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UNITED STATES DISTRICT COURT

CENTRAL DISTRICT OF CALIFORNIA

WESTERN DIVISION

K TECH TELECOMMUNICATIONS, INC., a Delaware corporation,

Plaintiff,

vs.

DIRECTV, a Delaware corporation,

Defendant.

Case No. CV11-09370 RGK (RZx)

FIRST AMENDED COMPLAINT FOR INFRINGEMENT OF UNITED STATES PATENT NOS. 6,785,903; 7,487,533; 7,761,893; AND 7,984,469.

DEMAND FOR JURY TRIAL

1. Plaintiff K Tech Telecommunications, Inc. ("K Tech"), a Delaware corporation, for its complaint, and demanding trial by jury under Rule 38, Fed. R. Civ. P., and Local Rule 38-1, alleges that Defendant DirecTV, a Delaware corporation, is infringing at least claim 24 of U.S. Patent 6,785,903 (the "'903 patent"); claim 13 of U.S. Patent 7,487,533 (the "'533 patent"); claims 1 and 9 of U.S. Patent 7,761,893 (the "'893 patent"); and claims 1, 5, 9, 12, and 15 of U.S. Patent 7,984,469 (the "'469 patent") (collectively "the K Tech patents"), by making, selling, and offering to sell, in this judicial district, systems and methods for modifying a major channel number, a minor channel number, and/or a carrier frequency to identify a television program that infringe the K Tech patents.

2. This is a civil action for patent infringement and arises under, among other things, the United States Patent Laws, 35 U. S. C. section 10, et seq. Jurisdiction is therefore based upon 28 U. S. C. sections 1331 and 1338(a), providing for federal question jurisdiction of patent infringement actions and exclusive jurisdiction of patent infringement actions in the U. S. district courts.

3. Plaintiff K Tech is informed and believes, and thereon alleges, that venue in this court is proper under 28 U. S. C. section 1391 (c) and section 1400 (b) because the acts of patent infringement alleged herein took place, at least in part, within this judicial district.

4. Plaintiff K Tech is a Delaware corporation, and has its principal place of business in Chatsworth, California.

5. Defendant DirecTV is a Delaware corporation, and has its principal place of business in El Segundo, California.

6. On August 31, 2004, the U. S. Patent and Trademark Office duly and lawfully issued the '903 patent under the title *Digital Television Translator with PSIP Update*. A true and correct copy of the '903 patent is attached hereto as **Exhibit A.** On February 3, 2009, the U. S. Patent and Trademark Office duly and lawfully issued the '533 patent under the title *Digital Television Translator with PSIP Update*. A true and correct copy of the '533 patent is attached hereto as **Exhibit B.** On July 20, 2010, the U.S. Patent and Trademark Office duly and lawfully issued the '893 patent under the title *Digital Television Translator with PSIP Update.* A true and correct copy of the '893 patent is attached hereto as **Exhibit C**. On July 19, 2011, the U.S. Patent and Trademark Office duly and lawfully issued the '469 patent under the title *Digital Television Translator with PSIP Update*. A true and correct copy of the '469 patent is attached hereto as **Exhibit D.**

7. DirecTV has infringed the K Tech patents by making, selling, and offering to sell, in this judicial district, systems and methods for modifying a major

channel number, a minor channel number, and/or a carrier frequency to identify a television program covered by one or more of the claims in the K Tech patents in this judicial district and elsewhere in the United States. The United States Congress mandated that June 12, 2009 would be the last day for full-power television stations in the U.S. to broadcast with analog signals. Since June 12, 2009, full-power television stations, such as CBS, ABC, NBC and FOX television networks, can only transmit digital television signals. Digital television signals carry multiple television programs over each, individual signal. Full-power television stations, such as CBS, ABC, NBC and FOX television networks, identify the individual television programs carried over a single digital television signal transmitted over the air using a major channel number, a minor channel number, and/or a carrier frequency. Under FCC rules, all digital television signals in the U.S. must follow ATSC specifications. These specifications require that a digital television signal be transmitted over-the-air and follow Program System Information Protocol ("PSIP") specifications. The PSIP specifications redefine a television program contained in the signal to be identified in a table called the Virtual Channel Table ("VCT") with a major channel number, a minor channel number, and a carrier frequency. The K Tech patents identify systems and methods for modifying a major channel number, a minor channel number, and/or a carrier frequency to identify a television program. In order to broadcast programs in a cable or satellite system, companies, such as DirecTV, must identify television programs with a channel number so that users can select the programs. These companies may also be using the carrier frequency to identify the programs. On information and belief, this infringement will continue unless enjoined by this court.

8. On August 26, 2010, Thomas Nelson of Morgan, Lewis & Bockius, LLP, a firm that earlier represented K Tech, wrote to Mr. Ronald Coslick, Assistant General Counsel for DirecTV. In that letter, Mr. Nelson stated to Mr. Coslick that he was enclosing claim charts of DirecTV's infringement of U.S. Patent Nos.

7,487,533 and 7,761,893, which are both at-issue in the present litigation. A copy of Mr. Nelson's August 26, 2010 is attached hereto as part of "Exhibit E".

9. Receiving no response to his August 26, 2010, Mr. Nelson wrote Mr. Coslick again on February 28, 2011, stating that it had been "six months since we last contacted you and have not heard back" but that "we would still like to schedule a meeting to discuss the patents and terms of a license." A copy of Mr. Nelson's February 28, 2011 letter is attached hereto as part of "Exhibit E".

10. On April 13, 2011, Mr. Coslick responded, by letter, to Mr. Nelson, stating that he had received both the August 26, 2010 letter and the February 28, 2011 letter and that:

> Upon receiving your August 26 letter I revisited the investigation that I undertook when we first corresponded to ensure that I correctly understood DIRECTV's local signal collection technology and any changes that may have occurred since our original correspondence. After completing that investigation it remained, and still remains, my opinion that DIRECTV does not practice the technology described in the K Tech patents or claimed in the K Tech patent claims.

A copy of Mr. Coslick's April 13, 2011 letter is attached hereto as part of "Exhibit E". This letter contains no facts supporting DirecTV's bare denial of infringement, and makes clear that the details of DirecTV's PSIP methods/systems are closely-guarded secrets.

11. DirecTV, on its website, lists numerous locations throughout the United States that receive local, over-the-air digital broadcast signals, raising, on information and belief, an inference of infringement. The URL for the website is: http://www.directv.com/DTVAPP/content/contact_us/local_receive_facilities.

12. United States patent 8,077,706 ("the '706 patent"), a patent that has been assigned to DirecTV, shows how DirecTV collects local, off-the-air digital television signals. Specifically, Box 66 in Figure 2 indicates that the DirecTV system receives the local, off-the-air digital television signal, and Boxes 74-76 indicate the channel number information. A copy of the '706 patent is attached

hereto as "Exhibit F". On information and belief, this patent, too, raises an inference of infringement.

13. On information and belief, Plaintiff believes that DirecTV is utilizing the methods and systems protected by the K Tech patents to update the digital signals it receives, rather than using other non-infringing methods and systems, because this receiving of digital television signals and channel reassignment appears to be covered by the K Tech patents, raising an inference of infringement, which constitutes probable cause for the case, even though DirecTV admits holding in confidence the details of its channel reassignment methods/systems.

14. DirecTV's infringement of the K Tech patents has damaged K Tech in an unknown amount. These damages continue to grow as DirecTV's infringement continues. Under Section 284 of Title 35 of the United States Code, K Tech seeks damages adequate to compensate for this infringement in an amount no less than a reasonable royalty, together with interest and costs affixed by the Court.

15. DirecTV's continuing infringement of the K Tech patents has caused and continues to cause irreparable harm to K Tech, including impairing the value of the K Tech patents in an amount yet to be determined. Pursuant to Section 283 of Title 35 of the United States Code, K Tech seeks a preliminary and a permanent injunction against further infringement of the K Tech patents.

PRAYER FOR RELIEF

WHEREFORE, K Tech prays for the following relief from this court against Defendant:

1. An order, pursuant to 35 U.S.C. Sections 154(d) and 271, declaring that DirecTV has infringed one or more claims of the K Tech patents;

2. A preliminary and a permanent injunction against DirecTV, prohibiting DirecTV from further infringement of the K Tech patents;

3. An award of the actual damages K Tech has suffered by reason of the infringement charged in this Complaint, in an amount not less than a reasonable

royalty on DirecTV's sales of the products charged with infringing the K Tech patents;

4. An award to Plaintiff K Tech of its costs of suit herein; and

5. Such other and further relief as the Court may deem just and proper.

Dated: February 27, 2012

Respectfully submitted,

WAGNER, ANDERSON & BRIGHT, PC

By: [signature]
Patrick F. Bright

Attorneys for Plaintiff

K TECH TELECOMMUNICATIONS, INC.

DEMAND FOR JURY TRIAL

Pursuant to Rule 38(b) of the Federal Rules of Civil Procedure, and Local Rule 38-1, Plaintiff K Tech does hereby demand trial by jury of each and every issue and claim as to which it is entitled to trial by jury under Rule 38(a) of the Federal Rules of Civil Procedure.

Dated: February 27, 2012

Respectfully submitted,

WAGNER, ANDERSON & BRIGHT, PC

By: [signature]
Patrick F. Bright

Attorneys for Plaintiff
K TECH TELECOMMUNICATIONS, INC.

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and accurate copy of the foregoing was filed with the United States District Court for the Southern District of California on February 28, 2012, and a copy was served, via first-class mail, on the following:

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Attorneys for Defendant DirecTV

Dated: February 28, 2012

Patrick F. Bright

EXHIBIT A

US006785903B1

(12) **United States Patent**
Kuh

(10) **Patent No.: US 6,785,903 B1**
(45) **Date of Patent: Aug. 31, 2004**

(54) **DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE**

(75) Inventor: **Steve Kuh**, Northridge, CA (US)

(73) Assignee: **K Tech Telecommunications, Inc.**, Chatsworth, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/545,613**

(22) Filed: **Apr. 5, 2000**

(51) **Int. Cl.**[7] **H04N 5/58**
(52) **U.S. Cl.** **725/50**; 725/132; 725/118; 725/127; 725/148; 725/149; 725/152; 370/486
(58) **Field of Search** 725/50, 132, 142, 725/152, 118, 199, 120, 127, 128, 148; 370/486

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2001/0009556 A1	*	7/2001	Kato et al.	370/486
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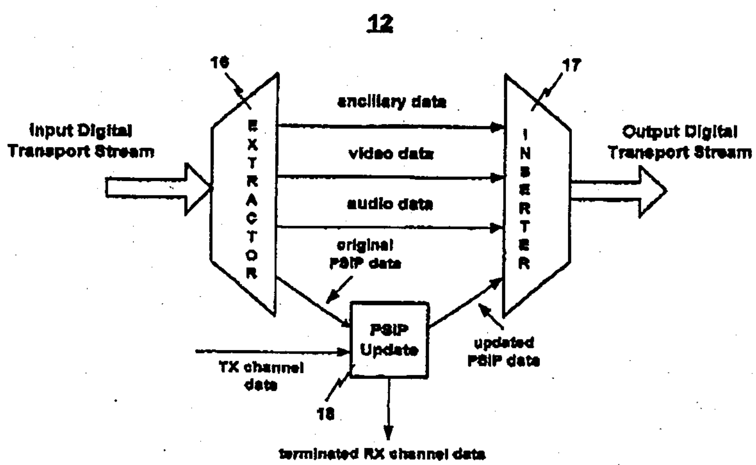
(List continued on next page.)

Primary Examiner—John Miller
Assistant Examiner—Nathan A Sloan
(74) *Attorney, Agent, or Firm*—Morgan, Lewis & Bockius LLP

(57) **ABSTRACT**

A digital television translator includes a digital television receiver for receiving a first digital television signal at a first frequency and generating a digital transport stream from the first digital television signal. The digital transport stream can include original Program and System Information (PSIP) data having RX channel data that is indicative of the first frequency, the first major channel number, and/or the first minor channel number. The digital television translator also includes a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data. The TX data is indicative of a second frequency, a second major channel number, and/or a second minor channel number. The digital television translator further includes a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal at the second frequency, where the second frequency can be the same or different from the first frequency.

58 Claims, 4 Drawing Sheets



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Prior Art

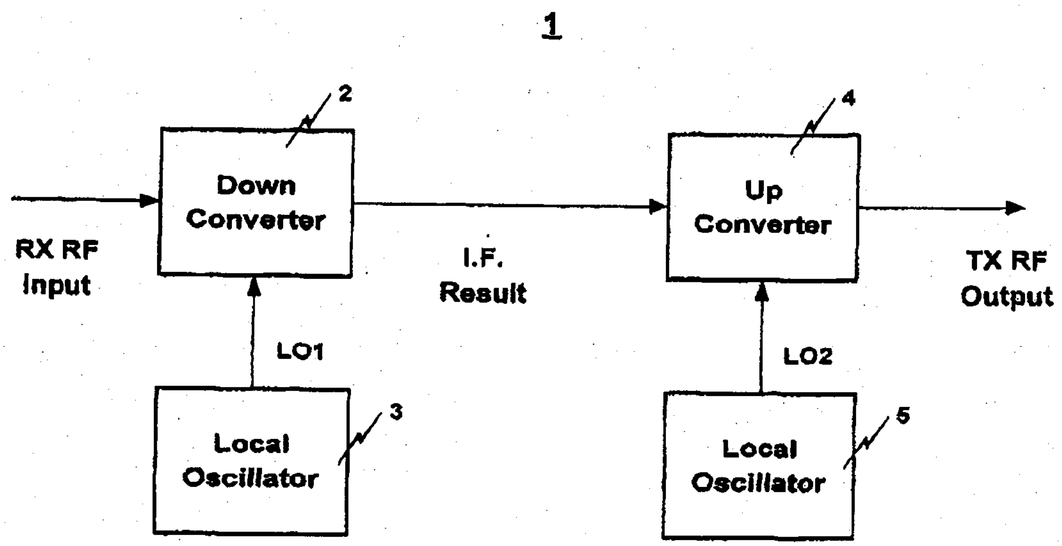

Fig. 1

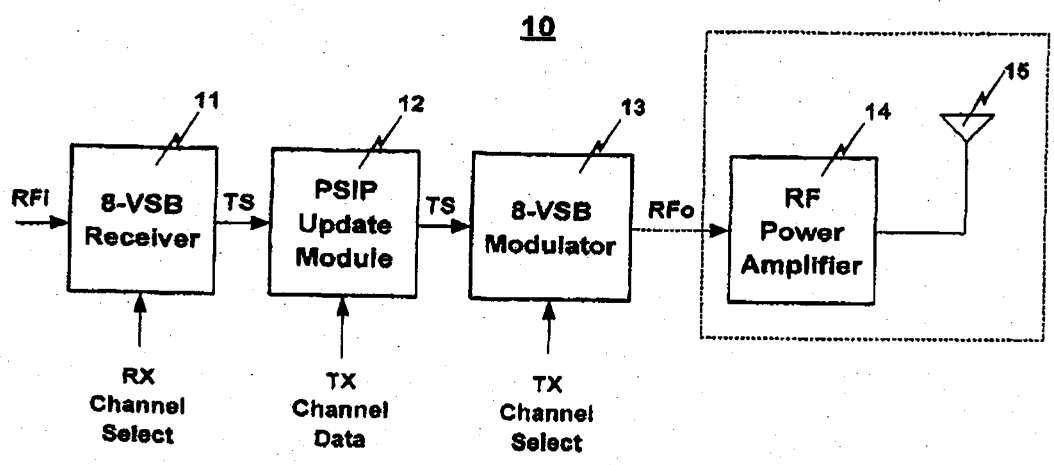
10
11
12
13
14
15
RFI
8-VSB Receiver
TS
PSIP Update Module
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
TX Channel Select

Fig. 2

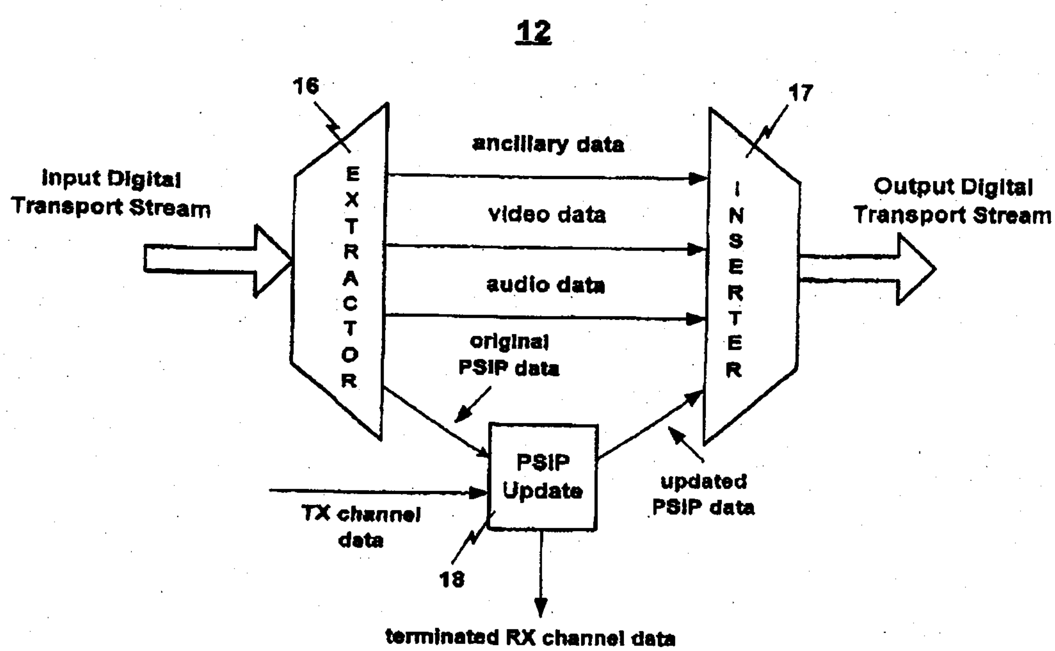
12
16
17
Input Digital Transport Stream
EXTRACTOR
ancillary data
video data
audio data
original PSIP data
INSERTER
Output Digital Transport Stream
PSIP Update
updated PSIP data
TX channel data
18
terminated RX channel data

Fig. 3

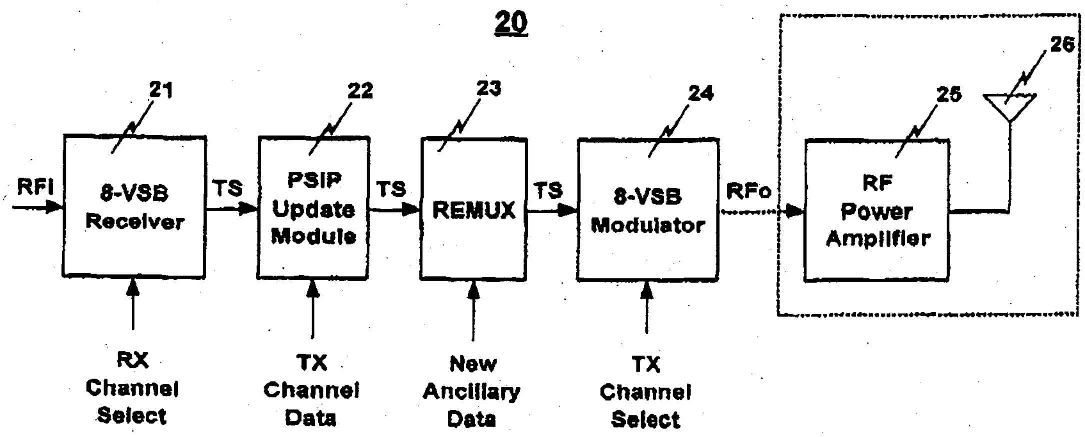
20
21
22
23
24
25
26
RFI
8-VSB Receiver
TS
PSIP Update Module
TS
REMUX
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
New Ancillary Data
TX Channel Select

Fig. 4

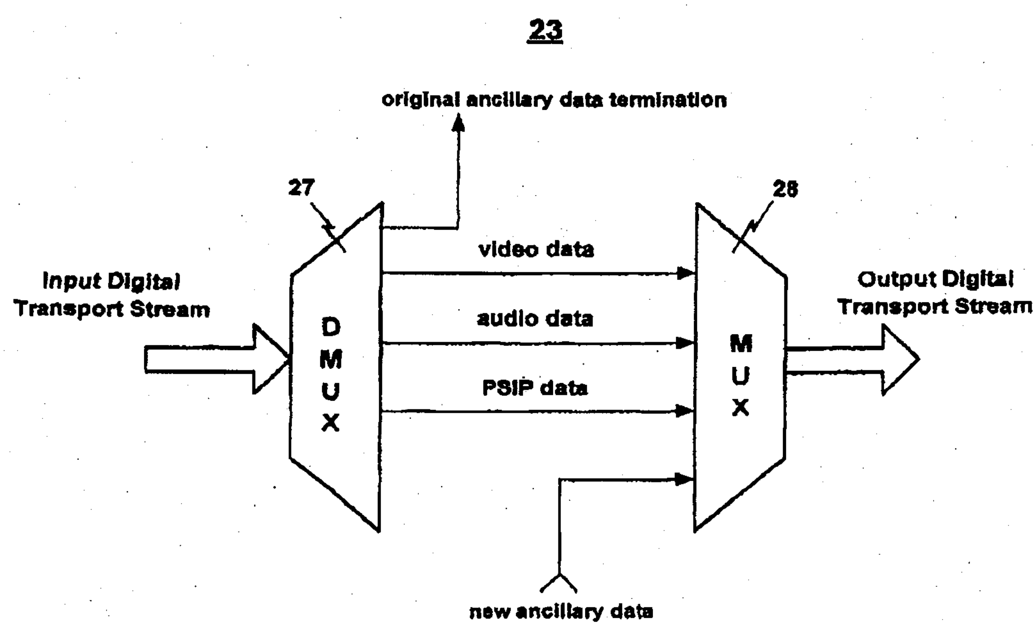
23
original ancillary data termination
27
28
Input Digital Transport Stream
D M U X
video data
audio data
PSIP data
M U X
Output Digital Transport Stream
new ancillary data

Fig. 5

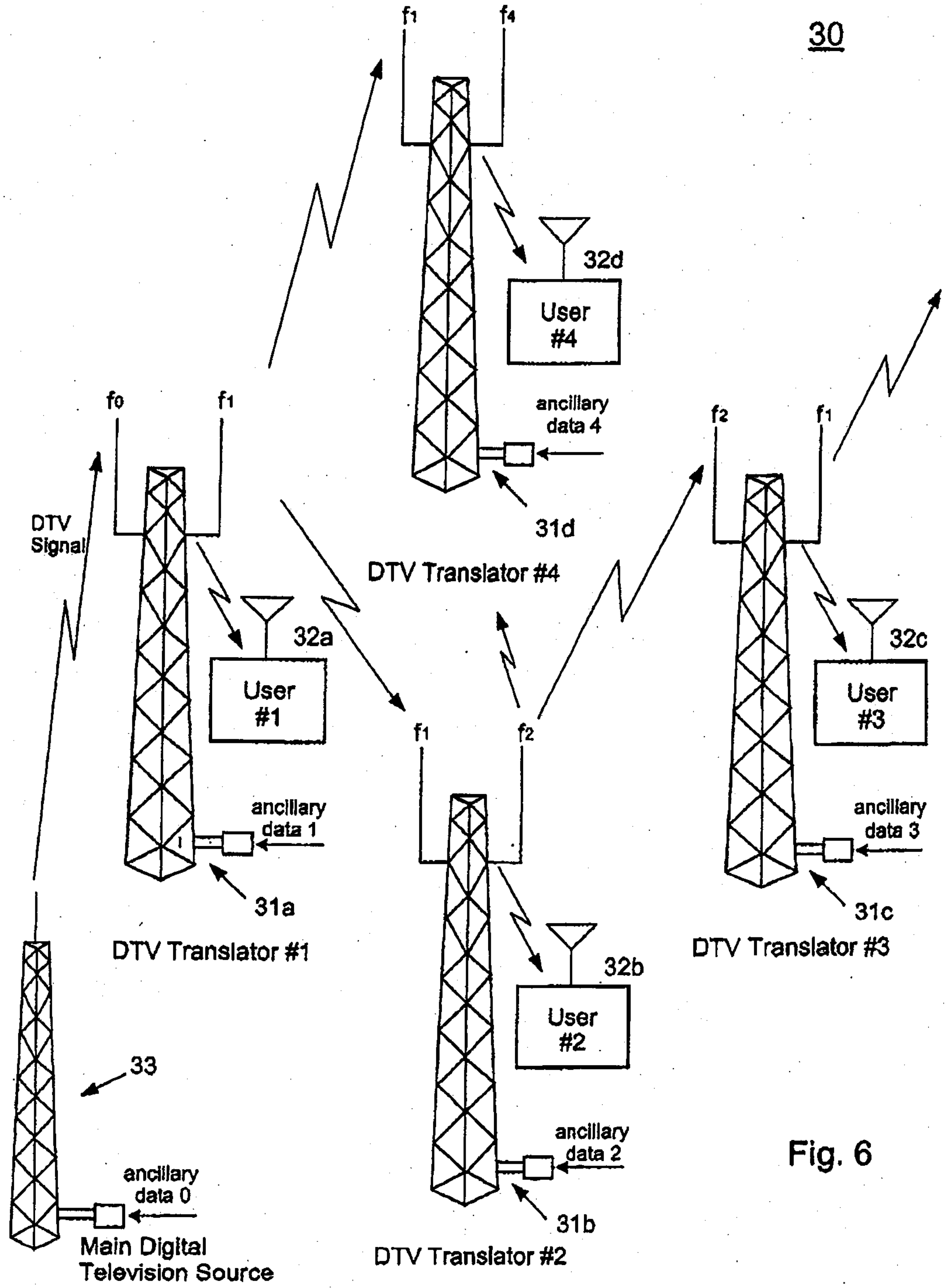
30
f1
f4
32d
User #4
ancillary data 4
31d
DTV Translator #4
f0
f1
DTV Signal
32a
User #1
ancillary data 1
31a
DTV Translator #1
f2
f1
32c
User #3
ancillary data 3
31c
DTV Translator #3
f1
f2
32b
User #2
ancillary data 2
31b
DTV Translator #2
33
ancillary data 0
Main Digital Television Source

Fig. 6

DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a digital television translator. More particularly, the present invention relates to a digital television translator that updates the program and system information protocol (PSIP) table with transmit (TX) channel data.

2. Discussion of the Related Art

Digital television (DTV) broadcasting systems are relatively new in the United States and offer many alternatives to traditional information and program distribution. In addition to traditional television programming, DTV systems offer the ability to distribute additional content in the form of data. This data can be any type of data including, for example, Internet data broadcast to one or more end users. Therefore, DTV broadcast systems offer great flexibility and diversity in the types of information they distribute. Like most conventional broadcast systems, DTV broadcast systems have a finite capacity limited by the bandwidth of its channels.

Additionally, as with other broadcast systems, such as analog television systems, the received DTV signal quality can vary greatly depending upon where the receiver is located. This problem is due to a number of adverse propagation effects such as multipath, interference, and simple attenuation. One solution to this problem is to use multiple low power repeaters (On-Channel boosters) and/or translators (Re-modulators) to improve reception in areas of poor DTV signal reception. For example, a repeater, placed in an area of poor signal reception, receives a transmitted signal from a high power DTV transmitter and re-transmits an amplified duplicate signal at the same frequency. Translators, on the other hand, can receive a transmitted signal from a high power DTV transmitter and re-transmit the signal at a frequency different than the received frequency. Repeaters and translators are also used to extend the coverage of a broadcast system incrementally, and economically, to specific geographical regions.

FIG. 1 shows an example of a conventional DTV translator 1. The conventional DTV translator includes a down converter 2, a first local oscillator 3, an up converter 4, and a second local oscillator 5. A received DTV signal (RX RF input) is down converted to IF (intermediate frequency) by down converter 2. The IF is determined by the difference between the frequency LO1 generated by the first local oscillator 3 and the RF frequency of the received DTV signal (RX RF Input). The IF signal is then up converted to RF by up converter 4. The frequency of the up converted RF DTV signal (TX RF Output) is determined by the sum of the frequency LO2 generated by the second local oscillator 5 and the IF. The up converted DTV signal (TX RF Output) is then amplified and transmitted. With this arrangement, the transmitted signal contains the same information as the received signal, but is amplified. Further, when LO1=LO2, the transmit frequency is the same as the received frequency, and the apparatus operates as an on-channel booster. Alternatively, when LO1≠LO2, the transmit frequency is different than the received frequency, and the apparatus operates as a translator.

In the DTV American Television Systems Committee (ASTC) standard, a DTV signal contains a Program and System Information Protocol (PSIP) table, which is a collection of hierarchically arranged sub-tables for describing system information and program guide data. One of sub-tables in the PSIP table is the Virtual Channel Table (VCT), which contains a list of attributes for virtual channels carried in the digital transport stream (baseband information). VCT fields "major channel number" and "minor channel number" are used for identification. The major channel number is used to group all channels that are to be identified as belonging to a particular broadcast corporation (or a particular identifying number such as channel "12"). The minor channel number specifies a particular channel within the group. The VCT also contains a "carrier frequency" field, which is used to identify the frequency at which the DTV signal is transmitted and received. As discussed herein, TX and RX channel data include at least one of the following major channel number, minor channel number, carrier frequency, and/or other data necessary for generating a proper DTV signal.

When a RF DTV signal is translated to a new frequency by the conventional DTV translator 1 of FIG. 1, the PSIP table no longer reflects the correct carrier frequency. In many DTV receivers, this discrepancy between the actual frequency of the received DTV signal and the carrier frequency data contained in the PSIP table prevents the receiver from properly receiving the DTV signal.

Also, a particular broadcast corporation may be assigned different major/minor channel numbers in geographical regions serviced by each translator. For example, Broadcast Corporation #1 could be assigned major/minor channel 12/04 in region #1 (served by a main DTV transmitter) and major/minor channel 37/04 in region #2 (served by a translator translating the main DTV transmitted signal). The conventional translator of FIG. 1 therefore generates a translated DTV signal that contains an incorrect channel number for transmission into region #2.

Moreover, in region #2, major minor/channel 12/04 may have already been assigned to Broadcast Corporation #2. In that case, a single DTV receiver in region #2 will receive two unique channels (Broadcast Corporation #1 and Broadcast Corporation #2) each having the same major/minor channel number in each of their PSIP tables. While some DTV receivers overcome these anomalies by allowing users to select whether to ignore PSIP data or to display the VCT information, other DTV receivers do not have this capability and are unable to properly tune to the program(s) of one or both of the two Broadcast Corporations.

SUMMARY OF THE INVENTION

Accordingly, the present invention relates to a digital television translator, and more particularly to a digital television translator that updates the PSIP table with proper channel and carrier frequency information. To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, there is provided a digital television translator, comprising a digital television receiver for receiving a first digital television signal and generating a digital transport stream from the first digital television signal, the digital transport stream including original PSIP data having RX channel data; a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data; and a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal.

In another aspect of the instant invention, there is provided an information distribution network using digital television transmission, the information distribution network comprising a plurality of digital television transmission nodes including a main digital television signal source for generating a main digital television signal; and a plurality of digital television translators receiving a digital television signal from one of the plurality of digital television nodes, at least one of said plurality of digital television translators including a digital television receiver for receiving the digital television signal from one of the plurality of digital television nodes and generating a digital transport stream from the received digital television signal, the digital transport stream including original ancillary data and original PSIP data having RX data, a data update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data and for replacing the original ancillary data in the digital transport stream with new ancillary data, and a digital television modulator for converting the digital transport stream having the new ancillary data and the updated PSIP data into a transmitted digital television signal, wherein at least two of the plurality of digital television transmission nodes transmit at the same frequency and the total ancillary data of the information distribution network includes the new ancillary data from multiple digital television translators of the plurality of digital television translators.

Additional features and advantages of the present invention will be set forth in the description that follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention that together with the description serve to explain the principles of the invention.

In the drawings:

FIG. 1 shows an example of a conventional DTV translator;

FIG. 2 shows a first embodiment of a DTV translator of the present invention having PSIP table update capability;

FIG. 3 shows an example of a PSIP update module;

FIG. 4 shows a second embodiment of a DTV translator of the present invention having both PSIP table update capability and a re-multiplexor;

FIG. 5 shows an example of the re-multiplexor; and

FIG. 6 shows an example of an information distribution network of the present invention using multiple translators.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

To overcome the problems associated with the prior art, i.e., tuning problems with some DTV receivers due to incorrect PSIP table information, the PSIP table information is updated by the translator to properly reflect the new transmit carrier frequency and channel number.

FIG. 2 shows a first embodiment of a DTV translator 10 of the present invention having PSIP table update capability. The DTV translator 10 includes an 8-VSB receiver 11, a PSIP update module 12, an 8-VSB modulator 13, an RF power amplifier 14, and a transmitting antenna 15. The receiver 11 receives an 8-VSB DTV signal (RFi) that may have been originally transmitted by a base station or another translator, over the air or by a cable. The receiver 11 processes the DTV signal according to ASTC DTV standards to produce a digital transport stream (TS) containing MPEG2 video data, audio data, ancillary data, and PSIP data. The PSIP data in the digital transport stream includes a major channel number, a minor channel number, and a carrier frequency, which together make up the RX channel data. As shown, the receiver 11 is controlled by an input (RX Channel Select) which informs the receiver 11 of which carrier frequency channel to tune.

The processing of the received DTV signal by the 8-VSB receiver 11 is in accordance with ATSC DTV standards and, accordingly, can include down conversion, digitization, carrier synchronization, symbol clock synchronization, frame and segment synchronization, matched filtering, equalization, bit-demapping, Trellis decoding, convolutional de-interleaving, Reed-Solomon forward error correction (FEC) decoding, and de-randomizing.

The digital transport stream (TS) is then input into PSIP update module 12. The PSIP update module 12 extracts the PSIP table data and updates the RX channel data with TX channel data. Specifically, the major channel number, the minor channel number, and the carrier frequency contained in the PSIP VCT are updated. Updated major and minor channel numbers are those numbers assigned to the broadcaster associated with the transport stream content for the geographical region covered by the DTV translator. Sometimes the original and updated channel numbers will be the same, for example when the translator is being used to fill in a poor reception area of the geographical area covered by the main transmitter. At other times, the original and updated channel numbers will be different, for example, when the translator is being used to extend coverage into a geographical area not covered by the main transmitter. In this instance, the broadcaster may be licensed to broadcast in the translator's geographical area, but at a different channel.

Also, the carrier frequency of the DTV signal transmitted from the translator must be reflected in the PSIP VCT. In most instances, the translator will transmit at a different frequency than it receives, requiring the PSIP VCT to be updated with the new transmitted carrier frequency. In some instances, the carrier frequency of the DTV signal can be transmitted at the same frequency that it is received, such as when the translator system is being used as an on-channel booster. In either instance, the updated PSIP table is then reinserted back into the digital transport stream.

Once the PSIP data is updated, the transport stream containing the updated PSIP data is then input into the 8-VSB modulator 13. 8-VSB modulator 13 processes the digital transport stream according to ATSC DTV standards to produce a DTV signal (Rfo) at the carrier frequency contained in the VCT of the updated PSIP table data. As shown, 8-VSB modulator 13 is controlled by input (TX Channel Select) which informs the 8-VSB modulator 13 at which frequency to transmit the DTV signal. Alternatively, the 8-VSB modulator can detect the carrier frequency information from the VCT of the DTV signal and transmit the DTV signal using the detected carrier frequency.

8-VSB modulator 13 processes the transport stream having the updated PSIP data according to ASTC terrestrial broadcast standards. Accordingly, this processing can include randomization, Reed-Solomon encoding, convolutional interleaving, symbol mapping, trellis encoding, and vestigial sideband filtering. After the digitally filtered signal is converted to an analog signal, the signal is up converted to a transmit RF signal (RFo) at the transmit frequency determined by TX channel select. The 8-VSB modulator 13 typically operates at a frequency of 54 MHZ–216 MHZ and 470 MHZ–806 MHZ and has a maximum output power of approximately 1 milliwatt. A power amplifier 14 and transmitting antenna 15 are usually added to the output of the 8-VSB modulator 13.

FIG. 3 shows an example of PSIP update module 12. The PSIP update module 12 includes an extractor 16 for extracting the original PSIP data, a PSIP update block 18 for replacing the major/minor channel number and carrier frequency contained in the PSIP table, and an inserter 17 for inserting the updated PSIP table data back into the transport stream. As shown, the PSIP table data is extracted by extractor 16 and input into the PSIP update block 18. The PSIP update block 18 replaces the major/minor channel number and transmit carrier frequency contained in the VCT (a sub-table of the PSIP table) while retaining the other PSIP data. The PSIP update block 18 then substitutes an updated major/minor channel number and transmit carrier frequency into the VCT. Thereafter, the updated PSIP table data is re-inserted back into the digital transport stream via inserter 17.

FIG. 4 shows a second embodiment of a DTV translator 20 of the present invention. The second embodiment includes an 8-VSB receiver 21, a PSIP update module 22, a re-multiplexor 23, and an 8-VSB modulator 24. Usually an RF power amplifier 25 and an antenna 26 are coupled to the 8-VSB modulator 24. The structure and operation of the second embodiment is the same as the structure and operation of the first embodiment, except that a re-multiplexor 23 is added for introducing new ancillary data into the digital transport stream.

The digital transport stream containing original ancillary data and the updated PSIP table data is input into the re-multiplexor 23. Re-multiplexor 23 substitutes new ancillary data in place of the original ancillary data in the digital transport stream. The digital transport stream is then sent to 8-VSB modulator 24 and converted into a DTV signal consistent with the operation as described in the first embodiment. In this way, each translator can distribute new ancillary data to user(s) in the translator's transmit range.

FIG. 5 is a block diagram of the re-multiplexor 23, which comprises a demultiplexor 27 and a multiplexor 28. As shown, the original ancillary data, video data, audio data, and updated PSIP table data is contained in the input digital transport stream, which is demultiplexed into separate bit streams by de-multiplexor 27. The original ancillary data is terminated (discarded). The multiplexor 28 then combines the video data, the audio data, the updated PSIP data, and new ancillary data back into the output digital transport stream, which is then input to the 8-VSB modulator 24.

The PSIP update step and the ancillary data insertion step are not required to take place in any particular order. For example, since the PSIP data has been separated into its constituent streams by demultiplexor 27 of re-multiplexor 23, the PSIP table update step could take place in the re-multiplexor 23 by updating the major/minor channel number and carrier frequency. The updated PSIP table data could be reinserted into the digital transport stream by multiplexor 28. Or, for example, the placement of the PSIP update module 22 and the multiplexor 23 could be reversed. Moreover, only a portion of the original ancillary data could be replaced with new ancillary data thereby allowing other portions of the ancillary data to be transmitted downstream by the translator.

The second embodiment allows DTV broadcasting stations to increase their data broadcasting capacity every time a DTV translator is added. For example, adding a DTV translator increases the number of users and increases the capacity for data transmission through employment of the new ancillary data, which permits the insertion of data, such as Internet data. Downstream Internet data can be inserted as new ancillary data by each translator and distributed to specific geographic regions and users without the need for additional bandwidth.

FIG. 6 shows an example of a third embodiment of the invention wherein an information distribution network 30 uses a plurality of translators to increase the data capacity of the network. As shown, a plurality of translators, collectively labeled 31*a*–31*d*, translate and distribute a DTV signal in both a star and daisy-chain configuration.

The first translator 31*a* receives a DTV signal, from a main digital television source, containing original ancillary data 0, such as Internet download data at a frequency fo. Translator 31*a* inserts ancillary data 1 and discards original ancillary data 0, and then retransmits the modified DTV signal having ancillary data 1 at a frequency f1. User 32*a* receives ancillary data 1 from translator 31*a*. A second DTV translator 31*b* receives the translated DTV signal from translator 31*a* at a frequency of f1, substitutes ancillary data 2 for ancillary data 1, and then retransmits at a frequency f2. User 32*b* receives the DTV signal transmitted from translator 31*b* along with ancillary data 2. User 32*d* also receives ancillary data 1 from translator 31*a*. A third DTV translator 31*c* receives the translated DTV signal from translator 31*b* at a frequency of f2, substitutes ancillary data 3 for the ancillary data 2, and retransmits at a frequency f1. User 32*c* receives the DTV signal transmitted from translator 32*c* along with ancillary data 3. DTV translators 31*a*, 31*b*, and 31*c* are thus configured in a daisy-chain fashion with translators 31*a* and 31c being endpoints.

Further, a fourth DTV translator 31*d* receives the translated DTV signal from translator 31*a* at a frequency of f1, substitutes ancillary data 4 for ancillary data 1, and then retransmits at a frequency f4. User 32*d* receives the DTV signal transmitted from translator 31*d* along with ancillary data 4. DTV translators 31*a*, 31*b*, and 31*d* are thereby configured in a star fashion with DTV translator 31 a configured as a hub. Moreover, a variety of translator topologies can be employed to transmit unique ancillary data to each of a very large number of users, or a group of users, without requiring an increase in the bandwidth of any single translator's transport stream or physical RF channel.

Even more efficient use of bandwidth can be achieved by allowing multiple translators to use the same transmit frequencies, as does translators 31*a* and 31*c*. Translators can be placed in any number of configurations to increase the data capacity of the DTV distribution network. Furthermore, the use of a PSIP update model in each of the translators can insure proper DTV reception.

Moreover, while the embodiments described herein can be implemented via current ASTC standards, it is contemplated that other DTV standards or a modified ASTC standard could be readily employed to realize the present invention. Further, while the video data on the digital transport stream can be MPEG2 standard video data, as described herein, the invention contemplates using variations of MPEG2 standard data in the digital transport system.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalence of such meets and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. A digital television translator, comprising:

a digital television receiver for receiving a first digital television signal and generating a digital transport stream from the first digital television signal, the digital transport stream including original PSIP data having RX channel data;

a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data; and

a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal,

wherein the RX channel data is associated with the first digital television signal and includes at least one of a major channel number, a minor channel number, and a carrier frequency, and the TX channel data is associated with the second digital television signal and includes at least one of an updated major channel number, an updated minor channel number, and an updated carrier frequency.

2. The digital television translator according to claim 1, further comprising a re-multiplexor for replacing original ancillary data in the digital transport stream with new ancillary data.

3. The digital television translator according to claim 2, wherein the re-multiplexor comprises:

a de-multiplexor for separating the digital transport stream into video data, audio data, one of the original PSIP data and the updated PSIP data, and the original ancillary data, and

a multiplexor for combining the video data, the audio data, the one of the original PSIP data and the updated PSIP data, and the new ancillary data into the digital transport stream.

4. The digital television translator according to claim 2, wherein the new ancillary data includes Internet data.

5. The digital television translator according to claim 1, wherein the digital television receiver processes the first digital television signal according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the digital transport stream, and the digital television modulator processes the digital transport stream according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the second digital television signal.

6. The digital television translator according to claim 1, wherein video data in the digital transport stream is MPEG2 video data.

7. The digital television translator according to claim 1, wherein video data in the digital transport stream is MPEG2 video data that conforms to the USA terrestrial digital television broadcast standard defined by the ATSC organization.

8. The digital television translator according to claim 1, wherein the first and second digital television signals are 8-VSB ATSC standard digital television signals.

9. The digital television translator according to claim 1, wherein the first and second digital television signals are 16-VSB ATSC standard digital television signals.

10. The digital television translator according to claim 1, wherein the second digital television signal is amplified by an RF power amplifier.

11. The digital television translator according to claim 1, wherein a frequency of the second digital television signal is approximately equal to a frequency of the first digital television signal.

12. The digital television translator according to claim 1, wherein a frequency of the second digital television signal is different from a frequency of the first digital television signal.

13. An information distribution network using digital television transmission, the information distribution network comprising:

a plurality of digital television transmission nodes including

a main digital television signal source for generating a main digital television signal; and

a plurality of digital television translators receiving a digital television signal from one of the plurality of digital television nodes, at least one of said plurality of digital television translators including

a digital television receiver for receiving the digital television signal from one of the plurality of digital television nodes and generating a digital transport stream from the received digital television signal, the digital transport stream including original ancillary data and original PSIP data having RX data,

a data update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data and for replacing the original ancillary data in the digital transport stream with new ancillary data, and

a digital television modulator for converting the digital transport stream having the new ancillary data and the updated PSIP data into a transmitted digital television signal, wherein at least two of the plurality of digital television transmission nodes transmit at the same frequency and the total ancillary data of the information distribution network includes the new ancillary data from multiple digital television translators of the plurality of digital television translators,

wherein the RX channel data is associated with the received digital television signal and includes at least one of a major channel number, a minor channel number, and a carrier frequency, and the TX channel data is associated with the transmitted digital television signal and includes at least one of an updated major channel number, an updated minor channel number, and an updated carrier frequency.

14. The information distribution network according to claim 13, wherein the data update module comprises:

a demultiplexor for separating the digital transport stream into video data, audio data, the updated PSIP data, and the original ancillary data, and a multiplexor for combining the video data, the audio data, the updated PSIP data, and the new ancillary data into the digital transport stream.

15. The information distribution network according to claim 13, wherein the new ancillary data includes Internet data.

16. The information distribution network according to claim 13, wherein the digital television receiver processes the received digital television signal according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the digital transport stream, and the digital television modulator processes the digital transport stream according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the transmitted digital television signal.

17. The information distribution network according to claim 13, wherein the video data in the digital transport stream is MPEG2 data.

18. The information distribution network according to claim 13, wherein the video data in the digital transport stream is MPEG2 video data that conforms to the USA terrestrial digital television broadcast standard defined by the ATCS organization.

19. The information distribution network according to claim 13, wherein the received and transmitted digital television signals are 8-VSB ATSC standard digital television signals.

20. The information distribution network according to claim 13, wherein the received and transmitted digital television signals are 16-VSB ATSC standard digital television signals.

21. The information distribution network according to claim 13, wherein the transmitted digital television signal is amplified by an RF power amplifier.

22. The information distribution network according to claim 13, wherein a frequency of the received digital television signal is approximately equal to a frequency of the transmitted digital television signal.

23. The information distribution network according to claim 13, wherein a frequency of the received digital television signal is different from a frequency of the transmitted digital television signal.

24. A method of translating a digital television signal, comprising the steps of:

receiving a first digital television signal and generating a digital transport stream from the first digital television signal, the digital transport stream including original PSIP data having RX channel data;

updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data; and

converting the digital transport stream having the updated PSIP data into a second digital television signal,

wherein the RX channel data is associated with the first digital television signal and includes at least one of a major channel number, a minor channel number, and a carrier frequency, and the TX channel data is associated with the second digital television signal and includes at least one of an updated major channel number, an updated minor channel number, and an updated carrier frequency.

25. The method of translating a digital television signal according to claim 24, further comprising the step of replacing original ancillary data in the digital transport stream with new ancillary data.

26. The method of translating a digital television signal according to claim 24, wherein the step of replacing the original ancillary data further comprising the steps of:

separating the digital transport stream into video data, audio data, one of the original PSIP data and the updated PSIP data, and the original ancillary data, and

combining the video data, the audio data, the one of the original PSIP data and the updated PSIP data, and the new ancillary data into the digital transport stream.

27. The method of translating a digital television signal according to claim 24, wherein the new ancillary data includes Internet data.

28. The method of translating a digital television signal according to claim 24, wherein the first digital television signal is processed according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the digital transport stream, and the digital transport stream is processed according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the second digital television signal.

29. The method of translating a digital television signal according to claim 24, wherein video data in the digital transport stream is MPEG2 video data.

30. The digital television translator according to claim 24, wherein video data in the digital transport stream is MPEG2 video data that conforms to the USA terrestrial digital television broadcast standard defined by the ATSC organization.

31. The method of translating a digital television signal according to claim 24, wherein the first and second digital television signals are 8-VSB ATSC standard digital television signals.

32. The method of translating a digital television signal according to claim 24, wherein the first and second digital television signals are 16-VSB ATSC standard digital television signals.

33. The method of translating a digital television signal according to claim 24, wherein the second digital television signal is amplified by an RF power amplifier.

34. The method of translating a digital television signal according to claim 24, wherein a frequency of the first digital television signal is approximately equal to a frequency of the second digital television signal.

35. The method of translating a digital television signal according to claim 24, wherein a frequency of the first digital television signal is different from a frequency of the second digital television signal.

36. An information distribution method using digital television transmission and increasing data capacity through frequency re-use, comprising the steps of:

generating a plurality of digital television signals each from one of a plurality of digital television transmission nodes, further comprising the steps of

generating a main digital television signal by one of the plurality of digital television transmission nodes; and

generating a plurality of translated digital television signals by the plurality of digital television transmission nodes, the generation of at least one of the plurality of translated digital television signals further comprising the steps of

receiving a digital television signal from at least one of the digital television transmission nodes and

generating a digital transport stream from the received digital television signal, the digital transport stream including original ancillary data and original PSIP data having RX channel data,

updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data, replacing the original ancillary data in the digital transport stream with new ancillary data, and

converting the digital transport stream having the new ancillary data and the updated PSIP data into a transmitted digital television signal, wherein at least two of the plurality of translated digital television signals are transmitted at a same frequency and the total ancillary data of the information distribution network includes new ancillary data from multiple digital television translators of the plurality of digital television translators,

wherein the RX channel data is associated with the received digital television signal and includes at least one of a major channel number, a minor channel number, and a carrier frequency, and the TX channel data is associated with a transmitted digital television signal and includes at least one of an updated major channel number, an updated minor channel number, and an updated carrier frequency.

37. The information distribution method according to claim 36, wherein replacing the original ancillary data further comprises the steps of:

separating the digital transport stream into video data, audio data, one of the original PSIP data and the updated PSIP data, and the original ancillary data, and

combining the video data, the audio data, the one of the original PSIP data and the updated PSIP data, and the new ancillary data into the digital transport stream.

38. The information distribution method according to claim 36, wherein the new ancillary data includes Internet data.

39. The information distribution method according to claim 36, wherein the received digital television signal is processed according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the digital transport stream, and the digital transport stream is processed according to the USA terrestrial digital television broadcast standard, defined by the ATSC organization, to generate the transmitted digital television signal.

40. The information distribution method according to claim 36, wherein video data in the digital transport stream is MPEG2 data.

41. The information distribution method according to claim 36, wherein video data in the digital transport stream is MPEG2 video data that conforms to the USA terrestrial digital television broadcast standard defined by the ATCS organization.

42. The information distribution method according to claim 36, wherein the received and transmitted digital television signals are 8-VSB ATSC standard digital television signals.

43. The information distribution method according to claim 36, wherein the received and transmitted digital television signals are 16-VSB ATSC standard digital television signals.

44. The information distribution method according to claim 36, wherein the transmitted digital television signal is amplified by an RF power amplifier.

45. The information distribution method according to claim 36, wherein a frequency of the transmitted digital television signal is approximately equal to a frequency of the received digital television signal.

46. The information distribution method according to claim 36, wherein a frequency of the transmitted digital television signal is different from a frequency of the received digital television signal.

47. The digital television translator according to claim 1, wherein the RX channel data includes a major channel number and the TX channel data includes an updated major channel number.

48. The digital television translator according to claim 1, wherein the RX channel data includes a minor channel number and the TX channel data includes an updated minor channel number.

49. The digital television translator according to claim 1, wherein the RX channel data includes a carrier frequency and the TX channel data includes an updated carrier frequency.

50. The digital television translator according to claim 13, wherein the RX channel data includes a major channel number and the TX channel data includes an updated major channel number.

51. The digital television translator according to claim 13, wherein the RX channel data includes a minor channel number and the TX channel data includes an updated minor channel number.

52. The digital television translator according to claim 13, wherein the RX channel data includes a carrier frequency and the TX channel data includes an updated carrier frequency.

53. The digital television translator according to claim 24, wherein the RX channel data includes a major channel number and the TX channel data includes an updated major channel number.

54. The digital television translator according to claim 24, wherein the RX channel data includes a minor channel number and the TX channel data includes an updated minor channel number.

55. The digital television translator according to claim 24, wherein the RX channel data includes a carrier frequency and the TX channel data includes an updated carrier frequency.

56. The digital television translator according to claim 36, wherein the RX channel data includes a major channel number and the TX channel data includes an updated major channel number.

57. The digital television translator according to claim 36, wherein the RX channel data includes a minor channel number and the TX channel data includes an updated minor channel number.

58. The digital television translator according to claim 36, wherein the RX channel data includes a carrier frequency and the TX channel data includes an updated carrier frequency.

* * * * *

EXHIBIT B

US007487533B2

(12) United States Patent
Kuh

(10) Patent No.: US 7,487,533 B2
(45) Date of Patent: Feb. 3, 2009

(54) **DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE**

(75) Inventor: **Steve Kuh**, Northridge, CA (US)

(73) Assignee: **K Tech Telecommunications, Inc.**, Chatsworth, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 938 days.

(21) Appl. No.: **10/890,210**

(22) Filed: **Jul. 14, 2004**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
H04N 7/173 (2006.01)

(52) **U.S. Cl.** **725/116**; 725/114; 725/115; 725/117; 725/118

(58) **Field of Classification Search** 725/114-118
See application file for complete search history.

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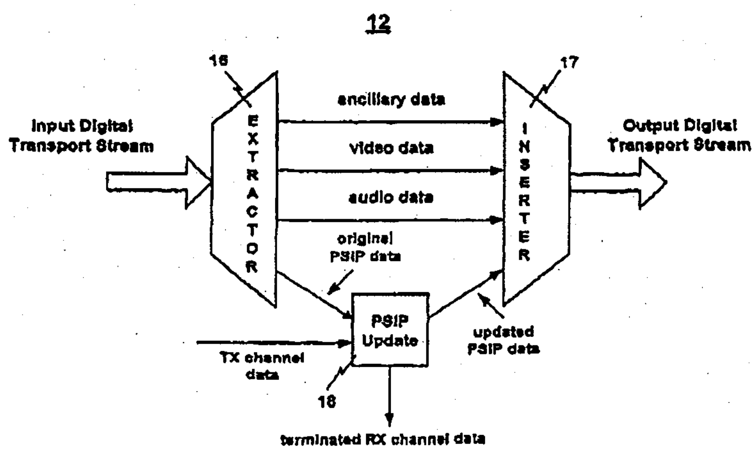
Primary Examiner—Hunter B. Lonsberry
(74) *Attorney, Agent, or Firm*—Morgan, Lewis & Bockius LLP

(57) **ABSTRACT**

A digital television translator includes a digital television receiver for receiving a first digital television signal at a first frequency and generating a digital transport stream from the first digital television signal. The digital transport stream can include original Program and System Information (PSIP) data having RX channel data that is indicative of the first frequency, the first major channel number, and/or the first minor channel number. The digital television translator also includes a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data. The TX data is indicative of a second frequency, a second major channel number, and/or a second minor channel number. The digital television translator further includes a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal at the second frequency, where the second frequency can be the same or different from the first frequency.

38 Claims, 4 Drawing Sheets



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Prior Art

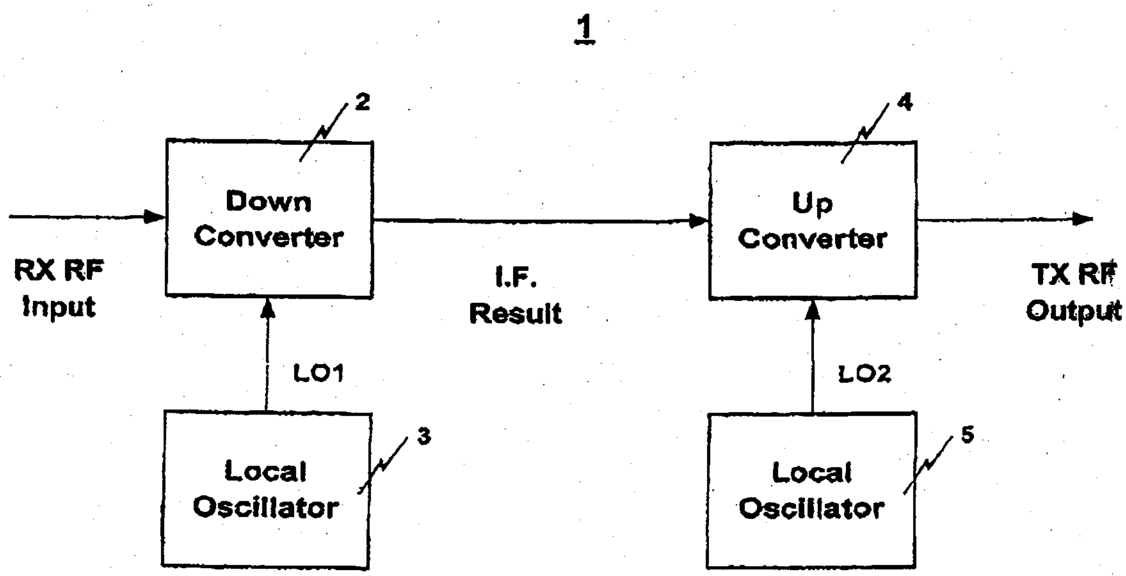

Fig. 1

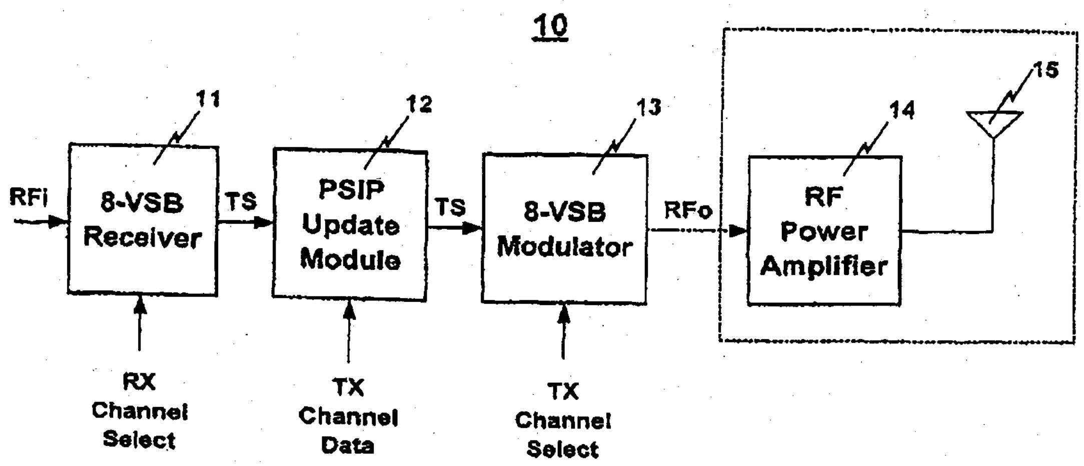
10
11
12
13
14
15
RFi
8-VSB Receiver
TS
PSIP Update Module
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
TX Channel Select

Fig. 2

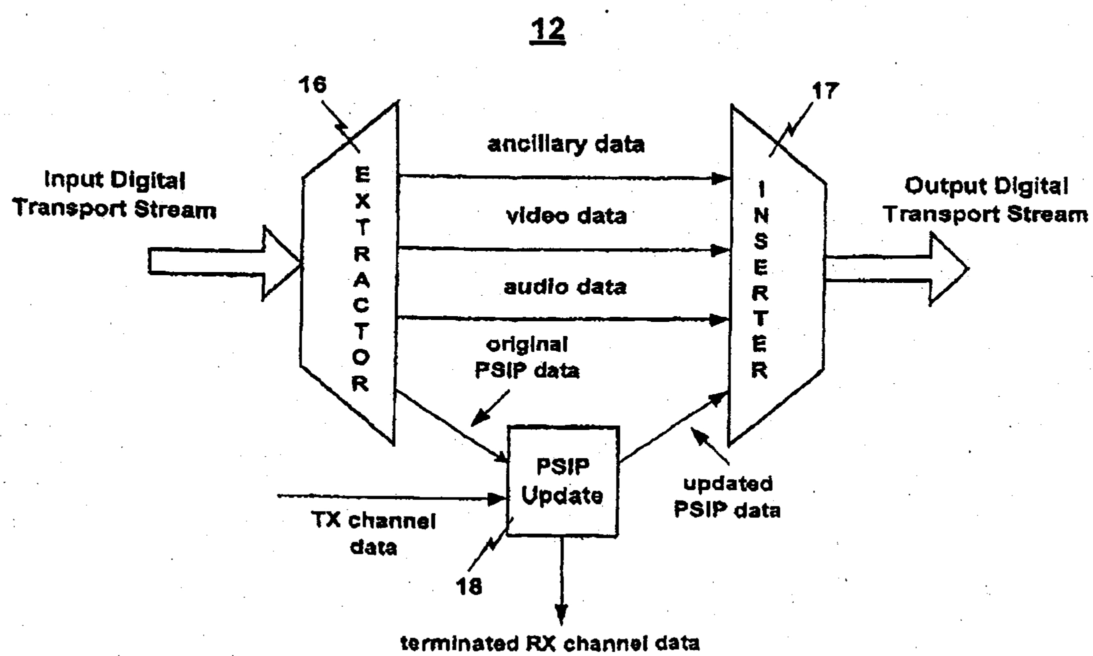
12
16
17
Input Digital Transport Stream
EXTRACTOR
ancillary data
video data
audio data
original PSIP data
INSERTER
Output Digital Transport Stream
PSIP Update
updated PSIP data
TX channel data
18
terminated RX channel data

Fig. 3

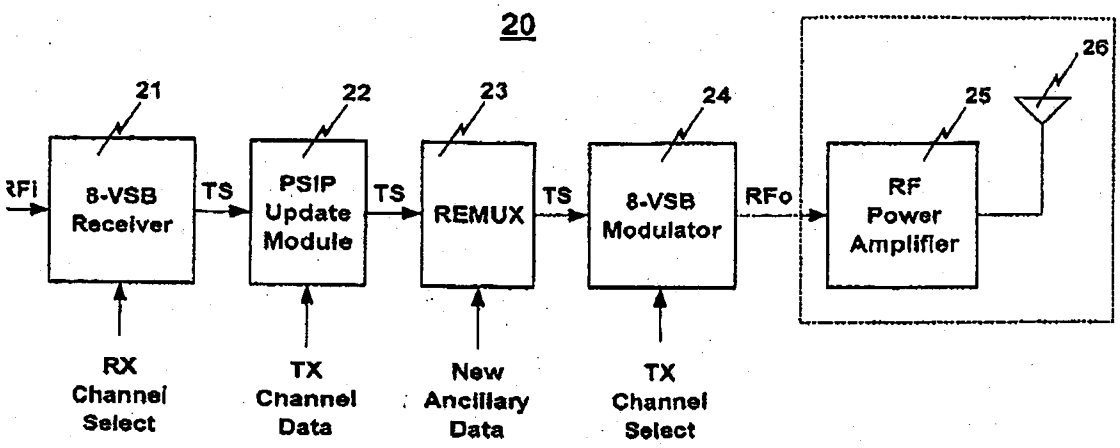
20
21
22
23
24
25
26
RFi
8-VSB Receiver
TS
PSIP Update Module
TS
REMUX
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
New Ancillary Data
TX Channel Select

Fig. 4

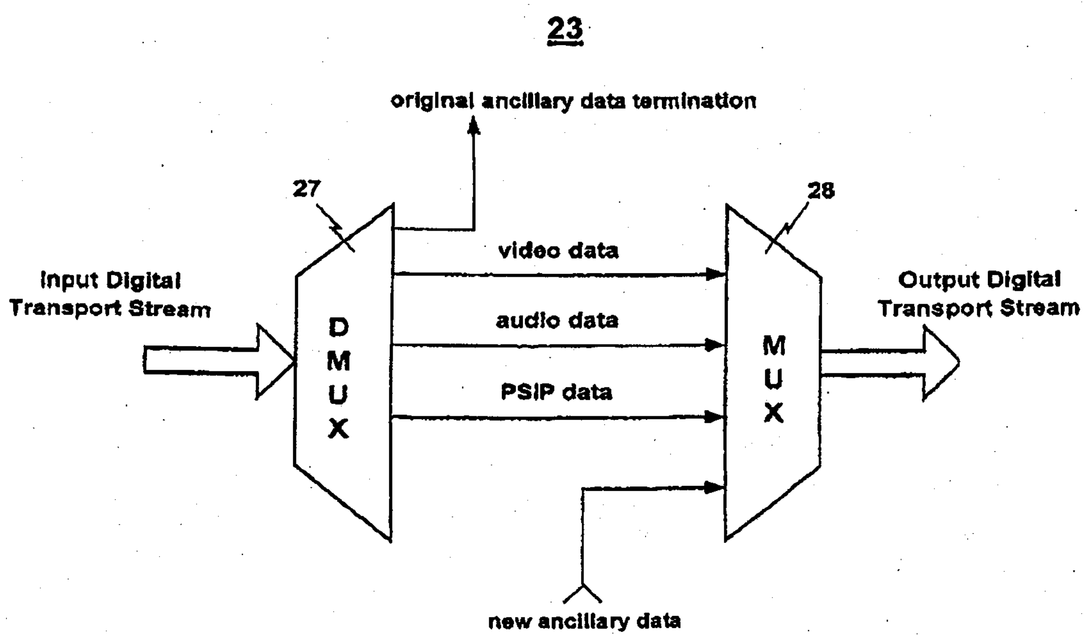
23
original ancillary data termination
27
28
Input Digital Transport Stream
D M U X
video data
audio data
PSIP data
M U X
Output Digital Transport Stream
new ancillary data

Fig. 5

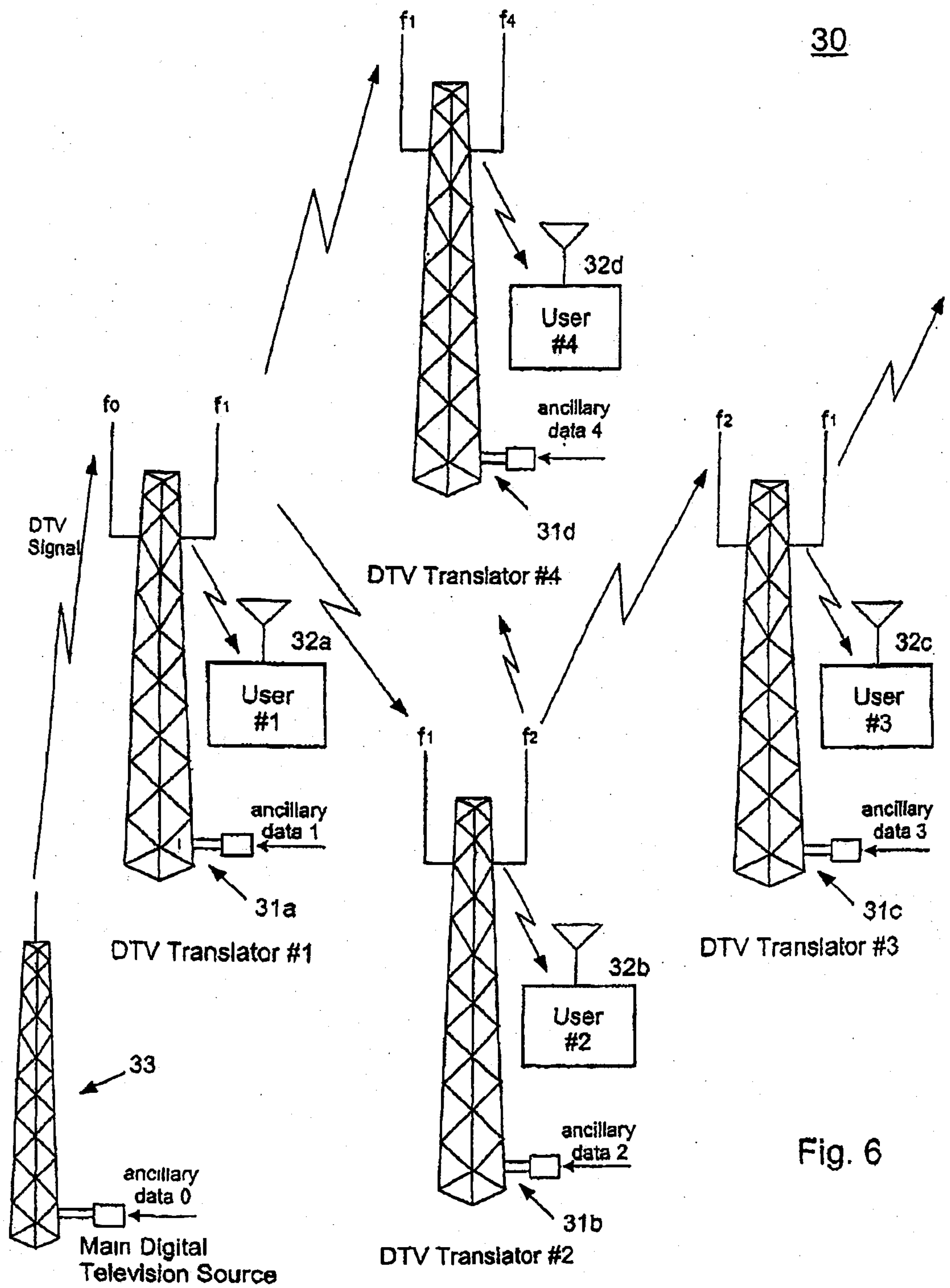
30
f1
f4
32d
User #4
ancillary data 4
31d
DTV Translator #4
fo
f1
DTV Signal
32a
User #1
ancillary data 1
31a
DTV Translator #1
f2
f1
32c
User #3
ancillary data 3
31c
DTV Translator #3
f1
f2
32b
User #2
ancillary data 2
31b
DTV Translator #2
33
ancillary data 0
Main Digital Television Source

Fig. 6

DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE

RELATED APPLICATIONS

This is a continuation application of prior U.S. patent application Ser. No. 09/545,613, filed on Apr. 28, 2000, now U.S. Pat. No. 6,785,903, issued on Aug. 31, 2004. The prior Application is incorporated by reference herein in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a digital television translator. More particularly, the present invention relates to a digital television translator that updates the program and system information protocol (PSIP) table with transmit (TX) channel data.

2. Discussion of the Related Art

Digital television (DTV) broadcasting systems are relatively new in the United States and offer many alternatives to traditional information and program distribution. In addition to traditional television programming, DTV systems offer the ability to distribute additional content in the form of data. This data can be any type of data including, for example, Internet data broadcast to one or more end users. Therefore, DTV broadcast systems offer great flexibility and diversity in the types of information they distribute. Like most conventional broadcast systems, DTV broadcast systems have a finite capacity limited by the bandwidth of its channels.

Additionally, as with other broadcast systems, such as analog television systems, the received DTV signal quality can vary greatly depending upon where the receiver is located. This problem is due to a number of adverse propagation effects such as multi-path, interference, and simple attenuation. One solution to this problem is to use multiple low power repeaters (On-Channel boosters) and/or translators (Re-modulators) to improve reception in areas of poor DTV signal reception. For example, a repeater, placed in an area of poor signal reception, receives a transmitted signal from a high power DTV transmitter and re-transmits an amplified duplicate signal at the same frequency. Translators, on the other hand, can receive a transmitted signal from a high power DTV transmitter and re-transmit the signal at a frequency different than the received frequency. Repeaters and translators are also used to extend the coverage of a broadcast system incrementally, and economically, to specific geographical regions.

FIG. 1 shows an example of a conventional DTV translator 1. The conventional DTV translator includes a down converter 2, a first local oscillator 3, an up converter 4, and a second local oscillator 5. A received DTV signal (RX RF input) is down converted to IF (intermediate frequency) by down converter 2. The IF is determined by the difference between the frequency LO1 generated by the first local oscillator 3 and the RF frequency of the received DTV signal (RX RF Input). The IF signal is then up converted to RF by up converter 4. The frequency of the up converted RF DTV signal (TX RF Output) is determined by the sum of the frequency LO2 generated by the second local oscillator 5 and the IF. The up converted DTV signal (TX RF Output) is then amplified and transmitted. With this arrangement, the transmitted signal contains the same information as the received signal, but is amplified. Further, when LO1=LO2, the transmit frequency is the same as the received frequency, and the apparatus operates as an on-channel booster. Alternatively, when LO1≠LO2, the transmit frequency is different than the received frequency, and the apparatus operates as a translator.

In the DTV American Television Systems Committee (ASTC) standard, a DTV signal contains a Program and System Information Protocol (PSIP) table, which is a collection of hierarchically arranged sub-tables for describing system information and program guide data. One of sub-tables in the PSIP table is the Virtual Channel Table (VCT), which contains a list of attributes for virtual channels carried in the digital transport stream (baseband information). VCT fields "major channel number" and "minor channel number" are used for identification. The major channel number is used to group all channels that are to be identified as belonging to a particular broadcast corporation (or a particular identifying number such as channel "12"). The minor channel number specifies a particular channel within the group. The VCT also contains a "carrier frequency" field, which is used to identify the frequency at which the DTV signal is transmitted and received. As discussed herein, TX and RX channel data include at least one of the following major channel number, minor channel number, carrier frequency, and/or other data necessary for generating a proper DTV signal.

When a RF DTV signal is translated to a new frequency by the conventional DTV translator 1 of FIG. 1, the PSIP table no longer reflects the correct carrier frequency. In many DTV receivers, this discrepancy between the actual frequency of the received DTV signal and the carrier frequency data contained in the PSIP table prevents the receiver from properly receiving the DTV signal.

Also, a particular broadcast corporation may be assigned different major/minor channel numbers in geographical regions serviced by each translator. For example, Broadcast Corporation #1 could be assigned major/minor channel 12/04 in region #1 (served by a main DTV transmitter) and major/minor channel 37/04 in region #2 (served by a translator translating the main DTV transmitted signal). The conventional translator of FIG. 1 therefore generates a translated DTV signal that contains an incorrect channel number for transmission into region #2.

Moreover, in region #2, major minor/channel 12/04 may have already been assigned to Broadcast Corporation #2. In that case, a single DTV receiver in region #2 will receive two unique channels (Broadcast Corporation #1 and Broadcast Corporation #2) each having the same major/minor channel number in each of their PSIP tables. While some DTV receivers overcome these anomalies by allowing users to select whether to ignore PSIP data or to display the VCT information, other DTV receivers do not have this capability and are unable to properly tune to the program(s) of one or both of the two Broadcast Corporations.

SUMMARY OF THE INVENTION

Accordingly, the present invention relates to a digital television translator, and more particularly to a digital television translator that updates the PSIP table with proper channel and carrier frequency information. To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, there is provided a digital television translator, comprising a digital television receiver for receiving a first digital television signal and generating a digital transport stream from the first digital television signal, the digital transport stream including original PSIP data having RX channel data; a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data; and a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal.

In another aspect of the instant invention, there is provided an information distribution network using digital television transmission, the information distribution network comprising a plurality of digital television transmission nodes including a main digital television signal source for generating a main digital television signal; and a plurality of digital television translators receiving a digital television signal from one of the plurality of digital television nodes, at least one of said plurality of digital television translators including a digital television receiver for receiving the digital television signal from one of the plurality of digital television nodes and generating a digital transport stream from the received digital television signal, the digital transport stream including original ancillary data and original PSIP data having RX data, a data update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data and for replacing the original ancillary data in the digital transport stream with new ancillary data, and a digital television modulator for converting the digital transport stream having the new ancillary data and the updated PSIP data into a transmitted digital television signal, wherein at least two of the plurality of digital television transmission nodes transmit at the same frequency and the total ancillary data of the information distribution network includes the new ancillary data from multiple digital television translators of the plurality of digital television translators.

Additional features and advantages of the present invention will be set forth in the description that follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention that together with the description serve to explain the principles of the invention.

In the drawings:

FIG. 1 shows an example of a conventional DTV translator;

FIG. 2 shows a first embodiment of a DTV translator of the present invention having PSIP table update capability;

FIG. 3 shows an example of a PSIP update module;

FIG. 4 shows a second embodiment of a DTV translator of the present invention having both PSIP table update capability and a re-multiplexor;

FIG. 5 shows an example of the re-multiplexor; and

FIG. 6 shows an example of an information distribution network of the present invention using multiple translators.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

To overcome the problems associated with the prior art, i.e., tuning problems with some DTV receivers due to incorrect PSIP table information, the PSIP table information is updated by the translator to properly reflect the new transmit carrier frequency and channel number.

FIG. 2 shows a first embodiment of a DTV translator 10 of the present invention having PSIP table update capability. The DTV translator 10 includes an 8-VSB receiver 11, a PSIP update module 12, an 8-VSB modulator 13, an RF power amplifier 14, and a transmitting antenna 15. The receiver 11 receives an 8-VSB DTV signal (RFi) that may have been originally transmitted by a base station or another translator, over the air or by a cable. The receiver 11 processes the DTV signal according to ASTC DTV standards to produce a digital transport stream (TS) containing MPEG2 video data, audio data, ancillary data, and PSIP data. The PSIP data in the digital transport stream includes a major channel number, a minor channel number, and a carrier frequency, which together make up the RX channel data. As shown, the receiver 11 is controlled by an input (RX Channel Select) which informs the receiver 11 of which carrier frequency channel to tune.

The processing of the received DTV signal by the 8-VSB receiver 11 is in accordance with ATSC DTV standards and, accordingly, can include down conversion, digitization, carrier synchronization, symbol clock synchronization, frame and segment synchronization, matched filtering, equalization, bit-demapping, Trellis decoding, convolutional de-interleaving, Reed-Solomon forward error correction (FEC) decoding, and de-randomizing.

The digital transport stream (TS) is then input into PSIP update module 12. The PSIP update module 12 extracts the PSIP table data and updates the RX channel data with TX channel data. Specifically, the major channel number, the minor channel number, and the carrier frequency contained in the PSIP VCT are updated. Updated major and minor channel numbers are those numbers assigned to the broadcaster associated with the transport stream content for the geographical region covered by the DTV translator. Sometimes the original and updated channel numbers will be the same, for example when the translator is being used to fill in a poor reception area of the geographical area covered by the main transmitter. At other times, the original and updated channel numbers will be different, for example, when the translator is being used to extend coverage into a geographical area not covered by the main transmitter. In this instance, the broadcaster may be licensed to broadcast in the translator's geographical area, but at a different channel.

Also, the carrier frequency of the DTV signal transmitted from the translator must be reflected in the PSIP VCT. In most instances, the translator will transmit at a different frequency than it receives, requiring the PSIP VCT to be updated with the new transmitted carrier frequency. In some instances, the carrier frequency of the DTV signal can be transmitted at the same frequency that it is received, such as when the translator system is being used as an on-channel booster. In either instance, the updated PSIP table is then reinserted back into the digital transport stream.

Once the PSIP data is updated, the transport stream containing the updated PSIP data is then input into the 8-VSB modulator 13. 8-VSB modulator 13 processes the digital transport stream according to ATSC DTV standards to produce a DTV signal (Rfo) at the carrier frequency contained in the VCT of the updated PSIP table data. As shown, 8-VSB modulator 13 is controlled by input (TX Channel Select) which informs the 8-VSB modulator 13 at which frequency to transmit the DTV signal. Alternatively, the 8-VSB modulator

can detect the carrier frequency information from the VCT of the DTV signal and transmit the DTV signal using the detected carrier frequency.

8-VSB modulator 13 processes the transport stream having the updated PSIP data according to ASTC terrestrial broadcast standards. Accordingly, this processing can include randomization, Reed-Solomon encoding, convolutional interleaving, symbol mapping, trellis encoding, and vestigial sideband filtering. After the digitally filtered signal is converted to an analog signal, the signal is up converted to a transmit RF signal (RFo) at the transmit frequency determined by TX channel select. The 8-VSB modulator 13 typically operates at a frequency of 54 MHZ-216 MHZ and 470 MHZ-806 MHZ and has a maximum output power of approximately 1 milliwatt. A power amplifier 14 and transmitting antenna 15 are usually added to the output of the 8-VSB modulator 13.

FIG. 3 shows an example of PSIP update module 12. The PSIP update module 12 includes an extractor 16 for extracting the original PSIP data, a PSIP update block 18 for replacing the major/minor channel number and carrier frequency contained in the PSIP table, and an inserter 17 for inserting the updated PSIP table data back into the transport stream. As shown, the PSIP table data is extracted by extractor 16 and input into the PSIP update block 18. The PSIP update block 18 replaces the major/minor channel number and transmit carrier frequency contained in the VCT (a sub-table of the PSIP table) while retaining the other PSIP data. The PSIP update block 18 then substitutes an updated major/minor channel number and transmit carrier frequency into the VCT. Thereafter, the updated PSIP table data is re-inserted back into the digital transport stream via inserter 17.

FIG. 4 shows a second embodiment of a DTV translator 20 of the present invention. The second embodiment includes an 8-VSB receiver 21, a PSIP update module 22, a re-multiplexor 23, and an 8-VSB modulator 24. Usually an RF power amplifier 25 and an antenna 26 are coupled to the 8-VSB modulator 24. The structure and operation of the second embodiment is the same as the structure and operation of the first embodiment, except that a re-multiplexor 23 is added for introducing new ancillary data into the digital transport stream.

The digital transport stream containing original ancillary data and the updated PSIP table data is input into the re-multiplexor 23. Re-multiplexor 23 substitutes new ancillary data in place of the original ancillary data in the digital transport stream. The digital transport stream is then sent to 8-VSB modulator 24 and converted into a DTV signal consistent with the operation as described in the first embodiment. In this way, each translator can distribute new ancillary data to user(s) in the translator's transmit range.

FIG. 5 is a block diagram of the re-multiplexor 23, which comprises a demultiplexor 27 and a multiplexor 28. As shown, the original ancillary data, video data, audio data, and updated PSIP table data is contained in the input digital transport stream, which is demultiplexed into separate bit streams by de-multiplexor 27. The original ancillary data is terminated (discarded). The multiplexor 28 then combines the video data, the audio data, the updated PSIP data, and new ancillary data back into the output digital transport stream, which is then input to the 8-VSB modulator 24.

The PSIP update step and the ancillary data insertion step are not required to take place in any particular order. For example, since the PSIP data has been separated into its constituent streams by demultiplexor 27 of re-multiplexor 23, the PSIP table update step could take place in the re-multiplexor 23 by updating the major/minor channel number and carrier frequency. The updated PSIP table data could be reinserted into the digital transport stream by multiplexor 28. Or, for example, the placement of the PSIP update module 22 and the multiplexor 23 could be reversed. Moreover, only a portion of the original ancillary data could be replaced with new ancillary data thereby allowing other portions of the ancillary data to be transmitted downstream by the translator.

The second embodiment allows DTV broadcasting stations to increase their data broadcasting capacity every time a DTV translator is added. For example, adding a DTV translator increases the number of users and increases the capacity for data transmission through employment of the new ancillary data, which permits the insertion of data, such as Internet data. Downstream Internet data can be inserted as new ancillary data by each translator and distributed to specific geographic regions and users without the need for additional bandwidth.

FIG. 6 shows an example of a third embodiment of the invention wherein an information distribution network 30 uses a plurality of translators to increase the data capacity of the network. As shown, a plurality of translators, collectively labeled 31*a*-31*d*, translate and distribute a DTV signal in both a star and daisy-chain configuration.

The first translator 31*a* receives a DTV signal, from a main digital television source, containing original ancillary data 0, such as Internet download data at a frequency fo. Translator 31*a* inserts ancillary data 1 and discards original ancillary data 0, and then retransmits the modified DTV signal having ancillary data 1 at a frequency f1. User 32*a* receives ancillary data 1 from translator 31*a*. A second DTV translator 31*b* receives the translated DTV signal from translator 31*a* at a frequency of f1, substitutes ancillary data 2 for ancillary data 1, and then retransmits at a frequency f2. User 32*b* receives the DTV signal transmitted from translator 31*b* along with ancillary data 2. User 32*d* also receives ancillary data 1 from translator 31*a*. A third DTV translator 31*c* receives the translated DTV signal from translator 31*b* at a frequency of f2, substitutes ancillary data 3 for the ancillary data 2, and retransmits at a frequency f1. User 32*c* receives the DTV signal transmitted from translator 32*c* along with ancillary data 3. DTV translators 31*a*, 31*b*, and 31*c* are thus configured in a daisy-chain fashion with translators 31*a* and 31*c* being endpoints.

Further, a fourth DTV translator 31*d* receives the translated DTV signal from translator 31*a* at a frequency of f1, substitutes ancillary data 4 for ancillary data 1, and then retransmits at a frequency f4. User 32*d* receives the DTV signal transmitted from translator 31*d* along with ancillary data 4. DTV translators 31*a*, 31*b*, and 31*d* are thereby configured in a star fashion with DTV translator 31*a* configured as a hub. Moreover, a variety of translator topologies can be employed to transmit unique ancillary data to each of a very large number of users, or a group of users, without requiring an increase in the bandwidth of any single translator's transport stream or physical RF channel.

Even more efficient use of bandwidth can be achieved by allowing multiple translators to use the same transmit frequencies, as does translators 31*a* and 31*c*. Translators can be placed in any number of configurations to increase the data capacity of the DTV distribution network. Furthermore, the use of a PSIP update model in each of the translators can insure proper DTV reception.

Moreover, while the embodiments described herein can be implemented via current ASTC standards, it is contemplated that other DTV standards or a modified ASTC standard could be readily employed to realize the present invention. Further, while the video data on the digital transport stream can be

MPEG2 standard video data, as described herein, the invention contemplates using variations of MPEG2 standard data in the digital transport system.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalence of such meets and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. A program information update module, comprising:

a demultiplexor, the demultiplexor separating a first program information table from video data and audio data contained in a first digital transport stream, the first program information table containing one or more attributes for a virtual channel of a digital television signal carried in the first digital transport stream;

a program information update unit, the program information update unit modifying the first program information table to form a second program information table, the second program information table including one or more new attributes for the virtual channel of the digital television signal carried in the first digital transport stream; and

a multiplexor, the multiplexor combining the second program information table with the separated video and audio data to form a second digital transport stream, wherein the second digital transport stream contains the one or more updated attributes for the virtual channel.

2. The program information update module of claim 1, wherein the first program information table is an ATSC PSIP table, wherein the program information update unit modifies a VCT table within the first program information table, and wherein the VCT table is in ATSC format.

3. The program information update module of claim 1, wherein the program information update unit modifies a virtual channel number within the first program information table.

4. The program information update module of claim 1, wherein the program information update unit modifies the first program information table by adding the one or more new attributes for the virtual channel to data from the first program information table to form the second program information table.

5. The program information update module of claim 1, wherein the program information update unit modifies the first program information table by replacing the one or more attributes for the virtual channel in the first program information table with the one or more new attributes for the virtual channel to form the second program information table.

6. The program information update module of claim 1, wherein the program information update unit modifies the first program information table by dropping the first program information table and inserting the second program information table including the one or more new attributes for the virtual channel, wherein the one or more attributes for the virtual channel identifies the digital television signal carried in the first digital transport stream.

7. The program information update module of claim 1, further comprising a remultiplexor, the remultiplexor inserting internet protocol packets arriving from an internet protocol network into one of the first and second digital transport streams.

8. The program information update module of claim 1, wherein the multiplexor combines new ancillary data with the second program information table and the separated video and audio data to form the second digital transport stream.

9. The program information update module of claim 1, further comprising a digital television receiver, the digital television receiver receiving a first RF television signal and converting the first RF television signal into the first digital transport stream.

10. The program information update module of claim 1, further comprising a digital television modulator, the digital television modulator receiving the second digital transport stream and converting the second digital transport stream into an RF modulated signal.

11. A digital television translator, comprising

a digital television receiver that generates a first digital transport stream from a first digital television RF signal;

a demultiplexor for separating original PSIP data from video data and audio data contained in the first digital transport stream;

a PSIP update unit, the PSIP update unit modifying a virtual channel table in the original PSIP data to form updated PSIP data;

a multiplexor for combining the updated PSIP data with the separated video and audio data to form a second digital transport stream; and

a digital television modulator that receives the second digital transport stream from the multiplexor and generates a second digital television RF signal.

12. The digital television translator of claim 11, further comprising an RF power amplifier for amplifying the second digital television RF signal.

13. A method of translating, comprising

separating a first program information table from video data and audio data contained in a first digital transport stream, the first program information table containing one or more attributes for a virtual channel of a digital television signal carried in the first digital transport stream;

forming a second program information table having one or both of a new carrier frequency and new virtual channel number;

combining the second program information table with the separated video and audio data to form a second digital transport stream;

modulating data from the second digital transport stream; and

generating a second digital television RF signal using the modulated data from the second digital transport stream.

14. The method of claim 13, further comprising generating the first digital transport stream from a first digital television RF signal.

15. The method of claim 14, further comprising receiving the first digital television RF signal over-the-air.

16. The method of claim 13, wherein the second program information table does not include a portion of data contained in the first program information table.

17. The method of claim 13, further comprising inserting internet protocol packets arriving from an internet protocol network into one of the first or second digital transport streams.

18. The method of claim 13, further comprising inserting ancillary data into one of the first or second digital transport streams.

19. A system for translating, comprising

a demultiplexor, the demultiplexor separating a first program information table from video data and audio data contained in a first digital transport stream, the first program information table containing one or more attributes for a virtual channel of a digital television signal carried in the first digital transport stream;

a program information update unit, the program information update unit replacing the first program information table with a second program information table, the second program information table including one or more new attributes for the virtual channel of the digital television signal carried in the first digital transport stream;

a multiplexor, the multiplexor combining the second program information table with the separated video and audio data to form a second digital transport stream.

20. The system for translating of claim 19, further comprising a digital modulator that receives the second digital transport stream from the multiplexor and generates a second digital television signal.

21. The system for translating of claim 19, further comprising a digital television receiver that generates the first digital transport stream from a first digital television signal, having ATSC PSIP tables.

22. The system for translating of claim 19, wherein the one or more attributes for a virtual channel of a digital television signal carried in the first digital transport stream identifies the virtual channel number of the first digital television signal carried in the first digital transport stream.

23. The system for translating of claim 19, wherein the one or more new attributes for a virtual channel of a digital television signal carried in the second digital transport stream identifies the virtual channel number of the digital television signal carried in the first digital transport stream.

24. The system for translating of claim 19, wherein the one or more new attributes for a virtual channel of a digital television signal carried in the second digital transport stream identifies the virtual channel number of the digital television signal carried in the second digital transport stream.

25. The system for translating of claim 19, further comprising:

a digital television receiver that generates the first digital transport stream from a first digital television signal, having ATSC PSIP tables; and

a digital modulator that receives the second digital transport stream from the multiplexor and generates a second digital television signal.

26. The system for translating of claim 19, wherein Internet Protocol packets arriving from an Internet Protocol network are inserted into one of the first or second digital transport streams.

27. The system for translating of claim 19, wherein the first digital transport stream includes ATSC PSIP Tables.

28. The system for translating of claim 20, further comprising an RF power amplifier for amplifying the second digital television signal.

29. A system for translating, comprising

a demultiplexor, the demultiplexor separating a first program information table from video data and audio data

contained in a first digital transport stream, the first program information table containing one or more attributes for a virtual channel of a digital television signal carried in the first digital transport stream;

a program information update unit, the program information update unit supplementing the first program information table with a second program information table, the second program information table including one or more new attributes for the virtual channel of the digital television signal carried in the first digital transport stream;

a multiplexor, the multiplexor combining the second program information table with the separated video and audio data to form a second digital transport stream.

30. The system for translating of claim 29, further comprising a digital modulator that receives the second digital transport stream from the multiplexor and generates a second digital television signal.

31. The system for translating of claim 29, further comprising a digital television receiver that generates the first digital transport stream from a first digital television signal, having ATSC PSIP tables.

32. The system for translating of claim 29, further comprising:

a digital television receiver that generates the first digital transport stream from a first digital television signal, having ATSC PSIP tables; and

a digital modulator that receives the second digital transport stream from the multiplexor and generates a second digital television signal.

33. The system for translating of claim 29, wherein Internet Protocol packets arriving from an Internet Protocol network are inserted into one of the first or second digital transport streams.

34. The system for translating of claim 29, wherein the first digital transport stream includes ATSC PSIP tables.

35. The system for translating of claim 30, further comprising an RF power amplifier for amplifying the second digital television signal.

36. The system for translating of claim 29, wherein the one or more attributes for a virtual channel of a digital television signal carried in the first digital transport stream identifies the virtual channel number of the first digital television signal carried in the first digital transport stream.

37. The system for translating of claim 29, wherein the one or more new attributes for a virtual channel of a digital television signal carried in the second digital transport stream identifies the virtual channel number of the digital television signal carried in the first digital transport stream.

38. The system for translating of claim 29, wherein the one or more new attributes for a virtual channel of a digital television signal carried in the second digital transport stream identifies the virtual channel number of the digital television signal carried in the second digital transport stream.

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EXHIBIT C

US007761893B2

(12) **United States Patent**
Kuh

(10) **Patent No.: US 7,761,893 B2**
(45) **Date of Patent: Jul. 20, 2010**

(54) **DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE**

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G06F 3/00 (2006.01)
G06F 13/00 (2006.01)

(52) **U.S. Cl.** 725/50; 725/115; 725/116

(58) **Field of Classification Search** 725/50, 725/114–118

See application file for complete search history.

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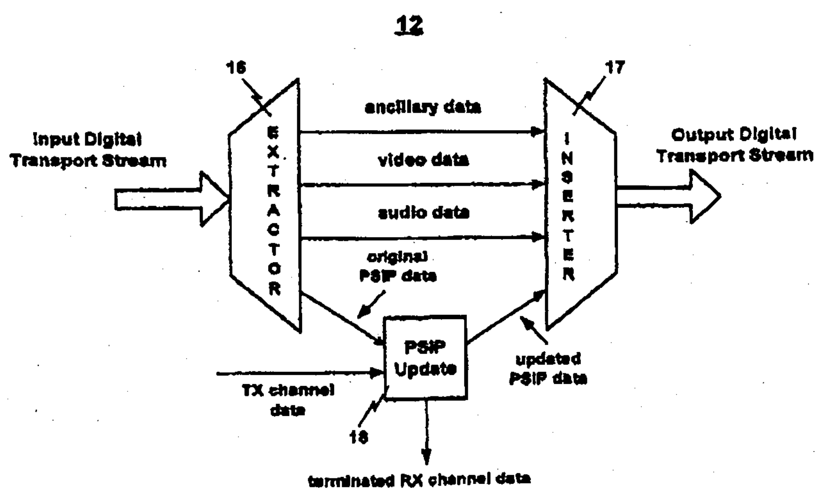
(57) **ABSTRACT**

A digital television translator includes a digital television receiver for receiving a first digital television signal at a first frequency and generating a digital transport stream from the first digital television signal. The digital transport stream can include original Program and System Information (PSIP) data having RX channel data that is indicative of the first frequency, the first major channel number, and/or the first minor channel number. The digital television translator also includes a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data. The TX data is indicative of a second frequency, a second major channel number, and/or a second minor channel number. The digital television translator further includes a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal at the second frequency, where the second frequency can be the same or different from the first frequency.

15 Claims, 4 Drawing Sheets



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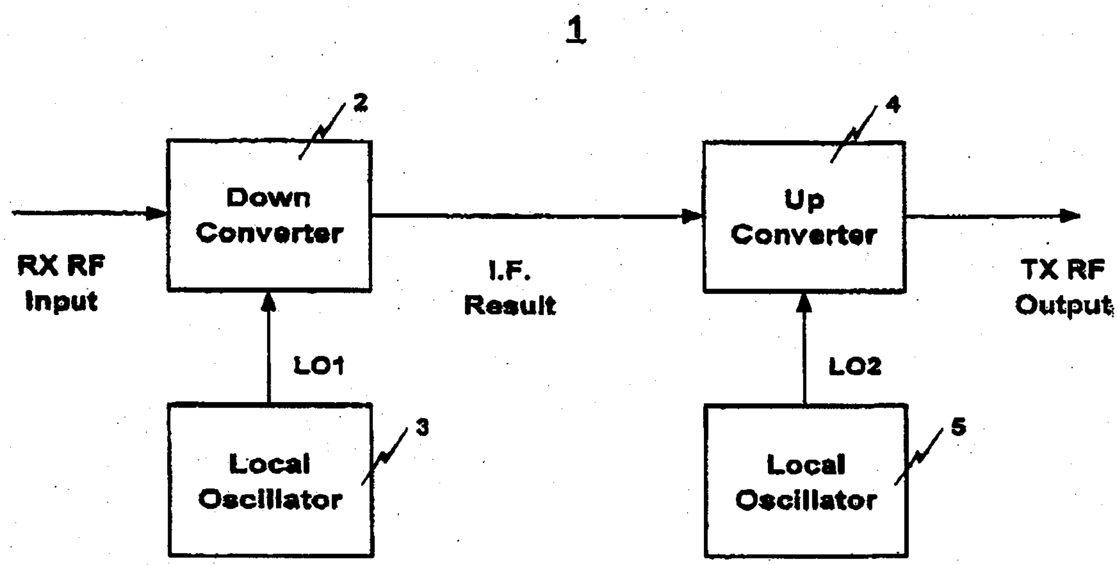

Fig. 1

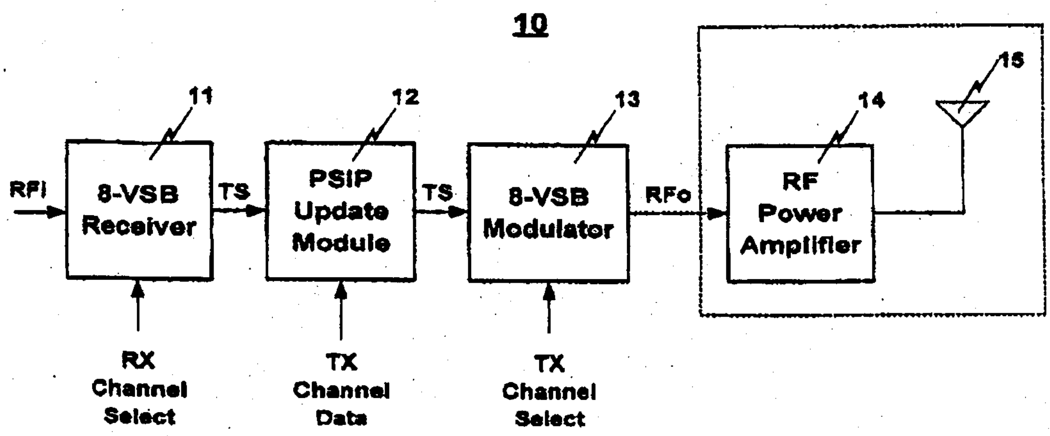
10
11
12
13
14
15
RFi
8-VSB Receiver
TS
PSIP Update Module
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
TX Channel Select

Fig. 2

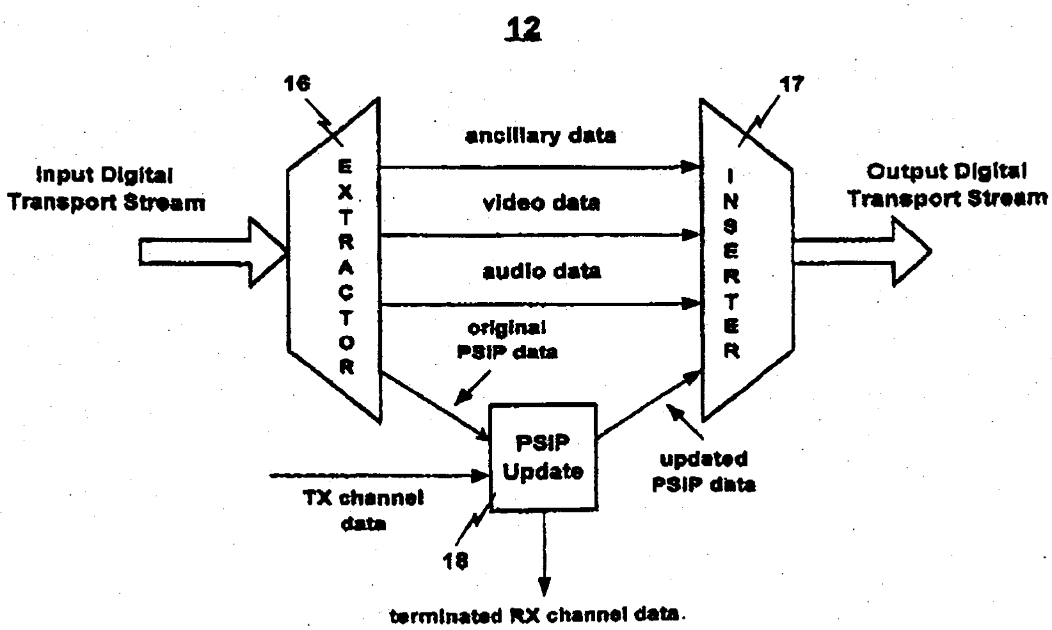
12
16
17
Input Digital Transport Stream
EXTRACTOR
ancillary data
video data
audio data
original PSIP data
INSERTER
Output Digital Transport Stream
PSIP Update
updated PSIP data
TX channel data
18
terminated RX channel data.

Fig. 3

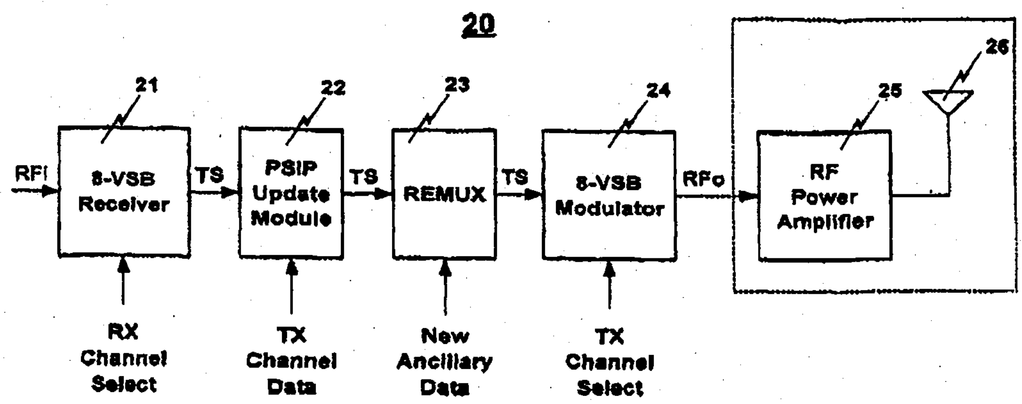
20
21
22
23
24
25
26
RFi
8-VSB Receiver
TS
PSIP Update Module
TS
REMUX
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
New Ancillary Data
TX Channel Select

Fig. 4

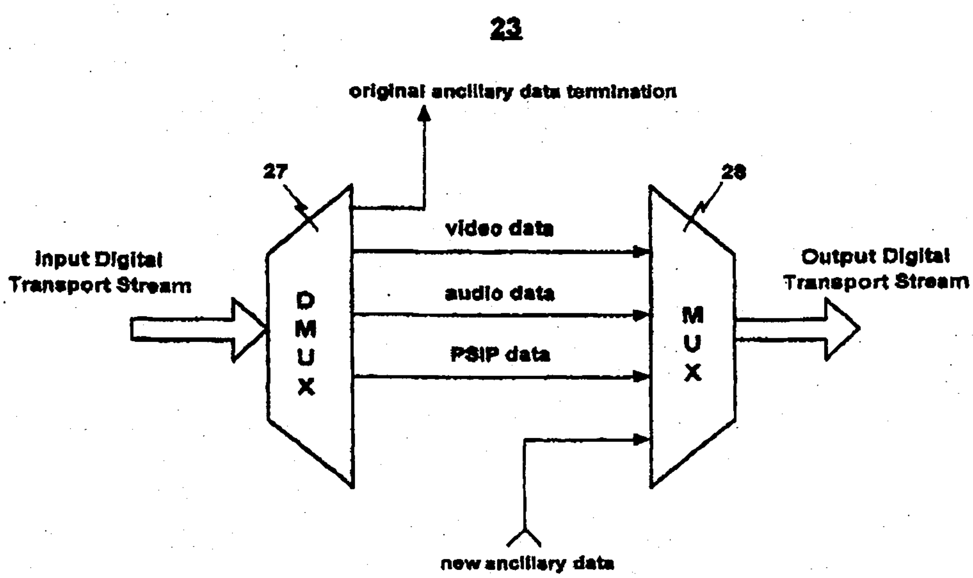
23
original ancillary data termination
27
28
Input Digital Transport Stream
D M U X
video data
audio data
PSIP data
M U X
Output Digital Transport Stream
new ancillary data

Fig. 5

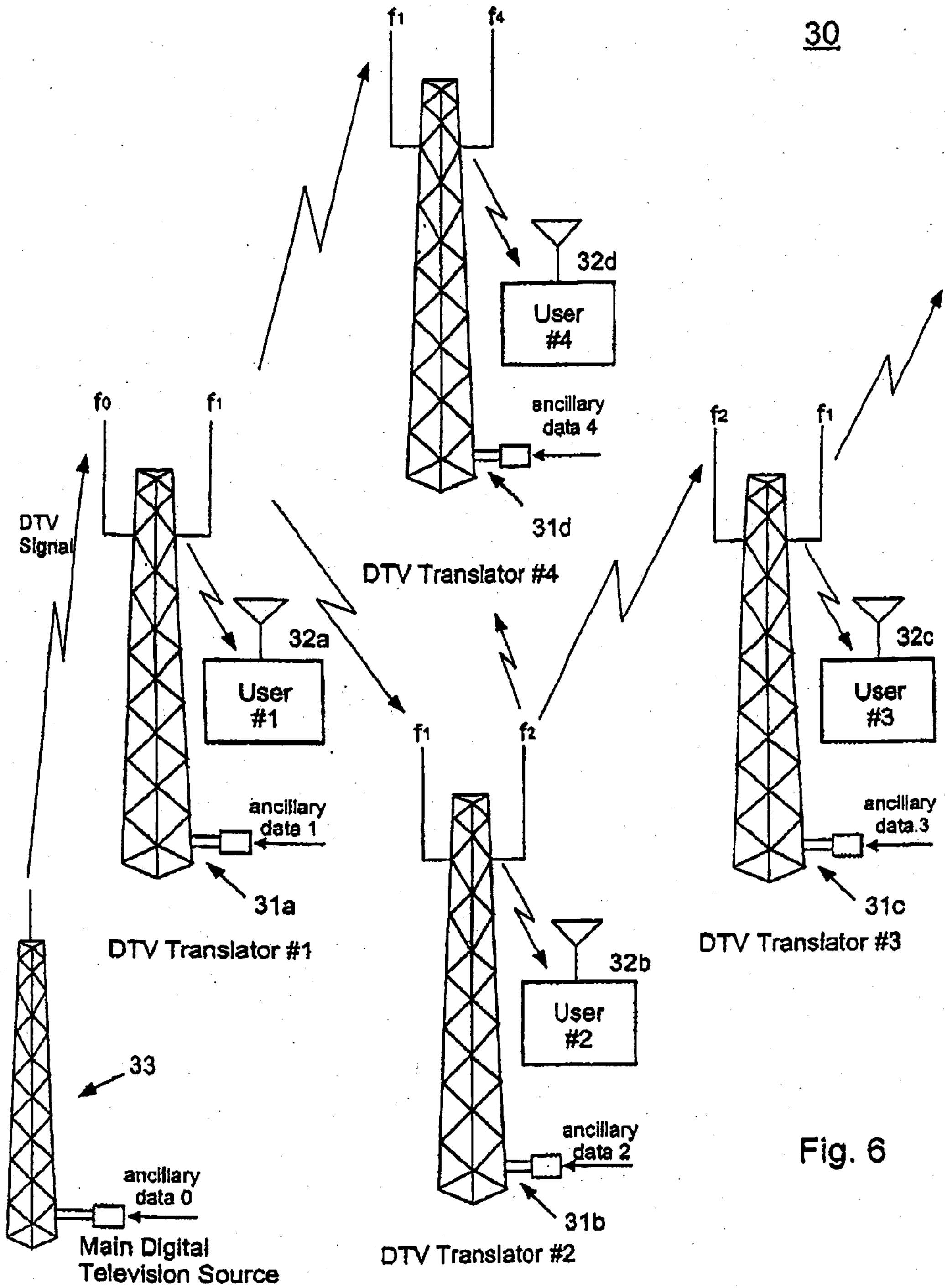
30
f1
f4
32d
User #4
ancillary data 4
31d
DTV Translator #4
f0
f1
DTV Signal
32a
User #1
ancillary data 1
31a
DTV Translator #1
f2
f1
32c
User #3
ancillary data.3
31c
DTV Translator #3
f1
f2
32b
User #2
ancillary data 2
31b
DTV Translator #2
33
ancillary data 0
Main Digital Television Source

Fig. 6

DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE

This application is a Continuation application of U.S. patent application Ser. No. 10/890,210 filed on Jul. 14, 2004, now U.S. Pat. No. 7,487,533, which is a continuation of U.S. patent application Ser. No. 09/545,613, filed on Apr. 5, 2000, now U.S. Pat. No. 6,785,903. The prior applications are incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a digital television translator. More particularly, the present invention relates to a digital television translator that updates the program and system information protocol (PSIP) table with transmit (TX) channel data.

2. Discussion of the Related Art

Digital television (DTV) broadcasting systems are relatively new in the United States and offer many alternatives to traditional information and program distribution. In addition to traditional television programming, DTV systems offer the ability to distribute additional content in the form of data. This data can be any type of data including, for example, Internet data broadcast to one or more end users. Therefore, DTV broadcast systems offer great flexibility and diversity in the types of information they distribute. Like most conventional broadcast systems, DTV broadcast systems have a finite capacity limited by the bandwidth of its channels.

Additionally, as with other broadcast systems, such as analog television systems, the received DTV signal quality can vary greatly depending upon where the receiver is located. This problem is due to a number of adverse propagation effects such as multi-path, interference, and simple attenuation. One solution to this problem is to use multiple low power repeaters (On-Channel boosters) and/or translators (Re-modulators) to improve reception in areas of poor DTV signal reception. For example, a repeater, placed in an area of poor signal reception, receives a transmitted signal from a high power DTV transmitter and re-transmits an amplified duplicate signal at the same frequency. Translators, on the other hand, can receive a transmitted signal from a high power DTV transmitter and re-transmit the signal at a frequency different than the received frequency. Repeaters and translators are also used to extend the coverage of a broadcast system incrementally, and economically, to specific geographical regions.

FIG. 1 shows an example of a conventional DTV translator 1. The conventional DTV translator includes a down converter 2, a first local oscillator 3, an up converter 4, and a second local oscillator 5. A received DTV signal (RX RF input) is down converted to IF (intermediate frequency) by down converter 2. The IF is determined by the difference between the frequency LO1 generated by the first local oscillator 3 and the RF frequency of the received DTV signal (RX RF Input). The IF signal is then up converted to RF by up converter 4. The frequency of the up converted RF DTV signal (TX RF Output) is determined by the sum of the frequency LO2 generated by the second local oscillator 5 and the IF. The up converted DTV signal (TX RF Output) is then amplified and transmitted. With this arrangement, the transmitted signal contains the same information as the received signal, but is amplified. Further, when LO1=LO2, the transmit frequency is the same as the received frequency, and the apparatus operates as an on-channel booster. Alternatively,

when LO1.noteq.LO2, the transmit frequency is different than the received frequency, and the apparatus operates as a translator.

In the DTV American Television Systems Committee (ASTC) standard, a DTV signal contains a Program and System Information Protocol (PSIP) table, which is a collection of hierarchically arranged sub-tables for describing system information and program guide data. One of sub-tables in the PSIP table is the Virtual Channel Table (VCT), which contains a list of attributes for virtual channels carried in the digital transport stream (baseband information). VCT fields "major channel number" and "minor channel number" are used for identification. The major channel number is used to group all channels that are to be identified as belonging to a particular broadcast corporation (or a particular identifying number such as channel "12"). The minor channel number specifies a particular channel within the group. The VCT also contains a "carrier frequency" field, which is used to identify the frequency at which the DTV signal is transmitted and received. As discussed herein, TX and RX channel data include at least one of the following major channel number, minor channel number, carrier frequency, and/or other data necessary for generating a proper DTV signal.

When a RF DTV signal is translated to a new frequency by the conventional DTV translator 1 of FIG. 1, the PSIP table no longer reflects the correct carrier frequency. In many DTV receivers, this discrepancy between the actual frequency of the received DTV signal and the carrier frequency data contained in the PSIP table prevents the receiver from properly receiving the DTV signal.

Also, a particular broadcast corporation may be assigned different major/minor channel numbers in geographical regions serviced by each translator. For example, Broadcast Corporation #1 could be assigned major/minor channel 12/04 in region #1 (served by a main DTV transmitter) and major/minor channel 37/04 in region #2 (served by a translator translating the main DTV transmitted signal). The conventional translator of FIG. 1 therefore generates a translated DTV signal that contains an incorrect channel number for transmission into region #2.

Moreover, in region #2, major minor/channel 12/04 may have already been assigned to Broadcast Corporation #2. In that case, a single DTV receiver in region #2 will receive two unique channels (Broadcast Corporation #1 and Broadcast Corporation #2) each having the same major/minor channel number in each of their PSIP tables. While some DTV receivers overcome these anomalies by allowing users to select whether to ignore PSIP data or to display the VCT information, other DTV receivers do not have this capability and are unable to properly tune to the program(s) of one or both of the two Broadcast Corporations.

SUMMARY OF THE INVENTION

Accordingly, the present invention relates to a digital television translator, and more particularly to a digital television translator that updates the PSIP table with proper channel and carrier frequency information. To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, there is provided a digital television translator, comprising a digital television receiver for receiving a first digital television signal and generating a digital transport stream from the first digital television signal, the digital transport stream including original PSIP data having RX channel data; a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data; and a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal.

In another aspect of the instant invention, there is provided an information distribution network using digital television transmission, the information distribution network comprising a plurality of digital television transmission nodes including a main digital television signal source for generating a main digital television signal; and a plurality of digital television translators receiving a digital television signal from one of the plurality of digital television nodes, at least one of said plurality of digital television translators including a digital television receiver for receiving the digital television signal from one of the plurality of digital television nodes and generating a digital transport stream from the received digital television signal, the digital transport stream including original ancillary data and original PSIP data having RX data, a data update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data and for replacing the original ancillary data in the digital transport stream with new ancillary data, and a digital television modulator for converting the digital transport stream having the new ancillary data and the updated PSIP data into a transmitted digital television signal, wherein at least two of the plurality of digital television transmission nodes transmit at the same frequency and the total ancillary data of the information distribution network includes the new ancillary data from multiple digital television translators of the plurality of digital television translators.

Additional features and advantages of the present invention will be set forth in the description that follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention that together with the description serve to explain the principles of the invention.

In the drawings:

FIG. 1 shows an example of a conventional DTV translator;

FIG. 2 shows a first embodiment of a DTV translator of the present invention having PSIP table update capability;

FIG. 3 shows an example of a PSIP update module;

FIG. 4 shows a second embodiment of a DTV translator of the present invention having both PSIP table update capability and a re-multiplexor;

FIG. 5 shows an example of the re-multiplexor; and

FIG. 6 shows an example of an information distribution network of the present invention using multiple translators.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

To overcome the problems associated with the prior art, i.e., tuning problems with some DTV receivers due to incorrect PSIP table information, the PSIP table information is updated by the translator to properly reflect the new transmit carrier frequency and channel number.

FIG. 2 shows a first embodiment of a DTV translator 10 of the present invention having PSIP table update capability. The DTV translator 10 includes an 8-VSB receiver 11, a PSIP update module 12, an 8-VSB modulator 13, an RF power amplifier 14, and a transmitting antenna 15. The receiver 11 receives an 8-VSB DTV signal (RFi) that may have been originally transmitted by a base station or another translator, over the air or by a cable. The receiver 11 processes the DTV signal according to ASTC DTV standards to produce a digital transport stream (TS) containing MPEG2 video data, audio data, ancillary data, and PSIP data. The PSIP data in the digital transport stream includes a major channel number, a minor channel number, and a carrier frequency, which together make up the RX channel data. As shown, the receiver 11 is controlled by an input (RX Channel Select) which informs the receiver 11 of which carrier frequency channel to tune.

The processing of the received DTV signal by the 8-VSB receiver 11 is in accordance with ATSC DTV standards and, accordingly, can include down conversion, digitization, carrier synchronization, symbol clock synchronization, frame and segment synchronization, matched filtering, equalization, bit-demapping, Trellis decoding, convolutional de-interleaving, Reed-Solomon forward error correction (FEC) decoding, and de-randomizing.

The digital transport stream (TS) is then input into PSIP update module 12. The PSIP update module 12 extracts the PSIP table data and updates the RX channel data with TX channel data. Specifically, the major channel number, the minor channel number, and the carrier frequency contained in the PSIP VCT are updated. Updated major and minor channel numbers are those numbers assigned to the broadcaster associated with the transport stream content for the geographical region covered by the DTV translator. Sometimes the original and updated channel numbers will be the same, for example when the translator is being used to fill in a poor reception area of the geographical area covered by the main transmitter. At other times, the original and updated channel numbers will be different, for example, when the translator is being used to extend coverage into a geographical area not covered by the main transmitter. In this instance, the broadcaster may be licensed to broadcast in the translator's geographical area, but at a different channel.

Also, the carrier frequency of the DTV signal transmitted from the translator must be reflected in the PSIP VCT. In most instances, the translator will transmit at a different frequency than it receives, requiring the PSIP VCT to be updated with the new transmitted carrier frequency. In some instances, the carrier frequency of the DTV signal can be transmitted at the same frequency that it is received, such as when the translator system is being used as an on-channel booster. In either instance, the updated PSIP table is then reinserted back into the digital transport stream.

Once the PSIP data is updated, the transport stream containing the updated PSIP data is then input into the 8-VSB modulator 13. 8-VSB modulator 13 processes the digital transport stream according to ATSC DTV standards to produce a DTV signal (Rfo) at the carrier frequency contained in the VCT of the updated PSIP table data. As shown, 8-VSB modulator 13 is controlled by input (TX Channel Select) which informs the 8-VSB modulator 13 at which frequency to transmit the DTV signal. Alternatively, the 8-VSB modulator

can detect the carrier frequency information from the VCT of the DTV signal and transmit the DTV signal using the detected carrier frequency.

8-VSB modulator 13 processes the transport stream having the updated PSIP data according to ASTC terrestrial broadcast standards. Accordingly, this processing can include randomization, Reed-Solomon encoding, convolutional interleaving, symbol mapping, trellis encoding, and vestigial sideband filtering. After the digitally filtered signal is converted to an analog signal, the signal is up converted to a transmit RF signal (RFo) at the transmit frequency determined by TX channel select. The 8-VSB modulator 13 typically operates at a frequency of 54 MHZ-216 MHZ and 470 MHZ-806 MHZ and has a maximum output power of approximately 1 milliwatt. A power amplifier 14 and transmitting antenna 15 are usually added to the output of the 8-VSB modulator 13.

FIG. 3 shows an example of PSIP update module 12. The PSIP update module 12 includes an extractor 16 for extracting the original PSIP data, a PSIP update block 18 for replacing the major/minor channel number and carrier frequency contained in the PSIP table, and an inserter 17 for inserting the updated PSIP table data back into the transport stream. As shown, the PSIP table data is extracted by extractor 16 and input into the PSIP update block 18. The PSIP update block 18 replaces the major/minor channel number and transmit carrier frequency contained in the VCT (a sub-table of the PSIP table) while retaining the other PSIP data. The PSIP update block 18 then substitutes an updated major/minor channel number and transmit carrier frequency into the VCT. Thereafter, the updated PSIP table data is re-inserted back into the digital transport stream via inserter 17.

FIG. 4 shows a second embodiment of a DTV translator 20 of the present invention. The second embodiment includes an 8-VSB receiver 21, a PSIP update module 22, a re-multiplexor 23, and an 8-VSB modulator 24. Usually an RF power amplifier 25 and an antenna 26 are coupled to the 8-VSB modulator 24. The structure and operation of the second embodiment is the same as the structure and operation of the first embodiment, except that a re-multiplexor 23 is added for introducing new ancillary data into the digital transport stream.

The digital transport stream containing original ancillary data and the updated PSIP table data is input into the re-multiplexor 23. Re-multiplexor 23 substitutes new ancillary data in place of the original ancillary data in the digital transport stream. The digital transport stream is then sent to 8-VSB modulator 24 and converted into a DTV signal consistent with the operation as described in the first embodiment. In this way, each translator can distribute new ancillary data to user(s) in the translator's transmit range.

FIG. 5 is a block diagram of the re-multiplexor 23, which comprises a demultiplexor 27 and a multiplexor 28. As shown, the original ancillary data, video data, audio data, and updated PSIP table data is contained in the input digital transport stream, which is demultiplexed into separate bit streams by de-multiplexor 27. The original ancillary data is terminated (discarded). The multiplexor 28 then combines the video data, the audio data, the updated PSIP data, and new ancillary data back into the output digital transport stream, which is then input to the 8-VSB modulator 24.

The PSIP update step and the ancillary data insertion step are not required to take place in any particular order. For example, since the PSIP data has been separated into its constituent streams by demultiplexor 27 of re-multiplexor 23, the PSIP table update step could take place in the re-multiplexor 23 by updating the major/minor channel number and carrier frequency. The updated PSIP table data could be reinserted into the digital transport stream by multiplexor 28. Or, for example, the placement of the PSIP update module 22 and the multiplexor 23 could be reversed. Moreover, only a portion of the original ancillary data could be replaced with new ancillary data thereby allowing other portions of the ancillary data to be transmitted downstream by the translator.

The second embodiment allows DTV broadcasting stations to increase their data broadcasting capacity every time a DTV translator is added. For example, adding a DTV translator increases the number of users and increases the capacity for data transmission through employment of the new ancillary data, which permits the insertion of data, such as Internet data. Downstream Internet data can be inserted as new ancillary data by each translator and distributed to specific geographic regions and users without the need for additional bandwidth.

FIG. 6 shows an example of a third embodiment of the invention wherein an information distribution network 30 uses a plurality of translators to increase the data capacity of the network. As shown, a plurality of translators, collectively labeled 31a-31d, translate and distribute a DTV signal in both a star and daisy-chain configuration.

The first translator 31a receives a DTV signal containing original ancillary data 0, such as Internet download data at a frequency fo. Translator 31a inserts ancillary data 1 and discards original ancillary data 0, and then retransmits the modified DTV signal having ancillary data 1 at a frequency f1. User 32a receives ancillary data 1 from translator 31a. A second DTV translator 31b receives the translated DTV signal from translator 31a at a frequency of f1, substitutes ancillary data 2 for ancillary data 1, and then retransmits at a frequency f2. User 32b receives the DTV signal transmitted from translator 31b along with ancillary data 2. User 32d also receives ancillary data 1 from translator 31a. A third DTV translator 31c receives the translated DTV signal from translator 31b at a frequency of f2, substitutes ancillary data 3 for the ancillary data 2, and retransmits at a frequency f1. User 32c receives the DTV signal transmitted from translator 32c along with ancillary data 3. DTV translators 31a, 31b, and 31c are thus configured in a daisy-chain fashion with translators 31a and 31c being endpoints.

Further, a fourth DTV translator 31d receives the translated DTV signal from translator 31a at a frequency of f1, substitutes ancillary data 4 for ancillary data 1, and then retransmits at a frequency f4. User 32d receives the DTV signal transmitted from translator 31d along with ancillary data 4. DTV translators 31a, 31b, and 31d are thereby configured in a star fashion with DTV translator 31a configured as a hub. Moreover, a variety of translator topologies can be employed to transmit unique ancillary data to each of a very large number of users, or a group of users, without requiring an increase in the bandwidth of any single translator's transport stream or physical RF channel.

Even more efficient use of bandwidth can be achieved by allowing multiple translators to use the same transmit frequencies, as does translators 31a and 31c. Translators can be placed in any number of configurations to increase the data capacity of the DTV distribution network. Furthermore, the use of a PSIP update model in each of the translators can insure proper DTV reception.

Moreover, while the embodiments described herein can be implemented via current ASTC standards, it is contemplated that other DTV standards or a modified ASTC standard could be readily employed to realize the present invention. Further, while the video data on the digital transport stream can be MPEG2 standard video data, as described herein, the invention contemplates using variations of MPEG2 standard data in the digital transport system.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalence of such meets and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. A system for translating a first digital transport stream containing one or more digital television programs carried in the first digital transport stream, comprising:

a program information update unit, the program information update unit supplementing one or more attributes for a virtual channel of a digital television program carried in the first digital transport stream; and

a multiplexor, the multiplexor combining the one or more attributes supplemented by the program information update unit and the first digital television program carried on the first digital transport stream to form a second digital transport stream.

2. A system for translating, comprising

an extractor, the extractor separating a first program information table from video data and audio data contained in a first digital transport stream, the first program information table containing one or more attributes for a virtual channel of a first digital television signal;

a program information update unit, the program information update unit replacing the first program information table with a second program information table, the second program information table including one or more new attributes for the virtual channel of the first digital television signal carried in the first digital transport stream; and

a combiner, the combiner combining the second program information table with the separated video and audio data.

3. The system for translating of claim 2, wherein an inserter adds new data to the second program information table.

4. The system for translating of claim 2, wherein an inserter adds Internet Protocol packets arriving from an Internet Protocol network to the separated video data and audio data.

5. The system for translating of claim 2, further comprising a digital television receiver that generates the first digital transport stream from the first digital television signal, having ATSC PSIP tables.

6. The system for translating of claim 2, wherein the one or more attributes for the virtual channel of the first digital television signal identifies the virtual channel number of the channel of the first digital television signal.

7. The system for translating of claim 2, wherein the first digital transport stream includes ATSC PSIP Tables.

8. The system for translating of claim 2, wherein the combiner combines the second program information table with the separated video and audio data to create a second digital transport stream.

9. A method for translating, comprising

separating a first program information table from video data and audio data contained in a first digital transport stream, the first program information table containing one or more attributes for a virtual channel of a first digital television signal;

replacing the first program information table with a second program information table, the second program information table including one or more new attributes for the virtual channel of the first digital television signal carried in the first digital transport stream; and

combining the second program information table with the separated video and audio data.

10. The method for translating of claim 9, further comprising adding new data to the second program information table.

11. The method for translating of claim 9, further comprising adding Internet Protocol packets arriving from an Internet Protocol network to the separated video data and audio data.

12. The method for translating of claim 9, further comprising generating the first digital transport stream from the first digital television signal, having ATSC PSIP tables.

13. The method for translating of claim 9, wherein the one or more attributes for the virtual channel of the first digital television signal identifies the virtual channel number of the channel of the first digital television signal.

14. The method for translating of claim 9, wherein the first digital transport stream includes ATSC PSIP Tables.

15. The method for translating of claim 9, further comprising combining the second program information table with the separated video and audio data to create a second digital transport stream.

* * * * *

EXHIBIT D

US007984469B2

(12) **United States Patent**
Kuh

(10) **Patent No.: US 7,984,469 B2**
(45) **Date of Patent: Jul. 19, 2011**

(54) **DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE**

(75) Inventor: **Steve Kuh**, Northridge, CA (US)

(73) Assignee: **KTech Telecommunications, Inc.**, Chatsworth, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **12/777,108**

(22) Filed: **May 10, 2010**

(65) **Prior Publication Data**

US 2010/0218212 A1 Aug. 26, 2010

Related U.S. Application Data

(63) Continuation of application No. 12/314,078, filed on Dec. 3, 2008, now Pat. No. 7,761,893, which is a continuation of application No. 10/890,210, filed on Jul. 14, 2004, now Pat. No. 7,487,533, which is a continuation of application No. 09/545,613, filed on Apr. 5, 2000, now Pat. No. 6,785,903.

(51) **Int. Cl.**

H04N 5/445	(2006.01)
H04N 7/16	(2006.01)
G06F 13/00	(2006.01)
G06F 3/00	(2006.01)

(52) **U.S. Cl.** 725/50; 725/115; 725/116

(58) **Field of Classification Search** 725/50, 725/114–118

See application file for complete search history.

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Primary Examiner — Hunter B Lonsberry

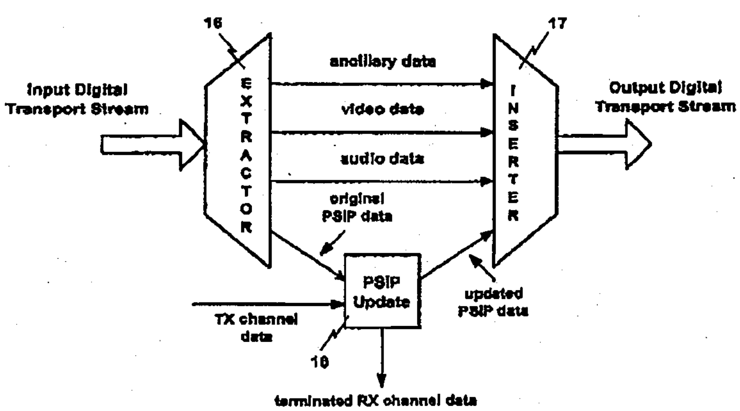
(74) *Attorney, Agent, or Firm* — Morgan, Lewis & Bockius LLP

(57) **ABSTRACT**

A digital television translator includes a digital television receiver for receiving a first digital television signal at a first frequency and generating a digital transport stream from the first digital television signal. The digital transport stream can include original Program and System Information (PSIP) data having RX channel data that is indicative of the first frequency, the first major channel number, and/or the first minor channel number. The digital television translator also includes a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data. The TX data is indicative of a second frequency, a second major channel number, and/or a second minor channel number. The digital television translator further includes a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal at the second frequency, where the second frequency can be the same or different from the first frequency.

21 Claims, 4 Drawing Sheets

12



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Prior Art

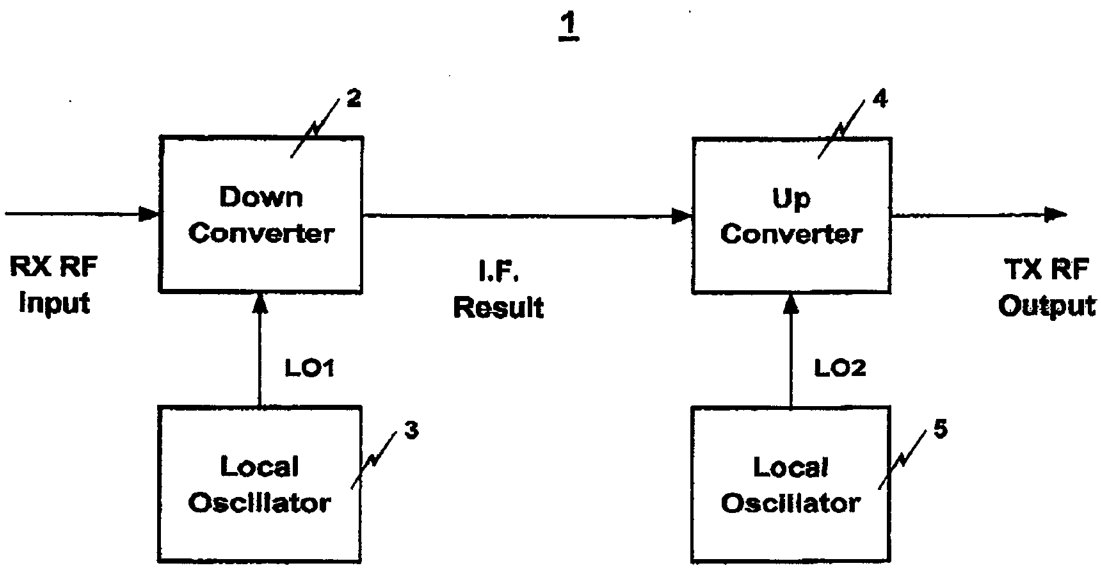

Fig. 1

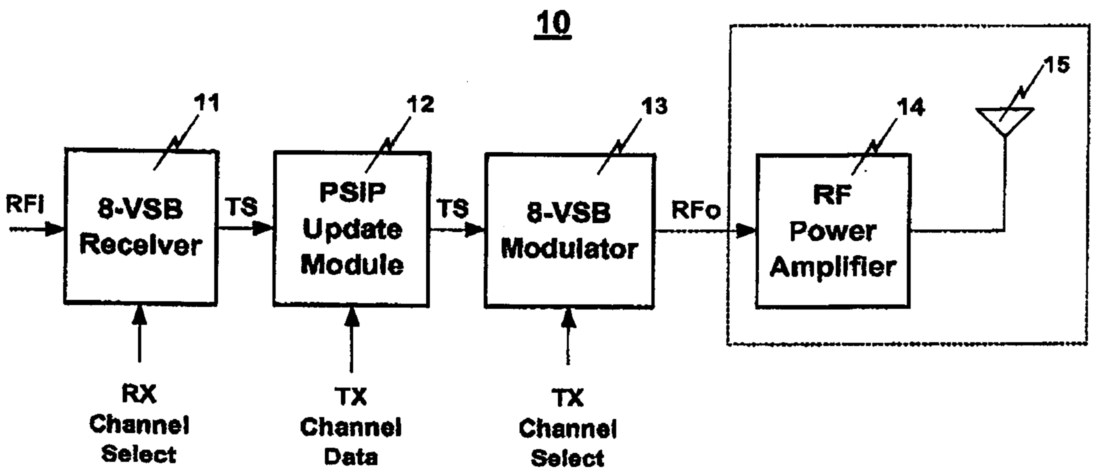
10
11
12
13
14
15
RFI
8-VSB Receiver
TS
PSIP Update Module
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
TX Channel Select

Fig. 2

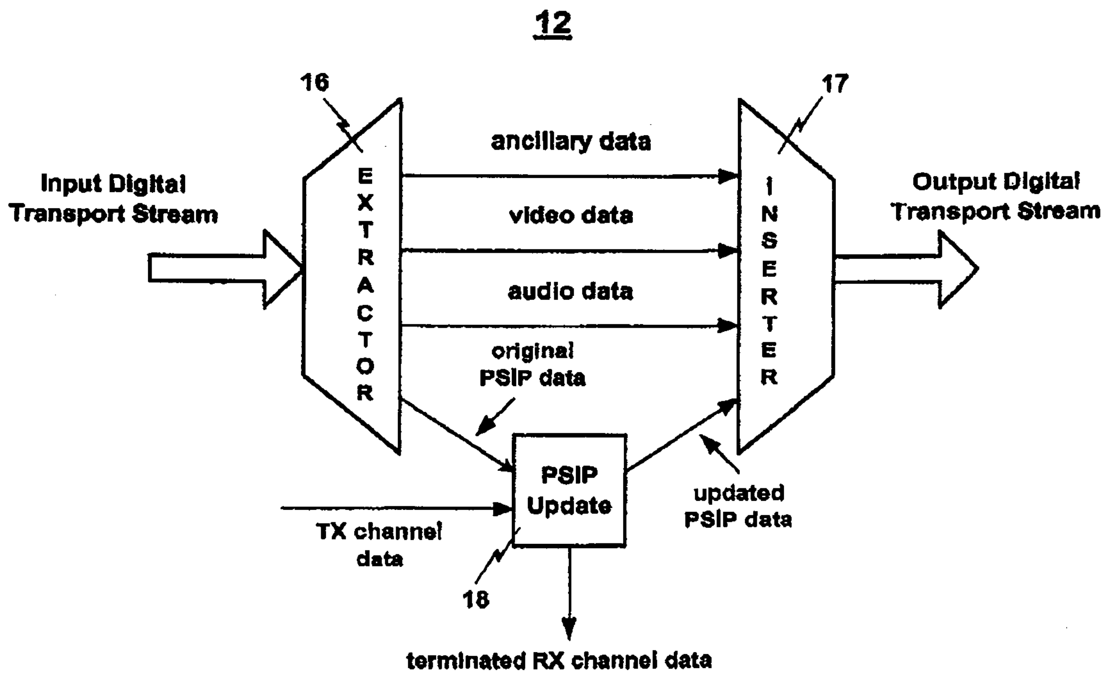
12
16
17
Input Digital Transport Stream
EXTRACTOR
ancillary data
video data
audio data
original PSIP data
INSERTER
Output Digital Transport Stream
PSIP Update
TX channel data
updated PSIP data
18
terminated RX channel data

Fig. 3

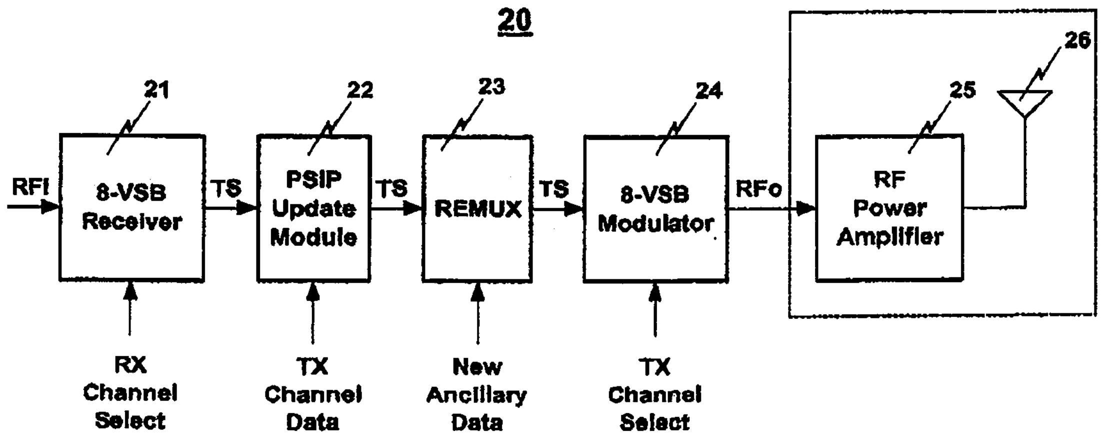
20
21
22
23
24
25
26
RFI
8-VSB Receiver
TS
PSIP Update Module
TS
REMUX
TS
8-VSB Modulator
RFo
RF Power Amplifier
RX Channel Select
TX Channel Data
New Ancillary Data
TX Channel Select

Fig. 4

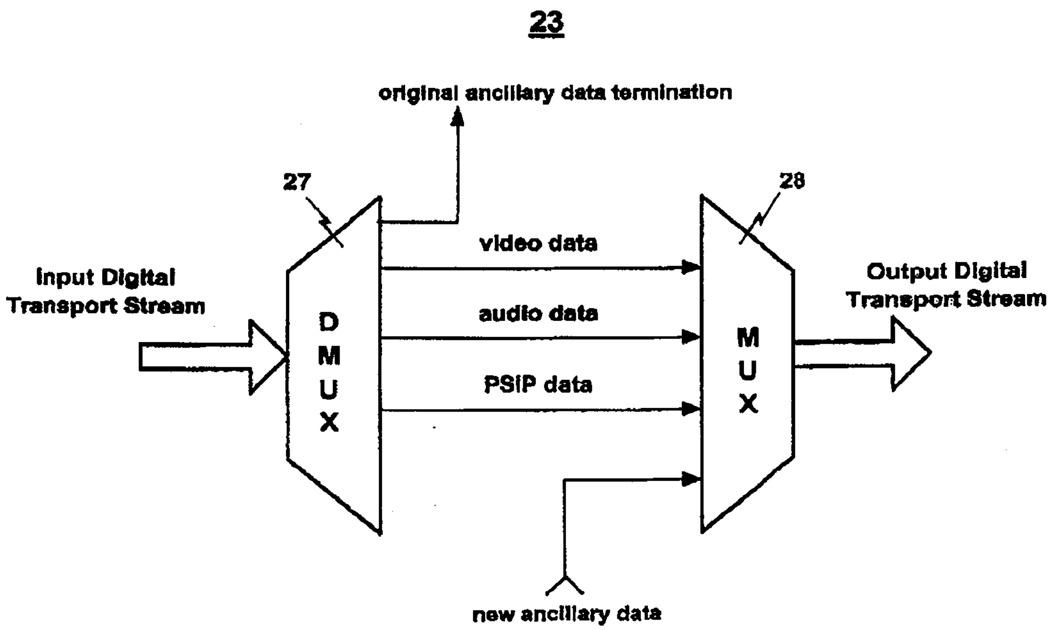
23
original ancillary data termination
27
28
Input Digital Transport Stream
D M U X
video data
audio data
PSIP data
M U X
Output Digital Transport Stream
new ancillary data

Fig. 5

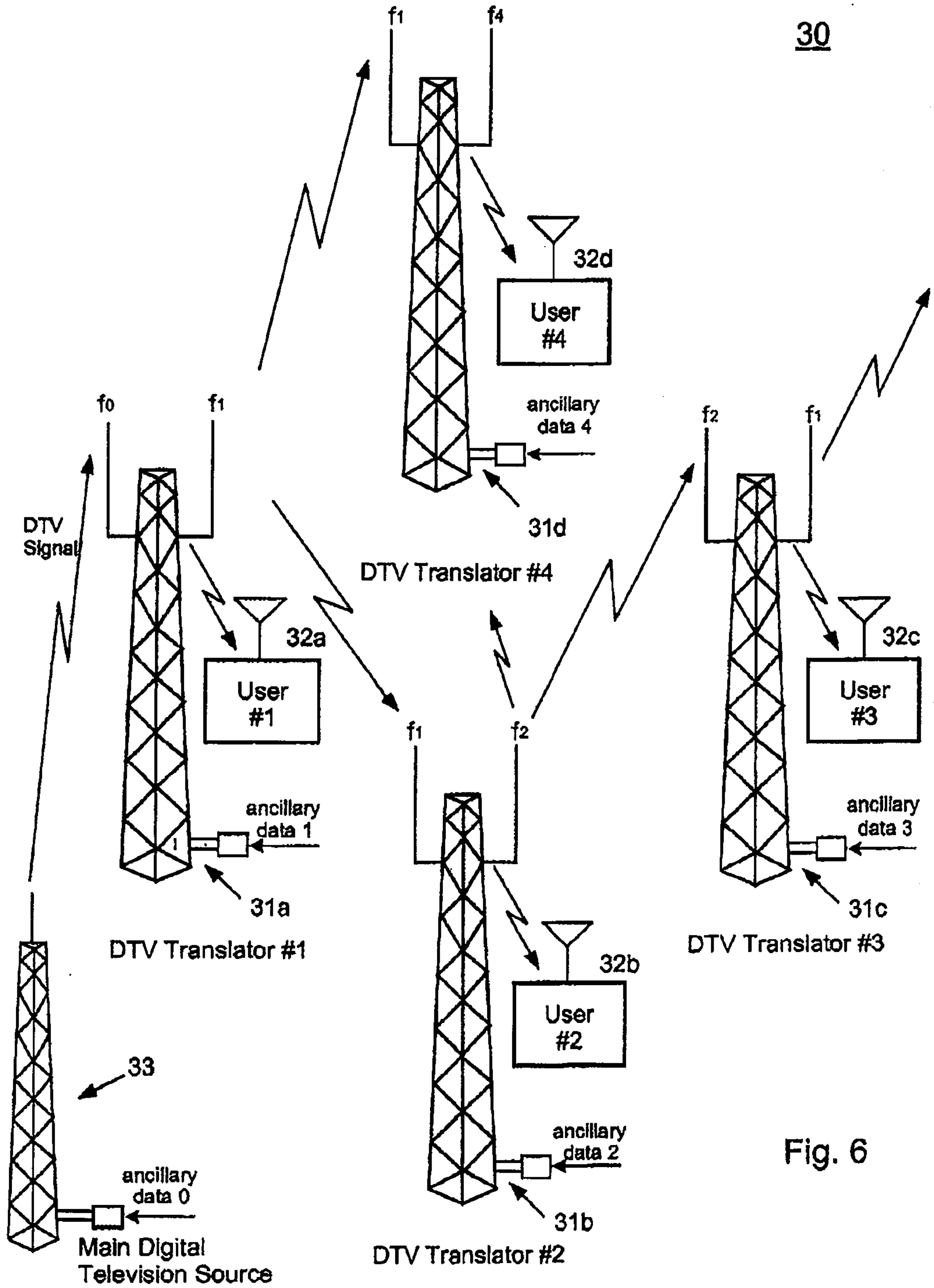
30
f1
f4
32d
User #4
ancillary data 4
31d
DTV Translator #4
f0
f1
DTV Signal
32a
User #1
ancillary data 1
31a
DTV Translator #1
f2
f1
32c
User #3
ancillary data 3
31c
DTV Translator #3
f1
f2
32b
User #2
ancillary data 2
31b
DTV Translator #2
33
ancillary data 0
Main Digital Television Source

Fig. 6

DIGITAL TELEVISION TRANSLATOR WITH PSIP UPDATE

This application is a Continuation application of U.S. patent application Ser. No. 12/314,078 now U.S. Pat. No. 7,761,893, filed on Dec. 3, 2008, which is a Continuation application of U.S. patent application Ser. No. 10/890,210, filed on Jul. 14, 2004, now U.S. Pat. No. 7,487,533, which is a Continuation application of U.S. patent application Ser. No. 09/545,613, filed on Apr. 5, 2000, now U.S. Pat. No. 6,785,903. The prior applications are incorporated by reference in their entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a digital television translator. More particularly, the present invention relates to a digital television translator that updates the program and system information protocol (PSIP) table with transmit (TX) channel data.

2. Discussion of the Related Art

Digital television (DTV) broadcasting systems are relatively new in the United States and offer many alternatives to traditional information and program distribution. In addition to traditional television programming, DTV systems offer the ability to distribute additional content in the form of data. This data can be any type of data including, for example, Internet data broadcast to one or more end users. Therefore, DTV broadcast systems offer great flexibility and diversity in the types of information they distribute. Like most conventional broadcast systems, DTV broadcast systems have a finite capacity limited by the bandwidth of its channels.

Additionally, as with other broadcast systems, such as analog television systems, the received DTV signal quality can vary greatly depending upon where the receiver is located. This problem is due to a number of adverse propagation effects such as multi-path, interference, and simple attenuation. One solution to this problem is to use multiple low power repeaters (On-Channel boosters) and/or translators (Re-modulators) to improve reception in areas of poor DTV signal reception. For example, a repeater, placed in an area of poor signal reception, receives a transmitted signal from a high power DTV transmitter and re-transmits an amplified duplicate signal at the same frequency. Translators, on the other hand, can receive a transmitted signal from a high power DTV transmitter and re-transmit the signal at a frequency different than the received frequency. Repeaters and translators are also used to extend the coverage of a broadcast system incrementally, and economically, to specific geographical regions.

FIG. 1 shows an example of a conventional DTV translator 1. The conventional DTV translator includes a down converter 2, a first local oscillator 3, an up converter 4, and a second local oscillator 5. A received DTV signal (RX RF input) is down converted to IF (intermediate frequency) by down converter 2. The IF is determined by the difference between the frequency LO1 generated by the first local oscillator 3 and the RF frequency of the received DTV signal (RX RF Input). The IF signal is then up converted to RF by up converter 4. The frequency of the up converted RF DTV signal (TX RF Output) is determined by the sum of the frequency LO2 generated by the second local oscillator 5 and the IF. The up converted DTV signal (TX RF Output) is then amplified and transmitted. With this arrangement, the transmitted signal contains the same information as the received signal, but is amplified. Further, when LO1=LO2, the transmit frequency is the same as the received frequency, and the apparatus operates as an on-channel booster. Alternatively, when LO1.noteq.LO2, the transmit frequency is different than the received frequency, and the apparatus operates as a translator.

In the DTV American Television Systems Committee (ASTC) standard, a DTV signal contains a Program and System Information Protocol (PSIP) table, which is a collection of hierarchically arranged sub-tables for describing system information and program guide data. One of sub-tables in the PSIP table is the Virtual Channel Table (VCT), which contains a list of attributes for virtual channels carried in the digital transport stream (baseband information). VCT fields "major channel number" and "minor channel number" are used for identification. The major channel number is used to group all channels that are to be identified as belonging to a particular broadcast corporation (or a particular identifying number such as channel "12"). The minor channel number specifies a particular channel within the group. The VCT also contains a "carrier frequency" field, which is used to identify the frequency at which the DTV signal is transmitted and received. As discussed herein, TX and RX channel data include at least one of the following major channel number, minor channel number, carrier frequency, and/or other data necessary for generating a proper DTV signal.

When a RF DTV signal is translated to a new frequency by the conventional DTV translator 1 of FIG. 1, the PSIP table no longer reflects the correct carrier frequency. In many DTV receivers, this discrepancy between the actual frequency of the received DTV signal and the carrier frequency data contained in the PSIP table prevents the receiver from properly receiving the DTV signal.

Also, a particular broadcast corporation may be assigned different major/minor channel numbers in geographical regions serviced by each translator. For example, Broadcast Corporation #1 could be assigned major/minor channel 12/04 in region #1 (served by a main DTV transmitter) and major/minor channel 37/04 in region #2 (served by a translator translating the main DTV transmitted signal). The conventional translator of FIG. 1 therefore generates a translated DTV signal that contains an incorrect channel number for transmission into region #2.

Moreover, in region #2, major minor/channel 12/04 may have already been assigned to Broadcast Corporation #2. In that case, a single DTV receiver in region #2 will receive two unique channels (Broadcast Corporation #1 and Broadcast Corporation #2) each having the same major/minor channel number in each of their PSIP tables. While some DTV receivers overcome these anomalies by allowing users to select whether to ignore PSIP data or to display the VCT information, other DTV receivers do not have this capability and are unable to properly tune to the program(s) of one or both of the two Broadcast Corporations.

SUMMARY OF THE INVENTION

Accordingly, the present invention relates to a digital television translator, and more particularly to a digital television translator that updates the PSIP table with proper channel and carrier frequency information. To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, there is provided a digital television translator, comprising a digital television receiver for receiving a first digital television signal and generating a digital transport stream from the first digital television signal, the digital transport stream including original PSIP data having RX channel data; a PSIP update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data; and a digital television modulator for converting the digital transport stream having the updated PSIP data into a second digital television signal.

In another aspect of the instant invention, there is provided an information distribution network using digital television transmission, the information distribution network comprising a plurality of digital television transmission nodes including a main digital television signal source for generating a main digital television signal; and a plurality of digital television translators receiving a digital television signal from one of the plurality of digital television nodes, at least one of said plurality of digital television translators including a digital television receiver for receiving the digital television signal from one of the plurality of digital television nodes and generating a digital transport stream from the received digital television signal, the digital transport stream including original ancillary data and original PSIP data having RX data, a data update module for updating the original PSIP data in the digital transport stream by replacing the RX channel data with TX channel data and for replacing the original ancillary data in the digital transport stream with new ancillary data, and a digital television modulator for converting the digital transport stream having the new ancillary data and the updated PSIP data into a transmitted digital television signal, wherein at least two of the plurality of digital television transmission nodes transmit at the same frequency and the total ancillary data of the information distribution network includes the new ancillary data from multiple digital television translators of the plurality of digital television translators.

Additional features and advantages of the present invention will be set forth in the description that follows, and in part will be apparent from the description, or may be learned by practice of the invention. The objectives and other advantages of the invention will be realized and attained by the structure particularly pointed out in the written description and claims hereof as well as the appended drawings.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention that together with the description serve to explain the principles of the invention.

In the drawings:

FIG. 1 shows an example of a conventional DTV translator;

FIG. 2 shows a first embodiment of a DTV translator of the present invention having PSIP table update capability;

FIG. 3 shows an example of a PSIP update module;

FIG. 4 shows a second embodiment of a DTV translator of the present invention having both PSIP table update capability and a re-multiplexor;

FIG. 5 shows an example of the re-multiplexor; and

FIG. 6 shows an example of an information distribution network of the present invention using multiple translators.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

To overcome the problems associated with the prior art, i.e., tuning problems with some DTV receivers due to incorrect PSIP table information, the PSIP table information is updated by the translator to properly reflect the new transmit carrier frequency and channel number.

FIG. 2 shows a first embodiment of a DTV translator 10 of the present invention having PSIP table update capability. The DTV translator 10 includes an 8-VSB receiver 11, a PSIP update module 12, an 8-VSB modulator 13, an RF power amplifier 14, and a transmitting antenna 15. The receiver 11 receives an 8-VSB DTV signal (RFi) that may have been originally transmitted by a base station or another translator, over the air or by a cable. The receiver 11 processes the DTV signal according to ASTC DTV standards to produce a digital transport stream (TS) containing MPEG2 video data, audio data, ancillary data, and PSIP data. The PSIP data in the digital transport stream includes a major channel number, a minor channel number, and a carrier frequency, which together make up the RX channel data. As shown, the receiver 11 is controlled by an input (RX Channel Select) which informs the receiver 11 of which carrier frequency channel to tune.

The processing of the received DTV signal by the 8-VSB receiver 11 is in accordance with ATSC DTV standards and, accordingly, can include down conversion, digitization, carrier synchronization, symbol clock synchronization, frame and segment synchronization, matched filtering, equalization, bit-demapping, Trellis decoding, convolutional de-interleaving, Reed-Solomon forward error correction (FEC) decoding, and de-randomizing.

The digital transport stream (TS) is then input into PSIP update module 12. The PSIP update module 12 extracts the PSIP table data and updates the RX channel data with TX channel data. Specifically, the major channel number, the minor channel number, and the carrier frequency contained in the PSIP VCT are updated. Updated major and minor channel numbers are those numbers assigned to the broadcaster associated with the transport stream content for the geographical region covered by the DTV translator. Sometimes the original and updated channel numbers will be the same, for example when the translator is being used to fill in a poor reception area of the geographical area covered by the main transmitter. At other times, the original and updated channel numbers will be different, for example, when the translator is being used to extend coverage into a geographical area not covered by the main transmitter. In this instance, the broadcaster may be licensed to broadcast in the translator's geographical area, but at a different channel.

Also, the carrier frequency of the DTV signal transmitted from the translator must be reflected in the PSIP VCT. In most instances, the translator will transmit at a different frequency than it receives, requiring the PSIP VCT to be updated with the new transmitted carrier frequency. In some instances, the carrier frequency of the DTV signal can be transmitted at the same frequency that it is received, such as when the translator system is being used as an on-channel booster. In either instance, the updated PSIP table is then reinserted back into the digital transport stream.

Once the PSIP data is updated, the transport stream containing the updated PSIP data is then input into the 8-VSB modulator 13. 8-VSB modulator 13 processes the digital transport stream according to ATSC DTV standards to produce a DTV signal (Rfo) at the carrier frequency contained in the VCT of the updated PSIP table data. As shown, 8-VSB modulator 13 is controlled by input (TX Channel Select) which informs the 8-VSB modulator 13 at which frequency to transmit the DTV signal. Alternatively, the 8-VSB modulator

can detect the carrier frequency information from the VCT of the DTV signal and transmit the DTV signal using the detected carrier frequency.

8-VSB modulator 13 processes the transport stream having the updated PSIP data according to ASTC terrestrial broadcast standards. Accordingly, this processing can include randomization, Reed-Solomon encoding, convolutional interleaving, symbol mapping, trellis encoding, and vestigial sideband filtering. After the digitally filtered signal is converted to an analog signal, the signal is up converted to a transmit RF signal (RFo) at the transmit frequency determined by TX channel select. The 8-VSB modulator 13 typically operates at a frequency of 54 MHZ-216 MHZ and 470 MHZ-806 MHZ and has a maximum output power of approximately 1 milliwatt. A power amplifier 14 and transmitting antenna 15 are usually added to the output of the 8-VSB modulator 13.

FIG. 3 shows an example of PSIP update module 12. The PSIP update module 12 includes an extractor 16 for extracting the original PSIP data, a PSIP update block 18 for replacing the major/minor channel number and carrier frequency contained in the PSIP table, and an inserter 17 for inserting the updated PSIP table data back into the transport stream. As shown, the PSIP table data is extracted by extractor 16 and input into the PSIP update block 18. The PSIP update block 18 replaces the major/minor channel number and transmit carrier frequency contained in the VCT (a sub-table of the PSIP table) while retaining the other PSIP data. The PSIP update block 18 then substitutes an updated major/minor channel number and transmit carrier frequency into the VCT. Thereafter, the updated PSIP table data is re-inserted back into the digital transport stream via inserter 17.

FIG. 4 shows a second embodiment of a DTV translator 20 of the present invention. The second embodiment includes an 8-VSB receiver 21, a PSIP update module 22, a re-multiplexor 23, and an 8-VSB modulator 24. Usually an RF power amplifier 25 and an antenna 26 are coupled to the 8-VSB modulator 24. The structure and operation of the second embodiment is the same as the structure and operation of the first embodiment, except that a re-multiplexor 23 is added for introducing new ancillary data into the digital transport stream.

The digital transport stream containing original ancillary data and the updated PSIP table data is input into the re-multiplexor 23. Re-multiplexor 23 substitutes new ancillary data in place of the original ancillary data in the digital transport stream. The digital transport stream is then sent to 8-VSB modulator 24 and converted into a DTV signal consistent with the operation as described in the first embodiment. In this way, each translator can distribute new ancillary data to user(s) in the translator's transmit range.

FIG. 5 is a block diagram of the re-multiplexor 23, which comprises a demultiplexor 27 and a multiplexor 28. As shown, the original ancillary data, video data, audio data, and updated PSIP table data is contained in the input digital transport stream, which is demultiplexed into separate bit streams by de-multiplexor 27. The original ancillary data is terminated (discarded). The multiplexor 28 then combines the video data, the audio data, the updated PSIP data, and new ancillary data back into the output digital transport stream, which is then input to the 8-VSB modulator 24.

The PSIP update step and the ancillary data insertion step are not required to take place in any particular order. For example, since the PSIP data has been separated into its constituent streams by demultiplexor 27 of re-multiplexor 23, the PSIP table update step could take place in the re-multiplexor 23 by updating the major/minor channel number and carrier frequency. The updated PSIP table data could be reinserted into the digital transport stream by multiplexor 28. Or, for example, the placement of the PSIP update module 22 and the multiplexor 23 could be reversed. Moreover, only a portion of the original ancillary data could be replaced with new ancillary data thereby allowing other portions of the ancillary data to be transmitted downstream by the translator.

The second embodiment allows DTV broadcasting stations to increase their data broadcasting capacity every time a DTV translator is added. For example, adding a DTV translator increases the number of users and increases the capacity for data transmission through employment of the new ancillary data, which permits the insertion of data, such as Internet data. Downstream Internet data can be inserted as new ancillary data by each translator and distributed to specific geographic regions and users without the need for additional bandwidth.

FIG. 6 shows an example of a third embodiment of the invention wherein an information distribution network 30 uses a plurality of translators to increase the data capacity of the network. As shown, a plurality of translators, collectively labeled 31*a*-31 *d*, translate and distribute a DTV signal in both a star and daisy-chain configuration.

The first translator 31*a* receives a DTV signal, from a main digital television source, containing original ancillary data 0, such as Internet download data at a frequency fo. Translator 31*a* inserts ancillary data 1 and discards original ancillary data 0, and then retransmits the modified DTV signal having ancillary data 1 at a frequency f1. User 32*a* receives ancillary data 1 from translator 31*a*. A second DTV translator 31*b* receives the translated DTV signal from translator 31*a* at a frequency of f1, substitutes ancillary data 2 for ancillary data 1, and then retransmits at a frequency f2. User 32*b* receives the DTV signal transmitted from translator 31*b* along with ancillary data 2. User 32*d* also receives ancillary data 1 from translator 31*a*. A third DTV translator 31*c* receives the translated DTV signal from translator 31*b* at a frequency of f2, substitutes ancillary data 3 for the ancillary data 2, and retransmits at a frequency f1. User 32*c* receives the DTV signal transmitted from translator 32*c* along with ancillary data 3. DTV translators 31*a*, 31*b*, and 31*c* are thus configured in a daisy-chain fashion with translators 31*a* and 31*c* being endpoints.

Further, a fourth DTV translator 31*d* receives the translated DTV signal from translator 31*a* at a frequency of f1, substitutes ancillary data 4 for ancillary data 1, and then retransmits at a frequency f4. User 32*d* receives the DTV signal transmitted from translator 31*d* along with ancillary data 4. DTV translators 31*a*, 31*b*, and 31*d* are thereby configured in a star fashion with DTV translator 31*a* configured as a hub. Moreover, a variety of translator topologies can be employed to transmit unique ancillary data to each of a very large number of users, or a group of users, without requiring an increase in the bandwidth of any single translator's transport stream or physical RF channel.

Even more efficient use of bandwidth can be achieved by allowing multiple translators to use the same transmit frequencies, as does translators 31*a* and 31*c*. Translators can be placed in any number of configurations to increase the data capacity of the DTV distribution network. Furthermore, the use of a PSIP update model in each of the translators can insure proper DTV reception.

Moreover, while the embodiments described herein can be implemented via current ASTC standards, it is contemplated that other DTV standards or a modified ASTC standard could be readily employed to realize the present invention. Further, while the video data on the digital transport stream can be

MPEG2 standard video data, as described herein, the invention contemplates using variations of MPEG2 standard data in the digital transport system.

As the present invention may be embodied in several forms without departing from the spirit or essential characteristics thereof, it should also be understood that the above-described embodiments are not limited by any of the details of the foregoing description, unless otherwise specified, but rather should be construed broadly within its spirit and scope as defined in the appended claims, and therefore all changes and modifications that fall within the meets and bounds of the claims, or equivalence of such meets and bounds are therefore intended to be embraced by the appended claims.

What is claimed is:

1. A method of translating, comprising:
receiving an ATSC digital television signal over the air;
converting the ATSC digital television signal into a first digital transport stream, the first digital transport stream containing video and audio data of a program and a program information table, the program information table having a major channel number and a minor channel number;
generating a new program information table containing a new channel number, the new channel number identifying the program represented by the major channel number and the minor channel number; and
combining the video and audio data with the new program information table.

2. The method of claim 1, wherein combining includes inserting the new program information table into a transport stream containing the video and audio data.

3. The method of claim 1, wherein new ancillary data is combined with the video data, the audio data, and the new program information table.

4. The method of claim 3, wherein a portion of original ancillary data present in the first digital transport stream is combined with the video data, the audio data, and the new program information table.

5. A method of translating, comprising:
receiving an ATSC digital television signal over cable;
converting the ATSC digital television signal into a first digital transport stream, the first digital transport stream containing video and audio data of a program and a program information table, the program information table having a major channel number and a minor channel number;
generating a new program information table containing a new channel number, the new channel number identifying the program represented by the major channel number and the minor channel number; and
combining the video and audio data with the new program information table.

6. The method of claim 5, wherein the combining includes inserting the new program information table into a transport stream containing the video and audio data.

7. The method of claim 5, wherein new ancillary data is combined with the video data, the audio data, and the new program information table.

8. The method of claim 7, wherein a portion of original ancillary data present in the first digital transport stream is combined with the video data, the audio data, and the new program information table.

9. A method of translating, comprising:
receiving an ATSC digital television signal over the air;
converting the ATSC digital television signal into a first digital transport stream, the first digital transport stream containing video and audio data of a program and a program information table, the program information table having a major channel number and a minor channel number;
generating a new program information table containing a new channel number, the new channel number identifying the program represented by the major channel number and the minor channel number; and
multiplexing the new program information table, the video, and the audio data.

10. The method of claim 9, further comprising multiplexing new ancillary data with the new program information table, the video, and the audio data.

11. The method of claim 10, further comprising multiplexing a portion of original ancillary data present in the first digital transport stream with the new program information table, the video, and the audio data.

12. A method of translating, comprising:
receiving an ATSC digital television signal over cable;
converting the ATSC digital television signal into a first digital transport stream, the first digital transport stream containing video and audio data of a program and a program information table, the program information table having a major channel number and a minor channel number;
generating a new program information table containing a new channel number, the new channel number identifying the program represented by the major channel number and the minor channel number; and
multiplexing the new program information table, the video, and audio data.

13. The method of claim 12, further comprising multiplexing new ancillary data with the new program information table, the video, and audio data.

14. The method of claim 13, further comprising multiplexing a portion of original ancillary data present in the first digital transport stream with the new program information table, the video, and audio data.

15. A method of translating, comprising:
selecting a carrier frequency;
receiving an ATSC digital television signal at the selected carrier frequency;
down-converting the received ATSC digital television signal;
digitizing the down-converted ATSC digital television signal;
converting the digitized ATSC digital television signal into a first digital transport stream, the first digital transport stream containing video and audio data of a program and a program information table, the program information table having a major channel number and a minor channel number;
generating a new program information table containing a new channel number, the new channel number identifying the program represented by the major channel number and the minor channel number;
combining the new program information table, the video and audio data; and
transmitting the combined new program information table, video data, and audio data over an antenna.

16. The method of claim 15, wherein the combining includes inserting the new program information table into a transport stream containing the video and audio data.

17. The method of claim 15, wherein ancillary data is combined with the video data, the audio data, and the new program information table.

18. The method of claim 17, wherein a portion of original ancillary data present n the first digital transport stream is combined with the new program information table, the video and audio data.

19. A method of translating, comprising:

selecting a carrier frequency;

receiving an ATSC digital television signal at the selected carrier frequency;

down-converting the received ATSC digital television signal;

digitizing the down-converted ATSC digital television signal;

converting the digitized ATSC digital television signal into a first digital transport stream, the first digital transport stream containing video and audio data of a program and a program information table, the program information table having a major channel number and a minor channel number;

generating a new program information table containing a new channel number, he new channel number identifying the program represented by the major channel number and the minor channel number;

multiplexing the new program information table, the video and the audio data into a second digital transport stream;

converting the second digital transport stream into an analog signal;

up-converting the analog signal to an RF signal at a selected transmit frequency;

amplifying the RF signal; and

transmitting the RF signal over an antenna.

20. The method of claim 19, further comprising multiplexing new ancillary data with the video data, the audio data, and the new program information table to form the second digital transport stream.

21. The method of claim 20, further comprising multiplexing a portion of original ancillary data present in the first digital transport stream with the video data, audio data, and the new program information table.

* * * * *

EXHIBIT E

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August 26, 2010

VIA FEDEX

Mr. Ronald Coslick
Assistant General Counsel
Intellectual Property
DIRECTV
2230 East Imperial Highway
El Segundo, CA 90245-0956

Re: U.S. Patent Nos. 7,487,533, 6,785,903, and 7,761,893

Dear Mr. Coslick:

We received your letter dated July 24, 2009, stating your need for more information about KTech's patents and DIRECTV's use thereof. In response, we enclose a claim chart for U.S. Patent No. 7,487,533. We also enclose a claim chart for U.S. Patent No. 7,761,893, which was recently granted to KTech. We further enclose illustrative slides for an exemplary set of claims from each of these patents. After you have had a chance to review the enclosed materials, we would like to schedule a meeting to discuss the patents and terms of a license.

Sincerely,

Thomas Nelson

Enclosures

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February 28, 2011

VIA FEDEX

Mr. Ronald Coslick
Assistant General Counsel
Intellectual Property
DIRECTV
2230 East Imperial Highway
El Segundo, CA 90245-0956

Re: U.S. Patent Nos. 7,487,533, 6,785,903, and 7,761,893

Dear Mr. Coslick:

We wrote to you on August 26, 2010, regarding your need for more information about KTech's patents and DIRECTV's use thereof. In that letter, we provided you with a claim chart for U.S. Patent No. 7,487,533 and U.S. Patent No. 7,761,893, as well as illustrative slides for an exemplary set of claims from each of these patents. It has been six months since we last contacted you and have not heard back. We would still like to schedule a meeting to discuss the patents and terms of a license. Let us know when you are available for such a meeting.

Sincerely,

Thomas Nelson

DB1/66541503.1

DIRECTV

April 13, 2011

Direct: (310) 964-5962
Facsimile: (310) 726-6464
Email: rcoslick@directv.com

Thomas Nelson
Morgan, Lewis & Bockius LLP
1111 Pennsylvania Ave. NW
Washington DC 20004

Re: Offer to license K Tech patents

Dear Mr. Nelson:

Thank you for your letter of February 28, 2011. Please accept my apology for my delay in responding to your earlier correspondence.

I did receive your August 26, 2010 letter and the enclosed claim charts and presentation slides. The time that you devoted to explaining your position in greater detail is appreciated, and your materials were helpful in allowing me to better understand your client's position concerning their patents.

Upon receiving your August 26 letter I revisited the investigation that I undertook when we first corresponded to ensure that I correctly understood DIRECTV's local signal collection technology and any changes that may have occurred since our original correspondence. After completing that investigation it remained, and still remains, my opinion that DIRECTV does not practice the technology described in the K Tech patents or claimed in the K Tech patent claims. As I indicated in my previous letter, I am willing to discuss this with your client under appropriate confidentiality terms, but unfortunately, given your role in the prosecution of the still-pending patent family, I cannot involve you in that discussion. Please let Mr. Kuh know that I invite him to have that conversation with me if he wishes.

While I appreciate your offer to discuss a license, the K Tech patents appear to have little value to DIRECTV at this time. I remain willing to review any additional information that you believe I should consider.

Very truly yours,

Ronald Coslick
Vice President
Associate General Counsel
Intellectual Property

RC/sat

EXHIBIT F

US008077706B2

(12) **United States Patent**
Wasden et al.

(10) **Patent No.:** **US 8,077,706 B2**
(45) **Date of Patent:** **Dec. 13, 2011**

(54) **METHOD AND SYSTEM FOR CONTROLLING REDUNDANCY OF INDIVIDUAL COMPONENTS OF A REMOTE FACILITY SYSTEM**

(75) Inventors: **Mitchell B. Wasden**, Redondo Beach, CA (US); **Vishal Arya**, Los Angeles, CA (US); **Daniel M. Miner**, Redondo Beach, CA (US); **Darren M. St. Laurent**, Stevenson Ranch, CA (US); **David T. Boltz**, La Mirada, CA (US)

(73) Assignee: **The DIRECTV Group, Inc.**, El Segundo, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 202 days.

(21) Appl. No.: **11/930,601**

(22) Filed: **Oct. 31, 2007**

(65) **Prior Publication Data**

US 2009/0109836 A1 Apr. 30, 2009

(51) **Int. Cl.**
H04Q 11/00 (2006.01)
H04L 12/28 (2006.01)
H04L 12/66 (2006.01)

(52) **U.S. Cl.** **370/359**; 370/419; 370/463

(58) **Field of Classification Search** 370/310–350, 370/359, 419, 463, 532, 535, 537, 540; 725/105, 725/115

See application file for complete search history.

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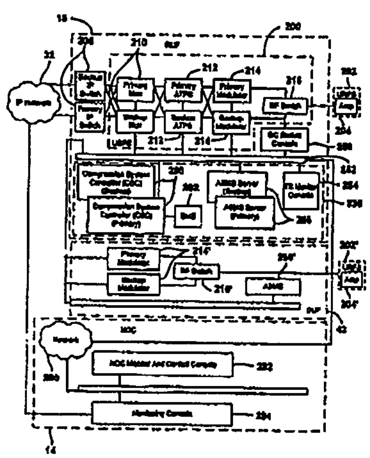
Primary Examiner — Warner Wong

(57) **ABSTRACT**

A remote facility and method for operating the same includes a signal processing system including a primary multiplexer multiplexing IP signals to form a multiplexed signal, a primary modulator a primary transport processing system forming a transport stream signal from the multiplexed signal, a primary modulator modulating the transport stream signal to form a modulated signal, a backup multiplexer multiplexing IP signals to form the multiplexed signal, a backup modulator a primary transport processing system forming a transport stream signal from the multiplexed signal, a backup modulator modulating the transport stream signal to form a modulated signal. The remote facility includes a controller in communication with the primary multiplexer, the primary transport processing system, the primary modulator, the backup multiplexer, the backup transport processing system and the backup modulator, said controller forming an output signal using at least one of the primary multiplexer, the primary transport processing system, and the primary modulator and at least one of the backup multiplexer, the backup transport processing system and the backup modulator. The remote facility may be part of a television signal collection system that includes an IP network and a local collection facility in communication with the remote collection facility through the IP network.

20 Claims, 9 Drawing Sheets



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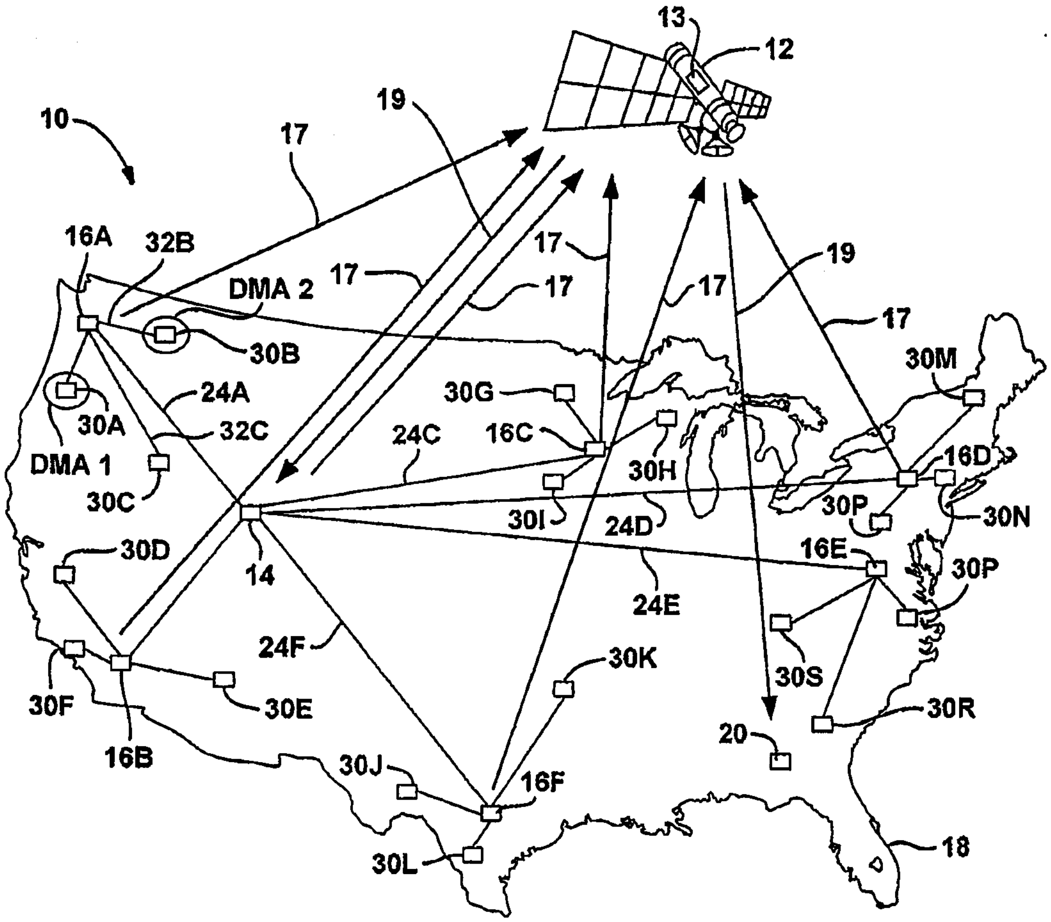
13
12
19
10
17
16A
32B
DMA 2
17
17
17
17
19
17
30B
30M
30A
24A
30G
DMA 1
32C
24C
16C
16D
30C
30H
30I
24D
30P
30N
30D
14
16E
30P
24E
24F
30K
30S
30F
30E
30R
16B
20
30J
16F
30L
18

FIG. 1

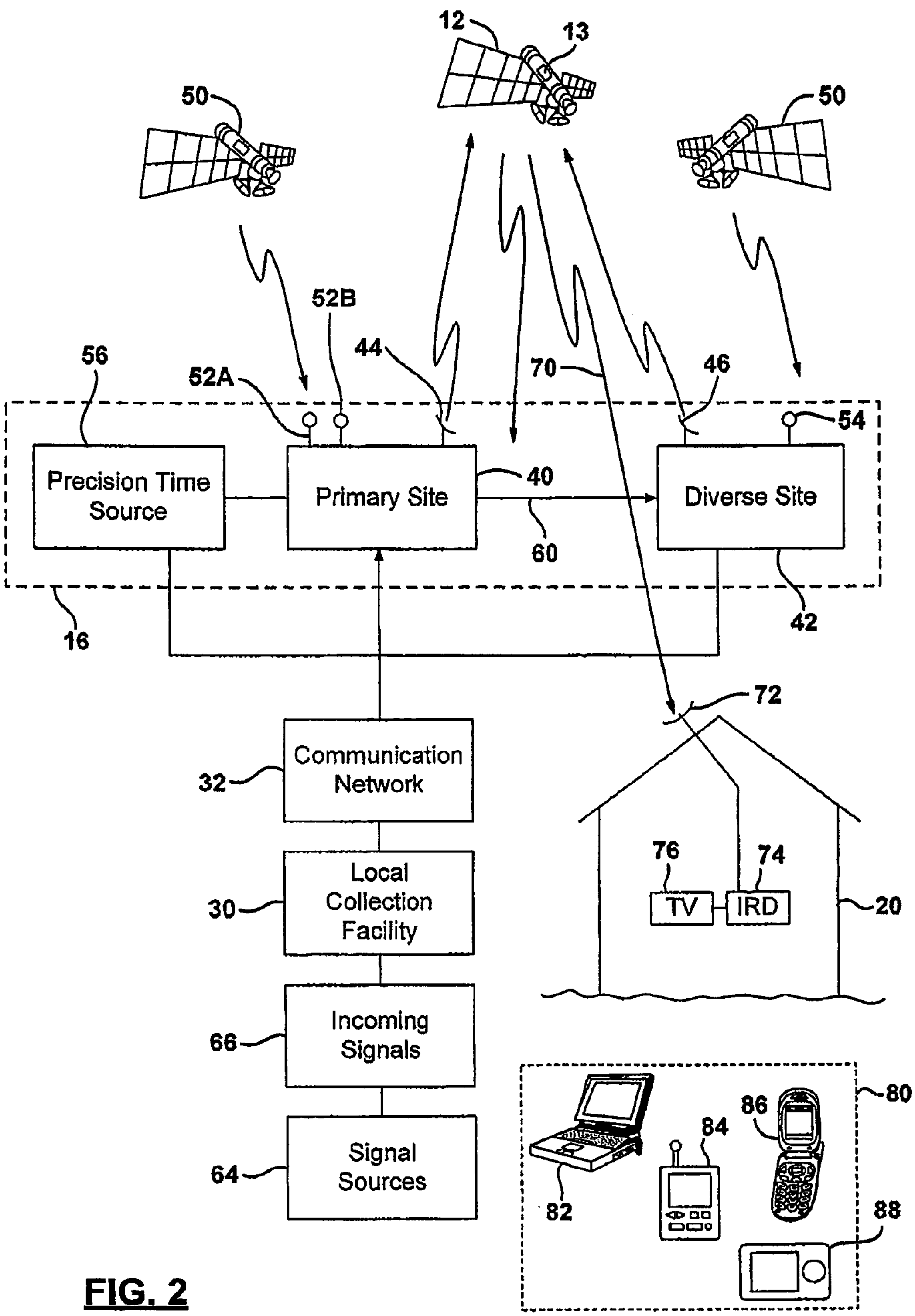
12
13
50
50
52B
56
52A
44
70
46
54
Precision Time Source
Primary Site
40
Diverse Site
60
16
42
72
Communication Network
32
Local Collection Facility
30
76
74
TV
IRD
20
Incoming Signals
66
Signal Sources
64
80
86
84
82
88

FIG. 2

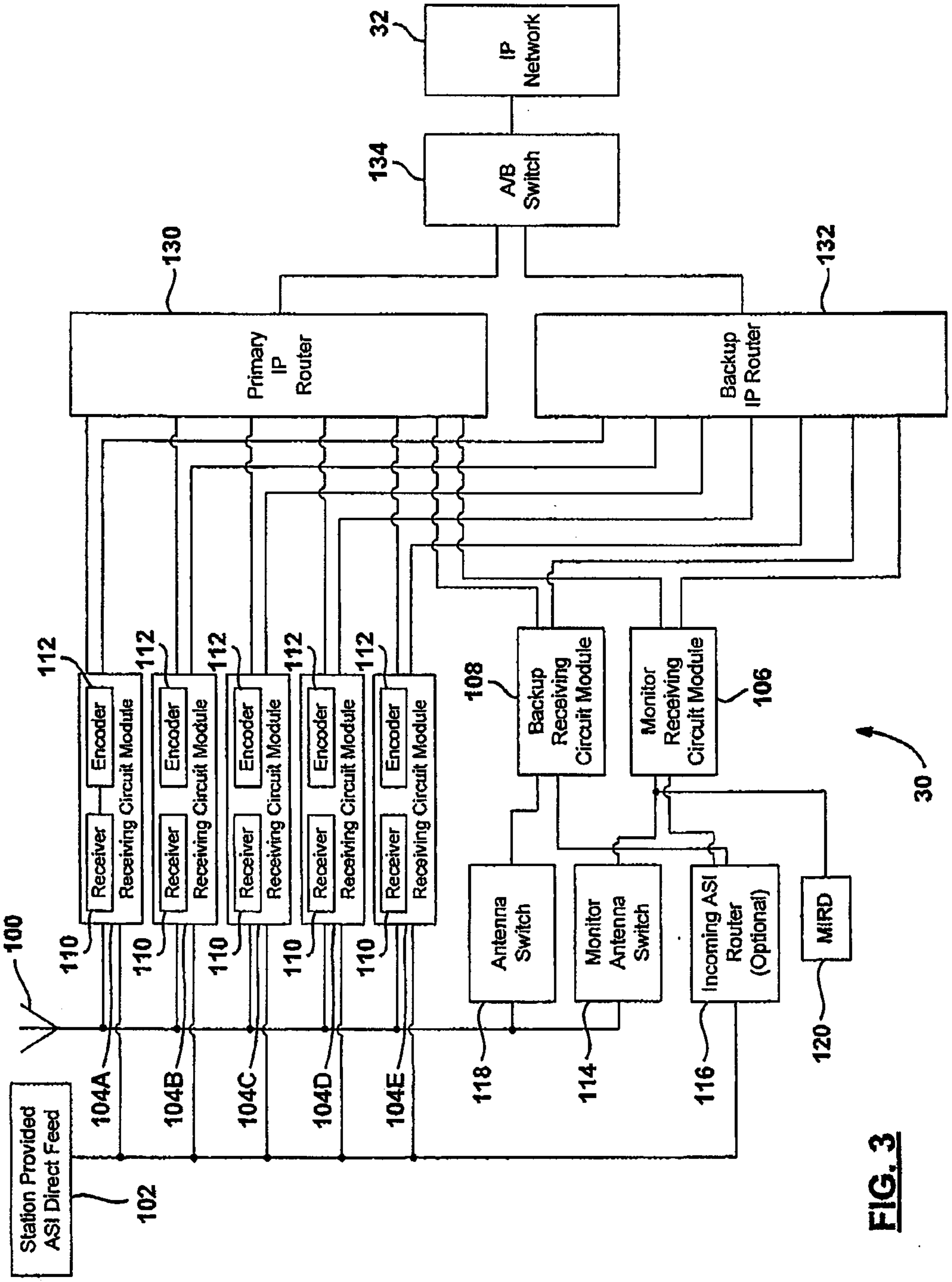
32
IP Network
134
A/B Switch
130
Primary IP Router
132
Backup IP Router
112
Encoder
Receiver
Receiving Circuit Module
110
100
104A
104B
104C
104D
104E
Station Provided ASI Direct Feed
102
108
Backup Receiving Circuit Module
Monitor Receiving Circuit Module
106
30
Antenna Switch
Monitor Antenna Switch
Incoming ASI Router (Optional)
MIRD
118
114
116
120

FIG. 3

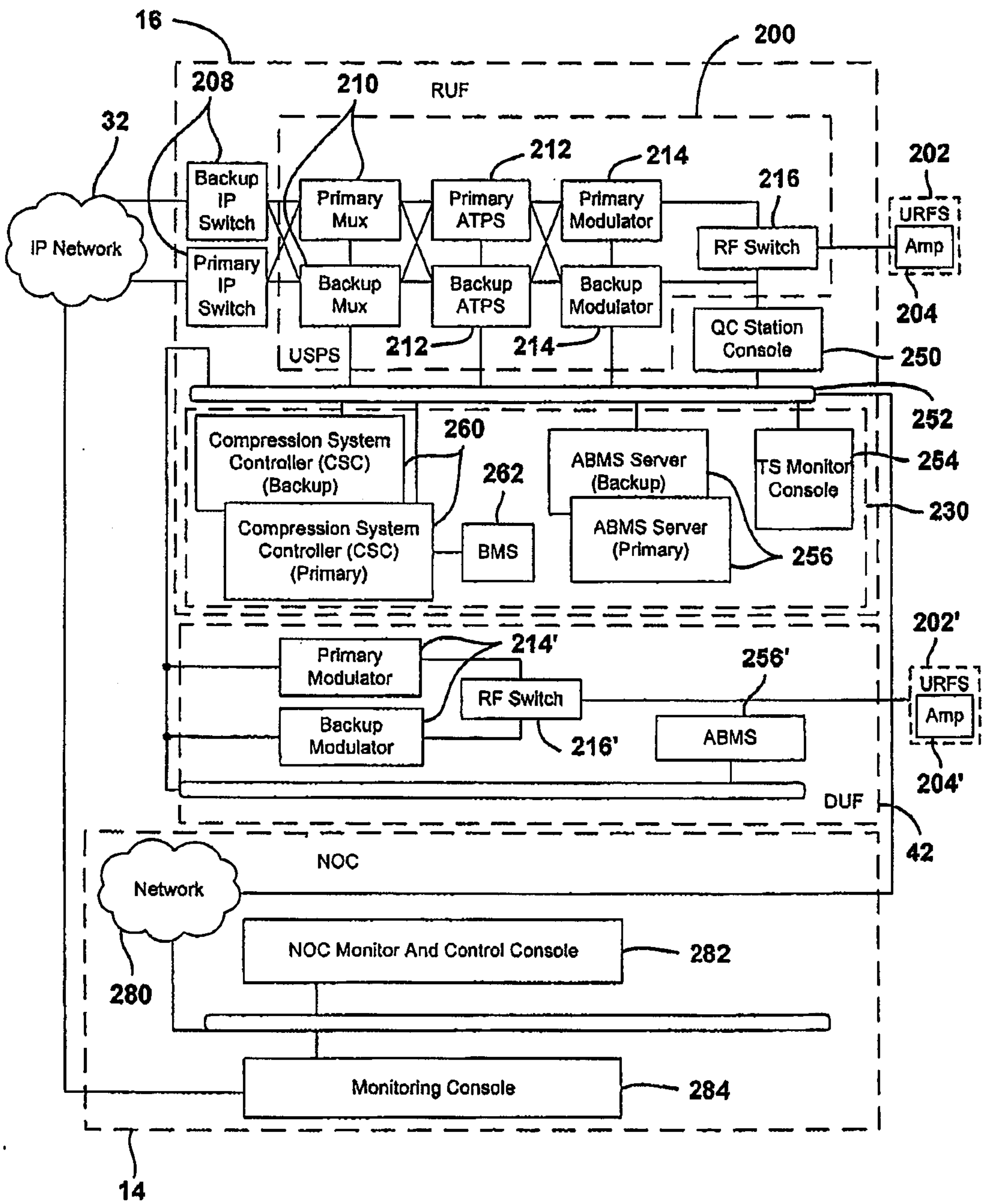
16
200
208
210
RUF
32
212
214
202
216
Backup IP Switch
Primary Mux
Primary ATPS
Primary Modulator
URFS
RF Switch
Amp
IP Network
Primary IP Switch
Backup Mux
Backup ATPS
Backup Modulator
204
QC Station Console
USPS
212
214
250
252
Compression System Controller (CSC) (Backup)
260
262
ABMS Server (Backup)
TS Monitor Console
254
230
Compression System Controller (CSC) (Primary)
BMS
ABMS Server (Primary)
256
202'
214'
Primary Modulator
256'
URFS
RF Switch
Amp
216'
ABMS
Backup Modulator
204'
DUF
42
NOC
Network
NOC Monitor And Control Console
282
280
Monitoring Console
284
14

FIG. 4

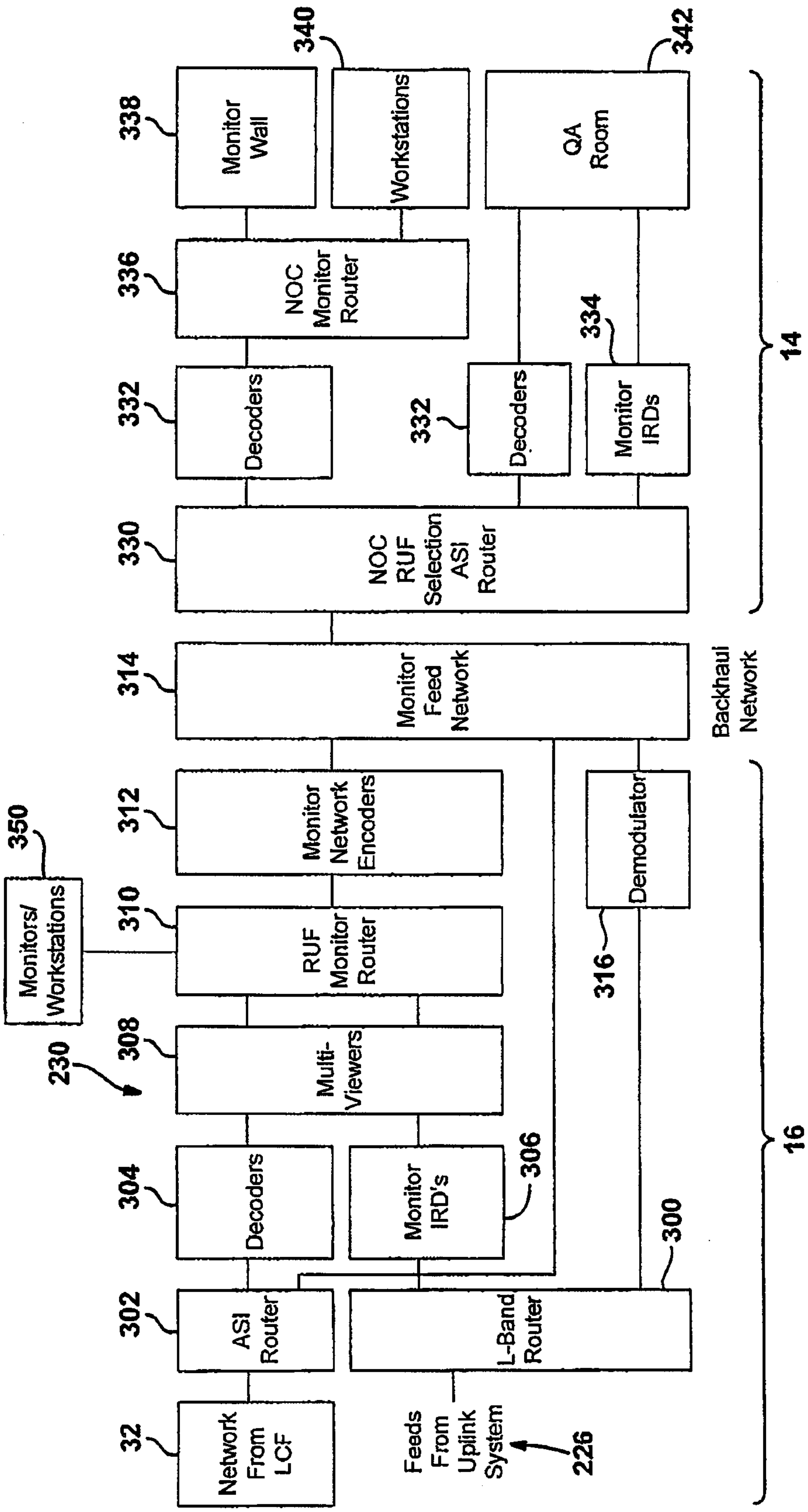
Monitor Wall
338
Workstations
340
QA Room
342
NOC Monitor Router
336
Decoders
332
Decoders
332
Monitor IRDs
334
NOC RUF Selection ASI Router
330
14
Monitor Feed Network
314
Backhaul Network
Monitor Network Encoders
312
Demodulator
316
Monitors/ Workstations
350
RUF Monitor Router
310
Multi-Viewers
308
230
Decoders
304
Monitor IRD's
306
300
16
ASI Router
302
L-Band Router
Network From LCF
32
Feeds From Uplink System
226

FIG. 5

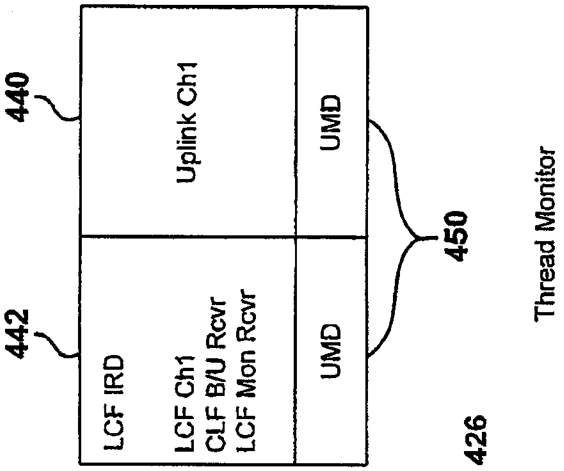

FIG. 6C

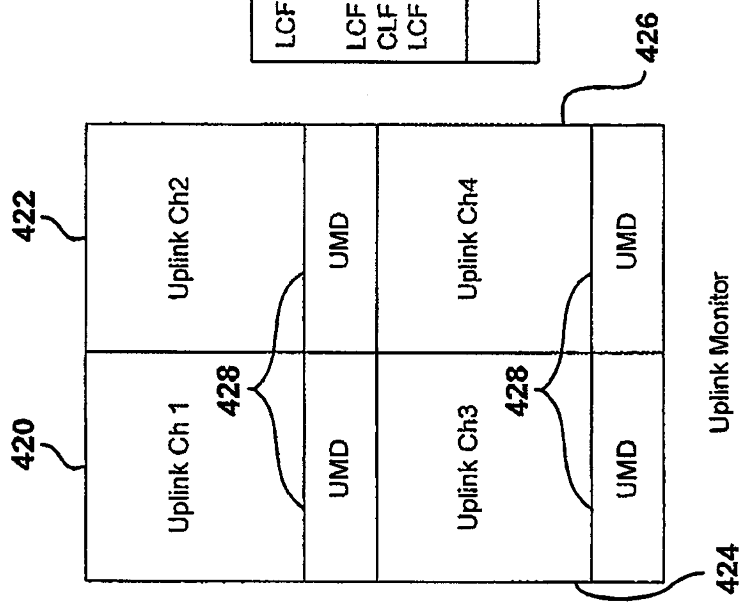

FIG. 6B

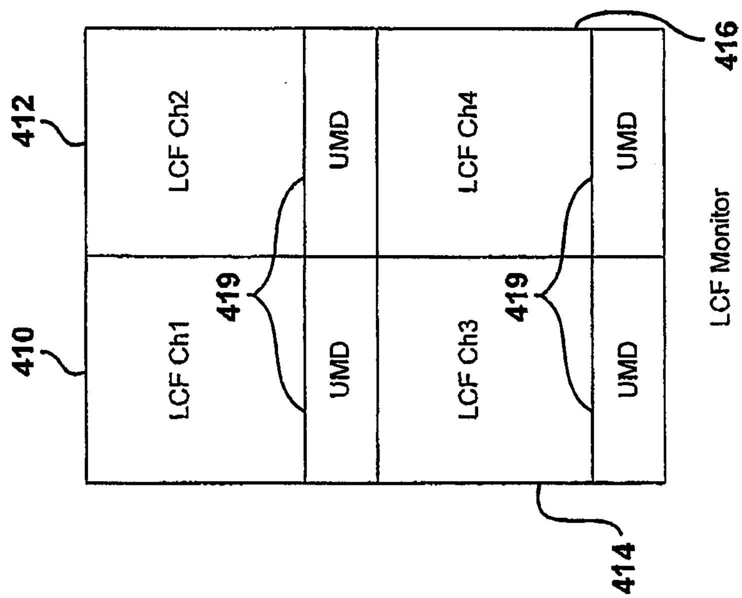

FIG. 6A

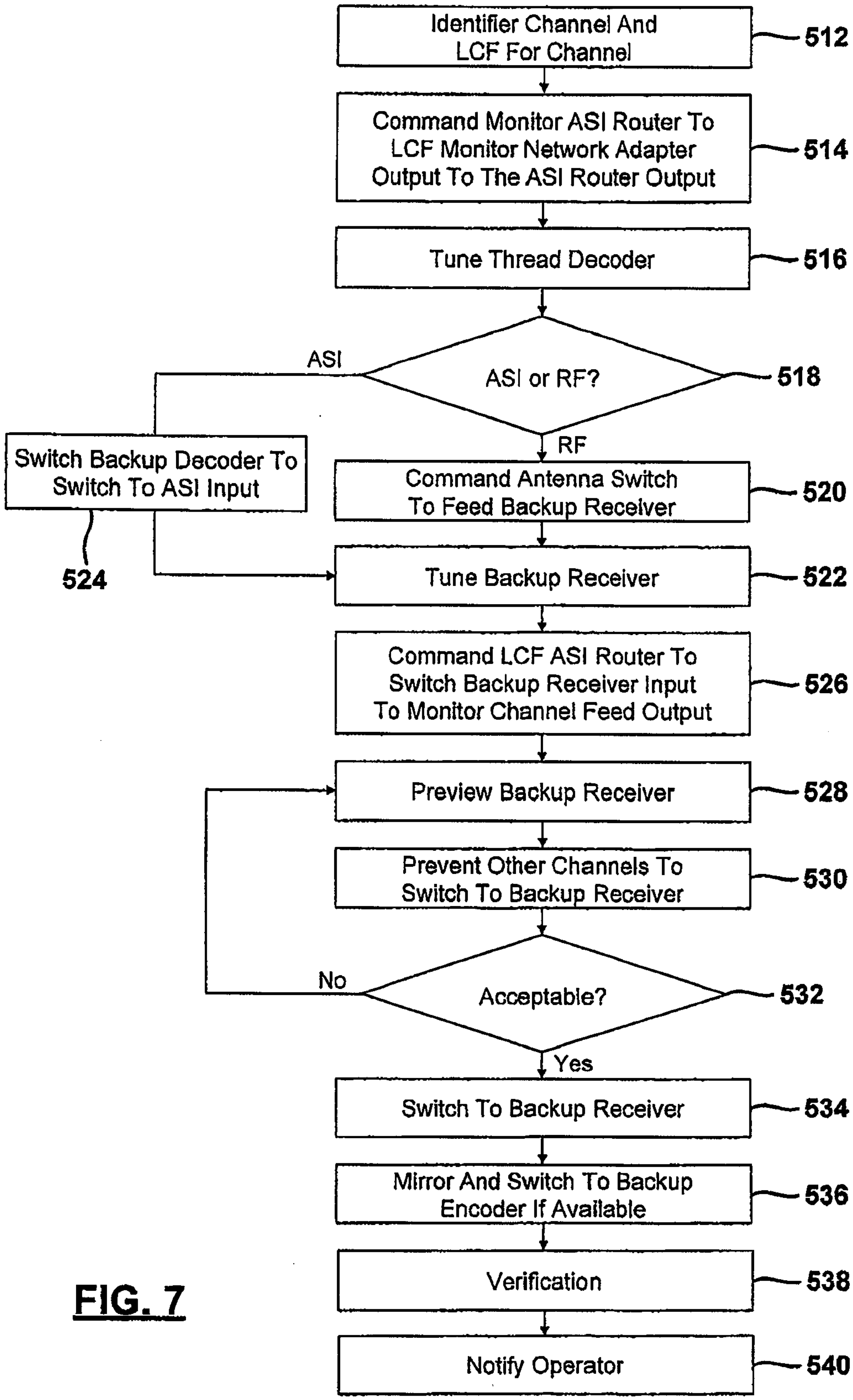
Identifier Channel And LCF For Channel
512
Command Monitor ASI Router To LCF Monitor Network Adapter Output To The ASI Router Output
514
Tune Thread Decoder
516
ASI
ASI or RF?
518
RF
Switch Backup Decoder To Switch To ASI Input
524
Command Antenna Switch To Feed Backup Receiver
520
Tune Backup Receiver
522
Command LCF ASI Router To Switch Backup Receiver Input To Monitor Channel Feed Output
526
Preview Backup Receiver
528
Prevent Other Channels To Switch To Backup Receiver
530
No
Acceptable?
532
Yes
Switch To Backup Receiver
534
Mirror And Switch To Backup Encoder If Available
536
Verification
538
Notify Operator
540

FIG. 7

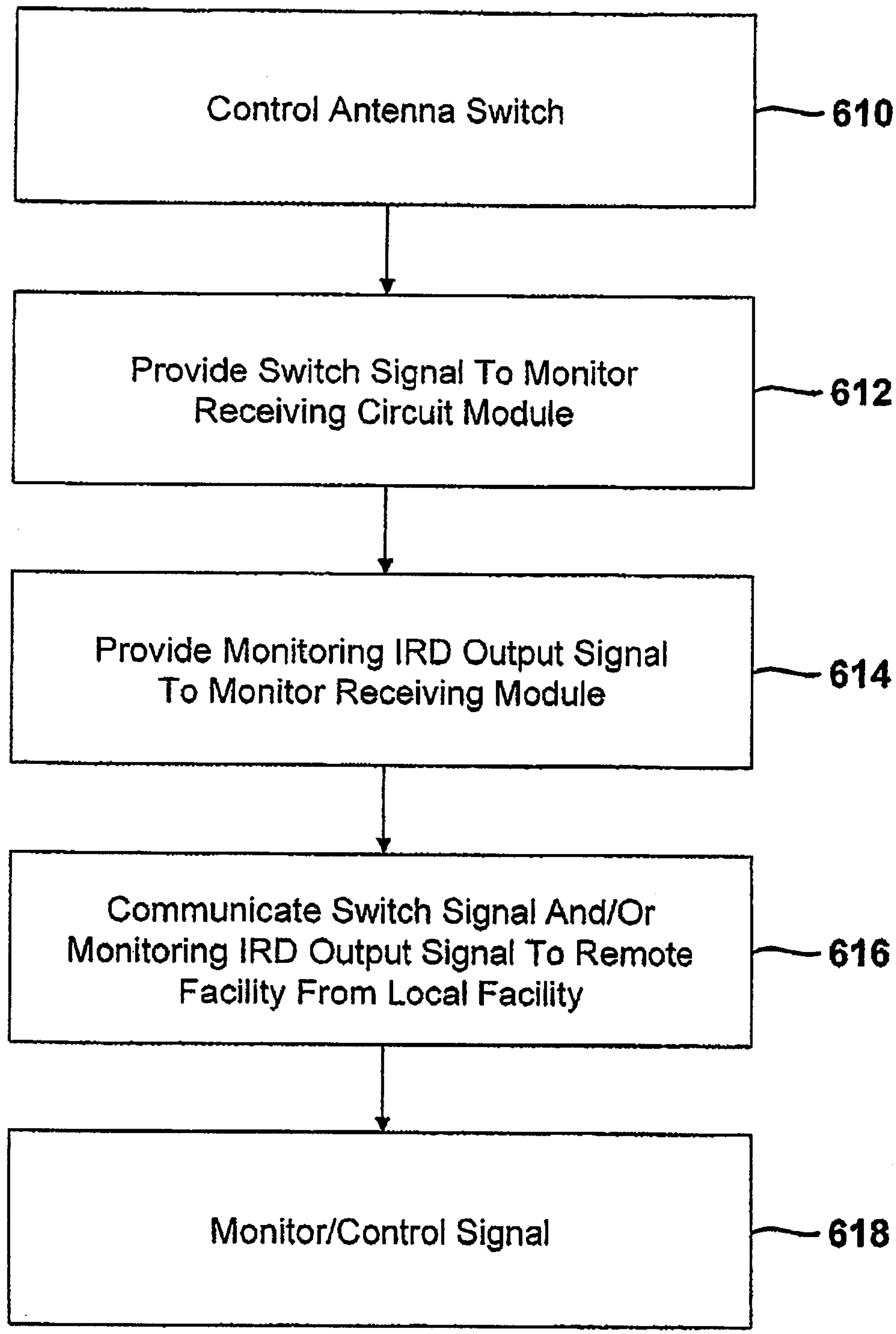
Control Antenna Switch
610
Provide Switch Signal To Monitor Receiving Circuit Module
612
Provide Monitoring IRD Output Signal To Monitor Receiving Module
614
Communicate Switch Signal And/Or Monitoring IRD Output Signal To Remote Facility From Local Facility
616
Monitor/Control Signal
618

FIG. 8

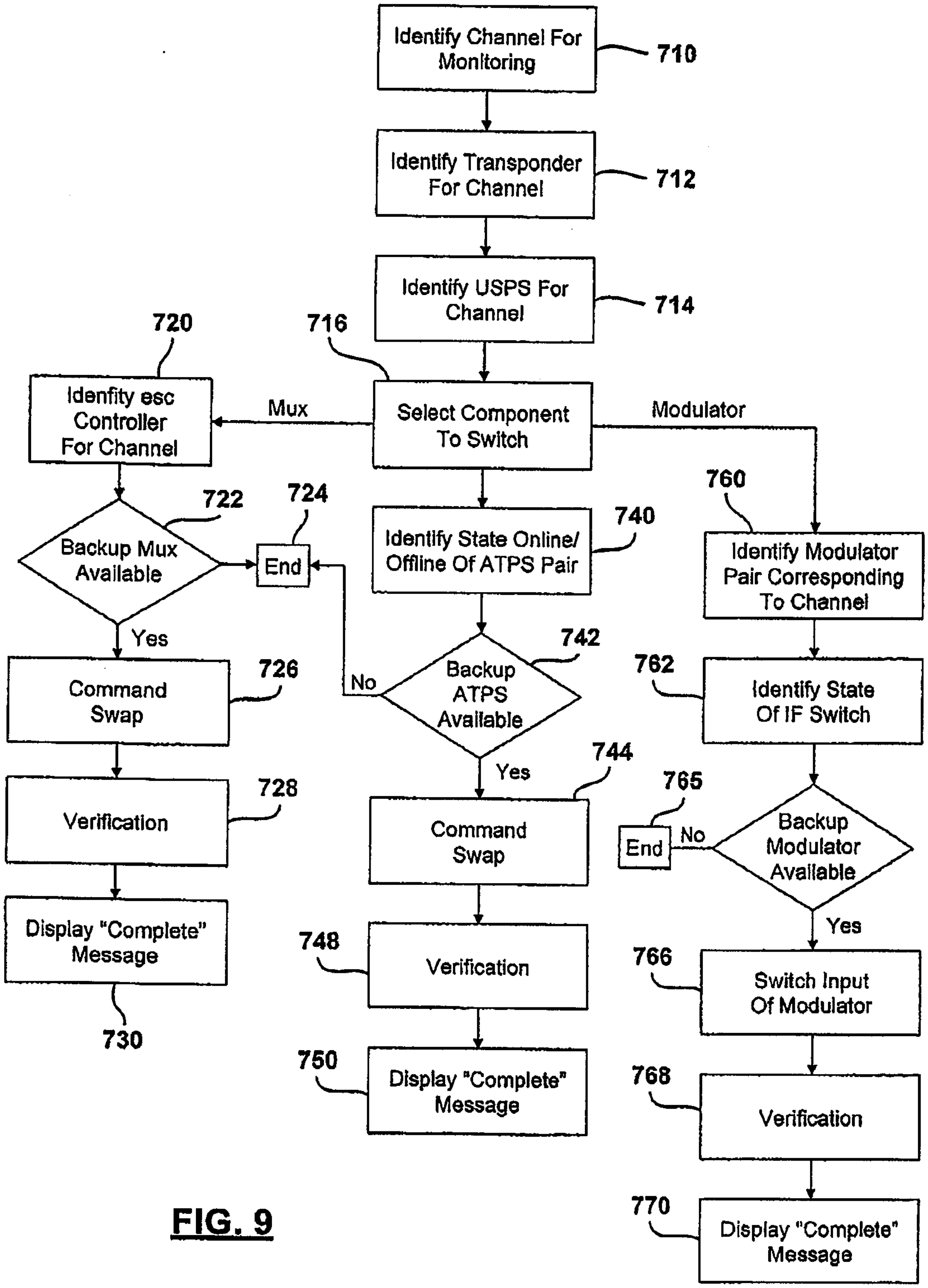
Identify Channel For Monitoring
710
Identify Transponder For Channel
712
Identify USPS For Channel
714
720
716
Idenfity esc Controller For Channel
Mux
Select Component To Switch
Modulator
722
724
Backup Mux Available
End
Yes
Identify State Online/ Offline Of ATPS Pair
740
760
Identify Modulator Pair Corresponding To Channel
726
Command Swap
No
Backup ATPS Available
742
762
Identify State Of IF Switch
728
Verification
Yes
744
Command Swap
765
End
No
Backup Modulator Available
Yes
Display "Complete" Message
730
748
Verification
766
Switch Input Of Modulator
750
Display "Complete" Message
768
Verification
770
Display "Complete" Message

FIG. 9

METHOD AND SYSTEM FOR CONTROLLING REDUNDANCY OF INDIVIDUAL COMPONENTS OF A REMOTE FACILITY SYSTEM

TECHNICAL FIELD

The present disclosure relates generally to communication systems, and more particularly to a method and system for providing redundancy of individually controlled components at a remote facility.

BACKGROUND

The statements in this section merely provide background information related to the present disclosure and may not constitute prior art.

Satellite broadcasting of television signals has increased in popularity. Satellite television providers continually offer more and unique services to their subscribers to enhance the viewing experience. Providing reliability in a satellite broadcasting system is therefore an important goal of satellite broadcast providers. Providing reliable signals reduces the overall cost of the system by reducing the number of received calls at a customer call center.

In satellite broadcasting systems, users have come to expect the inclusion of local channels in addition to the channels broadcast for the entire Continental United States. Collecting the channels may be performed in various manners, including providing a manned station that receives the signals. The signals may be uplinked from various locations. Providing manned stations increases the labor costs and thus increases the overall cost of the service.

SUMMARY

The present disclosure provides a means for receiving and monitoring signals at a local collection facility and communicating between a local collection facility and a remote collection facility. The system may be suitable for collecting television signals and communicating them to a remote facility such as an uplink facility.

In one aspect of the invention, a method includes multiplexing IP signals to form a multiplexed signal at a primary multiplexer, forming a transport stream signal from the multiplexed signal at a primary transport processing system, modulating the transport stream signal to form a modulated signal at a primary modulator, forming a first output signal from the modulated signal, after the steps of multiplexing, forming a transport stream, modulating and forming a first output signal, controlling one of multiplexing IP signals at a backup multiplexer, forming the transport stream signal at a backup transport processing system or modulating the transport stream at a backup modulator.

In still another aspect of the invention, a remote facility includes a signal processing system including a primary multiplexer multiplexing IP signals to form a multiplexed signal, a primary modulator a primary transport processing system forming a transport stream signal from the multiplexed signal, a primary modulator modulating the transport stream signal to form a modulated signal, a backup multiplexer multiplexing IP signals to form the multiplexed signal, a backup modulator a primary transport processing system forming a transport stream signal from the multiplexed signal, a backup modulator modulating the transport stream signal to form a modulated signal. The remote facility includes a controller in communication with the primary multiplexer, the primary transport processing system, the primary modulator, the backup multiplexer, the backup transport processing system and the backup modulator, said controller forming an output signal using at least one of the primary multiplexer, the primary transport processing system, and the primary modulator and at least one of the backup multiplexer, the backup transport processing system and the backup modulator.

The remote facility may be part of a television signal collection system that includes an IP network and a local collection facility in communication with the remote collection facility through the IP network.

Further areas of applicability will become apparent from the description provided herein. It should be understood that the description and specific examples are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

The drawings described herein are for illustration purposes only and are not intended to limit the scope of the present disclosure in any way.

FIG. 1 is an overall system view of a collection and communication system in the continental United States.

FIG. 2 is a system view at the regional level of the collection and communication system.

FIG. 3 is a detailed block diagrammatic view of a local collection facility illustrated in FIGS. 1 and 2.

FIG. 4 is a detailed block diagrammatic view of a remote uplink facility.

FIG. 5 is a block diagrammatic view of a monitoring system of FIG. 3.

FIG. 6A is a plan view of a local collection receiver monitoring display.

FIG. 6B is a plan view of an uplink monitoring display.

FIG. 6C is a plan view of a thread monitoring display.

FIG. 7 is a flowchart illustrating a method for controlling a back-up receiver decoder circuit module at the local collection facility from a remote facility.

FIG. 8 is a flowchart of a method for controlling monitoring in the local collection facility.

FIG. 9 is a flowchart with a method of controlling redundancy of components of a remote facility.

DETAILED DESCRIPTION

The following description is merely exemplary in nature and is not intended to limit the present disclosure, application, or uses. It should be understood that throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

As used herein, the term module, circuit and/or device refers to an Application Specific Integrated Circuit (ASIC), an electronic circuit, a processor (shared, dedicated, or group) and memory that execute one or more software or firmware programs, a combinational logic circuit, and/or other suitable components that provide the described functionality. As used herein, the phrase at least one of A, B, and C should be construed to mean a logical (A or B or C), using a non-exclusive logical or. It should be understood that steps within a method may be executed in different order without altering the principles of the present disclosure.

The present disclosure is described with respect to a satellite television system. However, the present disclosure may have various uses including satellite data transmission and reception for home or business uses. The system may also be used in a cable system or wireless terrestrial communication system.

Referring now to FIG. 1, a collection and communication system 10 includes a satellite 12 that includes at least one transponder 13. Typically, multiple transponders are in a satellite. Although only one satellite is shown, more than one is possible or even likely.

The collection and communication system 10 includes a central facility or Network operations center (NOC) 14 and a plurality of regional or remote uplink facilities (RUF) 16A, 16B, 16C, 16D, 16E and 16F. In a non-satellite system the facilities may be referred to as a remote facility. The regional or remote uplink facilities 16A-16F may be located at various locations throughout a landmass 18 such as the continental United States, including more or less than those illustrated. The regional or remote uplink facilities 16A-16F uplink various uplink signals 17 to satellite 12. The satellites downlink signals 19 to various users 20 that may be located in different areas of the landmass 18. The users 20 may be mobile or fixed users. The uplink signals 17 may be digital signals such as digital television signals or digital data signals. The digital television signals may be high definition television signals, standard definition signals or combinations of both. Uplinking may be performed at various frequencies including Ka band. The present disclosure, however, is not limited to Ka band. However, Ka band is a suitable frequency example used throughout this disclosure. The central facility or NOC 14 may also receive downlink signals 19 corresponding to the uplink signals 17 from the various regional or remote uplink facilities and from itself for monitoring purposes. The central facility 14 may monitor and control the quality of all the signals broadcast from the system 10.

The central facility 14 may also be coupled to the regional or remote uplink facilities through a network such as a computer network having associated communication lines 24A-24F. Each communication line 24A-F is associated with a respective regional or remote uplink site 16. Communication lines 24A-24F are terrestrial-based lines. As will be further described below, all of the functions performed at the regional or remote uplink facilities may be controlled centrally at the central facility 14 as long as the associated communication line 24A-F is not interrupted. When a communication line 24A-F is interrupted, each regional or remote uplink site 16A-F may operate autonomously so that uplink signals may continually be provided to the satellite 12. Each of the regional or remote uplink and central facilities includes a transmitting and receiving antenna which is not shown for simplicity in FIG. 1.

Each of the regional or remote uplink facilities 16A-16F may also be in communication with a local collection facility collectively referred to with reference numeral 30. As illustrated in FIG. 1, three local collection facilities are associated with each remote uplink facility 16. For example, remote uplink facility 16A has local collection facilities 30A, 30B and 30C associated therewith. Local collection facilities 30D-30S are associated with one of the other remote uplink facilities 16B-16F. Although only three local collection facilities are illustrated for each remote uplink facility 16, numerous local collection facilities may be associated with each remote uplink facility 16. The number of local collection facilities 30 may be numerous, such as 40 for each remote uplink facility. The number of local collection facilities 30 is limited by the amount of equipment and the capabilities thereof associated with each remote uplink facility 16.

The local collection facilities 30 are used for collecting local television stations in various designated marketing areas (DMA). As is illustrated, local collection facility 30A is located in DMA1 and local collection facility 30B is located in DMA2. For simplicity, only two DMAs are illustrated. However, each local collection facility may be located in a DMA.

The local collection facilities 30 may be in communication with each remote uplink facility 16 through a communication network 32. As will be described below, the communication network 32 may be an internet protocol (IP) network. The signals from the local collection facilities 30 may thus be video-over-IP signals. Each of the remote uplink facilities 16 are in communication with each local collection facility 30 through the communication network 32. As is illustrated, local collection facility 30A is in communication with the remote uplink facility 16A through communication network 32A, while local collection facility 30B is in communication with the remote uplink facility 16A through communication network 32B, and so on.

Referring now to FIG. 2, the regional or remote uplink facilities 16A-16F of FIG. 1 is illustrated collectively as reference numeral 16. The regional facilities 16 may actually comprise two facilities that include a primary site 40 (such as the remote uplink facility 16 above) and a diverse site 42. The primary site 40 may be referred to as a primary broadcast center (PBC). As will be described below, the central site 14 may also include a primary site and diverse site as is set forth herein. The primary site 40 and diverse site 42 of both the central and regional sites may be separated by at least 25 miles, or, more even more such as, at least 40 miles. In one constructed embodiment, 50 miles was used. The primary site 40 includes a first antenna 44 for transmitting and receiving signals to and from satellite 12. Diverse site 42 also includes an antenna 46 for transmitting and receiving signals from satellite 12.

Primary site 40 and diverse site 42 may also receive signals from GPS satellites 50. GPS satellites 50 generate signals corresponding to the location and a precision timed signal that may be provided to the primary site 40 through an antenna 52 and to the diverse site 42 through an antenna 54. It should be noted that redundant GPS antennas (52A,B) for each site may be provided. In some configurations, antennas 44 and 46 may also be used to receive GPS signals.

A precision time source 56 may also be coupled to the primary site 40 and to the diverse site 42 for providing a precision time source. The precision time source 56 may include various sources such as coupling to a central atomic clock. The precision time source 56 may be used to trigger certain events such as advertising insertions and the like.

The primary site 40 and the diverse site 42 may be coupled through a communication line 60. Communication line 60 may be a dedicated communication line. The primary site 40 and the diverse site 42 may communicate over the communication line using a video over internet protocol (IP).

Various signal sources 64 such as an optical fiber line, copper line or antennas may provide incoming signals 66 to the local collection facility 30. Incoming signal 66, as mentioned above, may be television signals. The television signals may be over-the-air high-definition signals, over-the-air standard television signals, or high or standard definition signals received through a terrestrial communication line. The incoming signals 66 such as the television signals may be routed from the local collection facility 30 through the communication network 30 to the primary site 40, or the diverse site 42 in the event of a switchover. The switchover may be manual or a weather-related automatic switchover. A manual switchover, for example, may be used during a maintenance condition.

Users 20 receive downlink signals 70 corresponding to the television signals. Users 20 may include home-based systems, business-based systems or multiple dwelling unit systems. As illustrated, a user 20 has a receiving antenna 72 coupled to an integrated receiver decoder (IRD) 74 that processes the signals and generates audio and video signals corresponding to the received downlink signal 70 for display on the television or monitor 76. It should also be noted that satellite radio receiving systems may also be used in place of the IRD 74. The integrated receiver decoder 74 may be incorporated into or may be referred to as a set top box.

The user 20 may also be a mobile user. The user 20 may therefore be implemented in a mobile device or portable device 80. The portable device 80 may include but are not limited to various types of devices such as a laptop computer 82, a personal digital assistant 84, a cellular telephone 86 or a portable media player 88.

Referring now to FIGS. 3, the local collection facility 30 is illustrated in more detail adjacent to the remote uplink facility (RUF) 16. As mentioned above, the local collection facility 30 is in communication with the remote uplink facility 16 through a network 32 such as an IP network. The local collection facility 30 is used for collecting signals in a designated marketing area or other area. The channel signals may be received as over-the-air television signals or through a direct local feed 102 such as an optical fiber or wire. The direct feed 102 may be in the form of an asynchronous series interface (ASI) signal. For an over-the-air signal, an antenna or plurality of antennas 100 are provided. The router signals are communicated to a plurality of receiver circuit modules 104A-E (collectively referred to as 104). The number of receiver circuit modules 104 depends upon various design parameters such as how many channels the designated market includes. Various numbers of receiver circuit modules 104 may be provided.

In addition to the receiver circuit modules 104, a monitor receiver circuit module 106 and a back-up receiver circuit module 108 may be included at the local collection facility 30. Each of the receiver circuit modules 104, 106, 108 may be monitored by a monitoring system as will be described below.

The details of the receiver circuit modules 104A-E, 106 and 108 will be further described below. The receiver circuit modules 104, 106, 108 generally include a receiver module 110 and an encoder module 112. The receiver module 110 is used to tune, demodulate and decode the over-the-air signals. The decoder within the receiver module 110 may decode received signals from MPEG2 format. The receiver circuit module 110, as will be described below, may include an ATSC receiver or an NTSC receiver. The receive signals are processed and encoded into a format such an IP format in the encoder 112. The encoder 112 may encode into MPEG4 format.

The monitor receiver circuit module 106 is used for generating monitor signals for one of the received channel signals. That is, although only one monitor receiver module 106 may be provided, the monitoring system may monitor one of the channel signals. This may be performed remotely through the network 32 from the remote uplink facility 16.

An incoming ASI router which is optional may also be in communication with the monitor receiving circuit module 106. The incoming ASI router 116 receives signals through the direct feed 102. The router 116 is used to select one of the ASI signals for input to the monitor receiving circuit module 106.

A back-up antenna switch 118 may be used to communicate one of the channel signals from the antenna 100 to the back-up receiving circuit module 108. The back-up antenna switch 118 provides a channel signal to the back-up receiving circuit module 108. Also, the incoming ASI router 116 may also provide a signal to the back-up receiving circuit module 108. The back-up receiving circuit module 108 may be used as a substitute for one of the receiving circuit modules 104A-E in the case of maintenance, failure, or the like.

The output of the receiving circuit modules 104A-E, 106 and 108 are in communication with a primary router 130 and a back-up router 132. A suitable example of a primary and back-up router is a Cisco® 7604. Preferably each of the receiving circuit modules 104, 106 and 108 are in communication with both the primary router 130 and the back-up router 132. An A-B switch 134 is used to generate an output signal corresponding to one of the primary router 130 or the back-up router 132. The routers 130, 132 route the IP signals through the switch 134 and through the network 32 which communicates the encoded channel signals to the remote uplink facility 16, diverse uplink facility and the network operation center. The routers 130, 132 and the switch 134 may be monitored and controlled by the compression system controlled or ABMS system described below.

A monitoring integrated receiver decoder (MIRD) 120 may also be provided within each local facility 30. The monitoring IRD 120 may provide monitoring signals to the monitor receiving circuit module 106. More specifically, the monitoring IRD 120 receives signals from the satellite corresponding to a tuned channel. The channel may be tuned through the monitoring system such as the compression system controller or the ABMS system, as will be described below. By providing the monitoring IRD 120, signals received from the satellite and broadcast to a particular local market may be monitored. That is, the same signals received in the local facility over the air or through the direct feed 102 and ultimately uplinked to the satellite may then be monitored by monitoring a downlink of the local signals. The monitoring system may control the tuning of the channel of the monitoring IRD 120. The monitoring system may also be used to monitor the output through the monitor receiving circuit module 106.

Referring now to FIG. 4, the remote uplink facility 16 may include an uplink signal processing system (USPS) 200. In a constructed embodiment several uplink signal processing systems 200 may be provided. This may include a secondary or back-up USPS (not shown). The encoded channel signals routed through the network 32 includes identification of the signal so that it may be properly routed to the proper uplink signal processing system. As described below, this may be done by multicasting. The uplink signal processing system 200 generates an output signal to an uplink RF system (URFS) 202 that includes a power amplifier 204. The output signal of each USPS 200 may correspond to one transponder of a satellite. The output signal is a multiplexed signal that may include both high definition television signals and standard definition television signals. The uplink signal processing system 200 may also provide redundant pairs of components to increase the reliability of the output signal. The pairs are provided so that less than the whole primary or secondary chain may be switched. That is, individual primary components may be replaced by back-up components.

The uplink signal processing system 200 may include an IP switch 208, a multiplexer 210, an advance transport processing system (ATPS) 212, and a modulator 214. Pairs of multiplexers 210, advance transport processing systems 212, and modulators 214 may be provided for redundancy. That is primary and back-up pairs of each may be provided.

The multiplexer 210 multiplexes the decoded channel signals from the local area network 32 into a multiplexed transport stream (MPTS). The multiplexer **210** may also act to insert advertising into the signal. Thus, the multiplexer **210** may act as a multiplexing module and as an ad insertion module. The multiplexer **210** may be a statistical multiplexer used to group signals from various local collection facilities. Various numbers of encoded channel signals may be multiplexed. In one constructed embodiment, eight channel signals were multiplexed at each multiplexer **210**. The multiplexer **210** may be a statistical multiplexer that may be used to join IP multicast groups together from more than one local collection facility.

The advance transport processing system (ATPS) **212** converts the transport stream from the multiplexer **210** into an advanced transport stream such as the DIRECTV® A3 transport stream. The ATPS **212** may support either ASI or MPEG output interface for the broadcast path. Thus, the ATPS **212** acts as an encryption module.

The modulators **214** modulate the transport stream from the ATPS **212** and generate an RF signal at a frequency such as an L-band frequency. An RF switch **216** is coupled to the primary modulator and back-up modulator **214**. The RF switch provides one output signal to the uplink RF system **202**. The USPS **200** may also be coupled to a quality control (QC) station console **250**. The quality control station console **250** may be coupled directly to the RF switch **216**. The quality control station console **250** may also be coupled to a communication monitoring bus **252**. The bus **252** may be used to communicate between a monitoring system **230**, used for monitoring and controlling the various components in the remote uplink facility, and the local collection facilities. The bus **252** may, for example, be in communication with a technical services (TS) monitor console **254**. The bus **252** may also be coupled to an advance broadcast management system (ABMS) server **256**. Both a primary server and a back-up server **256** may be used.

A compression system controller **260** may also be coupled to the bus **252** within the monitoring system **230**. As is illustrated, both a primary and back-up compression system controller **260** may be provided. The compression system controller **260** may be coupled to a broadcast management system **262** as will be further described below. The ABMS system **256** and the compression system controller **260** may be used to control various functions and monitor various functions of the remote uplink facility and the local collection facilities. These functions will be further described below.

The compression system controller **260** is a centralized server which is used to control and monitor the receiving circuit modules within the chain of a remote uplink facility. The compression system controller **260** may be used to manage, configure, control and monitor the receiving circuit modules and the encoders therein. The compression system controller **260** may also control the routers, switches and receivers within the receiving circuit modules. The compression system controller **260** may be physically located within the remote uplink facility. However, web access may be provided through a standard web browser for allowing users to interface, configure and control the various systems. In addition to controlling the receiving circuit modules and the statistical multiplexers, the compression system controller **260** may be used to initiate a redundancy switch to a back-up receiving circuit module or encoder within the local collection facilities. The compression system controller **260** may also be used to initiate a switch to a back-up statistical multiplexer within the remote uplink facility **16**. The compression system controller may also be used to update the remote broadcast management system **262**.

Each of the components of the USPS **200** may be coupled to the bus **252**. That is, the primary and back-up multiplexers **210**, the primary and back-up ATPS's **212**, the primary and back-up modulators **214** and the RF switch **216** may all be coupled to the bus **252**.

The ABMS system **256** may be used for various monitoring and controlling functions at the remote facility and the various local facilities. Monitoring may include monitoring transport level errors, video outages, audio outages, loss of connection from a redundancy controller or a data source or a compression system controller **260**.

The remote uplink facility may also include the diverse uplink facility or diverse site **42**. The diverse site may receive signals from the primary ATPS **212** in the event of a modulator **214** or switch failure **216**. The transport stream signals provided from the primary advanced transport processing system **212** are communicated to the primary modulator and back-up modulator **214'** of the diverse facility **42**. An RF switch **216'** may be used to couple the output of either the primary modulator or the back-up modulator **214'** to the uplink RF system **202**. The ABMS system **256'** may also be used to monitor the output of the diverse uplink facility **256'**.

The network operation center **14** may be coupled the IP network **32**. The network operation center may also be coupled to the remote uplink facility through an ATM or IP network **280**. The network operation center may have a monitor and control console **282** and a monitoring decoder **284** for monitoring and controlling various functions of the various remote uplink facilities. The network operation center monitor and control console **282** may also be used to control and monitor the various local collection facilities **30**. This may be performed directly or through the compression system controller **260**.

Referring now to FIG. **5**, the monitoring system **230** of FIG. **4** is illustrated in further detail. The monitoring system receives signals through the network **32**. As mentioned above, feeds from various uplink systems such as various IF switches **226**, may be provided to an L-band router **300**. An ASI router **302** may be used to route the signals from the local collection facilities to a decoder **304**. The decoder may be an ATSC decoder. Decoder **304** may be optional should the signals already be decoded at the local collection facility. The L-band router **300** may be in communication with a monitor IRD **306**. The output of the monitor IRD **306** and the decoders **304** are provided to a multi-viewer or plurality of multi-viewers **308**. A remote uplink facility monitor router **310** is used to provide signals to the monitor network encoders **312** which in turn provide signals to a monitor feed network **314**. The L-band routers may also provide signals to a demodulator **316**. The output of the demodulator **316** and the monitor network encoders **312** may be provided to the monitor feed network **314**. The monitor feed network **314** may be various types of transmission means used to communicate between the remote uplink facilities **16** and the network operation center **14**.

The remote uplink facility **16** may generate monitoring display **350** as well. The monitoring displays **350** may also be used to control the various functions at the local collection facilities. The monitoring displays may be in communication with the monitor router **310**.

The network operation center **14** may include an ASI router **330** for the selection of signals from a particular remote uplink facility. The ASI signals may be routed to an ATSC decoder **332** and a monitor IRD **334**. The ATSC decoder **332** may provide the signals to a monitor router **336**. A monitor wall **338** may be used to generate monitoring signals for use at the network operation center. A workstation **340** may also receive the signals from the network operation center monitor router 336. The ATSC decoders 332 and the monitor IRDs 334 may provide the signals to a quality assurance (QA) room 342. Screen displays at the monitor wall 338, the workstation 340 and the quality assurance room 342 are used for monitoring the various remote uplink facilities. The workstation 340 may also be used for control purposes. Signals are provided to the remote uplink facility and ultimately to the local collection facilities should a problem arise with the signals. Ultimately the control signals may be communicated back through the network 32.

The network operation center 14 may also include multiple workstations 340 as well as a large monitor wall 338. The workstations 340 may have access to various control surfaces that can configure the monitor walls 338 as well as signals fed to the various monitors at the station.

Control of the on-air failure recovery devices as well as the monitoring functions for every LCF and RUF are accomplished through control surfaces such as touch screens and keyboards together with a GUI at the workstations 340 in the network operation center 14. The control surfaces may be application-specific and present the status and control options for various multiple configurations for the application. The quality assurance room 342 may not have any control functions therein. The monitors 350 may be coupled to the monitor network encoders 315 for displaying various views from the remote uplink facility and the local collection facilities.

Further, the decoders 332 may be MPEG decoders since the signal may be in MPEG form (IP) when received from the remote uplink facility.

Referring now to FIG. 6A, a local collection facility monitor within a remote facility is generated having four local collection facility channels 410, 412, 414, and 416. Each display may also include an under-monitor display 418 used to identify the particular channel signal. The under-monitor displays 418 may display the actual channel number, the station identification or other information and the like.

In FIG. 6B, an uplink monitor is illustrated having an uplink channel one 420, an uplink channel two 422, an uplink channel three 424, and an uplink channel four 426. An under-monitor display 428 may also be included with each of the displays 420-426. The uplink channels receive the uplink channel signals so that they may be monitored. The uplink channel signals provide an indication as to the uplink channel. Various selections may be made for the particular uplink channels for the particular remote uplink facilities.

FIG. 6C includes an uplink channel signal 440 and a local collection facility IRD signal 442. The local collection facility IRD signal 442 may be received through the monitoring IRD located at the local collection facility. This is illustrated in FIG. 3 as reference numeral 120. The display may also display a channel from the local collection facility, the back-up receiver channel or the local collection facility monitor receiver. Both displays 440 and 442 may include an under-monitor display 450.

Referring now to FIG. 7, a method for changing or controlling a back-up receiving circuit module at a local collection facility from a remote collection facility is illustrated. In step 512, the monitoring system 230 identifies a channel and a local collection facility associated with the channel. This may be performed at a broadcast operation center channel or the like. This may also be performed at the network operation center 14. The channel may be identified by using the various monitors at the network operation center or the remote uplink facility as described above.

In step 514, the method includes commanding the monitor ASI router 302 of FIG. 5 to switch to the router input corresponding to the designated LCF monitor network adapter output to the ASI router output defined for the requesting console thread decoder input. The thread decoder may then be tuned to the station identification defined for the local channel source for the broadcast operation center in step 516. In step 518, it is determined whether the signal is an ASI signal received through a direct feed or an RF signal communicated through an RF antenna. In step 520, if the signal is an RF signal, the antenna switch 118 of FIG. 3 is commanded to feed the back-up receiver and the back-up receiver module 108 is tuned in step 522. It should be noted that the back-up receiver may be tunable, whereas the other receivers in the receiver circuit modules 104 may be fixed-tuned.

Referring back to step 518, if the signal is an ASI signal, the back-up receiver module is switched to the particular ASI input. This may be done through the ASI router 116 of FIG. 3. After step 524, the back-up receiver is tuned in step 522.

In step 526, the local collection facility ASI router is commanded to switch to the back-up receiver input to monitor the channel feed output at the network adapter. In step 528, a preview of the back-up signals is provided at the remote uplink facility. As mentioned above, the signal may also be provided to the network operation center.

In step 530, other channels are prevented to switch to the back-up receiver. In step 532, if the signal is not acceptable a preview is continued in step 528. In step 532, if the previewed signal is acceptable a switch to the back-up receiver is performed in step 534. In step 538, the monitoring system commands the system to mirror and switch to the back-up encoder if available. Mirroring means communicating any of the set-up configuration parameters from the receiver circuit module in question to the backup receiver circuit module. In step 538, if verification is received that the back-up receiver has been employed in the broadcast signal. In step 540, a notification is provided to the operation that a successful transition to the back-up encoder is provided.

Referring now to FIG. 8, a method of controlling the monitoring portion of the local collections facility is illustrated. To monitor a particular channel, the antenna switch may be switched to receive an ASI signal or an over-the-air antenna signal. The monitor antenna switch 114 of FIG. 3 may be controlled through the routers 130, 132 from the monitoring and control system. The signal from the switch 114 is provided to the monitor receiving circuit module 106 of FIG. 3. In addition, the monitoring IRD 120 of FIG. 3 may generate an output signal. The output signal may be tuned or controlled from the monitoring system through the routers 130, 132. In step 614, the monitoring IRD output signal is provided to the monitor receiving module where it is provided to the monitoring system through the routers 130, 132.

In step 616, the switch signal or the monitoring IRD output signal, or both, are provided to the remote facility from the local facility through the routers 130, 132. In step 618, the signals are monitored and controlled at the monitoring system. The monitor receiving circuit may be used for monitoring various signals including a received antenna signal downlinked from the satellite so that verification of the entire process may be monitored.

Referring now to FIG. 9, a method for monitoring and controlling the remote facility is illustrated. In this example, various aspects of the remote facility may be monitored and controlled. For example, the multiplexers 210, the ATPS 212, the primary modulator 214 may all be switched from primary to back-up modulators individually. In step 710, a channel for monitoring is identified in the monitoring system. In step 712, the transponder corresponding to the channel is identified. As mentioned above, more than one local collection facility may feed a particular transponder. Each USPS 200 corresponds to a plurality of signals that may be from various local collection facilities. In step **714**, the USPS for the particular channel is identified. In step **616**, a component to switch is determined. If a multiplexer is chosen, step **720** is performed. In step **720**, an identification of the CSC controller for the particular channel is chosen. In step **722**, it is determined whether a back-up multiplexer is available. If no back-up multiplexer is available, step **724** is performed. In step **722**, if a back-up, back-up multiplexer is available, step **726** is performed. In step **726**, a command is generated for swapping between the primary and back-up multiplexer. This may be performed with one of the various screens identified above. In step **728**, a verification is generated to confirm that a switch from a primary to a back-up multiplexer has taken place. In step **730**, a "complete" message may be generated by the system to indicate to the operator that switching from a primary to a back-up multiplexer has been performed. It should be noted that the above steps and the steps described below for switching may be performed at a primary or engineering USPS.

Referring back to step **716**, if an ATPS system is selected for component switching, step **740** identifies the state of the ATPS pair. The state may include an on-line and off-line status for each ATPS. In step **742**, if the back-up ATPS is not available, step **724** is executed in which the system ends. In step **742**, if a back-up ATPS is available, step **744** commands a swap from the primary to the back-up ATPS. In step **748**, a verification signal is generated to the monitoring system to confirm that a switch has been performed. In step **750**, a "complete" message may also be generated to indicate that the switch from the primary to the back-up ATPS may be performed or was performed.

Referring back to step **716**, if the modulator was the component to switch, then step **760** is performed. In step **760**, a modulator pair corresponding to the channel is identified. In step **762**, the state of the IF or RF switch is identified. In step **764**, if the back-up modulator is available or is not available, step **765** ends the process. In step **764**, if a back-up modulator is available, step **766** commands the switch to switch inputs from the primary to the back-up modulator. In step **768**, verification is performed to verify that a switch is taking place. In step **770**, a "complete" message may be generated to verify that switching from the primary to a back-up modulator has been performed.

As can be seen above, only one of the multiplexers, ATPS, or modulator may be selected for switching. In other words, less than the entire USPS chain may be switched. The above process may be performed depending on the transponder redundancy mode in the monitoring system. In a manual mode, individual components may be requested to be switched to the back-up function. In an automated mode, only the entire chain may be switched. That is, the primary multiplexer **210**, ATPS **212**, and modulator **214** may be switched from the primary ATPS to the back-up ATPS.

Those skilled in the art can now appreciate from the foregoing description that the broad teachings of the disclosure can be implemented in a variety of forms. Therefore, while this disclosure includes particular examples, the true scope of the disclosure should not be so limited since other modifications will become apparent to the skilled practitioner upon a study of the drawings, the specification and the following claims.

What is claimed is:

1. A method of controlling a signal processing system comprising:

receiving channel signals at a local collection facility;

encoding the channel signals into IP signals;

communicating IP signals from the local collection facility to a remote facility;

multiplexing IP signals to form a multiplexed signal at a primary multiplexer at the local collection facility;

multiplexing IP signals to form the multiplexed signal at a backup multiplexer at the local collection facility;

forming a transport stream signal by encrypting the multiplexed signal at a primary transport processing system;

forming the transport stream signal by encrypting the multiplexed signal at a backup transport processing system;

modulating the transport stream signal to form a modulated signal at a primary modulator;

modulating the transport stream signal to form the modulated signal at a backup primary modulator;

forming a first output signal from the modulated signal; and

forming an output signal using at least one of the primary multiplexer, the primary transport processing system, and the primary modulator and at least one of the backup multiplexer, the backup transport processing system and the backup modulator.

2. A method as recited in claim **1** wherein receiving channel signals comprises receiving a plurality of over-the-air channel signals at the local collection facility.

3. A method as recited in claim **1** wherein receiving channel signals comprises receiving, channel signals through a wire or optical fiber connection at the local collection facility.

4. A method as recited in claim **1** wherein forming an output signal comprises forming an uplink signal from the modulated signal; and

uplinking the uplink signal to a satellite from the remote facility.

5. A method as recited in claim **1** further comprising controlling the local collection facility from the remote facility.

6. A method as recited in claim **1** further comprising controlling the local collection facility from a network operation center.

7. A method as recited in claim **1** further comprising monitoring the primary multiplexer, the primary transport processing system, the primary modulator and generating a monitoring signal.

8. A method as recited in claim **7** wherein controlling comprises controlling from a monitoring system in a remote facility in response to monitoring.

9. A method as recited in claim **7** wherein controlling comprises controlling using a monitoring system in a network operation center disposed apart from a remote facility in response to monitoring.

10. A system comprising:

an IP network;

a remote facility comprising:

a signal processing system including

a primary multiplexer multiplexing IP signals to form a multiplexed signal;

a primary transport processing system forming a transport stream signal by encrypting the multiplexed signal;

a primary modulator modulating the transport stream signal to form a modulated signal;

a backup multiplexer multiplexing IP signals to form the multiplexed signal;

a backup transport processing system forming the transport stream signal by encrypting the multiplexed signal;

a backup modulator modulating the transport stream signal to form the modulated signal; and a controller in communication with the primary multiplexer, the primary transport processing system, the primary modulator, the backup multiplexer, the backup transport processing system and the backup modulator, said controller forming an output signal using at least one of the primary multiplexer, the primary transport processing system, and the primary modulator and at least one of the backup multiplexer, the backup transport processing system and the backup modulator; and

a local collection facility in communication with the remote facility through the IP network, said local collection facility receiving channel signals, encoding the channel signals into respective IP signals, communicating the respective IP signals through an IP network to the remote facility.

11. A remote facility as recited in claim **10** wherein the controller is in communication with the primary modulator and the backup modulator through a switch.

12. A remote facility as recited in claim **10** wherein the controller comprises a monitoring system.

13. A remote facility as recited in claim **12** wherein the monitoring system is disposed in a network operations center.

14. A remote facility as recited in claim **10** further comprising a primary IP switch and a backup IP switch.

15. A remote facility as recited in claim **10** wherein the controller monitors the primary multiplexer, the primary transport processing system, the primary modulator and controls forming the output signal in response to monitoring.

16. A system as recited in claim **10** wherein the IP signals comprise video-over-IP signals.

17. A system as recited in claim **10** wherein the channel signals comprise terrestrial over-the air channel signals received through an antenna.

18. A system as recited in claim **10** wherein the channel signals comprise standard definition terrestrial over-the air channel signals received through an antenna.

19. A system as recited in claim **10** wherein the channel signals comprise high definition terrestrial over-the air channel signals received through an antenna.

20. A system as recited in claim **10** wherein the local collection facility comprises a plurality of local collection facilities.

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