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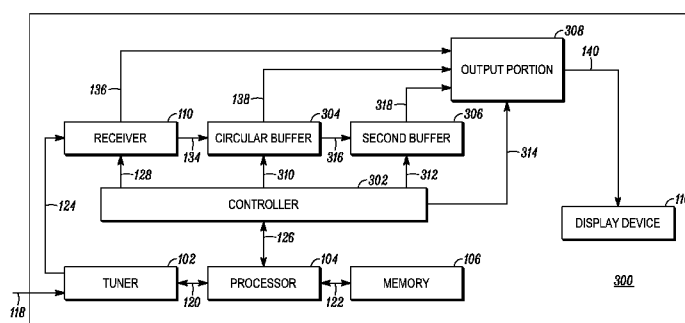


FIG. 3

(57) Abstract: An aspect of the present invention provides a device for use with a stream of video content and a video display. The device includes a receiver, a circular buffer, an output portion, a controller and a second buffer. The receiver receives the stream of video content. The circular buffer stores up to a predetermined first length of the stream of video content as buffered video content. The output portion outputs a first video signal, based on the buffered video content, to the video display. The controller controls the output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content. The second buffer stores a portion of the buffered video content as stored video content. The output portion outputs a second video signal, based on the stored video content, to the video display. The circular buffer continues to store the stream of video content when the controller controls the output portion to output the first video signal as one of the paused portion of the buffered video content and the previously played portion of the buffered video content. When the circular buffer stores the stream of video content for a second length that is greater than the first length, the controller can further control the second buffer to store a predetermined portion of the second length as the portion of the buffered video content.

DEVICE AND METHOD FOR RECORDING VIDEO CONTENT

BACKGROUND

[0001] The present invention relates to the field of digital broadcasting, in particular, storage of multimedia content in digital video recorders (DVR) or Set-Top-Boxes (STB).

[0002] With the advent of Digital TV/DVR and media delivery systems like IPTV (Internet Protocol Television) and VOD (Video On Demand), consuming media (video/audio) content has become very flexible. Modern STBs provide the users with flexibility to record the video contents and watch it later at their own convenience. A DVR records the digital video content on a storage device, which can store several hours of video content. Some STBs come with multiple tuners, which provide the users flexibility to record or watch multiple programs on multiple windows. STBs or DVRs are examples of CPE (Customer Premises Equipment), and are used interchangeably in this application.

[0003] A conventional STB supports Live-Off-Disk (LOD) mode, which allows the users to perform trick plays (pause, rewind, fast forward) on the live television content. Conventional STBs make use of a circular buffer for temporary storage of such LOD content. This is explained further using a conventional STB with the help of **FIG. 1**.

[0004] **FIG. 1** illustrates a conventional STB **100**.

[0005] As illustrated in the figure, conventional STB **100** includes a tuner **102**, a processor **104**, a memory **106**, a controller **108**, a receiver **110**, a circular buffer **112**, an output portion **114** and a display device **116**. In this example, tuner **102**, processor **104**, memory **106**, controller **108**, receiver **110**, circular buffer **112**, output portion **114** and display device **116** are distinct elements. However, in some embodiments, at least two of tuner **102**, processor

104, memory **106**, controller **108**, receiver **110**, circular buffer **112**, output portion **114** and display device **116** may be combined as a unitary element.

[0006] Further, in some embodiments, at least one of processor **104**, memory **106**, controller **108**, receiver **110**, circular buffer **112** or output portion **114** may be implemented as a non-transient, tangible, computer-readable media for carrying or having computer-executable instructions or data structures stored thereon. Such non-transient, tangible, computer-readable media can be any available media that can be accessed by a general purpose or special purpose computer. Non-limiting examples of non-transient, tangible, computer-readable media include physical storage and/or memory media such as RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to carry or store desired program code means in the form of computer-executable instructions or data structures and which can be accessed by a general purpose or special purpose computer. When information is transferred or provided over a network or another communications connection (either hardwired, wireless, or a combination of hardwired or wireless) to a computer, the computer properly views the connection as a non-transient, tangible, computer-readable medium. Thus, any such connection is properly termed a non-transient, tangible, computer-readable medium. Combinations of the above should also be included within the scope of non-transient, tangible, computer-readable media.

[0007] Tuner **102** is arranged to receive a data signal **118** and to output a signal **124** to receiver **110**. Data signal **118** may be a MPEG1/2/4 Transport Stream (TS) carrying the stream of video content including audio, video and protocol data transmitted by a headend (not shown).

[0008] Processor **104** is arranged to bi-directionally communicate with tuner **102** via a signal **120**; bi-directionally communicate with memory **106** via a signal **122**; and bi-directionally communicate with controller **108** via a signal **126**. Memory **106** may include program memory and/or data memory for storage. Memory **106** may also include a hard disk drive.

[0009] Controller **108** is arranged to communicate with receiver **110** via a signal **128**; communicate with circular buffer **112** via a signal **130**; and communicate with output portion **114** via a signal **132**. Controller **108** is operable to receive instructions from processor **104** to

provide controls to receiver **110**, circular buffer **112** and output portion **114** to support trick plays as requested by the user.

[0010] Output portion **114** receives the live media content from receiver **110** via a signal **136** and the buffered media content from circular buffer **112** via a signal **138**. Controller **108** provides a select signal **132** to output portion **114** for selecting the media data received from receiver **110** or circular buffer **112**. Output portion **114** provides the selected media data to display device **116** via a signal **140**.

[0011] Once tuner **102** is tuned to a channel, processor **104** instructs controller **108** to start receiving the media data in receiver **110**. Receiver **110** communicates with circular buffer **112** via a signal **134** for temporary storage of data. Conventional STB **100** supports LOD mode, thus allowing users to pause live media content and be able to rewind the media content for an amount of time as limited by the capacity of circular buffer **112**. As the media data is being received by receiver **110**, it is also temporarily stored in circular buffer **112** in order to provide trick play features to the user. Circular buffer **112** is a finite length of memory; therefore when circular buffer **112** is full and a subsequent write is performed, the oldest data in circular buffer **112** is overwritten. The functionality of circular buffer **112** is explained in detail with the help of **FIG. 2**.

[0012] **FIG. 2** illustrates an example embodiment of circular buffer **112**.

[0013] As illustrated in **FIG. 2**, a length **200** of circular buffer **112** is divided in to different blocks of data ranging from **202-228**. Block *a* starting at an address **202** is the oldest data written in circular buffer **112** with a length *b* and an end address indicated by block **212**. Another block *m* starting at an address **214** with a length *n* and an end address indicated by block **222** wraps around the boundary of circular buffer **112**. Blocks *x*, *y* and *z* are the recent blocks at addresses **224**, **226** and **228** respectively, block *z* being the most recent. In one example, different blocks of data may correspond to different programs stored in LOD mode.

[0014] Once tuner **102** is tuned to a channel, media data is stored in circular buffer **112**. When the user wishes to view the media data, it is read from circular buffer **112** and displayed on display device **116** via output portion **114**. The use of circular buffer **112** allows the user to perform trick plays on the media content, for example, the user; can 'pause' the live media content, which is being displayed through circular buffer **112**; can 'rewind' up to

certain duration; or can replay the media content. Since circular buffer **112** is of finite length, it only stores a certain amount of data and as the new data comes in, old data keeps getting overwritten in circular manner.

[0015] In LOD mode, when the user wishes to 'pause' the viewing, circular buffer **112** continues storing the new data. If the user does not 'resume' soon enough, portions of user desired content, which might have happened during the pause period, can get lost because the data stored in circular buffer **112** gets overwritten by the new data. Referring back to **FIG. 2**, as an example, if the user was watching a program, which is part of blocks **214-222**, the new data will start storing at address **202** and if the user did not 'resume' soon enough, the new data will overwrite the blocks **214-222**, resulting in the loss of user desired content. Further, in the case of when the user does not 'resume' from a 'pause' position then after a certain time all the contents of circular buffer **112** are overwritten.

[0016] What is needed is a system and method for storing media content, in order to minimize loss of media content during DVR trick plays.

BRIEF SUMMARY

[0017] The present invention provides a system and method for storing media content, in order to minimize loss of media content during DVR trick plays.

[0018] The present invention provides a device for use with a stream of video content and a video display. The video display can display a video based on the stream of video content. The device includes a receiver, a circular buffer, an output portion, a controller and a second buffer. The receiver is arranged to receive the stream of video content. The circular buffer can store up to a predetermined first length of the stream of video content as buffered video content. The output portion can output a first video signal, based on the buffered video content, to the video display. The controller can control the output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content. The second buffer can store a portion of the buffered video content as stored video content. The output portion can further output a second video signal, based on the stored video content, to the video display. The circular buffer can further continue to store the stream of video content when the controller controls the output portion to output the first video signal as one of the paused portion of the buffered video content and the previously played portion of the

buffered video content. When the circular buffer stores the stream of video content for a second length that is greater than the first length, the controller can further control the second buffer to store a predetermined portion of the second length as the portion of the buffered video content.

[0019] Additional advantages and novel features of the invention are set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following or may be learned by practice of the invention. The advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF SUMMARY OF THE DRAWINGS

[0020] The accompanying drawings, which are incorporated in and form a part of the specification, illustrate an exemplary embodiment of the present invention and, together with the description, serve to explain the principles of the invention. In the drawings:

[0021] **FIG. 1** illustrates a conventional STB;

[0022] **FIG. 2** illustrates an example embodiment of circular buffer;

[0023] **FIG. 3** illustrates an example STB in accordance with an aspect of the invention;

[0024] **FIGS. 4A-4C** illustrate different embodiments of multiplexing the metadata with the media content in accordance with aspects of the invention;

[0025] **FIG. 5** illustrates an example embodiment of data transfer between a circular buffer and a second buffer in accordance with an aspect of the invention; and

[0026] **FIG. 6** is a flow chart of an example method of operation of the STB of **FIG. 3**, in accordance with aspects of the present invention.

DETAILED DESCRIPTION

[0027] Aspects of the present invention provide a system and method, where in LOD mode, user desired media content is copied from the circular buffer to a second buffer based on metadata such that the media content is not lost when the circular buffer is overwritten. A non-limiting example of metadata includes a keyword.

[0028] In one embodiment of the invention, the second buffer is a linear buffer, which stores the designated portions of the circular buffer sequentially, marked by individual keywords. An STB including a second buffer in accordance with an aspect of the invention is explained in detail with the help of **FIG. 3**.

[0029] **FIG. 3** illustrates an STB **300** in accordance with an aspect of the invention.

[0030] As illustrated in the figure, STB **300** includes a controller **302**, a circular buffer **304**, a second buffer **306**, and an output portion **308**, in addition to few components of STB **100**, namely, tuner **102**, processor **104**, memory **106**, receiver **110** and display device **116**. In this example, tuner **102**, processor **104**, memory **106**, controller **302**, receiver **110**, circular buffer **304**, second buffer **306**, output portion **308** and display device **116** are distinct elements. However, in some embodiments, at least two of tuner **102**, processor **104**, memory **106**, controller **302**, receiver **110**, circular buffer **304**, second buffer **306**, output portion **308** and display device **116** may be combined as a unitary element.

[0031] Further, in some embodiments, at least one of tuner **102**, processor **104**, memory **106**, controller **302**, receiver **110**, circular buffer **304**, second buffer **306**, output portion **308** and display device **116** may be implemented as a non-transient, tangible, computer-readable media for carrying or having computer-executable instructions or data structures stored thereon. Such non-transient, tangible, computer-readable media can be any available media that can be accessed by a general purpose or special purpose computer.

[0032] Controller **302** is arranged to communicate with circular buffer **304** via a signal **310**; communicate with second buffer **306** via a signal **312**; and communicate with output portion **308** via a signal **314**. Circular buffer **304** is arranged to function similar to circular buffer **112** except that it interfaces with second buffer **306** via a signal **316**. Second buffer **306** is arranged to communicate with output portion **308** via a signal **318**.

[0033] In LOD mode, when tuner **102** is tuned to a channel as initiated by the user, media content starts recording on circular buffer **304** followed by reading from circular buffer **304** for displaying on display device **116**, as controlled by controller **302**. Note that the writing and reading to circular buffer **304** is performed in order to support trick plays on the media content instead of directly displaying the media content as received by receiver **110**. In order to avoid losing the media content because of circular buffer **304** getting overwritten during

trick play mode, the method, in accordance with aspects of the invention, suggests copying portions of the media content that is stored in circular buffer **304**, to second buffer **306** by attaching metadata, such as a keyword, to the user desired portions of the media content stored in circular buffer **304**. Different steps of the method are described below in detail.

[0034] In one embodiment of the invention, the program guide for television programs is forwarded from STB **300** to user's mobile device or computer for the user to select the desired programs. Controller **302** is operable to generate an interface for the user. Any known type of graphic user interface may be used. The interface enables the user to control the media content, such as for example by playing in real time, pausing buffered portions of the video content, and rewinding and playing previously played portions of the buffered video content. The interface additionally enables the user to specify different keywords for individual programs on his mobile device or computer, which is shared by STB **300** or the content server on the headend (not shown). As an example, for sports program, keywords could be 'goal', 'penalty', 'homerun' or 'touchdown'. For movie programs, some example keywords are "actor name" or "songs".

[0035] In another embodiment, the program keyword could be a scene description described using a scene description language. With the use of a scene description language, a media scene can be described using simple text, for example, ASCII (American Standard Code for Information Interchange). Some non-limiting examples of XML (Extensible Markup Language) based scene description languages are 3DMLW and X3D.

[0036] In one embodiment, metadata is concatenated to the user desired media content. In one embodiment, the media content is described in MPEG 2/4/7 format such that any of the below mentioned formal schemes may be used to identify and address the media content. For example, MPEG7 provides information about the content by tagging particular events and storing the associated metadata in order to allow fast and efficient searching of material that is of the interest to the user. Multimedia Description Schemes (MDS) are metadata structures, which are used for describing and annotating AV (Audio Visual) content. MDS provide a standardized way of describing the AV content and content management in XML in order to facilitate searching, indexing, filtering and access of multimedia data.

[0037] In one embodiment, MPEG4 audio/video objects is described using MPEG Syntax Description Language (MSDL) as metadata for the media content.

[0038] In one embodiment, Digital Asset Management (DAM) is employed for indexing, storing, searching and retrieving media content through metadata tags.

[0039] In another embodiment, the program keywords are associated with the CC (Closed Captions) or VBI (Vertical Blanking Interval) for a program.

[0040] In accordance with aspects of the invention, the keyword or the metadata is fed to the TS multiplexer along with corresponding A/V (Audio/Video), where the process ID (PID) assigned to the keyword/metadata is different than the PIDs assigned to A/V data. Some non-limiting examples of embedding more information in the media content using metadata are VBI, text, CCI and object descriptors. In one embodiment, metadata is multiplexed along with the media content before feeding to the TS multiplexer. This is explained further with the help of **FIGs. 4A-4C**.

[0041] **FIGs. 4A-4C** illustrate different embodiments of multiplexing the metadata with the media content in accordance with aspects of the invention.

[0042] As illustrated in **FIG. 4A**, a headend **402** provides media content with the program guide to a TS multiplexer **404** via a link **408**. For illustration purposes, media content is divided in to program1 on an input **412**, program2 on an input **414** and program 3 on an input **416**. In this example embodiment, metadata **418** is multiplexed with media content and a program guide **420**. A multiplexed TS **410** is broadcasted via a communication link **406** to STB **300**.

[0043] **FIG. 4B** illustrates another example embodiment, where the metadata is multiplexed with the media content itself. As illustrated in the figure, a program1 with metadata1 is provided on input **424**, a program2 with metadata2 is provided on input **426**, a program3 with metadata3 is provided on input **428**, and a program4 with metadata4 is provided on input **430**.

[0044] **FIG. 4C** illustrates another example embodiment, where the metadata is multiplexed with a program guide **432**.

[0045] As discussed with reference to **FIGs. 4A-4C**, metadata or keywords can be multiplexed with the media content or the program guide before feeding to TS multiplexer **404**, in accordance with aspects of the invention. The metadata or keywords can be created with any of the schemes discussed earlier.

[0046] STB **300** tunes to a program and presents it to the user in LOD mode, i.e., media content is being recorded on circular buffer **304**. Controller **302** monitors currently tuned program to search for the keywords provided by the user. For the purposes of discussion, assume that the keywords associated with that program are 'penalty' and 'goal'. If the user decides to 'pause' the program and during the 'pause' period, if an event with the keyword 'penalty' or 'goal' happens then controller **302** marks that portion of circular buffer **304**, which has this event. The marked portion of circular buffer **304** is copied to second buffer **306** as instructed by controller **302**. This is further explained in detail with the help of **FIG. 5**.

[0047] **FIG. 5** illustrates an example embodiment of data transfer between circular buffer **304** and second buffer **306** in accordance with an aspect of the invention.

[0048] As illustrated in the figure, circular buffer **304** is holding media content that is divided in to different blocks. The basic functionality of circular buffer **304** is similar to circular buffer **112**. The oldest data written in circular buffer **304** has a start address **502** and an end address **504**. The next data block has a start address **506** and an end address **512** with wrap around occurring at boundaries **508** and **510**. Blocks **224**, **226** and **228** are recent data blocks similar to circular buffer **112**.

[0049] Second buffer **306** has a length **500** and is also divided in to blocks with start and end addresses ranging from **526-528**, **530-532**, **534-536**, **538-540** and **542-544**.

[0050] As discussed with additional reference to **FIG. 3**, first media content, with a predetermined length, starts recording in circular buffer **304** from start address **502**. Suppose that the keyword 'goal' occurs at an address **522**. Controller **302** designates the keyword position by marking a start address that is few seconds before the keyword and an end address that is few seconds after the keyword. In this example embodiment, controller **302** designates the keyword position by marking a start address **514**, which is at a time **548** before keyword **522** and an end address **516**, which is at time **550** after keyword **522**.

[0051] In this example embodiment, controller **302** instructs circular buffer **304** to store a first-in portion of the media content to second buffer **306**, wherein the first-in portion of the media content is the oldest content. Controller **302** initiates copying of the first media content between start address **514** and end address **516** of circular buffer **304** to a first

location in second buffer **306** marked by a start address **530** and an end address **532**. Note that second buffer **306** contains a copy of previous media content between a start address **526** and an end address **528**.

[0052] Suppose that the first media content ended at address **504** and another program starts recording at address **506** with a keyword 'Pacino' associated with that program. Suppose that the keyword 'Pacino' happened at an address **524**. In this example embodiment, controller **302** designates the keyword position by marking a start address **518**, which is at a time **546** before keyword **524** and an end address **520**, which is at time **546** after keyword **524**. Time **546** can be a variable, which is controlled by processor **104**.

[0053] Controller **302** initiates copying of the second media content between start address **518** and end address **520** of circular buffer **304** to a second location in second buffer **306** marked by a start address **534** and an end address **536**. Note that the second location in second buffer **306** is right after the first location, where the first media content was copied, so that the two copies are concatenated. This example embodiment illustrates a copy of a third media content at a start address **538** and an end address **540**, which may have been marked by another instance of keyword 'Pacino' in circular buffer **304**. Note that second buffer **306** has not been written yet between a start address **542** and an end address **544**.

[0054] Lets assume that the user did not resume from 'pause' position for time long enough that circular buffer **304** is full. Now any new data that needs to be written in circular buffer **304** has to be stored after the most recent block **228**, starting at address **502**. If the size of the new data block is bigger than the first media content, that is, it continues after end address **504**, the user desired data with associated keywords gets overwritten. However, second buffer **306** holds a copy of portions of the first media data associated with the keywords in accordance with aspects of the invention. For all the events, which happen between the 'pause' position and the 'resume' position are copied to second buffer **306** in concatenation.

[0055] When the user 'resumes' from the 'pause' position, there are few options provided by controller **302** for viewing the media content. In one embodiment, the user can watch the live telecast, that is, output portion **308** feeds the media content from receiver **110** to display device **116**.

[0056] In another embodiment, the user first watches the keyword based media content stored in second buffer **306** before watching the live telecast. In this case, output portion **308** first feeds the stored media content from second buffer **306** before feeding the media content from receiver **110** to display device **116**.

[0057] In another embodiment, the user resumes from the 'pause' position and continues watching the remaining program. In this case, output portion **308** feeds the media content from circular buffer **304** to display device **116**. Note that in this case, some of the user desired contents may have been overwritten in circular buffer **304**, even though their copy exists in second buffer **306**.

[0058] In one embodiment, the user can watch the keyword based media content stored in second buffer **306** on PIP (Picture In Picture) window, while watching the live telecast on main window.

[0059] During the 'pause' period, if circular buffer **304** is wrapped few times, portions of all the keyword tagged media content are stored in timely manner on second buffer **306** to provide flexibility to the user for trick plays. Since the copied content on second buffer **306** are stored linearly, the user can perform fast forward (FF) on the contents if desired. At the same time, circular buffer **304** contains latest time shifted data in LOD mode, therefore, providing flexibility to perform trick plays on it.

[0060] In case of VOD, the user may desire to 'pause' and resume' in some situations. Aspects of the invention can be used to provide flexibility to watch keyword tagged contents first, before resuming to the live content. In this case, LOD mode may be performed on the storage attached to the network that is providing the VOD.

[0061] There may be situations where it is not desired to have the second buffer **306** grow indefinitely. Accordingly, in another embodiment, second buffer the **306** may be pruned. In some example embodiments, the second buffer **306** may be pruned when its limit is reached. For example, the second buffer **306** instructed to only maintaining a first and last event block, or some sampled event blocks between the first and the last event block.

[0062] An example method of consuming content in accordance with aspects of the present invention will now be described with additional reference to **FIG. 6**.

[0063] **FIG. 6** is a flow chart of an example method **600** of operation of STB **300** in accordance with aspects of the present invention.

[0064] As shown in **FIG. 6**, method **600** starts and content is received (**S604**). For example, returning to **FIG. 3**, tuner **102** receives data signal **118**, which includes content data. The content data may then be processed by receiver **110**.

[0065] The content is then buffered (**S606**). For example, receiver **110** may provide the content to circular buffer **112** as signal **134**. Up to a predetermined first length of the stream of video content may be stored in circular buffer **112** as buffered video content.

[0066] The buffered content is then provided as an output (**S608**). For example, in one embodiment, receiver **110** may provide the stream of video content to output portion **114** as signal **136** concurrently while providing the stream of video content to circular buffer **112**. Output portion **114** then provides the stream of video content to display device **116** as signal **140**. In another example embodiment, circular buffer **112** provides the stream of video content to output portion as signal **138**. In such an embodiment, signal **140** based on the buffered video content.

[0067] The output is then controlled (**S610**). For example, controller **302** may control output portion, via signal **308**, to output signal **140** as one of: the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content.

[0068] A portion of the buffered is then stored (**S612**). For example, in the event that circular buffer **304** becomes full, a portion of the data within circular buffer **304** may be copied to second buffer **306**. This will free space in circular buffer **304** for additional storage of the streaming content. The data stored in second buffer **306** may be considered as stored video content.

[0069] At this point in time, the stored content may be output (**S614**). For example, as discussed above, there may be a time when the user would like to rewind to previously stored content. However, the particular content of which the user is attempting to view is no longer in circular buffer **304**. Accordingly, second buffer **306** provides the content to output portion **114**, which then provides the stream of video content to display device **116** as signal **140**.

[0070] Method 600 then stops (S618).

[0071] As discussed with reference to FIGs. 3-6, aspects of the invention provide a system and method to store portions of the user desired contents of circular buffer 304 in to second buffer 306 such that when circular buffer 304 is overwritten, the user desired contents are available in second buffer 306 for displaying on display device 116.

[0072] The user provides certain keywords based on the program guide, which are shared with the STB and the headend. The metadata containing these keywords is multiplexed with the media stream or the program guide before feeding to the TS multiplexer. The controller or processor on the STB retrieves the metadata from the media stream and tags the portions of the circular buffer with the associated keywords. In LOD mode, when the user performs a 'pause', the media content tagged with the keywords are copied to the linear buffer. In this case, even if the circular buffer is overwritten multiple times, the linear buffer holds the copy of keyword tagged media contents. Once the user 'resumes' from the 'pause' position, user desired contents are available in the linear buffer for viewing on the display device as one of the options.

[0073] The foregoing description of various preferred embodiments of the invention have been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. The example embodiments, as described above, were chosen and described in order to best explain the principles of the invention and its practical application to thereby enable others skilled in the art to best utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. It is intended that the scope of the invention be defined by the claims appended hereto.

CLAIMS

What is claimed as new and desired to be protected by Letters Patent of the United States is:

1. A device for use with a stream of video content and a video display, the video display being operable to display a video based on the stream of video content, said device comprising:

a receiver arranged to receive the stream of video content;

a circular buffer operable to store up to a predetermined first length of the stream of video content as buffered video content;

an output portion operable to output a first video signal, based on the buffered video content, to the video display;

a controller operable to control said output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content; and

a second buffer operable to store a portion of the buffered video content as stored video content,

wherein said output portion is further operable to output a second video signal, based on the stored video content, to the video display,

wherein said circular buffer is further operable to continue to store the stream of video content when said controller controls said output portion to output the first video signal as one of the paused portion of the buffered video content and the previously played portion of the buffered video content, and

wherein when said circular buffer stores the stream of video content for a second length that is greater than the first length, said controller is further operable to control said second buffer to store a predetermined portion of the second length as the portion of the buffered video content.

2. The device of claim 1, wherein when said circular buffer stores the stream of video content for a second length that is greater than the first length, said controller is further operable to control said second buffer to store a first-in portion of the second length as the portion of the buffered video content.

3. The device of claim 2, wherein said controller is operable to generate an interface to enable an interactive choice for said output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content.
4. The device of claim 3,
wherein the stream of video content includes concatenated media data, and
wherein said controller is operable to generate the interface to enable the interactive choice for said output portion to output the first video signal as one of the buffered video content playing a paused portion of the buffered video content and a previously played portion of the buffered video content, based on the concatenated media data.
5. The device of claim 4, wherein said second buffer comprises a linear buffer.
6. The device of claim 1, wherein said controller is operable to generate an interface to enable an interactive choice for said output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content.
7. The device of claim 6,
wherein the stream of video content includes concatenated media data, and
wherein said controller is operable to generate the interface to enable the interactive choice for said output portion to output the first video signal as one of the buffered video content playing a paused portion of the buffered video content and a previously played portion of the buffered video content, based on the concatenated media data.
8. The device of claim 7, wherein said second buffer comprises a linear buffer.
9. The device of claim 1, wherein said second buffer comprises a linear buffer.
10. The device of claim 1, wherein said controller is further operable to control said second buffer to store the predetermined portion of the second length as the portion of the buffered video content based on metadata within the stored video content.

11. A method of displaying a stream of video content on a video display, the video display being operable to display a video based on the stream of video content, said method comprising:

receiving, via a receiver, the stream of video content;

storing, via a circular buffer, up to a predetermined first length of the stream of video content as buffered video content;

outputting to the video display, via an output portion, a first video signal based on the buffered video content;

controlling, via a controller, the output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content;

storing, via a second buffer, a portion of the buffered video content as stored video content;

outputting to the video display, via the output portion, a second video signal based on the stored video content;

continuing to store, via the circular buffer, the stream of video content when the controller controls the output portion to output the first video signal as one of the paused portion of the buffered video content and the previously played portion of the buffered video content; and

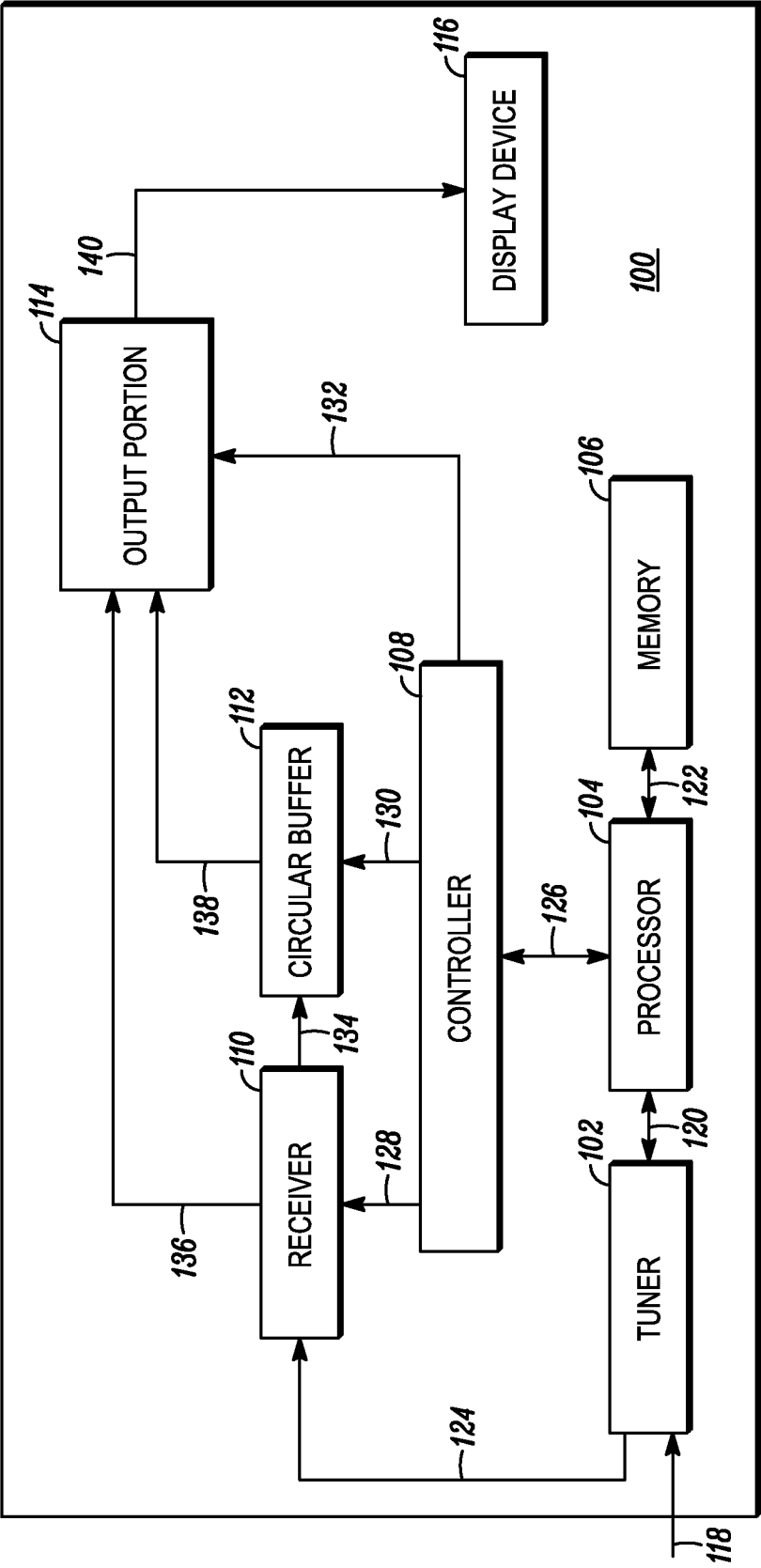
controlling, via the controller, the second buffer to store a predetermined portion of the second length as the portion of the buffered video content when the circular buffer stores the stream of video content for a second length that is greater than the first length.

12. The method of claim 11, wherein said controlling, via the controller, the second buffer to store a predetermined portion of the second length as the portion of the buffered video content when the circular buffer stores the stream of video content for a second length that is greater than the first length comprises controlling, via the controller, the second buffer to store a first-in portion of the second length as the portion of the buffered video content.

13. The method of claim 12, further comprising generating, via the controller, an interface to enable an interactive choice for the output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content.

14. The method of claim 13,
wherein the stream of video content includes concatenated media data, and
wherein said generating, via the controller, an interface to enable an interactive choice for the output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content comprises generating the interface to enable the interactive choice for the output portion to output the first video signal as one of the buffered video content playing a paused portion of the buffered video content and a previously played portion of the buffered video content, based on the concatenated media data.
15. The method of claim 14, wherein said storing, via a second buffer, a portion of the buffered video content as stored video content comprises storing, via a linear buffer.
16. The method of claim 11, further comprising generating, via the controller, an interface to enable an interactive choice for the output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content.
17. The method of claim 16,
wherein the stream of video content includes concatenated media data, and
wherein said generating, via the controller, an interface to enable an interactive choice for the output portion to output the first video signal as one of the buffered video content playing in real time, a paused portion of the buffered video content, and a previously played portion of the buffered video content comprises generating the interface to enable the interactive choice for the output portion to output the first video signal as one of the buffered video content playing a paused portion of the buffered video content and a previously played portion of the buffered video content, based on the concatenated media data.
18. The method of claim 17, wherein said storing, via a second buffer, a portion of the buffered video content as stored video content comprises storing, via a linear buffer.
19. The method of claim 11, wherein said storing, via a second buffer, a portion of the buffered video content as stored video content comprises storing, via a linear buffer.

20. The method of claim 11, wherein said controlling, via the controller, the second buffer to store a predetermined portion of the second length as the portion of the buffered video content when the circular buffer stores the stream of video content for a second length that is greater than the first length comprises controlling the second buffer to store the predetermined portion of the second length as the portion of the buffered video content based on metadata within the stored video content.



PRIOR ART

FIG. 1

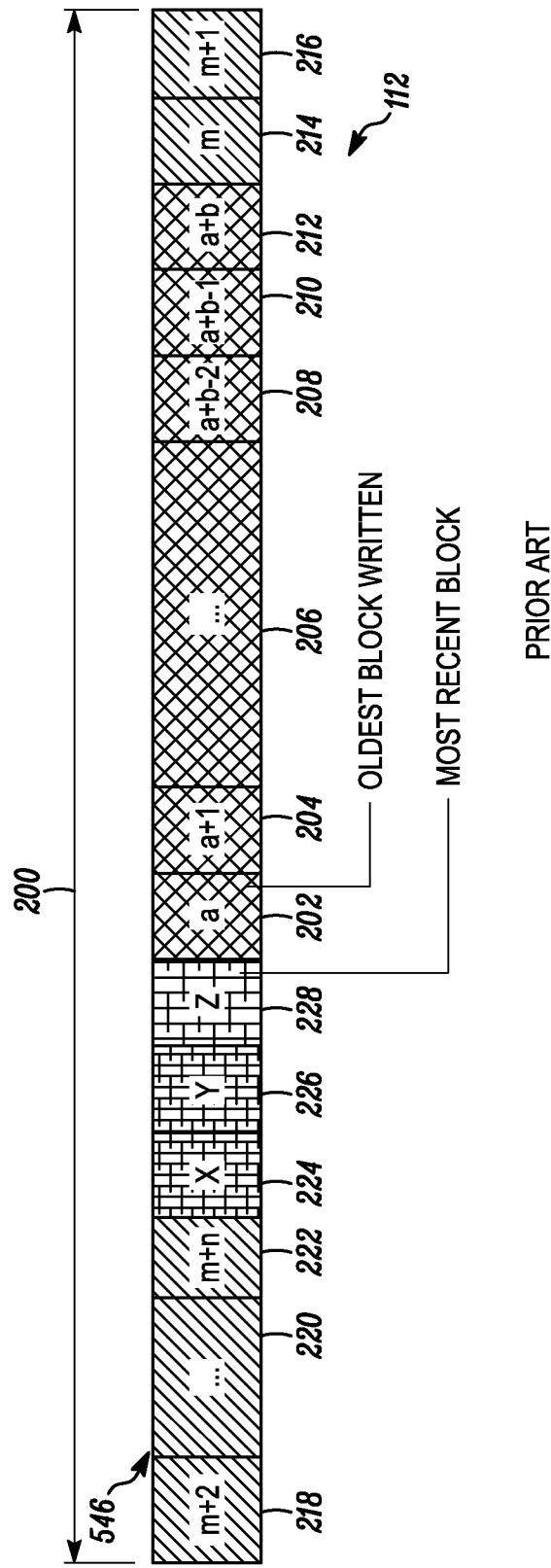


FIG. 2

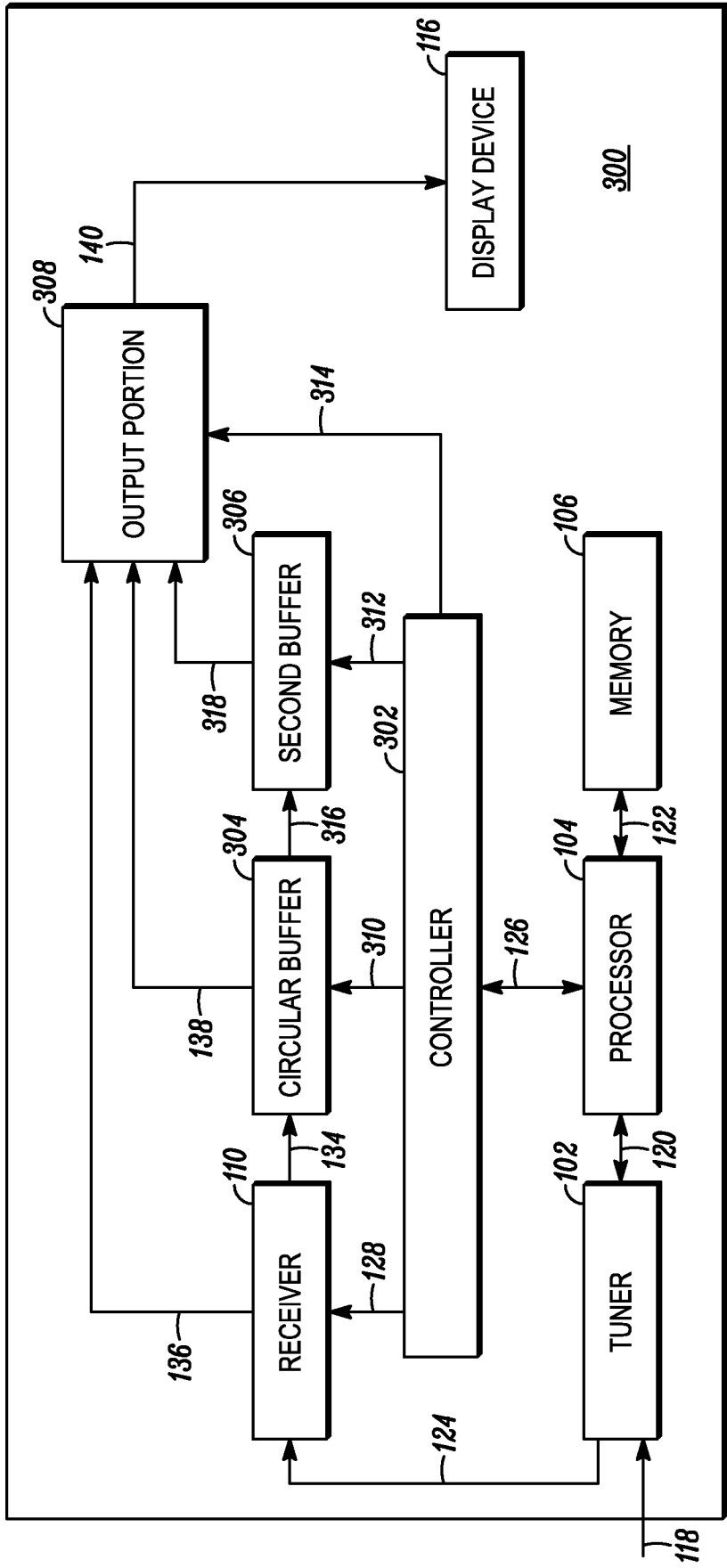
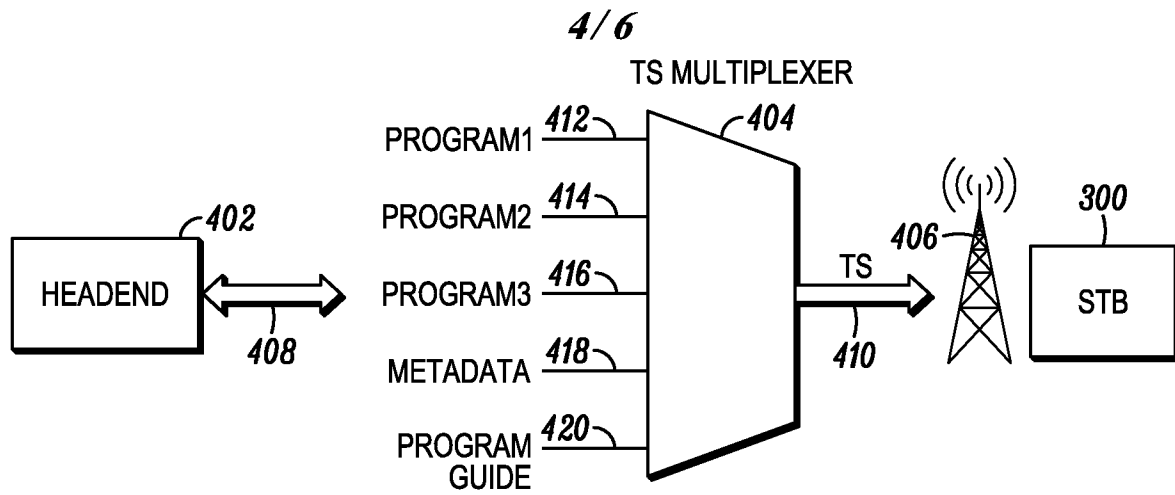
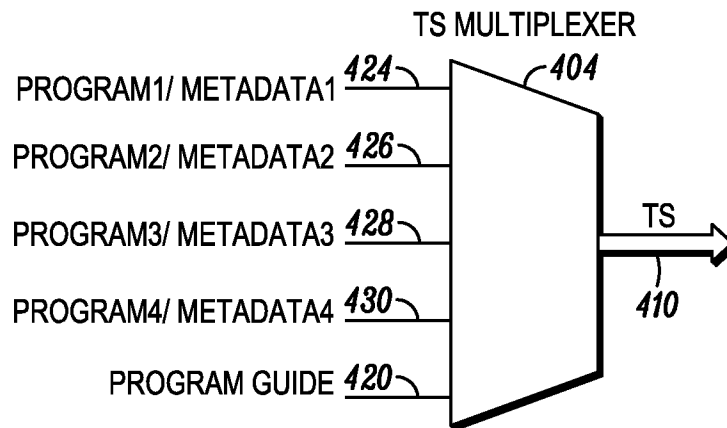
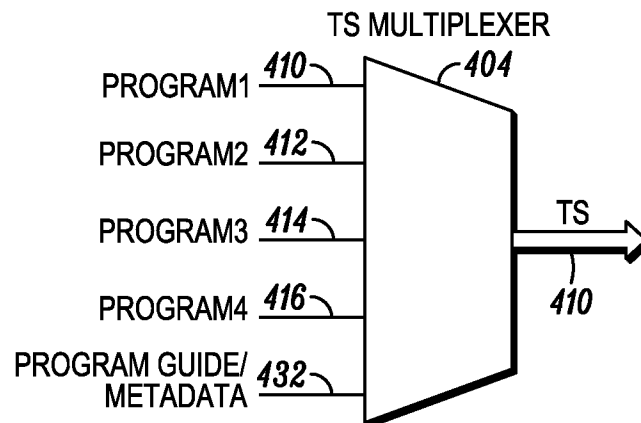


FIG. 3

*FIG. 4A**FIG. 4B**FIG. 4C*

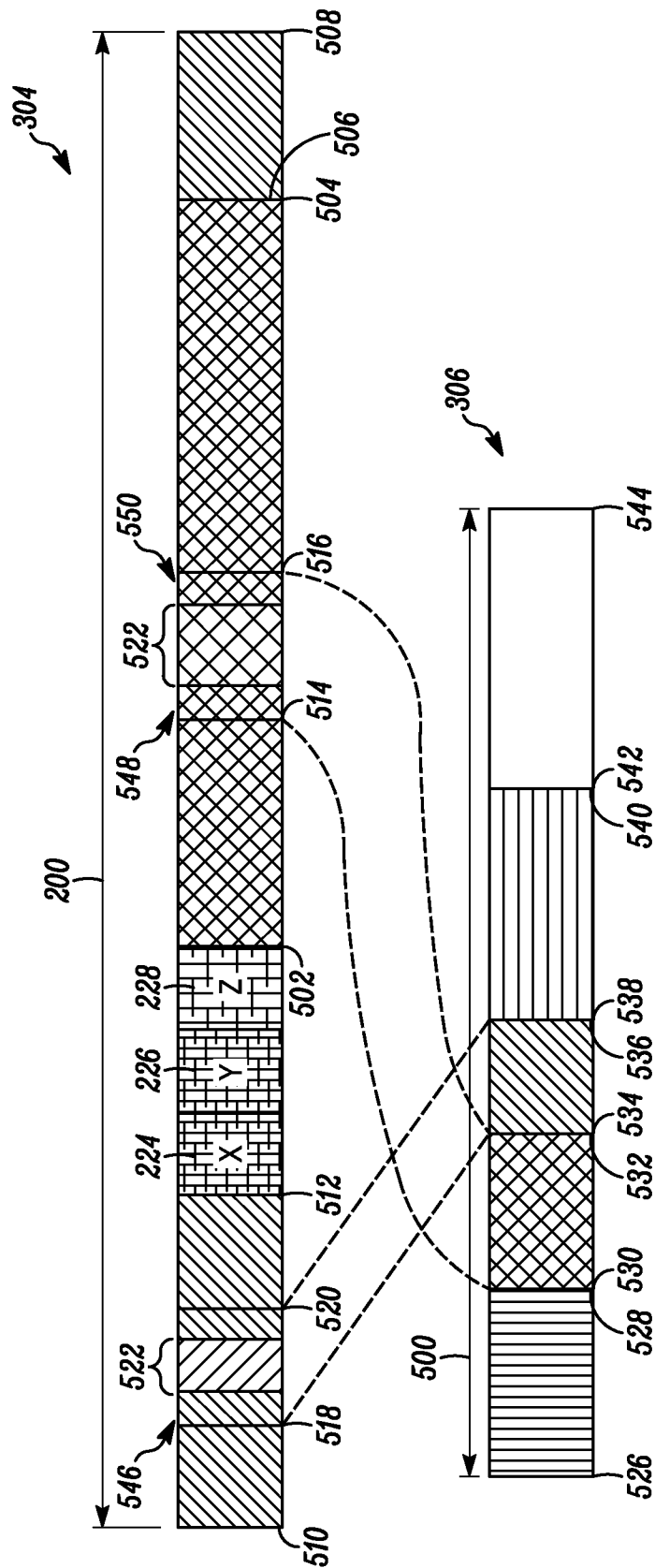


FIG. 5

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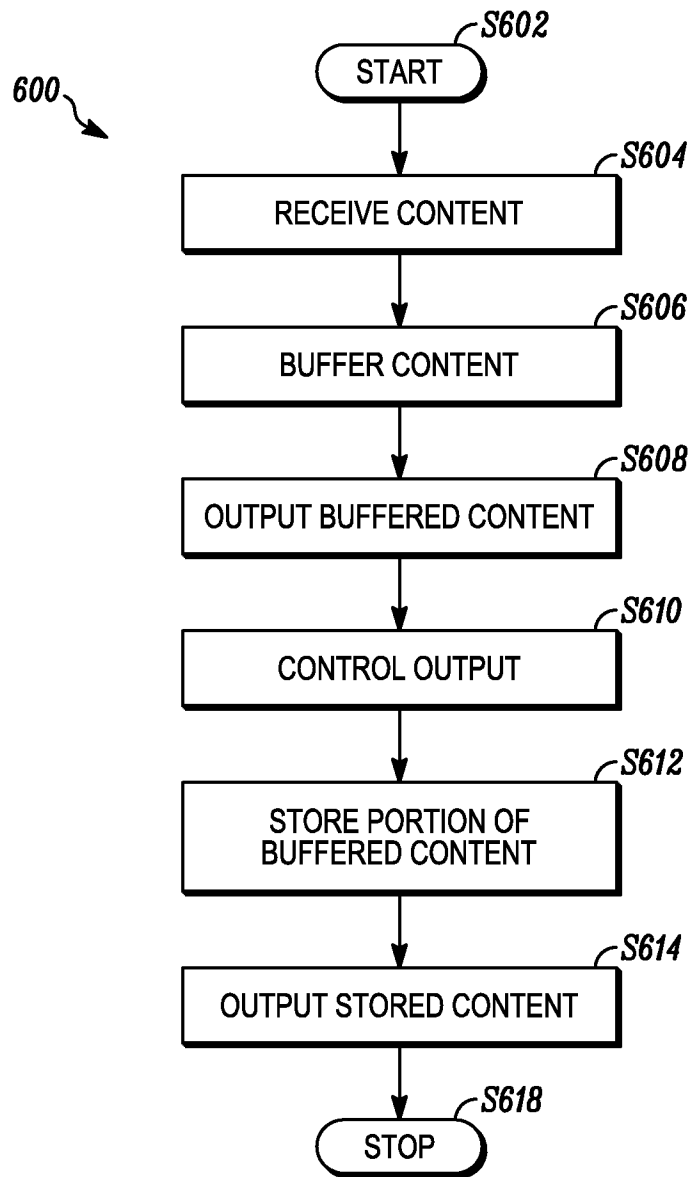


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2012/065405

A. CLASSIFICATION OF SUBJECT MATTER INV. H04N21/8405 H04N21/432 H04N21/433 H04N21/4335 H04N21/475 H04N5/76 G11B27/034 ADD. According to International Patent Classification (IPC) or to both national classification and IPC											
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) H04N G11B Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data											
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 2002/106185 A1 (FUJII CHIAKI [JP] ET AL) 8 August 2002 (2002-08-08) figures 1,5,7 paragraphs [0149], [0151], [0155] - [0158] paragraphs [0174] - [0175], [0178] - [0181], [0185] -----</td> <td>1-20</td> </tr> <tr> <td>X</td> <td>EP 1 367 824 A2 (MICROSOFT CORP [US]) 3 December 2003 (2003-12-03) figures 3,4,5 paragraphs [0032] - [0035], [0041] - [0043], [0046] - [0052], [0054], [0058] ----- -/-</td> <td>1-3,6,9, 10,12, 13,16, 19,20</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 2002/106185 A1 (FUJII CHIAKI [JP] ET AL) 8 August 2002 (2002-08-08) figures 1,5,7 paragraphs [0149], [0151], [0155] - [0158] paragraphs [0174] - [0175], [0178] - [0181], [0185] -----	1-20	X	EP 1 367 824 A2 (MICROSOFT CORP [US]) 3 December 2003 (2003-12-03) figures 3,4,5 paragraphs [0032] - [0035], [0041] - [0043], [0046] - [0052], [0054], [0058] ----- -/-	1-3,6,9, 10,12, 13,16, 19,20
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.									
X	US 2002/106185 A1 (FUJII CHIAKI [JP] ET AL) 8 August 2002 (2002-08-08) figures 1,5,7 paragraphs [0149], [0151], [0155] - [0158] paragraphs [0174] - [0175], [0178] - [0181], [0185] -----	1-20									
X	EP 1 367 824 A2 (MICROSOFT CORP [US]) 3 December 2003 (2003-12-03) figures 3,4,5 paragraphs [0032] - [0035], [0041] - [0043], [0046] - [0052], [0054], [0058] ----- -/-	1-3,6,9, 10,12, 13,16, 19,20									
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Date of the actual completion of the international search 9 January 2013		Date of mailing of the international search report 18/01/2013									
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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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