

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
10 May 2001 (10.05.2001)

PCT

(10) International Publication Number
WO 01/33844 A1

(51) International Patent Classification⁷: H04N 5/76

(21) International Application Number: PCT/US00/30030

(22) International Filing Date:
1 November 2000 (01.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/433,862 4 November 1999 (04.11.1999) US

(71) Applicant: XM SATELLITE RADIO INC. [US/US];
1500 Eckington Place N.E., Washington, DC 20002-2194 (US).

(81) Designated States (*national*): AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KR (utility model), KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States (*regional*): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

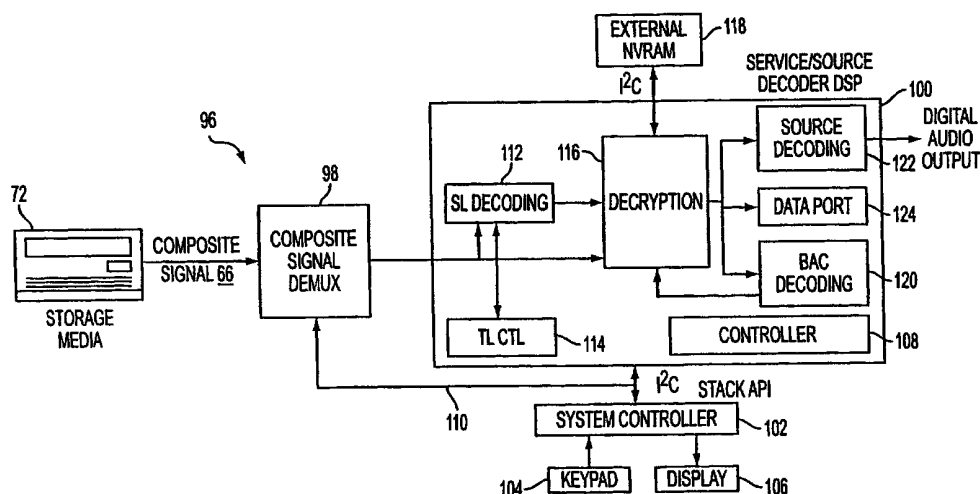
- With international search report.
- Before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments.

(72) Inventors: MARKO, Paul; 6320 S.W. 6 St., Pembroke Pines, FL 33023 (US). WADIN, Craig; 11015 N.W. 27 St., Sunrise, FL 33322 (US).

(74) Agents: LONGANECKER, Stacey et al.; Roylance, Abrams, Berdo & Goodman, 1300 19th Street, N.W., Suite 600, Washington, DC 20036 (US).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR COMPOSITE DATA STREAM STORAGE AND PLAYBACK



(57) Abstract: A composite data stream (66) is stored on a data storage medium (72). The composite data stream (66) comprises a plurality of program channels to provide services such as satellite digital audio radio service (SDARS), among others. The program channels are multiplexed into the composite data stream, which also comprises control data for indicating where services are located in the composite data stream. A playback device (96) is configured to access the composite data stream (66) on the data storage medium (72), to demultiplex at least the program channels and to retrieve selected services from the data storage medium (72) in response to user inputs by using the control data.

- 1 -

METHOD AND APPARATUS FOR
COMPOSITE DATA STREAM STORAGE AND PLAYBACK

5

Field of the Invention:

This invention relates to an apparatus and method for digitally recording and playing back a composite data stream. More particularly, the invention relates to digitally recording a composite data stream containing a plurality of multiplexed channels onto a recording media, retrieving the recording from the medium, and
10 selecting one of the channels and outputting the selected channel.

Background of the Invention:

Satellite digital audio radio service (SDARS), a satellite broadcast service
15 established by the U.S. Federal Communications Commission (FCC), has been proposed using satellite transmission of digital audio programs to radio receivers. The radio receivers can be stationary receivers, in which case a receiver antenna can be pointed for optimal line of sight (LOS) reception from a satellite. In contrast, the position of the receiver antenna relative to the satellite changes with mobile receivers
20 (e.g., a receiver that is hand-carried by a user or is mounted in a vehicle), and LOS reception from one satellite is not always available. Accordingly, mobile receivers are generally configured to receive broadcast signals from more than one satellite.

Service outages can occur in proposed systems which broadcast data, video, audio and other information using radio frequencies. These outages can prevent
25 receivers, and particularly mobile receivers, from receiving the broadcast service altogether, or cause them to receive a signal so degraded that the service is rendered unacceptable. These outages are generally due to physical blockage of transmission paths between the transmitter and receiver (e.g., due to mountainous terrain or long tunnels) and multipath fading and reflection of the transmission path. Satellite
30 broadcast systems can therefore use two transmission channels to provide diversity for mitigating service outages due to multipath, physical blockages and interference in mobile broadcast receivers. Terrestrial repeaters can also be provided to repeat satellite

- 2 -

signals in geographic areas where LOS reception is obscured by tall buildings, hills and other obstructions.

Nevertheless, for some users, adequate satellite or terrestrial broadcast coverage may not be available (e.g., users traveling by airplane or residing in apartment
5 buildings). On the other hand, some users may desire SDARS broadcast programming, and be in an area having coverage from at least one of a satellite or terrestrial repeater, but may not wish to purchase a radio receiver or a service that includes ongoing reception of broadcast signals. For example, a retail store may wish to have several hours of music programs intended for satellite broadcast but stored on a storage
10 medium for continuous and repeated playback in the store. The owner/operator of the retail store may not perceive the need for receiving additional broadcast data when a stored composite data stream, which can have plural channels comprising several hours of music, for example, satisfies the desire to provide customers with background music. A need therefore exists for storage of composite data streams (e.g., programs intended
15 for satellite broadcast) on a memory device that can be played back on a playback device, whereby the playback device need not be equipped to receive radio frequency broadcast signals.

A number of methods exist for digitally recording information onto a recording medium, and retrieving or otherwise playing back the recorded information using, for
20 example, a compact disc (CD) or a digital video disc (DVD). The recording techniques used with these types of recording media, however, only record a single information channel. The information channel can contain a number of content segments such as songs on a music CD, for example, or a film and related information such as the soundtrack for the film and director/actor interviews about the making of the film.
25 The content segments of the information channel are demarcated on the recording media during the recording process.

These playback devices (e.g., CD or DVD players), however, are not equipped to retrieve information from a composite data stream stored on recording media. As will be described in more detail below, a composite data stream such as an SDARS
30 signal comprises multiplexed program channels. Each of the program channels can comprise multiple service components. The number of frames of multiplexed channels required to transmit or playback the different program channels can vary. Accordingly,

- 3 -

headers having information for demultiplexing and decoding the multiplexed program channels and service components therein are provided. Conventional playback devices such as CD and DVD players are not configured to decode such header information in a composite data stream to locate program channels selected by a user for playback, but rather simply rely on content segment demarcation information provided on the recording media at the time of recording. A need therefore exists for an apparatus for and method of recording a composite data stream and retrieving selected content therefrom for playback.

10 Summary of the Invention:

Accordingly, an aspect of the present invention is to provide an apparatus, system and method for increasing the diversity of information that can be recorded on and retrieved from a recording medium.

Another aspect of the present invention is to provide an apparatus, system and method for recording a composite data stream on a storage medium and playing back selected content in the recorded composite data stream.

In accordance with another aspect of the present invention, an apparatus, system and method are provided for recording a composite data stream representing a plurality of broadcast channels in a time division multiplex format for later playback and simulation of a digital audio or video program received from a satellite broadcast.

In accordance with yet another aspect of the present invention, an apparatus for storing a composite signal includes a number of encoders which encode both analog and digital content to create service components. The apparatus generates payload channels having plural service components. A multiplexed composite data stream is then created which comprises at least a portion of the payload channels and header information to identify where in the composite data stream the portions of each payload channel therein reside. The composite signal is sent to a recorder for recording a selected duration of the data stream onto a memory storage device or recording medium.

In accordance with still yet another aspect of the invention, the storage medium containing a recorded composite digital signal is played, emulating a broadcast signal carrying at least two channels of information. During playback, the played composite

- 4 -

signal is demultiplexed and the service components of a selected channel can be decoded. Playback of the composite signal can also involve additional decoding if an outer layer of decoding is used with the composite data stream, as well as deinterleaving and/or forward error correcting (FEC) when interleaving and/or FEC techniques are also used. The demultiplexed signals are provided to a source or service layer decoder for further processing to extract a user- selected channel for output.

In this manner, a composite data stream that is generated to carry a plurality of SDARS program channels can be recorded onto a disc or other recording medium for playback at another time without having to be broadcast and received at a receiver. A user can insert the recorded medium into a player, such as a portable radio/cassette/CD portable stereo unit equipped with suitable playback electronics, and play the recorded medium as if it had received an SDARS broadcast. The user selects a program channel or content segment in a program channel for retrieval and playback in a manner similar to the selection of a program content from a received signal using a satellite receiver. The playback electronics decode and output selected content from the composite data stream on the storage media using the header information for digital-to-analog conversion and output to speakers, for example, for display on a display device, or annunciation via other output devices.

Brief Description of the Drawings:

The various aspects, advantages and novel features of the present invention will be more readily comprehended from the following detailed description when read in conjunction with the appended drawings, in which:

Fig. 1 illustrates an SDARS system constructed in accordance with an embodiment of the present invention;

Fig. 2 is a block diagram depicting the conversion of input information into a composite data stream for recording onto a storage medium in accordance with an embodiment of the present invention;

Fig. 3 is a block diagram depicting the conversion of input information into a payload channel in accordance with an embodiment of the present invention;

Fig. 4 illustrates a payload channel frame in accordance with an embodiment of the present invention;

- 5 -

Fig. 5 illustrates assembly of an exemplary composite data stream in accordance with an embodiment of the present invention;

Fig. 6 illustrates demultiplexing, decoding and playback of selected content in a composite data stream at a satellite receiver segment in accordance with an embodiment of the present invention;

Fig. 7 is a block diagram depicting the demultiplexing, decoding and playback of selected content in a composite data stream stored on a storage media in response to selection of a single channel or content segment in accordance with an embodiment of the present invention; and

Fig. 8 is a diagram illustrating a multi-point distribution system for playback of a composite data stream on a storage medium in accordance with an embodiment of the present invention.

Throughout the drawing figures, like reference numerals will be understood to refer to like parts and components.

Detailed Description of the Preferred Embodiments:

Fig. 1 depicts a satellite broadcast system 10 which comprises at least one geostationary satellite 12, for example, for line of sight (LOS) satellite signal reception at receiver units indicated generally at 14. The satellite broadcast system 10 can be used for SDARS, for example. Another geostationary satellite 16 at a different orbital position is provided for diversity purposes. One or more terrestrial repeaters 17 can be provided to repeat satellite signals from one of the satellites in geographic areas where LOS reception is obscured by tall buildings, hills and other obstructions. It is to be understood that different numbers of satellites can be used, and that satellites in other types of orbits can be used.

As illustrated in Fig. 1, a receiver unit 14 can be configured for stationary use (e.g., on a subscriber's premises), or mobile use (e.g., portable use or mobile use in a vehicle), or both. A control center 18 is provided for telemetry, tracking and control of the satellites 12 and 16. A programming center 20 is provided to generate and transmit a composite data stream via the satellites 12 and 16 which comprises a plurality of payload channels, as will now be described with reference to Figs. 2 through 5.

- 6 -

With reference to Fig. 2, the programming center 20 is configured to obtain content from different information sources and providers and to provide the content to corresponding encoders, as indicated at 30a and 30b. The content can comprise both analog and digital information such as audio, video, data, program label
5 information, auxiliary information, and so on. For example, the programming center 20 can provide SDARS having on the order of 100 different program channels to transmit different types of music programs (e.g., jazz, classical, rock, religious, country, and so on) and news programs (e.g., regional, national, political, financial, sports). The SDARS can also provide emergency information, travel advisory information,
10 educational programs, and the like.

With continued reference to Fig. 2, the types of content to be provided in a payload channel is determined manually, or automatically via a computer, based on contractual and financial arrangements with information providers, and demographic and financial decisions determining the types of programming to be provided via the
15 programming center 20. In addition, a payload channel can comprise plural service components to provide a plurality of different services, as indicated at 32a and 32b. Further, a number of service components in a payload channel can be related to the same service. For example, service components related to the same service can include an audio component, a video component, and a digital data stream comprising auxiliary
20 information or another audio channel to insert advertising information relating to the audio and video program. The programming center is operable to allocate bandwidth for services 32 to different payload channels 34a, 34b, ..., 34n which are configured to transmit the content. As will be described below, the programming center is also operable to allocate bandwidth in a multiplexed data stream among payload channels
25 34 for broadcast or distribution.

With reference to Fig. 3, a payload channel 34 is assembled using a payload channel multiplexer (MUX) 36. Inputs to the MUX 36 preferably comprise the service components 38a, ..., 38n of each service 32a, ..., 32n designated by the programming center 20 for transmission via that particular payload channel 34. In
30 addition, the MUX 36 receives preambles and other control information, as indicated at 40. A payload channel bit stream is preferably organized as frames of a predetermined duration. As shown in Fig. 4, each payload channel frame 42 is

- 7 -

preferably a time multiplex of preambles 44, a service control header (SCH) 46, and data 48 from service components 38. The preambles 44 are preferably 8 bits and repeated every selected number of bits throughout a payload channel frame 42. The SCH comprises bits indicated at 50 which are combined with a preamble 44 to demarcate the beginning of the payload channel frame 42.

The remaining portion 52 of the SCH in Fig. 4 comprises data 45 such as the following data: frame identification number or frame ID, the number of service components 38 in the frame, a service component control field (SCCF) for each service component 38 contributing data 48 in the frame 42 and an auxiliary data field. The auxiliary data field can be used for various purposes such as for providing a dynamic label to be displayed at the receiver 14 or other playback device, or for control information related to a service 32 or service component 38 (i.e., narrowcast control). The SCCFs can be used, for example, to dynamically change the bit rates of service components in a payload channel and therefore to dynamically increase or decrease the overall service rate in a payload channel.

With continued reference to Fig. 2, the generation of payload channels, as described above in connection with Figs. 3 and 4, is one of a class of functions performed by the programming center 20 which are hereinafter collectively referred to as the service layer 54. In addition to generating payload channels 34, the programming center 20 multiplexes messages in a broadcast information channel (BIC) 56 in the service layer. The BIC 56 includes auxiliary information useful for services selection and non-real-time control. For example, the BIC 56 can be used control a receiver 14 to switch to a selected channel to receive emergency information. The BIC 56 can also be used to define the relationship of a display channel (e.g., a channel number to be displayed at a receiver 14 or other playback device) to the location of the corresponding program in the composite data stream. The BIC 56 can also be used to display the station name of available services, a directory to the contents of the composite data stream, as well as the artist name, song title and program type of the services available in the composite data stream.

In accordance the present invention, the programming center 20 generates a composite data stream, which comprises a multiplex of payload channels and information for demultiplexing the payload channels, using a number of operations that

- 8 -

are collectively referred to as the transport layer 58 in Fig. 2. The transport layer will now be described with reference to Fig. 5. Each payload channel 34 comprising a series of frames 42 is preferably divided into prime rate channels (PRCs) 60, as indicated at 64. Each PRC 60 comprises a selected number of bits. The programming center 20 uses PRCs 60 from different payload channels 34 to generate a composite data stream 66. The number of PRCs provided to the data stream 66 depends on the desired bit rate of the service to which the PRCs belong.

With continued reference to Fig. 5, the payload channels 34 are so named since they are broadcast via satellite in the illustrated embodiment. It is to be understood that the payload channels can be distributed by other methods such as other signal transmission methods and, as described below in accordance with the present invention, via the distribution of storage media having payload channels 34 stored thereon or a multi-point network. In accordance with a preferred embodiment of the present invention, the composite data stream 66 is a time division multiplexed (TDM) ensemble comprising parts of different payload channels 34 (e.g., PRCs 60 or PRC symbols), as indicated at 62, arranged in time slots 74, a time slot control channel (TSCC) 68, and a master frame preamble (MFP) 70. As will be described below, the TSCC 68 is useful to demultiplex the PRCs 60 to their respective payload channels 34 at a satellite receiver 14, or at a playback device (Fig. 7) configured in accordance with the present invention to extract and playback selected information from a composite data stream 66 stored on a storage medium 72, as shown in Fig. 2. It is to be understood, however, that PRCs 60 from different payload channels 34 can be multiplexed using different techniques such as frequency division multiplexing.

The MFP 70 in the composite signal 66 allows for synchronization at the receiver 14. The TSCC 68 comprises TDM structure information (e.g., a payload channel-to-PRC-to-time slot assignment table) to indicate which time slots 74 in the composite signal 66 comprise symbols from which PRCs 60 and from which payload channels 34. The TDM structure information can be arranged in the TSCC as a number of time slot control words (TSCWs) corresponding to each PRC in the composite data stream 66. Each TSCW can consist of a selected number of bits to provide such data as a broadcast channel identification number (BCID), which

- 9 -

identifies the location of a payload channel in the composite data stream 66. The TSCC can also comprises time and date fields and the BIC 56 described above.

With continued reference to Figs. 2 and 5, the transport layer 58 can also employ additional processing of the TDM data stream such as inner forward error correction (FEC) encoding (e.g., convolutional encoding and puncturing) and interleaving. The physical layers 76 in Fig. 2 for the satellite and terrestrial signals comprises programming center 20 functions such as modulating the composite data stream (e.g., QPSK modulation) and otherwise preparing the data stream for signal transmission.

10 In accordance with an embodiment of the present invention, a recording device 80 is provided at the programming center 20 which is programmable via its processor 82 to store a selected portion of the composite data stream 66 in a memory device 72. The stored composite data stream 66 can then be used by playback devices that are not necessarily equipped to receive a satellite or terrestrial broadcast. The recording device
15 80 can be any device capable of recording a digital data stream onto a device memory 72 such as a compact disc read and write device (CD-RW) or a digital audio tape recorder. The recorder 80 can be implemented on a programmed general purpose computer, special purpose computer, a programmed microprocessor or microcontroller and peripheral integrated circuit elements, an application specific integrated circuit
20 (ASIC) or other integrated circuit, a digital signal processor, and the like. The memory device 72 can be any memory device that can store information in a digital format, and can include a floppy disk, a hard disk, a compact disc (CD), a digital video disc (CVD), an optical disc, RAM, ROM, a disk pack, digital audio tape, or any other medium for the storage and retrieval of digital information.

25 An exemplary receiver 14 is depicted in Fig. 6. The processing will be described to allow comparison thereof with a playback device that is not equipped to receive satellite or terrestrial signals. The receiver 14 comprises radio frequency/intermediate frequency or RF/IF components 84 to receive a satellite or terrestrial broadcast. The received signal is then demodulated (e.g., QPSK
30 demodulation), as indicated at 86. A TDM synchronization and demultiplexer device 88 locates PRCs 60 in the respective time slots 74 of the composite signal 66 using the TSCC. PRCs of the respective payload channels 34 in the composite data stream 66 are

- 10 -

the multiplexed, as indicated at 90. FEC decoding and de-interleaving can then be performed, as indicated at 92, if FEC and interleaving were employed by the programming center 20. Finally, a particular payload channel or service component is decoded in response to a user selection, as indicated at 94.

5 When the composite data stream is available via a storage medium 72, a receiver having an RF/IF front end 84 and a demodulation device 36 are not necessary, instead a playback device for a stored a composite data stream can be used such as the exemplary playback device 96 depicted in Fig. 7. The playback device has an input with which to retrieve data from the storage media 72. The input is configured to
10 accommodate the type of memory device 72 that is used. The input can be an optical disc drawer or tape carousel for receiving, respectively, a CD or DAT having a composite data stream 66 stored thereon, and include corresponding laser circuitry or tape heads to read the stored data stream therefrom.

 With continued reference to Fig. 7, the playback device 96 comprises a
15 composite data stream demultiplexer 98 which employs the MFP 70 and the TSCC 68 to demultiplex the PRC symbols in the stored data stream 66 to their respective payload channels 34. A service/source decoder digital signal processor (DSP) 100 is provided to decode the demultiplexed payload channels 34 to extract and playback selected services therein in response to user inputs, for example. A system controller
20 102 can receive user inputs via an input device such as a keyboard or keypad 104. The system controller 102 can be programmed in accordance with an application program interface (API) to provide users with one or more screens or messages on a display device 106 (e.g., an LCD or CRT monitor) to guide users when making selections regarding which channels and programs to retrieve from the stored data stream for
25 playback purposes. For example, the display device 106 can provide a directory to all of the channels which is provided by the BIC 56 in the composite data stream 66. The display device 106 can also provide the user with the number of the channel that is currently being played back, the type of program or service provided by that channel, artist and song title, among other information.

30 In response to user inputs, the system controller 102 communicates with a controller 108 in the decoder DSP 100 and the demultiplexer 98 via a serial bus 110, for example, to indicate which service is desired. A service layer decoder 112 in the

- 11 -

decoder DSP 100 uses transport layer information (e.g., TSCC), as indicated at 114 in the decoder DSP 100, as well as the demultiplexer 98, to locate the PRCs 60 corresponding to the payload channel 34 that provides the service selected by the user. The selected payload channel can then be decrypted, as indicated at 116 and 118. A
5 broadcast authorization channel decoder 120 is provided which can be used in the system 10 to prevent unauthorized use of the composite data stream 66. It is to be understood, however, that encryption of any payload channel is optional. The selected service components are then source decoded, as indicated at 122, and any auxiliary data can be provided to a data port 124 for display on the display device 106, for example.
10 Audio signals from the source decoding device 122 can be provided to a loudspeaker.

The playback device can be configured, for example, as a boom box with loudspeakers, or in a audio/video component chassis for user with an auxiliary input on a stereo tuner/receiver. In addition to a playback device 96, the memory device 72 having the stored composite data stream 66 can be used in a multi-point network, as
15 shown in Fig. 8. This type of network is useful in an airplane or apartment complex where satellite or terrestrial signal reception is impaired. The multi-point network is described in the above-referenced co-pending U.S. Patent Application Serial No. 09/435,315, on November 4, 1999 and incorporated by reference herein.

While advantageous embodiments have been chosen to illustrate the invention,
20 it will be understood by those skilled in the art that various changes and modifications can be made therein without departing from the scope of the invention as defined in the appended claims.

- 12 -

What is Claimed Is:

1. A method of using a composite data stream comprising a plurality of program channels, each of the program channels supporting at least one service having one or more audio, video and data information, the method comprising the steps of:
 - 5 obtaining a data storage medium having a portion of said composite data stream thereon to allow playback of any of said program channels for a selected period of time; and
 - operating a playback device for said composite data stream, said composite data stream comprising said program channels multiplexed therein, program channel
10 information to identify the types of services provided by said program channels, and control data for demultiplexing said composite data stream to allow extraction of said services therefrom, said playback device being programmable to receive a user input, and to process said control data in response to said user input by accessing said
15 composite data stream on said data storage medium to demultiplex and playback said service requested via said user input using said control data.

1/6

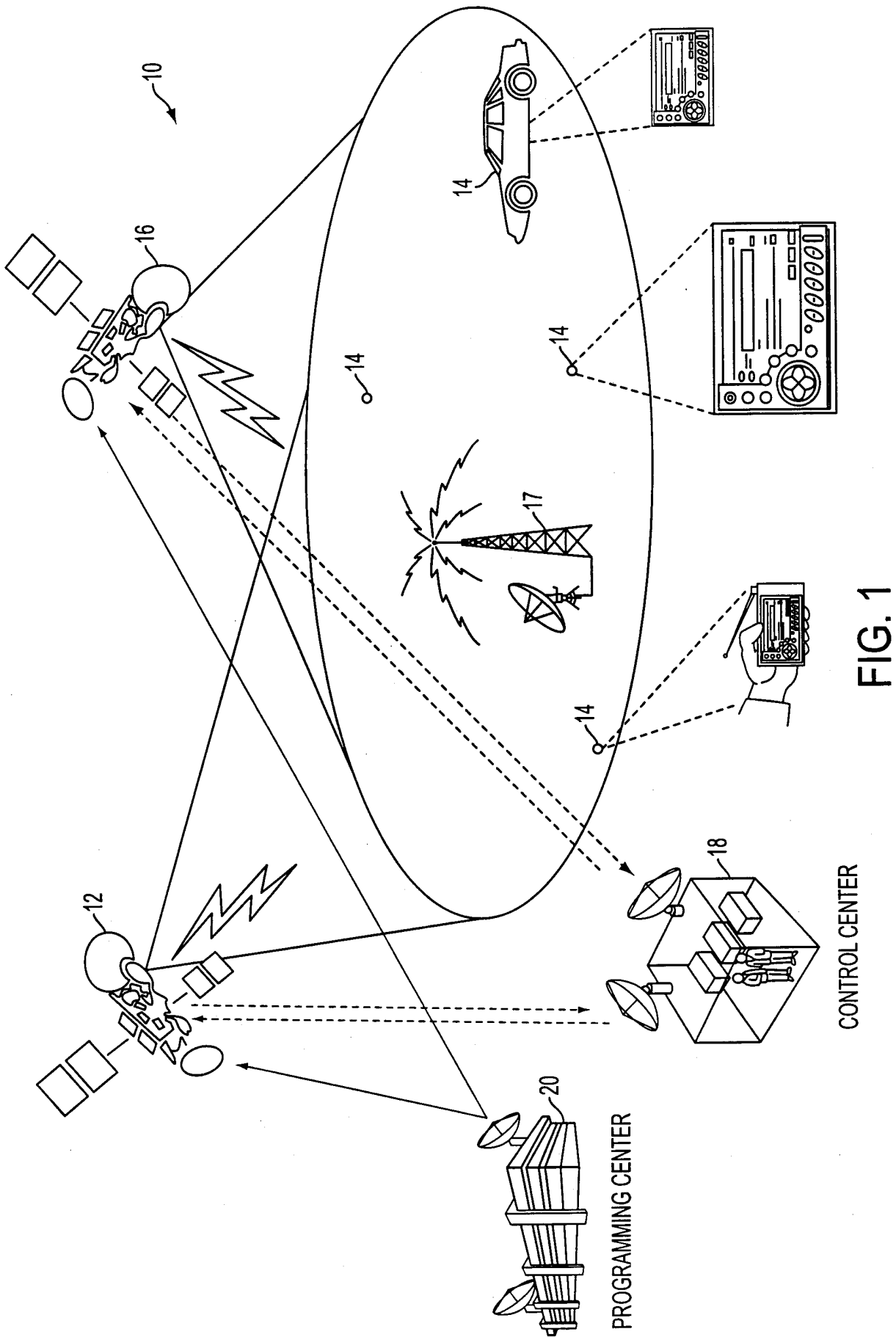


FIG. 1

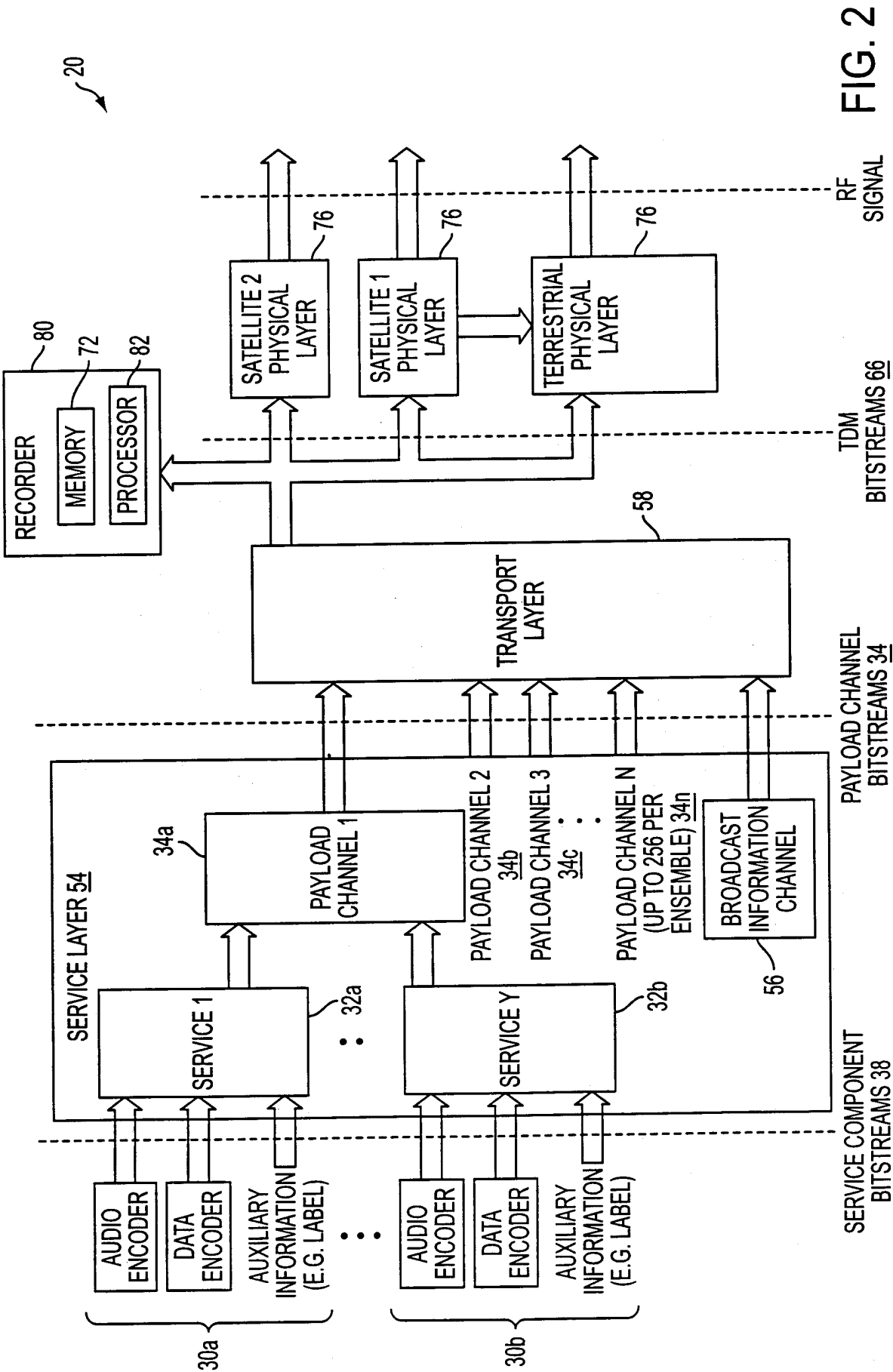


FIG. 2

3/6

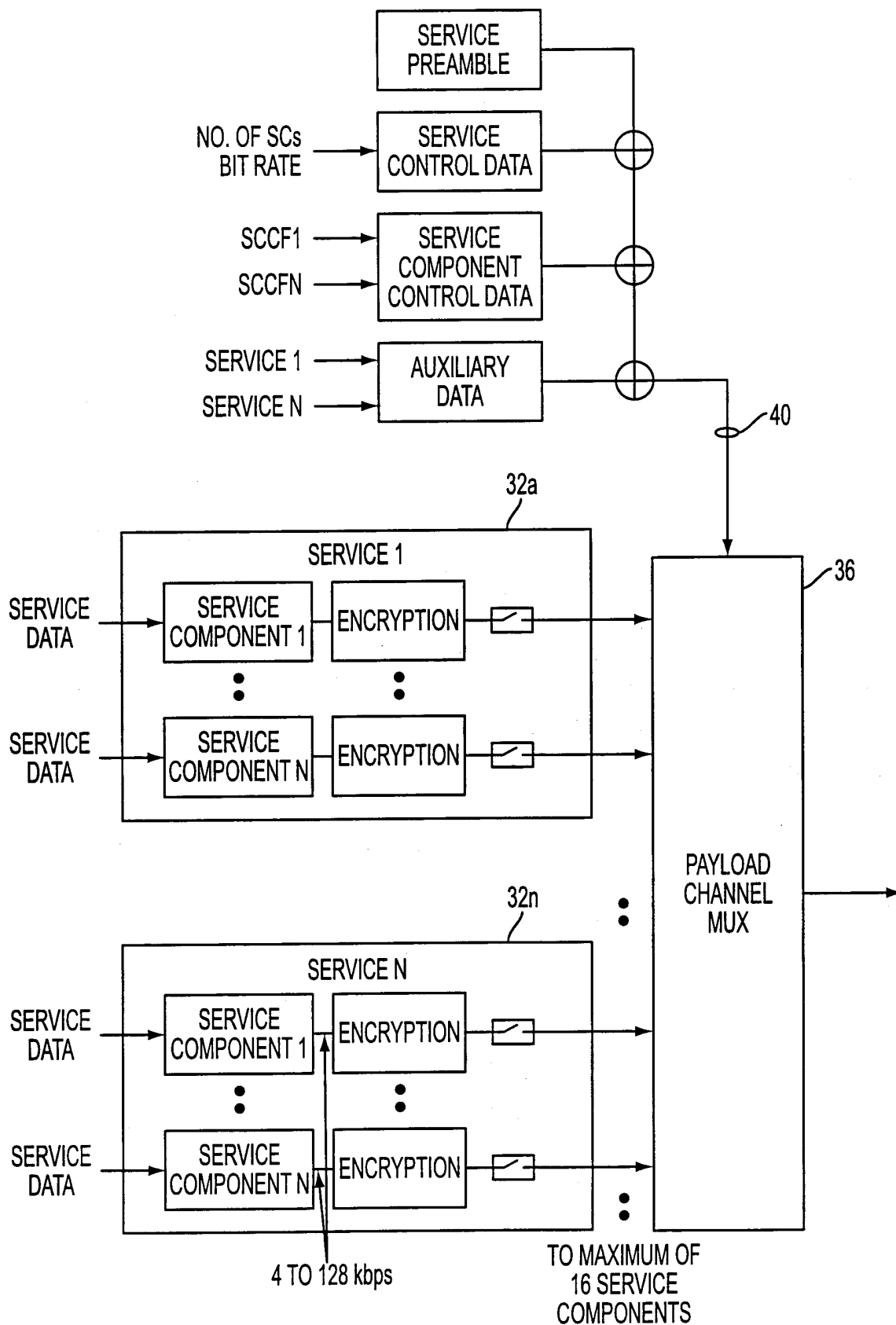


FIG. 3

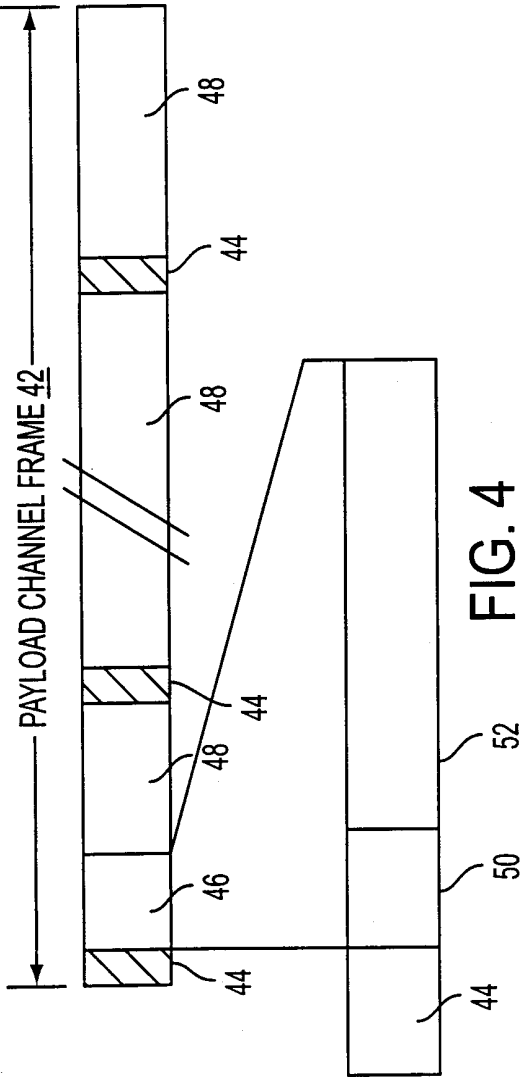


FIG. 4

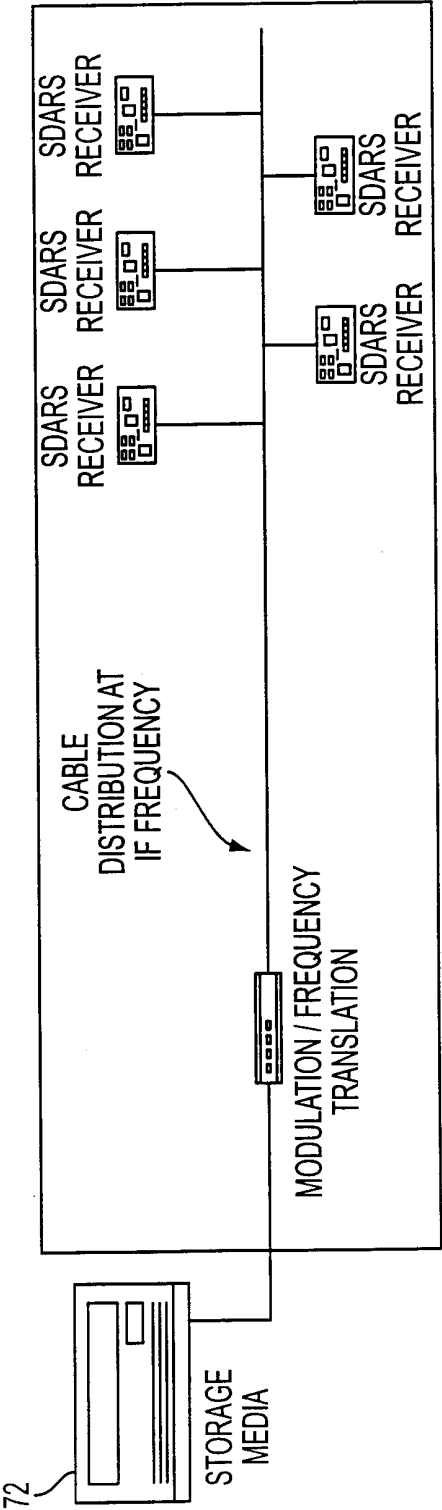


FIG. 8

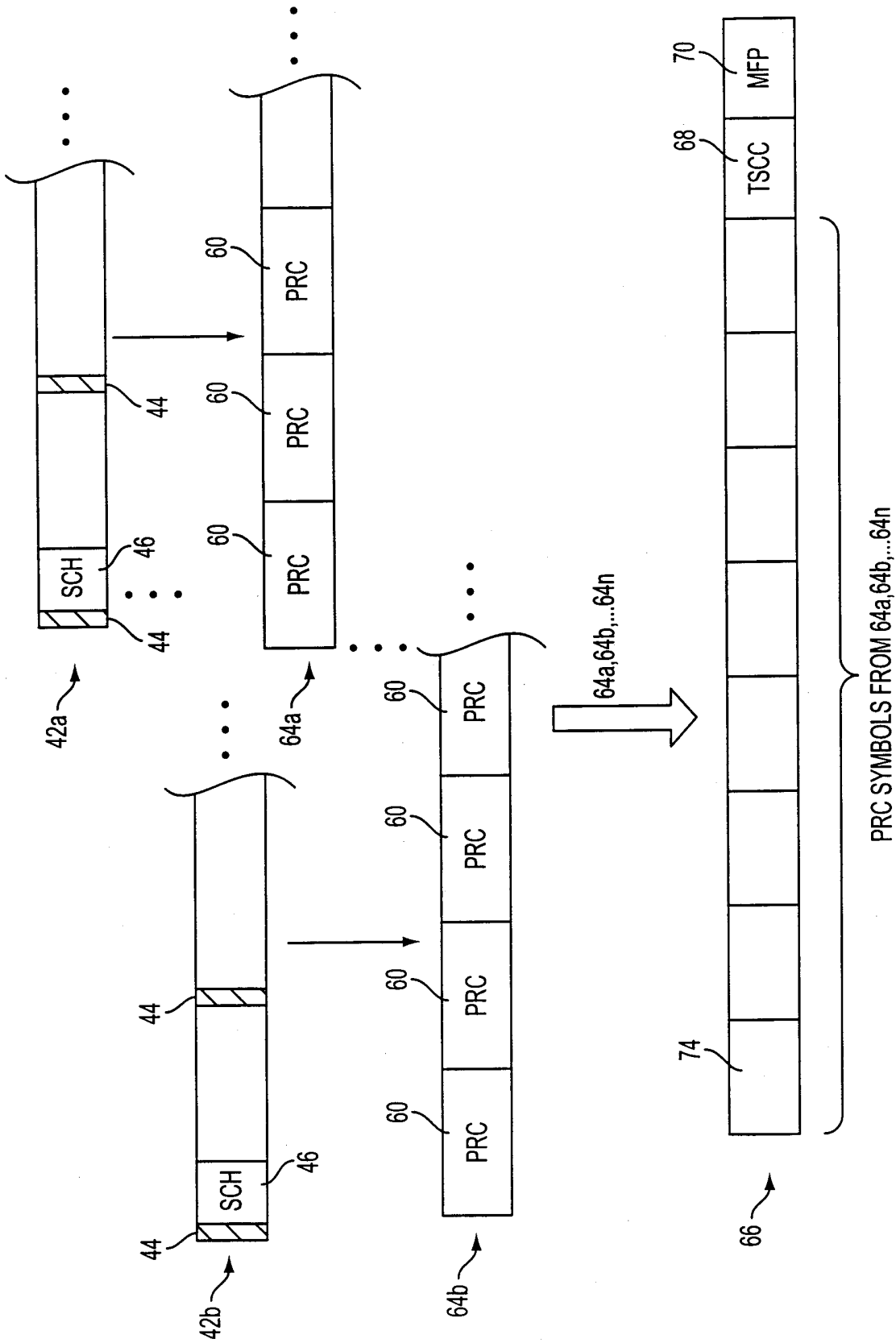


FIG. 5

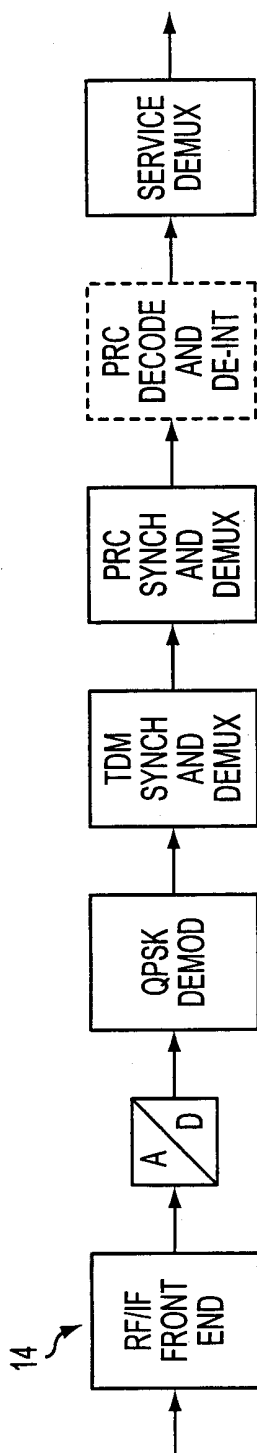


FIG. 6

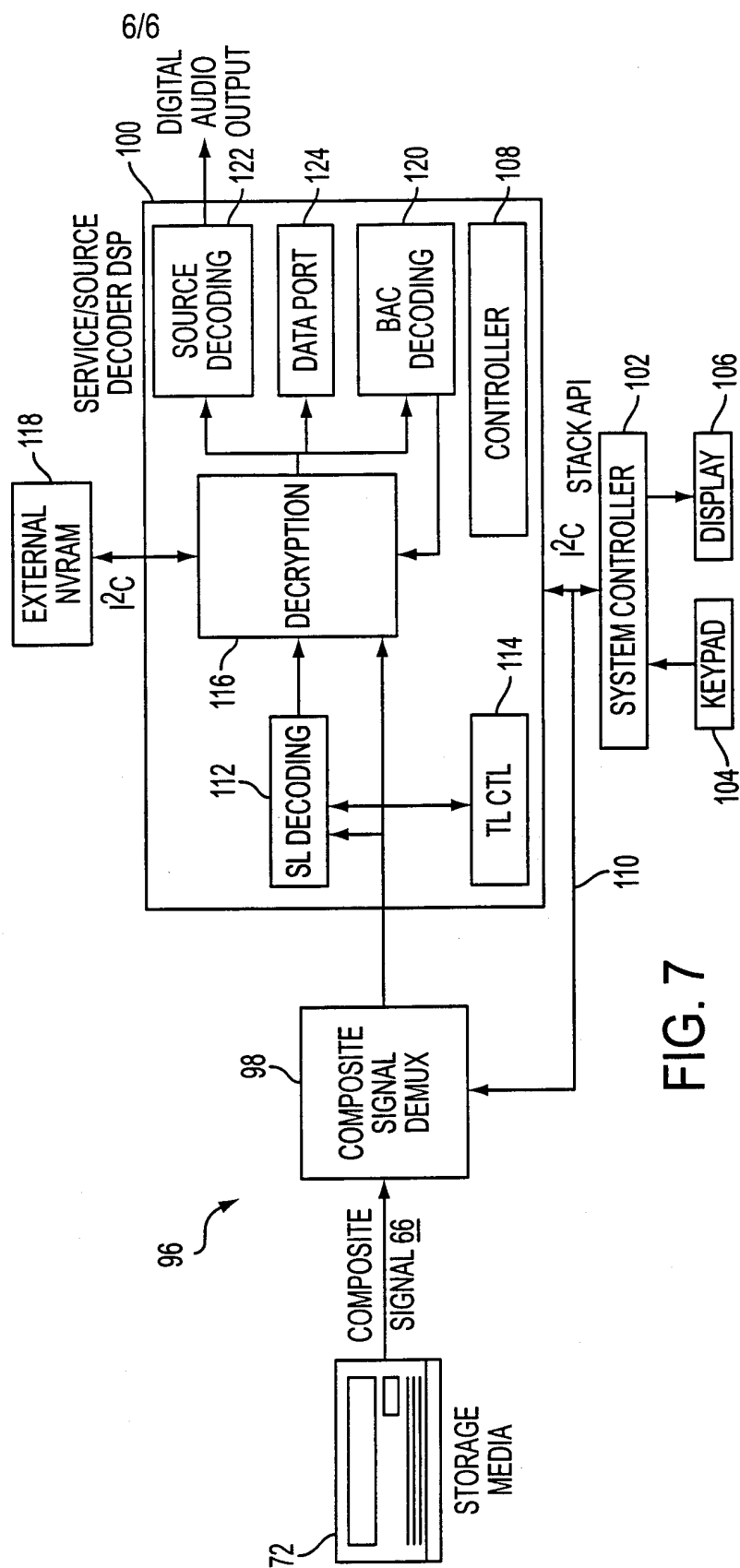


FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/30030

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :H04N 5/76

US CL :386/98

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
noneElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
none**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|--|-----------------------|
| X | US 5,977,962 A (CHAPMAN et al) 02 November 1999, Figs. 4-5. | 1 |
| X | US 5,850,500 A (HIRAYAMA et al) 15 December 1998, columns 11-12. | 1 |
| A | US 4,905,094 A (POCOCK et al) 27 February 1990, Figs. 2A-3. | 1 |



Further documents are listed in the continuation of Box C.



See patent family annex.

| | |
|---|--|
| * Special categories of cited documents: | *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention |
| "A" document defining the general state of the art which is not considered to be of particular relevance | "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone |
| "E" earlier document published on or after the international filing date | "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art |
| "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) | "&" document member of the same patent family |
| "O" document referring to an oral disclosure, use, exhibition or other means | |
| "P" document published prior to the international filing date but later than the priority date claimed | |

Date of the actual completion of the international search

02 FEBRUARY 2001

Date of mailing of the international search report

15 MAR 2001

Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231

Facsimile No. (703) 305-3230

Authorized officer

THAI TRAN

Telephone No. (703) 305-4725

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US00/30030

B. FIELDS SEARCHED

Minimum documentation searched

Classification System: U.S.

386/1, 45, 46, 95, 98, 125, 126; 348/460, 461; 725/105, 114, 115, 131, 133, 135, 136141, 143, 144, 145, 151, 153, 87, 91, 92, 100, 101; 705/26, 27.