encoded in the first radio program signal in the first region once it has obtained the digital signal. Listeners within the first region may then listen to a regional radio program that is broadcast as an FM broadcast and that is tailored to their interest, e.g. comprising local information such as news and documentaries, music etc. Although technically outdated, FM radios are still widely used, e.g. in cars and at the countryside. Since the plurality of radio program signals is transmitted in a digital signal, available digital distribution infrastructure may be used to distribute the first regional radio program although the first regional radio program is eventually transmitted as an FM broadcast.

[0019] However, for the at least one time frame, the plurality of radio program signal does not only comprise the first radio program signal but also the second radio program signal, which is a supra-regional radio program signal. Therefore, one or more other back-end transmitters of the plurality of back-end transmitters, e.g. FM back-end transmitters or other types of back-end transmitters, that are configured to broadcast a radio program in a geographic area different from the first region, may be provided with the supra-regional radio program signal at the same time. They may thus broadcast a supra-regional radio program encoded in the second radio program signal. Listeners outside the first region may then listen to a supra-regional radio program that is potentially of higher interest to them than the first regional radio program.

[0020] Playback devices capable of receiving and processing a digital input signal may also receive the digital signal - either directly from a back-end transmitter or, for instance, from an intermediate entity part of a transmission path from the head-end transmitter to the plurality of back-end transmitters and located in between the head-end transmitter and the plurality of back-end transmitters, e.g. from a relay such as, for instance, a satellite transponder.

[0021] Since the data rate of radio program signals is generally relatively low, e.g. as compared to TV signals, providing both a regional radio program signal and a supra-regional radio program signal in a digital signal may be performed while still keeping the required transmission capacity within an acceptable range.

[0022] The digital signal may for instance be a digital signal according to a standard for the digital transmission of media data such as audio and/or video data. Apart from radio program signals, e.g. the plurality of radio program signals the digital signal comprises for the at least one time frame, the digital signal may comprise other signals, e.g. TV signals, and/or additional data, for instance, service data and/or control data. According to one variant, the digital signal is a Digital Video Broadcasting, DVB, signal, for instance of a DVB-T, DVB-T2, DVB-S, DVB-S2, DVB-C, DVB-C2, DVB-H, or DVB-IPI signal. According to another variant, the digital signal is an Advanced Television Systems Committee (ATSC) signal.

[0023] Each of the radio program signals comprised by the digital signal may be any signal suitable for encoding a radio program. To give but one example, a radio

program signal may be a Moving Picture Experts Group (MPEG) transport stream (TS). For initiating the generation of the digital signal, each of the radio program signals may be received from the same source or from several different sources. For instance, the first radio program signal may be received from a first source and the second radio program signal may be received from a second source. Alternatively, both the first radio program signal and second radio program signal may be received from the same source.

[0024] Initiating the generation of the digital signal may for instance comprise forwarding the plurality of radio program signals to an apparatus or a component that is configured to generate the digital signal based thereon. Alternatively or in addition, it may comprise instructing an apparatus or component to generate the digital signal based on the plurality of radio signals. As an example, the apparatus according to the third aspect of the invention may comprise the apparatus or component configured to generate the digital signal. However, the apparatus or component may also be distinct therefrom.

[0025] Radio signals comprised by the digital signal may be multiplexed in the digital signal. Thus, in the method according to the first aspect of the invention, generating the digital signal may comprise multiplexing radio signals that are to form part of the digital signal, e.g., for the at least one time frame, multiplexing the plurality of radio program signals. Accordingly, the method according to the fourth aspect of the invention may comprise de-multiplexing the plurality of radio program signals and potentially one or more other radio program signals.

[0026] In one variant, radio programs of the same radio channel are encoded in the first radio program signal and the second radio program signal. Thus, while a regional radio program of radio channel X for the first region may be encoded in the first radio program signal, a supra-regional radio program of radio channel X may be encoded in the second radio program signal. Thus, for at least one time frame, a radio channel may simultaneously provide a regional radio program and a supra-regional radio program via the digital signal.

[0027] The supra-regional radio program signal may be a radio program signal for a geographic area comprising the first region but not being limited thereto. It may thus encode a supra-regional radio program for such a geographic area. As an example, it may be a national radio program signal for a country to which the first region belongs or it may even be an international radio program signal.

[0028] Since the digital signal comprises the plurality of radio program signals for at least one time frame, the plurality of radio program signals does not always have to be included in the digital signal. Thus, in a specific time frame, not the entire plurality of radio program signals may be included in the digital signal but only some radio program signals thereof, just one radio program signal thereof or even no radio program signal. For instance, in one or more time frames, the digital signal may comprise only the second radio program signal, but not the first radio program signal.

[0029] Initiating the transmission of the digital signal towards the plurality of back-end transmitters by the head-end transmitter may for instance comprise forwarding the digital signal to the head-end transmitter. The transmission of the digital signal towards the plurality of back-end transmitters may comprise the head-end transmitter transmitting the digital signal to an intermediate entity part of a transmission path from the head-end transmitter to the plurality of back-end transmitters and located in between the head-end transmitter and the plurality of back-end transmitters. The intermediate entity may thus act as a relay for the digital signal. In one variant of the system according to the second aspect of the invention, the system comprises such an intermediate entity. As an example, the intermediate entity may be a satellite transponder. To give but one further example the intermediate entity may be a server in a digital packet data network, such as the Internet, that is used for distributing the digital signal. Depending on the transmission infrastructure used for transmitting the digital signal towards the plurality of back-end transmitters, the type of the digital signal may be chosen differently. For instance, if the head-end transmitter is to transmit the digital signal to a network server acting as an intermediate entity, a DVB-IPI signal may be generated as the digital signal, whereas in case of a satellite transponder acting as an intermediate entity a DVB-S signal may be generated.

[0030] The plurality of back-end transmitters may include, apart from the first FM back-end transmitter, at least one further FM back-end transmitter and/or at least one back-end transmitter of another type, e.g. a DVB-T transmitter to give just one further non-limiting example. The first FM back-end transmitter may be located in the first region.

[0031] Obtaining the digital signal in the method according to the fourth aspect of the invention may for instance comprise receiving the digital signal from the head-end transmitter or from an intermediate entity. It may however also comprise having the digital signal forwarded from an entity that has received it previously or fetching the digital signal from such an entity.

[0032] The method according to the fourth aspect of the invention may for instance comprise de-multiplexing the plurality of radio program signals and also of one or more other program signals should such other radio signals be multiplexed into the digital signal as well.

[0033] The method according to the fourth aspect of the invention may comprise obtaining an indication that transmission of the first regional radio program is to be initiated. The indication may for instance be indicative of the first radio program signal having the first regional radio program encoded therein, thus indicating that transmission of the radio program encoded in the first radio program signal is to be initiated. In accordance with the indication, if the plurality of radio program signals comprises the first radio program signal, transmission of the

first regional radio program encoded therein will be initiated, not the transmission of another radio program, such as the supra-regional radio program encoded in the second radio program signal for instance. The indication may for instance be obtained in the context of a configuration of the apparatus performing the method. Obtaining the indication may for instance comprise receiving the indication from another apparatus, such as a user interface or another device, e.g. a device connected to the apparatus performing the method by a network. To give but one other example, the apparatus performing the method may comprise means for determining its position, e.g. a global navigation satellite system (GNSS) receiver, and obtaining the indication may comprise determining the position of the apparatus, determining that the position is a position within the first region and determining that first radio program signal is a radio program signal having a regional radio program for the first region encoded therein.

[0034] The method according to the fourth aspect of the invention may further comprise initiating generation of an FM radio program signal having the first regional radio program encoded therein based on the first regional radio program signal, the FM radio program signal being suitable for being transmitted by an FM transmitter. Initiating the generation of the FM radio program signal may for instance comprise instructing an apparatus or component that is distinct from the apparatus performing the method to generate the FM radio program signal based on the first regional radio program signal. Alternatively generation of the FM radio program signal may be performed by the apparatus itself.

[0035] Initiating the FM transmission of the first regional radio program by an FM back-end transmitter configured to broadcast a radio program in the first region may for instance comprise forwarding the first radio program signal to the FM back-end transmitter.

[0036] According to one variant, for at least one time frame, the digital signal comprises a status indicator indicative of whether or not the digital signal currently comprises the first radio program signal. Thus, it may be detected at the back-end whether or not the digital signal currently comprises the first radio program signal. For instance, in case it is detected that the first radio program signal is available, FM transmission of the first regional radio program by the FM back-end transmitter may be initiated. However, in case it is detected that the first radio program signal is not available, other measurements may be taken. As an example, actions necessary to determine another radio program for transmission may be carried out and its transmission may be initiated.

[0037] According to one implementation of the variant according to which the digital signal comprises the status indicator, the method according to the fourth aspect of the invention comprises attempting to initiate an FM transmission, by the FM back-end transmitter, of a radio program encoded in a radio program signal that is different from the first radio program signal, if the status indicator indicates that the digital signal does currently not comprise the first radio program signal.

[0038] According to one implementation wherein the digital signal is a DVB signal, the status indicator is provided using the "running_status" parameter of the Service Description Table (SDT) contained in the DVB signal. For instance, the running status of the first radio program signal being set to "not_running" may indicate that the digital signal does currently not comprise the first radio program signal. The running status being set to "running" may indicate that the DVB signal comprises the first radio program signal.

[0039] According to one variant, for at least one time frame, the digital signal comprises a replacement indicator indicative of a replacement radio program signal for the first radio program signal. Using this indicator, the radio program signal for which transmission by the first FM back-end transmitter is to be attempted to be initiated in case the first radio program signal is not comprised by the digital signal may be defined.

[0040] In one implementation of the above variant, the replacement radio program signal is the second radio program signal. Thus, it may be defined in the digital signal that if the first radio program signal is currently not available so that the first FM back-end transmitter cannot initiate transmission of the first regional radio program encoded therein, the first FM back-end transmitter should attempt to resort to the second radio program signal and thus initiate transmission of the supra-regional radio program encoded therein. Put differently, a basis for the first FM back-end transmitter to broadcast the supra-regional radio program to playback devices of listeners in the first region if it cannot initiate transmission of the first regional radio program is provided. Therein, the supra-regional radio program may be a radio program for a geographic area comprising the first region but not being limited thereto.

[0041] According to one implementation of the variant according to which the digital signal comprises the replacement indicator, the method according to the fourth aspect of the invention comprises attempting to initiate an FM transmission, by the FM back-end transmitter, of a radio program encoded in the replacement radio program signal, if the status indicator indicates that the digital signal does currently not comprise the first radio program signal.

[0042] According to one implementation wherein the digital signal is a DVB signal, the replacement radio program signal is indicated as a "service replacement service" in the "Linkage Descriptor" section of the SDT.

[0043] According to one variant, the plurality of radio program signals comprises a third radio program signal, which is a regional radio program signal for a second region. Thus, for at least one time frame, not only the first FM back-end transmitter may broadcast a regional radio program for the first region in the first region, but another back-end transmitter, e.g. an FM back-end transmitter, may be provided with a radio program signal encoding a

second regional radio program. According to one implementation, the plurality of back-end transmitters includes a second FM back-end transmitter configured to broadcast a second radio program encoded in the second radio program signal in the second region. The second FM back-end transmitter may then broadcast the second regional radio program in the second region. Playback devices in the second region may thus play back a regional radio program to listeners in the second region.

[0044] The explanations provided above with respect to the first radio program signal apply mutatis mutandis to the third radio program signal. It will further be understood that although only first, second and third radio program signals comprised by the plurality of radio program signals have been discussed herein, the plurality of radio program signals may also comprise further radio program signals, e.g. further regional radio program signals and/or further supra-regional radio program signals.

[0045] The embodiments described above and in particular their single features shall be understood to be disclosed in all possible combinations with each other.

[0046] These and further concepts of the invention will be apparent from and elucidated with reference to the detailed description presented hereinafter. While the detailed description focuses on an infrastructure in which DVB-S signals comprising a plurality of radio program signals are transmitted towards FM back-end transmitters in two different regions, it will be understood that this is merely an example and the concept of the invention may be applied to other infrastructures equally well, that more or less regions may be defined and that other types of digital signals comprising a plurality of radio program signals may be used.

[0047] In the figures show:

Fig. 1 a schematic illustration of a radio program distribution infrastructure that comprises an embodiment of a system according to the seventh aspect of the present invention;

Fig. 2 a schematic illustration of an embodiment of an apparatus according to the third aspect of the present invention, the apparatus forming part of the system illustrated in Fig. 1;

Fig. 3 a flowchart schematically illustrating an embodiment of a method according to the first aspect of the present invention which is carried out by the apparatus illustrated in Fig. 2 when the apparatus is operating;

Fig. 4 a schematic illustration of an embodiment of an apparatus according to the sixth aspect of the present invention, the apparatus forming part of the system illustrated in Fig. 1;

Fig. 5 a flowchart schematically illustrating an embodiment of a method according to the fourth aspect of the present invention which is carried out by the apparatus illustrated in Fig. 5 when the apparatus is operating; and

Fig. 6 a table schematically illustrating, for different time frames, the radio program signals comprised in a DVB-S signal transmitted within the system schematically illustrated in Fig. 1.

[0048] Fig. 1 shows a schematic illustration of a radio program distribution infrastructure 100 that comprises an embodiment of a system according to the seventh aspect of the present invention. The system comprises an embodiment of an apparatus 110 according to the third aspect of the present invention and embodiments of apparatuses 130, 160, 170 according to the sixth aspect of the present invention as well as a satellite transponder of a satellite 180. Apparatus 110 comprises a memory having an embodiment of a computer program according to the second aspect of the present invention stored thereon. Each of apparatuses 130, 160, 170 comprises a memory having an embodiment of a computer program according to the fifth aspect of the present invention stored thereon.

[0049] In the figure, a parabolic antenna 120 represents a head-end satellite transmitter configured to transmit a DVB-S signal 195 to the transponder of satellite 180. Apparatus 110 is operatively connected to head-end transmitter 120. Accordingly, apparatus 110 will be referred to as head-end apparatus 110 herein. Head-end apparatus 110 is configured to receive, e.g. having forwarded them from another apparatus, a plurality 190 program signals, wherein the plurality of program signals may comprise TV program signals and radio program signals. In the present example, each signal is being provided in the form of an MPEG-TS. All program signals of the plurality of program signals 190 may be received from the same source. Alternatively, at least some or even all of the signals of the plurality of program signals 190 may be received from different sources. It will be understood that not within every time frame a plurality of program signals has to be provided to head-end apparatus 110. For instance, in a specific time frame, only one program signal, e.g. a radio program signal, may be provided to it.

[0050] Each of apparatuses 130, 160, 170 is operatively connected to a respective back-end satellite receiver 140, 161, 171, each of which is represented by a parabolic antenna in the figure. Accordingly, apparatuses 130, 160, 170 will be referred to as back-end apparatuses herein. Each of back-end satellite receivers 140, 161, 171 is configured to receive DVB-S signal 195 from the transponder of satellite 180. Each back-end satellite receiver 140, 161, 171, is configured to provide the received DVB-S signal 195 to its associated back-end apparatus 130, 160 or 170.

[0051] Each of apparatuses 130, 160, 170 is operatively connected to a respective FM back-end transmitter 150, 162, 172, each of which is represented by a terres-

trial antenna in the figure. When head-end satellite transmitter 120 transmits DVB-S signal 195 towards the transponder of satellite 180, it also transmits DVB-S signal 195 towards, i.e. in the direction of, back-end satellite receivers 140, 161, 171, apparatuses 130, 160, 170 and thus also towards FM back-end transmitters 150, 162, 172 operatively connected thereto.

[0052] In the illustrated example, apparatus 130 together with its associated back-end satellite receiver 140 and its associated FM back-end transmitter 150 are located in a region denoted 'A'. FM back-end transmitter 150 is configured to broadcast a radio program in region A. Similarly, apparatus 160 together with its associated back-end satellite receiver 161 and its associated FM back-end transmitter 162 are located in a region denoted 'B'. FM back-end transmitter 162 is configured to broadcast a radio program in region B. Apparatus 170 together with its associated back-end satellite receiver 171 and its associated FM back-end transmitter 172 are located in region B as well. FM back-end transmitter 172 is configured to broadcast a radio program in region B. FM back-end transmitters 162 and 172 are installed within different areas of region B. Therefore, FM radio programs transmitted by transmitters 162 and 172 may be received by different playback devices.

[0053] In Fig. 1, three FM radio playback devices 201, 202, 203 are further shown. Playback device 201 is located in region A and may thus receive FM radio program signals broadcast by FM back-end transmitter 150, whereas playback devices 201 and 202 are both located in region B, however in different areas thereof. Accordingly, playback device 202 may receive radio program signals broadcast by FM back-end transmitter 162, whereas playback device 203 may receive radio program signals broadcast by FM back-end transmitter 172.

[0054] In the present example, at least for certain time frames, the plurality of signals 190 comprises one TV program MPEG-TS TVS and a respective MPEG-TS N-X, RA-X or RB-X for each of three radio programs. Therein, the radio programs encoded in MPEG-TSs N-X, RA-X, RB-X are radio programs of the same radio channel, in this case of a radio channel X. However, the radio programs encoded in MPEG-TSs N-X, RA-X, RB-X are not identical. The radio program encoded in MPEG-TS RA-X is a regional radio program for region A, i.e. it is tailored to the potential interest of listeners in region A. As an example, it may for instance comprise local information such as news and documentaries pertaining to region A, music having a tradition in region A, etc. By contrast, the radio program encoded in MPEG-TS RB-X is a regional radio program for region B. The radio program encoded in MPEG-TS N-X is a supra-regional radio program for a geographic area comprising both region A and region B and potentially further areas. More specifically, in the present example the radio program encoded in MPEG-TS N-X is a national radio program that is of potential interest to listeners nationwide.

[0055] It will be understood that DVB-S signal 195 transmitted by head-end satellite transmitter 120 may not have the same form as DVB-S signal 195 provided to transmitter 120 by head-end apparatus 110. For instance, modulation of DVB-S signal 195 for satellite transmission may be performed by head-end satellite transmitter 120, not by head-end apparatus 110, so that the DVB-S signal may differ as regards modulation. However, what is decisive here is the data carried by the DVB-S signal. Thus, no distinction is made herein between the DVB-S signal provided by head-end apparatus 110 and the DVB-signal transmitted by head-end satellite transmitter 120. Similarly, no distinction is made between the DVB-S signal received by back-end satellite receivers 140, 161, 171 and the DVB-S signals fed to back-end apparatuses 130, 160, 170 even though there may be differences. For instance, DVB-S signal 195 received by back-end satellite receivers 140, 161, 171 may still be modulated, whereas the DVB-S signals fed to back-end apparatuses 130, 160, 170 may already have been demodulated by the respective back-end satellite receiver.

[0056] Fig. 2 shows a schematic illustration of a head-end apparatus 110 of system 100 schematically illustrated in Fig. 1. As shown in Fig. 2, head-end apparatus 110 comprises a processors 111. Processor 111 may for instance be a microprocessor, a DSP, an FPGA, an ASIC etc. However, in some implementations several processors 111 may be provided instead of just one processor 111. Head-end apparatus 110 further comprises an interface 112 configured to receive program signals, such as the plurality of program signals 190 shown in Fig. 1, and to transmit signals, such as DVB-S signal 195, to another entity, including head-end satellite transmitter 120. Further comprised by head-end apparatus 110 is a first memory 113. In the present example, first memory 113 is a volatile memory, more specifically a RAM configured store data and instructions to be executed by a processor 111 when apparatus 110 is operating. Furthermore, head-end apparatus 110 comprises a second memory 114 which, in the present example, is a non-volatile memory, such as a ROM. A bus 116 interconnects processor 111, interface 112, first memory 113 and second memory 114.

[0057] An embodiment of a computer program 115 according to the second aspect of the present invention is stored on second memory 114. An operating system, for instance, may be stored in second memory 114 as well. In the present example, computer program 115 comprises program code that when loaded into first memory 113 and executed by processor 111 causes head-end apparatus 110 to initiate generation of DVB-S signal 195, wherein, for at least one time frame, DVB-S signal 195 comprises a plurality of radio program signals, namely the MPEG-TSs N-X, RA-X, RB-X illustrated in Fig. 1, but also a TV program signal, i.e. MPEG-TS TVS. Further, computer program 115 comprises program code that when loaded into first memory 113 and executed by processor 111 causes head-end apparatus 110 to initiate a transmission of DVB-S signal 195 by head-end satellite

transmitter 120 towards the transponder of satellite 180 and thus towards FM back-end transmitters 150, 162, 172. Thus, when executed, program code of computer program 115 causes head-end apparatus 110 to perform an embodiment of the method according to the first aspect of the invention. Processor 111 and second memory 114 and also first memory 113 and interface 112 may therefore be considered as means for performing an embodiment of the method according to the first aspect of the invention.

[0058] Further details of the computer program code of computer program 115 will be described in the following with reference to Fig. 3. Fig. 3 is a flowchart schematically illustrating an embodiment of a method according to the first aspect of the present invention which is carried out by apparatus 110 illustrated in Fig. 2 when the apparatus is operating. Put differently, when the program code of computer program 115 is loaded into first memory 113 and executed by processor 111 it causes head-end apparatus 110 to perform the method illustrated in the flowchart of Fig. 3. In the flowchart, some of the blocks are shown with dashed outlines, which is to indicate that it is optional to consider these blocks part of the embodiment.

[0059] Block 310 of the flowchart comprises receiving program signals by apparatus 110 via its interface 112. Specifically, for at least one time frame, the plurality of program signals 190 is received by the apparatus.

[0060] Block 320 comprises initiating generation of DVB-S signal 195, for instance by program code of computer program 115 executed on processor 111 calling a corresponding function provided by computer program 115. In the present example, head-end apparatus 110 is configured to itself operate as a signal generator for DVB-S signal 195.

[0061] Block 330 therefore comprises generating DVB-S signal 195. In the present example, generating DVB-S signal 195 comprises multiplexing (block 331) program signals that are to form part of DVB-S signal 195 and that are currently fed to apparatus 110 via its interface 112, e.g., for the at least one time frame, multiplexing the plurality of program signals 190, i.e. MPEG-TSs TVS, N-X, RA-X, RB-X. Generating DVB-S signal 195 further comprises configuring the SDT of DVB-S signal 195 (block 332). Inter alia, the SDT is configured to indicate a "running_status" for each program signal of the plurality of program signals 190 so that by analyzing the "running_status", a receiving device such as back-end apparatuses 130, 160, 170 may determine which program signals DVB-S signal 195 currently comprises. For instance, the "running_status" for MPEG-TS RA-X being set to "not_running" may indicate that DVB-S signal 195 does not comprise MPEG-TS RA-X, whereas the "running_status" for MPEG-TS RA-X being set to "running" may indicate that DVB-S signal 195 comprises MPEG-TS RA-X.

[0062] Generating DVB-S signal 195 further comprises configuring, the "Linkage Descriptor" section of the SDT of DVB-S signal 195 to indicate a "service replacement service" for each of the plurality of program signals 190. The "service replacement service" indicates a replacement program signal. For instance, for MPEG-TS RA-X, in which the regional radio program of radio channel X for region A is encoded, the "service replacement service" indicates MPEG-TS N-X, in which the national program of radio channel X is encoded, as the replacement program signal for MPEG-TS RA-X. For MPEG-TS RB-X, in which the regional radio program of radio channel X for region B is encoded, the "service replacement service" also indicates MPEG-TS N-X. By means of the "service replacement service" parameter, head-end apparatus 110 may thus indicate to a back-end device receiving DVB-S signal 195, such as one or more of back-end apparatuses 130, 160, 170, that it should resort to MPEG-TS N-X if MPEG-TS RA-X or MPEG-TS RB-X, respectively, is currently not available, i.e. not comprised by DVB-S signal 195. This may cause back-end apparatuses 130, 160, 170 to attempt to initiate transmission of the national program of radio channel X encoded in MPEG-TS N-X if the regional radio program signal for their respective region is not available.

[0063] Block 340 comprises initiating a transmission of thus generated DVB-S signal 195 by forwarding DVB-S signal 195 to head-end satellite transmitter 120 via interface 112 of apparatus 110, thereby initiating transmission of DVB-S signal 195 to the transponder of satellite 180 and thus towards FM back-end transmitters 150, 162, 172.

[0064] Fig. 4 shows a schematic illustration of back-end apparatus 130 of system 100 schematically illustrated in Fig. 1. The structure of back-end apparatus 130 is similar to that of head-end apparatus 110 schematically illustrated in Fig. 2. A detailed structural description of back-end apparatus 130 is therefore omitted. Focus is put on the aspects in which back-end apparatus 130 differs from head-end apparatus 110.

[0065] interface 132 of back-end apparatus 130 is configured to receive a DVB-S signal such as DVB-S signal 195. It is further configured to transmit signals to another entity, such as signals conveying radio programs and suitable for being processed by back-end FM transmitter 150 to transmitter 150.

[0066] An embodiment of a computer program 135 according to the fifth aspect of the present invention is stored in second memory 134. In the present example, computer program 135 comprises program code that, when loaded into first memory 133 and executed by processor 131, causes back-end apparatus 130 to obtain a DVB-S signal, specifically DVB-S signal 195 comprising, for at least one time frame, radio program signals, i.e. MPEG-TSs, N-X, RA-X, RB-X illustrated in Fig. 1, and TV program signal MPEG-TS TVS. In the present example, DVB-S signal 195 is received from the transponder of satellite 180 by back-end satellite receiver 140, which demodulate its and forwards it to back-end apparatus 130. Back-end apparatus 130 may then obtain the de-

modulated DVB-S signal 195 by receiving it via its interface 132. Further, computer program 135 comprises program code that, when loaded into first memory 133 and executed by processor 131, causes back-end apparatus 130 to initiate an FM transmission, for the at least one time frame, of the regional radio program for region A of radio channel X encoded in MPEG-TS RA-X by FM back-end transmitter 150 configured to broadcast a radio program in region A. Thus, when executed, program code of computer program 135 causes back-end apparatus 130 to perform an embodiment of the method according to the fourth aspect of the invention.

[0067] Processor 131 and second memory 134 and also first memory 133 and interface 132 may therefore be considered as means for performing an embodiment of the method according to the fourth aspect of the invention.

[0068] Further details of the computer program code of computer program 135 will be described in the following with reference to Fig. 5. Fig. 5 is a flowchart schematically illustrating an embodiment of a method according to the fourth aspect of the present invention which is carried out by apparatus 130 illustrated in Fig. 4 when the apparatus is operating. Put differently, when the program code of computer program 135 is loaded into first memory 133 and executed by processor 131, it causes back-end apparatus 130 to perform the method illustrated in the flowchart of Fig. 5. Again, dashed outlines indicate that it is optional to consider a block part of the embodiment.

[0069] Block 510 of the flowchart comprises receiving an indication of a radio program whose transmission is to be initiated. The indication may for instance indicate a radio program signal, thus indicating that transmission of the radio program encoded in said radio program signal is to be initiated. In the present example, the indication indicates that, for radio channel X, transmission of the regional radio program for region A, encoded in MPEG-TS RA-X, is to be initiated. Back-end apparatus 130 may for instance receive the indication from another apparatus, for instance a user interface or another device, e.g. a device connected to back-end apparatus 130 by a network. As another example, obtaining the indication may comprise back-end apparatus 130 determining its position using a GNSS signal, determining that the position is a position in region A and determining that MPEG-TS RA-X is a radio program signal having a regional radio program for region A of radio channel X encoded therein.

[0070] Block 520 of the flowchart comprises obtaining a digital signal program signals, in the present example DVB-S signal 195, by apparatus 110 via its interface 112.

[0071] Block 530 comprises checking if the "running_status" of the radio program signal having the radio program indicated by the indication received in block 610 encoded therein, i.e. in the present example of MPEG-TS RA-X, is "running". Depending on the result, the control flow branches.

[0072] If the "running_status" is "running", transmission of the radio program indicated by the indication, i,e. in the present example the regional radio program for region A of radio channel X, is initiated (block 540). In the present example, Initiating transmission of the radio program involves generating a signal having encoded therein the indicated radio program and being suitable for being processed, i.e. modulated and transmitted as an FM radio broadcast, by FM back-end transmitter 150 (block 541). Generating this signal in turn involves demultiplexing the program signals comprised by DVB-S signal 195, the program signals in the present example including inter alia radio program signals N-X, RA-X, RB-X, and then extracting the radio program signal having the indicated radio program encoded therein, in the present example MPEG-TS RA-X. The generated signal is then forwarded to FM back-end transmitter 150 via signal interface 132 (block 542) so that FM back-end transmitter 150 may perform the actual transmission of the radio program, in the present example of radio program for region A of radio channel X. The control flow then proceeds to block 580.

[0073] However, if it is determined in block 530 that the "running_status" of the radio program signal having the radio program indicated by the indication received in block 510 encoded therein, in the present example MPEG-TS RA-X, currently is "not_running", the corresponding "service replacement service" indicated in the "Linkage Descriptor" section of the SDT of DVB-S signal 195 is identified in block 550 and it is attempted to initiate transmission of a radio program encoded in the radio program signal indicated as the "service replacement service" by FM back-end transmitter 150. Attempting to initiate transmission comprises checking if the "running_status" of said radio program signal, in the present example of MPEG-TS N-X, is "running" (block 560). If it is, transmission of the radio program encoded therein is initiated (block 570) and it is then proceeded to block 580. If the "running_status" of the radio program signal indicated as the "service replacement service" is "not_running", it is the control flow proceeds to block 580.

[0074] Block 580 comprises checking, for each of the radio program signal having the radio program indicated by the indication received in block 510 encoded therein and the radio program signal indicated as the "service replacement service", if the corresponding "running_status" has changed. As long as no change has occurred, the check is repeatedly performed. If a change has occurred, it is returned to block 530.

[0075] It will be understood that while focus has been put on back-end apparatus 130 in region A, the above explanations apply mutatis mutandis to back-end apparatuses 160, 170 in region B. Being located in region B, back-end apparatuses 160, 170 are configured to transmit regional radio programs for region B if a corresponding radio program signal, e.g. MPEG-TS RB-X, is provided in DVB-S signal 195.

[0076] Fig. 6 is a table schematically illustrating, for different time frames T_1-T_9, the radio program signals

comprised by DVB-S signal 195 transmitted within the system 100 schematically illustrated in Fig. 1. Other program signals such as TV program signal TVS are disregarded for the sake of clarity.

[0077] In accordance with notation scheme used above for the radio program signals of radio channel X in the table, RA-Y, denotes a regional radio program signal of a radio channel Y for region A, RB-Y, denotes a regional radio program signal of radio channel Y for region B and N-Y denotes a national radio program of radio channel Y. N-Z denotes a national radio program of a radio channel Z.

[0078] As shown in the table, in time frames T_1-T_3, DVB-S signal 195 only comprises radio program signal, i.e. MPEG-TS, N-X. However, in each of time frames T_4 and T_5 DVB-S signal 195 comprises radio program signals, i.e. MPEG-TSs, N-X, RA-X and RB-X. In each of time frames T_6 and T_7 DVB-S signal 195 only comprises radio program signal N-Y, whereas in time frame T_8 it comprises radio program signals N-Y, RA-Y and RB-Y. In time frame T_9, only radio program signal N-Z is present in DVB-S signal 195.

[0079] Thus, in the present example, whenever any radio program signal of a specific radio channel is transmitted, a radio program signal having encoded therein the national radio program of that specific radio channel is comprised by DVB-S signal 195. Playback devices neither located in region A nor in region B may receive the national radio program, e.g. as an FM broadcast or, in case of playback devices connected to a satellite antenna, e.g. DBV-S set-top boxes or DVB-S enabled TV sets, directly from DVB-S signal 195.

[0080] In time frames T_1-T_3, only radio program signal N-X is provided in DVB-S signal 195 so that FM back-end transmitters 150, 162, 172 may only broadcast the national radio program of channel X. Similarly, in time frames T_6 and T_7, only the national radio program of channel Y may be broadcast. In time frame T_9, only the national radio program of channel Z may be broadcast by FM back-end transmitters 150, 162, 172. However, in time frames T_4 and T_5, DVB-S signal 195 inter alia comprises radio program signals RA-X and RB-X so that FM back-end transmitter 150 broadcasts the regional radio program of channel X for region A in region A, whereas FM back-end transmitters 162 and 172 broadcast the regional radio program of channel X for region B in the respective areas of region B they cover. Similarly, in time frame T_8, back-end transmitter 150 broadcasts the regional radio program of channel Y for region A, whereas FM back-end transmitters 162 and 172 broadcast the regional radio program of channel Y for region B. Thus, FM playback device 201 in region A may render a radio program specific to region A to a listener. FM playback device 202 and 203 in region B may render a radio program specific to region B to listeners. Thus, according to the present example, over time FM playback device 201 receives the radio program encoded in radio program signals N-X (time frames T_1-T_3), RA-X (T_4-T_5), N-Y (T_6-T_7), RA-Y (T_8), N-Z (T_9). FM playback devices 202, 203 receive the radio program encoded in radio program signals N-X (time frames T_1-T_3), RB-X (T_4-T_5), N-Y (T_6-T_7), RB-Y (T_8), N-Z (T_9). According to the embodiments described with reference to Figs. 1-6, users of FM playback devices, which are still widely used, e.g. in cars and at the countryside, in regions A and B may be provided with regional radio programs using DVB-S distribution infrastructure without compromising the provision of other playback devices with supra-regional radio programs.

Claims

1. A method performed by an apparatus (110), the method comprising:

   - initiating (320) a generation of a digital signal (195), wherein, for at least one time frame, the digital signal comprises a plurality of radio program signals (N-X, RA-X, RB-X),
   wherein the plurality of radio program signals (N-X, RA-X, RB-X) comprises a first radio program signal (RA-X), which is a regional radio program signal for a first region (A), and a second radio program signal (N-X), which is a supra-regional radio program signal; and
   - initiating (340) a transmission of the digital signal (195) by a head-end transmitter (120) towards a plurality of back-end transmitters (150, 162, 172), the plurality of back-end transmitters (150, 162, 172) including a first frequency modulation, FM, back-end transmitter (150) configured to broadcast a radio program in the first region (A).

2. The method of claim 1, wherein, for at least one time frame, the digital signal (195) comprises a status indicator indicative of whether or not the digital signal (195) currently comprises the first radio program signal (RA-X).

3. The method of any of the preceding claims, wherein, for at least one time frame, the digital signal (195) comprises a replacement indicator indicative of a replacement radio program signal (N-X) for the first radio program signal (RA-X).

4. The method of any of the preceding claims, wherein the plurality of radio program signals (N-X, RA-X, RB-X) comprises a third radio program signal (RB-X), which is a regional radio program signal for a second region (B) and the plurality of back-end transmitters (150, 162, 172) includes a second back-end transmitter (162, 172) configured to broadcast a second radio program encoded in the second radio program signal (RB-X) in the second region (B).

5. The method of any of the preceding claims, wherein the digital signal (195) is one of a Digital Video Broadcasting, DVB, signal and an Advanced Television Systems Committee, ATSC, signal.

6. A computer program (115) comprising program code for performing the method according to any of claims 1 to 5, when the computer program (115) is executed on a processor (111).

7. An apparatus (110) configured to perform the method according to any of claims 1 to 5.

8. A method performed by an apparatus (130), the method comprising:

- obtaining (520) a digital signal (195), wherein, for at least one time frame, the digital signal (195) comprises a plurality of radio program signals (N-X, RA-X, RB-X),
wherein the plurality of radio program signals (N-X, RA-X, RB-X) comprises a first radio program signal (RA-X), which is a regional radio program signal for a first region (A), and a second radio program signal (N-X), which is a supra-regional radio program signal; and
- initiating (540) a frequency modulation, FM, transmission, for the at least one time frame, of a first regional radio program encoded in the first radio program signal (RA-X) by an FM back-end transmitter (150) configured to broadcast a radio program in the first region (A).

9. The method of claim 8,

- wherein, for at least one time frame, the digital signal (195) comprises a status indicator indicative of whether or not the digital signal (195) currently comprises the first radio program signal (RA-X); and
- wherein the method comprises attempting (560, 570) to initiate an FM transmission, by the FM back-end transmitter (150), of a radio program encoded in a radio program signal (N-X) that is different from the first radio program signal (RA-X), if the status indicator indicates that the digital signal (195) does currently not comprise the first radio program signal (RA-X).

10. The method of claim 9,

- wherein, at least for a specific time frame, the digital signal (195) comprises a replacement indicator indicative of a replacement radio program signal (N-X) for the first radio program signal (RA-X); and
- wherein the method comprises attempting (660, 670) to initiate an FM transmission, by the FM back-end transmitter (150), of a radio program encoded in the replacement radio program signal (N-X), if the status indicator indicates that the digital signal (195) does currently not comprise the first radio program signal (RA-X).

11. The method of any of claims 8 to 10, wherein the plurality of radio program signals (N-X, RA-X, RB-X) comprises a third radio program signal (RB-X), which is a regional radio program signal for a second region (B).

12. The method of any of claims 8 to 11, wherein the digital signal (195) is one of a Digital Video Broadcasting, DVB, signal and an Advanced Television Systems Committee, ATSC signal.

13. A computer program (135) comprising program code for performing the method according to any of claims 8 to 12, when the computer program (135) is executed on a processor (131).

14. An apparatus (130) configured to perform the method according to any of claims 8 to 12.

15. A system (100) comprising the apparatus (110) of claim 7 and the apparatus (130) of claim 14.

FIG 1

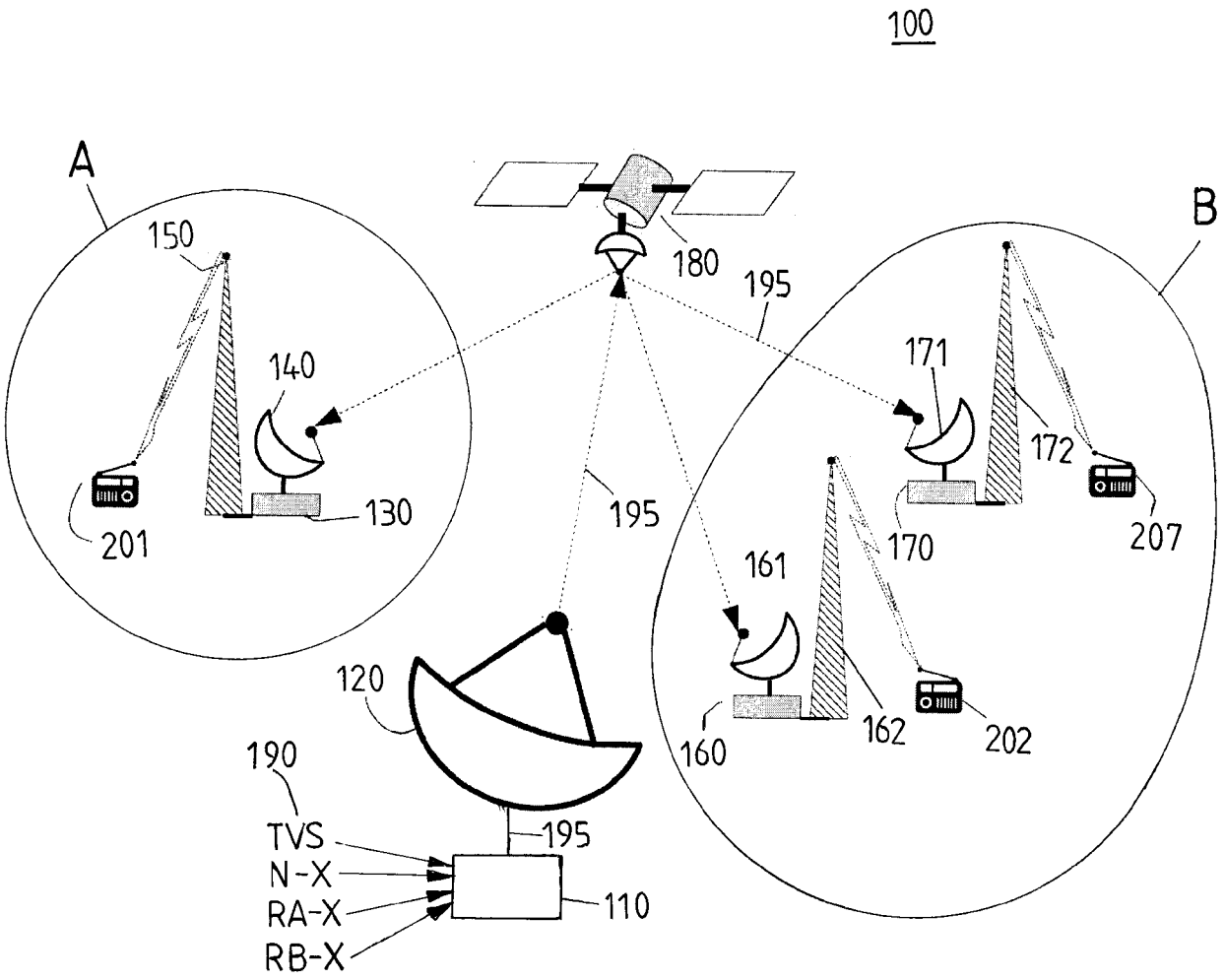
100
A
B
150
140
130
201
180
195
195
171
172
207
170
161
162
160
202
120
190
TVS
N-X
RA-X
RB-X
195
110

FIG 2

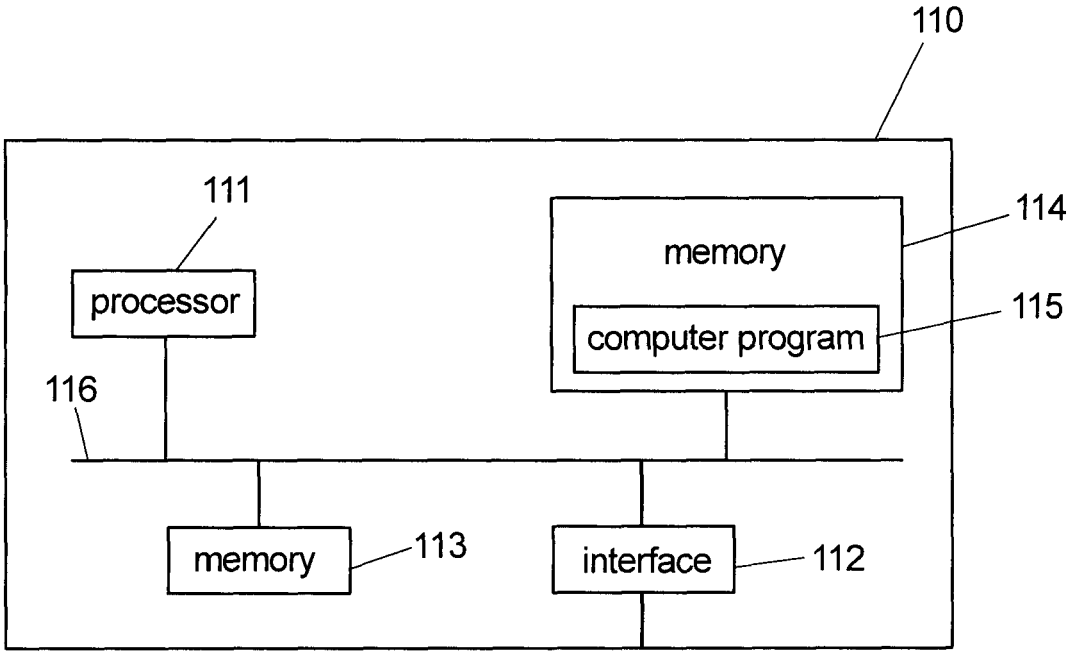
110
111
processor
memory
114
computer program
115
116
memory
113
interface
112

FIG 3

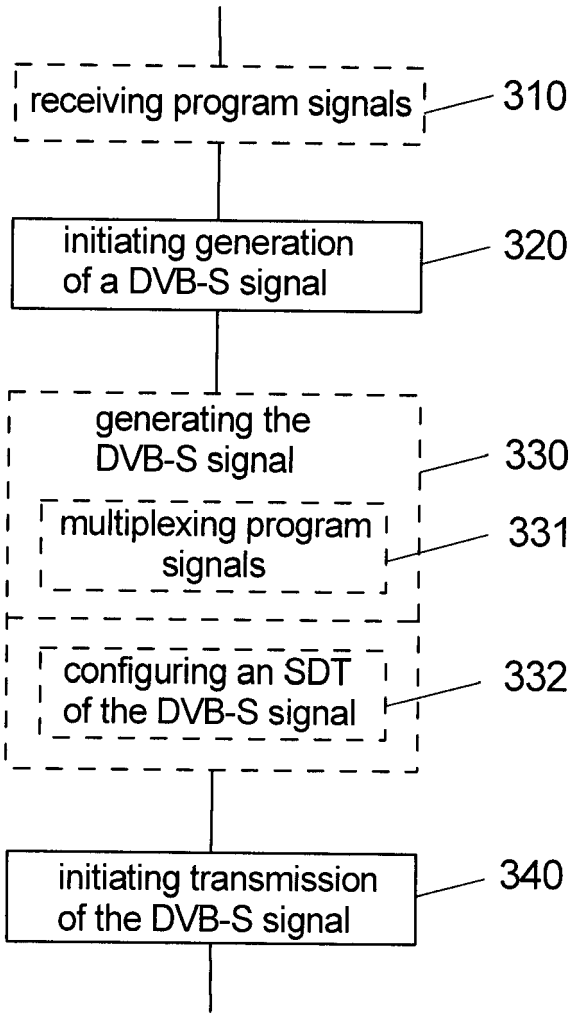
receiving program signals
310
initiating generation of a DVB-S signal
320
generating the DVB-S signal
330
multiplexing program signals
331
configuring an SDT of the DVB-S signal
332
initiating transmission of the DVB-S signal
340

FIG 4

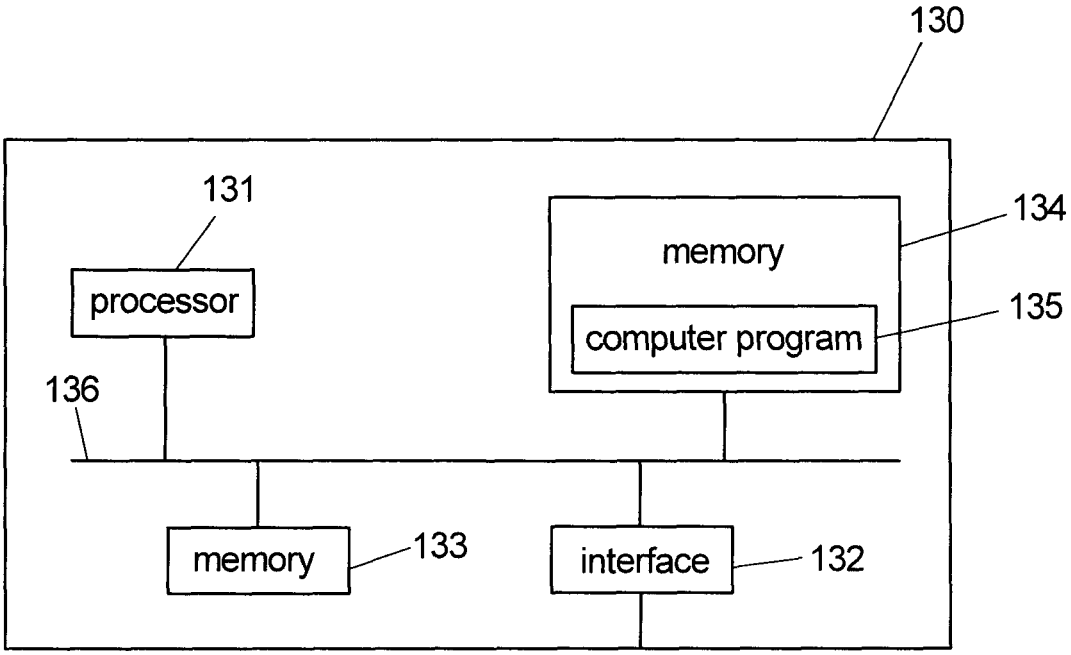
130
131
processor
memory
134
computer program
135
136
memory
133
interface
132

FIG 5

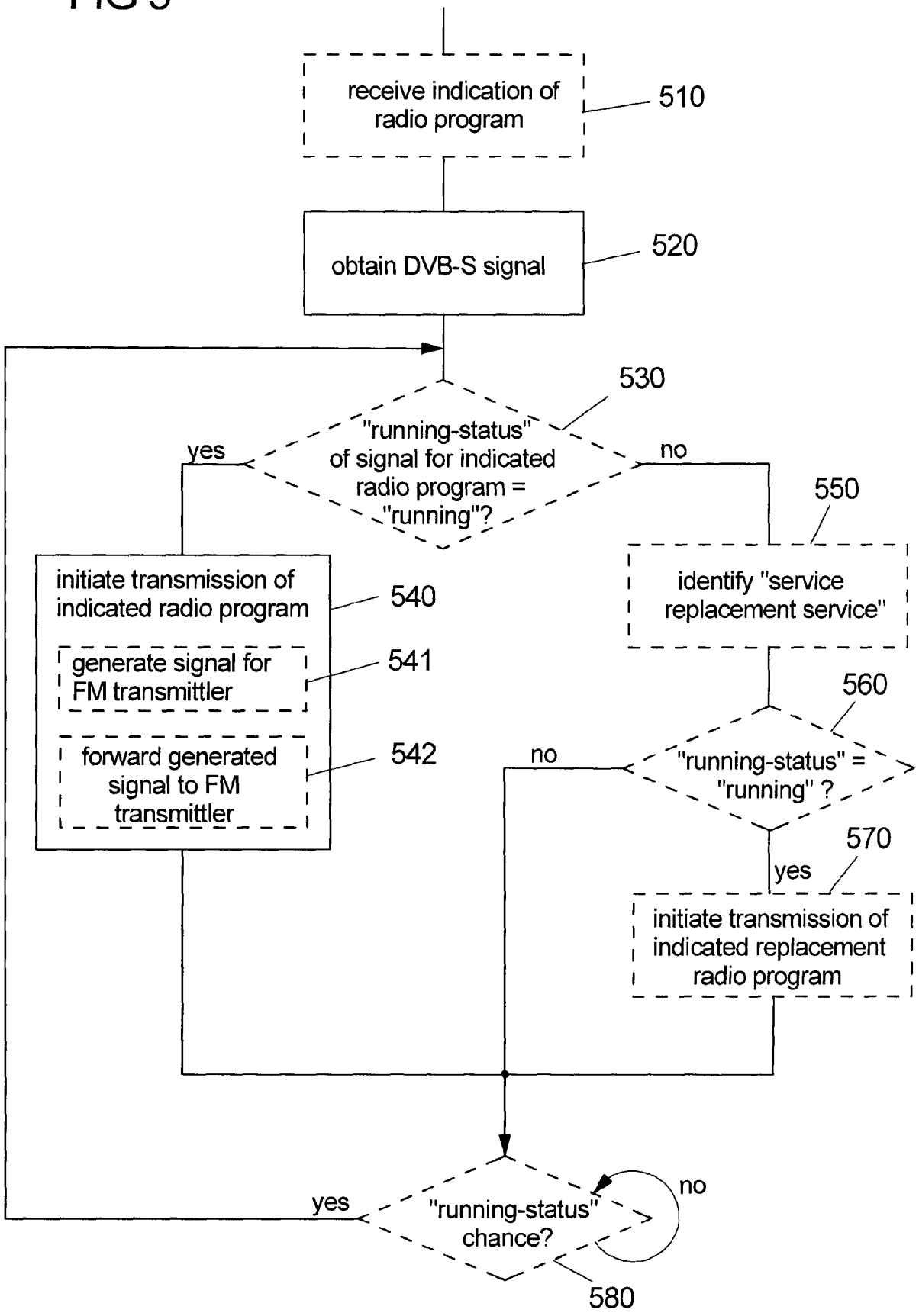
receive indication of radio program
510
obtain DVB-S signal
520
530
"running-status" of signal for indicated radio program = "running"?
yes
no
initiate transmission of indicated radio program
540
generate signal for FM transmittler
541
forward generated signal to FM transmittler
542
550
identify "service replacement service"
560
"running-status" = "running" ?
no
570
yes
initiate transmission of indicated replacement radio program
"running-status" chance?
yes
no
580

FIG 6

time frame	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	T_9
	N-X	N-X	N-X	N-X	N-X	N-Y	N-Y	N-Y	N-Z
				RA-X	RA-X			RA-Y	
				RB-X	RB-X			RB-Y	

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EUROPEAN SEARCH REPORT

Application Number
EP 17 20 8847

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	DVB ORGANIZATION: "gbs0565r02 - TRxxxxxx DVB Radio Handbook.doc", DVB, DIGITAL VIDEO BROADCASTING, C/O EBU - 17A ANCIENNE ROUTE - CH-1218 GRAND SACONNEX, GENEVA - SWITZERLAND, 30 May 2008 (2008-05-30), XP017803961, * pages 10-11 *	2,3,9,10	
A	US 6 741 834 B1 (GODWIN JOHN P [US]) 25 May 2004 (2004-05-25) * column 5, line 47 - column 6, line 50 *	1-15	
A	GB 2 449 426 A (THE TECHNOLOGY PARTNERSHIP PLC [GB]) 26 November 2008 (2008-11-26) * page 2, line 10 - page 3, line 22 * * page 19, line 12 - page 20, line 10 *	1-15	TECHNICAL FIELDS SEARCHED (IPC) H04H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 June 2018	Van Hoorick, Jan

CATEGORY OF CITED DOCUMENTS

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22-06-2018

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