tion.

[0094] This means that a search is made for a frame encoded by intra-frame encoding (I-Picture).

[0095] When the switching enable position is set, an instruction for switching encoded data is supplied to the switch device 702 by using the switching instruction information 731. FIG. 8 shows an example of this instruction. Assume that encoded data A is currently selected, and there occurs a need to execute switching to encoded data B according to the switch information 632.

[0096] At this stage, assume that a frame is processed at the time of "switching instruction" shown in FIG. 8. In such a case, if encoded data is switched, an unmatched image occurs. This is because a difference from the previous image is encoded in intra-frame encoding (P-Picture). Therefore, if encoded data is switched at the time of P-Picture, an attempt is made to reproduce the next picture (picture P11 of encoded data (B)) by using immediately preceding picture (decoded picture 111 of encoding data (A)). This provides a problem that a correct decode picture cannot be obtained, and a picture is destroyed. Thus, there occurs a need to execute switching at a timing of a picture of intra-frame encoding (I-Picture) undergoing encoding by that frame only. This timing is defined as a timing at a position marked with "execute switching".

[0097] As in FIG. 9, a case in which the number of frames or time position differs depending on encoded data is considered. In this case as well, a switching enable position of encoded data at a switching destination is detected, and switching of encoded data is executed when the switching enable position is set.

[0098] At the switching position detecting device 701 shown in FIG. 7, when a need to execute switching according to the switch information 632 occurs, it is possible to employ a method for temporarily stopping an output 132 to the encoded data transmitter 103, and then, outputting new encoded data to the encoded data transmitter 103 at a stage at which the switching position is set.

[0099] This method is effective when it is necessary to suppress a buffer overflow or the like by switching encoded data. When an underflow is problematic, a stuffing bit is forcibly inserted, thereby making it possible to counteract such an underflow.

(Third Embodiment)

[0100] Now, a third embodiment according to the present invention will be described here.

[0101] The present embodiment describes an exemplary configuration of an encoding parameter determination device 401 of the video encoder 102 shown in FIG. 4 according to the first embodiment when a time interval (GOP interval) between frames encoded in a intra-frame encoded mode is adjusted based on the network condition information 136 outputted from the network state determination device 105. Here, a description will be given by focusing on differences from the first embodiment.

[0102] FIG. 13 shows an exemplary configuration of the encoding parameter determination device 401. This device comprises a GOP interval calculator (GOP interval calculator) 1501 and an encoding parameter determination device 502.

[0103] The network condition information 136 outputted from the network condition determination device 105 (including at least packet loss rate information) is input to an encoding parameter determination device 502. The parameter determination device 502 inputs packet loss rate information 1531 of the network condition information 136 to the GOP interval calculator 1501. The GOP interval calculator 1501 calculates a GOP interval from the packet loss rate information 1531. The GOP interval information 1532 is notified to the encoding parameter determination device 401. The encoding parameter determination device 401 outputs encoding parameter information 431 that contains the inputted GOP interval information 1532. When internally generated parameter information exists, the encoding parameter determination device 401 outputs GOP interval information 1532 and encoding parameter information 431 that contains the internally generated parameter information.

[0104] FIG. 14 shows an example of a method for determining a GOP interval at the GOP interval calculator.

[0105] At the step S1601, it is determined whether or not a packet loss occurs from the network condition information 136. When such a packet loss occurs, the GOP interval is estimated by formula (3) below, for example, at the step S1602.

$$Gop = (TN - TL)/\{(FN - FL) \times r\} \quad (3)$$

where "gop" denotes a GOP interval, "r" denotes a packet loss rate, FN denotes a total number of current frames, FL denotes a total number of frames during past calculation, TN denotes a time, and TL denotes a time during past calculation.

[0106] The GOP interval obtained at the step S1602 is notified to the signal processor 402 at the step S1603, and encoding is carried out based on the notified value.

[0107] On the other hand, when no packet loss has occurred at the step S1601, the default GOP thresholds are read out at the step S1604. At the step S1603, this value is notified to the signal processor 402.

[0108] According to the present embodiment, it is possible to change dynamically the GOP interval to a value suitable to a network. In this manner, when a small number of errors occur, the GOP interval is increased, thereby making it possible to reduce wasteful intra-frame encoded modes in number. In contrast, when a large number of errors occur, the GOP interval is decreased, and a frame in the intra-frame encoded mode appears quickly, thereby making it possible to acceler-

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ate recovery. In the present embodiment, it is possible to efficiently select an intra-frame encoded mode.

[0109] FIG. 15 shows another example of a method for determining a GOP interval at the GOP interval calculator in accordance with a flow chart.

[0110] In this example, even when packet loss is fewer than that in the system shown in FIG. 14, the network condition is estimated from the past history of packet loss at the step S1704, and an optimal GOP interval is calculated. This technique makes it possible to estimate whether a network is completely free of an error or an error may occurs by checking the past history instead of resetting the GOP interval to the default value by determining that no packet loss occurs at one moment. In this manner, it is possible to determine the network condition more accurately.

[0111] FIG. 16 shows still another example of a method for determining a GOP interval at the GOP internal calculator in accordance with a flow chart.

[0112] In this example, the GOP interval is determined by a unique calculation system instead of determination based on the presence/absence of a packet loss. This system can be used to determine the GOP interval from the current packet loss rate in accordance with a single formula or to determine the most suitable GOP interval by checking the past history.

[0113] The following formula (4) shows an example of calculation formula for determining the GOP interval.

$$Gop = [(TN - TL)/\{(FN - FL) \times r\}] \times \alpha \qquad (4)$$

where "gop" denotes a GOP interval, "r" denotes a packet loss rate, α denotes a sensitivity coefficient, FB denotes a total number of current frames, FL denotes a total number of frames during past calculation, TN denotes a current time, and TL denotes a time during past calculation.

[0114] In this example, the GOP interval calculated from an actual value is multiplied by a sensitivity coefficient, thereby making it possible to meet a requirement for accelerating recovery by sacrificing efficiency or a requirement when one does not take care even if an effect of error is somewhat extended. For example, if the sensitivity coefficient α is set to be smaller than 1, a GOP interval which is smaller than that calculated from an actually measured value is output. In this manner, although the efficiency is sacrificed, when an error occurs, it is possible to estimate faster recovery.

[0115] The present embodiment is not limited to formulas (3) and (4). For example, in these formulas, a value is calculated by using an increment during past calculation and subsequent, it is possible to calculate the value by taking a margin such as the n preceding increment. In this manner, it is possible to cope with a gradual change hidden in a change in detailed state or to eliminate a temporal change to some extent. Similarly, algorithms are not limited to those shown in the present embodiment.

[0116] The foregoing embodiment has described an exemplary configuration when a time interval (GOP interval) is adjusted, the time interval being between the frames encoded in the intra-frame encoded mode based on the network condition information 136 at the encoding parameter determination device 401 of the video encoder 102 shown in FIG. 4 according to the first embodiment. Alternatively, there can be provided a configuration in which the network condition determination device 105 according to the first embodiment (FIGS. 1, 2, or 3) determines a time interval (GOP interval) encoded in the intra-frame encoded mode based on information from the network information or information from the network information receiver 104 and information from the video encoder 102, and provides the encoded time interval to the image encoder 102.

[0117] As described in the first embodiment, it is possible to configure a video encoder capable of determining a network condition, the video encoder having functions of the video encoder 102 and network condition determination device 105, thereby providing the previously described functions in one block.

[0118] In the foregoing, although a variety of embodiments have been described, in short, the present invention utilizes characteristics of RTP, and comprises a system (RTCP) for notifying network state information such as jitter or packet loss rate from a transmitter or receiver. At the transmitter, a bit rate of transmission data at the transmitter is adjusted according to a transmission state of a transmission channel based on the notification of network state information acquired from the receiver in the transmitter such as jitter or packet loss rate so that control such as change of the error resilience level can be carried out. Therefore, according to the above described present invention, data can be transmitted efficiently to the maximum so as to achieve data transmission that makes it possible to fully utilize transmission requiring real time properties as well.

[0119] The techniques described in the embodiments of the present invention can be distributed to be stored as a computer executable program in a recording medium such as a magnetic disk (such as a flexible disk or a hard disk); an optical disk (such as CD-ROM, CD-R, CD-RW, DVD, or MO), and a recording medium such as a semiconductor memory. Further, the above program can be distributed by means of transmission via a network.

[0120] According to the present invention, it is possible to determine a network condition, and then, optimally set an encoding parameter. In addition, when a packet loss caused by congestion and a loss of a channel error coexist in a network, it is possible to determine the loss, and then, to set a parameter.

[0121] Therefore, according to the present invention, there can be provided a data transmission apparatus and method in which data can be transmitted efficiently to the maximum so as to achieve data transmission that

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makes it possible to fully utilize transmission requiring real time properties.

Claims

1. A data transmission apparatus for transmitting transmission data from a transmitter to a receiver via a transmission channel, **characterized by** comprising:

   means (105) for estimating a transmission condition of the transmission channel in the transmitter based on at least Jitter information or a packet loss rate obtained from the receiver; and
   means (102) for changing at least one of a bit rate of transmission data and an error resilience level according to the estimated transmission condition.

2. An apparatus according to claim 1, **characterized in that** the transmitter includes means (102) for generating encoded data obtained by encoding a single content at different transmission rates, and means (603) for selecting optimum encoded data having optimum bit rate from the encoded data of the encoded data generating means (102) to adjust a bit rate of the transmission data in the transmitter according to the estimated transmission condition.

3. A data transmission method of transmitting transmission data from a transmitter to a receiver via a transmission channel, **characterized by** comprising:

   generating encoded data obtained by encoding a single content at different transmission rates;
   estimating a transmission condition of the transmission channel in the transmitter based on at least Jitter information or a packet loss rate obtained from the receiver; and
   selecting optimum encoded data having an optimum bit rate from the encoded data to adjust a bit rate of the transmission data in the transmitter according to the estimated transmission condition.

4. A data transmission method **characterized by** comprising:

   estimating a transmission condition of the transmission channel in the transmitter based on at least Jitter information or a packet loss rate obtained from the receiver; and
   changing at least one of a bit rate of transmission data and an error resilience level according to the estimated transmission condition.

5. A data transmitting apparatus that transmits transmission data from a transmitter to a receiver via a transmission channel, **characterized by** comprising:

   means (102) for generating plural encoded data obtained by encoding a single content at different bit rates, in the transmitter;
   means (105) for estimating a condition of the transmission channel based on Jitter information or packet loss rate; and
   means (603) for selecting encoded data having an optimum transmission rate from the plural encoded data according to the estimated transmission condition.

6. A method of transmitting transmission data from a transmitter to a receiver via a transmission channel, the method **characterized by** comprising:

   storing plural encoded data obtained by encoding a content at different bit rates;
   estimating a condition of the transmission channel based on Jitter information or packet loss rate;
   selecting encoded data having optimum transmission rate from the plural encoded data to adjust a bit rate of the transmission data in the transmitter.

7. A data transmission program stored on a computer readable medium, the program **characterized by** comprising:

   instruction means for instructing a computer to estimate a transmission condition of the transmission channel in the transmitter based on at least Jitter information or a packet loss rate obtained from the receiver; and
   instruction means for instructing the computer to change at least one of a bit rate of transmission data and a error resilience level according to the estimated transmission condition.

8. A data transmission apparatus, **characterized by** comprising:

   receiver means (104) for receiving network information regarding a condition of a network;
   determination means (105) for determining a network condition based on the network information from the receiver means;
   encoder means (102) for encoding a video data signal to generate encoded video data and control a bit rate or an error resilience level of the encoded video data according to the network condition information; and
   transmitter means (103) for transmitting the en-

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coded video data to the network.

9. An apparatus according to claim 6, **characterized in that** the encoder means (102) is supplied with an encoding parameter as the network condition information and generates encoded data whose bit rate is adjusted according to the encoding parameter,

the determination means (105) includes first storage means (302) for storing encoding parameter information obtained by the encoder means, second storage means (301) storing the network information input by the network information receiver, and determination means (303) for determine the encoding parameter by deciding the network condition based on network information input by the network information receiver, past encoding parameter information from the first storage means and past network information from the second storage means.

10. An apparatus according to claim 8, **characterized in that** the encoder means (102) includes parameter determination means (401) for determining the encoding parameter from the network condition information input from the receiver means, the encoder means (102) encoding the video data signal to generate the encoded video data whose bit rate is adjusted in correspondence with the encoding parameter determined by the determination means (401).

11. An apparatus according to claim 10, **characterized by** including encoding determination means (501) determine whether a next frame is to be encoded forcibly in an intra-frame encoding mode, when the parameter determination means (401) determines the encoding parameter using the network condition information.

12. An apparatus according to claim 8 or 9, **characterized in that** the determination means (105) includes computation means for computing a GPO interval from the network information input from the receiver means (104) to generate network condition information including GOP interval information indicating the GOP interval obtained by the computation means, and the encoder means (102) encodes the video data signal according to the GOP interval information included in the network condition information.

13. An apparatus according to claim 8 or 10, **characterized in that** the encoder means (102) includes GOP interval computation means for computing a GOP interval based on the network information input from the receiver means (104) and encodes the video data signal according to the GOP interval information indicating the GOP interval computed by the GOP interval computation means.

14. An apparatus according to claim 12 or 13, **characterized in that** the determination means (105) determines at least a packet loss rate as the network condition, and the GOP interval computation means computes the GOP interval based on at least the packet loss rate.

15. An apparatus according to claim 8, **characterized by** including switching means (602) for switching among plural encoded data encoded at different transmission rates, respectively, to select encoded data having a transmission rate corresponding to switching information, and selector means (603) for selecting a transmission rate of encoded data to be transmitted from the transmitter based on the network condition information outputted from the determination means (105) and output the selected transmission rate as the switching information to the switching means.

16. An apparatus according to claim 15, **characterized in that** the switching means (602) includes a switching position detector for detecting a switching position at which one of the encoded data can be switched to the other, and when an encoded data switching signal is generated by the switching information output from the selector means (603), the switching position detector detects the switching position, to switch the encoded data at the switching position.

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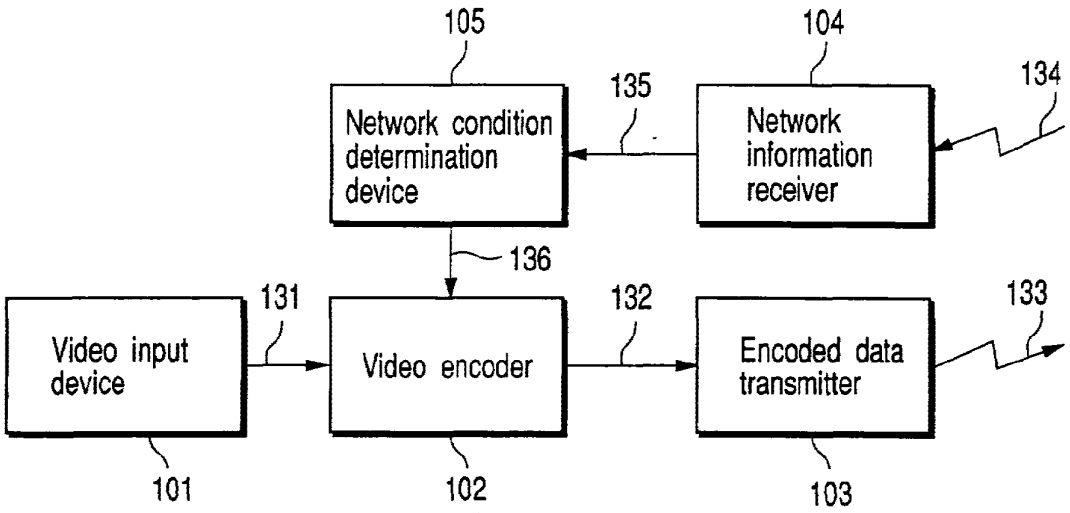


FIG. 1

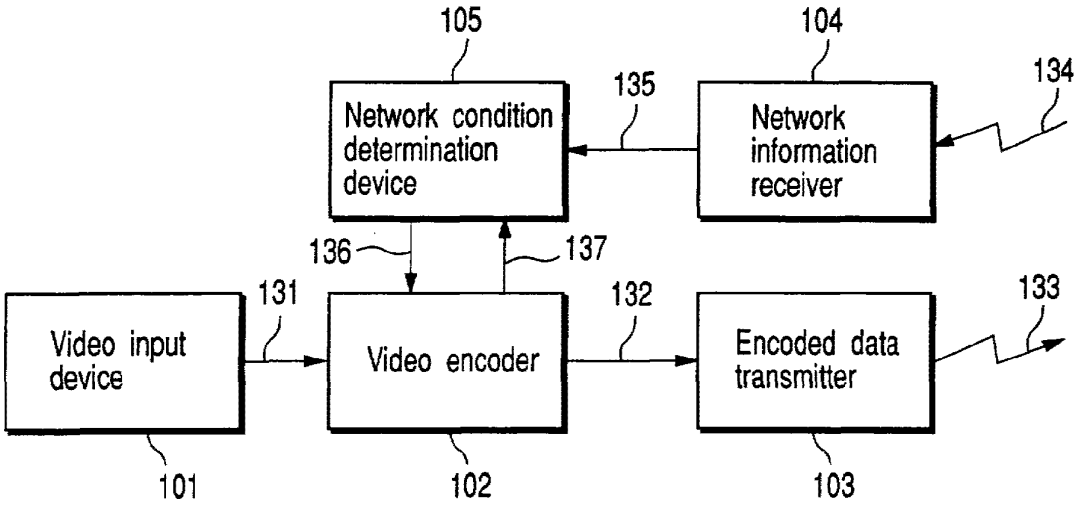


FIG. 2

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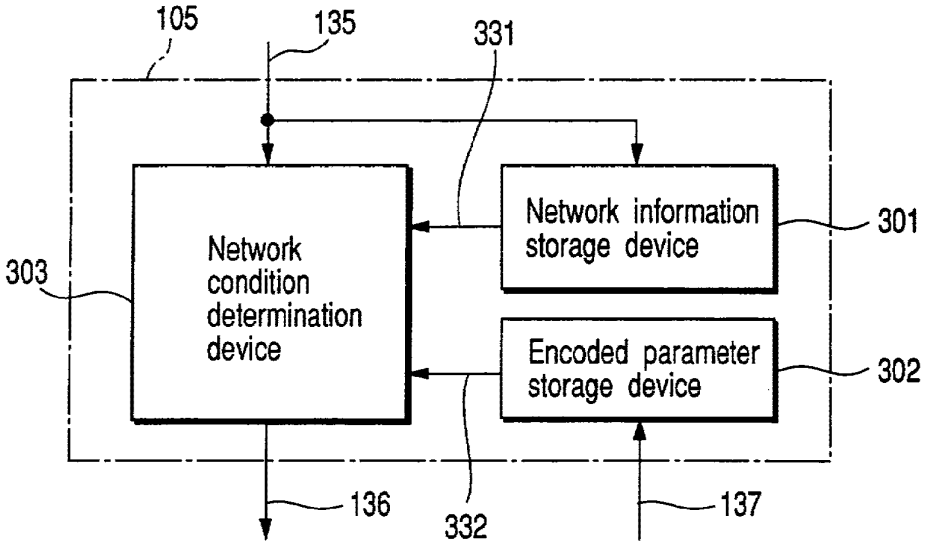


FIG. 3

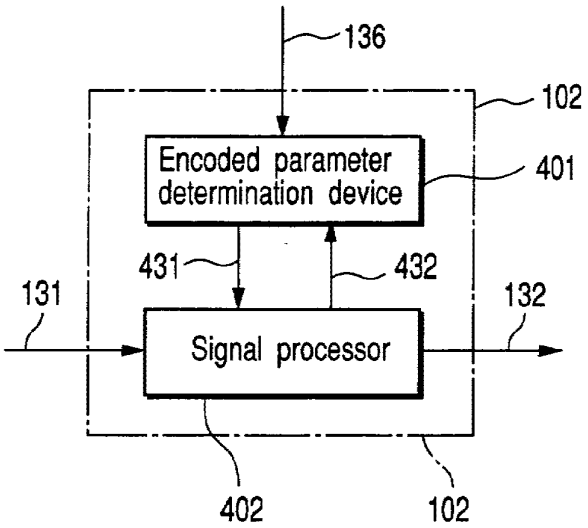


FIG. 4

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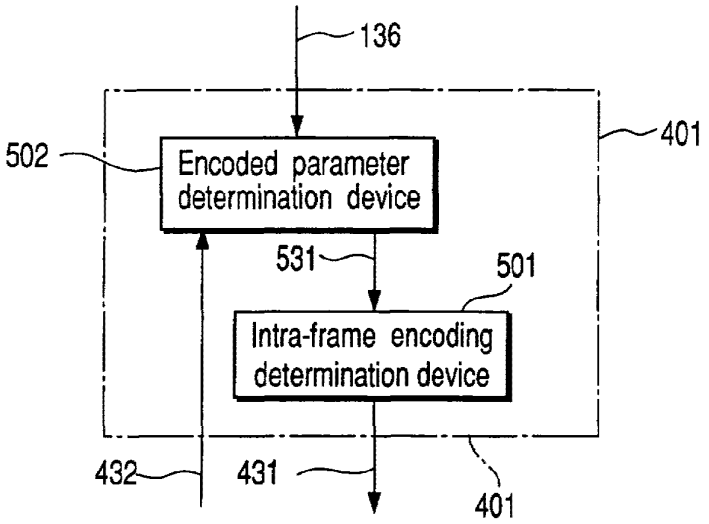


FIG. 5

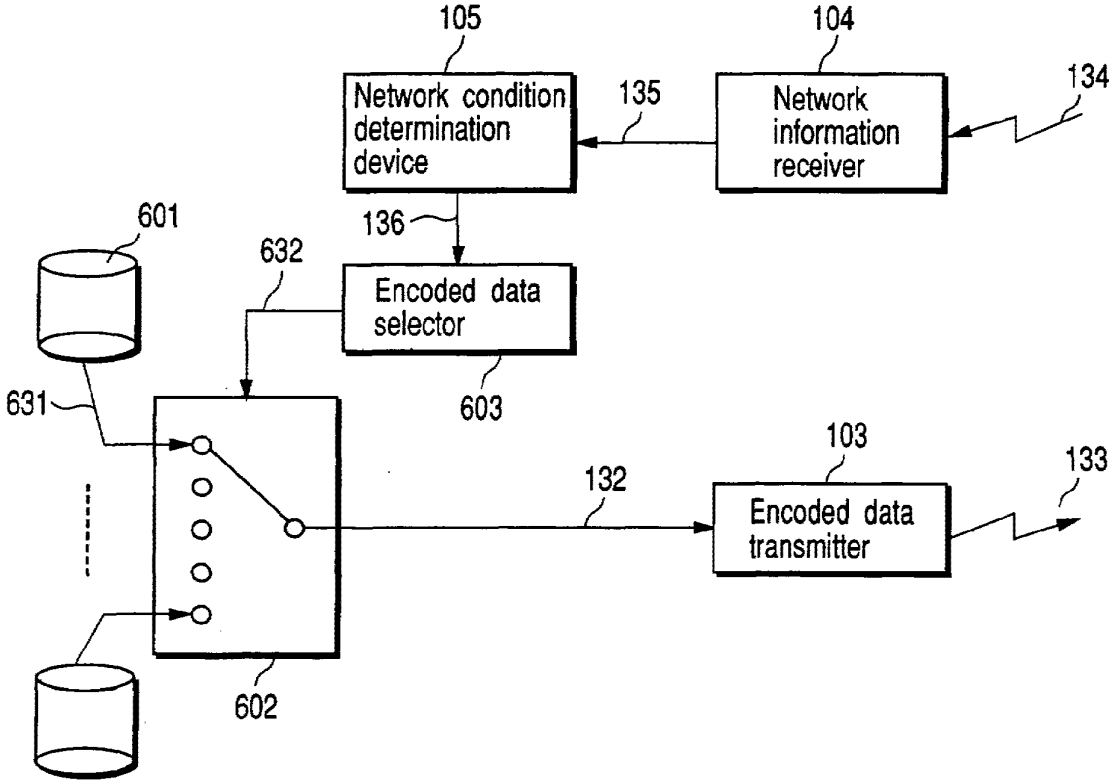


FIG. 6

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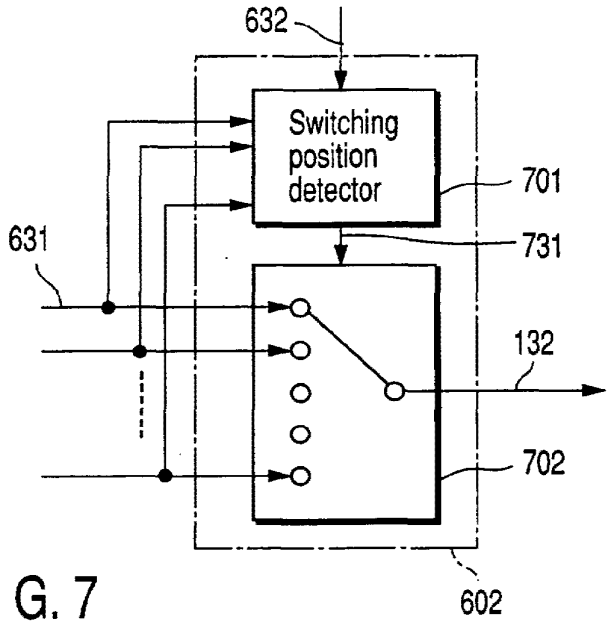


FIG. 7

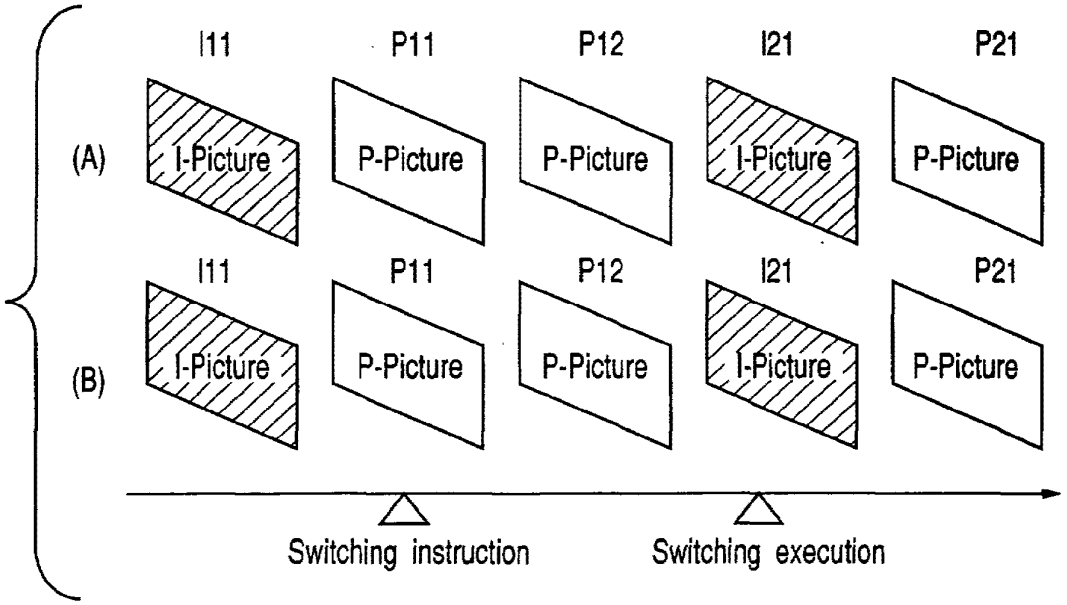


FIG. 8

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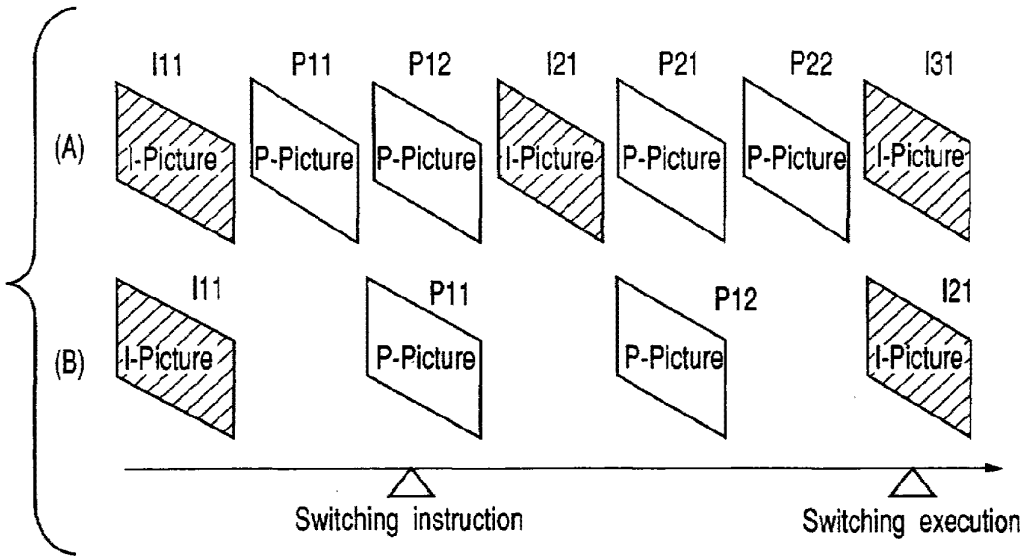


FIG. 9

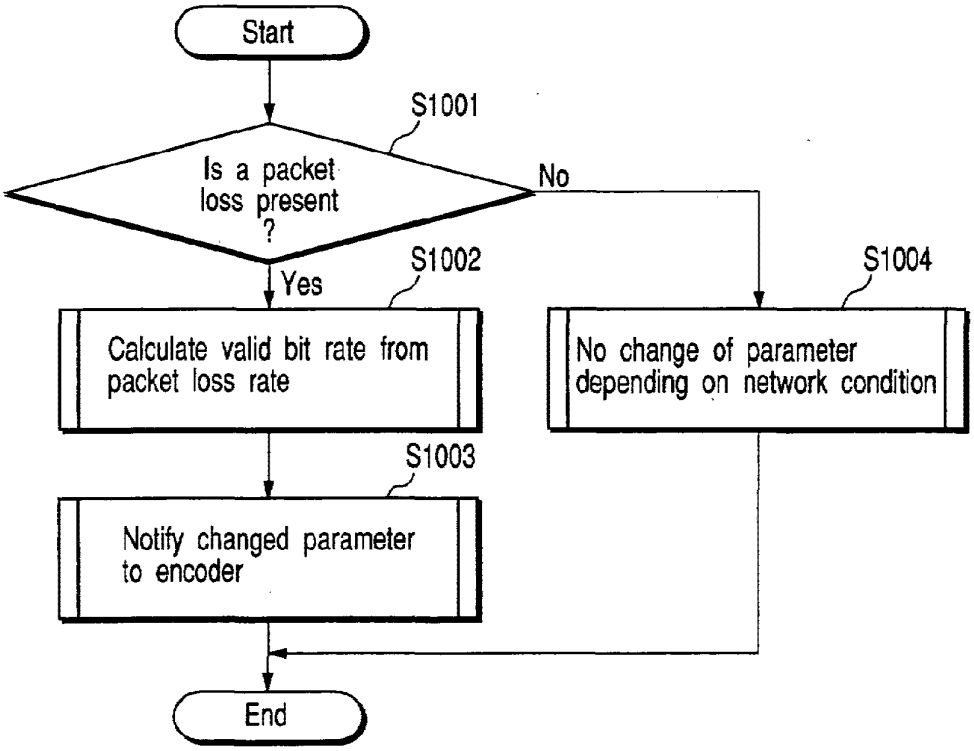


FIG. 10

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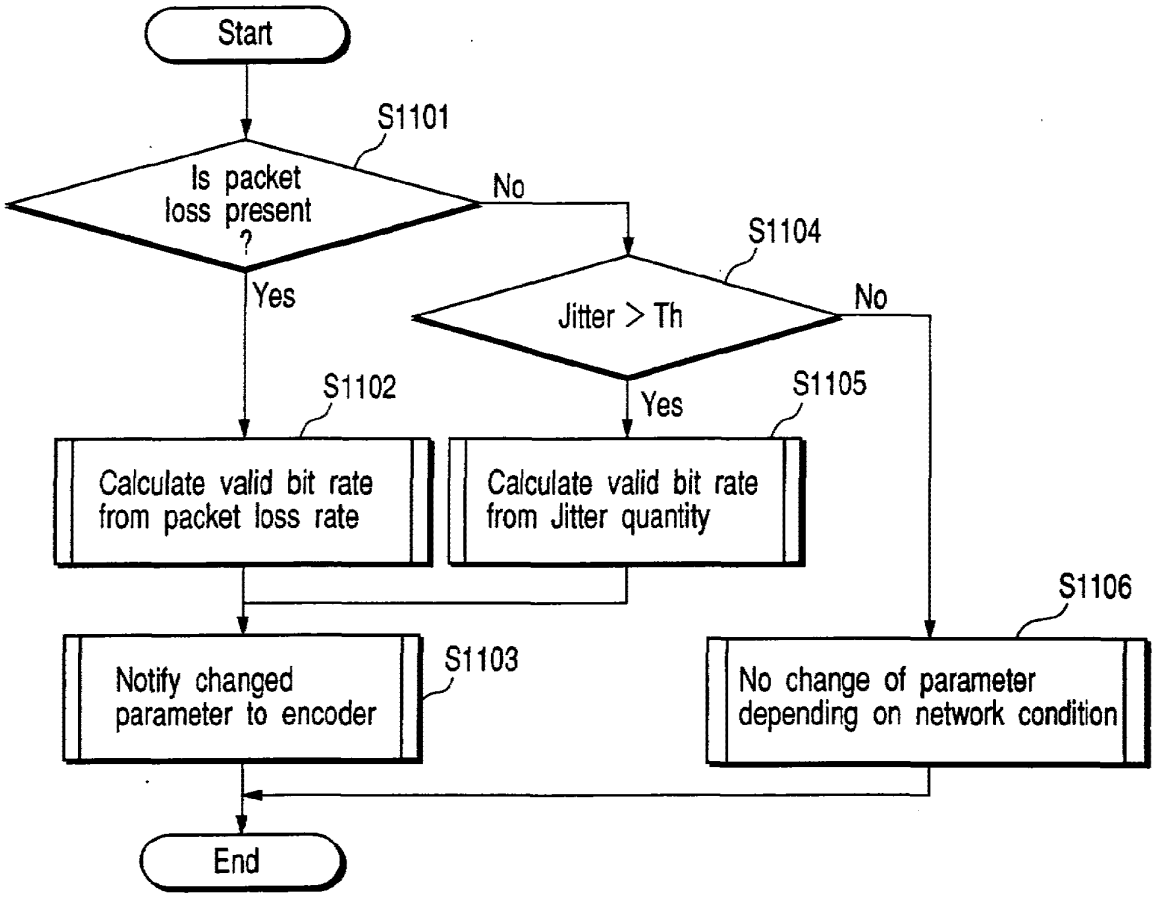


FIG. 11

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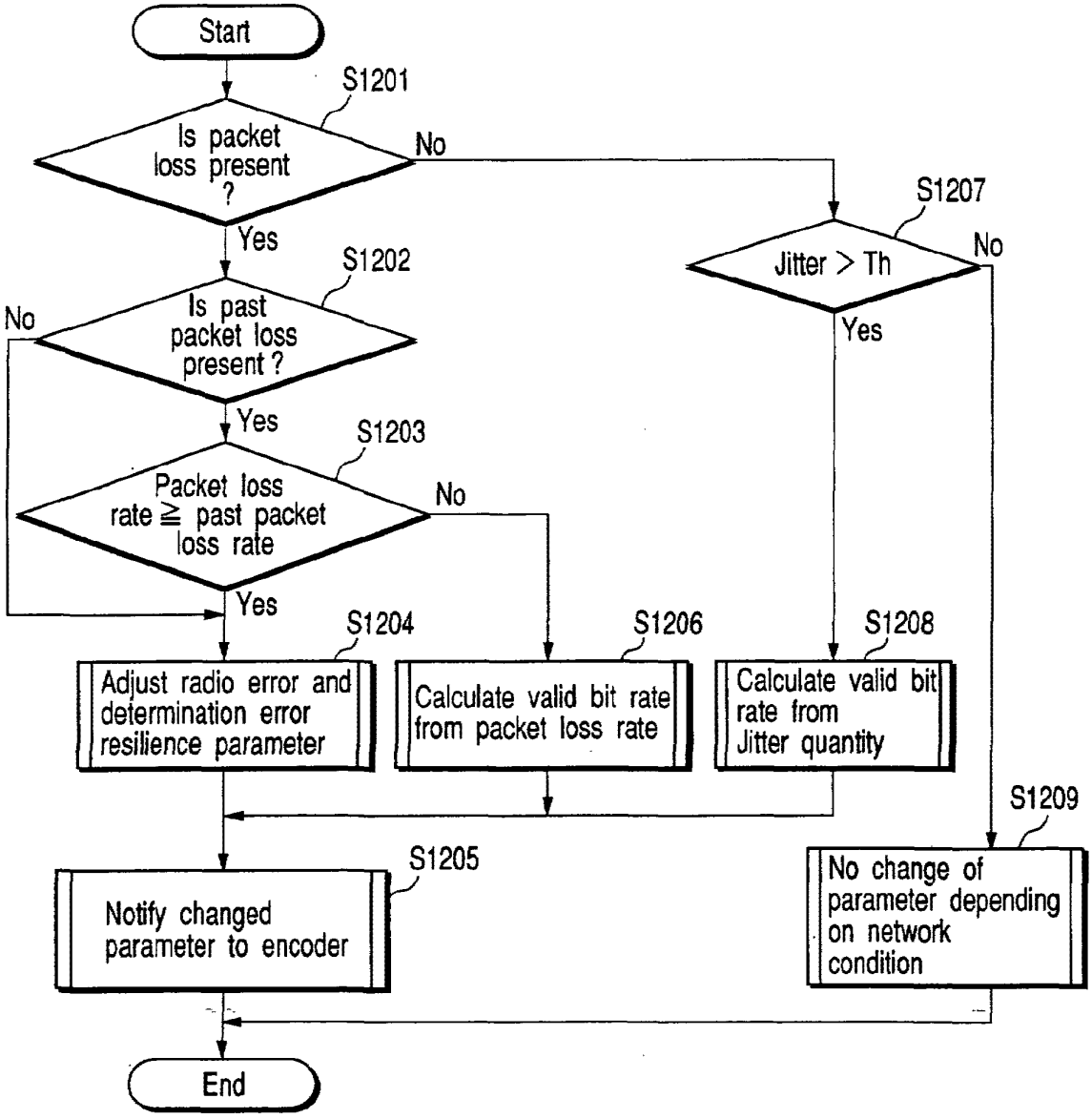


FIG. 12

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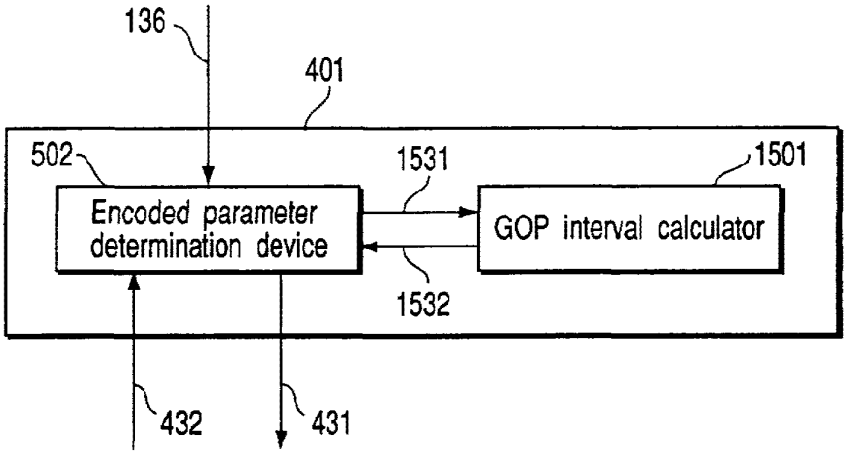


FIG. 13

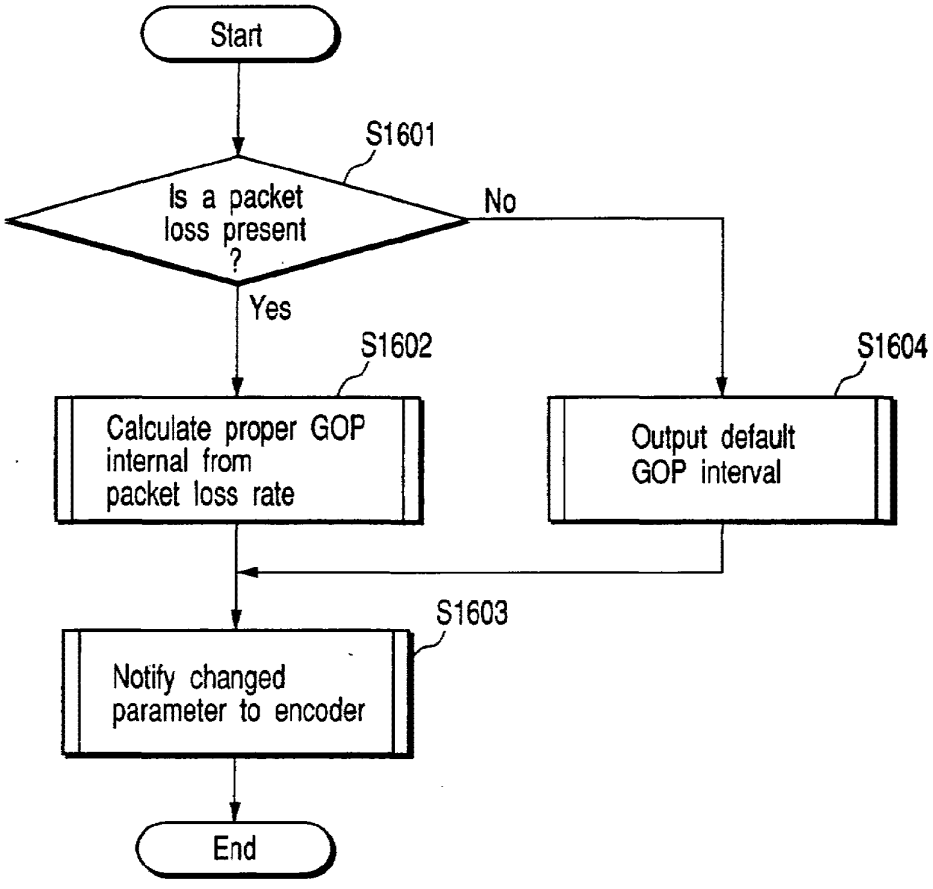


FIG. 14

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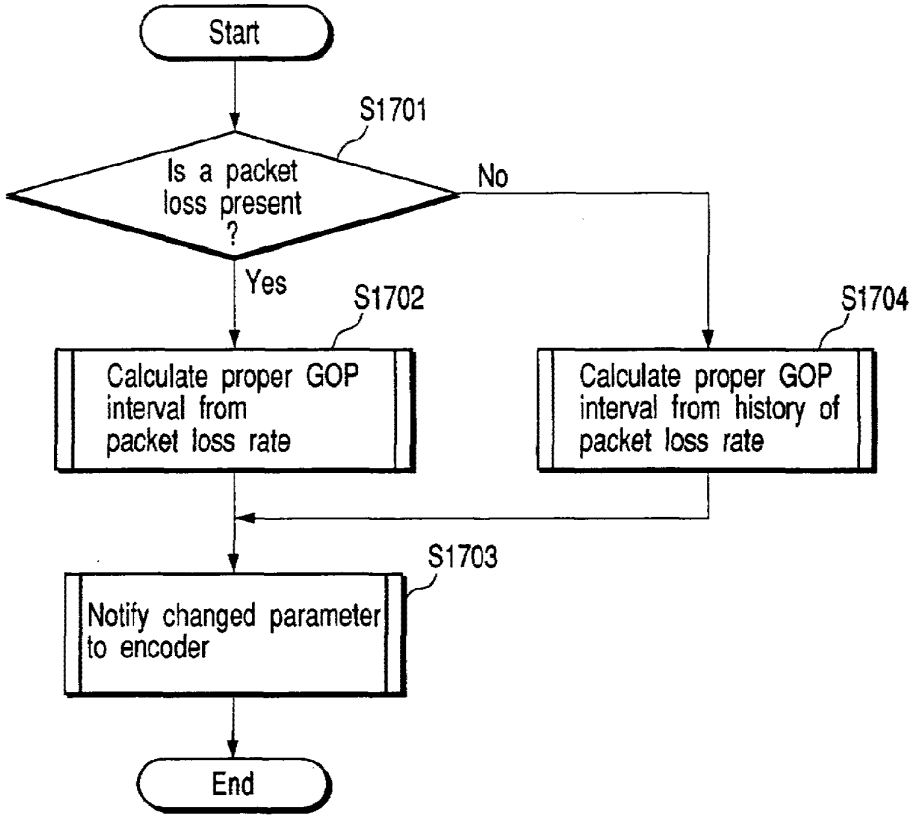


FIG. 15

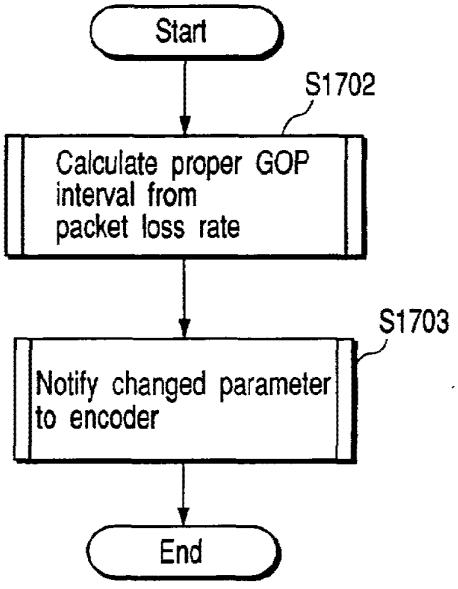


FIG. 16

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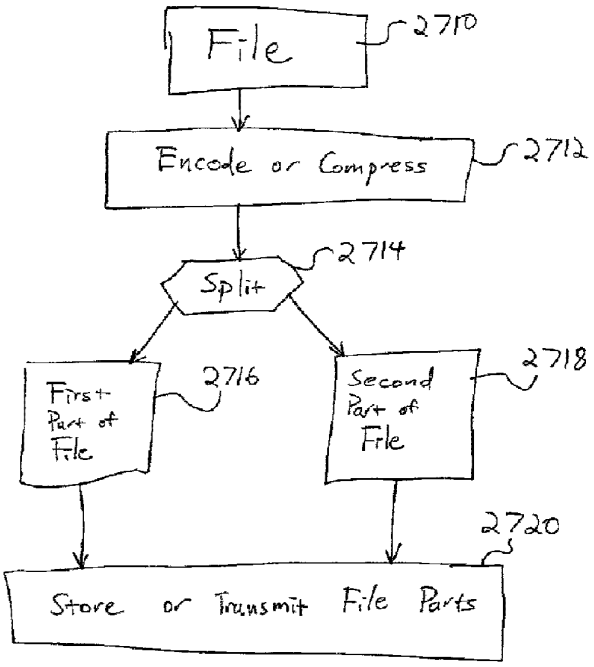
(74) **SIM & MCBURNEY**

(54) DECOUPAGE DE FICHIERS, CODAGE ECHELONNABLE, ET TRANSMISSION ASYNCHRONE DANS UN TRANSFERT CONTINU DE DONNEES

(54) FILE SPLITTING SCALADE CODING AND ASYNCHRONOUS TRANSMISSION IN STREAMED DATA TRANSFER

(57)

Files (2750) are divided into parts (2716, 2718) and at least some of the parts are transmitted to a client using a communication channel. At least some of the transmitted parts are cached locally. This allows subsequent streaming playback of the file while using 'less bandwidth by transmitting the part of the file that hasn't been cached, and combining the cached parts with the tramitted parts. In some embodiments, files may be represented at a low quality level by a first data set (2804), and at higher quality levels with additional data sets (2806). Data sets are cached locally, so that during subsequent streaming playback of the file, the quality level of the playback may be improved by sending additional data sets using bandwidth that would otherwise be dedicated to transmitting the cached data sets.



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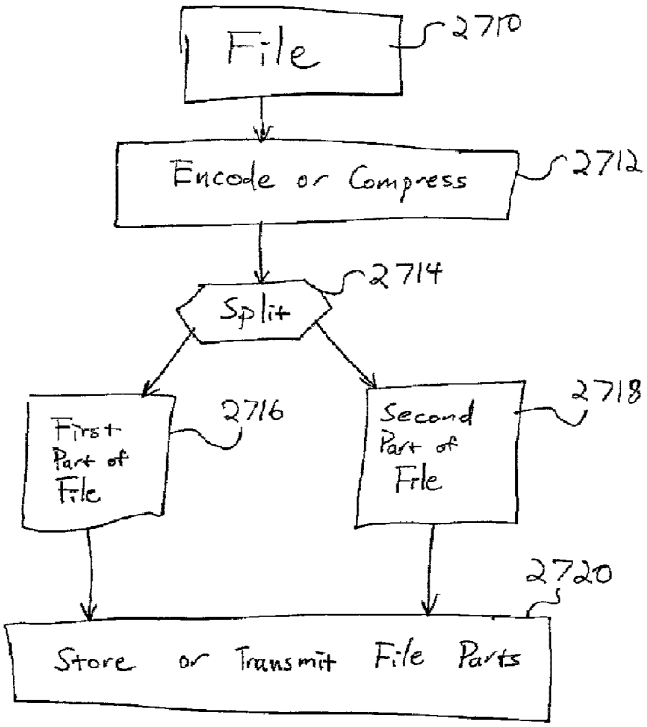
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(54) Title: FILE SPLITTING SCALADE CODING AND ASYNCHRONOUS TRANSMISSION IN STREAMED DATA TRANSFER



(57) Abrégé/Abstract:
Files (2750) are divided into parts (2716, 2718) and at least some of the parts are transmitted to a client using a communication channel. At least some of the transmitted parts are cached locally. This allows subsequent streaming playback of the file while using 'less bandwidth by transmitting the part of the file that hasn't been cached, and combining the cached parts with the

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(21) 2 466 482

(13) A1

(57) Abrégé(suite)/Abstract(continued):
tramitted parts. In some embodiments, files may be represented at a low quality level by a first data set (2804), and at higher quality levels with additional data sets (2806). Data sets are cached locally, so that during subsequent streaming playback of the file, the quality level of the playback may be improved by sending additional data sets using bandwidth that would otherwise be dedicated to transmitting the cached data sets.

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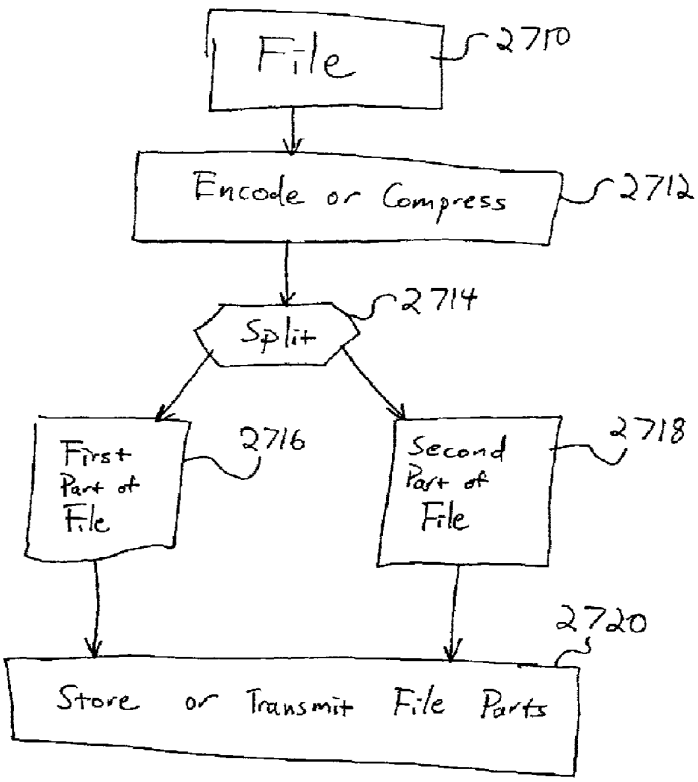
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[Continued on next page]

(54) Title: FILE SPLITTING SCALADE CODING AND ASYNCHRONOUS TRANSMISSION IN STREAMED DATA TRANSFER



(57) Abstract: Files (2750) are divided into parts (2716, 2718) and at least some of the parts are transmitted to a client using a communication channel. At least some of the transmitted parts are cached locally. This allows subsequent streaming playback of the file while using 'less bandwidth by transmitting the part of the file that hasn't been cached, and combining the cached parts with the tramitted parts. In some embodiments, files may be represented at a low quality level by a first data set (2804), and at higher quality levels with additional data sets (2806). Data sets are cached locally, so that during subsequent streaming playback of the file, the quality level of the playback may be improved by sending additional data sets using bandwidth that would otherwise be dedicated to transmitting the cached data sets.

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FILE SPLITTING, SCALABLE CODING, AND ASYNCHRONOUS TRANSMISSION IN STREAMED DATA TRANSFER

Cross-Reference to Related Application

[0001] This application is a continuation-in-part of U.S. Patent Application Serial Number 09/846,823, filed on April 30, 2001, Patent No. X,XXX,XXX, the disclosure of which is incorporated by reference, and which claimed priority from U.S. Provisional Application Serial Number 60/201,622, filed May 3, 2000, the disclosure of which is incorporated by reference. The present application also claims priority from provisional U.S. Patent Application Serial No. 60/337,939, for "File Splitting, Scalable Coding, and Asynchronous Transmission in Streamed Data Transfer," filed November 9, 2001, the disclosure of which is incorporated by reference.

Background of the Invention

Field of the Invention

[0002] The present invention is related to delivery of streamed programs such as audio and video, and more particularly to systems and methods providing improved control, efficiency, and quality of such streamed transmissions using file splitting, scalable coding, and asynchronous transmission.

Description of the Background Art

[0003] Delivery of audio and video programs over the Internet provides several advantages over conventional broadcast media such as radio and television. Unlike broadcast media, which require users to receive programs at particular times, or to record them for later use, Internet delivery allows users to select and receive programs upon demand, at a time that is convenient to them. For example, a user may browse to a news story, presented in text format, and click on a link that initiates playback of an audio report on the news item. Users may also click on links to hear songs or song samples, as is common in e-commerce sites, such as amazon.com or cdnow.com, in order to permit users to sample songs before purchasing compact discs (CDs). Internet delivery of audio programming may also be used for implementing personalized radio stations, which deliver music tracks selected in response to the tastes of particular users. Similar functionality is available for the delivery of video programs on demand, allowing users to view sports highlights, news reports, music videos, and even films and television shows, over the Internet.

[0004] Software for playing back such audio and video files is known in the art, including for example the Windows Media Player from Microsoft Corporation, and the RealPlayer from Real Networks, Inc. Functionality for audio and video delivery may also be built into browsers such as Netscape Navigator and Microsoft Internet Explorer.

[0005] One disadvantage of Internet delivery of audio and video programs is the relatively limited bandwidth that is available for any particular program. Compared with broadcast media, such as radio, television (over-the-air or cable), and the like, typical Internet connections offer far less bandwidth and thus limit the amount of information that may be transmitted to the end user in a given period of time. Thus, even with the application of aggressive compression algorithms, sound quality and picture quality of streamed programs received over the Internet tend to be substandard. For example, due to the limited number of bits available, existing Internet delivery schemes fail to provide received audio programs at a quality approaching that of CDs.

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[0006] As an alternative to streamed programs, and in order to improve quality of the received programs, users may download programs and then, subsequent to downloading them, play the received program via their computers. Since the program is not being viewed or listened to in "real time," more time is available to transmit and receive the program, so that larger files may be provided, and better quality achieved. However, it may take many minutes, or even hours, to download a short program at a reasonable level of quality. Thus, such a scheme does not provide the user with an immediate listening or viewing experience; rather, the user must wait until the program is downloaded before it can be viewed or listened to.

Summary of the Invention

[0007] The present invention provides improved quality, security, and efficiency for streamed programs, by combining received streamed data with previously-stored (cached) data. In one embodiment, a program file containing program data such as audio, video, or the like, is split into two or more sections. In one embodiment, each section is not usable on its own to provide program output (e.g., audio signals where the program file is an audio file), but can only be used when recombined with the remaining sections. In one embodiment, one section of the split data is considerably smaller than the other section(s). This splitting allows the second section to be cached by a client machine without a danger that the client has a persistent usable copy of the original file. This allows the benefits of caching to be realized without providing users with unauthorized persistent copies of files.

[0008] For example, the second section may be transmitted in advance of the actual playback of a program file, thus avoiding bottlenecks that may result when the entire program file is transmitted upon user demand. Until the first section is transmitted, the user will not be able to play the program file. The smaller first section may be streamed to allow playback of the program file. The first section is discarded after playback so that no persistent usable copy of the program file remains on the user's machine. The second section remains cached, allowing future streaming playback to be performed efficiently. The ability to not provide a persistent usable

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copy of the program file can be advantageous because copyright holders may not wish to authorize such persistent copies, since the persistent copy could cannibalize revenues from sales of the program file in a tangible medium (such as audio CDs), or paid future downloads, streamed or otherwise, of the program file.

[0009] Alternatively, the program file is split into sections in order to provide scalability in the playback quality level. The first section is playable at a relatively low quality level. Additional sections of data may be added to the first section to increase the quality level. Thus, the program file may be downloaded and played at a quality level determined by the bandwidth of the connection. The sections may be cached so that when it is desired to play the program file again, additional sections may be downloaded and added for higher quality playback.

[0010] In some embodiments, a persistent copy of a playable version of the program file is not stored on the client. The additional sections are not playable without the first level. Thus, the additional sections may be cached, so that the file can be played back by combining a downloaded first section with cached additional sections.

[0011] The file splitting and scalable coding embodiments may also both be used on the same program file. This allows most of the file to be cached while still providing the server control over when the file may be played back. It also allows subsequent playbacks of the file after the first to be progressively higher quality as more of the scalable sections are transmitted with every playback.

Brief Description of the Drawings

[0012] Fig. 1A is a block diagram of a functional architecture.

[0013] Fig. 2 is a block diagram of a conceptual architecture for one embodiment.

[0014] Figs. 3A and 3B illustrate a method for splitting a program file according to one embodiment of the present invention.

[0015] Figs. 3C and 3D illustrate a method of receiving and playing a previously split program file according to one embodiment of the present invention.

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[0016] Fig. 4A illustrates an example of a scalably-coded program file.

[0017] Fig. 4B is a block diagram illustrating the use and combination of primary data and secondary data to provide different playback quality levels.

[0018] Figs. 4C and 4D depict examples of scalable coding according to one embodiment of the present invention.

[0019] Figs. 5A and 5B depict techniques for combining file splitting and scalable coding according to one embodiment of the present invention .

Detailed Description of the Preferred Embodiments

[0020] The following description of preferred embodiments of the present invention is presented in the context of an Internet-based jukebox or personalized radio station where it is desirable to stream music files. One skilled in the art will recognize that the present invention may be implemented in many other domains and environments, both within the context of musical files, and in other contexts. Accordingly, the following description, while intended to be illustrative of a particular implementation, is not intended to limit the scope of the present invention or its applicability to other domains and environments. Rather, the scope of the present invention is limited and defined solely by the claims.

Architecture Overview

[0021] Referring now to Fig. 2, there is shown a conceptual architecture of one embodiment of the present invention. In the architecture of Fig. 2, the invention is implemented in connection with a web-based "jukebox" 103, or personalized radio station.

[0022] Stream delivery system 150 interacts with jukebox 103 to specify a sequence of audio files to deliver to jukebox 103. In some embodiments, this jukebox 103 may run on a client such as a personal computer, while the stream deliver server system is part of a remote server, connected to the client via a network. Jukebox 103 transmits requests to stream delivery system 150, and stream delivery system 150 delivers the audio files, as tracks, to jukebox 103. Stream delivery system 150 also communicates with real-time subscription authorization module 157, which includes real-

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time server 154 and database 156 that keep track of which user accounts are active and enforces global business rules about which accounts can listen to the radio at a given time. Within stream delivery system 150, there are a number of distinct software entities. Radio sequence generator 1613 receives requests from jukebox 103, receives format definitions 1611 and general constraints 1616, and receives recommendations from recommendation engine 107, to generate track selections to be transmitted to jukebox 103. The track selections generated by radio sequence generator 1613 specify which files to play according to estimated listener preferences as well as predetermined station formats. Authorization and content server 1614 keeps a record of the files that are selected by radio sequence generator 1613; server 1614 is consulted by radio sequence generator 1613 when files are requested. If generator 1613 does not provide the necessary security information, server 1614 flags this anomaly and declines to provide the data.

[0023] Referring now to Fig. 1A, there is shown a block diagram of a functional architecture for one embodiment of the present invention. Content index 110 provides a concise index of content stored in database 102, and is generated by conventional index generation means, to enable more efficient searching and updating of database 102.

Stream Delivery

[0024] In one embodiment, program files, such as audio files, are delivered to users as streamed data. The relationship discovery engine described in U.S. Patent Application Serial Number 09/846,823, filed on April 30, 2001, Patent No. X,XXX,XXX, describes one way to implement a personalized radio station, which may be used in conjunction with the present invention. The radio sequence transmitter 121 may deliver units of data to jukebox 103 in a format wherein each unit encodes a period of music. Since radio stations typically repeat their programming several times, it is beneficial to cache the data units in order to reduce the amount of transmitted data. In addition, if a sufficiently large time scale is used, different channels of the radio station may have considerable overlap among currently playing selections that are being delivered to various users. By identifying these common units, trans-

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mitter 121 can take advantage of further economies of transmission, so as to provide more efficient delivery of audio data.

[0025] In one embodiment, the transmitter 121 employs file splitting to improve the streaming performance, and provide streaming performance even in situations where channel capacity would otherwise be insufficient to provide the desired level of quality. In some embodiments, files are split prior to being stored in the content database 102 or with the compressed signal files 1615. In other embodiments, the files 101 are stored in the content database 102 or with the compressed signal files 1615 without first being split; the files are then split prior to being transmitted to a user for playback.

[0026] Fig. 3A is a flow diagram illustrating a method of splitting and storing a program file (such as a bitstream) containing program data such as audio, video, or the like, according to one embodiment. The process begins with the unsplit file 2710. Prior to being split, the file 2710 may be encoded and/or compressed 2712, although such operations are not essential to the present invention. Next the file 2710 is split 2714 into two or more parts, resulting in at least a first part 2716 of the file and a second part 2718 of the file. Particular techniques for splitting 2714 file 2710 are described in more detail in connection with Fig. 3B below. In one embodiment, the second part 2718 is substantially larger than the first part 2716. The file may be split 2714 into more than two parts. The parts 2716 and 2718 of the file 2710 are then stored 2720 in the content database 102 or with the compressed signal files 1615, or in some other location for later transmission. Alternatively, in an embodiment wherein files are split 2714 immediately prior to being transmitted, parts 2716 and 2718 are transmitted 2720 to an end user or remote computer for playback.

[0027] Fig. 3B is a block diagram illustrating an example of a method of splitting 2714 file 2710 into parts 2716, 2718 according to one embodiment. In the illustrated example, the file 2710 has M bits 2722-1 through 2722-M. The system generates first part 2716 of the file 2710 by taking N out of every P bits. The system generates second part 2718 of the file by taking the remaining P-N out of every P bits. In Fig. 3B, N is equal to one, and P is equal to four. Thus, the system assigns first bit 2722-1 to first part 2716, and assigns the next three bits 2722-2 through 2722-4 to sec-

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ond part 2718. The system then assigns fifth bit 2722-5 to first part 2716 and the next three bits 2722-6 through 2722-8 to second part 2718. The system repeats this pattern until all the bits of the file 2710 have been assigned to one of first and second parts 2716, 2718. In short, then, the system divides file 2710 into sections, with the first bit (or some other bit) of each section being sent to the first part 2716, and the remaining bits of each section being sent to the second part 2718. In general, the splitting technique of the present invention results in two or more sections 2716, 2718 each of which cannot be played back on its own, but can be played only when recombined with the other section or sections.

[0028] In one embodiment, N is equal to one, and P is equal to twenty, so that the first part 2716 is approximately 5% the size of the original file 2710, and the second part 2718 is approximately 95% the size of the original file 2710.

[0029] One skilled in the art will recognize that the system of the invention is not limited to file-splitting by bits, but may split files according to other units, such as bytes, or simply an arbitrary unit size. Alternatively, other file-splitting techniques may be used. For example, the system can include all headers, compression table selectors and scale factors into the first section 2716, and include all encoded program data (such as audio or video) into the second part 2718. Other methods of splitting the file 2710 into two or more parts may also be used.

[0030] In general, it is desirable in most embodiments that each part of the file 2710 is not decodable or able to be played back on its own, but can only be decoded and/or played back when recombined with the remaining part(s). This allows a part to be handled, transmitted, cached, or otherwise processed, without concerns that a user may permanently store and reuse an unauthorized copy of the program. Since a part cannot be used independently to recreate a recognizable facsimile of the signal in the original file 2710, the part can be cached by a client machine without any danger that the client has been given an unauthorized, useable persistent copy of the program file 2710. The ability to not provide a persistent usable copy of the program file can be advantageous because copyright holders may not wish to authorize such persistent copies, since the persistent copy could cannibalize revenues from sales of

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the program file in a tangible medium (such as audio CDs), or paid future downloads, streamed or otherwise, of the program file.

[0031] Fig. 3C is a flow diagram illustrating a method of receiving and playing a previously split program file according to one embodiment of the present invention. When a file is to be transmitted from stream delivery system 150 to the jukebox 103, the jukebox 103 or server 1614 determines 2724 whether the second part 2718 of the file 2710 has previously been stored, or cached, locally and is available for retrieval. If the second part 2718 is not available locally for retrieval, jukebox 103requests transmission of both parts 2716, 2718 of the file 2710. In response, server 1614 retrieves the requested parts 2716, 2718 from the files 1615 or the content database 102 (depending on where the parts 2716, 2718 have been stored), and transmits both the parts 2716, 2718 of the file 2710 to the jukebox 103, which receives 2726 them. Alternatively, if the files 2710 are stored unsplit, server 1614 retrieves the file 2710 to be sent, splits the requested file according to techniques described above, and then transmits the parts 2716, 2718 to the jukebox 103, which receives 2726 them.

[0032] Upon receiving 2726 parts 2716, 2718, in one embodiment the jukebox 103 stores 2732 the second part 2718 locally, so as to avoid the need to retransmit the second part 2718 if it is needed in the future. The jukebox 103 combines 2728 both parts 2716, 2718, and plays back 2730 the recombined program file 2710. This reception 2726, combination 2728, and playback 2730 may all take place concurrently, for example according to a streamed transmission methodology. In one embodiment, as the bits arrive at the jukebox 103, they are combined 2728 and played back 2730; the jukebox 103 need not wait until the entirety of the parts 2716, 2718 are received 2726 before combining 2728 and playing them back 2730. In one embodiment, the recombined file 2710 and the first part 2716 are discarded 2731 after or during playback. Since the cached second part 2718 represents only a portion of the program file 2710 and in one embodiment cannot be decoded or played back on its own, the invention prevents users from retaining an unauthorized playable copy of the program file 2710. Ultimate control over the user's playback of the program file 2710 thus remains with the server 1614, since the stored second part 2718 cannot be used to play back of the file 2710 until the server 1614 retransmits the first part 2716.

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[0033] If the second part 2718 has been received and stored locally in a prior session, jukebox 103 requests transmission of only the first part 2716 of the file 2710. In response, server 1614 retrieves the requested first part 2716 from the files 1615 or the content database 102, and transmits the first part 2716 to the jukebox 103, which receives 2734 it. Alternatively, if the files 2710 are stored unsplit, server 1614 retrieves the file 2710 to be sent, splits the requested file according to techniques described above, and then transmits the first part 2716 of the file 2710 to the jukebox 103, which receives 2734 it. The jukebox 103 retrieves 2736 the second part 2718 from local storage and combines 2738 the first and second parts 2716, 2718 to reconstruct the file 2710. The jukebox 103 plays back 2740 the reconstructed program file 2710. In one embodiment, as the bits arrive at the jukebox 103, they are combined 2738 with the stored second part 2718 to form a representation of the program file and played back 2740; the jukebox 103 need not wait until the entirety of the first part 2716 is received 2734 before combining and playing back the program. In other words, playback 2740 may take place while the first part 2716 is being streamed. As described above, in one embodiment, the recombined file 2710 and the first part 2716 are discarded 2731 after or during playback.

[0034] As can be seen from the description above, it is not necessary to transmit the second part 2718 more than once. The second part 2718 can be stored locally after the first transmission, so that, in one embodiment, only the first part 2716 need be transmitted for subsequent streaming playback of the program file 2710. Since in some embodiments the stored second part 2718 is substantially larger than the first part 2716, the present invention greatly reduces bandwidth requirements for streaming playback of the program file 2710. After the second part has been stored locally 2732, even clients with slow connections may effectively stream the program file 2710. Thus, from the user's perspective, the program file 2710 appears to be streamed in a manner equivalent to conventional streaming.

[0035] In addition, the described file splitting may provide advantages in licensing distribution of programs for playback by users. The file splitting benefits the licensor because the user does not receive a persistent usable copy of the program file, and the server retains control of playback of the program file 2710. This is advan-

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tageous because in contexts where blanket licensing or compulsory licensing is available for providing streamed data, in audio programming for example, a persistent copy would cannibalize revenues from future licensed streamed data downloads, and lack of control would make collecting licensing revenues difficult. The file splitting benefits users who do not want to wait while a large file is transmitted and received before accessing the program file. By splitting the file and storing part locally, transmission of large and unwieldy amounts of data in real-time is unnecessary. The user has quick access to the program file, even if he or she is using a slow communication channel.

[0036] The present invention thus improves efficiency in the transmission of program files such as audio or video files, and helps avoids bottlenecks associated with conventional streaming techniques, while still providing control and security.

[0037] Fig. 3D is a flow diagram illustrating a method of receiving and playing a previously split program file according to one embodiment of the present invention, so as to provide improved streaming performance from a user's perspective, even if adequate bandwidth to stream the entire file 2710 is not available, through advance downloading of the second section 2718. For example, the second section 2718 may be transmitted in advance of the actual playback of an audio or video program in a first session, thus avoiding potential bottlenecks that may result when the entire program file 2710 is transmitted upon user demand according to streamed techniques. Advance transmission can be performed at off-peak times, thus avoiding bandwidth bottlenecks. This advance transmission can occur when the user is not actually listening to music, so as to facilitate improved usage of an otherwise idle network connection.

[0038] The jukebox 103 determines 2742 which program files are likely to be requested by a user, so that at idle times it can transfer data that is likely to be useful in the future. Such determination may be made, for example, by using the learned artist relationships described in U.S. Patent Application Serial Number 09/846,823, filed on April 30, 2001, Patent No. X,XXX,XXX, in order to "guess" which tracks the user is most likely to request in the future. Alternative methods of determination may also be used. In some embodiments, the files the user will likely want may be

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known, such as when the user listens to a personalized radio station, or tends to listen to a particular online radio station. Such radio stations often have a list of the files that will be streamed later. Thus, this list can be used to determine 2742 what files will be required.

[0039] After the jukebox 103 determines 2742 what files will likely be required, the jukebox 103 requests the second parts 2718 of the files at a time when the connection is idle, or when sufficient bandwidth exists to transmit files. The authorization and content server 1614 then transmits 2744 the requested second parts 2718 to the jukebox 103. The jukebox 103 locally stores 2746 the second parts 2718 to the files. At a later time, when a user requests that a program file 2710 be streamed, the jukebox 103 requests the first part 2716 of the program file 2710, as described above. In response, authorization and content server 1614 transmits 2748 the first part 2716. The jukebox 103 combines 2750 the received first part 2716 with the stored second part 2718 to form a representation of the file 2710 and plays back 2752 the representation of the file 2710. Such a technique permits higher-quality playback than would otherwise be available, by pre-transmitting a significant portion of the data needed for playing back the media program. As described above, in one embodiment, the recombined file 2710 and the first part 2716 are discarded 2754 after or during playback.

[0040] In one alternative embodiment, instead of transmitting 2744 the second parts 2718 over a network, the second parts 2718 may be stored on physical media (such as a compact disc or floppy disk). That physical media is then physically sent to the location of the jukebox 103, where it can act as a local storage device, or the second parts 2718 may be transferred from the physical media to desired local storage. Thus, even for slow network connections, or for very large files, the user may enjoy a streaming experience, while the server retains control of the program file.

[0041] In another embodiment, the file is further split according to circumstances surrounding its transmission. The stream delivery system 150 begins to transmit all or part of the program file, such as an audio file, to the jukebox 103. When the program file, or part of the program file is partially transmitted, transmission is stopped. This stop can occur because of a disconnection between the stream

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delivery system 150 and the jukebox 103, because a user wishes to stop transmission and use the bandwidth for other purposes (such as when skipping to the next streamed song in a personalized radio station), or other reasons. The partially transmitted section of the program file or part of the program file is stored locally. Then, at a later time, the rest of the program file or part of the program file is transmitted and combined with the stored part. Such a process is more efficient than starting to transmit the entire program file or part of the program file from the beginning if it was not completely transmitted in a prior session.

[0042] In one embodiment, the size of the transmitted information is used to determine whether the entire file or section has been transmitted, and if not, what further information must be transmitted. At the beginning of transmission, the stream delivery system 150 sends information to the jukebox 103 indicating the size of the file and parts to be transmitted. This information may be sent to the jukebox 103 in other ways as well, as part of a sequence listing, for example. The jukebox 103 can then use the received size of the file in conjunction with the stored file size to determine what remaining information is needed from the stream delivery system 150. Other methods to identify what further information is needed to complete a partially received file may also be used.

[0043] For example, one embodiment splits a 1000 byte audio file into two parts, a first section 2716 of 50 bytes, and a second section 2718 of 950 bytes. The stream delivery system 150 transmits 800 bytes of the second section 2718 to the jukebox 103. At this point, a user chooses to start transmission of another audio file, and end transmission of the first audio file. The transmitted 800 bytes of the second section 2718 are stored locally. Thus, to allow the user to listen to the first audio file in its entirety, only the remaining 150 bytes of the second part 2718 need be transmitted to the jukebox. This subsequent transmission of the remaining 150 bytes may be done as needed, such as when a user begins to listen to the audio file again and the first 800 bytes are taken from local storage, then the last 150 bytes are received from the stream delivery system. This transmission can also be performed in advance of the time the user wishes to listen to the audio file, such as a scheme where the jukebox 103 periodically checks for partial file sections, such as partial second parts 2718, and auto-

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matically request transmission of the rest of the second part 2718. The jukebox 103 may identify partial file sections by comparing the total file size to the stored size, and then requesting only the missing information, or through other methods.

[0044] In another alternative embodiment, instead of discarding the first part 2716, the jukebox 103 encrypts the first part 2716 and stores the first part 2716 locally. This further reduces the amount of data that must be transmitted for program file 2710 playback. The server 1614 may still retain control over playback of the program file 2710 by controlling when the jukebox 103 may decrypt the first part 2716, for recombination with the second part 2718 and playback of the program file 2710. The second part 2718 could also be encrypted in place of, or in addition to, the first part 2716.

[0045] In yet another embodiment, transmitter 121 employs scalable coding to increase the quality of audio output despite limitations in channel capacity. Fig. 4A is a block diagram illustrating an example of a scalably-coded program file, including data stored in two sections 2804, 2806 that together form a program file 2802. Primary set of data 2804 is sufficient to play back the program file 2802 at a low quality level. Secondary set of data 2806 may be added to the primary set 2804 for higher-quality playback. The sets of data 2804, 2806 may be stored separately in the content database 102 or with the signal files 1615, or may be stored in a combined state, to be separated and transmitted as needed.

[0046] Fig. 4B is a block diagram illustrating the use and combination of primary data 2804 and secondary data 2806 to provide different playback quality levels. As mentioned above, the primary data 2804 is sufficient to play back the program file 2802 at a low quality level 2808. In one embodiment, the secondary data 2806 alone does not provide information sufficient for playback 2810 of the program file 2802. However, when the secondary data 2806 is combined 2812 with the primary data 2804, the combined data 2812 is sufficient to play back the program file 2802 at a high quality level 2814. For example, if the program file 2802 is an audio file, low-quality audio can be produced using the primary data 2804. Audio cannot be produced with secondary information 2806 alone. If secondary information 2806 is combined with the primary information 2804, output quality is enhanced. In one em-

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bodiment, additional levels of information may also be provided, each of which can be combined with the lower levels to further enhance output quality. This allows caching of lower-quality audio received in a first session and later receiving secondary information 2806 in a second session, which enables the jukebox 103 to combine the primary and secondary information to output audio of increased quality.

[0047] Since different sets of data are available that successively improve program file 2802 quality level, the quality of the output by the jukebox 103 depends on how much data can be transmitted in the time available. The first time an audio track is transmitted, transmitter 121 provides jukebox 103 with the primary information 2804 first, which allows the jukebox 103 to playback a representation of the program file 2802. Secondary 2806 (and additional) information is transmitted to allow improved quality levels as time permits. Jukebox 103 outputs the audio track with whatever level of information it has received at the time output is to commence. If only primary information 2804 has been received, jukebox 103 outputs lower-quality audio. If secondary information 2806 has also been received, it is combined with the primary information 2804 and jukebox 103 outputs higher-quality audio.

[0048] In addition, jukebox 103, in one embodiment, caches the received information. If the same audio track is requested at a later time, transmitter 121 provides jukebox 103 with the next level of information. Therefore, even if jukebox 103 was unable to provide higher-quality audio during the first listening, it may be able to provide higher-quality audio during subsequent listenings, by combining secondary (and/or additional) information with the previously cached primary information to generate the higher-quality audio output. Such a technique facilitates the output of high quality audio even when network transmission capacities are limited.

[0049] Referring now to Fig. 4C, there is shown an example of a transfer sequence for a channel with moderate bandwidth. Initially, tracks A and B are requested. Primary information for track A 2820 is downloaded. As primary information 2820 is downloaded, a low-quality representation of track A 2828 is played, according to conventional streaming audio techniques. Downloaded primary information 2820 is cached.

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[0050] Once the download of primary information for track A 2820 is complete, jukebox 103 begins to download primary information for track B 2822. This download may begin even though track A is still playing 2828. In the example shown in Fig. 4C, the download of primary information for track B 2822 is completed while track A is still playing 2828. Therefore, jukebox 103 begins to download secondary information for track B 2824. Then, when playback 2828 of track A is finished, jukebox 103 is able to output a high quality representation of track B 2830, by combining secondary information 2824 with previously downloaded primary information 2822. The output of the high quality version 2830 may take place while secondary information 2824 is still being downloaded, again using streaming techniques.

[0051] In the example of Fig. 4C, a request to play track A a second time is received. Therefore, once secondary information 2824 has been downloaded, jukebox 103 begins to download secondary information for track A 2826. Once the high quality version of track B 2830 is finished playing, jukebox 103 outputs a high quality representation of track A 2832, by combining secondary information 2826 with previously downloaded primary information 2820.

[0052] Referring now to Fig. 4D, there is shown another example of a transfer sequence for a channel with a lower bandwidth than that of Fig. 4C. Here, the secondary information for track B 2824 is not downloaded, because it would not arrive in time to improve the output of track B. Accordingly, a lower quality version of track B 2834 is output in lieu of the higher quality version 2830 of Fig. 4C. However, the higher quality version of track A 2832 can still be presented, since there is sufficient time to download secondary information for track A 2826 before the second playback of track A commences.

[0053] One skilled in the art will recognize that the tracks depicted in Figs. 4C and 4D may refer to individual songs, or song segments, or any other unit of information. One skilled in the art will further recognize that the scalable coding techniques described herein may be applied to video data, or to any other type of data, and are not limited to audio data.

[0054] The scalable coding techniques of the present invention thus facilitate the trading off of quality in bandwidth-limited situations, without requiring

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complex bandwidth estimation and determination. If insufficient bandwidth exists for the delivery of higher-quality versions, the system simply continues playing lower quality versions of tracks. No skipping, pausing, or other interruption of the audio stream is necessary. Jukebox 103 can determine whether to continue any particular transfer to improve the available quality or to download the next requested track, based on upcoming track selections. At any given moment, the next data segment to request can be determined by requesting the highest priority data segment from the next few audio segments. In one embodiment, priorities are defined to either play audio at a maximum short-term quality level or at a consistent quality level.

[0055] In one embodiment, jukebox 103 requests data for downloading according to the following order of priorities:

Priority	Type of value
1	Primary information, next track
2	Secondary information, next track
3	Primary information, track after next
4	Secondary information, track after next
5	Tertiary information, next track
6	Tertiary information, track after next
7	Data for subsequent tracks

[0056] One skilled in the art will recognize that any desired priority list may be provided. For example, if item 5 in this table is moved up to the third rank, the system will give more priority to high quality presentation at the possible expense of inconsistent quality on lower bandwidth connections.

[0057] In one embodiment, locally-cached downloaded data is stored in an encrypted or otherwise protected form, so as to prevent its abuse and to inhibit copyright infringement. In another embodiment, primary information is stored in an encrypted or otherwise protected form, but secondary and subsequent information is not, since the secondary and subsequent information is unusable without access to the primary information.

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[0058] In one embodiment, jukebox 103 downloads data sets when the user is not actually listening to music, so as to facilitate improved usage of an otherwise idle network connection. Jukebox 103 determines which items are likely to be requested by a user, so that at idle times it can transfer data that is likely to be useful for rendering audio segments in the future. Such determination may be made in the same way as described above with respect to the split files of Fig. 3D. In one embodiment, secondary information 2806 for such "predicted" audio segments is downloaded first, so that encryption is not required unless and until the user actually requests the tracks and the primary information 2804 is to be downloaded. Scalable coding may also be used to process a signal of a conventional broadcast radio station that plays music. An audio recognition device, as is conventional, pre-processes the signal in order to identify individual songs. Those portions of audio information that are not music are compressed and stored, and a transfer sequence is sent to jukebox 103 that references these recently encoded non-music segments as well as previously known and cached musical segments. The recently encoded segments can be encoded at a lower quality level in order to allow a jukebox 103 connected by a low speed line to transfer the recently encoded segments in real-time while still playing the cached musical segments at a higher quality level.

[0059] As with file splitting, portions of scalably coded files may also be sent on physical media rather than transmitted over a network. Similarly, if sections of scalably coded information are only partially transmitted, they may be stored locally, and then only the information not previously received is transmitted in a subsequent session.

[0060] File splitting and scalable coding may also be used in combination. Fig. 5A is a block diagram illustrating how a program file 2902 may be divided into primary data 2904 and secondary data 2906, and the primary data 2904 file split into a first part 2908 and a second part 2910. The primary data 2904 is split as described above with respect to Figs. 3A and 3B. This allows almost all of the primary data 2904 and secondary data 2906 to be cached locally without requiring encryption. Since, in one embodiment, the second part 2910 of the primary data 2904 is not playable without the first part 2908, and the secondary data 2906 is not playable without a playable

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set of primary data 2904, all of the program file 2902 except the first part 2908 of the primary data 2904 may be cached locally without providing the user with a usable copy of the program file 2902 that may be played back. This allows the server 1614 to retain control of playback of the program file 2902, as long as the first part 2908 of the primary data 2904 is not stored locally in a usable form.

[0061] Fig. 5B is a block diagram that illustrates how such a scheme provides advantages for streaming program files 2902. First, the first and second parts 2908, 2910 of the primary data 2904 are transmitted 2912 to the client by the server 1614. The first and second parts 2908, 2910 may be transmitted at roughly the same time in response to the jukebox 103 requesting the program file 2902. Alternatively, the second part 2910 may be transmitted in advance, after determination of what files 2902 are likely to be desired, as described above with respect to Fig. 3D. In an embodiment wherein the second part 2910 is transmitted in advance, the first part 2908 is transmitted in response to the jukebox 103 requesting the program file 2902. The first and second parts 2908, 2910 are sufficient to provide low quality playback 2914. The second part 2910 is then stored 2916 locally, and the first part 2908 is discarded. At a later time, such as when the jukebox 103 requests the program file 2902 again, the server 1614 transmits 2918 the first part of the primary data 2908 and the secondary data 2906. This allows sufficient information for the program file 2902 to be played back at a high quality level 2920. The secondary data 2906 is stored locally 2922, and the first part 2908 of the primary data 2904 is discarded. For subsequent playback of the program file 2902, only the first part 2908 of the primary data 2904 need be transmitted 2924 in order to enable high quality level playback 2920. Again, after such playback, the first part 2908 of the primary data 2904 is discarded, so that the server may retain control of program file 2902 playback. As an alternative to discarding the first part 2908, the first part 2908 may be encrypted, with decryption only occurring under the server's 1614 control.

[0062] Thus, a significant portion of the program file 2902 may be stored locally, with only the relatively small first part 2908 being transmitted from the server 1614 to provide the user with streaming file performance. This allows high quality streaming performance even over a relatively narrow bandwidth connection.

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[0063] As described above, when scalable coding or file splitting is used, the jukebox 103 plays back a representation of the program file. This representation may be an exact digital replica of the program file, such as when the program file is split, all parts are transmitted to the jukebox 103, and the entire file is combined for playback. The representation may also be a less than exact replica, such as when only some portions of a scalably coded program file are combined and played back.

Recommendation Engine

[0064] One method of determining in advance what program files a user may want streamed is through use of a recommendation engine, described more fully in U.S. Patent Application Serial Number 09/846,823, filed on April 30, 2001, Patent No. X,XXX,XXX. Note that there are also many other ways to determine what program files a user may want streamed in advance. Referring now to Fig. 2, the jukebox 103 or personalized radio station accepts a user's selections of music tracks and makes additional recommendations as to music tracks the user is likely to enjoy. The user is able to search for particular tracks and/or artists, and to control the playback of selected tracks. The system monitors the user's behavior with regard to searching, listening, and playback control, and generates and analyzes logs of such behavior in order to refine recommendations. Advertising, offers, and other information may be selected and presented to the user based on observations of user behavior and analysis as to which material may be of interest to the user.

[0065] Compressed signal files 1615 contain descriptions of music tracks, and in one embodiment contains digitized representations of the music tracks themselves. Compressed signal files 1615 are stored, for example, using conventional database storage means or in a conventional file system, and in one embodiment include several fields providing descriptive information regarding music tracks, such as title, album, artist, type of music, track length, year, record label, and the like.

[0066] Selected tracks are played via jukebox 103, which is implemented in one embodiment as a standalone application, or as a plug-in or bundled feature in browser 105. Jukebox 103 receives digitized representations of music tracks and plays the tracks over a speaker or headphones at the user's computer. In one embodiment,

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jukebox 103 can download and save music tracks in local storage (such as a hard disk drive, memory, or other local storage) in a compressed format, such as MP3, for playback on the user's computer or on a portable digital music listening device.

[0067] Recommendation engine 107 generates track preferences based on user information. Radio sequence generator 1613 uses track preferences, along with general constraints 1616 and format definitions 1611, to generate a sequence of tracks to be played. General constraints 1616 include particular rules and restrictions on the sequence of tracks, as may be required by law or as may be determined to be desirable for marketing or aesthetic purposes or for other reasons. Examples of constraints 1616 include: "no more than one song per hour from a particular album," or "do not play a fast song immediately after a slow song." Radio sequence generator 1613 may also incorporate a randomization element, if desired, and may be configurable by a website operator.

[0068] The track list is sent to jukebox 103 to be played to the user. A user activates jukebox 103 and selects music tracks for playback and/or purchase, via a user interface including controls and selectors. Authorization and content server 1614 checks that the appropriate security measures are in place (in order to prevent the user from "hacking" jukebox 103 to request unauthorized tracks from content server 1614), obtains the actual music tracks from files 1615, and provides them to jukebox 103 for output.

[0069] In one embodiment, the connections among the various elements of Figs. 1A and 2 are implemented over the Internet, using known protocols such as HTTP and TCP/IP. Secure sockets layer (SSL) or other encryption techniques may be employed for added security.

[0070] The recommendation engine may be employed in connection with conventional radio station programming techniques, to implement an improved personalized radio station. As is known in the art, conventional radio stations typically divide a programming block into a number of segments. Each segment is assigned a programming category, such as "power hit," "new release," "recurrent hit," and the like. For a particular programming block, music tracks are assigned to each of the segments based on the particular programming format of the radio station. Music

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scheduling software, such as Selector® by RCS Sound Software, applies heuristic rules for repetition limits and classes of songs, to automatically generate track lists for use by radio stations. The recommendation engine may be combined with such existing radio station programming techniques, to populate the defined segments with music tracks that are likely to appeal to a particular listener. Additional rules may be applied in generating track lists, so as to limit undesired repetition and to comply with limiting legislation (such as the Digital Millennium Copyright Act) and other restrictions.

[0071] From the above description, it will be apparent that the invention disclosed herein provides a novel and advantageous system and method for providing a user with a streaming program file experience. The foregoing discussion discloses and describes merely exemplary methods and embodiments of the present invention. As will be understood by those familiar with the art, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. For example, the invention may be applied to other domains and environments, and may be employed in connection with additional applications where personalized recommendations are desirable. Accordingly, the disclosure of the present invention is intended to be illustrative, but not limiting, of the scope of the invention, which is set forth in the following claims.

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[0072] What is claimed is:

1. In a client connected to a network and including a local storage device, a computer-implemented method of receiving and playing a media file comprising at least a first part and a second part, comprising:

receiving over the network and from a remote server in a first session the second part of the media file;

storing the second part at the local storage device;

receiving over the network and from a remote server in a second session subsequent to the first session the first part of the media file and not the second part of the media file;

combining the first part received in the second session with the stored second part after the start of the second session; and

playing a representation of the media file at the local client after combining at least part of the first and second parts after the start of the second session.

2. The computer-implemented method of claim 1, wherein the second part is not sufficient to properly play the representation of the media file back without being combined with the first part.

3. The computer-implemented method of claim 2, wherein the received parts of the media file are encoded, and the second part may not be decoded without being combined with the first part.

4. The computer-implemented method of claim 1, wherein the representation of the media file may not be played back at the local client without authorization by a remote server.

5. The computer-implemented method of claim 4, wherein authorization comprises the reception over the network and from a remote server the first part of the media file.

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6. The computer-implemented method of claim 1, wherein the neither the first part nor the second part may be used independently to recreate a recognizable facsimile of the content of the media file.

7. The computer-implemented method of claim 1, wherein the media file is divided into a plurality of sections, each section comprising a plurality of bits, wherein the first part comprises a first subset of bits from each section, and the second part comprises the remaining bits from each section.

8. The computer-implemented method of claim 1, wherein the media file is divided into a plurality of sections, each section comprising a plurality of bits, wherein the first part comprises a first bit from each section, and the second part comprises the remaining bits from each section.

9. The computer-implemented method of claim 7 or 8, wherein one of the sections contains exactly X bits, and wherein each of the remaining sections contains exactly Y bits, wherein X is less than or equal to Y.

10. The computer implemented method of claim 9, wherein Y equals 20.

11. The computer implemented method of claim 1, wherein the first part comprises headers, compression table selectors and scale factors of the media file.

12. The computer-implemented method of claim 1, further comprising:

receiving over the network and from a remote server during the first session the first part of the media file; and

playing the representation of the media file back at the local client during the first session.

13. The computer-implemented method of claim 1 or 12, wherein the first part is not stored at the local storage device after the playing of the media file.

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14. The computer-implemented method of claim 1 or 12, wherein the combined first and second parts are not stored at the local storage device after the playing of the media file.

15. The computer-implemented method of claim 1, wherein the played representation of the media file is an exact digital copy of the media file.

16. The computer implemented method of claim 1, wherein:

the media file further comprises a third part;

the first and second parts are combinable to form a representation of the media file at a first quality level; and

the first, second, and third parts are combinable to form a representation of the media file at a second quality level higher than the first quality level.

17. The computer implemented method of claim 16, further comprising:

receiving over the network and from a remote server the third part of the media file;

storing the third part at the local storage device;

combining the received third part with the stored first part and the stored second part to form the representation of the media file at the second quality level; and

playing the representation of the media file after combining the first, second, and third parts.

18. The computer implemented method of claim 17, wherein the third part is received over the network and from a remote server in a session other than the first session.

19. The computer implemented method of claim 17, wherein the third part and not the second part is received over the network and from a remote server in a session other than the first session.

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20. The computer-implemented method of claim 17, wherein the first part is not stored at the local storage device after the playing of the media file.

21. The computer-implemented method of claim 17, wherein the combined first, second, and third parts are not stored at the local storage device after the playing of the representation of the media file.

22. In a client connected to a network and including a local storage device, a computer-implemented method of receiving and playing a media file comprising at least a first part and a second part, comprising:

receiving over the network and from a remote server in a first session the first part of the media file, the first part of the media file a representation of the media file at a first quality level;

receiving over the network and from a remote server the second part of the media file, wherein the first and second parts are combinable to form a representation of the media file at a second quality level higher than the first quality level;

storing the second part at the local storage device;

receiving over the network and from a remote server in a second session subsequent to the first session the first part of the media file and not the second part of the media file;

combining the received first part with the stored second part; and

playing a representation of the media file at the local client.

23. The computer-implemented method of claim 22, wherein the first part is not stored at the local storage device after the playing of the media file.

24. The computer-implemented method of claim 22, wherein the representation of the media file is played after combining the first and second parts.

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25. The computer-implemented method of claim 22, wherein the representation of the media file is played in response to a command, and the representation of the media file is generated from at least the first part.

26. The computer-implemented method of claim 25, wherein the representation of the media file is generated from the second part as well as the first part if both the first part and the second part have been received at the time of playback.

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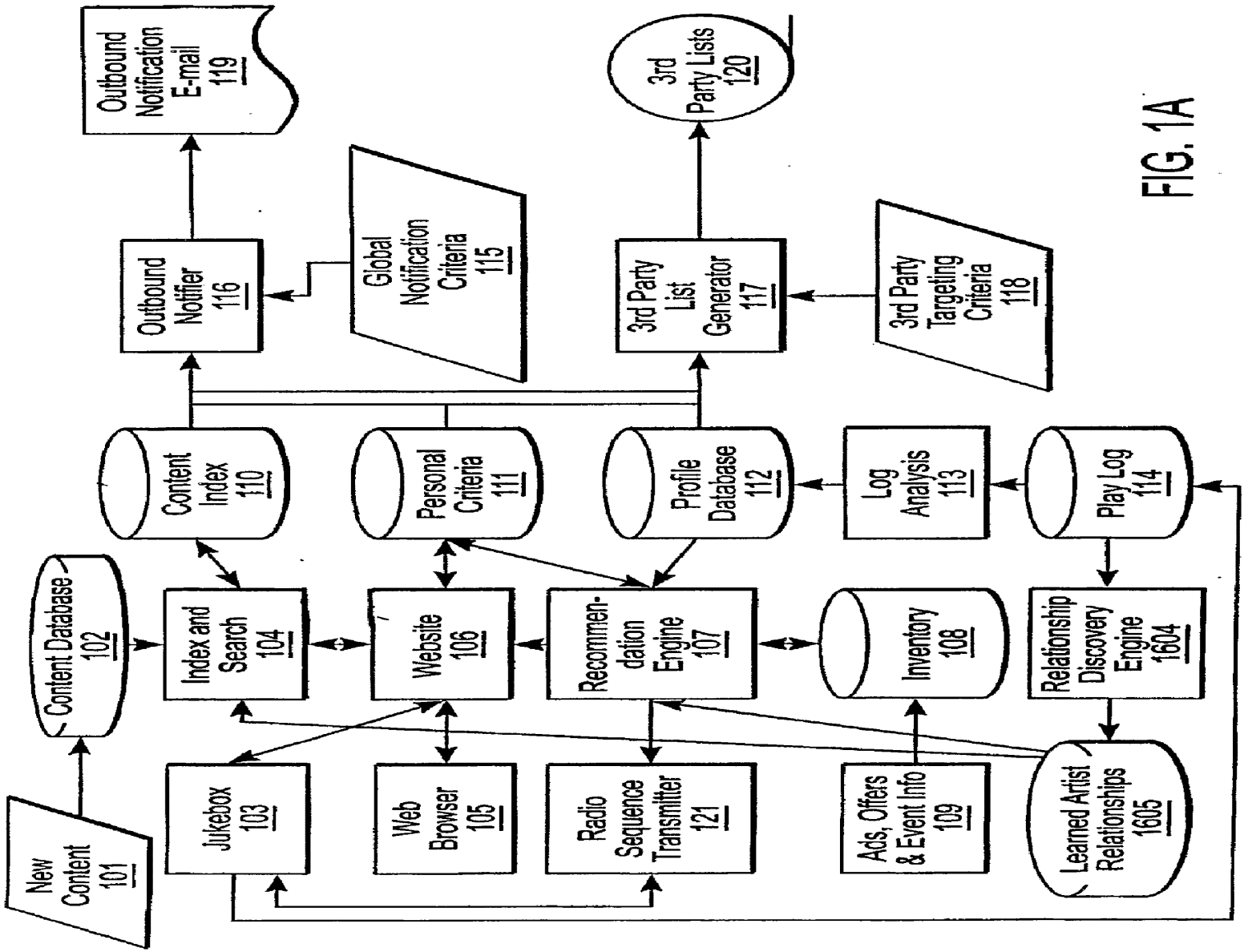


FIG. 1A

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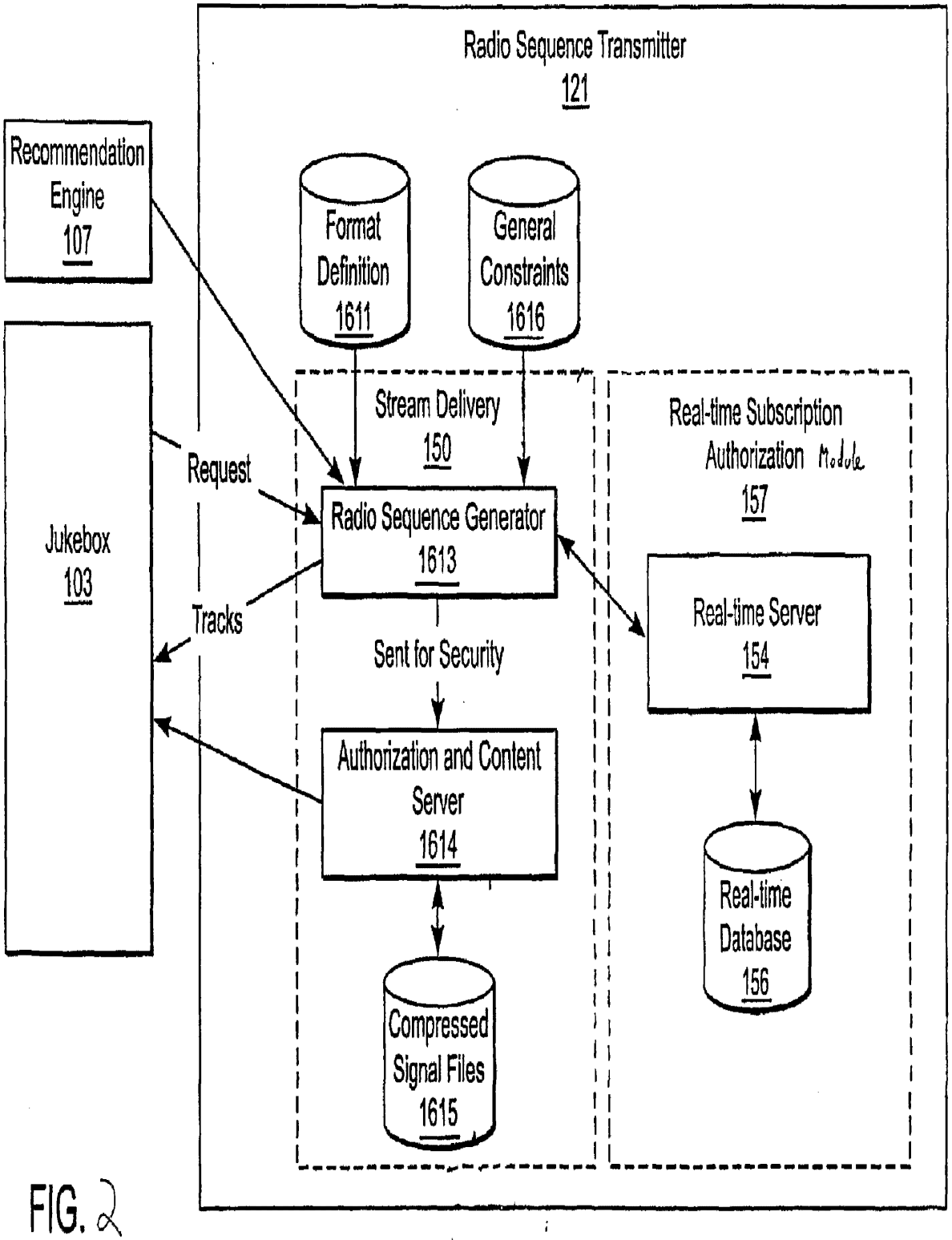

Radio Sequence Transmitter
121
Recommendation Engine
107
Format Definition
1611
General Constraints
1616
Stream Delivery
150
Real-time Subscription Authorization Module
157
Request
Radio Sequence Generator
1613
Jukebox
103
Tracks
Real-time Server
154
Sent for Security
Authorization and Content Server
1614
Real-time Database
156
Compressed Signal Files
1615

FIG. 2

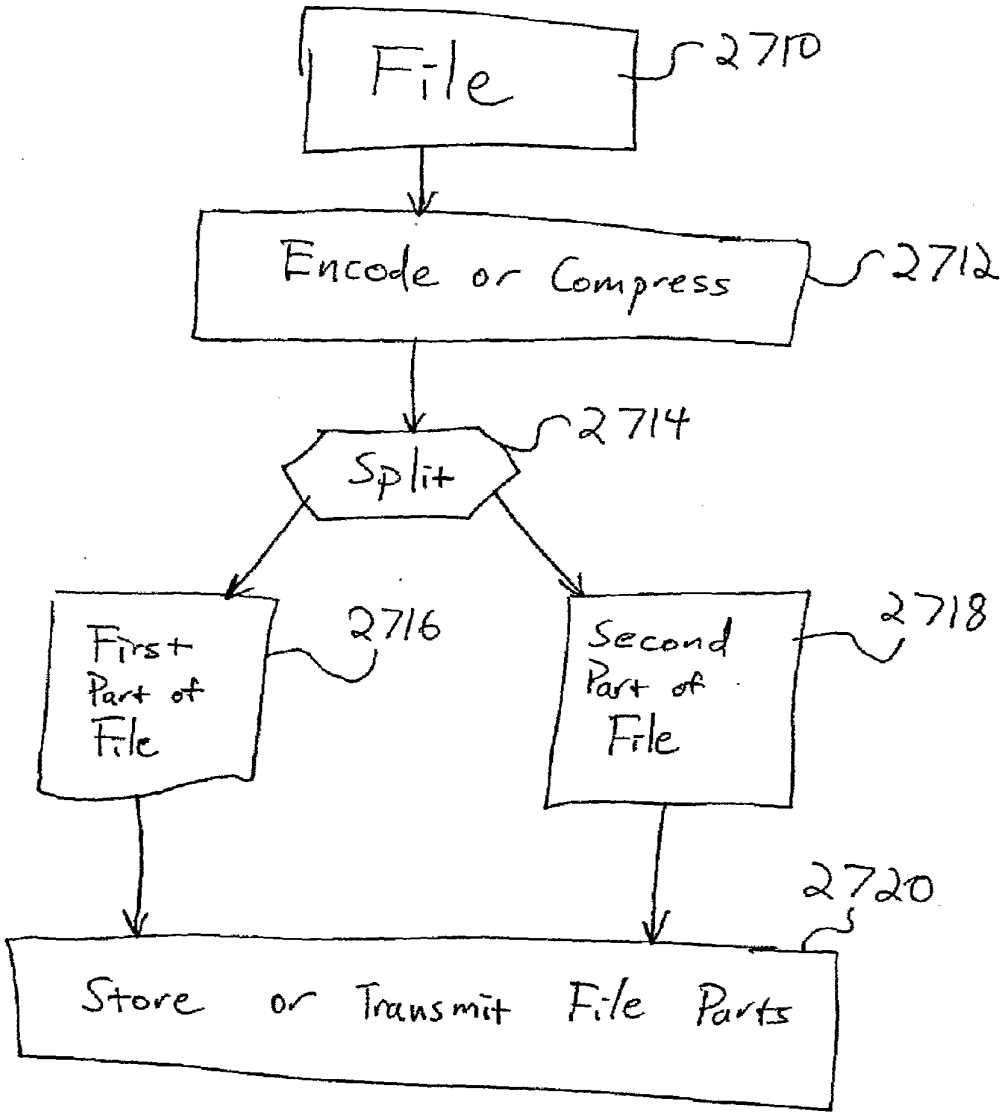

File
2710
Encode or Compress
2712
Split
2714
First Part of File
2716
Second Part of File
2718
Store or Transmit File Parts
2720

Fig. 3A

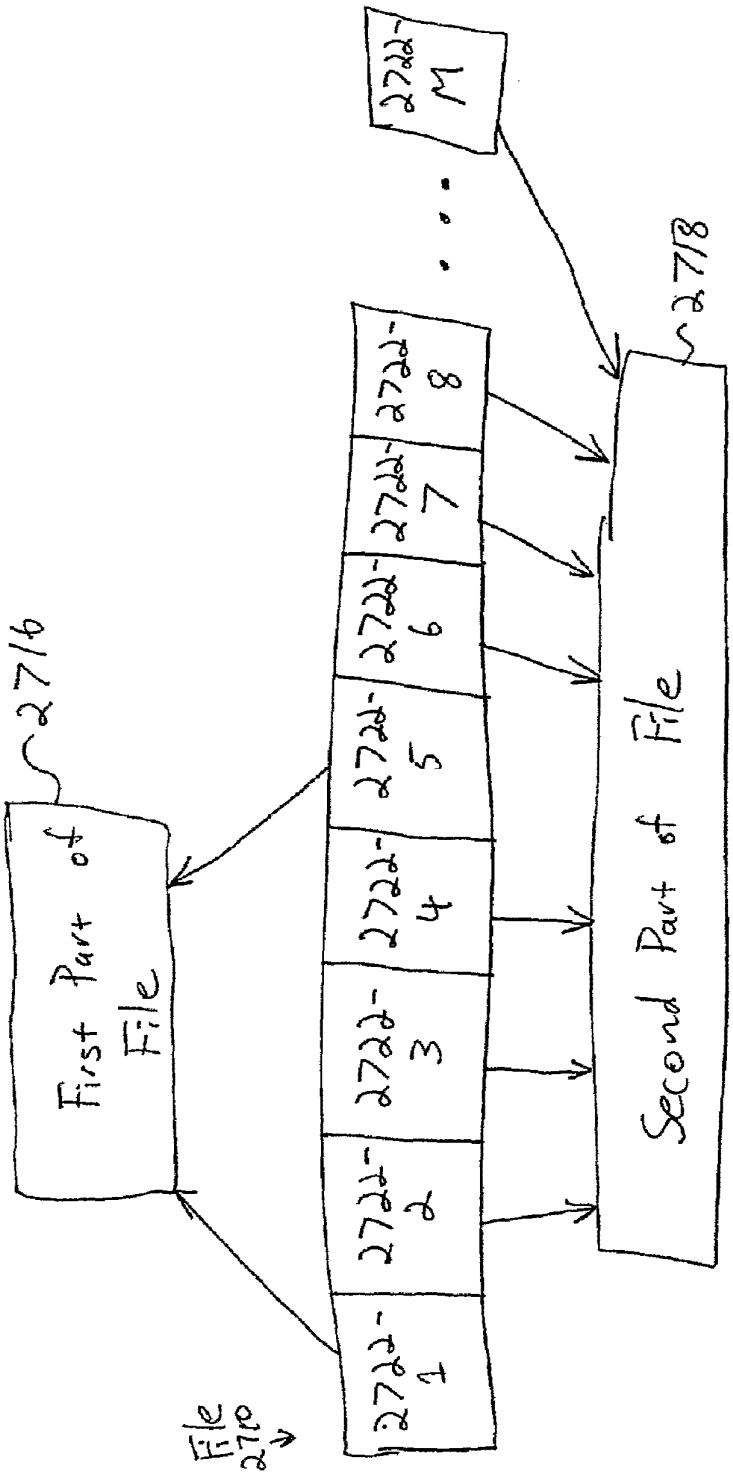

2716
First Part of File
2718
Second Part of File
File 2720
2722-1
2722-2
2722-3
2722-4
2722-5
2722-6
2722-7
2722-8
2722-M

Fig. 3B

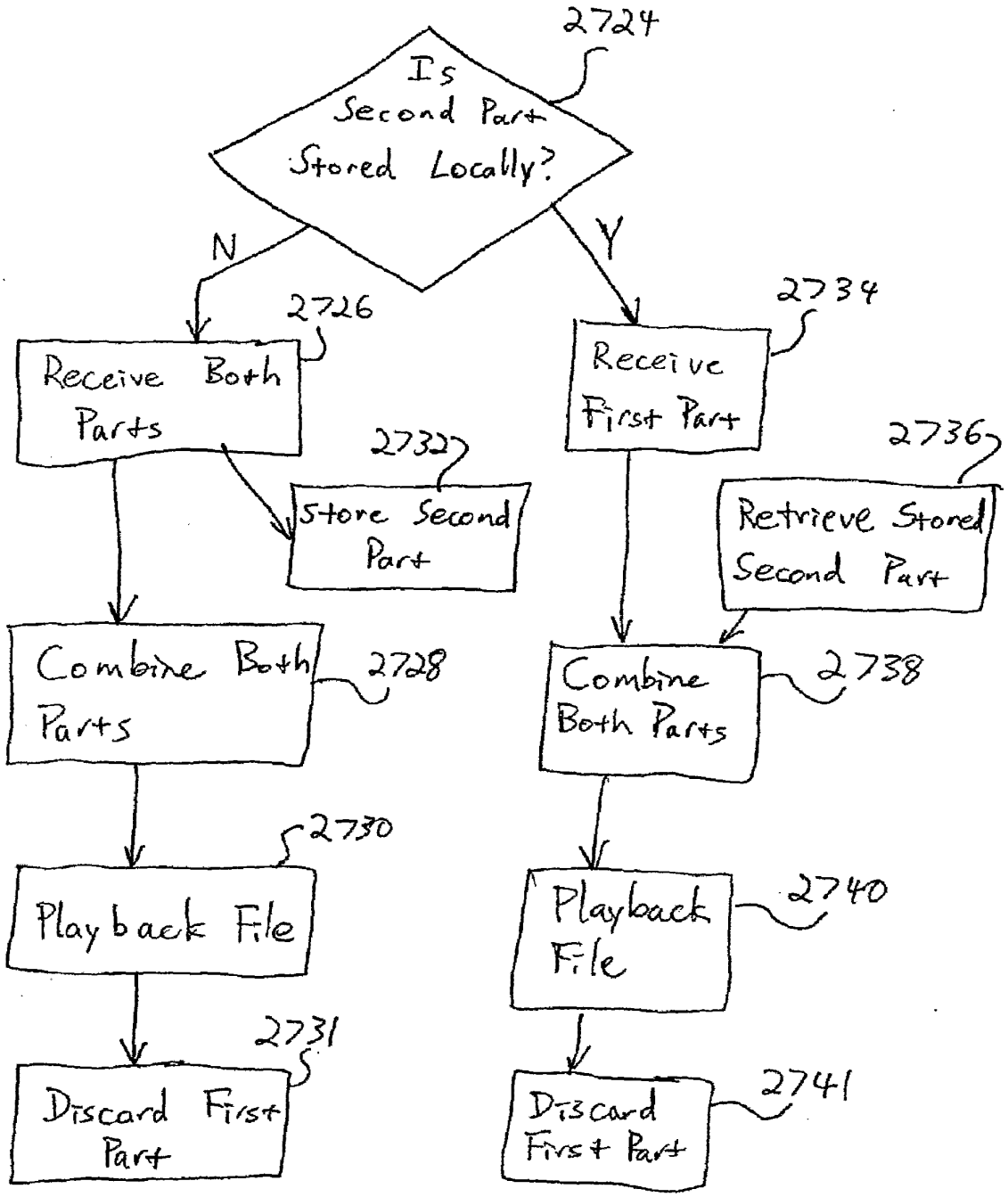

2724
Is Second Part Stored Locally?
N
Y
2726
Receive Both Parts
2732
Store Second Part
2734
Receive First Part
2736
Retrieve Stored Second Part
Combine Both Parts
2728
Combine Both Parts
2738
2730
Playback File
2740
Playback File
2731
Discard First Part
2741
Discard First Part

Fig. 3C

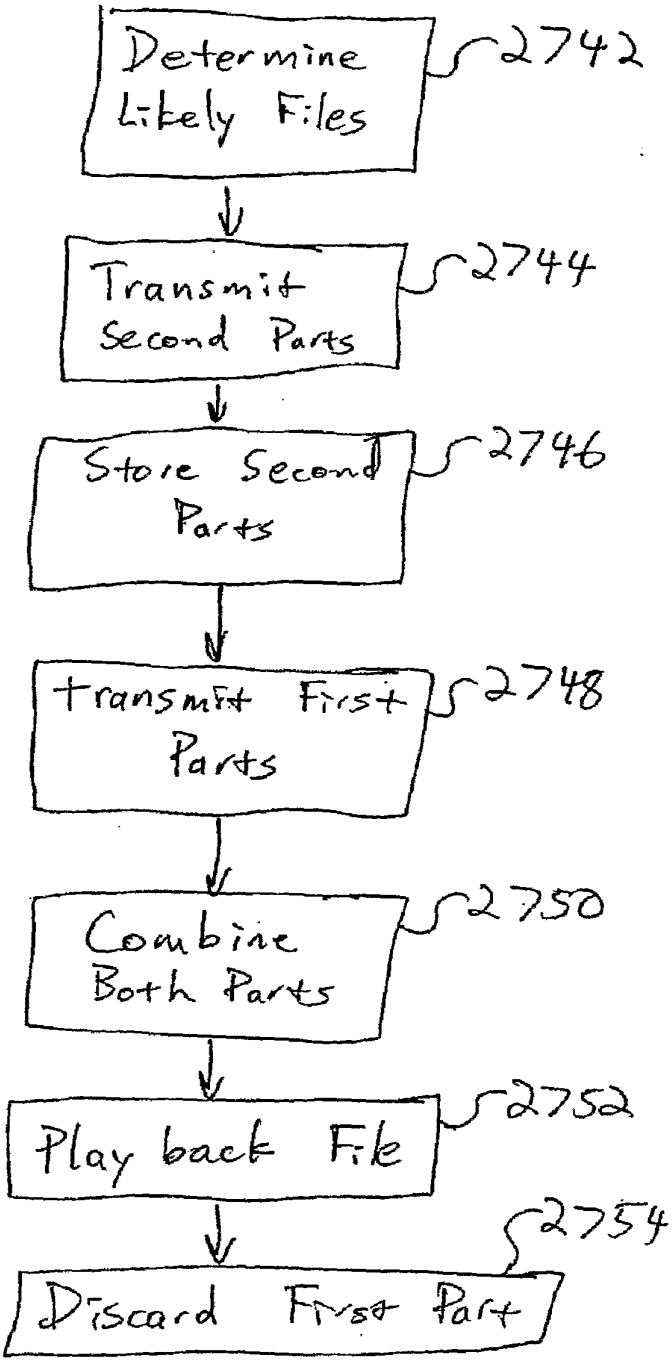
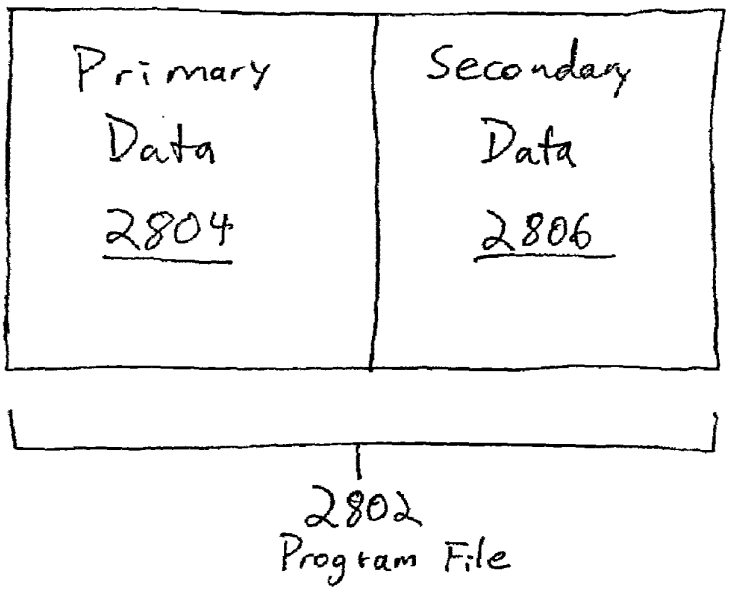

Determine Likely Files
2742
Transmit Second Parts
2744
Store Second Parts
2746
Transmit First Parts
2748
Combine Both Parts
2750
Play back File
2752
Discard First Part
2754

Fig. 3D

Fig. 4A


Primary Data 2804
Secondary Data 2806
2802 Program File

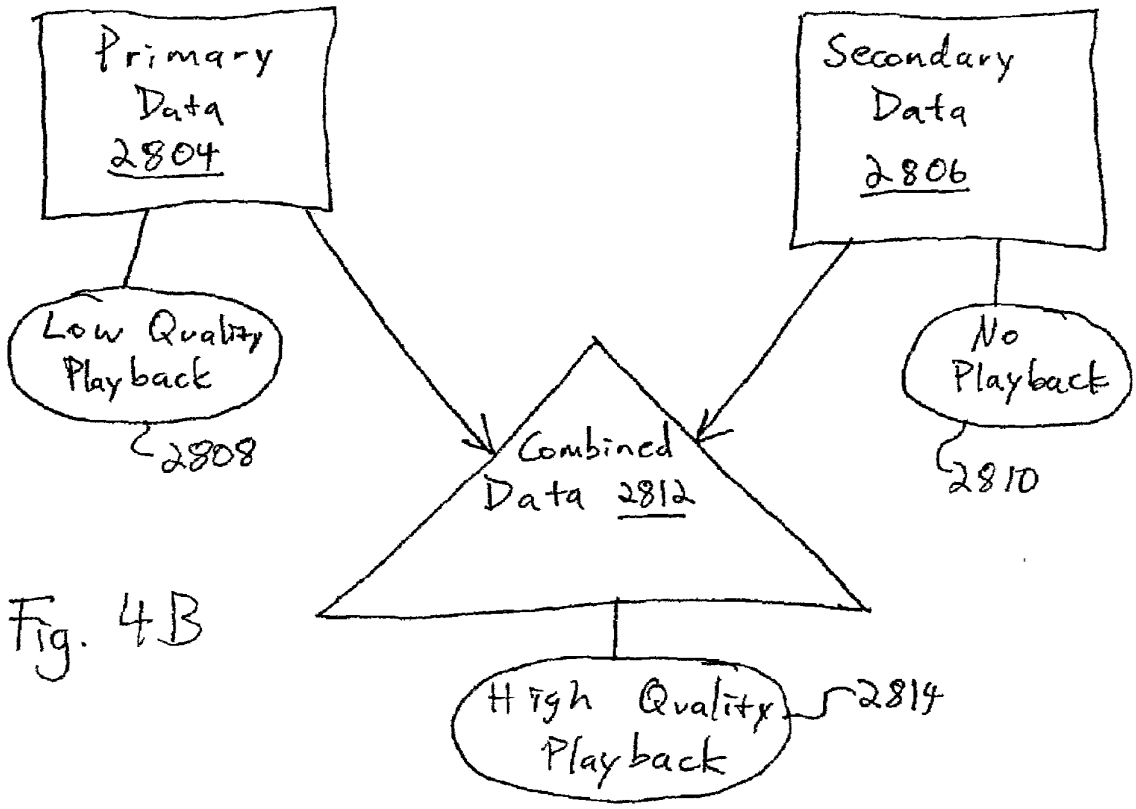

Primary Data 2804
Secondary Data 2806
Low Quality Playback
2808
Combined Data 2812
No Playback
2810
High Quality Playback
2814

Fig. 4B

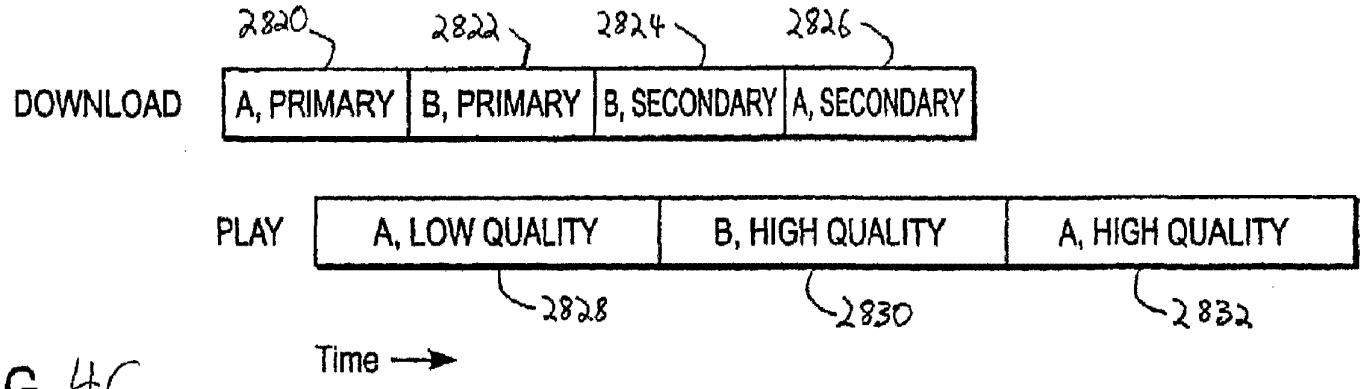


FIG. 4C

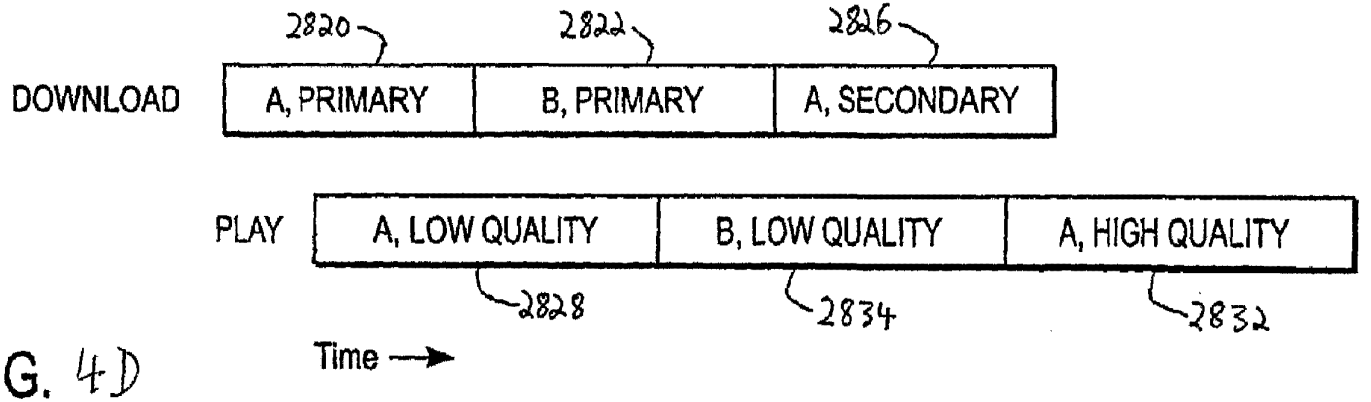


FIG. 4D

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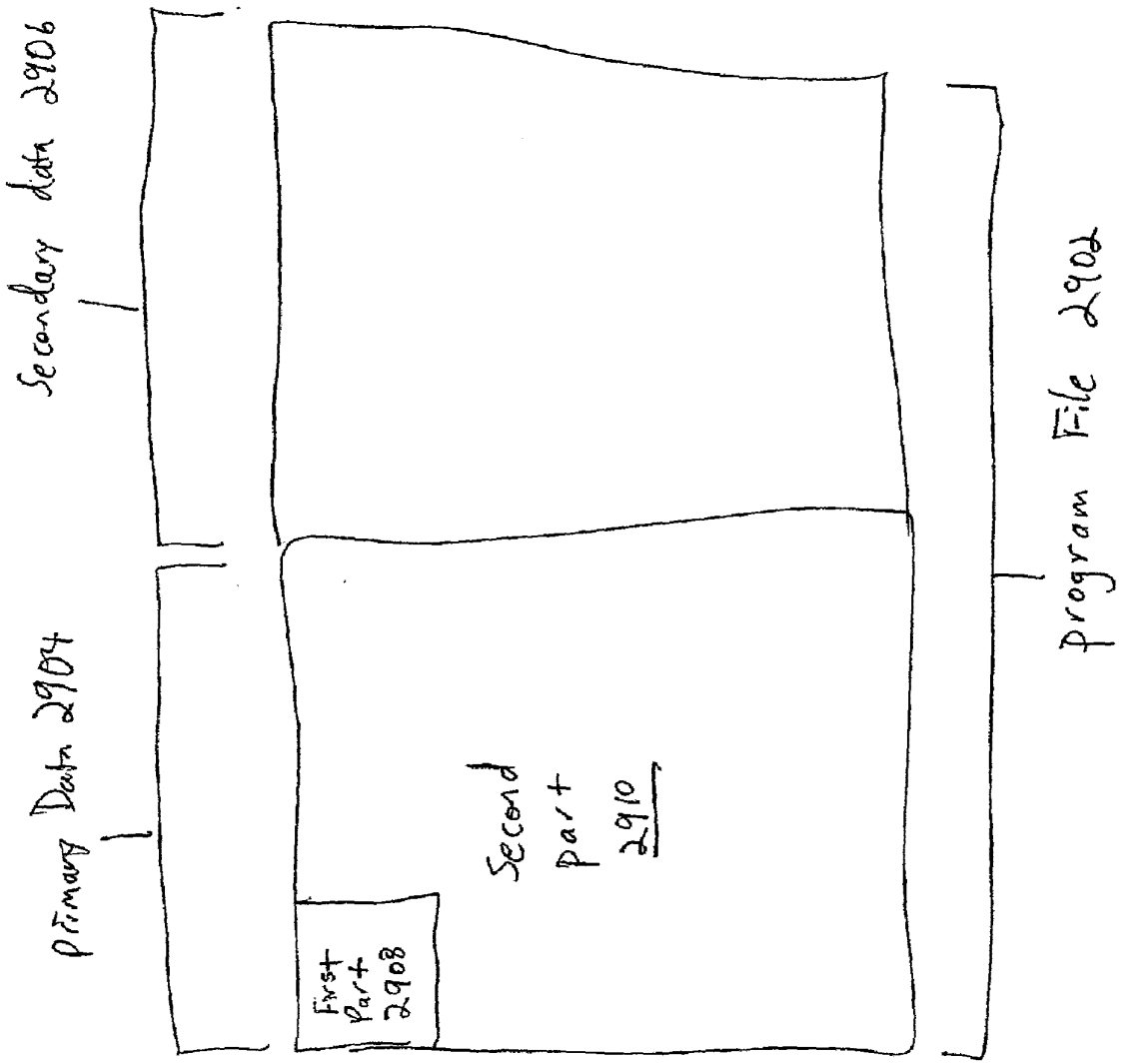


Fig. 5A

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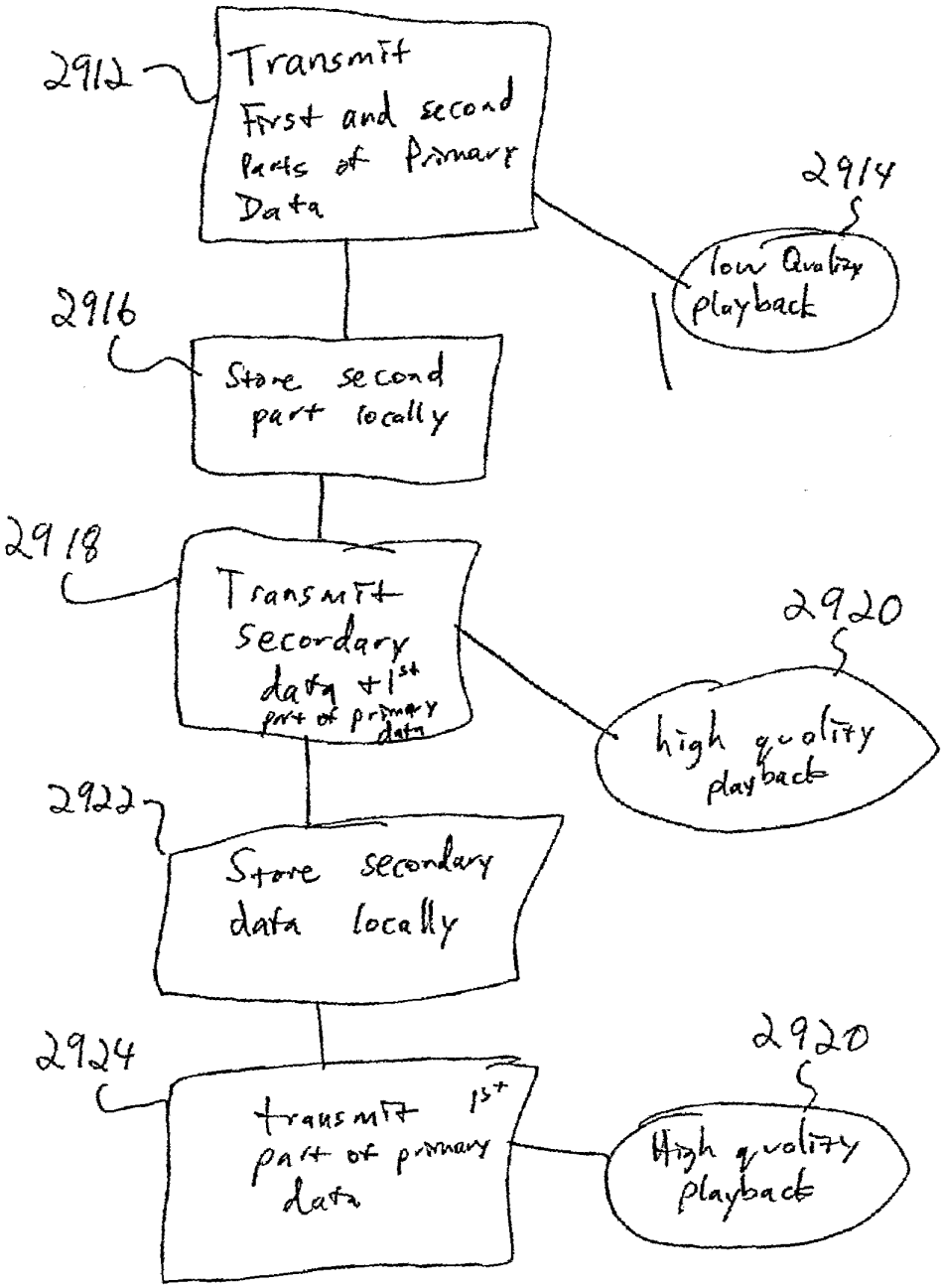


Fig. 5B

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PATENT ABSTRACTS OF JAPAN

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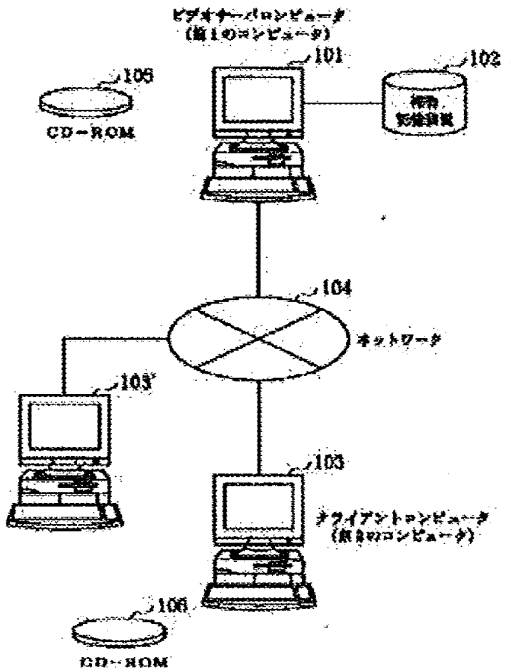
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AIKAWA NOBUYUKI
NIGO MASAKI

(54) SYSTEM FOR DISTRIBUTING PICTURE DATA AND RECORDING MEDIUM USED FOR THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a picture data distribution system capable of efficiently distributing picture data with appropriate quality in accordance with changes of the network connection environment of a client computer from moment to moment and a recording medium on which its program is recorded.
SOLUTION: This system has a 1st computer (image server computer 101) capable of distributing the picture data and one or more 2nd computers (client computer 103) receiving the picture data, and the 1st computer 101 receives a line situation notification message from the 2nd computer 103 and transmits the picture data (picture data extracted among a plurality of pieces of picture data which are preliminarily stored and have different compressibility or picture data compressed with optimum compressibility every time) which are subjected to compressibility being optimum to the communication speed of a line to which the 2nd computer is connected on the basis of the message.



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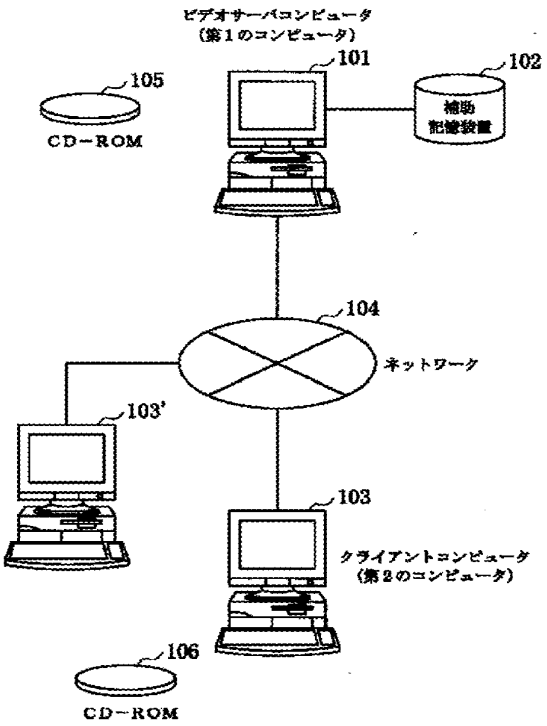
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(54)【発明の名称】　画像データ配信システムおよびそれに用いる記録媒体

(57)【要約】
【課題】　クライアントコンピュータのネットワーク接続環境の時々刻々の変化に応じて、適切な品質の画像データを効率よく配信することが可能な画像データ配信システムおよびそのためのプログラムを記録した記録媒体の提供。
【解決手段】　画像データを配信可能な第１のコンピュータ（画像サーバコンピュータ１０１）とその画像データを受信する１以上の第２のコンピュータ（クライアントコンピュータ１０３）を有し、第１のコンピュータ１０１は、第２のコンピュータ１０３から回線状況通知メッセージを受信し、そのメッセージに基づいて、第２のコンピュータが接続されている回線の通信速度に最適な圧縮を施した画像データ（予め記憶している圧縮率の異なる複数の画像データから抽出した画像データかまたはその都度最適な圧縮率で圧縮した画像データ）を送信する。



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【特許請求の範囲】

【請求項１】　画像データをストリーミング配信可能な第１のコンピュータとその画像データを受信する１以上の第２のコンピュータを有する画像データ配信システムにおいて、

前記第１のコンピュータは、

前記第２のコンピュータから回線状況通知メッセージに基づいて、該第２のコンピュータが接続されている回線の通信速度に最適な圧縮を施した画像データを送信する最適画像配信手段を有することを特徴とする画像データ配信システム。

【請求項２】　前記最適画像配信手段は、

送信時間を計測するタイマと、

圧縮率の異なる複数の画像データおよび該画像データ毎に該画像データの内容を識別可能な内部識別アドレスと送信の際の送信タイミングを規定するタイムスタンプとの対応データを保持する記憶手段と、

前記第２のコンピュータからの回線状況通知メッセージに基づいて前記記憶手段から最適な圧縮率の画像データを抽出するとともに、該抽出した画像データの、前記タイマで計測された送信時間に対応する前記内部識別アドレス以降の画像データ内容を配信する手段とを有することを特徴とする請求項１記載の画像データ配信システム。

【請求項３】　前記最適画像送出手段は、

１つの画像データを保持する記憶手段と、

前記第２のコンピュータから所定の時間間隔で受信する回線状況通知メッセージに基づいて、前記記憶手段に保持されている１つの画像データから、該第２のコンピュータが接続されている回線に最適な圧縮率の画像データを動的に作成して配信する手段とを有することを特徴とする請求項１記載の画像データ配信システム。

【請求項４】　前記第１のコンピュータは、画像サーバコンピュータであり、前記第２のコンピュータは、クライアントコンピュータであることを特徴とする請求項１または請求項２記載の画像データ配信システム。

【請求項５】　請求項１または２記載の第１のコンピュータにおける各手段および第２のコンピュータにおける各手段を実現する処理をプログラムコード化して記憶したことを特徴とするコンピュータで読み取り可能な記録媒体。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ネットワーク上でビデオストリーミングデータを送信する場合におけるデータ作成および配信システムに関し、特にデータを要求するクライアントコンピュータのネットワーク接続環境の動的な変化に対応して最適なビデオデータ配信を実現するビデオデータ配信システムおよびそのためのプログラムを記録した記録媒体に関する。

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【０００２】

【従来の技術】ネットワーク上における一般的なビデオデータ配信においては、ビデオサーバコンピュータはクライアントコンピュータのデータ送信要求に対し該当するデータのストリーミング配信を行なっている。通常のビデオデータは非常にサイズが大きいため、回線上に大きな帯域幅を必要としていた。従って、従来は、限られたネットワーク内において回線の帯域幅を考慮し適切な圧縮を行うことにより、ビデオデータ配信が行われていた。

【０００３】しかし、近年のインターネット技術の普及に伴い、インターネットを利用したビデオ配信システムが多数考案されている。インターネットを利用した場合、インターネットに接続され世界中に点在する膨大な数のコンピュータがクライアントコンピュータとなり得る。そのため、クライアントコンピュータのネットワーク接続環境はクライアントコンピュータ毎に異なることとなる。

【０００４】従って、例えば高品質（低圧縮率）のビデオデータを配信した場合、帯域幅の狭い通信回線に接続しているクライアントコンピュータは、配信された全てのビデオデータを受信しきれなくなる。この理由により、インターネット上でビデオ配信を行なう場合には、できるだけ多くのクライアントコンピュータで受信可能となるように、帯域幅の狭い通信回線に合わせた低品質（高圧縮率）のビデオデータを配信するようにしていた。この環境においては、高品質のビデオデータの受信可能なクライアントコンピュータであっても品質の低いビデオデータを受信することに甘んじなければならなかった。

【０００５】この問題点に関するものとして、ビデオサーバが、予め記憶装置に格納してある中間形態の動画データを事前に高品質および低品質の複数のデータを準備し、さらにビデオデータを要求するクライアントコンピュータが接続されている回線の通信速度を取得する手段を具備し、取得した通信速度により最適なデータを配信する仕組みが考案されている。

【０００６】

【発明が解決しようとする課題】しかしながら、一般に、クライアントコンピュータのネットワーク接続環境すなわち帯域幅は回線の混雑の度合等により刻々と変化するものであるが、上記従来技術においては、動画データの配信要求のあったクライアント端末のネットワーク性能（伝送速度）を検知し、それに応じた圧縮率の動画データを送信するものであり、ネットワーク性能の時々刻々の変化に応じて送信ビデオデータの品質（データ圧縮率）を変化させるものとはなっていない。

【０００７】本発明の目的は、クライアントコンピュータのネットワーク接続環境すなわち帯域幅の時々刻々の変化に応じて、適切な品質の画像データを効率よく配信

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することが可能な画像データ配信システムおよびそのためのプログラムを記録した記録媒体を提供することである。

【０００８】

【課題を解決するための手段】本発明は、上記目的を達成するために、画像データをストリーミング配信可能な第１のコンピュータ（好ましくは画像サーバコンピュータ）とその画像データを受信する１以上の第２のコンピュータ（好ましくはクライアントコンピュータ）を有する画像データ配信システムにおいて、第１のコンピュータは、第２のコンピュータから回線状況通知メッセージに基づいて、第２のコンピュータが接続されている回線の通信速度に最適な圧縮を施した画像データを送信する最適画像配信手段を有することを特徴としている。

【０００９】なお、前記最適画像配信手段は、（ａ）送信時間を計測するタイマと、圧縮率の異なる複数の画像データおよび該画像データ毎に該画像データの内容を識別可能な内部識別アドレスと送信の際の送信タイミングを規定するタイムスタンプとの対応データを保持する記憶手段と、第２のコンピュータからの回線状況通知メッセージに基づいて記憶手段から最適な圧縮率の画像データを抽出するとともに、該抽出した画像データの、タイマで計測された送信時間に対応する内部識別アドレス以降の画像データ内容を配信する手段とを有するか、あるいは、（ｂ）１つの画像データを保持する記憶手段と、第２のコンピュータから所定の時間間隔で受信する回線状況通知メッセージに基づいて、記憶手段に保持されている１つの画像データから、第２のコンピュータが接続されている回線に最適な圧縮率の画像データを動的に作成して配信する手段とを有している。

【００１０】また、本発明の記録媒体は、前記第１のコンピュータ（画像サーバコンピュータ）における各手段および第２のコンピュータ（クライアントコンピュータ）における各手段を実現する処理をプログラムコード化してコンピュータ読み取り可能なＣＤ－ＲＯＭ，ＤＶＤ，ＦＤなどの記録媒体に記録したものである。

【００１１】

【発明の実施の形態】以下、本発明の好ましい実施の形態を説明する。画像データを配信する機能を有するネットワークに接続されている画像配信サーバを具備し、該画像配信サーバは画像データを格納可能な記憶装置を具備し、画像配信サーバにアクセス可能な不特定多数のクライアントコンピュータを具備する構成とする。

【００１２】配信するビデオデータ作成において、ビデオサーバコンピュータは、オリジナルビデオデータを基に、高品質から低品質まで複数のビデオデータを記憶装置に作成し、個々のビデオデータに対し一定時間間隔のタイムスタンプを付加する機能を具備する。

【００１３】また、ビデオデータを受信するクライアントコンピュータでは、ビデオデータ受信中に受信パケットの状態を監視し、損失パケットが一定の基準を超えた場合、クライアント側の通信回線に十分な帯域が確保されていないと判定し、また、一定の基準時間の間に損失パケットが無い場合は、クライアント側の通信回線に十分な帯域が確保されていると判定し、その判定結果を配信中のビデオサーバコンピュータへ送信する手段を具備する。

【００１４】上述の判定結果を受信したビデオサーバは、その判定結果に適切な品質のビデオデータファイルを選択し、現在配信中のビデオデータファイルの切り換えを行う。その際、切り換え前後の２つのビデオデータに付加されているタイムスタンプを参照し、配信を中止する時点でのタイムスタンプと同様のタイムスタンプを持つ時点より切り換え後のビデオデータの配信を開始する機能を具備する。

【００１５】また、上記目的を達成するために、本発明は、ビデオデータを配信する機能を有するネットワークに接続されているビデオサーバコンピュータを具備し、さらにその記憶装置に記憶されているオリジナルビデオデータを送信時に所定の圧縮率で圧縮しながら配信する機能を具備する構成とする。

【００１６】ビデオデータを受信する際において、クライアントコンピュータは、ビデオデータ受信中に受信パケットの状態を監視し、損失パケットが一定の基準を超えた場合クライアント側の通信回線に十分な帯域が確保されていないと判定し、また、一定の基準の時間、損失パケットが無い場合、クライアント側の通信回線に十分な帯域が確保されていると判定し、その判定結果を配信中のビデオサーバコンピュータへ送信する手段を特徴とする機能を具備する。

【００１７】さらに、上述の判定結果を受信したビデオサーバコンピュータは、その判定結果に従い、動的に圧縮率に変更し、その変更された圧縮率で圧縮されたビデオデータを配信する機能を具備する。

【００１８】上記構成を採用することにより、配信されるビデオデータは、受信するクライアントコンピュータのネットワーク接続環境に従い配信するビデオデータの品質を動的に変化させることができる。これにより、クライアントコンピュータは常に最適化されたビデオデータを見掛け上切れ目なく受信することが可能となる。

【００１９】また、本発明の記録媒体は、上記の如きクライアントコンピュータが行う処理やビデオサーバコンピュータが行う処理をプログラムコード化してコンピュータ読み取り可能なＣＤ－ＲＯＭ，ＤＶＤ，ＦＤなどの記録媒体に記録したものである。

【００２０】（実施例の説明）以下、本発明の実施例として、２つの実施例を説明する。図１は、第１の実施例および第２の実施例における共通のハードウエア構成を示すブロック図である。本発明は、圧縮して配信することが可能な全てのデータ（特に画像データ）に対して適

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用可能であるが、本実施例では、ビデオデータ（動画データ）を例にとって説明する。

【００２１】図１において、１０１はビデオデータの作成および配信を行なうビデオサーバコンピュータ、１０２はビデオデータを格納する補助記憶装置、１０３および１０３’はクライアントコンピュータ、１０４はビデオサーバコンピュータ１０１とクライアントコンピュータ１０３が接続されるネットワーク環境である。以下の説明では、１つのサーバコンピュータと１つ以上のクライアントコンピュータからなるクライアント・サーバシステムの場合を用いて説明するが、第１のコンピュータから第２のコンピュータへの２つのコンピュータ間でのデータの配信にも適用可能であることはいうまでもない。

【００２２】（第１の実施例）まず、第１の実施例について図２～図６を用いて説明する。図２は、記憶装置に格納する圧縮ビデオデータファイルのファイル構造の説明図である。図２において、２０３は圧縮ビデオデータファイルのヘッダ情報、２０４は本実施例で取り上げる画像データファイル、２０５はＥＯＦ（ＥＯＦ：End of File）を示す。また、２０１は本発明の特徴である圧縮ビデオデータファイルのタイムスタンプであり、２０２は、タイムスタンプ２０１と対応する圧縮ビデオデータファイルの内部識別アドレスである。なお、本実施例で取り上げる圧縮率の異なる他の画像ファイル（圧縮画像ファイルＢおよび圧縮画像ファイルＣ）構造も図２と同様である。内部識別アドレス２０２は、ファイル毎にタイムスタンプ１０２に対応して設けられるものであるが、ファイルの品質（圧縮率）が異なればそれに伴って異なる値を有する。

【００２３】図３は、同一画像ファイルから生成された圧縮率の異なる３種類の圧縮ビデオデータファイルのヘッダ情報の説明図である。同図（ａ）は低圧縮画像ファイルＡのヘッダ情報を、同図（ｂ）は中圧縮画像ファイルＢのヘッダ情報を、同図（ｃ）は高圧縮画像ファイルＣのヘッダ情報を示している。３０１はタイムスタンプ情報、３０２は、インデックスに対応する図２に示すファイルの内部識別アドレスである。

【００２４】図４は、圧縮率の異なる３つの画像ファイルとタイムスタンプと内部識別アドレスの関係を説明するための図である。同図（ａ）は、低圧縮画像ファイルＡとタイムスタンプと内部識別アドレスの関係を、同図（ｂ）は中圧縮画像ファイルＢとタイムスタンプと内部識別アドレスの関係を、同図（ｃ）は高圧縮画像ファイルＣとタイムスタンプと内部識別アドレスの関係を、それぞれ示している。本例では、説明を簡単にするために、同図（ａ）に示す低圧縮画像ファイルＡを１／２に圧縮したものを中圧縮ファイルＢとして同図（ｂ）に示し、さらにこれを１／２に圧縮したものを高圧縮画像ファイルＣとして同図（ｃ）に示すとともに、タイムスタンプ，内部識別アドレスと圧縮画像ファイルＡ～Ｃの内容の関係がわかりやすいように画像ファイル中に「い」、「ろ」、「は」・・・などを便宜的に示した。

【００２５】図５は、ビデオサーバコンピュータ１０１に保持される、通信速度と該通信速度に最適化された圧縮画像ファイルとの対応図である。図５における通信速度を表わす記号（ｍ、ｎ）の大小関係は、ｍ＜ｎとする。同図に示すように、通信速度が低速の場合は（～ｍ）、低品質である高圧縮画像ファイルＣを、通信速度が高速の場合は（ｎ～）、高品質である低圧縮画像ファイルＡを配信するようにする。

【００２６】図６および図７は、第１の実施例の動作を説明するためのフローチャートである。まず、ビデオデータを配信するビデオサーバコンピュータ１０１の動作を、図６を用いて詳細に説明する。

【００２７】図６において、クライアントコンピュータ１０３からのデータ要求に従い、該当する記憶装置内のビデオデータ（システムには初期配信ファイルが設定済とする。本実施例では、初期配信ファイルは「中圧縮画像ファイルＢ」とする）の配信を開始し、かつ配信時間の計測を開始する（ステップ６０１）。

【００２８】クライアントコンピュータ１０３から低品質データの受信要求（後述する図７のステップ７０６参照）があった場合（ステップ６０３）、図５の対応図に従い、現在送信中のファイル（ファイルＢ）より１段階品質の劣る「高圧縮画像ファイルＣ」を送信ファイルとして確定する（ステップ６０４、６０５）。

【００２９】次に現在時点の配信時間を測定する（ステップ６０６）。本実施例では、この時の測定時間が４ｍｓであったと仮定し、図３に示すヘッダ情報より、「ファイルＢ」の４ｍＳの開始内部識別アドレスは「iiii」と確定する（ステップ６０７）。すなわち、画像「い」、「ろ」は配信済みとする。ビデオサーバコンピュータ１０１は即座に配信中の「中圧縮画像ファイルＢ」の配信を中止し、内部識別アドレス「iiii」から「高圧縮画像ファイルＣ」の画像「は」、「に」、・・・の配信を開始する（ステップ６０８）。

【００３０】逆に、クライアントコンピュータ１０３より高品質データの受信要求（後述する図７のステップ７０７参照）があった場合（ステップ６０３：Ｙ）、図５の対応図に従い、現在配信中の「中圧縮画像ファイルＢ」より１段階品質の高い「低圧縮画像ファイルＡ」を次送信ファイルとして確定する（ステップ６０４、６０５）。以下の動作は同様である。すなわち、ビデオサーバコンピュータ１０１は即座に配信中の「中圧縮画像ファイルＢ」の配信を中止し、内部識別アドレス「iiii」から「低圧縮画像ファイルＡ」の画像「は」、「に」、・・・の配信を開始する（ステップ６０８）。

【００３１】なお、現時点での配信データが「高圧縮画像ファイルＣ」であった場合にさらに低品質の高圧縮の

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画像ファイルが要求された場合、図５より１段階品質の劣るビデオデータは存在しないことがわかる。また、現時点での配信データが「低圧縮画像ファイルＡ」であった場合にさらに高品質の低圧縮画像ファイルが要求された場合にも、図５より１段階品質の高いビデオデータは存在しないことがわかる。このような場合は、データの存在しない旨のメッセージを送信し、現時点でのデータ配信を続行する（ステップ６０９）。

【００３２】また、ビデオサーバコンピュータ１０１は、ビデオデータの終端すなわち図２に示す「ＥＯＦ」まで配信を行った場合（ステップ６０２：Ｙ）、データの配信を終える。

【００３３】次に、ビデオデータを受信するクライアントコンピュータ１０３の動作を、図７を用いて詳細に説明する。図７において、先ず、ビデオサーバコンピュータ１０１に対するビデオデータ要求により、ビデオサーバから送信されたデータの受信を開始し、同時に損失パケット監視タイマをリセットする（ステップ７０１）。

【００３４】損失パケット数がシステムに既設定済の数を超過した場合（ステップ７０２：Ｙ）、クライアントコンピュータ側の通信回線に十分な帯域が確保されていないと判断し、ビデオサーバに低品質データの要求メッセージを送信する（ステップ７０６）。損失パケット数がシステムに既設定済の数を超過しない場合（ステップ７０２：Ｎ）、損失パケットの発生を常に監視し（ステップ７０３）、損失パケットが発生した場合（ステップ７０３：Ｙ）、損失パケット監視タイマをリセットする（ステップ７０４）。

【００３５】この損失パケット監視タイマが、システムに既設定済の一定時刻を超過した場合、すなわち損失パケットが一定時間発生しなかった場合（ステップ７０３：Ｎ，７０５：Ｙ）、クライアントコンピュータ１０３側の通信回線に十分な帯域が確保されており現在受信中のビデオデータよりも高品質なデータ（低圧縮のデータ）の受信が可能と判断し、ビデオサーバコンピュータ１０１に高品質データの要求メッセージを送信する（ステップ７０７）。ステップ７０８では、ビデオサーバコンピュータ１０１からの配信データに従い今までと異なる品質の配信データを受信し、同時に損失パケット監視タイマをリセットする。

【００３６】ここで、図６のステップ６０９に示すデータ無しのメッセージを受信した場合、そのメッセージに従い、低品質データ無しの場合はステップ７０６の低品質データ要求メッセージ送信を、また、高品質データ無しの場合はステップ７０７の高品質データ要求メッセージ送信を中止する。なお、クライアントコンピュータ１０３はビデオデータの終端をしめす「ＥＯＦ」まで受信した場合（ステップ７０９：Ｙ）、受信動作を終了する。

【００３７】最後に、ビデオデータフォーマットについて詳述する。本実施例における配信ビデオデータのフォーマットは、図２に示すようにヘッダ情報部分（２０３）とデータ部分（２０４）とから構成され、ヘッダ部分には、図３に示すような、タイムスタンプ毎のアドレスが保持されている。ビデオサーバによりビデオデータを圧縮する際に、ヘッダ部分を生成し付加する。なお、図２および図３における２０１と３０１、２０２と３０２は同値である。

【００３８】以上、第１の実施例は、オリジナルなビデオデータを基に高品質（低圧縮）から低品質（高圧縮）まで、品質の異なる複数のビデオデータをビデオサーバの記憶装置に記憶しておき、クライアントコンピュータからの配信要求に対し、クライアントコンピュータにおける受信状態に応じて、最適な品質のビデオデータを動的に切替えながら配信するものである。

【００３９】（第２の実施例）次に説明する第２の実施例は、ビデオサーバに保持するビデオデータは、オリジナルなもの１種類のみとし、サーバから配信するビデオデータの圧縮を、クライアントコンピュータにおける受信状態に応じて動的に最適化するものである。

【００４０】以下、本第２実施例のビデオサーバ側の処理を、図８を用いて詳細に説明する。同図において、まず、クライアントコンピュータからのデータ要求に従い、該当する記憶装置内のオリジナルビデオデータをビデオサーバに取り出し（ステップ８０１）、圧縮を行いながら（システムには初期圧縮レートが設定済とする。）送信する（ステップ８０３）。クライアントコンピュータ１０３より低品質データ要求または高品質データ要求のメッセージ受信があった場合（ステップ８０４）、圧縮レートを変更する（ステップ８０５）。

【００４１】なお、ビデオサーバコンピュータ１０１はビデオデータの終端まで配信した場合（ステップ８０２）、配信動作を終了する。

【００４２】ビデオデータを受信するクライアントコンピュータの動作は、第１の実施例と同様のため詳細な説明は省略する。

【００４３】なお、上記の如き、ビデオサーバコンピュータが行う各処理手順およびクライアントコンピュータが行う各処理手順を、ＣＤ－ＲＯＭ，ＤＶＤ，あるいはＦＤなどの記録媒体に一緒にまたは別々に記録して市場に流通させることができる。利用者は、この記録媒体をビデオサーバコンピュータとクライアントコンピュータにインストールすることにより、本発明を簡単に利用することが可能になる。

【００４４】

【発明の効果】以上詳細に説明したように、本発明によれば、ビデオサーバにより配信されるビデオデータは、受信するクライアントコンピュータのネットワーク接続環境に従い動的に変化させることが実現できる。これにより、クライアントコンピュータは常に最適化されたビ

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デオデータを見掛け上切れ目なく受信することが可能となる。

【図面の簡単な説明】

【図１】本発明の第１の実施例および第２の実施例における共通のハードウエア構成を示すブロック図である。

【図２】記憶装置に格納する圧縮ビデオデータファイルのファイル構造の説明図である。

【図３】同一画像ファイルから生成された圧縮率の異なる３種類の圧縮ビデオデータファイルのヘッダ情報の説明図である。

【図４】圧縮率の異なる３つの画像ファイルとタイムスタンプと内部識別アドレスの関係を説明するための図である。

【図５】ビデオサーバコンピュータに保持される、通信速度と該通信速度に最適化された圧縮画像ファイルとの対応図である。

【図６】第１の実施例におけるビデオサーバコンピュータの動作を説明するためのフローチャートである。

【図７】第１の実施例におけるクライアントコンピュータの動作を説明するためのフローチャートである。

【図８】第２の実施例におけるビデオサーバコンピュータの動作を説明するためのフローチャートである。

【符号の説明】

１０１：ビデオデータの作成および配信を行なうビデオサーバコンピュータ（第１のコンピュータ）

１０２：ビデオデータを格納する記憶装置

１０３，１０３’：ネットワークと接続されるクライアントコンピュータ（第２のコンピュータ）

１０４：ビデオサーバコンピュータとクライアントコンピュータが接続されるネットワーク環境

１０５：プログラム記録媒体（ＣＤ－ＲＯＭ）

１０６：プログラム記録媒体（ＣＤ－ＲＯＭ）

２０１：圧縮ファイルのタイムスタンプ

２０２：圧縮ファイルのタイムスタンプに対応した内部識別アドレス

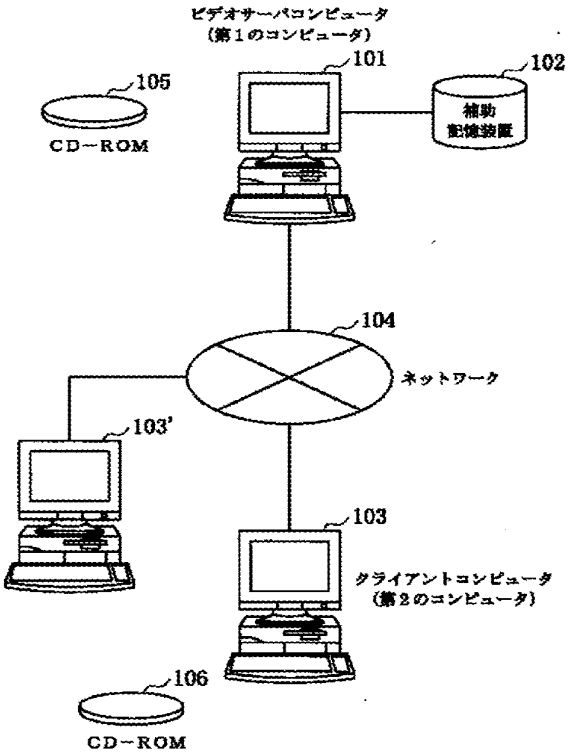
２０３：圧縮ファイルのファイルのヘッダ情報

２０４：本実施例で取り上げるファイルＡのファイルフォーマット

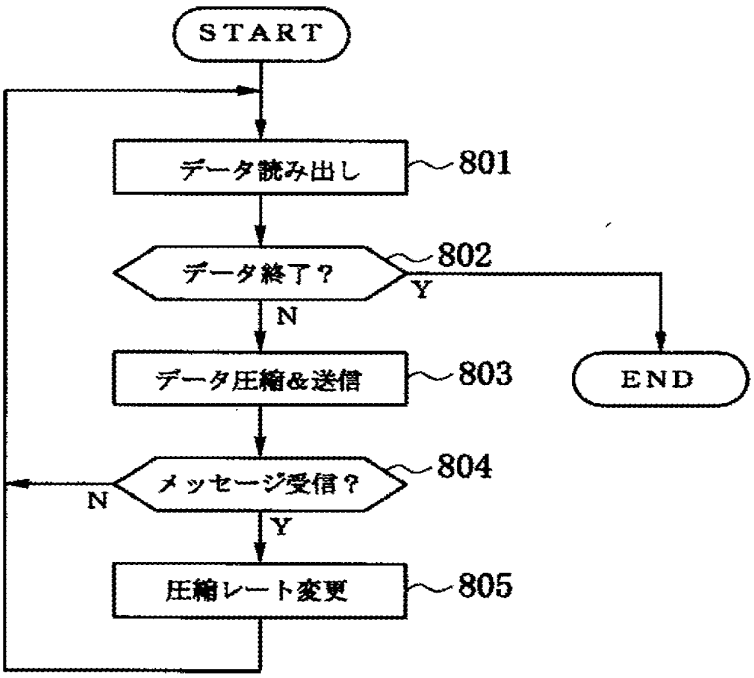
３０１：圧縮ファイルヘッダのタイムスタンプ情報

３０２：圧縮ファイルヘッダのタイムスタンプ情報に対応する内部識別アドレス

【図１】



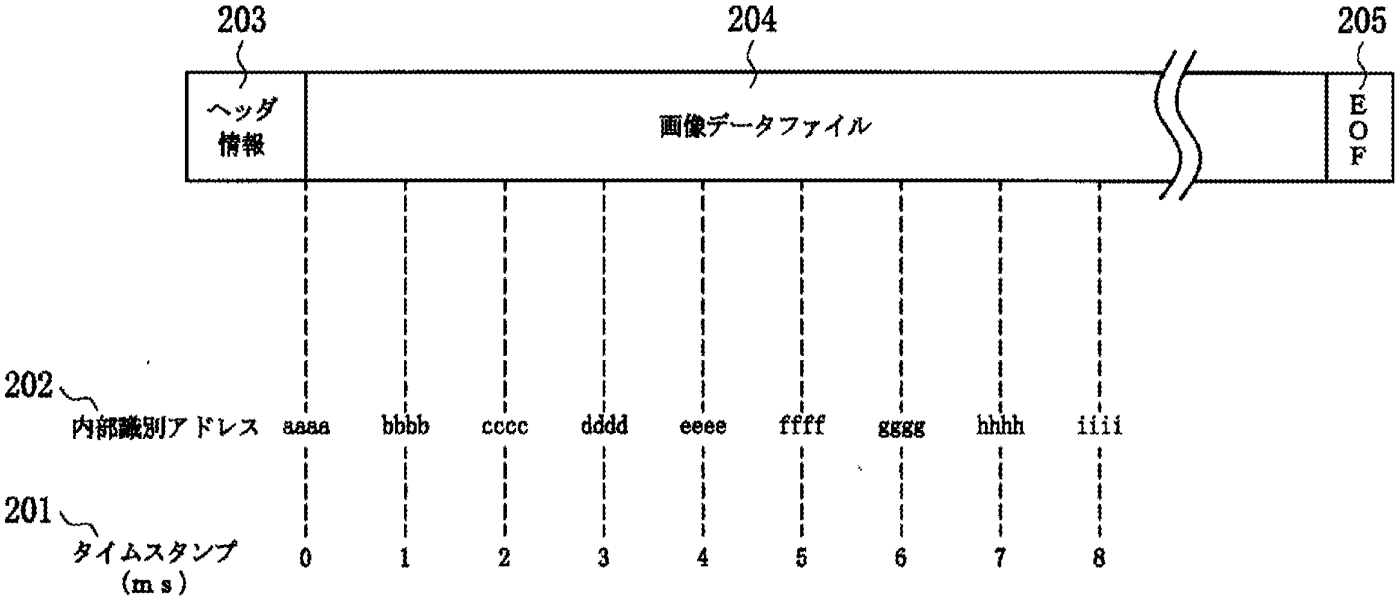
【図８】



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【図２】

画像データファイルのフォーマット



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【図３】

ヘッダ情報の構造

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タイムスタンプ	内部識別アドレス
0	a a a a
1	b b b b
2	c c c c
3	d d d d
4	e e e e
5	f f f f
6	g g g g
7	h h h h
8	i i i i
:	:

低圧縮
画像ファイル（A）

（a）

301　302

タイムスタンプ	内部識別アドレス
0	a a a a
1	c c c c
2	e e e e
3	g g g g
4	i i i i
5	k k k k
6	m m m m
7	o o o o
8	q q q q
:	:

中圧縮
画像ファイル（B）

（b）

301　302

タイムスタンプ	内部識別アドレス
0	a a a a
1	e e e e
2	i i i i
3	m m m m
4	q q q q
5	u u u u
6	y y y y
7	:
8	:
:	:

高圧縮
画像ファイル（C）

（c）

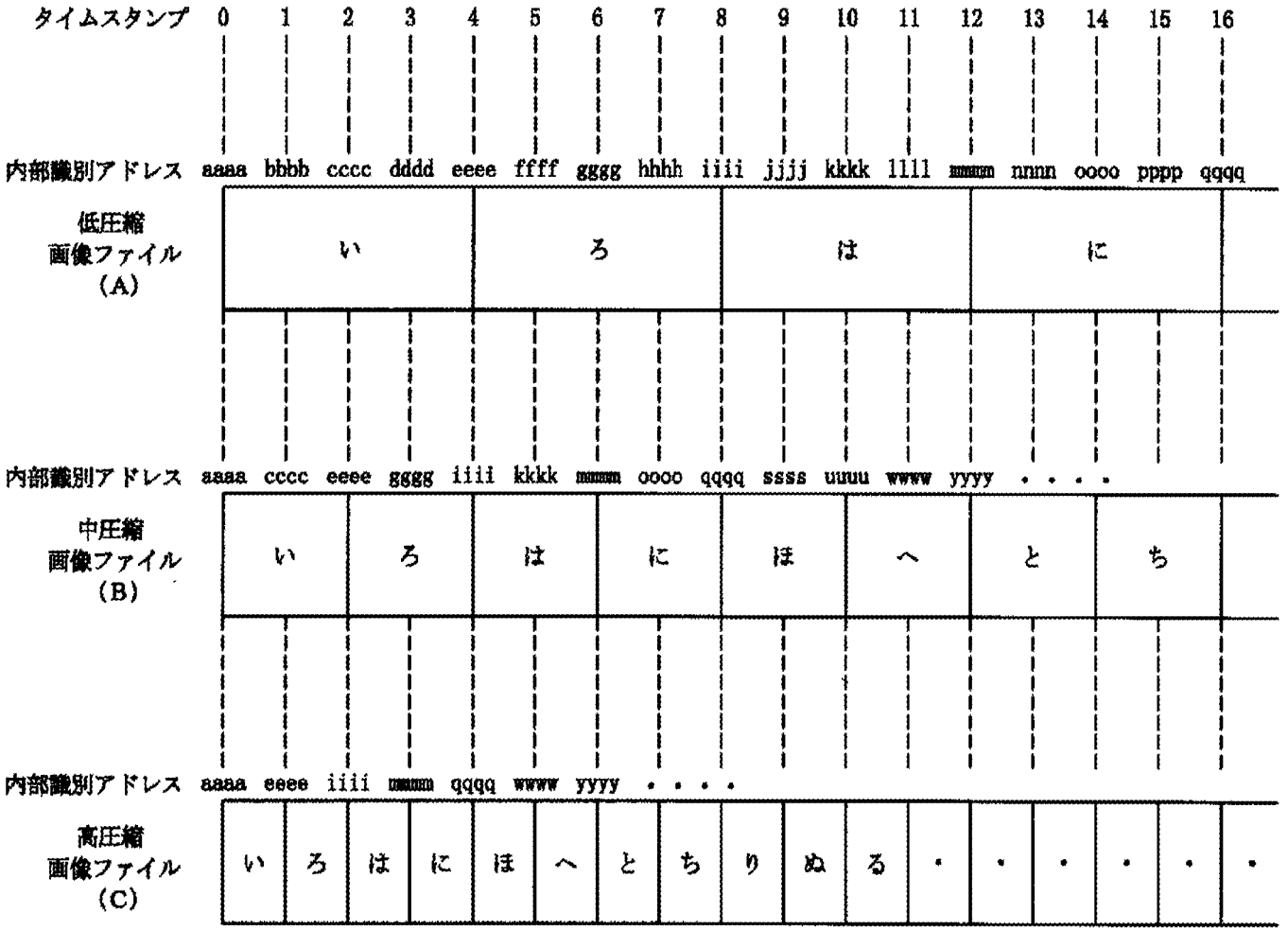
【図５】

通信速度と対応圧縮ファイル

項番	通信速度（ｂｐｓ）	ファイル名
1	～m	圧縮画像ファイルC
2	m～n	圧縮画像ファイルB
3	n～	圧縮画像ファイルA

通信速度の大小関係　m＜n

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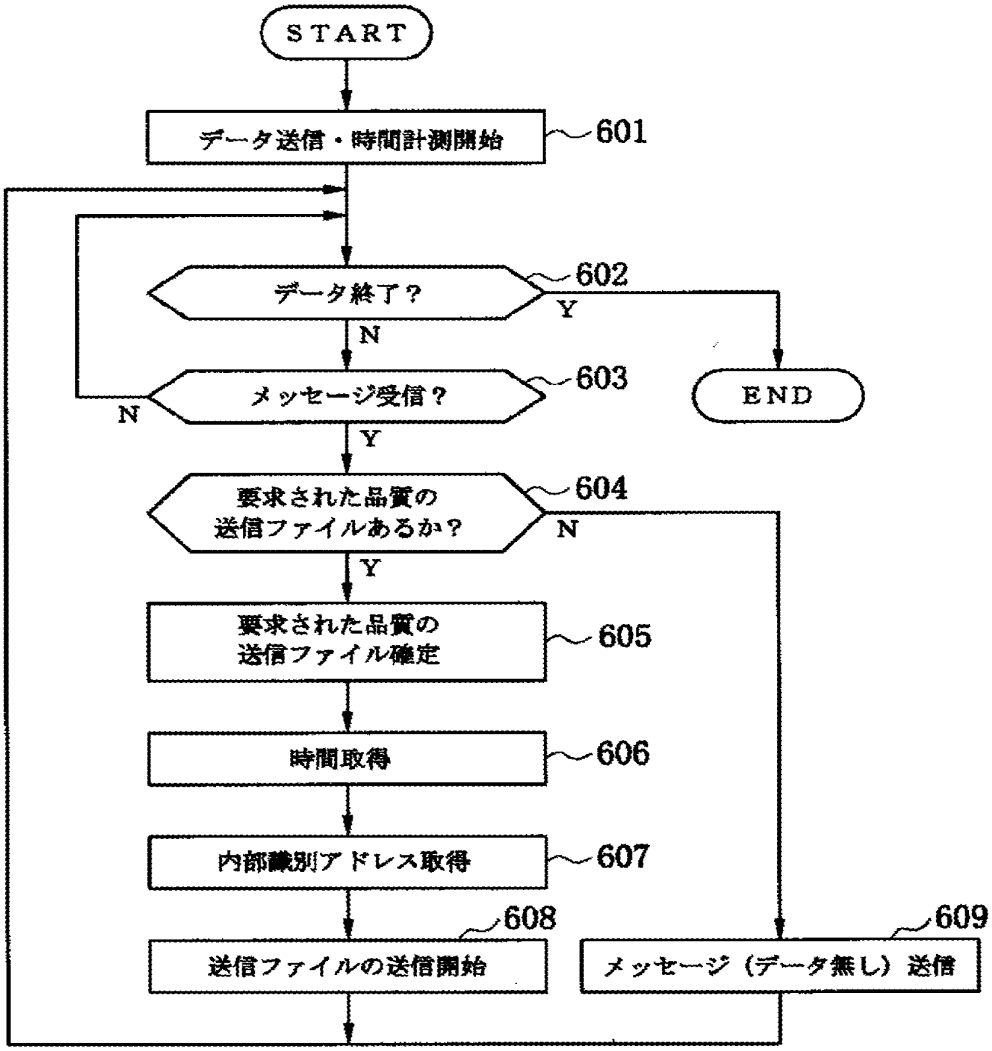
【図４】

特開２００１－９２７５２

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【図６】

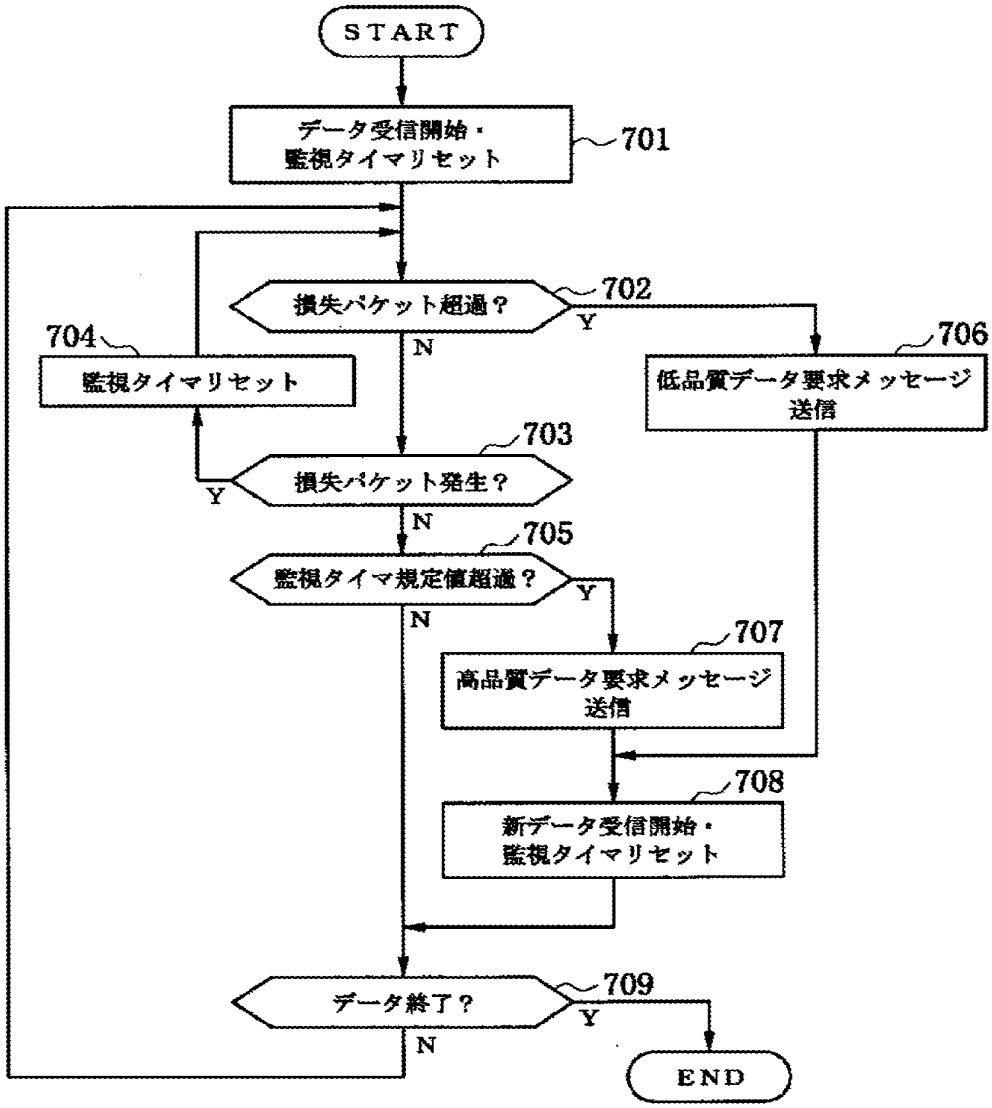
（ビデオサーバコンピュータの処理）



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【図７】

(クライアントコンピュータの処理)



フロントページの続き

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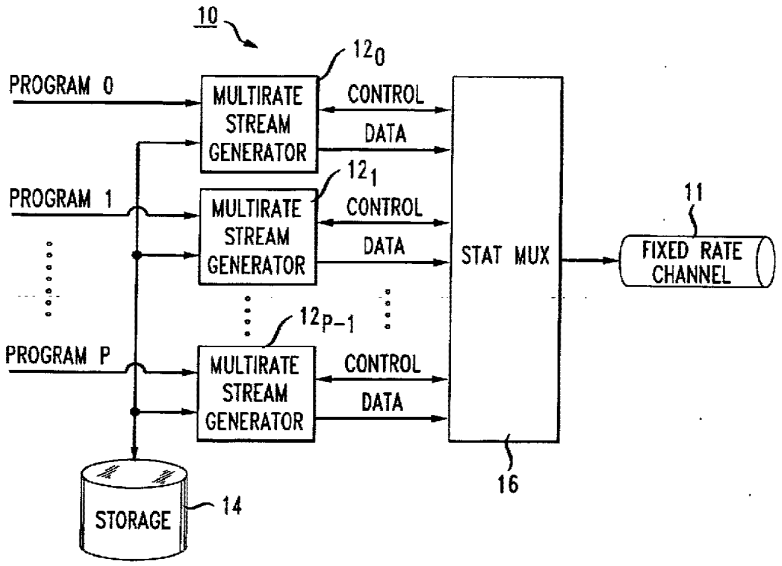
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(54) Title: VIDEO ON DEMAND SERVER SYSTEM AND METHOD



(57) Abstract: A Video-on-Demand Server architecture (100, 200, 300) transmits a plurality of pre-coded programs having different bit rates across a fixed bandwidth channel (11). For each program, a generator (120-12P-1, 110, 210) generates a plurality of different bit rate representations for each program. Each generator also provides control information at each of a plurality of successive time windows T for each bit rate representation. The control information provides a bit rate and a quality measure during each time window T. The control information enables a statistical multiplexer (16, 160, 260) to select a bit rate representation for each program during each time window T to maximize the quality of the selected representations while not exceeding the total available channel capacity.

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

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VIDEO ON DEMAND SERVER SYSTEM AND METHOD

TECHNICAL FIELD

This invention relates to a technique for efficiently providing video on demand while maintaining bandwidth constraints of a fixed channel.

BACKGROUND ART

Present day Video-on-Demand (VoD) systems typically transmit Constant Bit Rate (CBR) video. Transmitting CBR video does not achieve the same efficiency as transmitting variable bit rate (VBR) video for equivalent long-term average bit rates. Transmitting multiple pre-recorded VBR-encoded video programs over a constant bandwidth channel has problems since the sum of the instantaneous bitrates required by each program can sometimes exceed the total available bitrate. On the other hand, broadcast applications employing real-time encoders use statistical multiplexing to exploit the instantaneous bitrate variations between multiple programs being carried on the same carrier or transponder. The encoders operate in real time to enable the system to constrain the total combined bit rate for all programs so as not to exceed the channel capacity over a given time window. Each video program has an associated complexity measure. A central controller dynamically adjusts the bit rate allocated to each video program based upon the relative complexities.

There now exist devices known as "video transraters" that operate to reduce the bit rate of video streams within a common compression standard, such as MPEG 2 for example. Present day transraters often experience difficulties when converting between constant and variable bit rates. Such transraters also can experience difficulties when trying to alter the bit rate for bit streams that have many scene changes, or a large number of I-Pictures.

Scalable video encoding, which permits dividing a video signal into a base layer and one or more enhancement layers, can also address bit rate issues. Several methods of scalable video encoding exist, including spatial, SNR, temporal, data partitioning, fine grain scalability (FGS), frequency scalability. The MPEG-2 and MPEG-4 video compression standards include several scalability methods. Using scalable encoding requires both the transmitter and receiver have the same ability to implement different coding algorithms, thus introducing additional complexity.

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Thus, there exists a need for a technique for managing variable bit rate video on demand that obviates the disadvantages of the prior art.

BRIEF SUMMARY OF THE INVENTION

Briefly, in accordance with present principles, there is provided a method for transmitting a plurality of pre-coded programs having different bit rates across a fixed bandwidth channel. For each program, at least two, and preferably, a plurality of different bit rate representations are generated. Control information is provided at each of a plurality of successive time windows for each bit rate representation. The control information provides a bit rate and a quality measure during each time window. The control information enables selection during each time window of a bit rate representation for each program to maximize the quality of the selected representations while not exceeding the total available channel capacity in that time window.

BRIEF SUMMARY OF THE DRAWING

FIGURE 1 depicts a block schematic of first preferred embodiment of a Video-on-Demand server architecture in accordance with the present principles;

FIGURE 2 depicts a block schematic of second preferred embodiment of a Video-on-Demand server architecture in accordance with the present principles; and

FIGURE 3 depicts a block schematic of third preferred embodiment of a Video-on-Demand server architecture in accordance with the present principles.

DETAILED DESCRIPTION

Before proceeding to describe the technique of the present principles, the following terminology will prove helpful:

T is the time interval over which the system optimization is being contemplated

C is the total channel capacity available in time frame T

P is the total number of programs

$p \in (0, P\text{-}1)$, is the index of a particular program

$N[p]$ is the total number of representations of program p

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$n[p] \in (0, N[p]-1)$ is the index of a particular representation of program p

$r[p, x]$ is the bit rate of representation x of program p during T

$q[p, x]$ is the quality of representation x of program p during T

FIGURE 1 depicts a first preferred embodiment of a Video-on-Demand server architecture 10 in accordance with the present principles for transmitting pre-encoded CBR and/or VBR audio/video programs over a fixed bandwidth channel 11 having a total channel capacity, C. The server architecture 10 includes a plurality of multirate stream generators 12_0, $12_1 \ldots 12_{P-1}$, where P is an integer greater than zero corresponding to the number of separate input streams. The stream rate generators 12_0-12_{P-1} each pre-code a corresponding one of the programs Program 0, Program 1...Program $P-1$ at a plurality of different bit rates. Stated another way, each multirate stream generator pre-codes the corresponding program to yield at least two or more different bit rate representations. A representation can include a particular stored encoded bit stream, or a combination of various portions of different encoded bit streams. A storage device 14, typically in the form of a single disc drive, a Redundant Array of Inexpensive Discs (RAID), or a plurality of RAIDs, serves to store the pre-coded representations generated by the multirate stream generators 12_0-12_{P-1}.

Each of the multirate stream generators 12_0-12_{P-1} generates control information for each time window T of for the corresponding one of Programs 0 to $P-1$, respectively. The control information for each time window T for each representation of each program includes an indication of the bit rate of that representation and a quality measure, such as the peak signal-to-noise ratio (PSNR) of the representation. A central statistical multiplexer ("stat mux") 16 receives the control information for each representation. At each successive time window T, the stat mux 16 selects a representation for each program to maximize the quality of the transmitted programs while maintaining the total bit rate at or below the total capacity C of the channel 11.

The lowest bit rate representation for each program should not exceed a prescribed value such that the sum of the lowest bit rates for all programs will not exceed the channel capacity for each interval T. In this way, at least one representation of each program can undergo transmission over the channel 11. Requiring the lowest bit rate representation for each program to have a peak bit rate of C/P or less can achieve this constraint. Other methods exist that meet the constraint $\sum_{p=0}^{P-1} r[p,0] \le C$ for all time windows T of all programs. Typically, advance knowledge does not exist as to when playback of particular programs will commence. Therefore,

enforcing capacity restraints becomes easiest by requiring that the bit rate limit of the lowest bit rate representation be the same for all time windows T of a particular program.

The process for the maximization of the overall combined quality can occur in several different ways. In all cases, the constraint $\sum_{p=0}^{P-1} r[p,n[p]] \leq C$ must remain met for all time windows T of all programs. A minimax approach can satisfy the constraint by choosing *n[p]* for each $p \in (0, P\text{-}1)$ to maximize the quality of the minimum quality program (i.e., minimizing the maximum distortion.)

The minimax approach can be implemented by sorting the control information for each representation of each program so that the quality and bit rate index increases monotonically increasing with the index. The change in bit rate for each step (referred to as the "delta (Δ)"bit rate) is then stored. The stat mux 16 begins with the lowest index for each program representation and computes the total capacity S. The stat mux 16 the selects the program representation at the lowest quality and checks if adding its delta bit rate to S exceeds C. If the addition of the representation does not exceed C, the index for that representation is incremented, and process is repeated. Once C is exceeded, the representation with the next to lowest quality is checked to see if adding its delta bit rate to S exceeds C. The process is repeated until no increment in any representation can be made without exceeding the channel capacity C. Alternatively, the total quality of all programs could be optimized by maximizing the sum of the individual program qualities which involves solving the following constrained optimization problem:

$$\max_{n[.]} \sum_{p=0}^{P-1} q[p,n[p]]; \text{ subject to } \sum_{p=0}^{P-1} r[p,n[p]] \leq C$$

It is also possible to optimize the product of the individual program qualities in the following manner:

$$\max_{n[.]} \prod_{p=0}^{P-1} q[p,n[p]]; \text{ subject to } \sum_{p=0}^{P-1} r[p,n[p]] \leq C$$

A weighted average can also be used, in order to provide different classes of service for different viewers.

The multirate stream generators 12_0-12_{P-1} can use several different methods, or a combination of methods to form multiple representations of each program. In all cases, a random access point, such as an intra-coded (I) frame should occur at the beginning of each time window T, for each representation, so that for each time window T a different representation can be

chosen without causing drift. Each representation can use either CBR or VBR coding as long as the capacity of the lowest bit rate representation meets the total channel capacity constraint.

In a first method, a multirate video encoder encodes each program at several different bit rates into several independent bit streams. Each different bit rate bit stream serves as a different representation. FIGURE 2 depicts an architecture 100 for carrying out this method. As seen in FIG. 2, a multirate video encoder 110 serves to encode a corresponding program to yield a plurality of different rate representations. A separate one of transport packetizers 112_0, $112_2 \ldots 112_{P-1}$ each packetizes a corresponding representation. The multirate encoding performed by the multirate encoder 110, and the packetization performed by the packetizers 112_0-112_{P-1} occurs once, not necessarily in real time, prior to storage in a storage device 140 similar in construction to the storage device 14 of FIG. 1.

Selection of the representations stored in storage device 140 for output in real time occurs in response to a signal received from a selector block 150. The selector block 150 identifies the stored representation for output in response to a request from the stat mux 160 for a particular representation. Upon receipt of the signal from the selector block 150, the storage device 140 supplies the selected packetized representations to the stat mux 160 for output.

In a second method, portions of the several different bit streams are combined to yield additional representations of a program. The presence of random access points at the same location in all bit streams of a program (as would naturally occur at scene changes) or the use of fixed group-of-pictures structures, permits the combination of compressed data from different bit rate streams at random access boundaries to form new representations. No need exists to store each representation independently, as long as the ability exists to generate each representation from the data that is stored. Consider the following example where T is one second, the data is coded at 30 fps, and I frames are inserted every 15 frames, yielding three different bit rate bit streams, designated as Bit stream 0, Bit stream 1, and Bit Stream 2, respectively. Each bit stream constitutes a separate representation. An additional representation can be formed which uses Bitstream 0 for the first 15 frames and Bitstream 1 for the second 15 frames, and so on.

Assuming alignment of the random access points with the transport packets, the server architecture 100 of FIG. 2 works well when the transport packetization occurs in advance. FIGURE 3 depicts a VoD server architecture 200 better suited when the random access points do not necessarily align with the transport packets. Referring to FIG. 3, VoD server architecture 200 includes multirate video encoder 210 for generating a plurality of different bit rate

representations for storage in a storage device 240 similar to the storage devices 14 and 140. The representations stored in the storage device 140 exist as un-packetized bit streams.

Selection of the representations stored in storage device 240 for output in real time occurs in response to a signal received from a selector block 250. The selector block 250, similar in nature to the selector block 150 of FIG. 2, identifies the stored representation for output in response to a request from a static mixer/multiplexer 260 for a particular representation. Upon receipt of the signal from the selector block 250, the storage device 240 supplies the selected packetized representations to the static mixer/multiplexer. A packetizer 212 packetizes the output stream of the static mixer/multiplexer 260 for output on the channel (not shown).

Representations also can be formed by switching between stored bit streams for non-reference pictures, such as for video codecs (not shown) that include pictures that are not used as reference pictures for predicting other pictures, such as MPEG-2 B frames or JVT non-stored pictures. Each non-reference picture can be selected from a different stored bitstream without affecting the quality of subsequently coded pictures, as the non-stored pictures are not used for prediction. Complete elimination of a non-reference picture in a representation can also occur. Each non-reference picture could be switched individually, or groups of non-reference pictures could be switched together, allowing for many possible total bit rate representations. The multirate stream signal generators 12_0-12_{P-1} of FIG. 1 can choose to limit the number of possible representations to send to the stat mux 16 of FIG. 1 to choose those with significant differences in quality and bit rate. It is not necessary for each representation to be independently stored in storage, but a table listing the location and length of each coded frame can be stored to simplify generation of the representation when needed. It is also possible to store multiple bit rate bit streams only for the non-stored pictures and only store a single version of the reference (I and P) pictures, which can significantly reduce storage requirements.

With the VoD server architectures 100 and 200 of FIGS. 2 and 3, respectively, the stat mux 160 and the static mixer/multiplexer 260 generate a bit stream corresponding to the selected representation. If individual pictures are not transport packet aligned, the architecture 200 of FIG. accomplishes transport packetization after the generation of the bit stream for a particular representation. Otherwise, the VoD server architecture 100 of FIG. 2 FIG. 2 will work well.

In accordance with another aspect of the present principles, scalable video coding can occur by the use of a scalable video encoder (not shown) to form a base layer and one or more enhancement layers. Any type of scalability that which employs the base layer for motion compensated reference picture prediction in order to avoid drift can be used, such as frequency

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scalability, FGS, SNR scalability or temporal scalability. The lowest bit rate representation corresponds to the base layer. The peak bit rate of the base layer must be such that when the bit rates of all programs' base layers are summed, the channel capacity C is not exceeded for each time window T. Other higher bit rate representations will correspond to the base layer plus some portion of the enhancement layer. This approach requires that the video decoder support the type of scalability used. The VoD server architecture 100 of FIG. 2 is used upon inclusion of an entire enhancement layer in a particular representation. The VoD server architecture 200 of FIG. 3 is used if portions of an enhancement layer are used in a representation.

For systems which use encryption for contents right management, the VoD server architecture 100 of FIG. 2 does not require any decryption or encryption in real time, as encryption is added to the transport packetization process done in non-real time and entire encrypted transport packets are stored and transmitted. The VoD server architecture 200 of FIG. 3 requires that encryption be performed along with transport packetization in real-time.

VoD programs generally include both audio and video. As audio bit rates are generally significantly lower than video bit rates and are also generally at a fixed bit rate, there is less advantage to be gained by selecting from different pre-encoded audio bit streams by the stat mux 16 and 160 of FIGS 1 and 2, and the static mixer/multiplexer 260 of FIG. 3. A user likely will find the switching of audio quality during the viewing of a single program disturbing. The total channel capacity C can be considered to be totally consumed by the video channel; assuming that a single bit rate audio stream is also sent for each program. Alternatively, the above-described methods can also be applied to audio, where multiple representations of audio programs with different bit rates and qualities can be generated.

A video player (not shown) that works with the VoD server architectures of the present principles will contain a video decoder (not shown) and some storage for buffering. For the particular program being received, the data can arrive at a non-uniform data rate, but with the requirement that the data corresponding to time unit T will arrive any time within the T time window. The video player must have the capability of buffering and delaying for T. An upper limit on the maximum bit rate that can be transmitted for a given representation of a program for a time window T can be pre-determined to limit the decoder complexity and decoder buffer size. The decoding buffer is generally a requirement of a video decoder, e.g. MPEG-2 levels sets buffer size particular requirements, and the combination of T and the bitrate may be chosen to meet it.

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Fast forward and fast reverse tracks for each program can also be stored at the VoD server. They can be stored at a single bit rate, or at several different bit rates, and allowed to adapt as is done for the normal play program.

Determination of the time window T length is based on several factors. T should be as large as possible to get the most statistical multiplexing gain, but small enough to constrain the delay at the video player for start-up and switching between normal play and trick play streams. T should be small enough to meet decoder requirements.

The foregoing describes a system and method for efficiently providing video on demand while maintaining bandwidth constraints of a fixed channel.

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CLAIMS

1. A method for transmitting a plurality of pre-coded programs having different bit rates across a fixed bandwidth channel, comprising the steps of:

generating at least two different bit rate representations of each program;

providing control information at each of a plurality of successive time windows T for each representation of each program, the control information for each successive window indicating a bit rate and quality measure for a representation of a corresponding program; and

during each time window T, selecting a representation for each program such to maximize the quality of the selected representations while not exceeding a total available capacity for the channel.

2. The method according to claim 1 wherein the step of generating at least two different bit rates representation further comprises the step of generating for each program a lowest bit rate representation having a peak bit rate not greater than C/P where C is the total channel capacity in time T and P is the total number of programs.

3. The method according to claim 1 wherein the step of providing the control information further comprises the step of establishing the peak signal-to-noise ratio (PSNR) as the quality measure embodied in the control information.

4. The method according to claim 1 wherein the selecting step further comprises the step of selecting a representation for each program which meets the constraint $\sum_{p=0}^{P-1} r[p, n[p]] \leq C$ for all time windows wherein:

C is the total channel capacity available in time frame T;

P is the total number of programs;

$p \in (0, P\text{-}1)$, is the index of a particular program;

$N[p]$ is the total number of representations of program p;

$n[p] \in (0, N[p] - 1)$ is the index of a particular representation of program p; and

$r[p, x]$ is the bit rate of representation x of program p during T

5. The method according to claim 4 further comprising the step of choosing each program's representation n[p] $\in$ (0, N[P]-1) to maximize the quality of the program p that had the minimum quality.

6. The method according to claim 5 further comprising the steps of:

(a) sorting the quality information for with the bit rate and quality measure monotonically increasing with an index value;

(b) storing each bit rate increment (delta) and quality value for each index value;

(c) beginning with a lowest index value, computing total capacity S for program representations selected thus far for such index value;

(d) selecting a program representation at a lowest quality measure;

(e) checking whether the bit rate increment of the selected program at the lowest quality, when added to the representations selected thus far, exceeds total channel capacity, and if not

(f) incrementing the index value; and

(g) repeating steps (c)-(f).

7. The method according to claim 1 wherein the selecting step further comprises the step of selecting the representation for each program such to maximize a sum of individual program qualities by solving $\max_{n[.]} \sum_{p=0}^{P-1} q[p, n[p]]$; subject to $\sum_{p=0}^{P-1} r[p, n[p]] \leq C$

wherein ,

C is the total channel capacity available in time frame T;

P is the total number of programs;

$p \in (0, P\text{-}1)$, is the index of a particular program;

$N[p]$ is the total number of representations of program p;

$n[p] \in (0, N[p] - 1)$ is the index of a particular representation of program p;

$r[p, x]$ is the bit rate of representation x of program p during T; and

$q[p, x]$ is the quality of representation x of program p during T.

8. The method according to claim 1 wherein the selecting step further comprises the step of selecting the representation for each program such to maximize a product of individual program qualities by solving

$$\max_{n[.]} \prod_{p=0}^{P-1} q[p,n[p]]; \text{ subject to } \sum_{p=0}^{P-1} r[p,n[p]] \leq C$$

where,

C is the total channel capacity available in time frame T;

P is the total number of programs;

$p \in (0, P\text{-}1)$, is the index of a particular program;

$N[p]$ is the total number of representations of program p;

$n[p] \in (0, N[p]-1)$ is the index of a particular representation of program p;

$r[p, x]$ is the bit rate of representation x of program p during T; and

$q[p, x]$ is the quality of representation x of program p during T.

9. The method according to claim 8 further comprising the step of applying a weighted average to provide different classes of service for different viewers.

10. A system for transmitting a plurality of pre-coded programs having different bit rates across a fixed bandwidth channel, comprising the steps of:

means for generating at least two different bit rate representations of each program;

means providing control information at each of a plurality of successive time windows T for each representation of each program, the control information for each successive window indicating a bit rate and quality measure for a representation of a corresponding program; and

means for selecting during each time window T a representation for each program such to maximize the quality of the selected representations while not exceeding a total available capacity for the channel.

11. The system according to claim 10 wherein the generating means and control information providing means collectively comprise:

a plurality of multirate stream generators, each associated with a corresponding one of the plurality of pre-coded programs.

12. The system according to claim 10 wherein the generating means and control information providing means collectively comprise:

a multirate video encoder for encoding at least two bit rate representations of each pre-coded program.

13. The system according to claim 10 wherein the generating means and control information providing means collectively comprise:

a multirate video encoder for encoding at least two bit rate representations of each pre-coded program; and

a plurality of transport packetizers, each serving to packetize the bit rate presentations for each pre-coded program.

14. The system according to claim 10 wherein the selecting means includes a static multiplexer.

15. The system according to claim 12 wherein the selecting means comprises:

a static multiplexer; and

a transport packetizer for packetizing the selecting representation.

16. The system according to claim 10 wherein the selecting means generates for each program a lowest bit rate representation having a peak bit rate not greater than C/P where C is the total channel capacity in time T and P is the total number of programs.

17. The system according to claim 10 wherein control information providing means establishes quality measure in accordance with a peak signal-to-noise ratio (PSNR).

18. The system according to claim 10 wherein the selecting means selects a representation for each program which meets the constraint $\sum_{p=0}^{P-1} r[p, n[p]] \leq C$ for all time windows where:

C is the total channel capacity available in time frame T;

P is the total number of programs;

$p \in (0, P\text{-}1)$, is the index of a particular program;

$N[p]$ is the total number of representations of program p;

$n[p] \in (0, N[p] - 1)$ is the index of a particular representation of program p; and

$r[p, x]$ is the bit rate of representation x of program p during T.

19. The system according to claim 18 wherein the selecting means chooses each program's representation n[p] $\in$ (0, N[P]-1) to maximize the quality of the program p that had the minimum quality.

20. The system according to claim 10 wherein the selecting means selects the representation for each program such to maximize a sum of individual program qualities by solving:

$$\max_{n[.]} \sum_{p=0}^{P-1} q[p,n[p]]; \quad \text{subject to} \quad \sum_{p=0}^{P-1} r[p,n[p]] \le C$$

where,

C is the total channel capacity available in time frame T;

P is the total number of programs;

$p \in (0, P\text{-}1)$, is the index of a particular program;

$N[p]$ is the total number of representations of program p;

$n[p] \in (0, N[p] - 1)$ is the index of a particular representation of program p;

$r[p, x]$ is the bit rate of representation x of program p during T; and

$q[p, x]$ is the quality of representation x of program p during T.

21. The system according to claim 10 wherein the selecting means selects the representation for each program such to maximize a product of individual program qualities by solving:

$$\max_{n[.]} \prod_{p=0}^{P-1} q[p,n[p]]; \quad \text{subject to} \quad \sum_{p=0}^{P-1} r[p,n[p]] \le C$$

where,

C is the total channel capacity available in time frame T;

P is the total number of programs;

$p \in (0, P\text{-}1)$, is the index of a particular program;

$N[p]$ is the total number of representations of program p;

$n[p] \in (0, N[p] - 1)$ is the index of a particular representation of program p;

$r[p, x]$ is the bit rate of representation x of program p during T; and

$q[p, x]$ is the quality of representation x of program p during T.

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22. The system according to claim 10 wherein a weighted average is applied to provide different classes of service for different viewers.

ABSTRACT OF THE DISCLOSURE

A Video-on-Demand Server architecture (100, 200, 300) transmits a plurality of pre-coded programs having different bit rates across a fixed bandwidth channel (11). For each program, a generator (12_0-12_{P-1}, 110, 210) generates a plurality of different bit rate representations for each program. Each generator also provides control information at each of a plurality of successive time windows T for each bit rate representation. The control information provides a bit rate and a quality measure during each time window T. The control information enables a statistical multiplexer (16, 160, 260) to select a bit rate representation for each program during each time window T to maximize the quality of the selected representations while not exceeding the total available channel capacity.

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FIG. 1

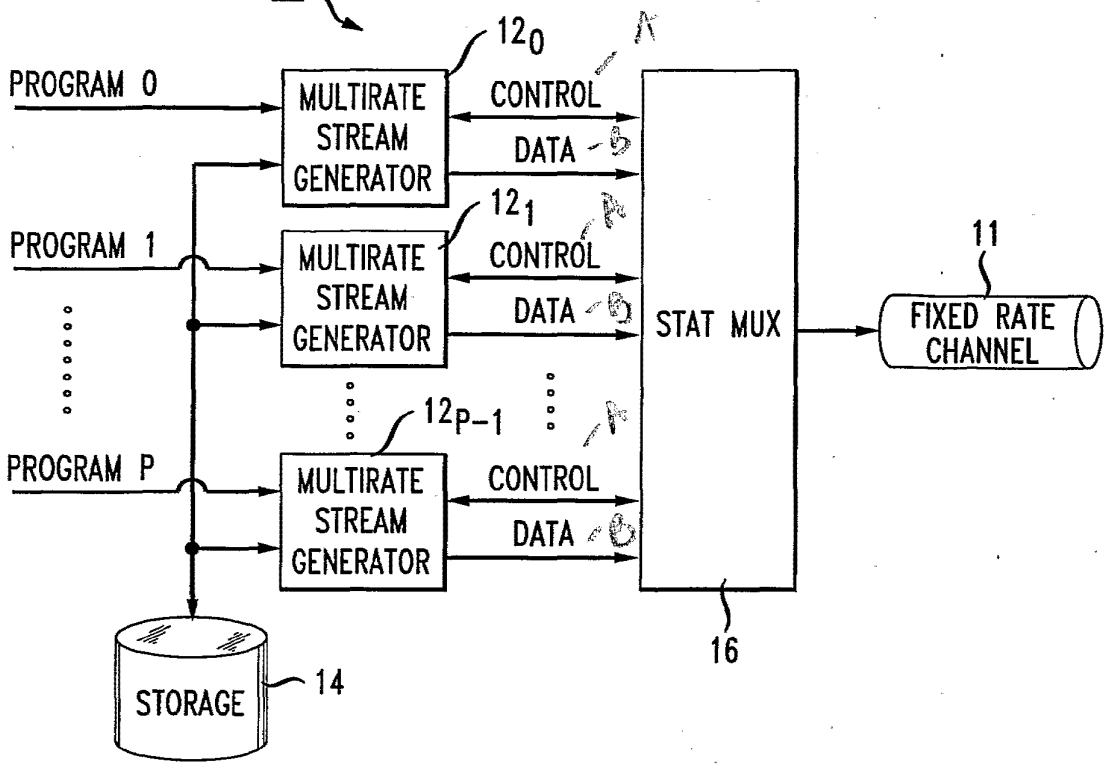

10
PROGRAM 0
PROGRAM 1
PROGRAM P
MULTIRATE STREAM GENERATOR
12_0
12_1
12_{P-1}
CONTROL
DATA
STAT MUX
11
FIXED RATE CHANNEL
16
STORAGE
14

FIG. 2

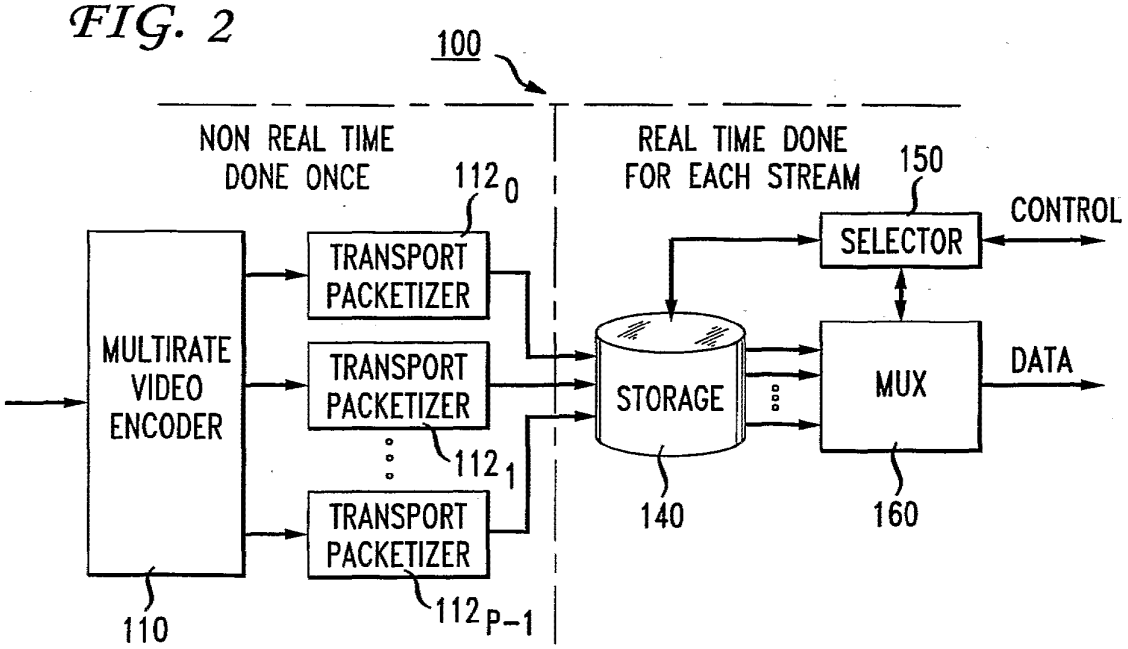
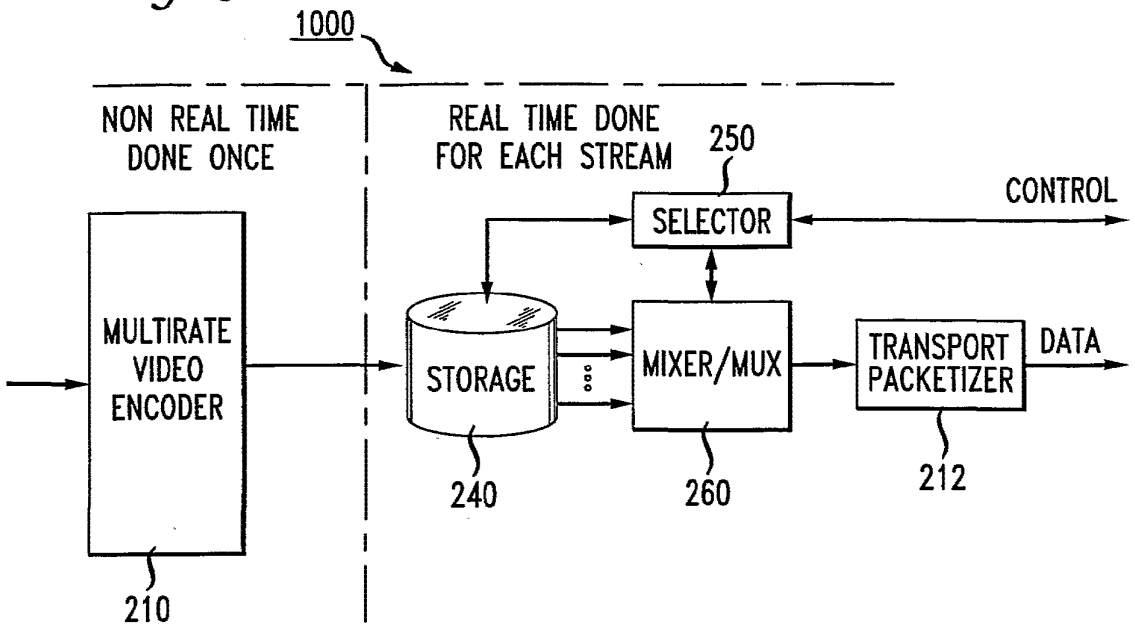

100
NON REAL TIME DONE ONCE
REAL TIME DONE FOR EACH STREAM
MULTIRATE VIDEO ENCODER
110
TRANSPORT PACKETIZER
112_0
112_1
112_{P-1}
STORAGE
140
SELECTOR
150
CONTROL
MUX
160
DATA

FIG. 3


1000
NON REAL TIME
DONE ONCE
REAL TIME DONE
FOR EACH STREAM
250
SELECTOR
CONTROL
MULTIRATE
VIDEO
ENCODER
STORAGE
MIXER/MUX
TRANSPORT
PACKETIZER
DATA
210
240
260
212

PCT
New International Application
Inventory of Unscannable or Missing Items

Serial Number

Check This Column if Item Is Present	Item	Check This Column if Item Is Missing on Filing
✓	Return Receipt Postcard	
	Check (amount $ _____)	✓
✓	PCT EASY Diskette	
	DNA Diskette	
	Exhibit	
✓	Express Mail Label or Envelope	
	Applicant Supplied Priority Document	
	Other (specify)	XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX
XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX	Cover Letter	
XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX XXXXXXXXXXXX	Other (specify)	

Winword/PTO\Automation\Unscanned inventory.wpd sheet

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(54) Method for coding/decoding of a digital signal

(57) The invention concerns a method for primary processing a digital signal comprising the steps of :

- providing a digital signal to a primary processing unit ;
- primary processing said signal with said primary processing unit according to a plurality of primary processing algorithms to provide primary processed output signals,
- determining statistics of use of at least one of said primary processing algorithms,
- providing a digital statistics signal representative of said statistics for each of said primary processed output signals
- associating to each of said primary processed output signals its own statistics signal ;
- determining a complexity primary processing information signal based on said statistic signal.

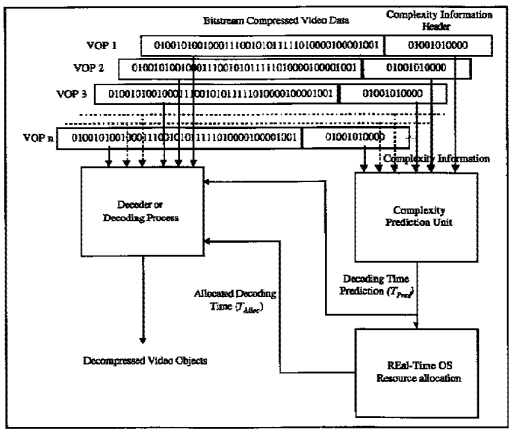


Figure 12

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Description

DEFINITION OF THE INVENTION

[0001] The present invention is a processing apparatus which aims at controlling and guaranteeing the real-time performance of data processing. The invention is based on the principle of collecting statistics of the algorithms used to process the data, on transmitting such statistics when necessary, and of associating a complexity information to such statistics. The real-time processing control can be done generating a processing time prediction signal which is a function of the complexity information, and use such prediction signal to provide processing resources which guarantee real-time processing or enables the definition of an associated degraded processing that guarantees real-time processing. Although the described invention is of general application, this document describes its application to video coding and decoding and suggests the straightforward extensions to audio coding-decoding, and to composition and rendering of media objects.

1. FIELD OF THE INVENTION

[0002] The implementation of software based video/audio decoders is an advantageous solution over traditional dedicated hardware systems. The main reason of this fact is the possibility of decoding several different video/audio compression standards, at different levels and profiles, by just changing the software while using the same hardware platform, main memory, and interfaces. Another favorable feature is the flexibility of the decoder able to cope with new developments and new tools included into future versions of the standards by just updating the decoding software. However, simultaneously guaranteeing real-time performance, needed when processing video/audio bit-streams, and an efficient use of the processing power, remains a very difficult task.

[0003] The present invention reports the main reasons of such difficulties and presents a new technique able to predict the decoding time of compressed video/audio bit-streams without the need of the actual decoding. This can be obtained if appropriate statistical information about the actual encoding processing is included and transmitted with the compressed video/audio data. Moreover, the present invention reports how such results can be used to implement new efficient processing resource allocation strategies. New possible schemes of such intelligent interactions between the encoder and the real-time OS are also proposed. An example of implementation for the MPEG-4 VM6 video algorithm based on these developments is presented. This implementation enables, at the same time, to guarantee real time performances even when the available processing resources are lower than the one theoretically necessary, and it yields optimal (minimal) image quality degradation. Such results are obtained by using the prediction of the decoding-resource needs to implement Computational Graceful Degradation techniques. The invention only reports simulation results for the MPEG-4 VM6.1 video compression algorithm, but the techniques and concepts presented here are of general application. Indeed, these techniques can be easily applied to audio coding, synthetic audio reproduction and to any future or existing compression and composition method. More precisely, they can be used for any video compression standard that is capable of transmitting in an appropriate form the statistical coding information (i.e. MPEG-1 and MPEG-2 using an appropriate transport system), and they can be implemented in any processor-based platform.

[0004] The present description is organized as follows. Section 2 discusses the problems and utility of defining and using worst case and average case complexities, justifying the need of complexity prediction. Section 3 presents the modeling of decoding complexity and the general principles of the prediction techniques. Section 4 presents the background of the invention. Section 5 summarizes the main concepts of the invention while section 6 summarizes the content of the diagrams and drawings illustrating the details and main characteristics of the invention.

[0005] In section 7, experimental results of the MPEG-4 VM6 texture coding algorithm are reported. Section 8 presents the definition of the proposed intelligent interactions between real-time OS-schedulers and video decoders. Section 9 presents the basic principles and the definition of the developed Computational Graceful Degradation (CGD) techniques, and section 10 reports overall experimental results of the control of decoding complexity using complexity prediction joint with the application of CDG techniques. Finally, section 11 concludes the description of the invention, summarizing the achievements of the invention by declaring the corresponding claims.

2. WORST-CASE AND AVERAGE-CASE DECODING COMPLEXITY

[0006] A simple solution to the problem of the variability of decoding complexity is to implement software/hardware solutions that always guarantee worst case complexity decoding. Such solutions are, in fact, the ones implicitly implemented in most of the dedicated hardware decoders. Dedicated hardware platforms, in general, are designed to guarantee worst case complexity decoding. The various hardware modules implementing the different decoding procedures are synchronized with the input/output data rate. These dedicated hardware modules can always handle any input bit-stream, not exceeding a maximum rate, and containing compressed sequences of appropriate maximum image reso-

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lutions. This can be always guaranteed, irrespectively from the coding options selected to produce the compressed bitstream.

[0007] In contrast, in the case of programmable platforms it is necessary to define what is a worst case decoding complexity. Let us consider video coding even if the same concept can be extended to natural and synthetic audio and to other form of multimedia processing. In the video compressing field one can assume that the worst case decoding complexity is represented by the decoding of each bit/macroblock, using the coding options allowed by the considered standard that requires the highest decoding time. The coding algorithms/modes of H.263 can be approximately considered as a superset of the algorithms/modes of the various video compression standards (H.261, MPEG-1 and MPEG-2). The complete results and details of this worst-case/average-case study are omitted here for brevity. The conclusions resulting from this analysis can be summarized as follows :

1) Decoding functions can be divided into two classes. For one class a worst case can be easily defined. Let us denote this class as A. To this class belong function such as IDCT, inverse quantisation, motion compensated prediction in its various form (forward, backward, bi-directional, overlapped ... .). For the other class denoted as class B, complexity is extremely data dependent and cannot be easily characterized by the simple parameters of an hypothetical MPEG-2 like complexity profile. To this class belong operations such as VLD, VLC coding, Syntax-based Arithmetic Coding (SAC) and in general all parsing operations. The difficulty of defining a worst case is evident considering for instance SAC for which the difference between a theoretical worst-case and experimental cases is about two orders of magnitude.

2) A strict worst case complexity analysis, of both class A and B functions, leads to unrealistic results. In other words, the computational resources necessary to handle the strict worst-case complexity decoding is much higher than the resources used in average.

3) For class A functions, the actual decoding complexity depends on the actual coding options and reports a large range of variability.

4) For class B functions, the actual decoding complexity reports a dependence on coding options, but presents a reasonably narrow range of variability which is much lower than the range theoretical worst case-average case.

[0008] Worst case analysis, therefore, is not adequate to define a useful decoding complexity reference. This fact is true not only for operations which are strongly data dependent (class B), but in general for all functions even those that have a very well defined worst case such as all class A functions. From these results it is clear that guaranteeing a worst case decoding implies guaranteeing the decoding of pathologically complex sequences that in practice have an extremely low probability of occurrence. Moreover, such a guarantee would imply the allocation of a processing power up to two orders of magnitude higher than the one actually needed for the decoding of the standard test sequences. The processor in practice would work in normal conditions exploiting only a small fraction of the theoretically available processing power. Such solution to the problem of guaranteeing real-time performance is not economical and, obviously, not useful in practical applications.

[0009] Another possibility for the solution of the problem of guaranteeing real-time performance could be to consider as reference an average case decoding complexity. Before being able to successfully use such average complexity, a few questions need to be answered. Is it meaningful to define an average complexity? How can it be done? Is the average complexity sequence dependent? How can it be converted on different platforms? Can the average complexity accurately be described by parameters such as image resolution and bit-rate? Are average results characterized by sufficiently narrow variance bounds so as they can be used a priori without the need of knowing some information about the actual complexity of the incoming sequence?

[0010] One will here briefly summarize the main results and experiments that answer the mentioned questions. So as to try to define an average case for the complexity that have been considered in previously, the H.263 standard uses four typical test sequences over a wide bit-rate range from 16 kbit/sec up to 1024 kbit/sec. The sequences in CIF format are : Akiyo (300 frames), Coastguard (300 frames), Foreman (300 frames) and Mobile & Calendar (300 frames), and all these test sequences have been evaluated at fifteen different bit-rate values. Although a rigorous statistical analysis would have required a much higher number of sequences and specific statistical confidence tests, it is believed that the number of frames (1200) and the different contents of the test images are well representative of typical image sequence contents. One have considered separately the operations that have unrealistic worst case complexities (class B) from the one with a well-defined worst case behavior (class A). The experiments, for the class B operations, yield figures that are not strongly bit-rate dependent. Variance bounds for each frame are relatively narrow and these values do not report relevant variations depending on the test sequence. Such results confirm also the fact that it is not necessary to worry about strict worst case complexity. In the other case of class A, the complexity of the operations reports a relatively regular statistical behavior at very low bit-rates (< 16 kb/s), but complexity reports dependence on the bit-rate, on the image content and in particular on the used encoding options.

[0011] Figure 1 reports one example of H.263 complexity using different coding options for the same sequence (Akyio

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CIF) and same bit-rate. On this figure, the decoding time or decoding complexity (expressed in μsec) is given versus the frame number for the sequence Akyio CIF encoded with H.263 at 128 Kb/sec using different coding options. Top curve options : advanced prediction modes (APM), syntax-based arithmetic coding and unrestricted motion vectors (UMV) ; middle curve options : APM and UMV ; bottom curve options : UMV. The same sequence presents, at the same bit-rate, average-decoding complexities that range up to a factor 4 (from about 0.05 to 0.2 sec per frame). Local fluctuations for a relatively static sequence such as Akyio are also considerably large. The decoder is the Telenor H.263 software release running on a Sun Ultrasparc platform.

[0012] Figure 2 reports the same experiment for the sequence Coastguard. The range of the complexity figures considering both average and local values is very large as can be easily noticed. On this figure, decoding time or decoding complexity (expressed in msec) is given versus frame number for the sequence Coastguard encoded with H.263 at 128 Kb/sec using different coding options. Top curve : advanced prediction modes (APM), syntactic arithmetic coding and unrestricted motion vectors (UMV) ; middle curve APM and UMV ; bottom curve : UMV. The same sequence at the same bit-rate has average decoding complexities that range within a factor 4 from about 0.05 to 0.2 sec per frame. The decoder is the Telenor H.263 software release on a Sun Ultrasparc platform.

[0013] Although far from the theoretical worst case complexities, the variation range is less than one order of magnitude, experimental results reports behaviors for which it is difficult to be able to predict the average complexity values only relying on resolution and bit-rate. Image content and coding options (i.e. intra or inter prediction modes, advanced prediction modes, half pixel vector prediction and so on) play a fundamental role. As it will be reported in the next sections, the situation of the complexity variations for MPEG-4 sequences is much higher due to the presence of different sized VOPs arbitrarily shaped objects, of static and dynamic sprites, and the large variety of coding modes.

[0014] From a pure mathematical point of view an average complexity value can always be defined considering a large data-base of encoded sequences and using the more probable occurrence of encoding options. Conversely, such a theoretical average value is not useful at all for the aim of the present invention that is the efficient scheduling of each decoding task and the efficient use of the available processing power. Even the local average values of the actual sequence often are not stationary, and their variations around the mathematical average one are so unpredictable that no useful scheduling policy can be realized.

[0015] Therefore, the consequences of this study are that straightforward solutions to the problem of real-time resource allocation policy are of two kinds. The first is a sustained over-sizing of the processing resources. The second is to accept interruptions of the audio/video output stream when the needed decoding resources exceed the ones available on the system. Obviously, both are not desirable being respectively not efficient and economical, or they provide a quality of the services which may easily results perceptually unacceptable.

[0016] The ideal solution would be to develop techniques that are able to accurately predict such unknown behaviors and, therefore, make feasible resource allocation policies that can guarantee real-time and minimize QoS degradation.

[0017] The description of such techniques and the presentation of the results are the subjects of the next sections.

[0018] As discussed above, the key issue for the implementation of any real-time application on a software-based platform is to be able to understand when the required decoding processing time exceeds the available processing time without the need of performing the actual decoding. This is particularly important, for instance, in MPEG-4 systems in which a number of bit-streams containing a variable number of VOPs and sprites need to be decoded respecting real-time constraints, but it is also important for existing compression standards (MPEG-1, MPEG-2). The available processing time is known, in general, because it is allocated by the OS-scheduler to each decoding process. The problem is how to estimate the necessary decoding processing requirements without the need of an actual decoding of each of the incoming VOP bit-streams. Decoding each bit-stream using a priori allocated processing could result in exceeding the time slot and, therefore, in missing real-time requirements. Real-time requirements are generally defined implicitly by the frame/sampling rate of video audio bit-streams or can be easily extracted by an appropriate relative time information associated to each video frame or audio object (also denoted as time stamp). Such extraction of the real-time constraints is trivial and is not discussed here. The consequence of missing real-time constraints is the introduction of sudden interruptions on the video content. A complete analysis of the conditions which lead to miss real time-constraints for the various OS scheduling algorithm (pre-emptive multi-threading, etc.) is out of the scope of this document and it is not discussed here. The reader can refer to the included reference S. Battista, F. Gasperoni, B. Klaiber, M. Mattavelli, L. Pautet, S. Tardieu, Concurrent over Sequential Modeling for MSDL, ISO/IEC JTC1/SC29/WG11, Doc. M1525, Maceio, Brazil, November 1996 incorporated herein by reference.

3. BACKGROUND OF THE INVENTION

[0019] Without any doubt, the recent trend in multimedia system implementation technology is towards moving from dedicated real-time hardware to software/processor based platforms. The processing power of the last on the market processors, and of the newly announced video/audio-processor families, enables the software implementation of video/audio decoding of various compression standards and different resolution levels. Unfortunately, simply relying on

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the average processing power does not guarantee to respect real-time constraints of video/audio decoding ; furthermore it does not solve the problem of an efficient processing resource allocation. The fundamental reason of these facts is that the complexity of the video/audio decoding process is a fluctuating function of the time, as described in M. Mattavelli and S. Brunetton, A statistical study of MPEG-4 VM texture decoding complexity, ISO/IEC JTC1/SC29/WG11, Doc. M924, Tampere Finland, July 1996 incorporated herein by reference.

[0020] The term complexity here simply means the time needed by the decoding process. Other more abstract measures of complexity such as the amount and type of executed algorithmic elementary operations, the executed processor cycles, the amount of memory transfers to and from the external frame memories, and their combinations could be used as more precise and specific complexity measures. In the context of the present invention however, one is interested on the final results of these complexity factors. Without any loss of generality, one can consider, for any specific target software-hardware implementation, the actual processor decoding time. Indeed all the above mentioned measures of complexity can be converted for each specific platform into a single complexity measure given by the execution time.

[0021] Even by considering a specific processor platform or a specific compression standard with a relative level and profile, the complexity of video decoding is a variable and unpredictable quantity, as described in ISO/IEC MPEG2 incorporated herein by reference. The actual figures of decoding complexity depend in a complex way on many different factors. One can mention, for instance, the actual bit-rate, the image content, the options used for encoding, the Group Of Picture (GOP) structure, or the Group Of Video Object Planes (noted as VOP) structure (GOV) which can change on the fly, the state of the buffer that controls the quantization parameters and many others, as described in M. Mattavelli and S. Brunetton, Scalability of MPEG-4 VM based on the computational power of texture decoding, ISO/IEC JTC1/SC29/WG11, Doc. M925, Tampere, Finland, July 1996 incorporated herein by reference.

[0022] The complexity variability range increases with the richness of the standard. Richness means the number of implemented coding algorithms or coding modes and the number of possible coding options having different complexities. For instance, the richness of H.263 is much higher than H.261, but it is lower than the new MPEG-4 standard under development where multiple Video Object Planes (VOPs) of different sizes and characteristics need to be decoded.

[0023] In this description, Video Object (VO) means a temporal sequence of two-dimensional or three-dimensional arbitrarily shaped Video Object Planes (VOP). In case of rectangular or square shapes, these video object planes, also called hereinafter video planes, are denoted by the classical name of frames. An audio object means a stream of packets containing digital audio samples, or audio events in mono or multichannel format which can be associated to a VO. One or more audio packets can be associated to one VOP or video frame. By three-dimensional arbitrarily shaped video object planes we mean the projection or view of any three-dimensional natural or synthetic 3-dimensional object or 3-dimensional model.

In summary, the processor decoding time of each incoming frame or VOP for any given compression standard is highly variable and impossible to predict just relying on resolution and bit-rate information. Therefore, an efficient resource allocation policy (process scheduling) which aims at guaranteeing real-time performances is very difficult in these conditions. Scheduling policies that release the thread to the decoding process and receive it back after the task is completed are clearly not adequate. The same conclusion is true for a priori allocated processing time intervals. If more processing time than the one actually allocated is needed, real-time constraints are already violated by the video application. The implementation of emergency measures such as skipping frames or portions of images, on one hand might succeed in recovering the correct timing, on the other could have catastrophic effects on the Quality of Services (QoS) of the video application.

4. SUMMARY OF THE INVENTION

[0024] It is an object of the present invention to control and to guarantee real-time performance of data processing. It is another object of the present invention to provide a processing apparatus that associates a complexity information to the processed data.

[0025] It is another object of the present invention to provide a coding-decoding apparatus that further includes the associated complexity information to be transmitted to the decoder.

[0026] It is another object of the present invention to provide a system that, on the basis of said complexity information, provides a complexity prediction signal to be used to allocate processing resources to optimize real-time data processing.

[0027] It is another object of the present invention to provide a processing system that supervises the processing using an allocated resource signal, a predicted complexity signal, a complexity information signal and provide a processing that satisfy specified real-time constraints. According to the present invention, there is provided a processing apparatus comprising a method for processing a digital signal including the steps of : providing a digital signal, processing said signal using a plurality of processing algorithms, determining statistics of use of processing algorithms, providing a digital statistical signal representative of the statistics, associating to each of the processed signal its own

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associated statistics and determining a complexity information signal based on said statistic signal.

[0028] According to the present invention, there is also provided a coding apparatus that further inserts the said complexity information signal into a transmission layer containing or not the associated data and transmits the said complexity information to a decoder apparatus.

[0029] According to the present invention, there is also provided a processing apparatus that generates from the complexity information signal a processing prediction signal which is used to allocate processing resources in order to optimize the real-time processing of the associated data.

[0030] According to the present invention, there is also provided a processing apparatus that receives the processing prediction signal, the allocated processing resources and the complexity information signal, and uses the said signals to generate processing directives so as the data is processed according to the system real-time constraints.

[0031] Although the described invention is of general application, the present description describes its application to the preferred embodiment of the video coding and decoding, and suggests the straightforward extensions to audio coding-decoding and to composition and rendering of media objects.

[0032] The technique provided by the present invention is capable of predicting with an excellent degree of approximation the complexity of video or audio decoding, without the need of the actual decoding of the incoming bit-stream. These results are possible when an appropriate coding information can be included in the incoming bit-streams. The experiments demonstrate that the degree of approximation achievable is excellent considering the range of variability of the actual decoding complexity of video or audio compression standards, and that such degree is more than adequate to enable an efficient processor resource allocation. One application of the proposed technique to the MPEG-4 VM6 video coding algorithm is also demonstrated. Real-time video performances are guaranteed using the predicted decoding complexity to implement Computational Graceful Degradation (CGD) features whenever the video decoding complexity exceeds the available processing resources. By means of the proposed technique, it can be guaranteed at the same time the satisfaction of the real-time constraints and the aim of minimizing the unavoidable degradation of the QoS due to temporary lack of processing resources or to peaks of the intrinsic video decoding complexity. The same approach can obviously be used for audio decoders.

[0033] It is clear that the approach is not limited to the coding/decoding process for compression purposes, but that it can be applied to the process of composing and rendering media objects (i.e. video, audio, text, graphics, two-dimensional and three-dimensional graphic primitives and models) to the display output. The term composition means the action of putting these objects together in the same representation space. The action of transforming the media objects from a common representation space to a rendering device (speakers and viewing window) is called rendering. An illustrative example of the terminal environment for the handling of multimedia object is reported in Figure 19. More specific possible examples of the decoding, composition and rendering processes are reported in Figure 20 and 21. Figure 19 reports the processing stages in an audiovisual terminal illustrating inputs outputs and processing of audiovisual objects. Figure 20 reports an example of a decoder which provides uncompressed audiovisual objects to the audio/video compositor. Figure 21 reports an illustrative example of composition of audiovisual objects.

[0034] Additional objectives and advantages of the invention will be set forth in the description that follows, and in parts will be obvious from the description, or may be learned by practice of the invention. The objectives and advantages of the invention may be realized and obtained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

5. BRIEF DESCRIPTION OF THE DRAWINGS

[0035] The accompanying drawings constitute a part of the specification and illustrate the principles of the invention.

- Figures 1 and 2 report a graphical representation of the decoding complexity of H.263 video illustrating the needs and background of the invention for the video decoding embodiments ;
- Figure 3 reports the an example of the modeling of processing algorithms. It includes the association of processing statistic to each state associated to the execution of a specific algorithm ;
- Figure 4 reports the extension of the model of figure 3 for a more complete and accurate model of the algorithmic complexity ;
- Figure 5 reports one preferred embodiment of the invention for the MPEG-4 video decoding. It illustrates a complexity model with the associated statistics for MPEG-4 texture decoding ;
- Figure 6 extends the model of figure 5 including additional coding modes and coding parameters plus the associated statistics ;
- Figures 7 and 8 report simulation results of a preferred embodiment of the invention. By associating a complexity measure to the statistics of the data processing (video decoding in the preferred embodiment), it is possible to predict the processing complexity of data ; actual decoding time, predicted decoding time and prediction error are represented.

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- Figure 9 reports the measured decoding time and Decoding Time Prediction (expressed in μsec) versus the sequence VOP number of the MPEG-4 VM6 for the sequence Coastguard (Background, Small boat, Big Boat and Water VOPs) at 64 Kb/s ; these results being obtained on a specific decoder.
- Figure 10 reports the measured decoding time and Decoding Prediction Time (expressed in μsec) versus the sequence VOP number of the MPEG-4 VM6 for the sequence Coastguard (Background, Small boat, Big Boat and Water VOPs) at 128 Kb/s ; these results being obtained on a specific decoder.
- Figure 11 reports the measured decoding time and Decoding Prediction Time (expressed in μsec) versus the sequence VOP number of the MPEG-4 VM6 for the sequence Coastguard (Background, Small boat, Big Boat and Water VOPs) at 128 Kb/s ; these results being obtained on a specific decoder
- Figure 12 reports a block diagram of part of the invention. The statistics carrying the complexity information and associated to each data to be processed are read by a prediction unit which generates a prediction signal sent to the OS scheduler which allocates resources as function of the prediction signal. The figure is reporting one example of preferred embodiment for the video decoding of multiple VOP ;
- Figure 13 reports a block diagram of part of the invention relative to the construction of the complexity information header at the encoder side. Statistics of the coding and/or decoding algorithms/modes/parameters are generated at the encoder side and then inserted in a bit-stream to be transmitted to the decoder ;
- Figure 14 reports a block diagram of part of the invention relative to the interaction between the decoder supervisor and the decoder using various signals in order to guarantee real-time decoding of the data ;
- Figure 15 reports the diagram of a complexity model including associated degradation algorithms ;
- Figures 16, 17, 18 report examples of results of a preferred embodiment of the invention. The video decoding for the MPEG-4 texture decoding is provided imposing a maximum constant decoding time (complexity) for each VOP. Degradation results are also reported ;
- Figure 19 reports an example of a possible preferred embodiment of the invention illustrating the various interactions and processing related to the handling of media objects (audio, video, text, graphic, 2-D and 3D models) in a multimedia terminal ;
- Figure 20 reports an example of a portion of multimedia terminal block diagram that is another possible embodiment of the invention, and
- Figure 21 reports a drawing illustrating the composition and rendering processes, both being possible preferred embodiments of the invention.

6. PREDICTING DECODING COMPLEXITY BY MEANS OF ENCODING STATISTIC INFORMATION

6.1 A model of decoding complexity for data dependent processing

[0036] To achieve the objectives of the present invention, one need a simple model of data processing complexity that preferably has the following properties :

1) it is only related to the processing of the incoming data,
2) it is as compact as possible so that its description requires the minimum amount of information (number of bits),
3) it is representative in terms of processing complexity,
4) it is not related to the any specific software or hardware implementation of the given processing,
5) it can be easily mapped on any software/hardware platform implementation,
6) it is sufficiently accurate to yield useful predictions of the processing execution time.

[0037] A way of describing the operations of processing incoming data can be to consider the sequence of ensembles of operations as appropriate distinct algorithms. If the sequence of algorithms is not dependent explicitly on the actual content of the data to be processed or by the intermediate results of the processing, the complexity of the processing can be easily calculated a priori and the complexity-modeling problem is trivial.

[0038] In general, if the sequence of operations is explicitly data dependent (i.e. the processing instructions are contained in the data themselves) and depends also on intermediate results of the processing, the problem of modeling algorithmic complexity is much more difficult.

[0039] It is well known that any processing can be modeled by a finite-state-machine for which next state depends on the input, current state and current output (the well-known machine of Mealy). This formulation is rigorous and general. In theory it could also be used to measure the processing complexity. If one assume to associate a complexity measure to each state transition, one could measure the global complexity of the processing by monitoring the state of the machine at each step, and adding up the complexity related to each state transition. In practice, such model is not useful for two main reasons. The state machine description of usual video decoding would result extremely complex. The global complexity associated to the sequence of state transition would result too abstract to make feasible the mapping

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on different implementations than the canonical state machine. In practice, it would be extremely difficult to derive a complexity expressed as total execution time for different specific platforms.

[0040] A more useful model is to represent the decoding process by a flux diagram for which each data state corresponds to the execution of a specific algorithm f. Such representation is more naturally related to the usual representations of the execution of software programs. Let us associate to each data state a measure of the occurrence of such state, which is incremented each time the data processing falls in each state. Let us suppose to monitor the execution of the decoding process and, for the occurrence of each algorithm execution, to increment the associated measure. The result of this model is a representation of the data processing given by a sequence of measures associated to each algorithm composing the complexity model. In general, any encoder knows which algorithm sequence is needed for the decoding, since the encoding and the coding syntax define without ambiguities the decoding algorithms . In particular, video decoders have to implement a decoder, to build, reference images, therefore they are able indeed to generate the described complexity representation.

[0041] This modeling approach has the nice feature that admits different levels of complexity resolution. One can consider only a very limited number of main algorithms, or partitioning into a large set of sub-algorithms or any intermediate representation. The cost of the representation, obviously, depends on the number of algorithms that compose the model. The accuracy of the complexity representation depends on the number and type of algorithms, in other words on their relevance in terms of complexity. A simple example of a complexity model is reported in figure 3 which reports a flow graph for the modeling of a processing composed by three algorithms f and associated occurrence complexity measures c. In this model, the processing is represented by tree algorithms f and by the associated counters c. Figure 4 reports a flow graph of the model of Figure 3 for which the complexity modeling of algorithms f1 and f3 have been designed by partitioning f1 and f3 in two new algorithms and their associated complexity models, the model is more accurate since the algorithms 1 and 3 are partitioned into other algorithms associated to new algorithm occurrence measures. It must be noted that what are considered as coding modes associated to specific coding options in the usual coding language, are from the point of view of the invention distinct algorithms, since different complexities correspond to different coding modes. It must be also noted that the executions of the same algorithm using different parameters can be considered as the executions of distinct algorithms associated to the corresponding parameters.

[0042] The mapping of the complexity into any software/hardware implementation is straightforward. By knowing the complexity (execution time) of each algorithm on a specific platform and by using the information of the actual occurrence measure of each algorithms in the decoding process, one can easily calculate the total execution time (what is denoted as complexity) for the processing of an incoming bit-stream.

[0043] The key issue of this approach is to be able to find the representation in terms of minimal set of algorithms and sub-algorithms (tools) that being representative of the processing complexity, yields the best approximation of the execution time. This is particularly evident for very complex processing task such as video decoding. The importance of a minimal set is to keep as compact as possible the cost of the complexity representation and, therefore, make possible its separate transmission at a low cost.

[0044] Another feature of the proposed model is that it can easily take into account parallel software or hardware implementations. No hypothesis has been done on the internal implementation of each algorithms. In fact, they can be implemented at any level of hardware or software parallelism. The case for which different algorithms of the model have parallel implementations can also be treated by simplifying the model and just ignoring some counters associated to algorithms implemented in parallel. Simple practical examples of these cases are given below after the complete definition of the modeling-prediction complexity problem.

6.2 A technique to predict video decoding complexity : Decoding Complexity Prediction by Coding Statistics (DCPCS)

[0045] Let us consider a specific software/hardware implementation of a video decoder, running on a specific hardware platform. Since no hypothesis is made on the architecture of the software or on the architecture of the hardware, the approach doesn't loose any generality.

[0046] Let us consider that the true complexity C* (execution time) for the decoding of a given input data (i.e. a single frame or a MPEG-4 VOP) is a function P*, specific for the software/hardware implementation at hand, of the sequence of all the various processing operations p_l 1=1,...,L needed to decode the incoming data :

$$C^* = P^*(p_1, p_2, .., p_l, ... p_L). \quad (1)$$

[0047] The p_l describe the sequence of operations that define the decoding process. They are, for instance, the parsing of the bit-stream, the sequence of operations for decoding the in various form Intra, Inter, Not-Coded, Shape, Padding, the inverse quantisation, the IDCT, the motion compensation in its various form OBMC, simple prediction, 4 vector prediction , the parameter that characterize the processing of each prediction mode (integer pel vector prediction, half pel vector prediction), the number of bitwise parsing operations, the number of non-zero DCT coefficients and so on.

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[0048] The actual expression of the function P* is certainly extremely difficult to obtain. On the other hand, the objective of the present invention is to avoid the necessity to know all the parameters that define the complexity, but just to be able to predict the true complexity C* with a good degree of approximation. The cost of the description of the exact complexity function P* in terms of all coding parameters would be, indeed, prohibitive for the purposes of the present invention.

[0049] Therefore, let us leave the problem of finding the exact expression of the complexity function P* and try to find a sufficiently accurate approximation F of the function P* which provides a prediction C, using the model proposed in the previous section. One is therefore limited to consider a number I of algorithms fi, with i=1,...,I with I << L, and the associated model counters c_i :

$$C = F(c_1 \cdot f_1, c_2 \cdot f_2, .. c_i \cdot f_i, .. c_1 \cdot f_1) = c_1 \cdot w_1 + c_2 \cdot w_2 + ... + c_i \cdot w_i + ... + c_1 \cdot w_1 \approx C^* \quad (2)$$

where the coefficients w_i related to each c_i are complexity weight corresponding to the model algorithm f_i which accounts for the specific software and hardware architecture at hand.

[0050] Let us suppose now, that the values of the vector c for the incoming data (frame or VOP) are known. If the vector w of the w_i weights is known, one can predict the complexity of the incoming VOP bit-stream by a simple linear combination.

6.3 A method to estimate the algorithms weight coefficients w

[0051] The values of the vector w can be obtained by direct measurements on the platform, if the complexity values (execution time) of each function are accessible. In general, they can be also indirectly estimated by means of a simple linear regression applied on a set of measures of the true complexities C^*_k, with k =1 ... K, obtained by K samples of data processing (i.e. K frames or K VOPs taken from different sequences) on the selected platform :

$$\begin{cases} C^*_1 = W_1 \cdot C_{11} + W_2 \cdot C_{12} + ... + W_i \cdot C_{1i} + ... + W_I \cdot C_{1I} \\ C^*_2 = W_1 \cdot C_{21} + W_2 \cdot C_{22} + ... + W_i \cdot C_{2i} + ... + W_I \cdot C_{2I} \\ ..... \\ C^*_k = ... \\ ..... \\ C^*_K = W_1 \cdot C_{K1} + W_2 \cdot C_{K2} + ... + W_i \cdot C_{Ki} + ... + W_I \cdot C_{KI} \end{cases} \quad (3)$$

[0052] In matrix form the estimated vector of weights w can be expressed by the classical least square minimization expression :

$$\hat{w} = (c^T c)^{-1} c^T C, \quad (4)$$

where T indicates the transpose matrix,
and -1 indicates the inverse matrix.

[0053] Obviously, the linear regression and the measures of the C_k complexities can be made off-line since they have as objective the estimation of the vector w which is characteristic of a specific software/hardware decoder implementation and do not depend on the incoming data.

[0054] Once the vector of the w parameters is estimated, the evaluation of the actual complexity C of the incoming bit-stream can be simply done by calculating the linear combination of the complexity function. In practice, this can be done by reading the actual c_i counter values written in an appropriate form in the incoming data, and calculating the value of F(c). This fact implies, for instance, that video compression standards should be able to insert complexity information in appropriate headers of frames or VOPs, or transmit them as accompanying information. Figure 7 reports the measured decoding time and Decoding Time Prediction (expressed in msec) versus the sequence VOP number of the texture decoding of MPEG-4 VM6 for the sequence Akyio (Background and Akyio VOPs) at different bit-rates. The decoder is the Momusys VM6 on a Sun Ultrasparc. The absolute value of the Decoding Time Prediction error is

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reported in the bottom curve near the 0 value.

6.4 Definition of the complexity models for the texture decoding of MPEG-4 VM6 VOPs

[0055] In the previous section, a model for decoding complexity has been developed, aiming at being at the same time related only to the processing and apt to be mapped on any platform implementation. These ideal requirements have been expressed in six points. A last requirement needs to be verified. Does the model and the associated complexity representation provide complexity (time) predictions sufficiently compact but accurate enough for the aims of the present invention? There is described in this paragraph an example of application of the modeling to the texture decoding of MPEG-4 VM6 VOPsm, excluding the processing of shape coding and the padding of macroblocks. This exclusion is just motivated by the fact that at the time of the modeling and simulations, one have investigated only the stable coding modules of the MPEG-4 VM. The same modeling principles can be applied to those and to all new MPEG-4 coding algorithms and modes.

[0056] Let us partition the decoding of each MPEG-4 VOP in the following seven algorithms which represent all the texture coding process of any VOP including luminance and chrominance (Intra, Inter, Skip, Advanced Prediction Mode (ADM), Normal Prediction Mode (NPM), DCT coefficient processing (DCT_coeff), and DCT line processing (DCT_line)). Let us associate to each coding-decoding algorithm a statistic measure defined as follows. For Intra, Inter and Skip, it counts each time a macroblock is coded by using the Intra, Inter or Non-Coded coding mode. For ADM and NPM the statistic measure indicates the number of blocks 8x8 predicted using advanced prediction modes (OBMC or four vectors for macroblock) or normal prediction modes. For DCT_coeff, the measure counts the total number of DCT coefficients per VOP, and DCT_line the total number of executed DCT 8x1 per VOP. All these counters can be easily inserted in any MPEG-4 compliant or any other video/audio encoder. Figure 13 reports a schematic diagram of the process of counting coding algorithms/modes/parameters and provides a statistic description of the decoding process according to any complexity model. This diagram represents the generation of the Complexity Information Header at the encoder side. The encoder increments the counters of the coding algorithms/modes/parameters that are used to encode the video frame or video object to generate the associated statistics signal (known as complexity information). At the end of the encoding of each video frame or video object the statistics of the used coding algorithms/modes/parameters is inserted in the Complexity Information Header. Figure 1 reports a simplified flow graph of the MPEG-4 VM6 texture decoding algorithms. Note that, in the proposed technique, it is not necessary to explicitly model the actual decoder flow graph. The above graph represents the schematic flow diagram of a possible simple VOP texture decoding model of MPEG-4. It has to be noticed that by estimating the complexity weights using the total VOP decoding measures as explained in the previous paragraph, it is not even necessary to explicitly specify all transitions in the decoding flow diagram model.

[0057] More accurate complexity models could be designed by introducing new algorithms and the associated measures of occurrences. An example of a more accurate model including the partitioning of APM and NPM into predicted or bi-directional modes and into half-pel motion compensation modes is reported in Figure 6 which represents an example of extension of the MPEG-4 texture decoding complexity model including the different mode prediction and half-pel motion compensation functions.

[0058] A reduction to simpler decoding models when many counters of different algorithms are available is straightforward. Some counters can be ignored if, in a specific software/hardware implementation, they do not implies any or any relevant complexity difference. For instance, if the implementation does not yields different processing time if a macroblock is predicted by a full pel or half pel vector, or if there is no difference between APM or NPM, all these counters can be ignored or can be combined. The specific action depends on the architecture and on the complexity features of the software/hardware decoding platform used.

[0059] As reported in these model examples, a meaningful partitioning of the algorithms in terms of complexity can be easily done only referring to the processing of the data and without the need of specifying any software or hardware implementation. Only in the phase of estimating the weights w_i and to perform the actual prediction it is necessary to refer to a specific hardware/software implementation.

[0060] The two simple models presented here are also capable of taking into account parallel implementations which are implemented in each algorithm such as any packed arithmetic implementation or higher levels of parallelism. Parallel implementations at levels of macroblock decoding are not likely to occur in MPEG-4 systems. Decoders need to respect a given sequential order in decoding the macroblocks that is intrinsic in the syntax of the video data flow. Moreover, for multimedia processor implementations, the ones that are particularly considered in this description, parallelism is likely to be implemented at much lower levels than macroblock decoding. Higher levels are indeed very unlikely to appear.

[0061] Platforms that include also some hardware module accelerators, can be taken into account for the model. If one have, for instance, the hardware implementation of a 8x8 DCT module, one can simply discard the DCT_coeff and DCT_line counters and simply use the combination of Intra and Inter counters to predict the DCT decoding complexity.

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Similar measures can be taken for other hardware accelerator modules.

[0062] The present complexity modeling approach can be applied to the audio/video decoding, composition and rendering of media objects or to any real-time processing of data.

7. EXPERIMENTAL RESULTS OF VIDEO DECODING COMPLEXITY PREDICTION

[0063] This section reports simulation results of the prediction of VOP decoding complexity for the MPEG-4 VM6 compression standard. Counters corresponding to the algorithms defined by the model of Figure 5 have been inserted in the Momusys VM6 encoder implementation to generate the mentioned statistic measures. These integer figures have been converted into percentage values referred to the actual number of VOP macroblocks, normalized to 8 bit values and have been supposed to be transmitted as a VOP complexity header for each VOP. The cost of this information transmission results of a few tenths of bits and can be considered negligible if compared to the total video bit-rate. Obviously, any other representation of the statistical coding information which has a sufficient precision can be employed. A schematic diagram of this decoding time (complexity) prediction signal generation process is reported in figure 14 which represents a schematic diagram of VOP video decompression interactions between the Video Decoder and the Video Decoder Supervisor when the Allocated Decoding Time (T_{Alloc})is lower than the Decoding Time Prediction (T_{Pred}). The Target Decoding Time and Decoder Time Reference are used to verify that the Decompressed Video elements are made available at the desired time. The Target Decoding Time is derived implicitly by the frame or sampling rate or by the information associated to each VOP or video frame (associated time stamps).

[0064] Measures of the texture decoding time of each VOP for different video sequence have been performed on a Sun UltraSparc platform. The decoder is the Momusys VM6 decoder.

[0065] The estimation of the weight w vector has been obtained by a linear regression applied on the measured decoding time of each VOP using the expression of equation (4). To demonstrate the robustness of the proposed technique, the complexity prediction results have been generated using a vector w, estimated using the complexity measurements of all the test sequences, except the one for which the prediction is calculated. For instance, to predict a sequence A, the weights estimated on sequences B and C have been used, and so on respectively for the other test sequences. Table 1 reports the results of the different estimates of the vector w for the sequences Akyio, Coastguard and Bream. As can be easily noticed, complexity (time) estimates from different sequences do not differ relevantly from one to the other. Disposing of a relatively large set of sequences with the associated measurements, one can easily perform off-line estimates of decoder weights w characteristic of the decoder at hand.

[0066] Figure 7 reports the measured VOP decoding time, the VOP decoding time prediction and the time prediction errors (in absolute value) for the two VOPs of the sequence Akyio. Figure 8 represents the measured decoding time and Decoding Time Prediction (expressed in msec) versus the sequence VOP number of the MPEG-4 VM6 for the sequence Bream (Background and Fish VOP) at different bit-rates. The decoder is the Momusys VM6 on a Sun Ultrasparc. The absolute value of the Decoding Time Prediction error is reported in the bottom curve near the 0 value. The results have been obtained at different bit-rates and all measures are expressed in msec. The same experiment results are reported for the sequences Bream and Coastguard. In figures 9, 10 and 11, as can be easily noticed, while the measured actual decoding time has strong variations for each VOP, the decoding time prediction is very accurate and the two curves for most of the samples are difficult to distinguish one from the other. In these experiments, the error of the prediction is lower than 5% for each VOP and in average is around 1-2%.

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W (msec/f)	Akiyo	Bream	Coastguard
Intra	38.68	38.84	38.15
Inter	30.95	29.60	29.56
Skip	5.55	5.53	5.51
DCT_line	2.15	0.37	1.24
DCT_coeff	1.47	6.58	6.18
APM	226.47	230.23	228.70
NPM	36.30	37.60	36.01

Table 1. Estimated complexity weights vector w for the texture decoding complexity model of Figure 5 for different sets of measures. The complexity relevance for each weight is given by the product of the algorithm count and by the weight itself.

[0067] The excellent results demonstrate that a relatively simple complexity model is able to predict the decoding time (complexity) with a very good degree of approximation, when appropriate coding statistics are available. The degree of approximation resulting from the proposed method, indeed, is more than adequate to enable an intelligent and efficient resource allocation strategy.

[0068] The description and discussion of the new possible schemes of interaction between the real-time OS and the video decoder are the subject of next sections.

[0069] Another important conclusion is the fact that a very complex process such as MPEG-4 texture video decoding can be described by a suitable high level coding statistic information which is not directly related to any software or hardware implementation. The vector of coding mode counter values is, in fact, a compact coding parameter and coding mode information of the compressed bit-stream. Moreover, the obtained results reports that it is not necessary to define a very detailed model of the software/hardware decoder platform. Very complex decoder features such as cash strategy or memory accesses which could have a non-strictly deterministic behavior, can be taken into account in a statistical sense when one estimate the value of the weight vector characteristic of the decoder platform used.

8. NEW SCHEMES OF DECODER-OS SCHEDULER INTERACTIONS

[0070] New schemes of interaction between the decoder and the OS scheduler of the multimedia processor are possible when decoding time prediction is feasible. These schemes of interaction can be designed in order to provide the best resource allocation policy able to guarantee real-time performances.

[0071] In Figure 12, an example of decoding scheme employing decoding time prediction is reported. This figure represents a decoding scheme example in which the Complexity Information of each VOP is processed by the Complexity Prediction Unit which provides the Decoding Time Prediction signal to the decoder and to the real-time OS/scheduler that allocates the necessary resources (Allocated Decoding Time) to the decoder or decoding processes. The Decoding Time Prediction unit reads the Complexity Information Header carried in each VOP/frame bit-stream header or transmitted as side information in any format, produces the decoding time prediction for each frame/VOP, and provides this information to the real-time OS scheduler. In this way, the OS scheduler can allocate the necessary resources (i.e. Allocated Decoding Time) for the decoding of each or all the VOPs respecting the associated real-time constraints. In case of non real-time encoding, the complexity information can be compressed and transmitted before the real-time transmission and real-time decoding of the video/audio bit-streams. The usefulness of such scheme is evident considering that many VOPs of unknown complexity (decoding time) need to be decoded within an associated time interval

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T_c. This scheme is able to guarantee real-time performances if the available video processing resources T_{Alloc} (i.e. Allocated Decoding Time) are sufficient for the decoding of all N incoming VOPs within the given time interval. Formally, the following relation has to be satisfied :

$$T_c \geq T_{Alloc} \geq \sum_{n=1}^{N} T_n(t) \tag{5}$$

where T_n is the decoding time of the nth VOP, with n=1,..., N, where N being the VO and VOP index and t being the VOP sampling time.

[0072] This simple procedure scheme is applicable in two cases. The first is when all the VOPs belongs to the same sampling time t (implicitly defined by the sampling rate or also carried by time stamps associated to each VOP). In this case, there is no additional delay introduced by the decoder. The second case occurs when the VOPs can also belong to sequential sampling periods, i.e. M sampling intervals of the reference time t denoted as Dt (also referred as different time stamps). In this case, an additional delay has to be considered and an output buffer needs to be added to the decoder :

$$T_c \geq T_{Alloc} \geq \sum_{n=1}^{N} \sum_{m=1}^{M} T_n(t+m\Delta t) \tag{6}$$

[0073] This second scheme enables to smooth out computational peaks on a larger number of VOPs and on a larger time interval than a single image sampling period Dt. In other words, expression (6) might be satisfied even when expression (5) is not for some values of the sampling time t. Obviously, this result is obtained at the cost of an additional delay and an additional output buffer.

[0074] When the available processing resources (i.e. time) are not sufficient to decode all VOPs, this simple strategy cannot guarantee the respect of the real-time constraints. In such cases, other form of interactions and new decoding techniques are needed.

[0075] The main idea is to reduce the complexity of the decoding in order to satisfy relation (5) and (6) accepting some degradation to the resulting image quality. These techniques are called here Computational Graceful Degradation (CGD).

[0076] A schematic diagram of the construction of the complexity information header at the encoder side is reported in Figure 13. The encoder, during the encoding process, increments the registers (counters) corresponding to a set of encoding algorithms/modes/parameters used for the actual VOP or frame compression. At the end of the process, the counters contains a compact encoding/decoding statistical information that is written in the Complexity Information Header.

9. COMPUTATIONAL GRACEFUL DEGRADATION (CGD)

[0077] The main idea of CGD is to make available results of poorer quality when the results of the desirable quality cannot be obtained in real time. When the complexity of the task exceeds the available processing power, real-time services, possibly of degraded quality, are nevertheless provided respecting all real-time constraints. This approach makes the guarantee of the correct scheduling of tasks possible, even when the computational system load fluctuates and relation (5) and (6) cannot be satisfied.

[0078] The concept of graceful system degradation using imprecise results has been previously introduced in the field of real-time computing with applications to control system and automation. In these contexts, imprecise results are defined as intermediate results with the property that the more recent and intermediate result is the closer one that approximates the final result (i.e. the idea only works in monotonically improving computations). For more details, the reader can refer to W.A. Halang, A.D. Stoyenko, Constructing predictable real time systems, Kluwer Academic Publisher, 1991 ; K. Lin, S. Natarjan, J. Liu, Imprecise results : Utilizing partial computations in real-time systems, Proceedings of IEEE Real-Time System Symposium, December 1987 ; J. Liu, K. Lin, S. Natarjan, Scheduling real time periodic jobs using imprecise results, Proceedings of the IEEE Real-Time System Symposium, December 1987 incorporated herein by reference.

[0079] In these cases the problems to be solved are more concerned with fault tolerance, I/O overloads, stability and reactivity to unexpected inputs, and the corresponding techniques are not suitable for purposes of real-time decoding of compressed video/audio bit-streams.

[0080] In contrast, the aim of the present invention is to be able to provide the guarantee of real-time video decoding

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with possible degradations of the image quality, i.e. reductions of the peak signal to noise ratio (PSNR), without loosing parts of the image or parts of the audio content. Such alternative is certainly much more desirable than other straightforward options such as cutting image portions or simply skipping frames. These latter options, as can be easily understood, can have catastrophic consequences on prediction based coding systems. In H.263 systems, for instance, skipping the decoding of a single frame or a portion of it implies the skipping of all future incoming frames (or portion of them) before the next incoming Intra frame. The time interval of such skipping operation might cover many seconds, and the information content loss might be very relevant. Such abrupt interruptions, which are perceptually very annoying, might he caused not only by the simple fluctuation of the decoding complexity load as discussed in the previous sections, but also by the fluctuations of the load of other non-video/audio processing tasks which reduce the available processing resources (time). Moreover, such events are in general out of the control of the video/audio decoder system and cannot be easily forecasted. Considering these facts, the importance of techniques able to filter out complexity decoding peak loads or able to reduce the average decoding computation load without causing perceptually annoying consequences is evident. Skipping B-VOP could be, in some cases, a viable option for video accepting the introduction of motion judder in the sequence reproduction. Unfortunately, the presence of B-frames or B-VOP cannot be guaranteed in any bit-stream and just at the right time for which a reduction of the complexity is needed to respect the real time constraints. For audio applications, any skip of part of the content has perceptually a very annoying result.

[0081] In contrast with what could be commonly thought, also the classical multi-resolution coding features such as spatial or temporal scalabilities are not really useful for the aims of the present invention. In general, they are used to optimize the transmission bandwidth usage, enabling the compatibility of services at different bit-rates and spatial resolutions, but they must be embedded in the original bit-stream at the encoder side. If they are not embedded, the changes of resolution at the decoder size can results more computationally expansive than the simple decoding at the given resolution.

[0082] Another important reason for the introduction of CGD is given by the definition of profiles, levels and conformance tests for video compression standards based on software/processor platforms. For the MPEG-4 standard, it is expected to have a range of applications that will be much broader than the one of MPEG-1 and MPEG-2. Two possible scenarios can be identified. The first is the definition of a limited number of profiles and levels based on computational power. The second is the possibility of a continuum of decoders of different computational power. The first scenario faces very difficult tasks such as the definition of decoder conformance testing, and at the end it may result in a jungle of too many different levels and profiles.

[0083] The second scenario is completely open to platforms of different computational power. It requires pure functional decoder conformance testing and is able to provide the maximum quality of the service that is achievable by the capabilities of each platform.

[0084] The second scenario, although much more attractive than the first, poses new questions and problems have not yet been studied in video and audio coding. It is mandatory that all decoders can decode all MPEG-4 services but at different levels of quality. It means that a scalability-based on computational power is needed. This new type of scalability should enable a graceful degradation of the video quality when less than theoretically necessary computational power is available at the decoding side. In contrast with MPEG-2 scalabilities that are discrete, embedded in the bit-stream and designed for specific applications, this computational power based scalability should be continuous and implemented in all MPEG-4 bit-streams.

[0085] From these arguments, the usefulness of CGD and its important features and applications are clear. The last key point that has left CGD as a good idea but of difficult usage and implementation for video coding was that it was not clear how to implement it efficiently. Now that the present invention has developed a technique able to predict with a good degree of approximation the required decoding time of each decoding process, one have the key for useful and efficient implementation of CGD techniques.

9.1 Principles of decoding using CGD techniques

[0086] Let us consider a complexity model such as the one of Figure 3 composed by a set of I algorithms fi, with i = I,...,I and suppose to be able to design for all, or only for a subset S^{CGD} of the functions f_i composing the model, new functions f_i^{CGD} which have the following three properties :

1) the execution of a function f_i^{CGD} yields results that are an approximation of the ones produced by the original function f_i,
2) the execution of f_i^{CGD} does not prevent the exact execution of any subsequent decoding functions,
3) the weight w_i^{CGD} associated to f_i^{CGD} in the considered decoder implementation is lower than the corresponding w_i associated at f_i (i.e. $w_i^{CGD} < w_i$).

[0087] For a schematic representation of a complexity model which includes new degraded functions, one can refer

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to Figure 15 which represents a schematic diagram of a complexity model including CGD algorithms, CGD counters (b_i) and new state transitions generated by the new CGD functions. In this example $f_1, f_3 \hat{I} S^{CGD}$, and $f_2 \hat{I} S^{orig}$. In other words, for video decoding for instance, the execution of any f_i^{CGD} might produces PSNR degradations in the reconstruction of some image parts, but not prevents from correctly decoding the rest of the frame or VOP.

[0088] Let us partition the functions forming the complexity model into two disjoint sets, S^{Orig} and S^{CGD} respectively, for the ones that do not admit a CGD version and for the ones for which it is possible to design a CGD version.

[0089] Let us consider for simplicity an image sequence composed by a sequence of single frames or single VOPs (i.e. N=1) and suppose that expression (5) is not satisfied for some values of the decoder reference time t :

$$T(t) > T_{Alloc} \tag{7}$$

where T(t) is the decoding time of the VOP at hand at the sampling time t, and to define as processing deficit T_{Def} the time for which the decoding complexity exceeds the Allocated Decoding Time :

$$T(t) - T_{Alloc} = T_{Def} \tag{8}$$

[0090] Since the decoding time can be approximated by its prediction (Decoding Time Prediction) it can be expressed by :

$$T(t) \cong T_{Pred}(t) = \sum_{i=1}^{I} c_i w_i \tag{9}$$

where the c_i are the counters of the complexity model and the w_i are the corresponding complexity weights.

[0091] The lower limit of the decoding time executing all CGD algorithms f_i^{CGD} at the place of f_i for any $i \hat{I} S^{CGD}$, is given by :

$$T_{CGD} = \sum_{i \in S_{CGD}} c_i w_i^{CGD} + \sum_{i \in S_{Orig}} c_i w_i \tag{10}$$

[0092] If $T_{CGD} < T_{Alloc} < T_{Pred}$ it is therefore possible to guarantee the real-time constraints by executing the f_i^{CGD} algorithms and accepting approximate decoding results. The difference $T_{Pred} - T_{CGD}$ can also be expressed as :

$$T_{Pred} - T_{CGD} = \sum_{i \in S_{CGD}} c_i (w_i - w_i^{CGD}) \tag{11}$$

[0093] If $T_{CGD} < T_{Alloc} < T_{Pred}$, it is therefore possible to find for each c_i with $i \hat{I} S^{CGD}$, a couple of integer coefficients a_i, b_i, for which :

$$a_i + b_i = c_i \tag{12}$$

and denoting as $T_{Process}$ any decoding time interval which respects the real time constraints (obtained by the implicit sampling rate or expressed using appropriate time stamps associated to each VOP or video frames, or audio packet), one can express the desired process decoding time as any decoding time value that satisfy the expression :

$$T_{process} = \sum_{i \in S_{CGD}} (a_i w_i^{CGD} + b_i w_i) + \sum_{i \in S_{Orig}} c_i w_i \leq T_{Alloc} \tag{13}$$

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[0094] Obviously for any Allocated Decoding Time the aim is to respect the real-time constraints with the lowest degradation in the video/audio content. Associating a degradation measure to each w_i^{CGD} it is possible to minimize the degradation for a given TAlloc. Therefore, the aim is to find the set $S_{a,b}$ of couple of coefficients a_i, b_i, with $i \hat{I} S^{CGD}$, that satisfy expression (12) and minimize the video or audio degradations expressed as difference with the non degraded output :

$$S_{a,b}=\text{argmin}(a,b)_{i \in S_{CGD}}:(PSNR\text{-}PSNR(a_i,b_i)) \tag{14}$$

[0095] The determination of the set $S_{a,b}$ can be done by means of any suitable optimization method or any suitable optimization heuristic by the Video Decoder Supervisor, schematically represented in Figure 14. In summary, the Video Decoder Supervisor receives from the OS the Allocated Decoding Time signal (T_{Alloc}), the decoding time prediction signal (TPred) from the Complexity Prediction unit, and the Complexity Information signal represented by the actual values of the coding/decoding statistic (set of ci coefficients) for the VO. Since the Video Decoder Supervisor knows the values of the set of w_i and w_i^{CGD} it can determine, by a suitable standard optimization technique, the corresponding set of coefficients a_i,b_i such that expression (12) is satisfied. Having defined the set of a_i,b_i coefficients the CGD decoding is partially defined. In other words, the set of coefficients defines for each $i \hat{I} S^{CGD}$ how many degraded algorithms (f_j^{CGD}) at the place of original algorithms (f_j) need to be executed.

[0096] Since the determination of the degradation coefficients is done on the basis of the decoding time prediction, the video decoder can generate a Decoding Status signal reporting the status of the decoding (i.e. the fraction of the bit-stream or the fraction of the VO already decoded). The signal representing the Decoding Status of the decoding process reports to the Video Decoder Supervisor an information which can be used to correct the Computational Graceful Degradation Directive signal (i.e. the setting of the a_j,b_j coefficients in this example) if the Current Decoding Time and the Current Decoding Time Prediction signal are not conformant. Current Predicted Decoding Time means the Decoding Time Prediction calculated by using elation (13), only counting the occurrences of the decoding algorithms actually used to decode the fraction of the decoded bit-stream at the current reference time (time for which the decoding status signal is generated). The term not conformant means that the actual Decoding Time is greater than the Decoding Time Prediction of an amount of time which overcomes statistical variations which are functions of the complexity information, thus reporting possible errors in the Decoding Time Prediction signal.

[0097] The described interactions between OS, the Decoder and Video Decoder Supervisor can be easily extended for the case of sequences containing multiple VO at the same sampling time (associated time stamps), or belonging to a defined time interval containing several sampling periods (several associated time stamps). Expressions (10,11,13,14) can be easily modified including the appropriate summation over all VOP. Therefore, in the case of N VOP at the same sampling time t, one have :

$$T_N(t)=\sum_{n=1}^{N} T_n(t) > T_{Alloc} \tag{15}$$

where T_N (t) is the total decoding time of the N VOP.

$$T_N(t) \cong T_{Pred,N}=\sum_{n=1}^{N} T_{Predn}(t)=\sum_{n=1}^{N}\sum_{i=1}^{I} c_{i,n}w_i \tag{16}$$

$$T_{CGD,N}=\sum_{n=1}^{N}\left(\sum_{i \in S_{CGD}} c_{i,n}w_i^{CGD}+\sum_{i \in S_{Orig}} c_{i,n}w_i\right) \tag{17}$$

$$T_{Pred,N}\text{-}T_{CGD,N}=\sum_{n=1}^{N}\sum_{i \in S_{CGD}} c_{i,n}(w_i\text{-}w_i^{CGD}) \tag{18}$$

$$a_{i,n}+b_{i,n}=c_{i,n} \tag{19}$$

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$$T_{Process,N}=\sum_{n=1}^{N}\Big(\sum_{i\in S_{CGD}}(a_{i,n}w_i^{CGD}+b_{i,n}w_i)+\sum_{i\in S_{Orig}}c_{i,n}w_i\Big)\le T_{Alloc} \quad (20)$$

$$S_{a,b,N}=\text{argmin}_{(a,b)_i\in S_{CGD}}\Big(\sum_{n=1}^{N}(PSNR-PSNR(a_{i,n},b_{i,n}))\Big) \quad (21)$$

or :

$$S_{a,b,N}=\text{argmin}_{(a,b)_i\in S_{CGD}}\Big(\sum_{n=1}^{N}\alpha_n(PSNR-PSNR(a_{i,n},b_{i,n}))\Big) \quad (22)$$

where a_n is a semantic degradation coefficient which might be available in the coded bitstreams.

[0098] For N Video Objects and M sampling time intervals Dt (denoted also as time stamps) one have :

$$T_{N,M}=\sum_{m=1}^{M}T_N(t+m\Delta t)=\sum_{m=1}^{M}\sum_{n=1}^{N}T_n(t+m\Delta t)>T_{Alloc} \quad (23)$$

$$T_{N,M}\cong T_{Pred,N,M}=\sum_{m=1}^{M}\sum_{n=1}^{N}T_{Predn}(t+m\Delta t)=\sum_{m=1}^{M}\sum_{n=1}^{N}\sum_{i=1}^{I}c_{i,n,m}w_i \quad (24)$$

$$T_{CGD,N,M}=\sum_{m=1}^{M}\sum_{n=1}^{N}\Big(\sum_{i\in S_{CGD}}c_{i,n,m}w_i^{CGD}+\sum_{i\in S_{Orig}}c_{i,n,m}w_i\Big) \quad (25)$$

$$T_{Pred,N,M}-T_{CGD,N,M}=\sum_{m=1}^{M}\sum_{n=1}^{N}\sum_{i\in S_{CGD}}c_{i,n,m}(w_i-w_i^{CGD}) \quad (26)$$

$$a_{i,n,m}+b_{i,n,m}=c_{i,n,m} \quad (27)$$

$$T_{Process,N,M}=\sum_{m=1}^{M}\sum_{n=1}^{N}\Big(\sum_{i\in S_{CGD}}(a_{i,n,m}w_i^{CGD}+b_{i,n,m}w_i)+\sum_{i\in S_{Orig}}c_{i,n,m}w_i\Big)\le T_{Alloc} \quad (28)$$

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$$S_{a,b,N,M} = \text{argmin}_{(a,b)_{i \in S_{CGD}}} \left(\sum_{m=1}^{M} \sum_{n=1}^{N} (PSNR - PSNR(a_{i,n,m}, b_{i,n,m})) \right) \quad (29)$$

or

$$S_{a,b,N,M} = \text{argmin}_{(a,b)_{i \in S_{CGD}}} \left(\sum_{m=1}^{M} \sum_{n=1}^{N} \alpha_n (PSNR - PSNR(a_{i,n,m}, b_{i,n,m})) \right) \quad (30)$$

9.2 Extension of the techniques to video/audio composition

[0099] The methods aiming at predicting the decoding time (i.e. generating a Decoding Time prediction Signal) of video frames or video objects, so as to respect the real-time constraints specified implicitly by the audio/video rates or by the timing information carried by the associated time stamps, can be easily extended to the video/audio composition processes. Composition process means the action of putting decompressed video or audio objects together in the same representation space. In a similar way of the decoding process, one can generate a Composition Time Prediction for each composition process according to the interactions described in Figure 12. Such Composition Time Prediction is a function of the occurrence of composition algorithms, composition modes and composition parameters (associated composition statistics). Differently from the decoding process, composition algorithms, modes and parameters can be also provided by an interactive user interface. In a similar way the Composition Allocated Time can be generated as function of the Composition Time Prediction. The interactions between the compositor and the OS can be described as in Figure 12 where the Decoder is substituted by the Compositor.

[0100] The technique of associating Decoding Degradation Algorithms and decoding by using degradation algorithms described in section 6.1 and Figure 14 can be applied by substituting respectively the Allocated Decoding Time by the Decoding Time Prediction, the Target Decoding Time and the Decoder Reference Time by the Allocated Composition Time, the Composition Time Prediction by the Target Composition Time and the Compositor Reference Time. All relations and equations reported in section 6.1 referring to the decoding process can be referred to the composition process.

9.3 Examples of possible degradation modes

[0101] The decoding operations of a video compression algorithm can be divided into two main categories :

1) operations that cannot be simplified since they may prevent the extraction and usage of relevant coding information,
2) operations that can be simplified, possibly leading to imprecise or degraded video results.

[0102] To the first category typically belong all bit-stream parsing operations, entropy decoding (i.e. VLD and arithmetic coding), and all operations related to synchronization and to the syntax of the decoding process. For these operations, no degradation mode definition is possible, otherwise it would imply skipping image portions or entire frames since either the data or the coding modes and coding parameters are lost.

[0103] To the second category, for instance, belong operations such as the IDCT, the prediction with and without motion compensation in its various forms (PB/B-frame prediction, overlapped block motion compensation (OBMC), half pixel interpolation and so on, padding, shape coding. Simplifications of such operations applied to pixels or transform coefficients are always possible but at the expenses of imprecise results. The challenge can be expressed as follows : given a specific compression standard, software and processor architecture, implement it and find the f_i^{CGD} which provides the maximum complexity reduction ($w_i - w_i^{CGD}$) versus the minimum image/audio quality degradation (usually measured in PSNR). Many are the algorithms that can be simplified. We report here only two examples that illustrate the idea.

9.3.1 IDCT simplified modes

[0104] IDCT on a 8x8 block can be decomposed into 16 IDCT operation on a 8x1 block, or on IDCT considering only

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the lowest 4x4 or 2x2 coefficients. Skipping higher order 8x1 IDCT or enabling processing only 2x2 or 4x4 coefficients constitute some alternatives which are less complex than the standard 8x8 IDCT. Obviously, these less demanding alternatives yield a filtering of the high frequency possibly contained in the higher order coefficients.

9.3.2 Simplified prediction modes

[0105] Many prediction modes can be simplified at the expenses of some PSNR degradations. In particular, the most complex such as the OBMC with or without half-pel motion compensation can yield relevant complexity decreases of both computational complexity and memory bandwidth by implementing simpler algorithms.

10. EXAMPLES OF RESULTS FOR THE MPEG-4 VIDEO COMPRESSION STANDARD

[0106] This section reports simulation results of the decoding of VOP using the complexity model and decoding time prediction results described in Section 4. The MPEG-4 VM6 algorithm in the Momusys VM6 implementation modified adding degradation functions to the advanced prediction modes has been used for the simulations. A fixed amount of processing time is allocated for each VOP composing the sequences. In case the decoding time prediction (T_{Pred}) for each VOP exceeds the fixed allocated time (T_{Alloc}), an appropriate number of advanced prediction modes are executed using degraded functions in order to satisfy relation (13).

[0107] Figures 16, 17, 18 report the decoding results at 64, 128 and 256 kb/s for the four VO (Small Boat, Big Boat, background and Water) of the sequence Coastguard. On the left, the diagrams report the decoding time of each VO expressed in msec versus the VOP number. Two curves are reported : original decoding and decoding using degradation function in order to satisfy the decoding time limits. The PSNR image degradations corresponding to the execution of degraded functions are reported on the right.

[0108] Figure 16 reports on the left standard decoding time and CGD decoding time (in msec) for the four VO of the sequence Coastguard at 64 kb/s. Each VO has a upper bound for the CGD decoding time. On the right the PSNR loss of the CGD decoding with reference to the standard decoding.

[0109] Figure 17 reports on the left standard decoding time and CGD decoding time (in msec) for the four VO of the sequence Coastguard at 128 kb/s. Each VOP has a upper bound for the CGD decoding time. On the right the PSNR loss of the CGD decoding with reference to the standard decoding.

[0110] Figure 18 reports on the left standard decoding time and CGD decoding time (in msec) for the four VO of the sequence Coastguard at 256 kb/s. Each VO has a upper bound for the CGD decoding time. On the right the PSNR loss of the CGD decoding with reference to the standard decoding.

[0111] The implementation of CGD base on the decoding time prediction generation technique enables, within the discussed limits, the a priori setting of the decoding time guaranteeing the possibility of a scheduling of each decoding task that satisfy real time constraints, even if the available resources (Allocated Decoding Time) are inferior to the theoretically necessary ones. Moreover, the degradations introduced are visually acceptable and they can be minimized according to expression (14) by suitable techniques. The results obtained with a PSNR degradated are certainly much more desirable than introducing sudden interruptions and image content losses to the video sequence, and enables an efficient resource allocation policy.

Claims

1. Method for primary processing a digital signal comprising the steps of :

   - providing a digital signal to a primary processing unit ;
   - primary processing said signal with said primary processing unit according to a plurality of primary processing algorithms to provide primary processed output signals,
   - determining statistics of use of at least one of said primary processing algorithms,
   - providing a digital statistics signal representative of said statistics for each of said primary processed output signals
   - associating to each of said primary processed output signals its own statistics signal ;
   - determining a complexity primary processing information signal based on said statistic signal.

2. Digital primary processed output signal, generated by a primary processing unit using primary processing algorithms and being intended to be transmitted to a receiving device wherein said primary processed output signal comprises data bit streams, each of said data bit streams comprising a main bit string representative of said primary processed output signal and a secondary bit string representative of the statistics of use of said primary processing algorithms associated to said main bit string.

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3. Method for secondary processing a secondary digital output signal according to claim 2 comprising the steps of :

(a) reading said secondary bit string ;
(b) determining, from the secondary bit string, primary processing algorithms to be used to secondary process said primary output signal associated to said main bit string, for generating a complexity primary processed information signal for each signal ;
(c) allocating a secondary processing time and/or operating system resources as a function of said complexity primary processed information signal for secondary processing of said primary output signal ;
(d) sending main bit string to secondary processing means ;
(e) secondary processing said main bit string using said allocated secondary processing time and/or operating system resources, according to a secondary process and
(f) generating a secondary processed signal.

4. Method for coding a digital signal comprising the steps of :

- providing an uncompressed digital signal including audio packets, video frames, video planes, or audio/video objects to an encoder ;
- compressing said signal with said encoder according to a compression syntax, said encoder using a plurality of coding algorithms to provide a compressed signal including coded audio packets, video frames, video planes or audio/video objects,
- determining statistics of use of at least one of decoding algorithms necessary to decode each of said coded audio packets, video frames, video planes or audio/video objects from said associated coding algorithms, and/or determining statistic of use of at least one of coding algorithms,
- providing a digital statistics signal representative of said statistics for each of said coded audio packets, video frames, video planes or audio/video objects,
- associating to each of said coded audio packets, video frames, video planes or audio/video objects its own statistics signal.

5. Coding method according to claim 3, wherein the step of determining statistics consists in determining the statistics of use of some of decoding algorithms, wherein to each decoding algorithm is associated at least one decoding mode and/or decoding parameter and wherein the statistics signal is based on the decoding modes and/or decoding parameters.

6. Coding method according to claim 3 or 4, wherein the step of determining statistics further consists in determining the statistics of use of some of coding algorithms when said coding algorithms and the compression syntax allow the determination of corresponding decoding algorithms necessary to decode each of said coded audio packets, video frames, video planes or audio/video objects wherein to each coding algorithm is associated at least one coding mode and/or coding parameter and wherein the statistics signal is based on the coding modes and/or coding parameters necessary to decode when using said coding algorithms.

7. Coding method according to claim 4, wherein the statistic signal is generated by juxtaposing digital words each representing the occurrences of use of a decoding mode and/or decoding parameter necessary to decode said associated audio packet, video frame, video plane or audio/video object.

8. Coding method according to claim 5 and/or 6, wherein the statistic signal is generated by juxtaposing digital words each representing the occurrences of use of a coding mode and/or coding parameter necessary to decode said associated audio packet, video frame, video plane or audio/video object.

9. Coding method according to any of claims 3 to 7, wherein the step of associating consists in inserting said statistics signal into said compressed signal for each associated coded audio packet, video frame, video plane or audio/video object.

10. Coding method according to any of claims 3 to 8, wherein the step of determining statistics consists in computing the occurrence of use of said coding and/or decoding algorithms for determining a complexity information for each coded audio packet, video frame, video plane or audio/video object.

11. Digital compressed signal including coded audio packets, video frames, video planes or audio/video objects, said signal being generated by an encoder using a compression syntax and coding algorithms and being intended to be

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transmitted to a receiving device wherein said signal is decoded according to decoding algorithms, and wherein said signal comprises at least a layer of coded audio packets, video frames, video planes or audio/video objects bit streams, each of said bit streams comprising a main bit string representative of the coded audio packets, video frames, video planes or audio/video objects and a secondary bit string representative of the statistics of use of said coding and/or decoding algorithms associated to said main bit string.

12. Digital compressed signal, according to claim 10, wherein said secondary bit string is inserted in said layer of said bit streams.

13. Digital compressed signal, according to claim 10, further comprising a plurality of parallel layers of coded audio packets, video frames, video planes, or audio/video objects bit streams, wherein said main bit string is inserted or transmitted in a layer different to said second bit string.

14. Digital compressed signal, according to claim 11 or 12, wherein said secondary bit string is inserted or transmitted prior to said main bit string.

15. Digital compressed signal, according to any of claims 10 to 13, wherein to each decoding algorithm is associated at least one decoding mode and/or decoding parameter and wherein said secondary bit string consists of words each representing the occurrences of use of the decoding modes and/or decoding parameters.

16. Digital compressed signal, according to claim 10 or 14, wherein to each coding algorithm is further associated at least one coding mode and/or coding parameter and wherein said secondary bit string consists of words each representing the occurrences of use of the coding modes and/or coding parameters, said coding algorithms and the compression syntax allowing the determination of corresponding decoding algorithms necessary to decode each of said coded audio packets, video frames, video planes or audio/video objects.

17. Method for decoding a digital compressed signal according to any of claims 10 to 15 comprising the steps of :

(a) reading said secondary bit string ;
(b) determining, from the secondary bit string, decoding algorithms to be used to decode said coded audio packets, video frames, video planes or audio/video objects, associated to said main bit string, for generating a complexity information signal for each coded audio packet, video frame, video plane or audio/video object ;
(c) allocating a decoding time and/or operating system resources as a function of said complexity information signal for the decoding process of said compressed audio packet, video frames, video planes or audio/video objects ;
(d) sending main bit string to decoding means ;
(e) decoding said main bit string using said allocated decoding time and/or operating system resources, according to a decoding process and
(f) generating a decompressed signal including decoded audio packets, video frames, video planes or audio/video objects.

18. Method for decoding a digital compressed signal according to claim 16 wherein the step determining decoding algorithms is also based on the occurrence of use of the decoding modes and/or decoding parameters necessary to decode the said audio packets, video frames, video planes or audio/video objects.

19. Method for decoding a digital compressed signal according to claim 16 or 17 wherein the step determining decoding algorithms is further based on the occurrence of use of the coding modes and/or coding parameters used by said coding algorithms, wherein said coding algorithms and the compression syntax allow the determination of corresponding decoding algorithms necessary to decode each of said coded audio packets, video frames, video planes or audio/video objects

20. Decoding method according to any of claims 16 to 18 further comprising the step of determining a decoding time prediction signal as a function of said complexity information signal ; said decoding time prediction signal being used for the step of allocating said decoding time and/or operating system resources for optimizing said decoding process and or decoding processes.

21. Decoding method according to claim 19 wherein the step of decoding the main bit string consists in

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- generating an allocated decoding time signal,
- sending said decoding time prediction signal and allocated decoding time signal to decoder supervisor means ;
- generating and sending a degradation directive signal to said decoding means, as a function of said decoding time prediction signal, allocated decoding time, so as to define the use of number and type of decoding algorithms and degradation algorithms to be used in the decoding process of said main bit string.

22. Decoding method according to claim 20 wherein the step of decoding the main bit string further consists in :

- generating a decoder time reference signal and a target decoding time signal,
- sending said decoder time reference signal and said target decoding time signal to decoder supervisor means ;
- generating and sending said degradation directive signal to said decoding means while also taking into account said decoder time reference signal and said target decoding time signal.

23. Decoding method according to claim 20 or 21 wherein the step of decoding the main bit string further consists in :

- generating a decoding status signal from said decoding means
- sending said decoding status signal to said decoder supervisor means from the said decoding means ;
- generating and sending said degradation directive signal to said decoding means while also taking into account said decoding status signal.

24. Decoding method according to claim 16 wherein steps (a) to (c) are carried out prior to step (e).

25. Decoding method according to any of claims 20 to 23, further comprising the step of sending said complexity information signal to said decoder supervisor means.

26. Decoding method according to any of claims 20 to 24 wherein the step of generating said degradation directive signal consists in associating at least one degradation algorithm to at least one decoding algorithm, said decoding algorithm and said degradation algorithm being associated to a complexity coefficient/weight representative of the execution time of said decoding algorithm and said degradation algorithm.

27. Decoding method according to claim 25 wherein said complexity coefficients/weights are dependent on the decoder used for implementing said decoding method.

28. Decoding method according to claim 25 or 26, wherein said decoding time prediction is a function of the occurrence of use of said decoding algorithm and said complexity coefficients/weights according to the following equation :

$$T(t) \cong T_{Pred}(t) = \sum_{i=1}^{I} c_i w_i \qquad (9),$$

where T is the time necessary to decode a coded audio packet, video frame, video plane or audio/video object, T_{Pred} is the decoding time prediction of said audio packets, video frames, video planes or audio/video objects, c_i is the occurrence of said decoding algorithm, and w_i is the complexity coefficient/weight.

29. Decoding method according to claim 27, wherein when the decoding time prediction is a function of the occurrence of use of said decoding algorithms and degradation algorithms, said degradation algorithms being associated to a complexity coefficient/weight.

30. Decoding method according to claim 27 or 28, wherein when the decoding time prediction is greater than the allocated decoding time, one uses a degradation method according to which one selects the degradation algorithm instead of its associated decoding algorithm according to equation :

$$T_{process} = \sum_{i \in S_{CGD}} (a_i w_i^{C_{GD}} + b_i w_i) + \sum_{i \in S_{Orig}} c_i w_i \leq T_{Alloc} \qquad (13)$$

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where, $T_{Process}$ is the prediction time necessary to decode a audio packets, video frames, video planes or audio/video objects, said decoding time prediction taking account the degradation, c_i is the occurrence of decoding algorithm, a_i is the number the selected degradation algorithms, w_i^{CGD} is the complexity coefficient/weight of the degradation algorithm, b_i is the number of the non selected degradation algorithms, and w_i is the complexity coefficient/weight, where $a_i + b_i = c_i$, so as to reach a $T_{Process}$ lesser than or equal to said allocated decoding time.

31. 30. Decoding method according to claim 28 or 29, wherein said decoding status signal is also used for monitoring the current decoding time of a coded audio packets, video frames, video planes or audio/video objects and make sure that said current decoding time is in conformity with the associated decoding time prediction.

32. Decoding method according to claim 30, wherein if said current decoding time is not in conformity with the associated predicted decoding time, then said decoder supervisor means uses at least one further degradation algorithm defined in claim 29.

33. Decoding method according to claim 31, wherein if said current decoding time is not in conformity with the associated decoding time prediction, then said decoder supervisor means further uses said complexity information signal.

34. Decoding method according to any of claims 29 to 32 for a plurality of audio packets, video frames, or video planes, some of them belonging to different audio/video objects, wherein when the decoding time prediction is the sum of the decoding time prediction of each of said audio packets, video frames or video planes of said plurality, said decoding time prediction being defined in claim 28.

35. Coding system for an uncompressed digital signal including audio packets, video frames, video planes or audio/video objects, comprising :

- an audio/video encoder receiving said audio packets, video frames, video planes or audio/video objects on one input terminal, said encoder being intended to code said signal according to a compression syntax by using a plurality of coding algorithms, and to provide, on one output terminal, a compressed signal including coded audio packets, video frames, video planes or audio/video objects intended to be decompressed according to associated decoding algorithms ;
- means for determining statistic of use of at least one of said coding algorithms, and/or means for determining statistic of use of at least one of said decoding algorithms ;
- and means for generating a digital statistic signal representative of said statistics for each of said coded audio packets, video frames, video planes or audio/video objects.

36. Coding system according to claim 27, wherein said statistics determining means comprise computing means for counting the occurrence of use of coding modes and/or coding parameters used by the encoder for encoding said signal, when using said coding algorithms.

37. Coding system according to claim 34 or 35, wherein said statistics determining means further comprise computing means for counting the occurrence of use of decoding modes and/or decoding parameters from said coding algorithms used by the encoder for encoding said signal.

38. Coding system according to any of claim 34 to 36, further comprising means for generating a compressed output signal including coded audio packets, video frames, video planes or audio/video objects wherein each of said coded audio packet, video frame, video plane or audio/video object is associated with its statistics signal.

39. Decoding system for a digital signal including coded audio packets, video frames, video planes or audio/video objects according to any of claims 5 to 15, comprising :

- a decoder receiving said main bit string, representative of a coded audio packets, video frames, video planes or audio/video objects, on a first input terminal and providing, on an output terminal, a decompressed signal including decoded audio packets, video frames, video planes or audio/video objects,
- resource allocation means ;
- means for complexity prediction receiving, on one input terminal, said secondary bit string, and providing to resource allocation means a decoding time prediction signal which is determined as a function of the information contained in said secondary bit string, said resource allocation means providing to the decoder information representative of the allocated decoding time.

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40. Decoding system according to claim 38 wherein said resource allocation means comprises an operating system or a layer of an operating system.

41. Decoding system according to claim 38 or 39 wherein said decoding time prediction signal is also provided to a second input terminal of said decoder.

42. Decoding system according to any of claims 38 to 40, wherein

- said decoder comprises decoder supervisor means and audio/video decoding means,
- said decoder supervisor means receiving, on a first input terminal, said allocated decoding time signal and, on a second input terminal, said predicted decoding time signal and providing on one output terminal a degradation directive signal,
- said decoding means receiving on a first input terminal said main bit string and on a second input terminal said degradation directive signal and providing on an output terminal said decompressed signal including decoded audio packets, video frames, video planes or audio/video objects.

43. Decoding system according to claim 41 wherein said decoder further receive a complexity information signal on third input terminal.

44. Decoding system according to claim 41 wherein said decoder further receive a decoder time reference signal and a target decoding time signal respectively on fourth and fifth input.

45. Decoding system according to any of claims 41 at 43 wherein said decoding means are arranged to provide a decoding status signal to a sixth input of the decoder supervisor means.

46. Decoding system according to claim 44 wherein said complexity information signal is applied to said decoder supervisor means.

47. Method for composing a digital signal comprising the steps of :

- providing an uncompressed video element including video frames and/or video planes and/or video objects, textures, texts, 2 and 3 dimensional graphic primitives, 2 and 3 dimensional models to a composing device ;
- composing said video element with said composing device according to a composition syntax an/or a interactivity information, said composing device using a plurality of composing algorithms necessary to compose each of said video elements and provide a representation in a common visual representation space of the said multiple elements,
- determining statistics of use of at least one of said composing algorithms for generating a complexity information
- associating to each of said video elements its own complexity information.

48. Composition method according to claim 46 further consisting in :

- providing an uncompressed digital audio element including audio packets, audio objects, synthetic audio objects
- composing said audio element with said composing device according to a composition syntax, said audio composing device using a plurality of composing algorithms necessary to compose each of said audio elements and provide a representation in a common audio representation space
- determining statistics of use of at least one of said algorithms for generating a complexity information.
- associating to each of said audio element its own complexity information.

49. Composition method according to claim 46 or 47, wherein to each composition algorithm is associated at least one composition mode and/or composition parameter and wherein the statistics is based on the occurrence of use of composition modes and/or composition parameters.

50. Method for composing a digital signal according to any of claims 46 to 48 comprising the steps of :

(a) reading the complexity information associated to at least one of said video element and/or audio element
(c) allocating a composition time and/or operating system resources as a function of said complexity informa-

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tion signal for the composition process of said associated video element and/or audio element ;
(d) sending said video element and/or audio element to composition means ;
(e) compose in a common representation space said video element and/or audio element using said allocated composition time and/or operating system resources, according to a composition process, and
(f) generating a common representation space including said video element and/or audio element according to the composition syntax.

51. Method for composing digital video/audio elements according to claim 49 wherein the step determining composition algorithms is also based on the occurrence of use of the composition modes and/or composition parameters necessary to compose the said composition elements in a common composition space.

52. Composition method according to any of claims 48 to 50 further comprising the step of determining a composition time prediction signal as a function of said complexity information ; said composition time prediction signal being used for the step of allocating said composition time and/or operating system resources for optimizing said composition process and or composition processes.

53. Composition method according to claim 50 wherein the step of composing the audio/video elements consists in

- generating an allocated composition time signal,
- sending said composition time prediction signal and allocated composition time signal to composition supervisor means ;
- generating and sending a degradation directive signal to said composition means, as a function of said composition time prediction signal, allocated composition time, so as to define the use of number and type of composition algorithms and degradation algorithms to be used in the composition process of said video/audio composition elements.

54. Composition method according to claim 52 wherein the step of composing the video/audio elements further consists in :

- generating a compositor time reference signal and a target composition time signal,
- sending said compositor time reference signal and said target composition time signal to composition supervisor means ;
- generating and sending said degradation directive signal to said composition means while also taking into account said compositor time reference signal and said target composition time signal.

55. Composition method according to claim 52 or 53 wherein the step of composing the audio/video elements further consists in :

- generating a compositor status signal from said composition means
- sending said compositor status signal to said composition supervisor means from the said composition means ;
- generating and sending said degradation directive signal to said means while also taking into account said compositor status signal.

56. Composition method according to claim 48 wherein steps (a) to (c) are carried out prior to step (e).

57. Composition method according to any of claims 51 to 55, further comprising the step of sending said complexity information signal to said compositor supervisor means.

58. Decoding method according to any of claims 53 to 56 wherein the step of generating said degradation directive signal consists in associating at least a degradation algorithm to at least one composition algorithm, said composition algorithm and said degradation algorithm being associated to a complexity coefficient/weight representative of the execution time of said composition algorithm and said degradation algorithm.

59. Composition method according to claim 57 wherein said complexity coefficients/weights are dependent on the compositor used for implementing said composition method.

60. Composition method according to claim 57 or 58, wherein said composition time prediction signal is a function of

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the occurrence of use of said composition algorithms and said complexity coefficients/weights according to the following equation :

$$T(t) \cong T_{Pred}(t) = \sum_{i=1}^{I} c_i w_i \quad (9),$$

where T is the time necessary to compose a audio/video element, T_{Pred} is the composition time prediction of said audio/video element, c_i is the occurrence of said composition algorithm, and w_i is the complexity coefficient/weight.

61. Composition method according to claim 59, wherein when the composition time prediction is a function of the occurrence of use of said composition algorithms and degradation algorithms, said degradation algorithms being associated to a complexity coefficient/weight.

62. Composition method according to claim 59 or 60, wherein when the composition time prediction is greater than the allocated composition time, one uses a degradation method according to which one selects the degradation algorithm instead of its associated composition algorithm according to equation :

$$T_{process} = \sum_{i \in S_{CGD}} (a_i w_i^{CGD} + b_i w_i) + \sum_{i \in S_{Orig}} c_i w_i \leq T_{Alloc} \quad (13)$$

where, $T_{Process}$ is the prediction time necessary to compose a audio/video element, said composition time prediction taking account the degradation, c_i is the occurrence of composition algorithm, a_i is the number the selected degradation algorithms, w_i^{CGD} is the complexity coefficient/weight of the degradation algorithm, b_i is the number of the non selected degradation algorithms, and w_i is the complexity coefficient/weight, where $a_i + b_i = c_i$, so as to reach a $T_{Process}$ lesser than or equal to said allocated composition time.

63. Composition method according to claim 60 or 61, wherein said composition status signal is also used for monitoring the current composition time of a composition video/audio element and make sure that said current composition time is in conformity with the associated composition time prediction.

64. Composition method according to claim 62, wherein if said current composition time is not in conformity with the associated composition time prediction, then said composition supervisor means uses at least one further degradation algorithm defined in claim 61.

65. Composition method according to claim 63 wherein if said current composition time is not in conformity with the associated composition time prediction, then said decoder supervisor means further uses said complexity information signal.

66. Composition method according to any of claims 51 to 63 for a plurality of audio/video composition elements wherein when the composition time prediction is the sum of the composition prediction time of each of said audio/video composition elements, said composition time prediction being defined in claim 50.

67. Composition system for an uncompressed digital video element including video frames and/or video planes and/or video objects, textures, texts, 2 and 3 dimensional graphic primitives, 2 and 3 dimensional models, comprising :

- a video compositor receiving said video element on one input terminal, said compositor being intended to compose said video element using a composition syntax using a plurality of composing algorithms, and to provide, on one output terminal, a representation in a common video representation space said video element ;
- means for determining statistic of use of at least one of said composition algorithms,
- and means for generating a digital statistic signal representative of said statistics for each of said composed video element.

68. Composition system for an uncompressed digital audio element including audio packets, audio objects, synthetic audio objects, comprising :

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- a audio compositor receiving said audio element on one input terminal, said compositor being intended to compose said audio element using a composition syntax using a plurality of composing algorithms, and to provide, on one output terminal, a representation in a common audio representation space said audio element ;
- means for determining statistic of use of at least one of said composition algorithms,
- and means for generating a digital statistic signal representative of said statistics for each of said composed audio element.

69. Composition system for an audio-visual object comprising a composition system according to claim 66 combined with a composition system according to claim 67.

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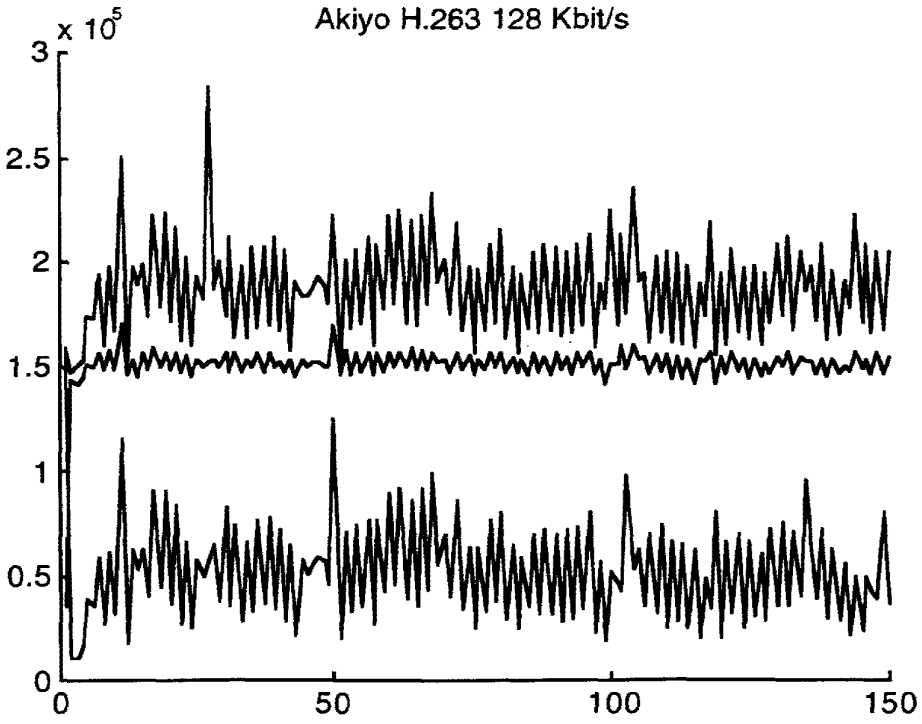


Figure 1

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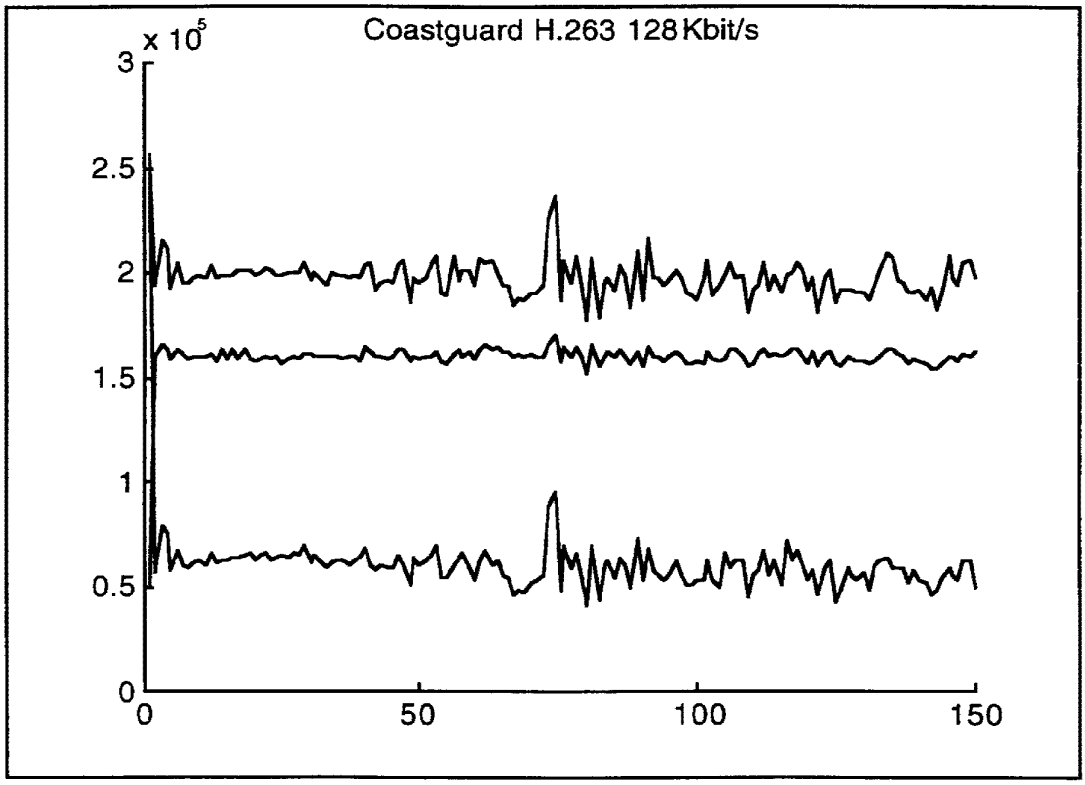


Figure 2

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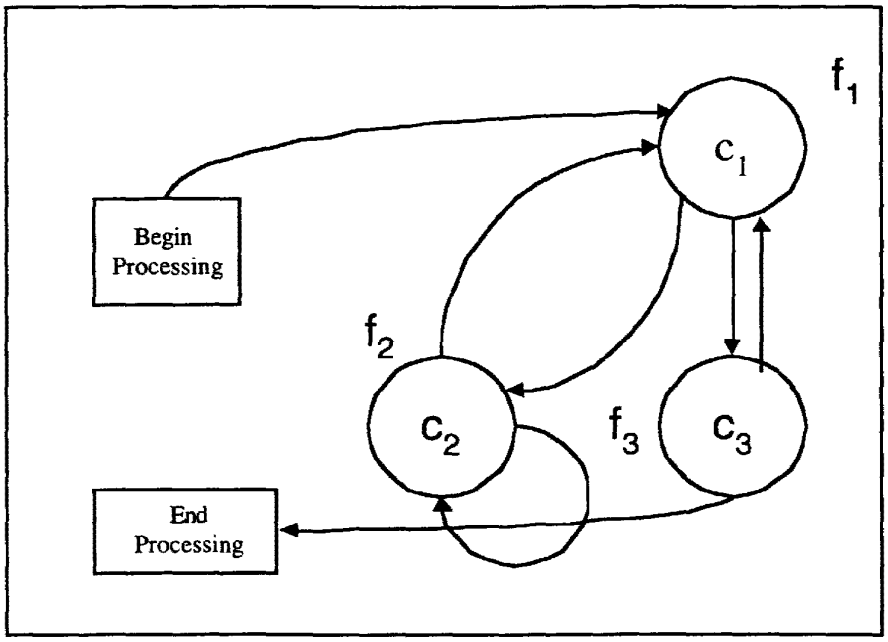


Figure 3

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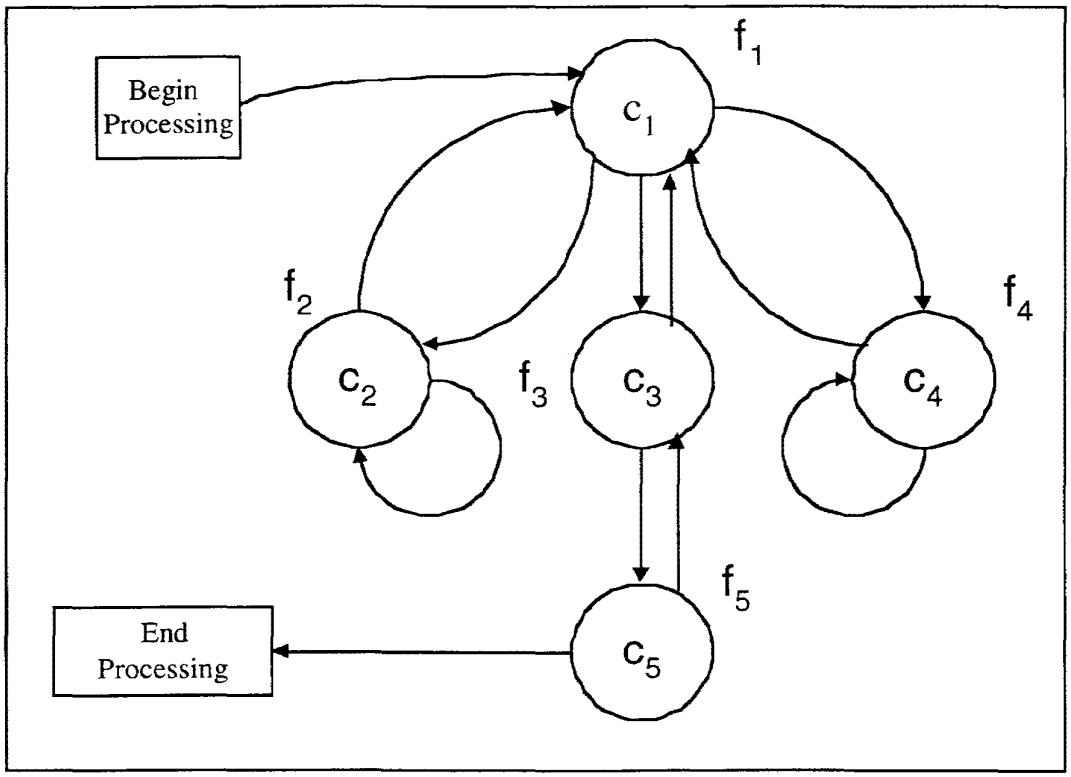


Figure 4

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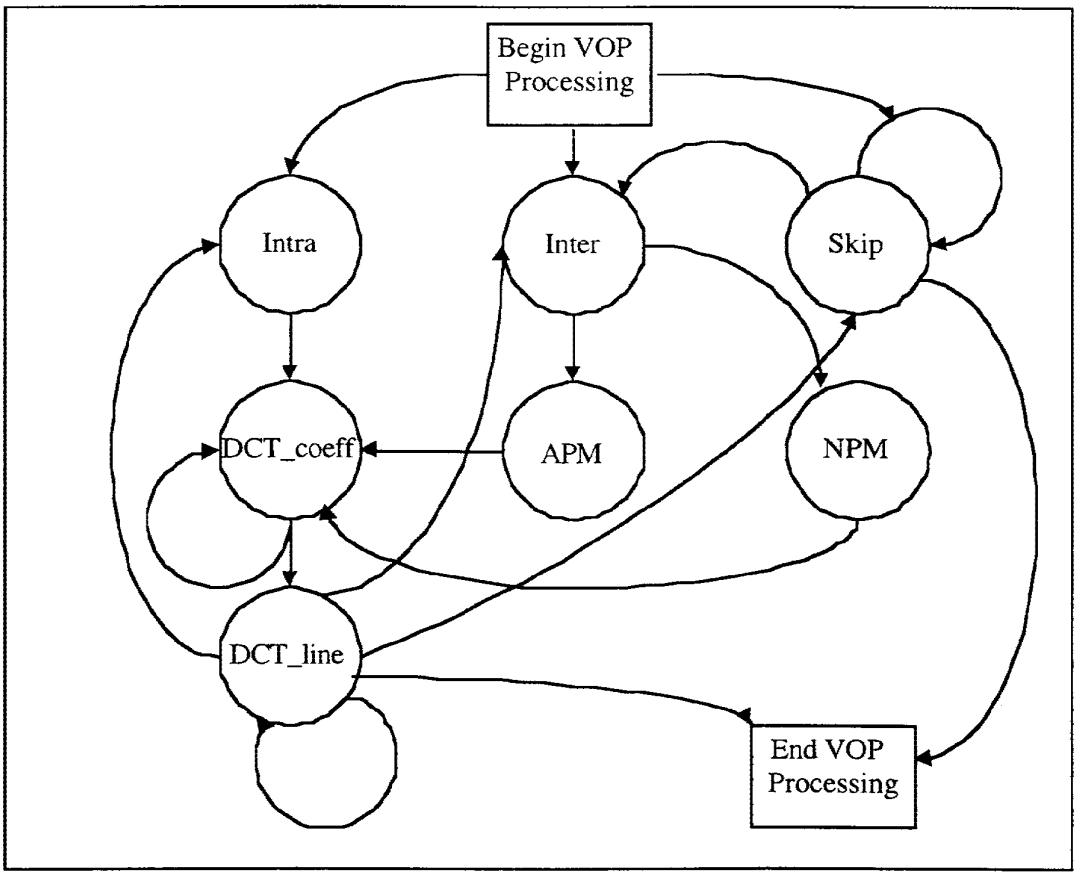


Figure 5

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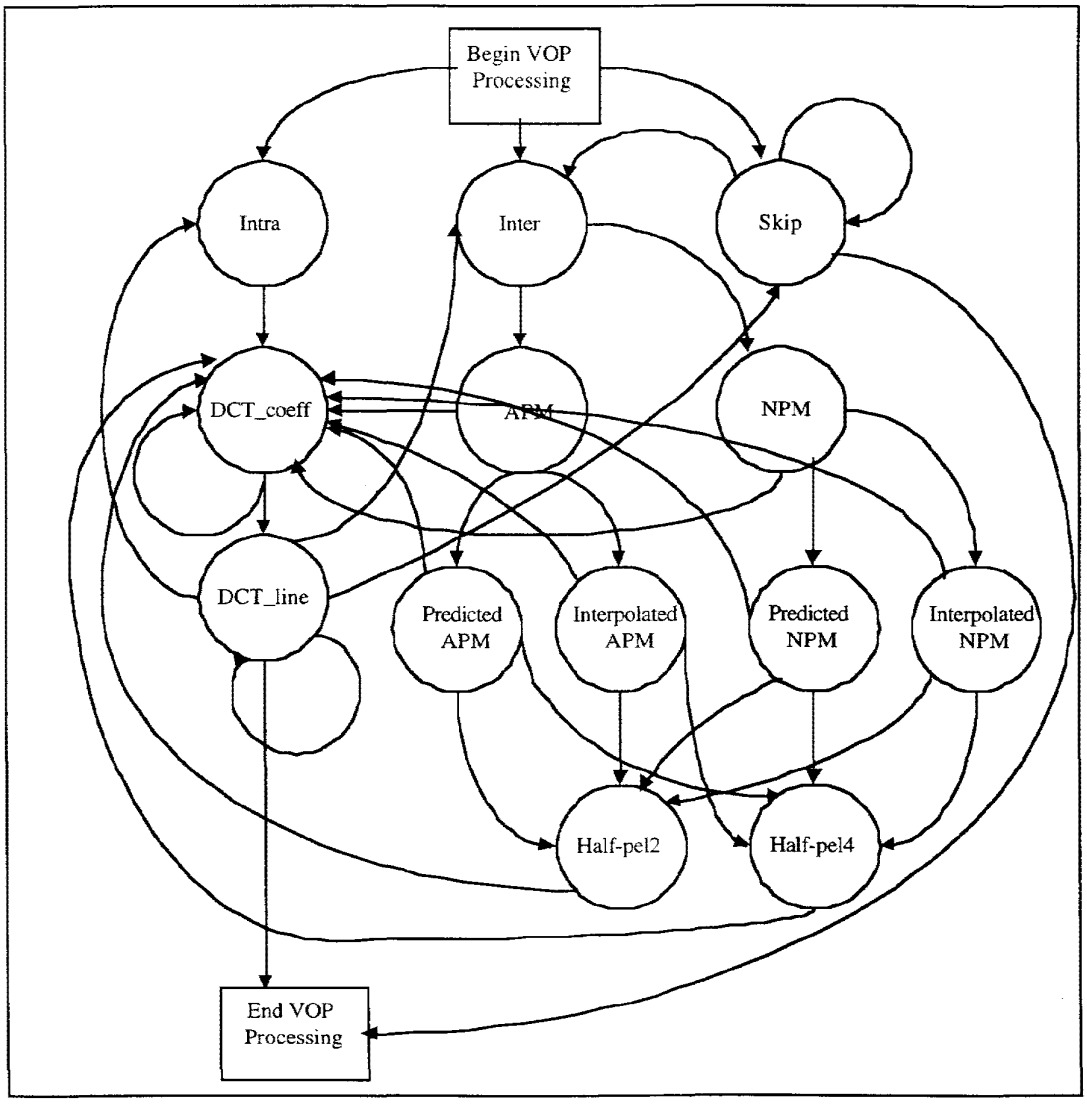


Figure 6

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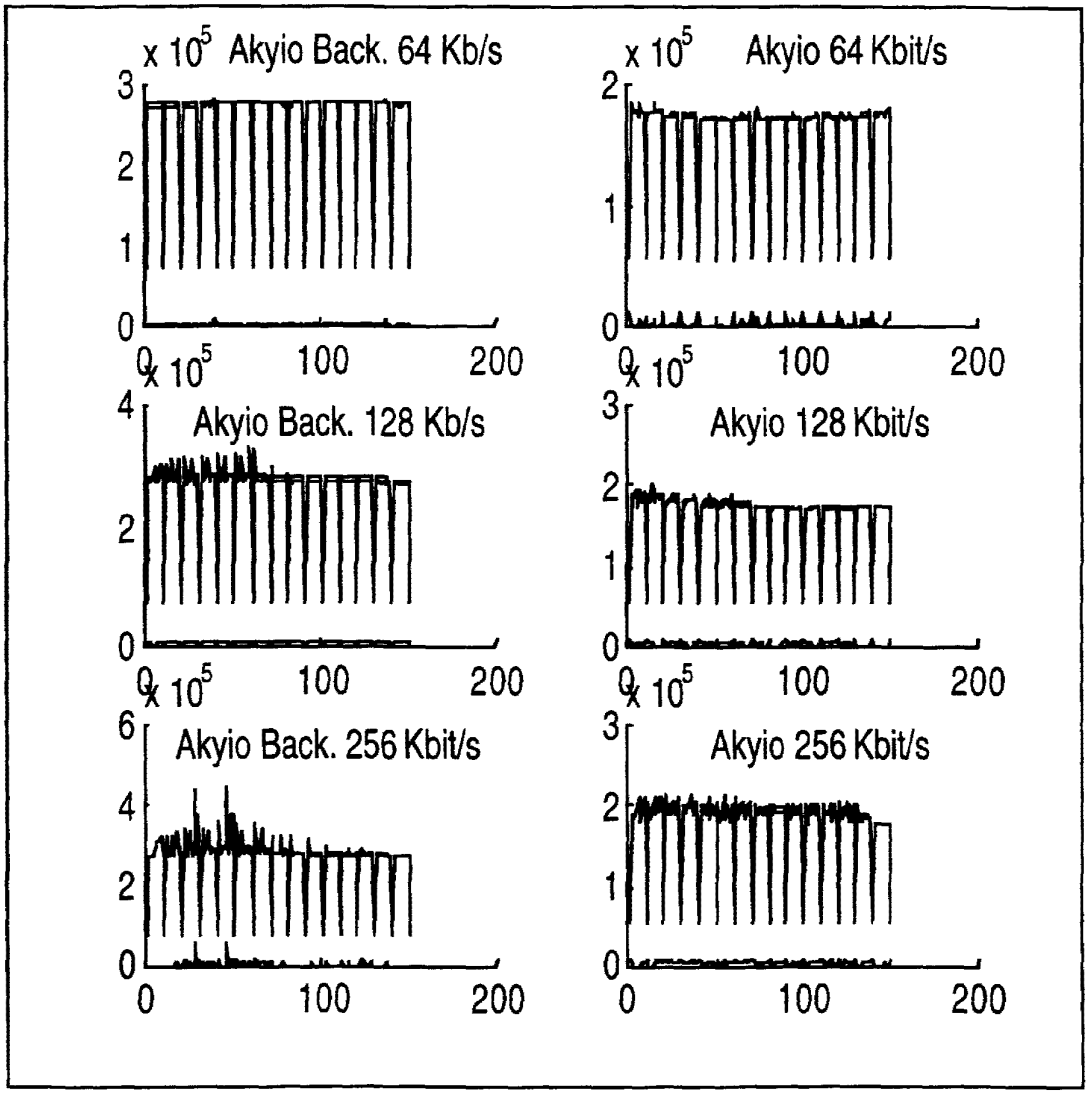


Figure 7

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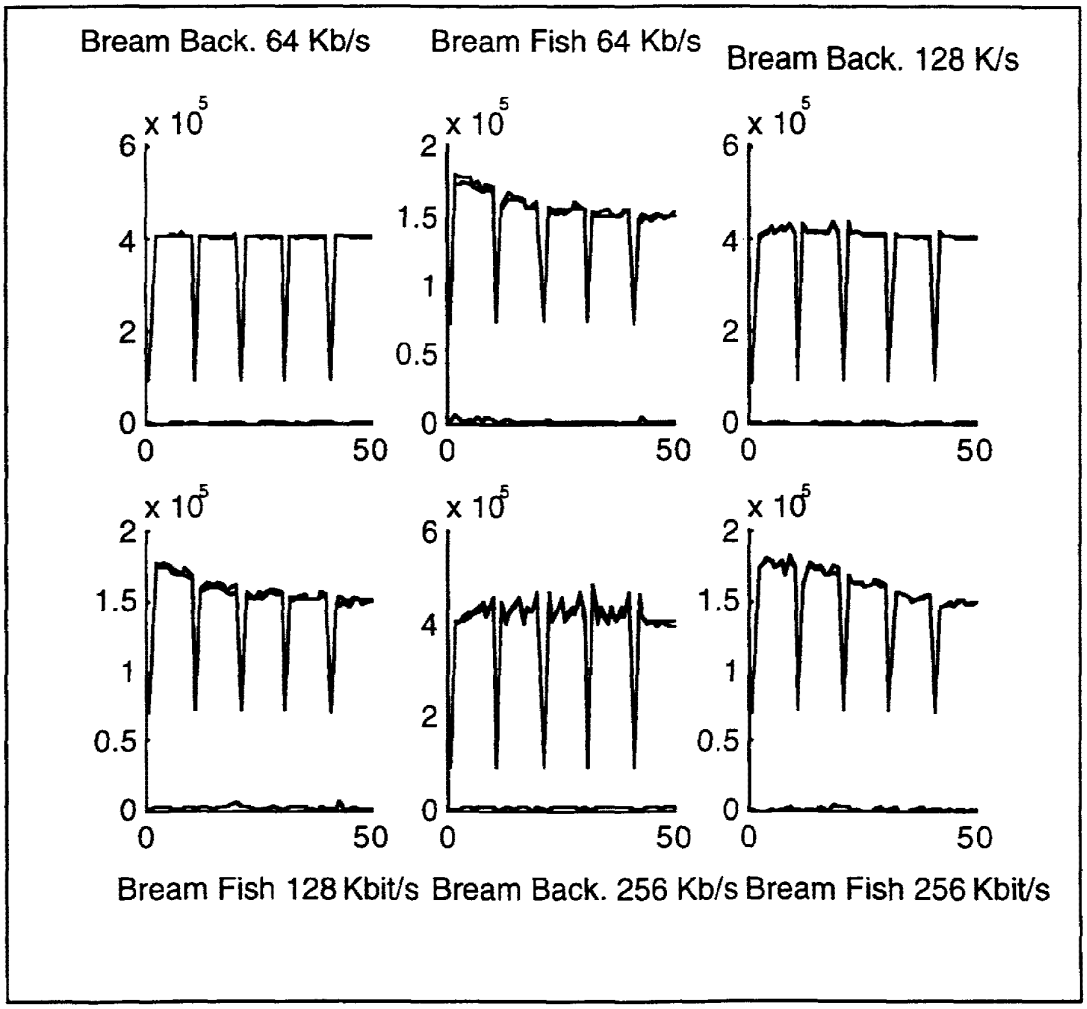


Figure 8

fuboTV Media Inc.
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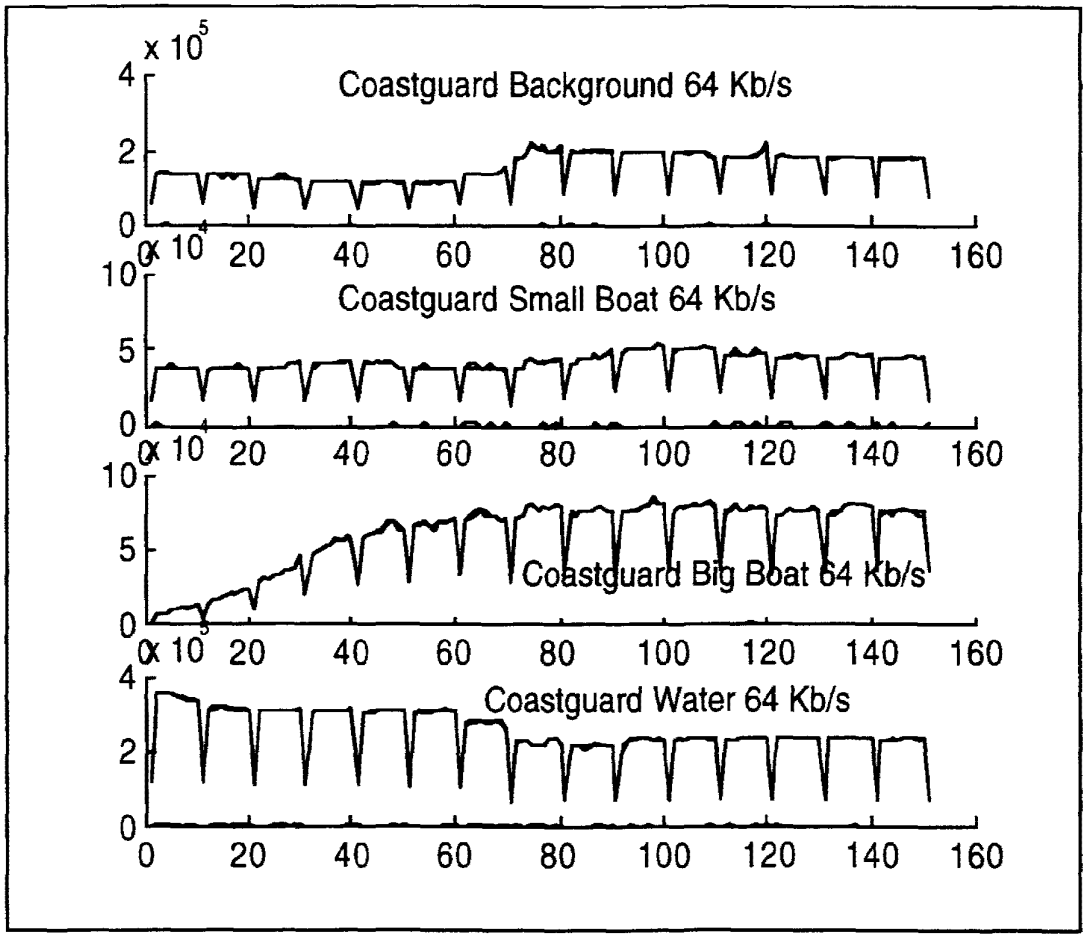


Figure 9

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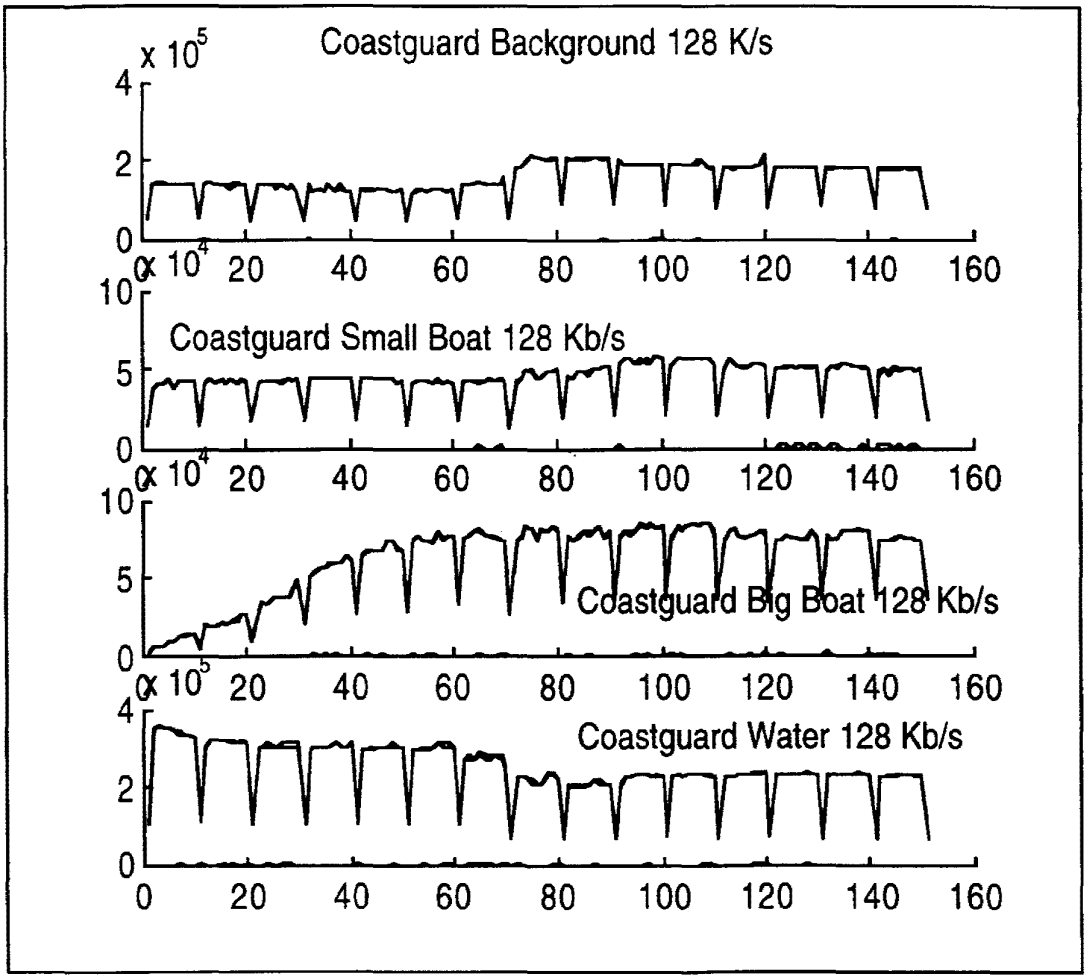


Figure 10

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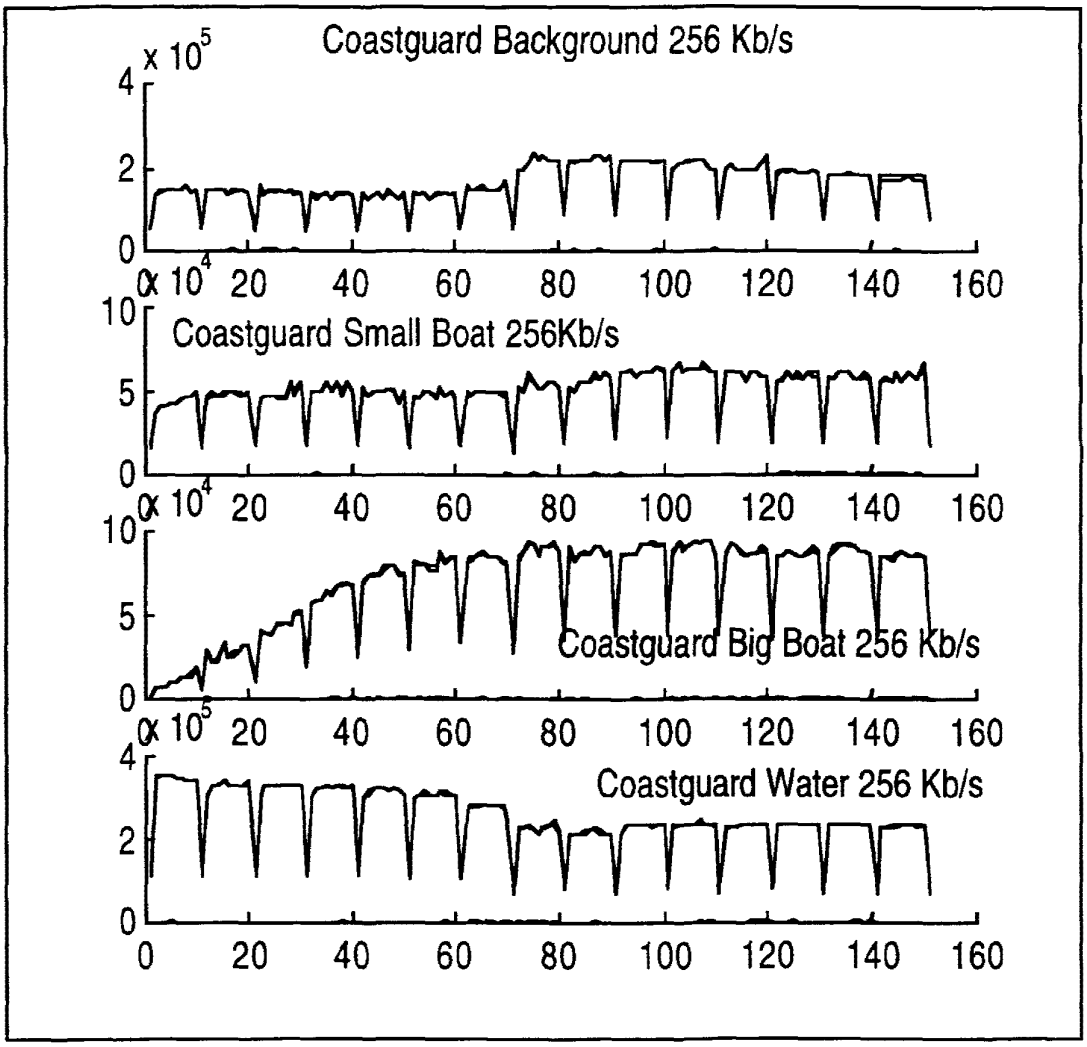


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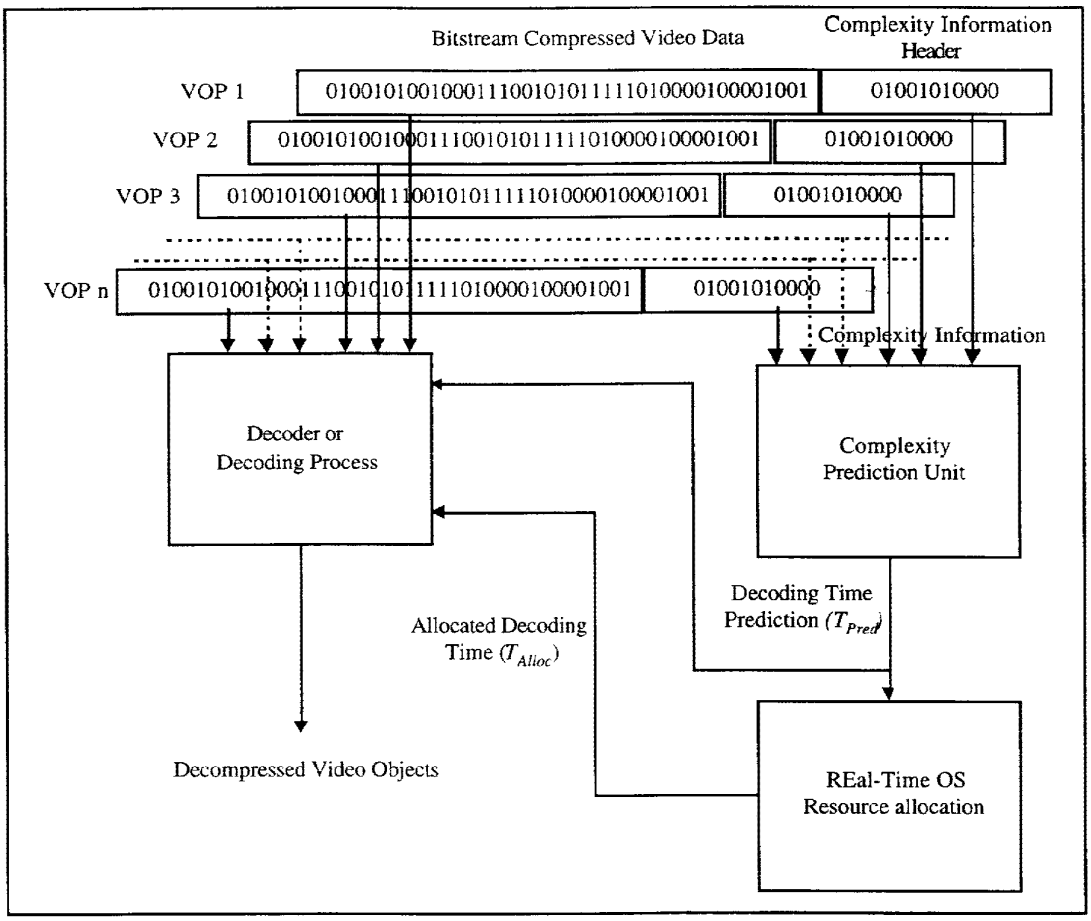


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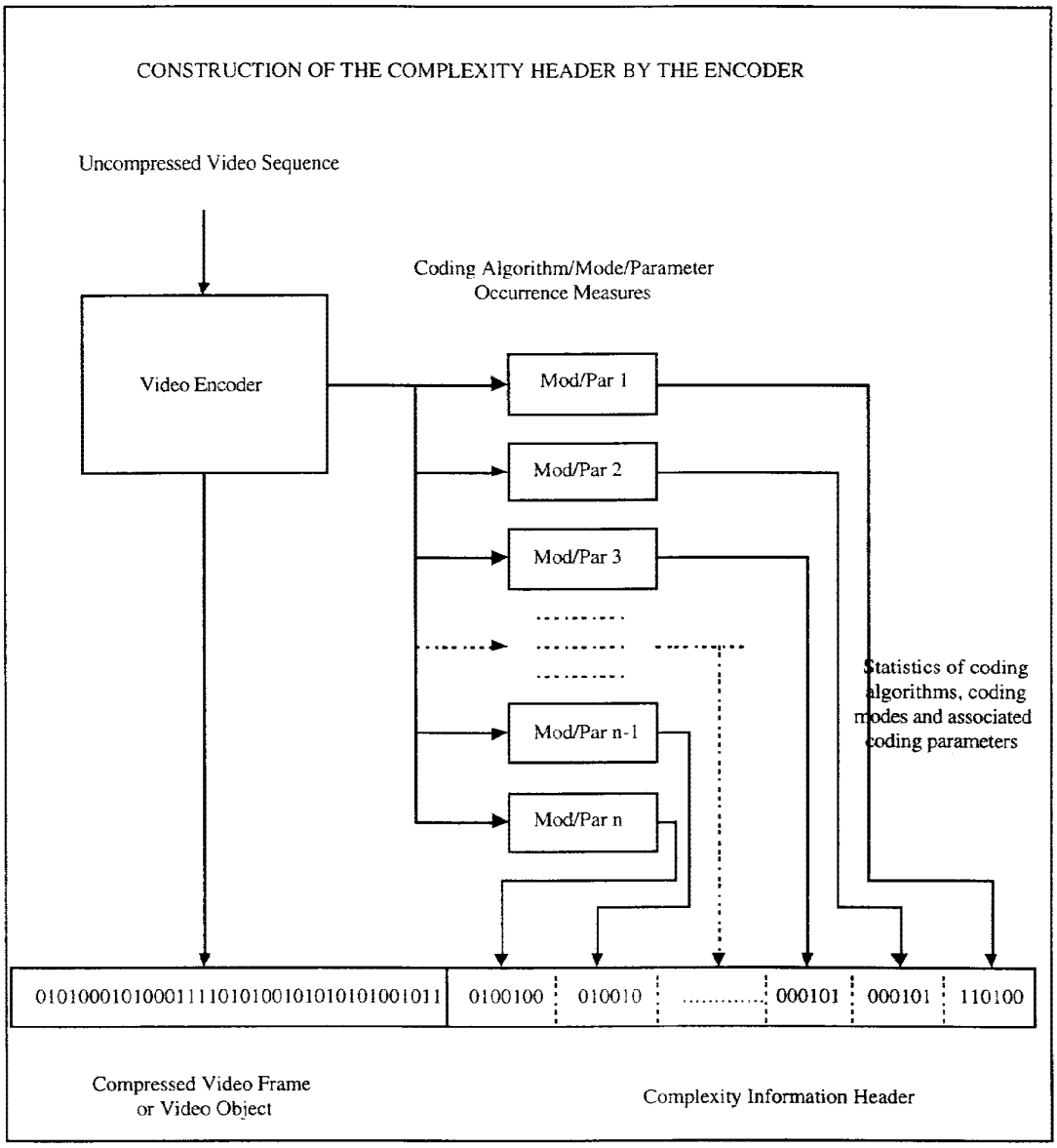


Figure 13

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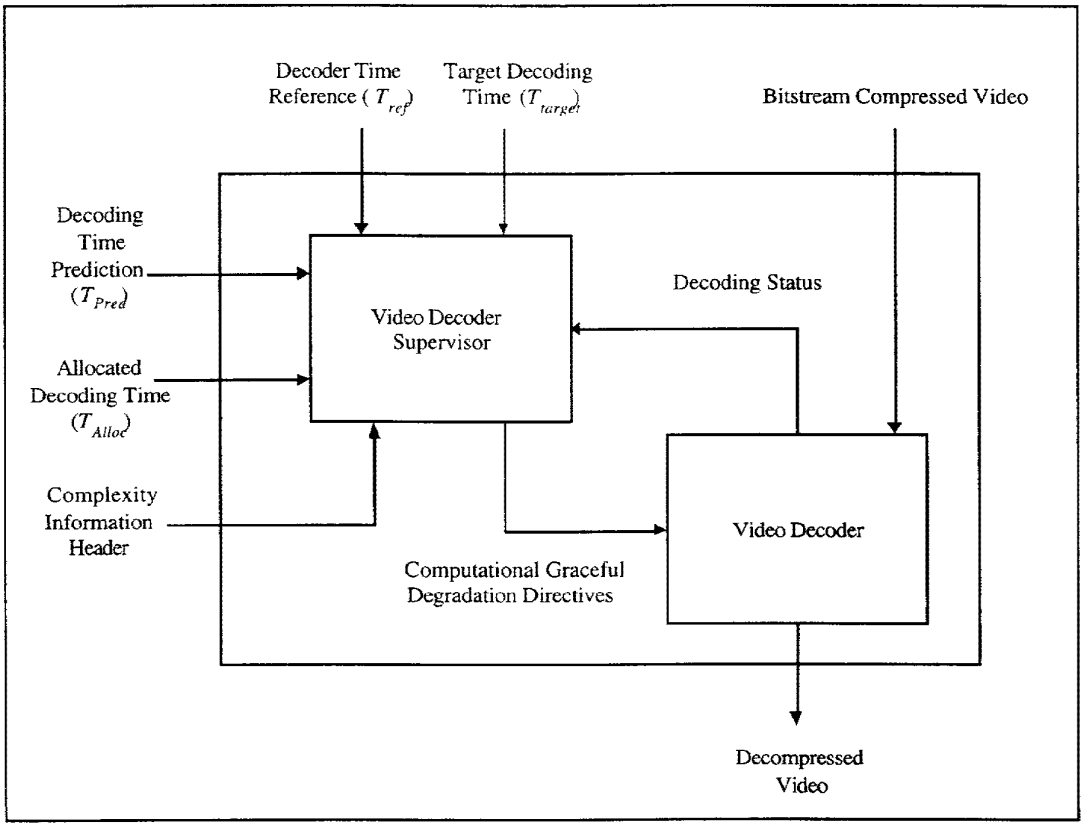


Figure 14

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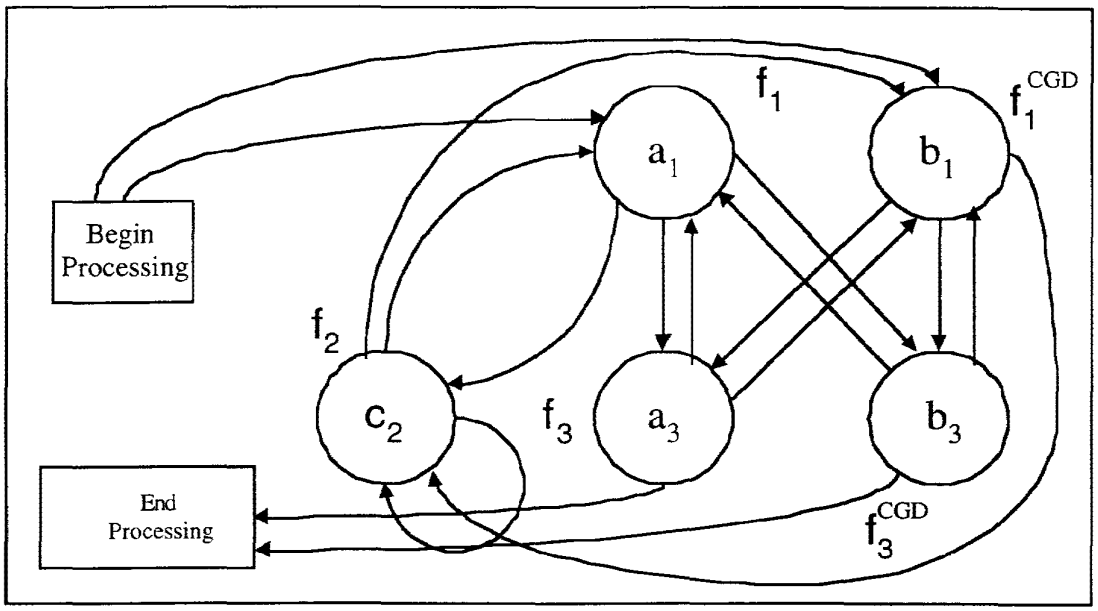


Figure 15

fuboTV Media Inc.
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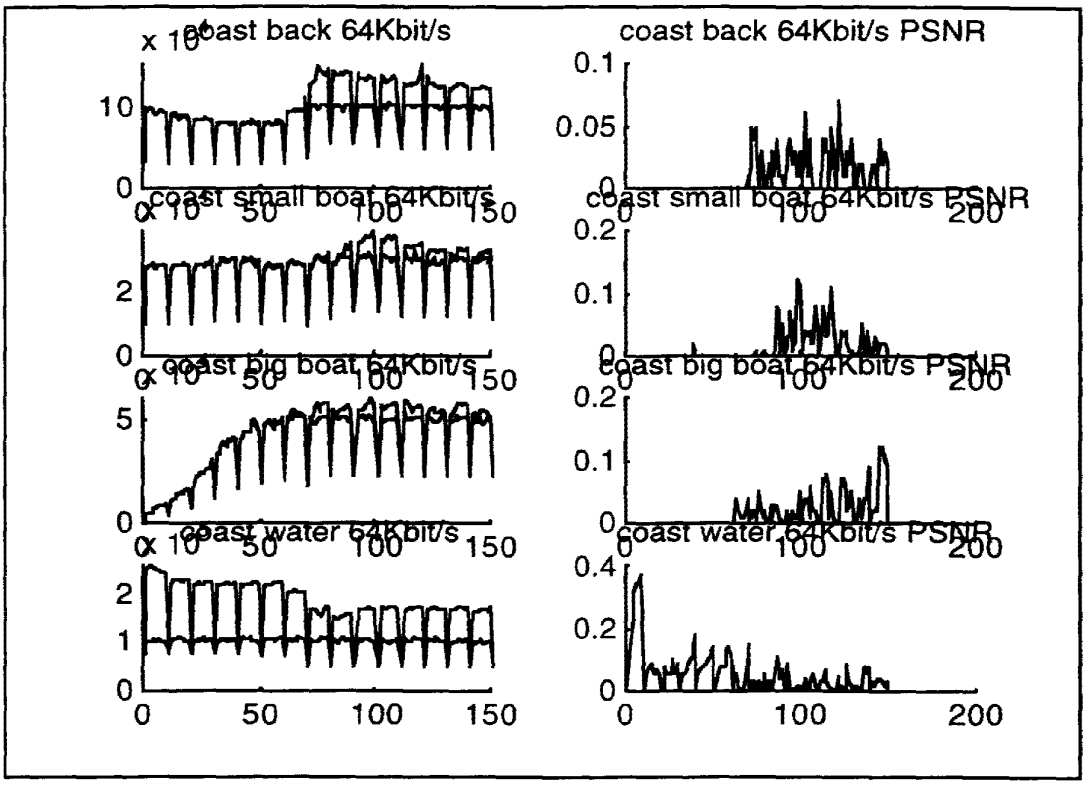


Figure 16

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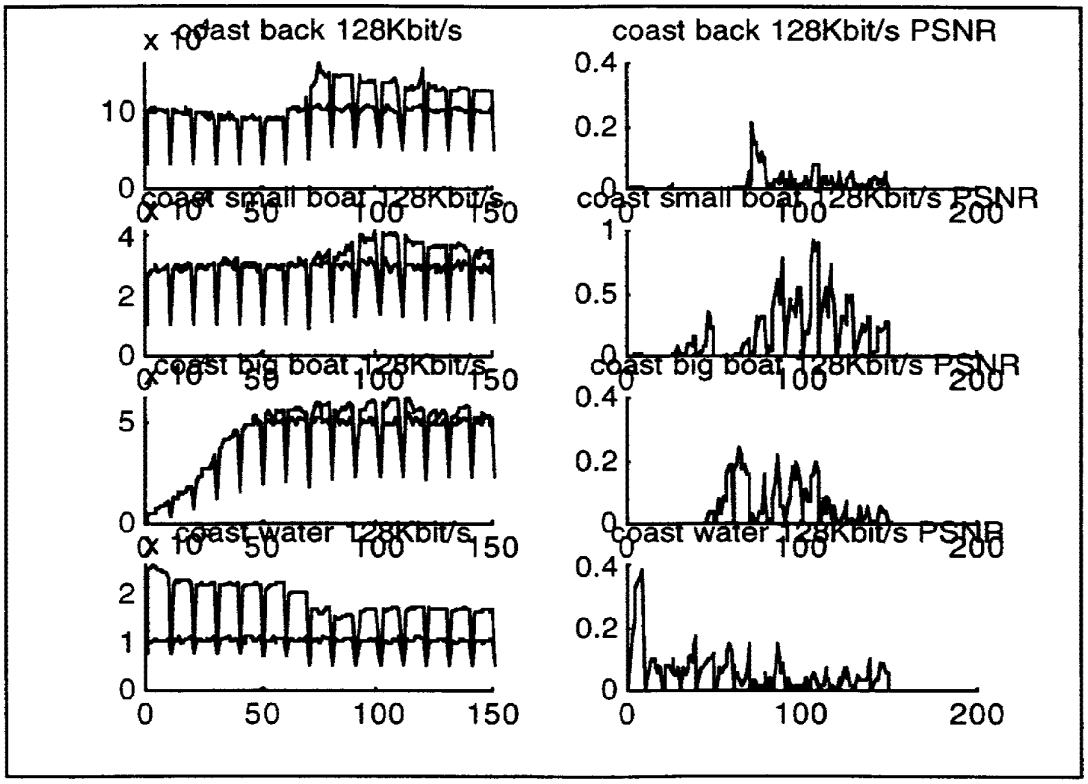


Figure 17

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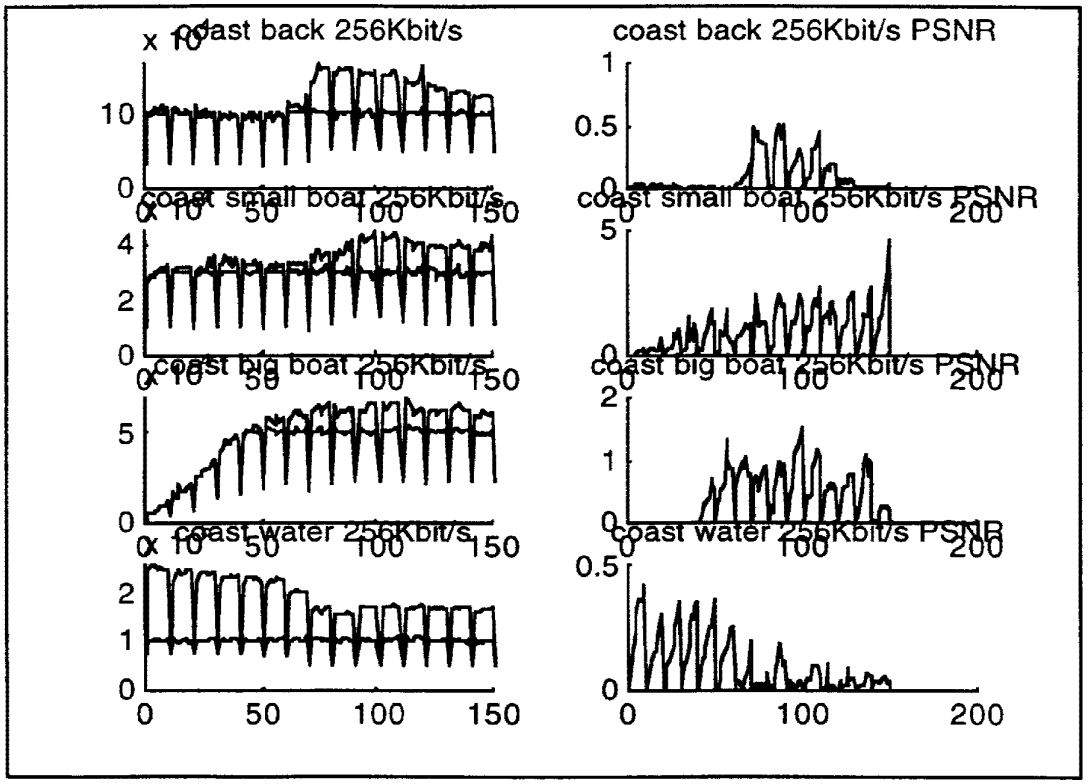


Figure 18

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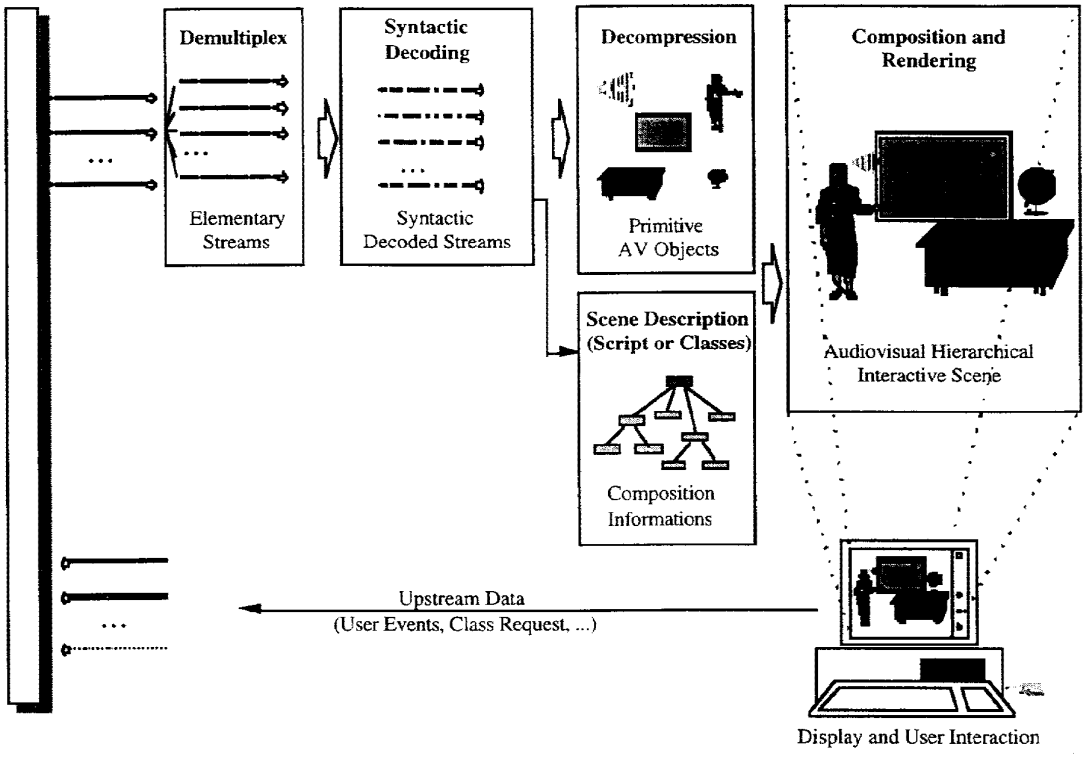


Figure 19

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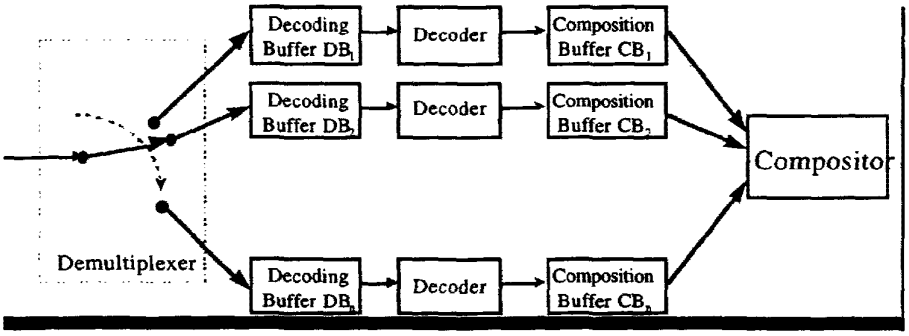


Figure 20

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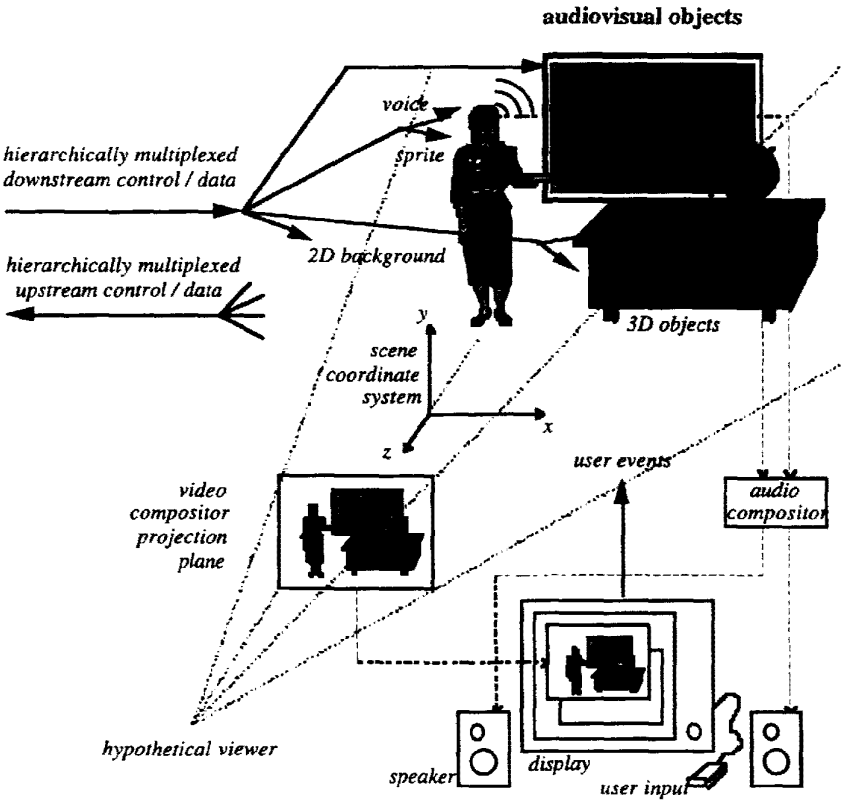


Figure 21

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 10 9423

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
E	EP 0 866 426 A (ALSTHOM CGE ALCATEL) 23 September 1998 * abstract; claims 1,5,6 * ---	1-68	G06T9/00
A	EP 0 512 174 A (SEMAPHORE INC) 11 November 1992 * page 2, line 40 - line 43 * * page 3, line 32 - line 36 * ---	1-68	
A	MATTAVELLI M ET AL: "Computational graceful degradation for video sequence decoding" PROCEEDINGS. INTERNATIONAL CONFERENCE ON IMAGE PROCESSING (CAT. NO.97CB36144), PROCEEDINGS OF INTERNATIONAL CONFERENCE ON IMAGE PROCESSING, SANTA BARBARA, CA, USA, 26-29 OCT. 1997, pages 330-333 vol.1, XP002080307 ISBN 0-8186-8183-7, 1997, Los Alamitos, CA, USA, IEEE Comput. Soc, USA -----		TECHNICAL FIELDS SEARCHED (Int.Cl.6) G06T

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	12 October 1998	Pierfederici, A

CATEGORY OF CITED DOCUMENTS

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A : technological background
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Electronic Acknowledgement Receipt

EFS ID:	36433920
Application Number:	16252356
International Application Number:	
Confirmation Number:	8631
Title of Invention:	APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING
First Named Inventor/Applicant Name:	DAVID F. BRUECK
Customer Number:	70560
Filer:	Brett Carlson/Julie Graf
Filer Authorized By:	Brett Carlson
Attorney Docket Number:	066.0141X1C8
Receipt Date:	27-JUN-2019
Filing Date:	18-JAN-2019
Time Stamp:	15:33:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$240
RAM confirmation Number	062819INTEFSW15355300
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-201343
(43)Date of publication of application : 18.07.2000

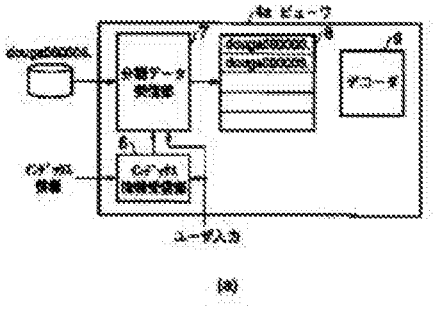
(51)Int.Cl. H04N 7/173

(21)Application number : 11-000497
(22)Date of filing : 05.01.1999

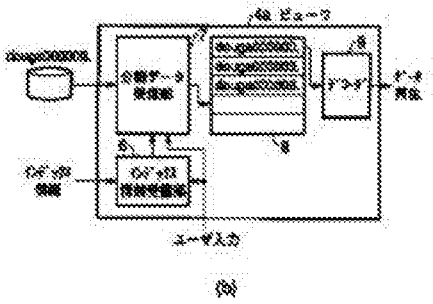
(71)Applicant : TOSHIBA CORP
(72)Inventor : CHIJITANI MASAHIDE

(54) MOVING IMAGE DATA REPRODUCING DEVICE, MOVING IMAGE DATA DIVIDING DEVICE AND RECORDING MEDIUM READABLE BY COMPUTER IN WHICH PROGRAM IS RECORDED

(57)Abstract:
PROBLEM TO BE SOLVED: To enable random access to moving image data without changing a server function.
SOLUTION: A moving image data reproducing device with an index information receiving means 6 to receive index information to be generated by relating plural pieces of divided data to be obtained by deviding the moving image data to its reproduction time information by requesting the information to a server, a divided data receiving means 7 to receive the divided data related to reproduction time information at the reproduction time information to which starting of reproducing is instructed and afterward by successively requesting the information to the server by referring to the index information received by the index information receiving means 6, a storage means 9 to store the divided data received by the divided data receiving means 7 and a reproducing means to successively reproduce the divided data stored in the storage means 9 according to the index information received by the index information receiving means 6 is provided.



(a)



(b)

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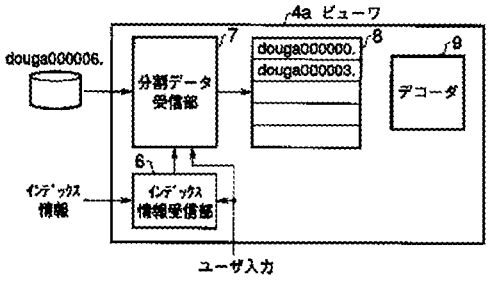
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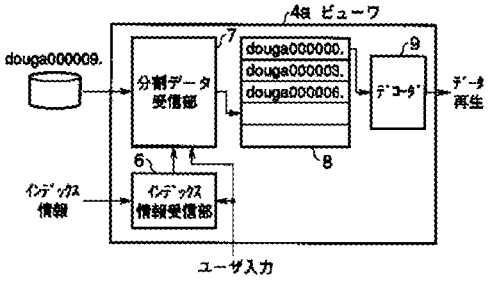
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(54)【発明の名称】　動画像データ再生装置及び動画像データ分割装置並びにプログラムを記録したコンピュータ読み取り可能な記録媒体

(57)【要約】
【課題】サーバの機能を変更することなく、動画像データのランダムアクセスを可能にする。
【解決手段】動画像データが分割されて得られる複数の分割データとその再生時刻情報とを関連付けて生成されるインデックス情報を、サーバに要求して受信するインデックス情報受信手段と、当該インデックス情報受信手段に受信されたインデックス情報を参照し、再生開始を指示された再生時刻情報以降の再生時刻情報に関連付けられた分割データをサーバに順次要求して受信する分割データ受信手段と、当該分割データ受信手段に受信された分割データを記憶する記憶手段と、インデックス情報受信手段に受信されたインデックス情報にしたがって、記憶手段に記憶されている分割データを順次再生させる再生手段とを具備した動画像データ再生装置を提供する。



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【特許請求の範囲】

【請求項１】　動画像データが分割されて得られる複数の分割データとそれぞれの再生時刻情報とを関連付けて生成されるインデックス情報を、サーバに要求して受信するインデックス情報受信手段と、

当該インデックス情報受信手段に受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられた分割データを、サーバに順次要求して受信する分割データ受信手段と、

当該分割データ受信手段によって受信された分割データを記憶する記憶手段と、

前記記憶手段に記憶されている分割データを順次再生させる再生手段とを具備したことを特徴とする動画像データ再生装置。

【請求項２】　請求項１記載の動画像データ再生装置において、

前記分割データの送信をサーバに要求してから、この分割データを受信するまでの時間を推定する時間推定手段を付加し、

前記分割データ受信手段は、当該時間推定手段によって推定された時間とほぼ同じ時間分の分割データが前記記憶手段に記憶されていない場合に、前記インデックス情報にしたがってサーバに分割データを要求し、

前記再生手段は、前記時間推定手段によって推定された時間とほぼ同じ時間分の分割データが前記記憶手段に記憶された場合に、この記憶手段に記憶されている分割データの再生を開始することを特徴とする動画像データ再生装置。

【請求項３】　動画像データが分割されて得られる複数の分割データについて伝送速度が異なる複数の種別が生成されている場合に、この複数種別の各分割データとそれぞれの再生時刻情報とを関連付けて生成されるインデックス情報を、サーバに要求して受信するインデックス情報受信手段と、

前記分割データの送信をサーバに要求してから、この分割データを受信するまでの時間を推定する時間推定手段と、

当該時間推定手段によって推定された時間に基づいて、要求する分割データの種別を選択する分割データ選択手段と、

前記インデックス情報受信手段に受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられ、かつ前記分割データ選択手段によって選択されている種別の分割データを、サーバに順次要求して受信する分割データ受信手段と、

当該分割データ受信手段によって受信された分割データを記憶する記憶手段と、

前記記憶手段に記憶されている分割データを順次再生させる再生手段とを具備したことを特徴とする動画像データ再生装置。

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【請求項４】　請求項３記載の動画像データ再生装置において、

前記分割データ受信手段は、前記時間推定手段に推定された時間とほぼ同じ時間分の分割データが前記記憶手段に記憶されていない場合に、前記データ選択手段によって選択されている種別の分割データを、前記インデックス情報にしたがって前記サーバに要求し、

前記再生手段は、前記時間推定手段によって推定された時間とほぼ同じ時間分の分割データが前記記憶手段に記憶された場合に、この記憶手段に記憶されている分割データの再生を開始することを特徴とする動画像データ再生装置。

【請求項５】　動画像データを複数に分割して複数の分割データを生成し、かつ前記複数の分割データとこの分割データの再生時刻情報とを関連付けたインデックス情報を生成する動画像データ分割装置。

【請求項６】　動画像データが分割されて得られる複数の分割データについて伝送速度が異なる複数の種別を生成し、この複数の種別の各分割データをそれぞれの再生時刻情報に関連付けたインデックス情報を生成する動画像データ分割装置。

【請求項７】　コンピュータに、

動画像データが分割されて得られる複数の分割データとそれぞれの再生時刻情報とを関連付けて生成されるインデックス情報を、サーバに要求して受信するインデックス情報受信機能と、

当該インデックス情報受信機能によって受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられた分割データを、サーバに順次要求して受信する分割データ受信機能と、

当該分割データ受信機能によって受信された分割データを記憶する記憶機能と、

前記記憶機能によって記憶されている分割データを順次再生させる再生機能とを実現させるためのプログラムを記録したコンピュータ読み取り可能な記録媒体。

【請求項８】　請求項７記載のコンピュータ読み取り可能な記録媒体において、

前記分割データの送信をサーバに要求してから、この分割データを受信するまでの時間を推定する時間推定機能を付加し、

前記分割データ受信機能は、当該時間推定機能によって推定された時間とほぼ同じ時間分の分割データが前記記憶機能によって記憶されていない場合に、前記インデックス情報にしたがってサーバに分割データを要求し、

前記再生機能は、前記時間推定機能によって推定された時間とほぼ同じ時間分の分割データが前記記憶機能によって記憶された場合に、この記憶機能によって記憶され

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ている分割データの再生を開始することを特徴とするコンピュータ読み取り可能な記録媒体。

【請求項９】　コンピュータに、
動画像データが分割されて得られる複数の分割データについて伝送速度が異なる複数の種別が生成されている場合に、この複数種別の各分割データとそれぞれの再生時刻情報とを関連付けて生成されるインデックス情報をサーバに要求して受信するインデックス情報受信機能と、
前記分割データの送信をサーバに要求してから、この分割データを受信するまでの時間を推定する時間推定機能と、
当該時間推定機能によって推定された時間に基づいて、要求する分割データの種別を選択する分割データ選択機能と、
前記インデックス情報受信機能によって受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられ、かつ前記分割データ選択機能によって選択されている種別の分割データを、サーバに順次要求して受信する分割データ受信機能と、
当該分割データ受信機能によって受信された分割データを記憶する記憶機能と、
前記記憶機能によって記憶されている分割データを順次再生させる再生機能とを実現させるためのプログラムを記録したコンピュータ読み取り可能な記録媒体。

【請求項１０】　請求項９記載のコンピュータ読み取り可能な記録媒体において、
前記分割データ受信機能は、前記時間推定機能によって推定された時間とほぼ同じ時間分の分割データが前記記憶機能に記憶されていない場合に、前記データ選択機能によって選択されている種別の分割データを、前記インデックス情報にしたがって前記サーバに要求し、
前記再生機能は、前記時間推定機能によって推定された時間とほぼ同じ時間分の分割データが前記記憶機能によって記憶された場合に、この記憶機能によって記憶されている分割データの再生を開始することを特徴とするコンピュータ読み取り可能な記録媒体。

【請求項１１】　コンピュータに、
動画像データを複数に分割して複数の分割データを生成し、かつ前記複数の分割データとこの分割データの再生時刻情報とを関連付けたインデックス情報を生成する機能を実現させるためのプログラムを記録したコンピュータ読み取り可能な記録媒体。

【請求項１２】　コンピュータに、
動画像データが分割されて得られる複数の分割データについて伝送速度が異なる複数の種別を生成し、この複数の種別の各分割データをそれぞれの再生時刻情報に関連付けたインデックス情報を生成する機能を実現させるためのプログラムを記録したコンピュータ読み取り可能な記録媒体。

【請求項１３】　サーバに記憶されている動画像データをクライアントに配信する動画像データ配信システムにおいて、
前記サーバは、
前記動画像データが分割されて得られる複数の分割データと、この各分割データとそれぞれの再生時刻情報とを関連付けたインデックス情報とを保持し、
前記クライアントは、
前記インデックス情報を前記サーバに要求して受信するインデックス情報受信手段と、
当該インデックス情報受信手段に受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられた分割データを前記サーバに順次要求して受信する分割データ受信手段と、
当該分割データ受信手段によって受信された分割データを記憶する記憶手段と、
前記記憶手段に記憶されている分割データを順次再生させる再生手段とを備えることを特徴とする動画像データ配信システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、サーバの構成及び機能を変更することなく、動画像データのランダムアクセスを可能にするための動画像データ再生装置及び動画像データ分割装置並びにプログラムを記録したコンピュータ読み取り可能な記録媒体に関する。

【０００２】

【従来の技術】従来の動画像データ配信システムは、主にクライアントとＷＷＷサーバとから構成される。この従来の動画像データ配信システムでは、まずクライアントからＷＷＷサーバに再生を求める動画像データ（動画コンテンツ）の伝送要求が送信される。

【０００３】ＷＷＷサーバは各種データを保持しており、このデータの中から要求された動画像データを選択し送信する。

【０００４】送信された動画像データは、伝送要求を送信したクライアントに受信され、ストリーム再生がなされる。

【０００５】このような従来の動画像データ配信システムにおいて、クライアント及びＷＷＷサーバがインターネットを介して接続されている場合には、一般的にＨＴＴＰプロトコルにより動画像データの伝送がなされる。

【０００６】ここで、例えば動画像データの再生を求めるユーザの中には、動画像データの途中位置からの再生（以下、「ランダムアクセス」という）を求める者もいる。

【０００７】従来の動画像データ配信システムによってランダムアクセスを実現するためには、ランダムアクセスを可能とする専用のＨＴＴＰサーバをこの動画像デー

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タ配信システムに適用する必要がある。

【０００８】また、別の手法として、ランダムアクセスを可能とする専用のプログラムであるＣＧＩ（Common Gateway Interface）をWWWサーバに実装させる必要がある。

【０００９】この専用のＨＴＴＰサーバや、ＣＧＩを実装したWWWサーバは、動画像データを再生するクライアントから独自の要求を受信し、動画像データを指定された位置からＨＴＴＰプロトコルによって送信する機能を持つ。

【００１０】

【発明が解決しようとする課題】しかしながら、上記のように、ランダムアクセスを可能とするために専用のＨＴＴＰサーバを用いたり、サーバにＣＧＩを実装する方法においては、従来の動画像データ配信システムのWWWサーバに手を加える必要があり、現状のインフラのままでは実現することができない。

【００１１】したがって、ランダムアクセスの実現、導入が困難であり、作業が複雑である。

【００１２】また、この従来の方法では、ランダムアクセスのための処理が主にサーバでなされるため、サーバの負荷が増加するという問題が生じる。特に、動画像データ配信システムが複数のクライアントを有する場合には、その傾向が強くなる。

【００１３】本発明は、以上のような実状に鑑みてなされたもので、サーバの構成や機能に手を加えることなく動画像データのランダムアクセスを可能とするための動画像データ再生装置及び動画像データ分割装置並びにプログラムを記録したコンピュータ読み取り可能な記録媒体を提供することを目的とする。

【００１４】

【課題を解決するための手段】本発明の骨子は、動画像データを複数の分割して分割データとし、この分割データにそれぞれの再生時間を示す再生時刻情報を関連づけてインデックス情報とし、このインデックス情報にしたがって分割データを順次再生する点にある。

【００１５】以下、本発明を実現するにあたって講じた具体的手段について説明する。

【００１６】第１の発明は、動画像データが分割されて得られる複数の分割データとそれぞれの再生時刻情報とを関連付けて生成されるインデックス情報をサーバに要求して受信するインデックス情報受信手段と、当該インデックス情報受信手段に受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられた分割データをサーバに順次要求して受信する分割データ受信手段と、当該分割データ受信手段によって受信された分割データを記憶する記憶手段と、インデックス情報受信手段に受信されたインデックス情報の再生時刻情報にしたがって、記憶手段に記憶されている分割データを順次再生させる再生手段とを具備した動画像データ再生装置である。

【００１７】この第１の発明の動画像データ再生装置においては、再生開始を指示された再生時刻情報以降の分割データが順次受信されストリーム再生される。

【００１８】また、この動画像データ再生装置を適用する場合には、サーバは自己が保持するデータのうち要求されたデータを送信する機能を有していればよい。

【００１９】したがって、第１の発明においては、サーバに新しい構成や機能を付加することなく容易にランダムアクセスが実現される。

【００２０】また、ランダムアクセスを実現させるための処理が、サーバではなく動画像データ再生装置（クライアント）側によって実行されるため、サーバの負荷の増加を防止することができる。

【００２１】第２の発明は、第１の発明の動画像データ再生装置において、分割データの送信をサーバに要求してから、この分割データを受信するまでの時間を推定する時間推定手段を付加し、分割データ受信手段は、当該時間推定手段によって推定された時間とほぼ同じ時間分の分割データが記憶手段に記憶されていない場合に、前記インデックス情報にしたがってサーバに分割データを要求し、再生手段は、時間推定手段によって推定された時間とほぼ同じ時間分の分割データが記憶手段に記憶された場合に、この記憶手段に記憶されている分割データの順次再生を開始する動画像データ再生装置である。

【００２２】この第２の発明の動画像データ再生装置においては、分割データを要求してから受信するまでの間に再生されると推測される分割データが、記憶手段に保持される。

【００２３】したがって、この第２の発明においては、第１の発明と同様の作用効果に加えて、必要最低限の量の分割データが格納されしだい、動画像データの再生がなされるため、再生が開始されるまでの時間を最適化することができる。

【００２４】これにより、再生開始までの時間を短縮させることができる。

【００２５】また、次の分割データが要求されてから受信されるまでの間に必要な分割データは確保済みであるため、動画像データの再生が途切れることを防止することができる。

【００２６】さらに、分割データをサーバに要求してから受信するまでの時間が逐次測定され、この時間にしたがって再生可能な状態で記憶しておく分割データの量が決定される。

【００２７】ゆえに、回線の動的な負荷変動にも対応することができ、適切な量の分割データが確保される。

【００２８】したがって、スムーズなストリーム再生が可能となる。

【００２９】第３の発明は、動画像データが分割されて得られる複数の分割データについて伝送速度が異なる複

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数の種別が生成されている場合に、この複数種別の各分割データとそれぞれの再生時刻情報とを関連付けて生成されるインデックス情報をサーバに要求して受信するインデックス情報受信手段と、分割データの送信をサーバに要求してから、この分割データを受信するまでの時間を推定する時間推定手段と、当該時間推定手段によって推定された時間に基づいて、要求する分割データの種別を選択する分割データ選択手段と、インデックス情報受信手段に受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられ、かつ分割データ選択手段によって選択されている種別の分割データをサーバに順次要求して受信する分割データ受信手段と、当該分割データ受信手段によって受信された分割データを記憶する記憶手段と、インデックス情報受信手段に受信されたインデックス情報の再生時刻情報にしたがって、記憶手段に記憶されている分割データを順次再生させる再生手段とを具備した動画像データ再生装置である。

【００３０】この第３の発明の動画像データ再生装置においては、伝送速度の異なる複数種別の分割データのうち、回線の負荷変動を考慮して適した伝送速度の分割データが選択され受信される。

【００３１】したがって、回線の伝送速度が遅い場合には、高速伝送可能な分割データにより伝送がなされるため、再生すべきデータが未伝送となることを防止することができる。

【００３２】また、第１の発明と同様の作用により、サーバを変更することなく、ランダムアクセスが可能である。

【００３３】第４の発明は、第３の発明の動画像データ再生装置において、分割データ受信手段は、時間推定手段に推定された時間とほぼ同じ時間分の分割データが記憶手段に記憶されていない場合に、データ選択手段によって選択されている種別の分割データを、インデックス情報にしたがってサーバに要求し、再生手段は、時間推定手段によって推定された時間とほぼ同じ時間分の分割データが記憶手段に記憶された場合に、この記憶手段に記憶されている分割データの順次再生を開始する動画像データ再生装置である。

【００３４】この第４の発明の動画像データ再生装置においては、第３の発明と同様の作用効果に加えて、分割データをサーバに要求してから受信するまでの間の再生に必要と推測される分の分割データが記憶手段に保持される。

【００３５】したがって、先の第２の発明と同様の効果を得ることができる。

【００３６】第５の発明は、動画像データを複数に分割して複数の分割データを生成し、かつ前記複数の分割データとこの分割データの再生時刻情報とを関連付けたインデックス情報を生成する動画像データ分割装置である。

【００３７】この第５の発明の動画像データ分割装置を用いて複数の分割データ及びインデックス情報を作成してサーバに備え、第１又は第２の発明の動画像データ再生装置を用いることで、サーバの構成、機能に手を加えることなくランダムアクセスが可能となる。

【００３８】また、この動画像データ分割装置を用いることで、複数の分割データ及びインデックス情報を容易に作成できる。

【００３９】第６の発明は、動画像データが分割されて得られる複数の分割データについて伝送速度が異なる複数の種別を生成し、この複数の種別の各分割データをそれぞれの再生時刻情報に関連付けたインデックス情報を生成する動画像データ分割装置である。

【００４０】この第６の発明の動画像データ分割装置を用いて複数種別の各分割データ及びインデックス情報を作成してサーバに備え、第３又は第４の発明の動画像データ再生装置を用いることで、サーバの構成、機能に手を加えることなくランダムアクセスが可能となり、伝送にかかる時間を調節することができる。

【００４１】また、この動画像データ分割装置を用いることで、複数種別の分割データ及びインデックス情報を容易に作成できる。

【００４２】第７乃至第１２の発明は、それぞれ上記第１乃至第６の発明と同様の機能をコンピュータに実現させるためのプログラムを記録したコンピュータ読み取り可能な記録媒体である。

【００４３】この第７乃至第１２の発明のようなプログラムを記録した記録媒体を用いることによって、上述した機能を有していない装置や、計算機においても、簡単に上述した機能を付加することができる。

【００４４】第１３の発明は、サーバに記憶されている動画像データをクライアントに配信する動画像データ配信システムにおいて、サーバは、動画像データが分割されて得られる複数の分割データと、この各分割データとそれぞれの再生時刻情報とを関連付けたインデックス情報とを保持し、クライアントは、インデックス情報をサーバに要求して受信するインデックス情報受信手段と、当該インデックス情報受信手段に受信されたインデックス情報にしたがって、再生開始を指示された再生時刻情報及びその後の再生時刻情報に関連付けられた分割データをサーバに順次要求して受信する分割データ受信手段と、当該分割データ受信手段によって受信された分割データを記憶する記憶手段と、インデックス情報受信手段に受信されたインデックス情報の再生時刻情報にしたがって、記憶手段に記憶されている分割データを順次再生させる再生手段とを備える動画像データ配信システムである。

【００４５】この第１３の発明の動画像データ配信システムにおいては、クライアントが先の第１の発明の動画

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像データ再生装置と同様に機能する。

【００４６】これにより、第１の発明と同様の作用効果を得ることができる。

【００４７】なお、第２乃至第１２の発明も、この第１３の発明と同様に、動画像データ配信システムに適用可能である。

【００４８】

【発明の実施の形態】以下、図面を参照しながら本発明の実施の形態について説明する。

【００４９】（第１の実施の形態）本実施の形態においては、動画像データ（動画コンテンツ）を複数に分割した分割データと、この複数の分割データとそれぞれの再生時間情報を関連付けたインデックス情報とを用いることで、サーバを変更することなく動画像データのランダムアクセスを可能とする動画像データ配信システムについて説明する。

【００５０】図１は、本実施の形態に係る動画像データ配信システムの構成を示すブロック図である。

【００５１】この動画像データ配信システム１は、動画像データから分割データとインデックス情報とを生成するエンコーダ２と、内部の記憶装置３ａに各種データをファイル形式で記憶するサーバ３と、動画像データ再生用のビューワ４ａを有するクライアント４とから構成されている。

【００５２】この動画像データ配信システム１では、動画像データがスプライスポイントでファイル分割されており、ビューワ４ａがインデックス情報に基づいて好きな位置の分割データをサーバ３に要求し、受信する。

【００５３】以下、この動画像データ配信システム１の各構成要素について詳しく説明する。

【００５４】図２は、本実施の形態に係る動画像データ配信システム１に備えられるエンコーダ２の機能を示すブロック図である。

【００５５】このエンコーダ２は、動画エンコード時に、ビデオ等の動画素材からなる動画像データ（動画コンテンツ）を所定のスプライスポイント毎に分割して複数の分割データを生成する。また生成した各分割データには異なるファイル名を付けて出力する。この図２では、分割データのファイル名の例として「douga000000」、「douga000003」、「douga000006」等が示されている。

【００５６】なお、この各分割データは、ビューワ４ａ内の受信ページバッファの１ページ内に収まるサイズで生成される。

【００５７】さらに、このエンコーダ２は、各分割データのファイル名と、それぞれの再生時刻の情報とを関係付けてインデックス情報５を生成し、ファイル形式で出力する。

【００５８】図３は、本実施の形態に係る動画像データ配信システム１に備えられるサーバ３の構成を示すブロック図である。

【００５９】サーバ３は、主に記憶装置３ａと、サーバ本体３ｂとから構成される。

【００６０】サーバ本体３ｂは、記憶装置３ａに様々なデータを蓄積する機能と、クライアント４からの要求にしたがって記憶装置３ａの内容を読み出して送信する機能を有する。

【００６１】記憶装置３ａは、各種のデータを記憶し、ここではエンコーダ２によって生成された複数の分割データ及びインデックス情報５も記憶している。

【００６２】クライアント４は、図１で示すように、主にクライアント本体４ｂと、動画像データ再生装置として機能するビューワ４ａとから構成されており、クライアント本体４ｂ上でビューワ４ａが稼働する。

【００６３】図４は、本実施の形態に係る動画像データ配信システム１に備えられるビューワ４ａの機能を示すブロック図である。

【００６４】なお、図４（ａ）は再生開始前のバッファリング中の状態を示し、３ページ分の分割データがページバッファに格納されるまでの状態を示している。

【００６５】一方、図４（ｂ）は再生中の状態を示しており、１ページ分の分割データがデコーダに読み出されると、再びサーバ３から分割データが読み出される状態を示している。

【００６６】このビューワ４ａは、動画像データを再生する装置であり、インデックス情報受信部６、分割データ受信部７、ページバッファ８、デコーダ９から構成される。

【００６７】インデックス情報受信部６は、再生を求める動画像データの指定をユーザから入力する。また、指定された動画像データに関するインデックス情報５をサーバ３に要求し、この要求の応答としてサーバ３からインデックス情報５を受信して保持する。

【００６８】分割データ受信部７は、動画像データの再生開始位置となる再生時刻情報をユーザから入力する。また、インデックス情報受信部６のインデックス情報５を参照し、ユーザから入力された再生時刻情報以降の再生時刻情報に関連付けられているファイルの送信をサーバ３に要求する。この要求は、ページバッファ８に格納された分割データの量が一定量（ここでは３つとする）になるまで順次出力する。

【００６９】そして、この分割データ受信部７は、この要求の応答として分割データを順次受信し、ページバッファ８に出力する。

【００７０】ページバッファ８は、複数のページからなり、各ページ毎に一つの分割データをバッファリングする。また、各ページの内容を再生時刻順に並び替えて記憶する。さらに、デコーダ９によって読み出されたページ内の分割データを破棄し、次に入力される分割データを新規に確保する。

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【００７１】デコーダ９は、ページバッファ８内に一定量の分割データが記憶されると、デコード処理を開始し、その後順次デコード処理を続ける。これにより滞りなく動画像データの再生がなされる。

【００７２】次に、上記のような構成を有する動画像データ配信システム１の動作について以下に説明する。

【００７３】まず、エンコーダ２によって動画像データが分割され、分割データ及びインデックス情報が生成され、サーバ３に記憶される。

【００７４】次に、再生を求める動画像データの指定及び再生を開始させる位置が、ユーザによってビューワ４ａに入力される。

【００７５】次に、ユーザに指定された動画像データから生成されたインデックス情報５が、ビューワ４ａのインデックス情報受信部６からサーバ３に要求され、受信される。

【００７６】この受信されたインデックス情報５には、動画像データの再生時刻情報に対して分割データのファイル名が記述されている。

【００７７】分割データ受信部７では、受信されたインデックス情報５に基づいて、再生を開始したい位置以降に対応付けられている分割データがサーバ３に要求され、受信される。

【００７８】受信された分割データは、ページバッファ８の各ページに格納され、再生される時刻順に並び替えられる。

【００７９】また、ページバッファ８において一定量のバッファリングがなされると、デコーダ９によってストリーム再生が開始される。

【００８０】ページバッファ８においては、分割データが１ページ分再生される度にそのデータが破棄されてページが空けられる。

【００８１】そして、分割データ受信部７において、未受信の次の分割データが、インデックス情報５に基づいて検索され、サーバ３に要求、受信され、再生が繰り返される以上説明したように、本実施の形態に係る動画像データ配信システム１においては、動画像データがスプライスポイントにおいてファイル分割されており、その状態がインデックス情報５に記述されている。

【００８２】また、ビューワ４ａが、このインデックス情報５を要求し、続いてこのインデックス情報５に記されている好きな位置から分割データを順次要求・受信し、再生する。

【００８３】したがって、ユーザの望む位置からの分割データが順次再生されるため、動画像データのランダムアクセスが可能となる。

【００８４】また、本実施の形態においては、サーバ３の機能はファイルを保持し、またこの保持されているファイルの中から要求されたファイルを送信するのみである。したがって、この動画像データ配信システム１を導入する場合にはサーバ３に新しい機能や作用を追加する必要がない。

【００８５】ゆえに、クライアント４側のビューワ４ａを備え、サーバ３に分割データとインデックス情報５とを格納するのみで、容易にランダムアクセスを実現することができる。

【００８６】さらに、ランダムアクセスを実現させるための処理が、サーバ３ではなくビューワ４ａによって実行されるため、クライアント４が複数存在してもサーバ３の負荷の増加を防止することができる。

【００８７】なお、本実施の形態に係る動画像データ配信システム１では、エンコーダ２の機能をクライアント４に実装させ、クライアント４がネットワークを介して分割データ及びインデックス情報５をサーバ３に格納するとしてもよい。

【００８８】また、本実施の形態においては、ビューワ４ａの機能をブラウザ等の機能として実現可能であり、サーバ３はWWWサーバとすることができる。

【００８９】これにより、ブラウザで参照する動画コンテンツのランダムアクセスが可能となる。

【００９０】さらに、本実施の形態に係る動画像データ配信システム１では、クライアント４の台数を複数にすることができる。

【００９１】（第２の実施の形態）本実施の形態においては、第１の実施の形態に係る動画像データ配信システム１に備えられるビューワ４ａを変形したビューワについて説明する。

【００９２】先の第１の実施の形態においては、ビューワ４ａがサーバ３に分割データを要求してから受信するまでの時間がネットワークの回線の負荷に依存する。また、この回線の負荷は、様々な要因により時々刻々と変化する。

【００９３】先のビューワ４ａでは、伝送に要する時間や、回線の負荷による伝送速度の変化を吸収するために、動画像データの再生開始時に一定量分（しきい値を設定する）の分割データをバッファリングし、以後順次分割データを読み出している。

【００９４】この手法では、ビューワ４ａにバッファリングされる分割データの量を大きくすればその分だけ回線の負荷による遅延に対応可能となるが、その分再生開始までの待ち時間が長くなる。

【００９５】この再生開始までの待ち時間は、回線の負荷による遅延を吸収できる範囲で最小化されることが望ましい。したがって、バッファリングされる分割データの量も、回線負荷による伝送時間の変化に対応可能な範囲で最小化されることが望ましい。

【００９６】本実施の形態においては、分割データを要求してから受信するまでの時間を推定する。また、この推定された時間に基づいて、ページバッファに記憶しておく分割データの量を変更し、バッファリングされる分

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割データの量を動的に最適化するビューワに関して説明する。

【００９７】図５は、本実施の形態に係るビューワの構成を示すブロック図であり、図４と同一の部分には同一の符号を付してその説明を省略し、ここでは異なる部分についてのみ詳しく説明する。

【００９８】このビューワ１０は、第１の実施の形態において説明したビューワ４ａの分割データ受信部７の機能を変更した分割データ受信部１１を備え、新規の構成として時間推定部１２を付加している。また、このビューワ１０は、第１の実施の形態と同様の動画像データ配信システム１に設置可能である。

【００９９】時間推定部１２は、分割データ受信部１１がサーバ３に分割データを要求し、この分割データを受信するまでの時間（以下、「要求受信時間」という）を測定する。

【０１００】なお、この測定された要求受信時間を厳密に用いると、バッファリングの際に余裕がなくなる。したがって、時間推定部１２は多少余分を持たせるために若干多めの値を要求受信時間として推定する。例えば実際の要求受信時間が０．５秒であってとしても、要求受信時間を０．７秒と推定し、設定する。

【０１０１】この時間推定部１２において、要求受信時間は、再生開始以降には分割データが要求されて受信される度に再推定され、更新される。

【０１０２】分割データ受信部１１は、先の第１の実施の形態で説明した分割データ受信部７と同様の処理を行うが、サーバ３から分割データを読み出す際の条件が異なっている。

【０１０３】再生開始前においては、この分割データ受信部１１は、ページバッファ８内の分割データの再生時間の合計が要求受信時間を超えるまで、サーバ３から分割データを受信する。

【０１０４】再生中においては、現在再生中の分割データに関連付けされている再生時刻情報に現状の要求受信時間を加算し、この加算値に該当する再生時刻情報に関連付けされた分割データを要求し、受信する。すなわち、例えば要求受信時間が０．７秒と設定されているとすると、０．７秒後に再生されることになる分割データを要求し、受信する。

【０１０５】上記のような構成を有するビューワ１０の動作について以下に説明する。

【０１０６】図６は、本実施の形態に係るビューワ１０の再生開始前までの動作を示すフローチャートである。

【０１０７】このビューワ１０においては、まずインデックス情報５がサーバ３から受信される（ｓ１）。

【０１０８】次に、このインデックス情報５とユーザの指定内容に基づいて、再生開始位置の分割データが要求される（ｓ２）。

【０１０９】次に、要求された分割データが受信され（ｓ３）、この際に余分を持たせた要求受信時間が推定される（ｓ４）。

【０１１０】次に、インデックス情報５を参照して、次の分割データが要求され（ｓ５）、受信される（ｓ６）。

【０１１１】そして、要求受信時間分の分割データが、ページバッファ８に受信されたか否かが判定され（ｓ７）、受信されている場合には、再生が開始される。

【０１１２】受信されていない場合には、再度次の分割データが要求され、受信される。

【０１１３】図７は、本実施の形態に係るビューワ１０の再生開始後の動作を示すフローチャートである。

【０１１４】再生開始後においては、ページバッファ８に空きがあり（ｔ１）、かつ要求受信時間分の分割データがページバッファ８にない場合に（ｔ２）、次の分割データが要求される（ｔ３）。

【０１１５】なお、この間にもページバッファ８内の分割データはデコードされ再生されている（ｔ４、ｔ９）。

【０１１６】次に、要求された分割データが受信され（ｔ５）、この分割データが最後の分割データか否かが判定される（ｔ６）。

【０１１７】最後の分割データの場合にはデコード処理及び再生が継続され（ｔ７）、処理が終了される。

【０１１８】最後の分割データでない場合には、余分を持たせた要求受信時間が推定され（ｔ８）、デコード処理の実行により動画像データが再生されつつ（ｔ９）、上記の処理が繰り返される。

【０１１９】以上説明したように、本実施の形態に係るビューワ１０においては、サーバに分割データを要求してから受信するまでの時間に多少の余分を加えた時間分の分割データがページバッファ８に蓄積される。

【０１２０】したがって、必要最小限の分割データのみが先行確保されるため、再生開始までの時間を最適化することができる。

【０１２１】（第３の実施の形態）動画像データの再生中に、ネットワークの負荷により回線の伝送速度が分割データの伝送速度未満となると、動画像データがビューワにおいて途切れなく再生されない場合がある。

【０１２２】本実施の形態においては、このような場合に、再生の途中からでも高速伝送可能な分割データに切り換えて伝送を行い、これによりスムーズな再生を維持する動画像データ配信システムについて説明する。

【０１２３】本実施の形態に係る動画像データ配信システムは、図１と同様の構成を有するが、エンコーダ及びビューワに特別の機能が付加されている。

【０１２４】本システムのエンコーダは、元の動画像データが同一であり、スプライスポイントも同一であるが同一の条件における伝送速度が異なる複数種別の分割データ及びインデックス情報を生成する。

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【０１２５】また、本システムのビューワは、要求受信時間に基づいて分割データの種別を選択する機能を有する。

【０１２６】以下、図１の場合と異なる機能を有するエンコーダ、及びビューワについて詳しく説明する。

【０１２７】図８は、本実施の形態に係る動画像データ配信システムに備えられるエンコーダの機能を示すブロック図である。

【０１２８】このエンコーダ１３は、エンコード時に、１つの動画像データから伝送速度の異なる複数種別の分割データを生成し、出力する。

【０１２９】なお、以下においては伝送速度の異なる２つの種別の分割データが生成される場合を例として説明するが、３つ以上の種別が生成される場合も同様である。また、この２つの種別のうち、一方を標準分割データとし、この標準分割データよりも伝送速度の速いもう一方を高速分割データとして説明する。

【０１３０】さらに、このエンコーダ１３は、生成された標準分割データのファイル名と高速分割データのファイル名を再生時刻情報に関連付けたインデックス情報１４を生成し、ファイル形式で出力する。

【０１３１】すなわち、このインデックス情報１４には、各再生時刻情報に複数列の分割データのファイル名が関連付けられており、この各列は異なる伝送速度になるようにエンコードされた分割データ列である。

【０１３２】サーバは、標準分割データ、高速分割データ、インデックス情報をファイルとして記憶し、クライアントのビューワから要求されたファイルを送信する。

【０１３３】ビューワは、第２の実施の形態に係る図５のビューワ１０と同様の構成を有するが、分割データ受信部１１に分割データ選択機能が付加されている点が異なる。

【０１３４】この分割データ選択機能は、標準分割データを要求してから受信するまでの時間が、時間推定部１２で推定された要求受信時間よりも大幅に大きい場合に、ネットワークの伝送速度が分割データの伝送速度よりも遅いと判断する。この場合、分割データ選択機能は、インデックス情報１４中の分割データの参照を、標準分割データ列から高速分割データ列に切り換える。

【０１３５】一方、高速分割データを要求してから受信するまでの時間が、時間推定部１２で推定された要求受信時間よりもある程度小さくなった場合には、ネットワークの伝送速度が分割データの伝送速度よりも速くなったと判断し、インデックス情報１４中の分割データの参照を、高速分割データから伝送速度は遅いが画質のよい標準分割データ列に切り換える。

【０１３６】図９は、このビューワにおいて再生開始後に実行される処理を示すフローチャートである。

【０１３７】このビューワでは、動画像データがデコードされ、再生されるが（ｕ１）、それと並列に要求伝送時間分の分割データがページバッファ８に格納されているか否かが判定される（ｕ２）。

【０１３８】ここで、要求伝送時間分の分割データがページバッファ８に格納されていない場合には、この要求伝送時間が大きすぎるか否かが分割データ選択機能によって判定される（ｕ３）。

【０１３９】要求伝送時間が大きすぎる場合には、インデックス情報１４の分割データ列のうち伝送速度の速い方が選択される（ｕ４）。

【０１４０】一方、要求伝送時間が大きすぎない場合には、要求伝送時間が小さすぎないか否かが判定される（ｕ５）。

【０１４１】要求伝送時間が小さすぎる場合には、インデックス情報１４の分割データ列のうち伝送速度の遅い方が選択される（ｕ６）。

【０１４２】そして、この分割データ選択機能によって選択された種別における次の分割データが、サーバに要求される（ｕ７）。

【０１４３】この間にも、動画像データのデコード処理が実行され、再生がなされている（ｕ８）。

【０１４４】要求された分割データが受信されると（ｕ９）、余分を持たせた要求受信時間が推定される（ｕ１０）。

【０１４５】そして、要求する分割データがなくなり（ｕ１１）、かつ再生する分割データもなくなると（ｕ１２）、処理が終了する。

【０１４６】要求する分割データが存在する場合には、上記の処理が繰り返される。

【０１４７】以上説明したように、本実施の形態に係る動画像データ配信システムにおいては、異なる伝送速度の分割データが生成され、分割データを要求してから受信するまでの時間が長い場合には、ビューワは伝送速度の速い分割データを読み出す。

【０１４８】また、分割データの種別の切り替えは各分割データの読み出し毎に行うことができるため、動画像データの再生開始後においても伝送速度を変更することができ、ネットワークの状況変更に柔軟に対応することができる。

【０１４９】さらに、伝送速度に余裕のある場合には画質のよい分割データに変更することができる。

【０１５０】ゆえに、クライアントのビューワで動画像データを途切れなく、良好に再生することができる。

【０１５１】なお、上記の各実施の形態において説明したビューワ、エンコーダの機能は、コンピュータに実行させることのできるプログラムとして、例えば磁気ディスク（フロッピーディスク、ハードディスク等）、光ディスク（ＣＤ－ＲＯＭ、ＤＶＤ等）、半導体メモリなどの記録媒体に書き込んで適用したり、通信媒体により伝送して各種装置に適用することも可能である。このビューワやエンコーダの機能を実現するコンピュータは、記

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録媒体に記録されたプログラムを読み込み、プログラムによって動作が制御されることにより、上述した処理を実行する。

【０１５２】

【発明の効果】以上詳記したように本発明では、動画像データを分解した複数の分割データと、この各分割データとそれぞれの再生時刻情報とを関連付けたインデックス情報をサーバに備える。

【０１５３】そして、動画像データ再生装置は、まずインデックス情報を受信し、再生を開始したい位置の時間再生情報以降に関連付けられている分割データを順次読み出す。

【０１５４】これにより、サーバの構成、機能に手を加えることなく、ランダムアクセスが可能になる。

【０１５５】また、このランダムアクセスのための処理がサーバではなく動画像データ再生装置によって実行されるため、ランダムアクセス実行によるサーバの負荷の増加を防止することができる。

【０１５６】さらに、本発明では、動画像データ再生装置に蓄える分割データの量を、分割データを要求してからこの分割データを受信するまでの時間分とすることで、再生開始までの待ち時間を最適化することができる。

【０１５７】さらに、本発明では、伝送速度の異なる複数種別の分割データを用意しておき、ネットワークの状況によって受信する分割データの種別を切り換えることで、ネットワークにおける負荷の影響を受けることなくスムーズな再生が可能となる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態に係る動画像データ配信システムの構成を示すブロック図。

＊【図２】同実施の形態におけるエンコーダの機能を示すブロック図。

【図３】同実施の形態に係る動画像データ配信システムに備えられるサーバの構成を示すブロック図。

【図４】同実施の形態に係る動画像データ配信システムに備えられるビューワの機能を示ブロック図。

【図５】本発明の第２の実施の形態に係るビューワの構成を示すブロック図。

【図６】同実施の形態に係るビューワの再生開始前までの動作を示すフローチャート。

【図７】同実施の形態に係るビューワの再生開始後の動作を示すフローチャート。

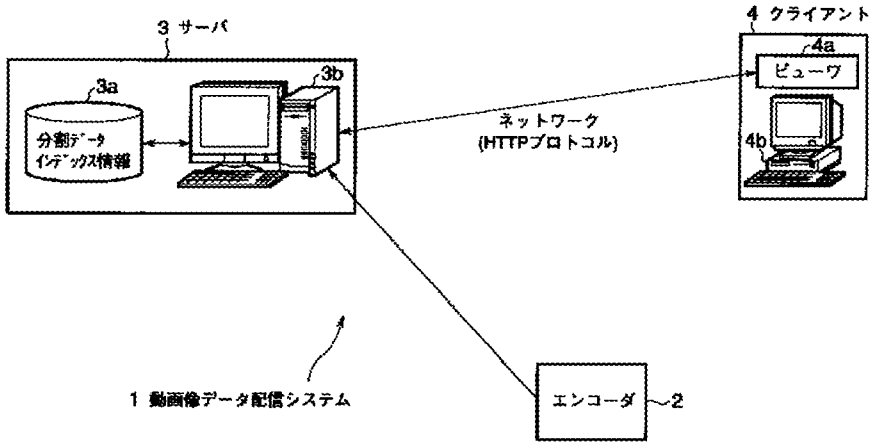
【図８】本発明の第３の実施の形態に係る動画像データ配信システムに備えられるエンコーダの機能を示すブロック図。

【図９】同実施の形態に係る動画像データ配信システムに備えられるビューワの再生開始後の動作を示すフローチャート。

【符号の説明】

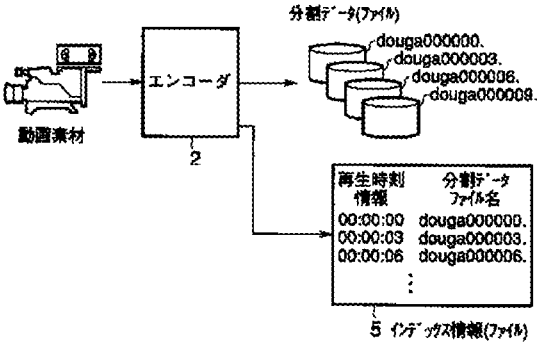
１…動画像データ配信システム
２、１３…エンコーダ
３…サーバ
４…クライアント
４ａ、１０…ビューワ
５、１４…インデックス情報
６…インデックス情報受信部
７、１１…分割データ受信部
８…ページバッファ
９…デコーダ
１２…時間推定部

【図１】

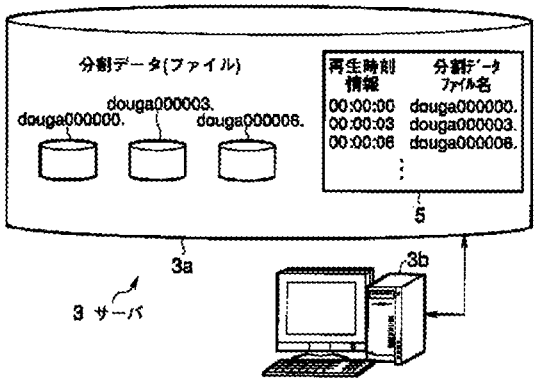


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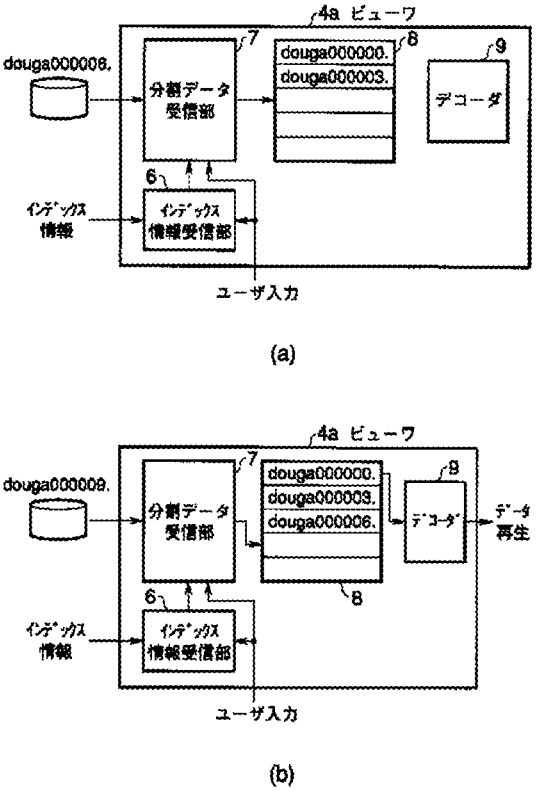
【図２】



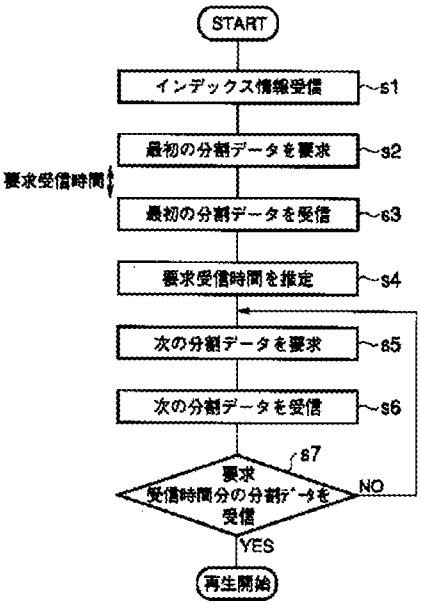
【図３】



【図４】

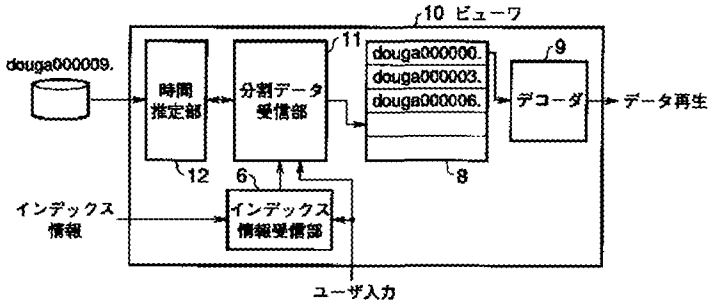


【図６】

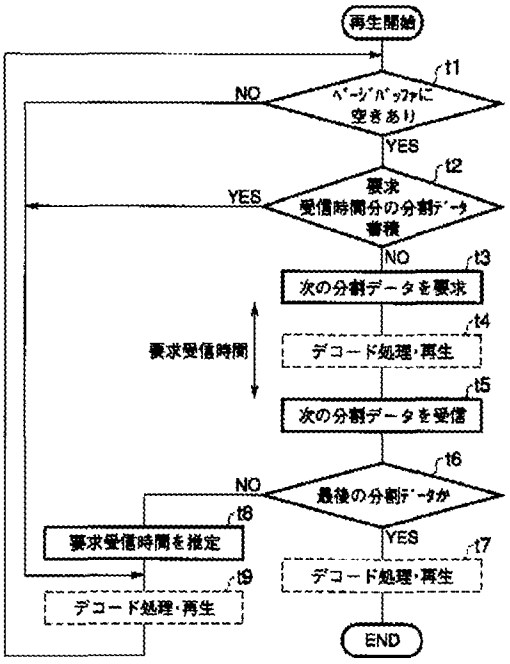


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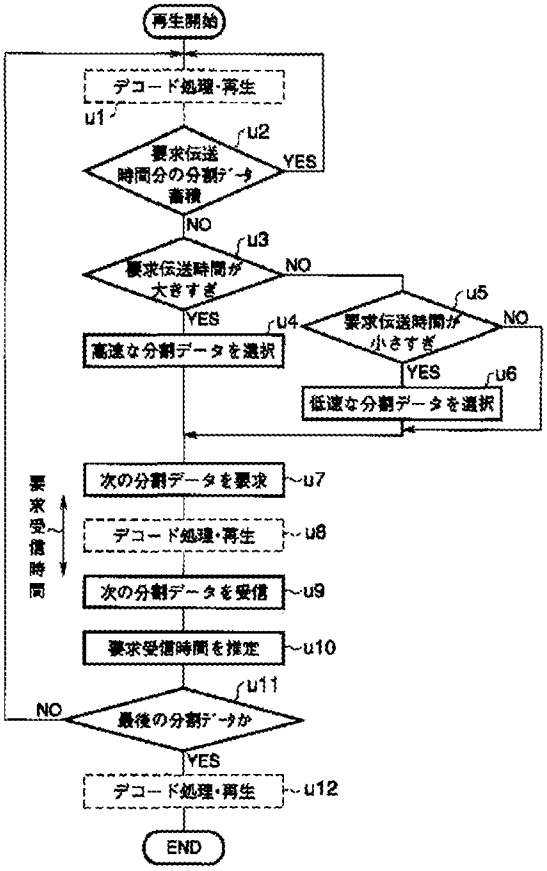
【図５】



【図７】

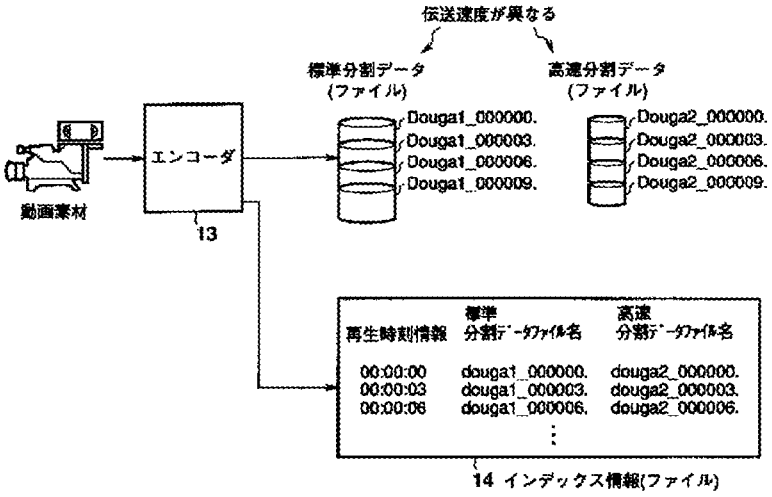


【図９】



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【図８】



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(54) A method of transmitting data streams with data segments of variable length

(57) A method of transmitting data streams between a sending host and a receiving host using a transport protocol comprising the steps of making available data streams at the sending host in the form of mono-rate or multi-rate content streams having the same content but different encoding rates, establishing a connection between the sending host and the receiving host, transmitting data streams with a selected encoded rate to the receiving host, and separating the data streams into data segments of variable length at the sending host as required during transmission.

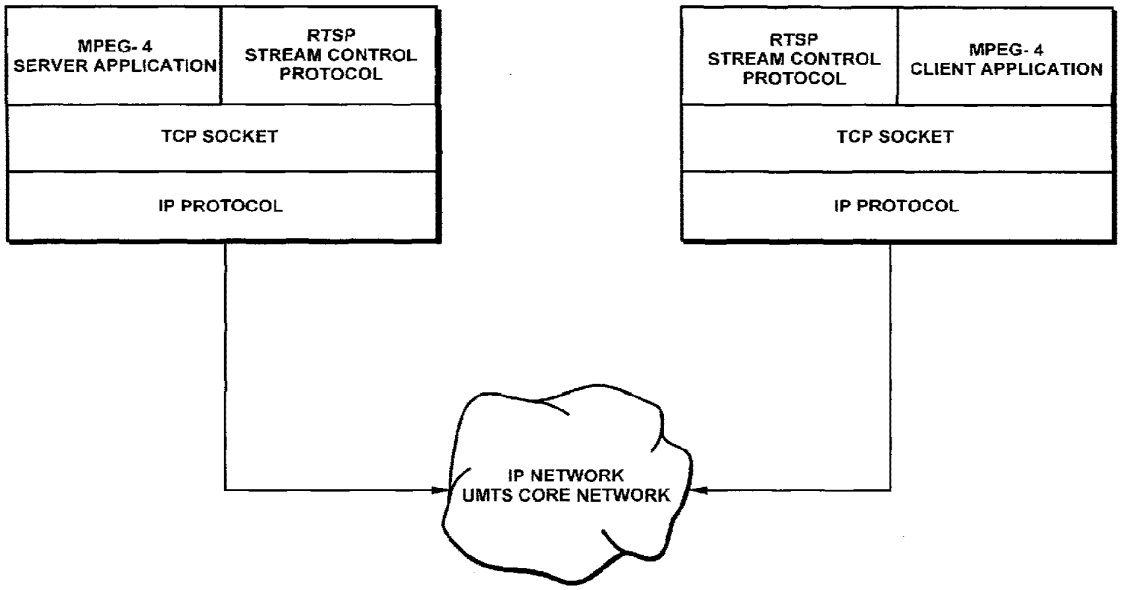


Fig. 1

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Description

[0001] The present invention relates to a method of transmitting data streams between a sending host and a receiving host using a transport protocol such as TCP.

[0002] In network communications between a sending host and a receiving host, the transmission of data packets is mostly done on a best-effort basis. In the communication link, the available bandwidth and the current link conditions vary and hence, the end hosts must be provided with mechanisms to probe and adjust themselves to the current link conditions.

[0003] With the development of 3rd generation networks, so-called streaming applications are gaining importance. Streaming applications are understood as a continuous stream of data, e.g. video or audio data which is typically sensitive to time delays. In order that the user will be able to receive multimedia data streams on a portable receiver, for example a mobile phone, several requirements on the transport mechanism will be imposed in order that the delivered data meets with the resulting time constraints. These constraints are difficult to meet in a best-effort environment, which is subject to bandwidth variations and delays.

[0004] To cope with the problem of bandwidth adaption, it is common praxis to make several data streams with different encoding rates but same content available at the sending host. According to the available bandwidth, it is then switched between the data streams in order to adjust the rate to the available bandwidth. In other words, multi-rate content streams at the sending host are transmitted and switching operations between streams are performed depending on the available bandwidth. The current stream is forwarded to the receiving host in one piece and consequently, for every switching operation, the ongoing connection must be torn down and a new one must be set up. As a result, this operation is inefficient and decreases the data throughput.

[0005] Alternatively, it is possible to transmit only one stream of data to the receiving host and to discard data packets based on priority and time constraints. However, this leads to a loss of data and is therefore not an optimal solution.

[0006] The object subject to the present invention is to minimize the latency of the switching operation and to ensure fast recovery from an incorrect switching decision.

[0007] This object is solved according to the present invention with a method as set forth in claim 1. Preferred embodiments of the method are subject to various dependent claims.

[0008] The method of the present invention supposes the existence of multi-rate content data streams at the sending host. With the method of the present invention, it is possible to quickly switch between data streams that are variably segmented at the application layer as required during transmission. Instead of using data streams of fixed segment length, the data segments given to the socket are made smaller before, during and after the switching. For each content several video streams encoded with different rates are stored at the video server. Under normal sending conditions, i.e. the transmission has reached some equilibrium where the bandwidth is enough and the losses are not dominating, the video content is passed to the sending TCP socket in segments of the same size (irregardless of the stream encoding rate, the segment size is a function of the link, not of the encoding rate). Only when the server is notified (or knows by other means) that a stream switch might be needed, then it reduces the size of these segments.

[0009] Further, with the method of the present invention, it is neither necessary to modify the originally encoded data at the sending host or to modify the transport protocol nor to introduce additional control messages, making the method easy to implement.

[0010] Preferably, the switching is performed between data streams of different rate and the variable segmentation of the data streams is performed around the switching instant. Hence, a quick stream switching from the old to the new data stream can be performed. Further, preferably, the segmentation during, before or after the switching instance is made finer, such that the switching operation is more resilient to an incorrect decision and enables a quicker, further switching operation.

[0011] Advantageously, the step of switching between streams involves a feedback message (e.g. an RTSP command) i.e. communication between hosts when a switching operation is needed and when to make the necessary preparations therefor, for example, to start with finer segmentation.

[0012] It is furthermore of advantage if the feedback message includes at least one of the parameters, which comprise the length of data segment, an identifier of the data to be sent or a stream control command which makes the operation smoother and less susceptible to data losses.

[0013] Preferably, the length of the data segments is gradually increased after a switching instant to reduce interface communication, i.e. between application and TCP socket.

[0014] The present invention will be more fully understood from the following detailed description with reference to the accompanying drawings which show:

Figure 1: the basic architecture of a sending host and a receiving host connected by a communications network in which the method subject to the present invention can be performed,

Figure 2: a block diagram of a server architecture as the sending host in which the method of the present invention is performed, and

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Figure 3: a block diagram of a client architecture.

[0015] Figure 1 illustrates the basic architecture of a communications network for connecting a video server as a sending host to a video client acting as a receiving host. The communications network is, for example, a UMTS core network, an external network, such as the internet or an internal intranet over which the server and the client communicate by means of a transport protocol. As transport protocol TCP is selected as an example, but it is clear to a skilled person that any other transport protocol for transmitting data can be employed.

[0016] In a more general way, it will now be explained how TCP handles the exchange of data between the server and the client.

[0017] First of all, the video server needs to transfer its data to the protocol and tell it to send same to the client. To progressively read and send data, the protocol uses a kind of buffer with added functionalities, a so-called TCP socket. Generally, sockets are unequivocally identified by the IP addresses of the correspondents, the protocols and ports which are used. Once a connection between two sockets is established, the communication can be controlled by use of interface calls, which, for example may comprise "create a socket", "bind a socket to a transport address", "accept" or "close a connection", "send", "receive" or "write" data between the sender and the receiver.

[0018] Wide-spread socket implementations are UNIX BSD 4.2 and Windows Winsock 2.0, where equivalent interface calls are implemented.

[0019] Each interface call has parameters, e.g. for the "send" call, parameters of relevance are the socket descriptor, the identifier of the data to be sent and the length of the data stream. Once a data stream is passed in one call, no single bit of this data stream can be modified. The only way to abort transfer of this data stream is to break down the connection.

[0020] Nevertheless, in order to close the connection, the application must explicitly issue a "close" call. Interface calls can be queued as, for example, in FTP. When asked for a file, the FTP server usually issues two interface calls for this transmission, namely a "send" call indicating the socket, the identifier of the data stream and the length thereof and a "close" call identifying the socket. The two interface calls are put into the queue and when the "send" call is completed, the connection is irreversibly broken down because the "close" call was next in the queue.

[0021] Alternatively, for example, in case of TELNET, the connection is established and the socket is set to wait for incoming data, i.e. commands typed on the keyboard.

[0022] Of course, the application can be configured such that the server only issues a send call and waits for the client to close. However, this is uncommon.

[0023] Additionally, it is assumed that the TCP protocol provides a means for asynchronously signaling certain information about events in the socket. Often in the specification, the information will be an error message. In other cases, there will be information relating to the completion of processing a SEND or RECEIVE or another interface call.

[0024] Referring again to Figure 1, the video server provides, e.g. an MPEG 4 compressed data stream, i. e. a given video content, which is made available to the TCP socket in the form of mono-rate or multi-rate streams. Multi-rate streams are defined for the purpose of this and the following description, as one or several data streams with the same video content at different encoding rates. The MPEG data streams are forwarded to the TCP socket. Subsequently, by means of an IP protocol, data is transmitted to the video client. A stream control protocol, e.g. RTSP, should be used to perform such operating as PLAY, PAUSE or STOP the transmission.

[0025] With reference to Figure 2, which shows the basic architecture of a video server 200, at the MPEG server application 210, video content is made available in a buffer 211 at different coding rates. A switch 212, which receives stream control RTSP commands from RTSP block 220, such as "Play", "Pause", "Tear down" or "Change rate", selects one of the data streams which is forwarded to the TCP socket 230 in form of an MPEG file.

[0026] It is clear to a skilled person that other stream control protocols than RTSP could be used at the server and the client. The stream control protocol typically instructs to perform play, forwarding, rewinding, pause or stop functions. Additionally, if multi-rate content is available, switch to a higher or lower encoding rate can be instructed.

[0027] Once a server has received a request for a file containing a chosen content encoded at a desired rate, the server application forwards each of the segments, in which the file was previously segmented, one after another to the TCP socket by means of consecutive interface calls, e.g. consecutive SEND calls. Unlike in current FTP applications, the connection is not torn down after each data transmission process is completed. The data connection remains open, so that there is no need to build up a new connection every time a segment is transmitted. Following this, the TCP socket forms with these segments packet data units (PDUs) for transmission to the client, as it finds most appropriate

[0028] Upon establishing a connection, the TCP socket selects a segment size for the data streams which the server finds most appropriate for the link under consideration of the channel bandwidth and starts transmitting.

[0029] Initially, the size of the segments is made small before, during and after a switching operation in order to avoid a large waiting time before a further switch operation can be performed in case the previous switch decision was incorrect. Subsequently, the size of the data segments can be increased gradually throughout the connection time.

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[0030] Eventually, when there is a change in the available link bandwidth, the video client shall indicate a possible switch operation by means of, for example, an RTSP message and the server will start doing finer segmentation. Hence, the server switches between data streams of different encoding rates. This is done based on initial information and subsequently controlled by feedback from the client. Alternatively, this could be determined by the server, which would, however, impose processing requirements on the server. Also a combination of control mechanisms at the server and the client is possible. How the server or the client exactly makes the decision to perform a switching operation or indicates a possible anticipated switch is out of the scope of the present invention.

[0031] The basic architecture of a TCP streaming client 300 is illustrated in Figure 3. The client 330 typically consists of a TCP socket 310, an application layer buffer 320 and a buffer manager 330 for the application layer buffer.

[0032] The client 300 processes the data segments of variable length as they come. In response thereto, it sends ACKs and performs flow control in order to prevent an overflow of the TCP socket 310 while extracting the maximum bit rate possible from the link. To do this, the TCP socket indicates to the server, with each ACK, how much data it can receive until the socket is full using a window field in the header of the TCP protocol. If needed, the TCP client signals a zero-window telling the server to enter a "Persist" mode wherein no data is sent until the client allows to do so while the connection is maintained. The Persist mode and the signaling of a window field are standard functionalities of the TCP protocol. When the TCP circuit has capacity for more data, it signals this to the server. Streaming control commands are signalled to the server by means of RTSP commands.

[0033] The application layer buffer 320, also called "play-out buffer" receives data from the socket and transmits same to the MPEG client application 340. The manager 330 for the application layer buffer 320 receives a frame request from the MPEG client application and issues a socket request upon considering the state of the application layer buffer. The buffer manager 320 therefore insures that the bit rate with which the TCP socket 310 can deliver the new data to the application layer buffer 320 matches the bit rate at which the application layer buffer is emptied to the MPEG client application 340. The exact control mechanism of the buffer manager is out of the scope of the present invention.

[0034] Finally, from the MPEG client application, the data is transferred to a display 350 for visualization for the user.

Claims

1. A method of transmitting data streams between a sending host and a receiving host using a transport protocol comprising the steps of:

   making available data streams at the sending host in form of mono-rate or multi-rate content streams having same content but different encoding rates,

   establishing a connection between the sending host and the receiving host for the duration of transmission,

   transmitting data streams of the same content with a selected encoding rate to the receiving host, and

   separating the data streams in data segments of variable length at the sending host as required during the established connection.

2. The method according to claim 1, further comprising the steps of switching between data streams of different rate and performing the variable segmentation of the data streams around the switching instant.

3. The method according to claim 1 or 2, wherein the data streams are finer segmented during, before or after the switching instant.

4. The method according to claim 2, wherein the step of switching between streams involves a feedback message.

5. The method according to claim 4, wherein the feedback message includes signalling at least one of the parameters which comprise data segment length, an identifier of the data to be sent or a stream control command.

6. The method according to one of claims 1-5, wherein the receiving host communicates to the sending host when a stream switching is needed.

7. The method according to one of claims 1-6, wherein the sending host determines the timing of the switching instant dependent on the available bandwidth of the communication link.

8. The method according to one of claims 1-7, wherein the length of the data segments is gradually increased after a switching instant.

9. The method according to one of claims 1-8, wherein the received data streams at the receiving host are temporarily stored in an internal buffer.

10. The method according to one of claims 1-9, wherein the receiving host issues stream control commands

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to the sending host depending on the state of the internal buffer.

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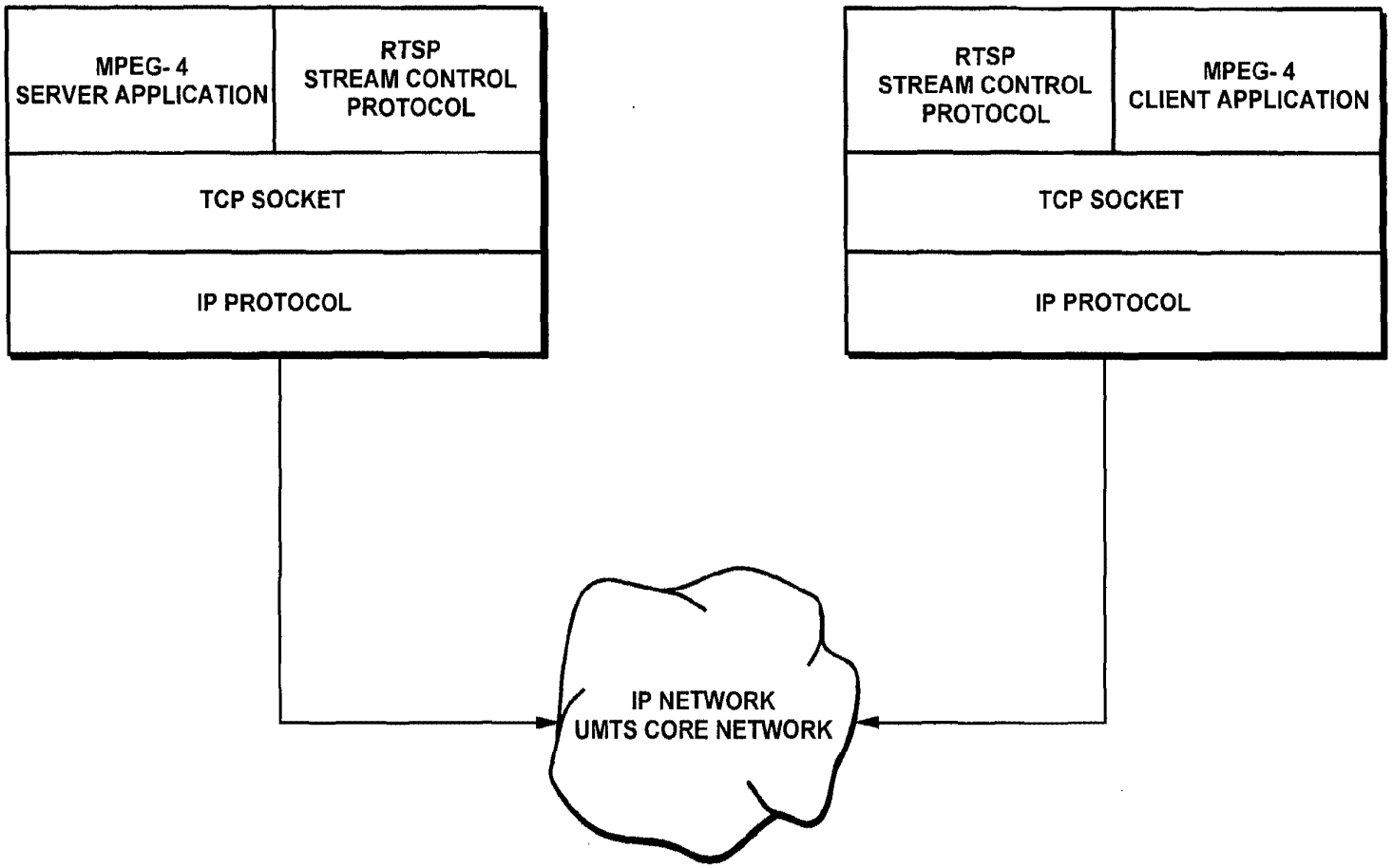


Fig. 1

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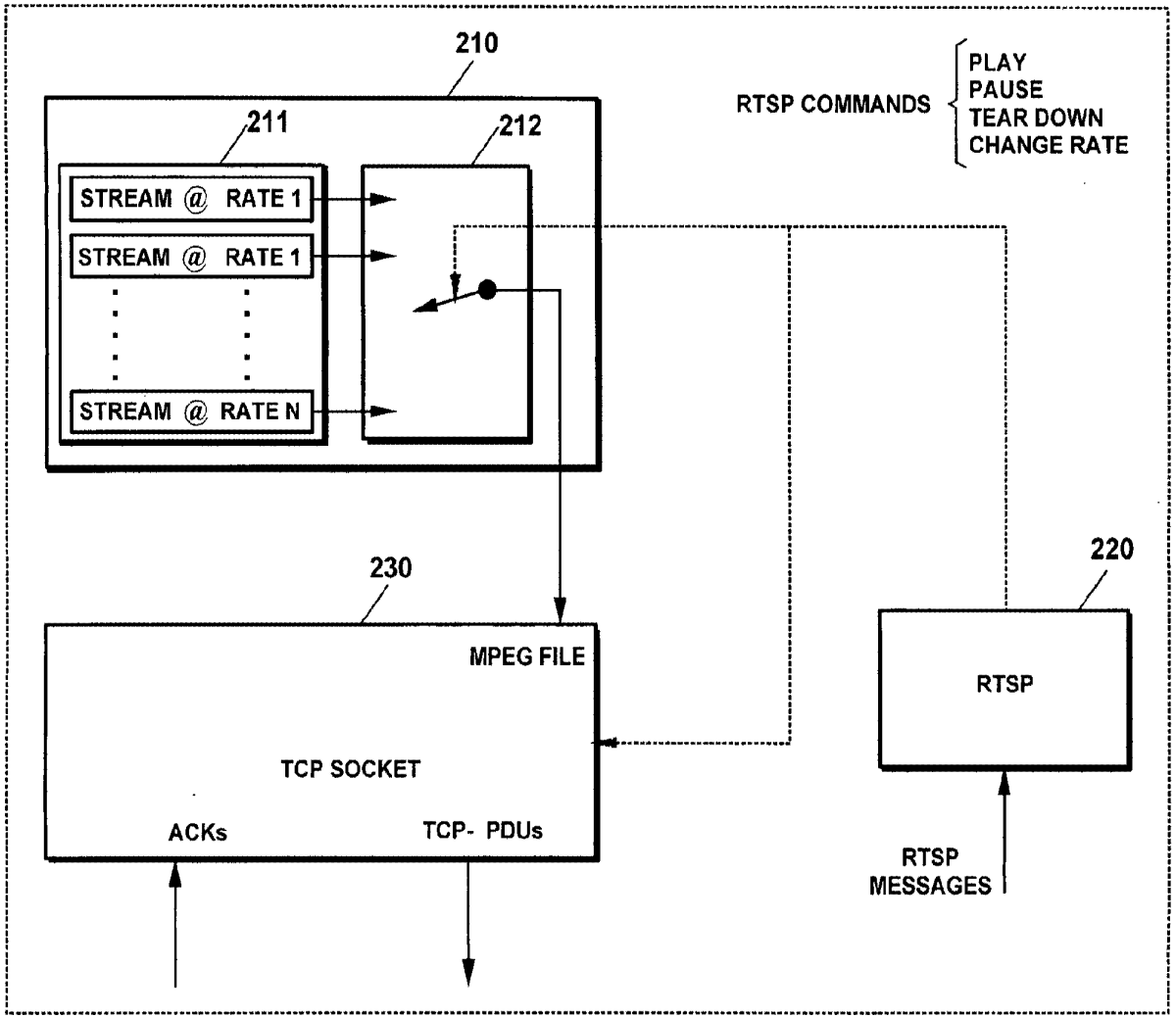


Fig. 2

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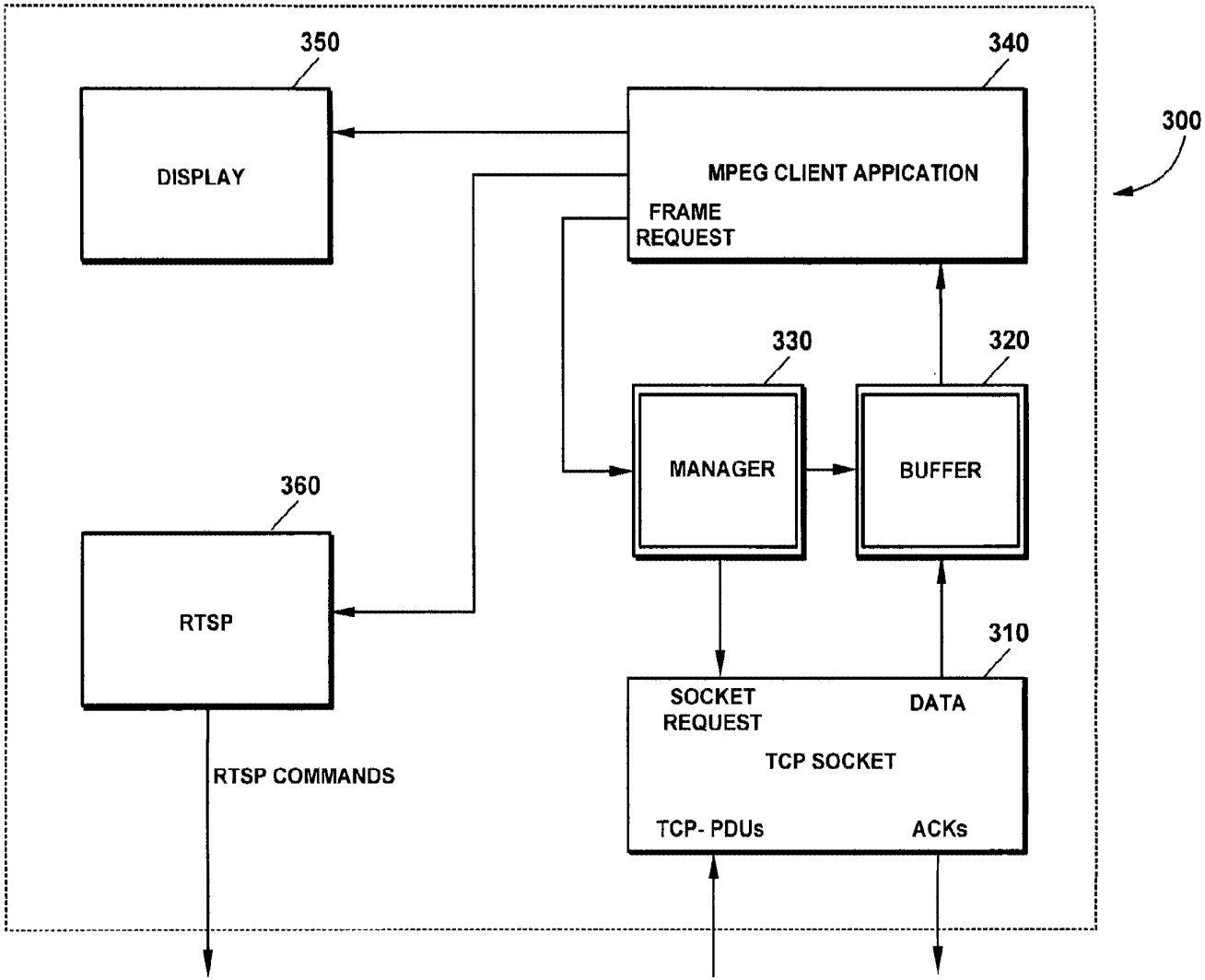


Fig. 3

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 9052

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	CONKLIN G J ET AL: "VIDEO CODING FOR STREAMING MEDIA DELIVERY ON THE INTERNET" IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, IEEE INC. NEW YORK, US, vol. 11, no. 3, March 2001 (2001-03), pages 269-281, XP001093477 ISSN: 1051-8215 * page 271, left-hand column, line 35 - line 44; figures 1,2 * * page 270, left-hand column, line 11 - line 20 * ---	1-10	H04L29/06 H04L29/08
Y	EP 0 786 885 A (NOKIA TELECOMMUNICATIONS OY) 30 July 1997 (1997-07-30) * abstract * * page 2, column 2, line 14 - line 34 * ---	1-10	
X	WO 02 054284 A (LEISTAD GEIRR I ;DANKWORTH HARALD (NO); FAST SEARCH & TRANSFER ASA) 11 July 2002 (2002-07-11) * page 2, line 31 - page 3, line 7 * * page 4, line 6 - page 5, line 6; figure 1 * * page 9, line 18 - page 10, line 15 * * page 11, line 3 - line 28; figure 3 * --- -/--	1	TECHNICAL FIELDS SEARCHED (Int.Cl.7) H04L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	7 January 2003	Michael, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 02 01 9052

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	HUI J Y ET AL: "CLIENT-SERVER SYNCHRONIZATION AND BUFFERING FOR VARIABLE RATE MULTIMEDIA RETRIEVALS" IEEE JOURNAL ON SELECTED AREAS IN COMMUNICATIONS, IEEE INC. NEW YORK, US, vol. 14, no. 1, 1996, pages 226-237, XP000548824 ISSN: 0733-8716 * page 228, left-hand column, line 15 - line 33 * * page 228, right-hand column, line 14 - line 32 * ---	10	
A	JONGWON KIM ET AL: "TCP-friendly Internet video streaming employing variable frame rate encoding and interpolation" IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY, vol. 10, no. 7, October 2000 (2000-10), pages 1164-1177, XP002226167 ISSN: 1051-8215 * page 1164, right-hand column, line 25 - line 40; figure 1 * ---	7	TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	WO 02 052859 A (DURRANT SIMON ;LAKE JULIAN (GB); MULROY PAT (GB); PA CONSULTING SE) 4 July 2002 (2002-07-04) * page 3, line 12 - line 30 * -----	7	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	7 January 2003	Michael, T

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 9052

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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07-01-2003

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0786885 A	30-07-1997	FI 960382 A	27-07-1997
		EP 0786885 A2	30-07-1997
		US 5914960 A	22-06-1999
WO 02054284 A	11-07-2002	NO 20010056 A	05-07-2002
		WO 02054284 A1	11-07-2002
WO 02052859 A	04-07-2002	WO 02052859 A1	04-07-2002

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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(12) UK Patent Application (19) GB (11) 2 367 219 (13) A

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(51) INT CL[7]
H03M 7/30 , H04L 1/00

(52) UK CL (Edition T)
H4P PDCFM

(56) Documents Cited
EP 1049074 A1 **WO 99/00984 A1**
WO 98/09387 A1 **WO 00/72601 A2**
US 5847760 A

(58) Field of Search
UK CL (Edition S) **H4P PDCFM PDCFP PDCFX PF**
INT CL[7] **H03M 7/30 , H04L 1/00 , H04N 7/26 7/32**
Online: WPI, EPODOC, JAPIO

(54) Abstract Title
Streaming of media file data over a dynamically variable bandwidth channel

(57) A method of transmitting data streams over a variable bandwidth channel, comprising modifying the quantity of data to be injected into the channel to accord with a measured capacity or bandwidth of the channel. An input stream is passed through a plurality of parallel compressors 40.1-40.4 which each produce an output stream of a different rate to the other streams. Each stream preferably comprises key or reference frames and delta frames. The reference frames are synchronized between the streams so that a data unit in one stream contains the same information as the corresponding data unit in another stream, but is compressed to a different extent. A data stream for transmission along the channel is produced by selecting data units from more than one compressor output stream so as to produce a stream which makes optimum use of the available channel bandwidth. In one embodiment the duration of the data units are one of a group comprising fixed predetermined durations and duration determined by changes in the channel bandwidth. The method is useful in sending multimedia data streams such as audio and video over a channel such as a cellular telephone network or the internet.

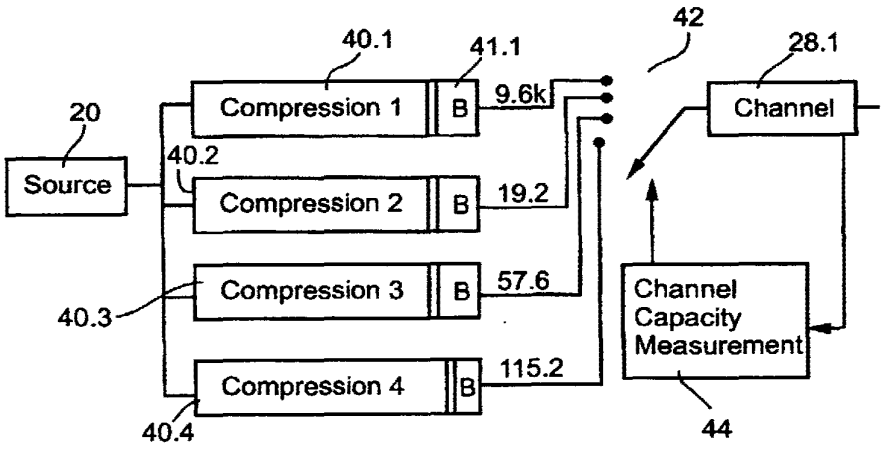


Fig. 4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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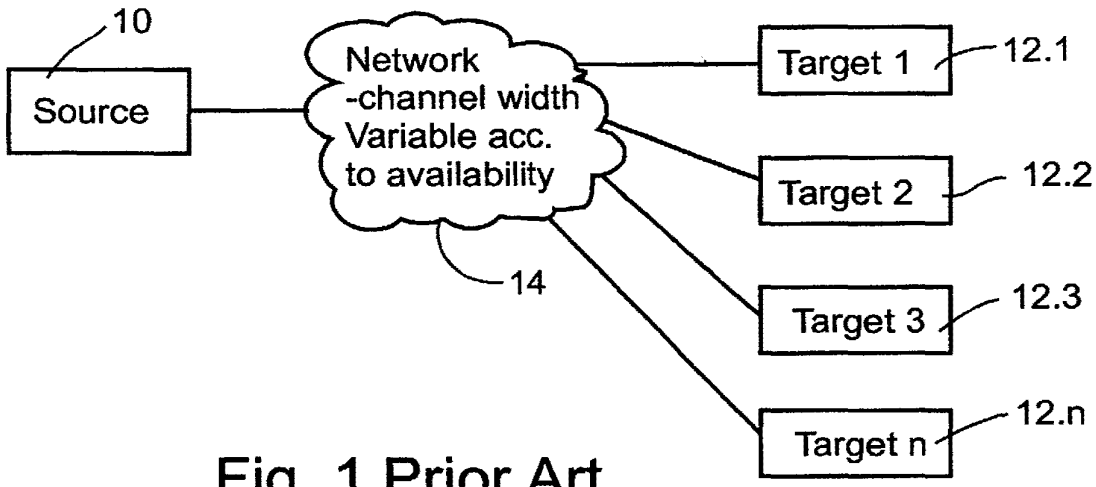


Fig. 1 Prior Art

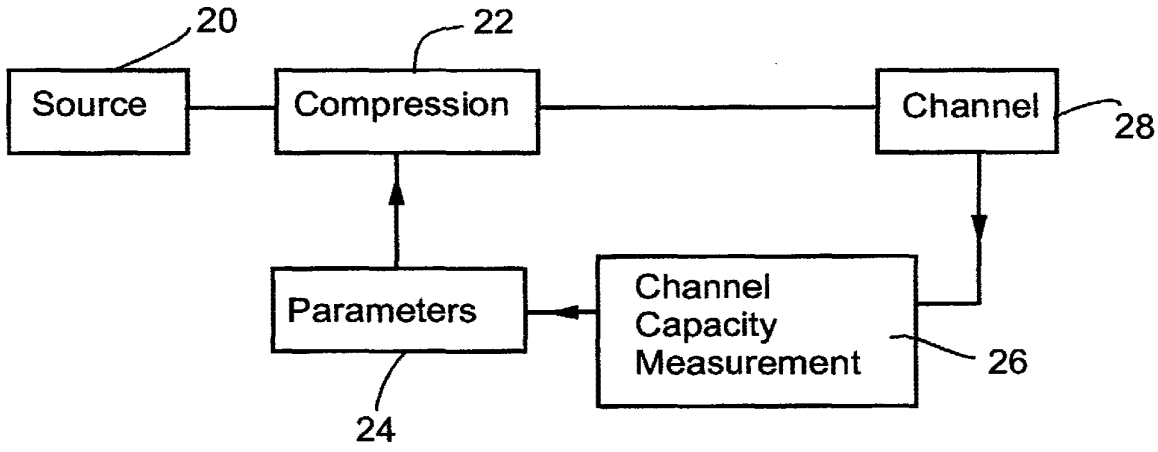


Fig. 2

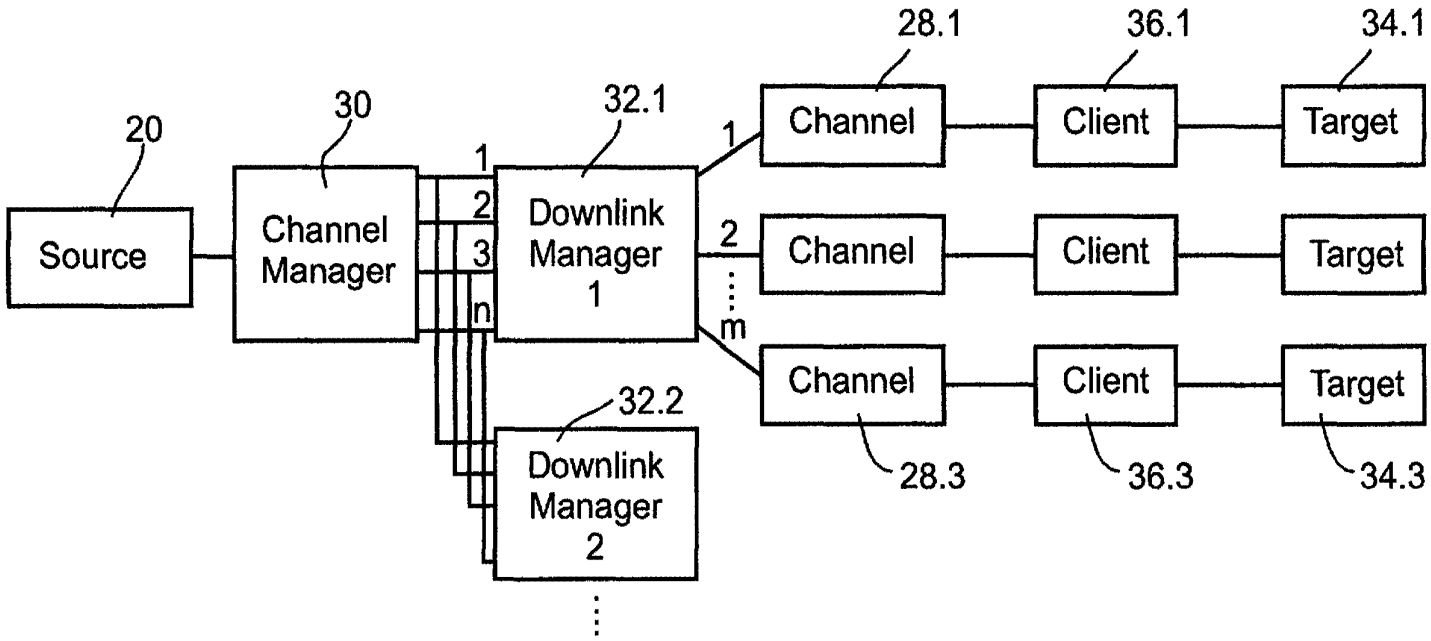


Fig. 3

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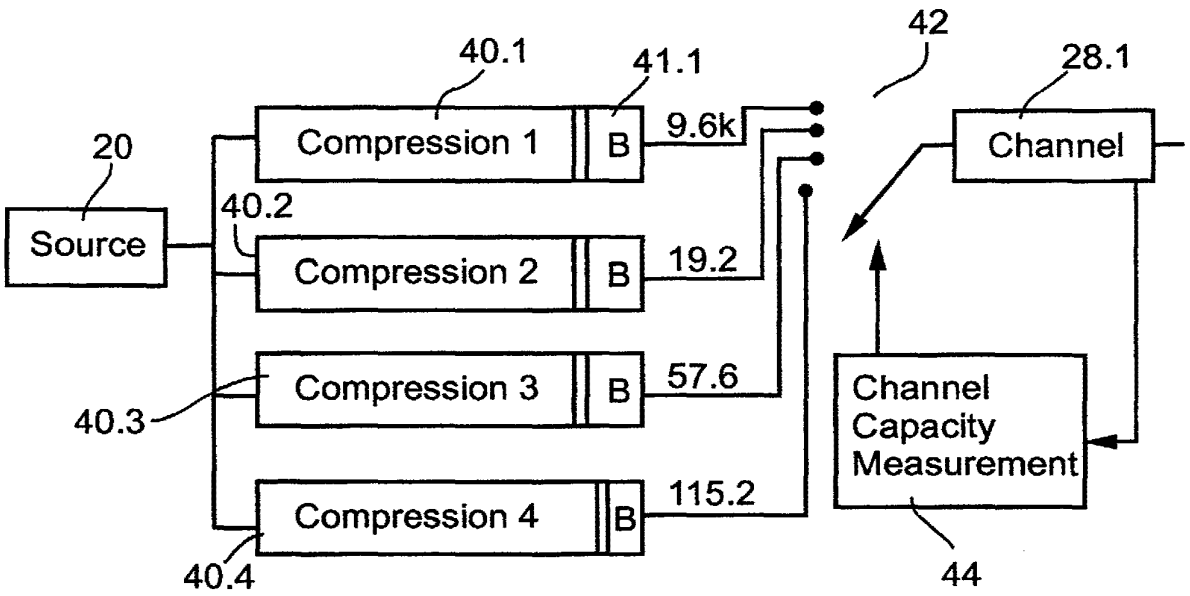

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40.1
41.1
28.1
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9.6k
Channel
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Source
Compression 2
B
19.2
Compression 3
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Measurement
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Compression 4
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115.2
40.4
44

Fig. 4

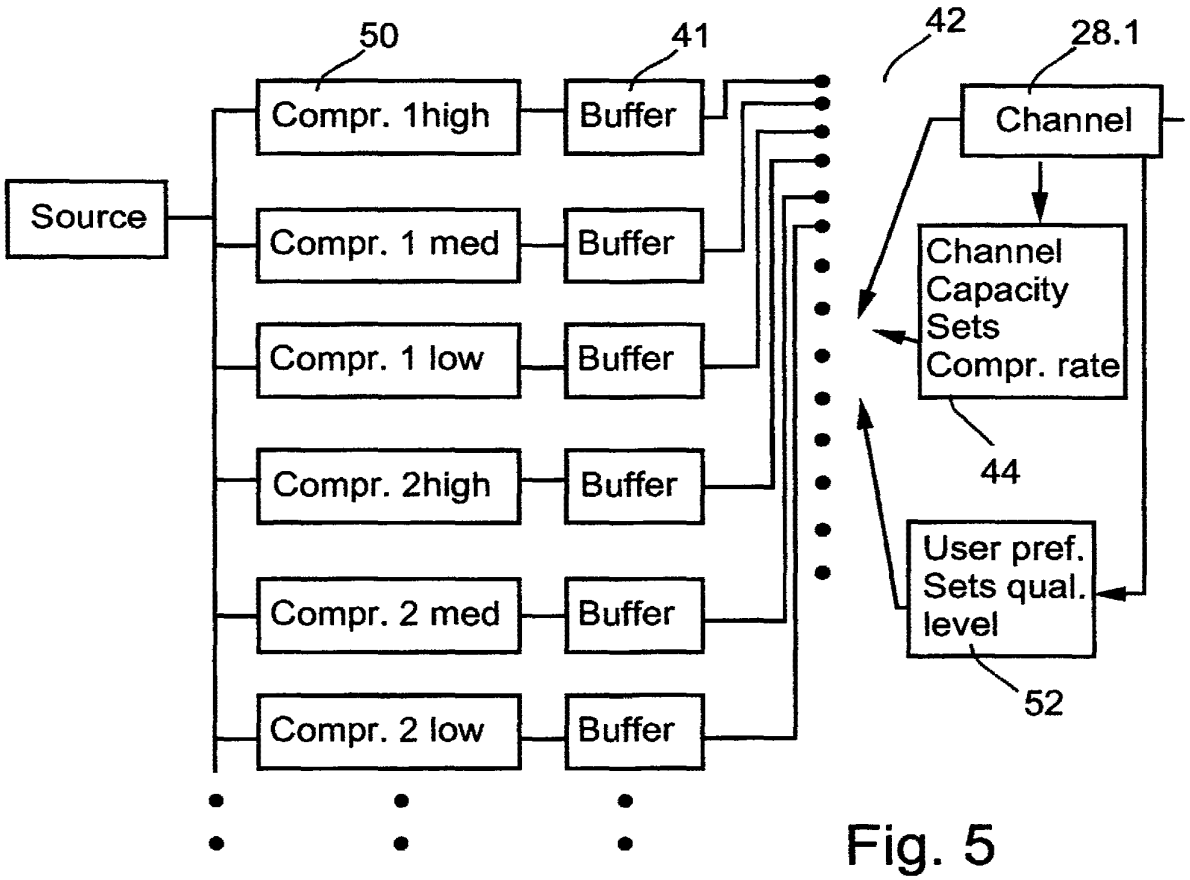

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Compr. 2 low
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Fig. 5

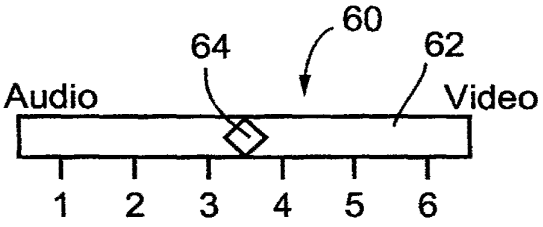


Fig. 6

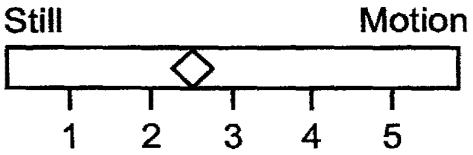


Fig. 7

00/20757 -UK. 9/12/00

Title of the Invention

Streaming of Media File Data Over a Dynamically Variable Bandwidth Channel

Field of the Invention

The present invention relates to streaming of media file data over a channel having a dynamically variable bandwidth, and more particularly but not exclusively to streaming of multimedia data such as video and /or audio data over a channel having a dynamically variable bandwidth.

Background of the Invention

Dynamically varying channel bandwidths are particularly encountered over the Internet and like networks and over radio and cellular telephone links. On the Internet the total bandwidth is fixed and the bandwidth available per channel tends to depend on the amount of usage, the greater the usage the smaller the bandwidth available per user. In radio and cellular links the available bandwidth depends on usage, but the overall capacity may also be dependent on environmental factors.

The Internet relies on packet switched communication, whereas radio and cellular telephone links may be either circuit-switched or packet switched. Either way, the same considerations of channel bandwidth broadly apply.

As the bandwidth changes, a number of approaches are currently in use. One of these is simply to buffer received video frames, to start to show the frames as soon as the buffer is full, and to continue to show the video until the buffer is empty, then to halt the display until the buffer is full again. Another method is to show the video at a real time rate, displaying all frames that arrive in time and dropping all frames that arrive too late.

In both of these methods, data is sent at the same high rate. In the first method, unacceptable delays in showing the data are experienced. In the second method, valuable channel bandwidth is wasted transmitting data that does not get used.

Whether the network is a cellular telephone network or the Internet or like wide area data network, the bandwidth of the data network is variable. In all cases the

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larger the number of users the lower the bandwidth per user, and radio-based networks may also suffer from reduced bandwidth due to environmental conditions. Furthermore, in the case of cellular telephone networks, events such as handover between two base stations may also affect the available bandwidth.

In general, cellular networks are able to absorb changes in bandwidth without the user noticing a change in the quality of the voice signal. However, it is desirable to go beyond mere voice communication over cellular telephone networks. Already, low level data capability is being built into mobile telephones and it is envisaged that within the next few years, mobile telephones will be able to receive and display multimedia data. Multimedia data uses large amounts of bandwidth and generally requires to be displayed in real time. Thus bandwidth fluctuations will be immediately noticeable. Currently, however, transmission of video data over cellular phone channels is not being attempted on a commercial basis.

At present, mobile telephone systems are on their second generation and a third generation is on the drawing board but will not be available for some years. The problem is particularly associated with the design of advanced second generation equipment (generation 2.5) which, it is envisaged will be able to provide multimedia within the limitations of second generation capacity. It should be noted however that the same considerations apply to further generations of mobile telephones and also to other environments in which it is desired to transmit multimedia data, such as the Internet.

Generally, multimedia data is sent over a network as a datastream in compressed form. There are numerous algorithms for compressing data, and different forms of compression are appropriate for compressing different forms of data. Furthermore, a single form of compression may give rise to different levels of compression according to compression parameters that may be set. The greater the compression the lower will be the resulting data rate and a high level of compression may be used to overcome channel capacity constraints. A solution may involve selection of the compression parameters to meet a likely worst-case scenario. However, the solution is not complete as a high level of compression leads to low quality output and no advantage is taken of the availability for most of the transmission time of a higher bandwidth availability.

US Patent No. 6,014,694, Aharoni et al, discloses a system for adaptively transporting video over networks wherein the bandwidth varies with time. The

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system comprises a video/audio codec that functions to compress, encode, decode and decompress video streams that are transmitted over networks having available bandwidths that vary with time and location. Depending on the channel bandwidth, the system adjusts the compression ration to accommodate a plurality of bandwidths ranging from 20kbps for POTS to several Mbps for switched LAN and ATM environments. Bandwidth adjustability is provided by offering a trade-off between video resolution, frame rate and individual frame quality. The system generates a video data stream comprising of key, P and B frames from a raw video source. Each frame type is further comprised of multiple levels of data representing varying degrees of quality. In addition, several video server platforms can be utilized in tandem to transmit video/audio information with each video server platform transmitting information for a single compression/resolution level.

P and B frames are delta frames that depend on previous frames to allow a complete picture to be generated. Thus it is not possible simply to mix groups of frames of different quality levels since the deltas between frames are different. The above US Patent solves the problem by taking advantage of what is known as a group of pictures (GOP) which is a self-contained unit such as a scene. Because they are self-contained, GOPs of different compression levels can be successfully mixed. However, GOP boundaries are content related and thus irregular. When GOP boundaries are widely spaced, dynamic following of bandwidth changes are highly inaccurate or generate delays for new users.

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Summary of the Invention

Embodiments of the present invention attempt to solve the above problems by modifying the quantity of data to be injected into the channel to accord with a measured capacity or bandwidth of the channel. The quantity of data is preferably modified only by altering compression parameters, so that data fully usable in real time can be received from the channel. Thus a reduction in bandwidth of the channel leads to a drop in quality of the received signal and not to dropped frames or a reduction in performance.

According to a first aspect of the present invention there is thus a device for streaming of media file data to be sent over at least one channel having a dynamically variable bandwidth, comprising

an input for receiving media file data at a first rate,

a multiple stream creator for creating a plurality of streams of said media file data, each stream compressed to predetermined other rates, each stream comprising a series of autonomous compressed data units which are mutually compatible, and

a stream selector for dynamically matching a bandwidth of the channel to rates of said streams to send said data file as a combination of said autonomous units from said streams via said channel,

wherein said autonomous units have durations which are one of a group comprising fixed predetermined durations and durations determined by changes in said channel bandwidth.

Preferably, said stream selector is operable to select a combination of said streams in succession said combination being chosen to produce an average stream rate over a period of time which matches said channel bandwidth.

Preferably, said bandwidth of said channel is liable to vary dynamically and wherein said stream selector is operable to repeat said matching throughout said streaming operation.

Preferably, said bandwidth of said channel is liable to vary dynamically and wherein said stream selector is operable to repeat said matching throughout said streaming operation.

Preferably, said autonomous units match each other across said plurality of streams, thereby to enable switching between said streams.

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Preferably, said data file is arranged in said streams in a compressed media format utilizing reference frames and delta frames and wherein each autonomous unit is self-contained in respect of reference frames.

In an embodiment, said channel is a cellular telephone channel. Alternatively, said channel is an Internet channel.

Preferably, the predetermined other rate is different for each stream. In another embodiment, the predetermined other rate is identical for a set of said streams, each stream in said set being assigned a different balance between quality and speed of said media.

A preferred device comprises a plurality of media types, said predetermined other rate being identical for a set of said streams, each stream in said set being assigned a different balance between quality of said different media types.

Preferably, streams in said set are selectable by a signal received from said channel.

Preferably, streams in said set are selectable by a signal received from said channel.

An embodiment comprises a detector for detecting a change in the bandwidth of said at least one channel and operable to request a corresponding change in the data rate, and wherein the device is operable, upon receipt of said request, to set a delay, and to issue a reference frame within said delay.

The device preferably issues said reference frame at the end of said delay.

The device alternatively issues said reference frame at the occurrence of a largest detected interframe change within the time delay.

According to a second aspect of the invention there is provided a multiple stream creator for receiving a data stream at a first data rate and converting said data stream into a plurality of data streams at a plurality of data rates, said creator comprising an input for receiving said data stream at said first data rate, and a plurality of outputs, each operable to receive said data stream at said first rate and to output said data stream at a predetermined rate individually set for each output as a series of autonomous units having a duration, and wherein said duration is one of a group comprising a fixed predetermined duration and a duration dynamically changeable in accordance with bandwidth conditions in a transmission channel.

Preferably said outputs each comprise data buffers.

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The multiple stream creator preferably comprises a data stream processor for processing said data stream received at said first rate into said plurality of autonomous units, said autonomous units being synchronized blocks, thereby allowing said output streams to be mixed in said transmission channel to produce continuously usable output.

Preferably, said received data stream is in an uncompressed data format and said data is compressed into a compressed data format independently for each one of said output data streams.

According to a third aspect of the invention there is provided a method of sending a datastream over a variable bandwidth channel comprising modifying a quantity of data to be injected into the channel to accord with a measured capacity of the channel, said method comprising the steps of

compressing the datastream, using an algorithm having compression parameters, to produce a plurality of compressed datastreams each comprising reference frames and delta frames, each compressed datastream produced by using the algorithm together with different parameters, and

synchronizing reference frames between the compressed datastreams so that combinations of said compressed datastreams can be sent via said channel.

Preferably, said step of synchronizing reference frames is carried out at intervals determined by a dynamic status of said channel bandwidth.

Alternatively or additionally, said step of synchronizing reference frames is carried out at predetermined intervals.

Alternatively or additionally, said combination of said compressed datastreams is selected substantially dynamically to match the measured capacity of the channel.

Preferably, a change in bandwidth of a channel causes a request for commencement of a new autonomous unit, and wherein said request causes initiation of measurement of a time delay, and wherein a new autonomous unit is commenced within said time delay.

Preferably, the new autonomous unit is commenced at the end of said time delay.

Preferably, the step is provided of determining the largest delta frame during the time delay and sending a reference frame, to initiate said new autonomous unit, in place of said determined largest delta frame.

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According to a fourth aspect of the present invention there is provided a tool for controlling receipt of media file data over a network, wherein said media file data is available at a plurality of quality levels, the tool comprising a quality selector to enable a user to select between said different quality levels for receipt.

Preferably, said media file comprises a plurality of data groups and each quality level is a different balance between quality levels of the plurality of data groups.

Preferably, said quality selector comprises a slider operable to be moved along a scale, the position of the slider on the scale indicating a quality level.

Brief Description of the Drawings

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, purely by way of example, to the accompanying drawings, in which:

Fig. 1 is a generalized diagram showing a data source sending data to a series of targets over a variable bandwidth network,

Fig. 2 is a generalized block diagram showing a first embodiment of the present invention in which feedback concerning available bandwidth within a channel is used to modify parameters governing compression of the datastream,

Fig. 3 is a generalized block diagram showing a second embodiment of the present invention in which a series of compressed datastreams are continually created and are selected for use in individual channels according to measured parameters of the channel,

Fig. 4 is a generalized block diagram showing the channel manager and part of a downlink manager of Fig. 3 in greater detail,

Fig. 5 is a generalized block diagram showing a third embodiment of the present invention in which the user is able to set a quality level of the data that is being sent,

Fig. 6 is a generalized schematic diagram of a quality level selection tool for use by a user in selecting a quality level in the embodiment of Fig. 5, and

Fig. 7 is a generalized schematic diagram of another quality level selection tool for use with the device of Fig. 5.

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Description of the Preferred Embodiments

Reference is now made to Fig. 1, which is a generalized diagram showing a data source 10 sending data to a series of targets 12.1..12.n over a variable bandwidth network 14. The network may be a cellular telephone network or the Internet or like wide area data network or a combination. In both cases, the bandwidth of the data network is variable. In all cases the larger the number of users the lower the bandwidth per user, and radio-based networks may also suffer from reduced bandwidth due to environmental conditions. Furthermore, in the case of cellular telephone networks, events such as handover between two base stations may also affect the available bandwidth.

Data is generally compressed before sending over the channel. The level of compression may be preselected to accord with known or likely channel capabilities, as described in the introduction. However such a solution has to concentrate on the lower margins of available bandwidth and thus fails to make full use of higher bandwidth levels when available. Conversely, solutions which send datastreams at higher data rates and do not take the lower bandwidth levels into account lead to unacceptable breaks and delays in performance at the receiving end.

Reference is now made to Fig. 2 which is a generalized block diagram showing a first embodiment of the present invention in which feedback concerning available bandwidth within a channel is used to modify parameters governing compression of a datastream.

A multimedia datastream is received from a source 20 such as a host or server. The datastream may be a video datastream and may be in uncompressed or barely compressed format, for example AVI or MPEG1. The datastream is passed to a compression unit 22 which compresses the data into a very low bit-rate stream using compression parameters. A typical format that may be used for the very low bit-rate stream is MPEG 4 which uses a system based on reference frames and delta frames to compress the image part of the video data. H.263 is another typical format that may be used. A video frame is selected as a reference frame and encoded in its entirety. Then a series of subsequent frames are selected, but for each of these frames, the only data that is encoded is that which has changed with respect to the previous frame. The encoded changes form what is known as the delta frame.

Whichever of the available compression formats are used, compression is governed by a series of parameters 24. This allows the compression level to be raised

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or lowered depending on the data rate required and the quality of picture desired. A greater level of compression gives a lower quality of data at a lower data rate and a lower level of compression gives a higher quality of data at a higher data rate.

In the embodiment of Fig. 2 a channel capacity measurement 26 is received from a channel 28 over which the transmission occurs. The measurement may be received from a receiving client who simply reports the received data rate. If the received data rate is reported to be lower than the rate at which data is being sent then it is assumed that data is being produced too fast for the channel and the parameters 24 are altered to increase the compression level until the data output rate is the same as the channel rate. Conversely, if the data rate rises at the receiving end, the parameters 24 may be altered to reduce the compression level and increase the output data rate.

Reference is now made to Fig. 3, which is a generalized block diagram showing a second embodiment of the present invention in which a series of compressed datastreams are continually created and are selected for use in individual channels according to measured parameters of the channel. Parts that are the same as those mentioned in previous embodiments are given the same reference numerals and are not referred to again except as necessary for an understanding of the present embodiment.

In the embodiment of Fig. 3, an input datastream is received from a source 20 as before. The stream is passed to a channel manager 30, which compresses the input datastream. However, instead of compressing it once only, it compresses it into a plurality of output data streams, each one using different compression parameters so as to produce a plurality of streams each having a different data rate. The various streams are then passed to one or more downlink managers 32.1...32.n, each of which is able to manage a limited number of channels 28 for sending output data to a limited number of targets 34. Each target 34 is associated with a client 36, typically client software located at the target 34, which is able to send back, to the downlink manager 32, feedback data such as the received channel rate.

The downlink manager 32 simply obtains the received channel rate from the client 36 and mixes the various streams from the channel manager to produce an average stream rate which matches the channel rate as closely as possible. For example if the received channel rate is 39.5 kbits/sec and the downlink manager has available a 35 kbits/sec stream and a 45 kbits/sec stream then the downlink manager

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will attempt to mix the two streams in suitable proportions to match the 39.5 kbits/sec channel. Thus the target 36 may receive a continuous stream of data, the quality of the channel influencing only the quality of the data and not the continuity.

It will be recalled that the compression systems in use include reference and delta frame style compression. Such compression systems, when used to produce streams at different data rates, do not produce delta frames which are interchangeable between the different data rates. Thus in order to create streams that are interchangeable, it is preferable to arrange all of the streams as a series of self-contained packets of given time duration. Each of the packets is self-contained in that it begins with a reference frame and hence does not depend on previously transmitted data. Thus the target is able to use consecutive packets from different streams without any data discontinuity.

The self-contained units are preferably of relatively short duration. The shorter the duration the better the system is able to follow dynamically changes in the bandwidth of the connection. On the other hand, since each unit must start with a reference or key frame, and such frames are very costly in bandwidth since they must be transmitted in full, the use of short self-contained units itself increases the required bandwidth. A compromise unit length of less than ten seconds, preferably 3, 5 or 7 seconds, is preferred.

In an alternative embodiment the length of the self-contained unit is itself allowed to vary dynamically in accordance with circumstances. When the downlink manager 32 detects a significant change in the channel bandwidth it issues a request for a new data rate from the channel manager 30. Alternatively, a new target may be requesting the data feed. The channel manager 30 initiates a time delay when a first request is received, the delay being less than ten seconds, as discussed above, and at the end of the delay starts new self-contained units at all data rates. Thus dynamic following of changes in bandwidth is provided whilst transmitting the minimum possible number of key or reference frames. If no request is received, then the system continues to use delta frames as long as it is practical.

In a variation of the above, instead of waiting to the end of the time delay, the channel manager first of all looks ahead at the approaching data stream and checks whether there is a reference frame approaching during the time delay period in any case. If so, no further action is needed. If there is no reference frame then the channel manager looks ahead to find the biggest delta frame, representing the biggest

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instantaneous change in the picture, over the delay time period. A reference frame is then inserted in place of the identified largest delta frame. Thus, the insertion of a full reference frame is optimized to the data.

Reference is now made to Fig. 4 which is a generalized block diagram showing the channel manager 30 and a part of a downlink manager 32 of Fig. 3 in greater detail. Parts that are the same as those mentioned in previous embodiments are given the same reference numerals and are not referred to again except as necessary for an understanding of the present embodiment.

As shown in Fig. 4, the channel manager 30 comprises a series of compression units 40.1, 40.2, 40.3, etc. Each of these compression units is preferably operative to compress an input signal received from source 20, using a different compression parameter or set of compression parameters to produce an output having a different data rate. Each compression unit is followed by a buffer 41. The buffer 41 may be used to arranged the compressed data into packets of fixed time duration.

The downlink manager 32 comprises a series of selector switches 42, one for each channel being managed. For the sake of simplicity, only one such switch 42 is shown in the figure. The switch 42 receives each one of the data streams produced by the source 20 and selects one of them at any given time to be sent to the channel 28. Selection is carried out based on a channel capacity measurement 44, which is received from the client 36.

Reference is now made to Fig. 5, which is a generalized block diagram showing a third embodiment of the present invention in which the user is able to set a quality level of the data that is being sent. Parts that are the same as those mentioned in previous embodiments are given the same reference numerals and are not referred to again except as necessary for an understanding of the present embodiment. As described above, compression parameters are altered in order to change the data rate. Generally speaking, there are numerous parameters that can be set in order to alter the data rate, and there are numerous combinations of these parameters that can give the same data rate. For example, parameters that may be altered include:

the extent of image compression within an individual frame,

the number of frames per second to be transmitted,

the proportion of reference frames to delta frames, and

a balance between compression levels of different parts of the data – for example video data includes both sound and image. It is possible to increase a level

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of compression to the image and to decrease a level of compression to the sound or vice versa.

In Fig. 5, part of a channel manager 30 is shown as well as a switch 42 of a downlink manager. In the channel manager of the embodiment of Fig. 5, a series of data compressors 50 are provided for each required data rate. The data compressors are labeled high, medium and low, although in fact they are different compromises between compression parameters. For example "high" may indicate high image quality but low frame rate, whereas "low" may indicate low image quality but high frame rate. The selector switch 48 is the same as in the previous embodiment except that it now chooses channels based on two different items of information. One item of information is the received channel rate 44, which selects the data rate as before. The other item of information is a data quality request which is received from the target. This selects, within the given data rate, between the different quality levels.

Reference is now made to Fig. 6, which is a generalized schematic diagram of a quality level selection tool 60 for use by a user in selecting a quality level in the embodiment of Fig. 5. The selection tool 60 comprises a simple longitudinal bar 62 which may be marked with labels and numbers, and a slider 64 for moving along the bar 62. The bar shown in Fig, 6 indicates that the user may select different compromises between sound quality and image quality.

Reference is now made to Fig. 7, which is a generalized schematic diagram of another quality level selection tool 70 for use by a user in selecting a quality level in the embodiment of Fig. 5. The selection tool 70 is likewise in the form of a bar and slider but this time the choice is between high quality images at a low frame rate (marked "still") and low quality images at a high frame rate (marked "motion"). It will be appreciated that a low bandwidth "high" may yield a lower image quality than a high bandwidth "low" and vice versa.

Embodiments of the present invention thus provide a system and method in which the measured received data level of a channel is used to select a transmitted data rate so that full advantage may be taken of fluctuating channel capacity levels to send the highest possible quality multimedia data.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention

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which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable subcombination.

It will be appreciated by persons skilled in the art that the present invention is not limited to what has been particularly shown and described hereinabove. Rather the scope of the present invention is defined by the appended claims and includes both combinations and subcombinations of the various features described hereinabove as well as variations and modifications thereof which would occur to persons skilled in the art upon reading the foregoing description.

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Claims

1. A device for streaming of media file data to be sent over at least one channel having a dynamically variable bandwidth, comprising

an input for receiving media file data at a first rate,

a multiple stream creator for creating a plurality of streams of said media file data, each stream compressed to predetermined other rates, each stream comprising a series of autonomous compressed data units which are mutually compatible, and

a stream selector for dynamically matching a bandwidth of the channel to rates of said streams to send said data file as a combination of said autonomous units from said streams via said channel,

wherein said autonomous units have durations which are one of a group comprising fixed predetermined durations and durations determined by changes in said channel bandwidth.

2. A device according to claim 1, wherein said stream selector is operable to select a combination of said streams in succession said combination being chosen to produce an average stream rate over a period of time which matches said channel bandwidth.

3. A device according to claim 1, wherein said bandwidth of said channel is liable to vary dynamically and wherein said stream selector is operable to repeat said matching throughout said streaming operation.

4. A device according to claim 2, wherein said bandwidth of said channel is liable to vary dynamically and wherein said stream selector is operable to repeat said matching throughout said streaming operation.

5. A device according to claim 1, wherein said autonomous units match each other across said plurality of streams, thereby to enable switching between said streams.

6. A device according to claim 5, wherein said data file is arranged in said streams in a compressed media format utilizing reference frames and

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delta frames and wherein each autonomous unit is self-contained in respect of reference frames.

7. A device according to claim 1, wherein said channel is a cellular telephone channel.

8. A device according to claim 1, wherein said channel is an Internet channel.

9. A device according to claim 1, said predetermined other rate being different for each stream.

10. A device according to claim 1, said predetermined other rate being identical for a set of said streams, each stream in said set being assigned a different balance between quality and speed of said media.

11. A device according to claim 1, said media file comprising a plurality of media types, said predetermined other rate being identical for a set of said streams, each stream in said set being assigned a different balance between quality of said different media types.

12. A device according to claim 10, said streams in said set being selectable by a signal received from said channel.

13. A device according to claim 11, said streams in said set being selectable by a signal received from said channel.

14. A device according to claim 1, comprising a detector for detecting a change in the bandwidth of said at least one channel and operable to request a corresponding change in the data rate, and wherein the device is operable, upon receipt of said request, to set a delay, and to issue a reference frame within said delay.

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15. A device according to claim 14, operable to issue said reference frame at the end of said delay.

16. A device according to claim 14, operable to issue said reference frame at the occurrence of a largest detected interframe change within the time delay.

17. A multiple stream creator for receiving a data stream at a first data rate and converting said data stream into a plurality of data streams at a plurality of data rates, said creator comprising an input for receiving said data stream at said first data rate, and a plurality of outputs, each operable to receive said data stream at said first rate and to output said data stream at a predetermined rate individually set for each output as a series of autonomous units having a duration, and wherein said duration is one of a group comprising a fixed predetermined duration and a duration dynamically changeable in accordance with bandwidth conditions in a transmission channel.

18. A multiple stream creator according to claim 17, wherein said outputs each comprise data buffers.

19. A multiple stream creator according to claim 17, comprising a data stream processor for processing said data stream received at said first rate into said plurality of autonomous units, said autonomous units being synchronized blocks, thereby allowing said output streams to be mixed in said transmission channel to produce continuously usable output.

20. A multiple stream creator according to claim 17, wherein said received data stream is in an uncompressed data format and wherein said data is compressed into a compressed data format independently for each one of said output data streams.

21. A method of sending a datastream over a variable bandwidth channel comprising modifying a quantity of data to be injected into the channel to accord with a measured capacity of the channel, said method comprising the steps of

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compressing the datastream, using an algorithm having compression parameters, to produce a plurality of compressed datastreams each comprising reference frames and delta frames, each compressed datastream produced by using the algorithm together with different parameters, and

synchronizing reference frames between the compressed datastreams so that combinations of said compressed datastreams can be sent via said channel.

22. A method according to claim 21, wherein said step of synchronizing reference frames is carried out at intervals determined by a dynamic status of said channel bandwidth.

23. A method according to claim 21, wherein said step of synchronizing reference frames is carried out at predetermined intervals.

24. A method according to claim 21, wherein said combination of said compressed datastreams is selected substantially dynamically to match the measured capacity of the channel.

25. A method according to claim 22, wherein a change in bandwidth of a channel causes a request for commencement of a new autonomous unit, and wherein said request causes initiation of measurement of a time delay, and wherein a new autonomous unit is commenced within said time delay.

26. A method according to claim 25, wherein said new autonomous unit is commenced at the end of said time delay.

27. A method according to claim 25, comprising the step of determining the largest delta frame during the time delay and sending a reference frame, to initiate said new autonomous unit, in place of said determined largest delta frame.

28. A tool for controlling receipt of media file data over a network, wherein said media file data is available at a plurality of quality levels, the

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tool comprising a quality selector to enable a user to select between said different quality levels for receipt.

29. A tool according to claim 28, wherein said media file comprises a plurality of data groups and wherein each quality level is a different balance between quality levels of the plurality of data groups.

30. A tool according to claim 28, wherein said quality selector comprises a slider operable to be moved along a scale, the position of the slider on the scale indicating a quality level.

31. A device for streaming of media file data to be sent over at least one channel having a dynamically variable bandwidth, substantially as hereinbefore described with reference to the accompanying drawings.

32. A multiple stream creator for receiving a data stream at a first data rate and converting said data stream into a plurality of data streams at a plurality of data rates, substantially as hereinbefore described with reference to the accompanying drawings.

33. A method of sending a datastream over a variable bandwidth channel comprising modifying a quantity of data to be injected into the channel to accord with a measured capacity of the channel, substantially as hereinbefore described with reference to the accompanying drawings.

34. A tool for controlling receipt of media file data over a network, substantially as hereinbefore described with reference to the accompanying drawings.

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Application No: GB 0023062.3 **Examiner:** John Cullen
Claims searched: 1-27, 31-33 **Date of search:** 6 November 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): H4P (PDCFM, PDCFP, PDCFX, PF)

Int Cl (Ed.7): H03M 7/30; H04L 1/00; H04N 7/26, 7/32

Other: Online: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A, E	EP 1049074 A1	(LUCENT) See Abstract, Figs. 2 and 4, and paragraphs 14-18 and 28-35.	---
A, E	WO 00/72601 A2	(BIGBAND NETWORKS) See Figs. 1-4, 6, 7 and 9, line 26 of p15 to line 24 of p17 and line 10 of p21 to line 2 of p22.	---
A	WO 99/00984 A1	(CITRIX) See Fig. 15 and line 13 of p30 to line 14 of p33.	---
A	WO 98/09387 A1	(ERICSSON) See Figs. 3A, 6 and 7, and line 35 of p14 to line 26 of p15.	---
A	US 5847760	(OPTIBASE) See whole document.	---

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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Examiner Name	Chirag R. Patel
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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8521836	B2	2013-08-27	Kewalramani et al.	
	2	7558869	B2	2009-07-07	Leon et al.	
	3	7707303	B2	2010-04-27	Albers et al.	
	4	7925781	B1	2011-04-12	Chan et al.	
	5	8880721	B2	2014-11-04	Hurst et al.	
	6	9344496	B2	2016-05-17	Hurst et al.	
	7	8683066	B2	2014-03-25	Hurst et al.	
	8	8686066	B2	2014-04-01	Kwampian et al.	

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	9	6708213	B1	2004-03-16	Bommaiah et al.	
	10	6757796	B1	2004-06-29	Hofmann	
	11	9462074	B2	2016-10-04	Guo et al.	

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	1	20050033855	A1	2005-02-10	Moradi et al.	
	2	20030093790	A1	2003-05-15	Logan et al.	
	3	20030195977	A1	2003-10-16	Liu et al.	
	4	20040199655	A1	2004-10-07	Davies et al.	
	5	20040267956	A1	2004-12-30	Leon et al.	
	6	20040220926	A1	2004-11-04	Lamkin et al.	

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	Application Number	16252356
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	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	066.0141X1C8

	7	20060010003	A1	2006-01-12	Kruse	
	8	20060277564	A1	2006-12-07	Jarman	
	9	20150058496	A1	2015-02-26	Hurst et al.	
	10	20100262711	A1	2010-10-14	Bouazizi	
	11	20050251832	A1	2005-11-10	Chiueh	
	12	20040221088	A1	2004-11-04	Lisitsa et al.	
	13	20040179032	A1	2004-09-16	Huang	
	14	20020161908	A1	2002-10-31	Benitez et al.	
	15	20030021282	A1	2003-01-30	Hospodor	
	16	20080120330	A1	2008-05-22	Reed et al.	
	17	20080120342	A1	2008-05-22	Reed et al.	

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	18	20110307545	A1	2011-12-15	BOUAZIZI	
	19	20050262257	A1	2005-11-24	Major et al.	
	20	20030236904	A1	2003-12-25	Walpole et al.	

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	1	Krasic et al., QUALITY-ADAPTIVE MEDIA STREAMING BY PRIORITY DROP, Oregon Graduate Institute, 2001.	☓
	2	Krasic et al., QoS SCALABILITY FOR STREAMED MEDIA DELIVERY, Oregon Graduate Institute School of Science & Engineering Technical Report CSE 99-011, September 1999.	☒
	3	Huang et al., ADAPTIVE LIVE VIDEO STREAMING BY PRIORITY DROP, Portland State University PDXScholar, July 21, 2003.	☒

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	4	Walpole et al, A PLAYER FOR ADAPCTIVE MPEG VIDEO STREAMING OVER THE INTERNET, Oregon Graduate Institute of Science and Technology, October 25, 2012.	☒
	5	ALBANESE, ANDREW ET AL. "Priority Encoding Transmission", TR-94-039, August 1994, 36 pgs, International Computer Science Institute, Berkeley, CA.	☒
	6	BIRNEY, BILL "Intelligent Streaming", May 2003, Microsoft.	☒
	7	GOYAL, VIVEK K. "Multiple Description Coding: Compression Meets the Network," September 2001, pgs. 74-93, IEEE Signal Processing Magazine.	☒
	8	ON2 TECHNOLOGIES, INC. "TrueMotion VP7 Video Codec" White Paper, Document Version 1.0, January 10, 2005.	☒
	9	PATHAN, AL-MUKADDIM ET AL. "A Taxonomy and Survey of Content Delivery Networks" Australia, February 2007, available at http://www.gridbus.org/reports/CDN-Taxonomy.pdf.	☒
	10	PURI, ROHIT ET AL. "Multiple Description Source Coding Using Forward Error Correction Codes," October 1999, 5 pgs., Department of Electrical Engineering and Computer Science, University of California, Berkeley, CA.	☒
	11	WICKER, STEPHEN B. "Error Control Systems for Digital Communication and Storage," Prentice-Hall, Inc., New Jersey, USA, 1995, parts 1-6.	☒
	12	LIU, JIANGCHUAN ET AL. "Opportunities and Challenged of Peer-to-Peer Internet Video Broadcast," School of Computing Science, Simon Fraser University, British Columbia, Canada.	☒
	13	CLEMENT, B. "Move Networks closes $11.3 Million on First Round VC Funding," Page One PR, Move Networks, Inc. Press Releases, February 7, 2007, http://www.move.tv/press/press20070201.html.	☒
	14	MOVE NETWORKS, INC. "The Next Generation Video Publishing System," April 11, 2007; http://www.movenetworks.com/wp-content/uploads/move-networks-publishing-system.pdf.	☒

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	15	YOSHIMURA, TAKESHI ET AL. "Mobile Streaming Media CDN Enabled by Dynamic SMIL", NTT DoCoMo, Multimedia Laboratories and Hewlett-Packard Laboratories,dated May 7-11, 2002, ACM 1-58113-449-5/02/0005; http://www2002.org/CDROM/refereed/515/.	☒
	16	Nguyen, T. et al., Multiple Sender Distributed Video Streaming, IEEE TRANSACTINOS ON MULTIMEDIA, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 6, no. 2, April 1, 2004, pages 315-326, XP011109142, ISSN: 1520-9210, DOI: 10.1109/TMM.2003.822790.	☒

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Examiner Name	Chirag R. Patel
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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

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☐ Before the mailing date of a first Office Action on the merits. In the event that a first Office Action on the merits has been mailed, please consider this IDS under 37 C.F.R. 1.97(c) and see the statement under 1.97(e) **or** charge deposit account 50-2091 the fee specified by 37 C.F.R. 1.17(p) if such statement is not selected in Section IV.

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VI. CONCLUSION

It is respectfully submitted that the claims presently on file patently distinguish the present invention from each of the references cited in this IDS. The references cited in this IDS are being cited only in the interest of candor and without any admission that they constitute statutory prior art or contain matter which anticipates the invention or which would render the same obvious, either singly or in a combination, to a person of ordinary skill in the art. Furthermore the filing of this IDS should not be construed to be an admission that the information cited in this IDS is, or is considered to be, material to patentability as defined in 1.56(b). In addition, the filing of this IDS should not be construed as a representation that a search has been made.

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(54) Adaptive media stream

(57) This invention relates to media streams transmitted in a network, such as the Internet. The idea is to change the source of the content of a media stream when an available transmission speed rate changes. Each source contains essentially the same information (such as video and voice), but the suitability of each source for transmission has been adjusted to a certain speed rate.

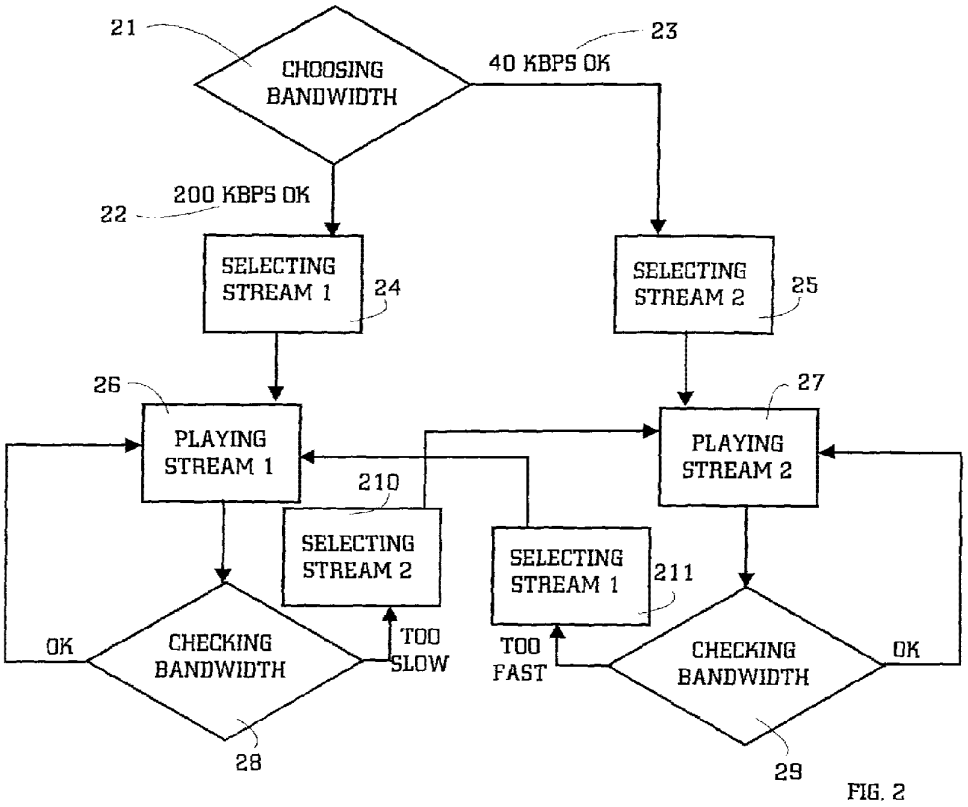


FIG. 2

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Description

FIELD OF THE INVENTION

[0001] This invention relates to media streams transmitted in a network, such as the Internet. Especially, the invention relates to media streams concerning video pictures and voice.

BACKGROUND OF THE INVENTION

[0002] When media streams that contain continuous data, for example video pictures and voice, are transmitted in a network, such as the Internet, the speeds of the media streams have to be adjusted with the speed of the transmission connection available at the time. Often, in the case of video pictures, the adjustment is made by changing the visual quality of the pictures. The speed of a transmission connection in the Internet depends strongly on a user's Internet terminal. Some terminals support technically higher speed rates than others (usually older terminals). Thus, speed adjusted media streams must be offered for a variety of terminals.

[0003] Transmission speed may also vary with time. For example, when congestion happens in the network, the transmission speed may decrease considerably. After the congestion, the transmission speed returns to the normal speed rate.

[0004] Nowadays, most of the content of the Internet is in WWW servers, which use the HTTP protocol for transmitting desired contents to users. Originally, the HTTP protocol was not designed for continuous media streams (video, voice). The problem of the known solutions is that when a media stream has to be adjusted for a changed transmission condition, i.e. to be an adaptive media stream, a special software or protocol must be used, instead of the HTTP protocol. Real Server® (RealNetworks Inc, Seattle, Washington), Quicktime® Server (Apple Computers, Cupertino California), and Windows Media Server® (Microsoft, Redmond, Washington) are commercial server software, which support adaptive media streams. These software packages use special protocols, such as RTP (Real-Time Transport Protocol) and RTSP (Real Time Streaming Protocol), which are designed for the adaptive media streams.

[0005] However, using these software packages usually requires a user to invest and maintain parallel devices and software in addition to the WWW server that is used to serve other Internet content, such as web pages. User communities such as corporations require support staff which must be educated to use these systems. For a service provider this means in practice that a special media stream server must be maintained. The goal of this invention is to eliminate these drawbacks. This is achieved in a way described in the claims.

SUMMARY OF THE INVENTION

[0006] The following definitions should be kept in mind when reading these specifications:

Connection: A transport layer virtual circuit established between two programs for the purpose of communication. A connection can have varying transmission speed rates.

HTTP transport: An application layer transmission of data from a file on a server computer to a user terminal using HTTP 1.1 protocol. One HTTP 1.1 connection can consist of one or several HTTP 1.1 transports.

Stream: A continuous transmission of data over for example HTTP transport

[0007] An important aspect of the invention is to change the source of an adaptive media stream when an available connection speed rate changes. Each source contains essentially the same information (such as video and voice), but the suitability of each source for transmission has been adjusted to a certain connection speed rate. The coding of the source information can be different among the sources, which affects the speed rate. The picture information can be black-and-white instead of a color picture. The picture size can be smaller or larger. The video can be with or without voice. When the source is changed, also a new HTTP transmission for the new source is started for a new stream containing the information of the new source. In other words, the adaptive media stream, i.e. the adaptive stream, comprises at least one media stream for transmitting information.

[0008] In an arrangement according to the invention a source file is formed. The source file contains a plurality of sources intended for different media streams, according to such parameters as bandwidth, computing capability of the receiving terminal, etc. At the beginning of the transmission the optimal transmission speed rate at the time is chosen according to an information transfer condition. The source in the source file, which corresponds to the available speed rate, is selected to be the source of the adaptive media stream. When the available transmission speed rate changes, either to be faster or slower, a command for changing the source of the adaptive media stream, is sent from the user's terminal to the service provider's server, i.e. the source server, wherein the file of the service is. Preferably commands are sent using an HTTP protocol. When the available transmission speed rate changes again, a new command for changing the source is sent from the user's terminal to the source server. The commands are sent when it is possible to use a higher speed rate or when a lower speed rate must be used.

[0009] In one aspect, the invention thus provides a method for providing an adaptive media stream between a sending terminal and a user's terminal wherein

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the adaptive media stream comprises at least one media stream and the method comprises the steps of choosing a transmission speed rate for the media stream, selecting a suitable data source for the media stream among sources containing essentially the same information content, each source intended for a certain information transfer condition and playing the media stream. During such playing, checking the suitability of the actual transmission speed rate, and continuing playing the media stream if the transmission speed is still suitable or selecting a new data source, which is suitable at the moment as a response for the selection of the new data source, playing a new media stream. Those selection actions continue until the played stream stops.

[0010] Optionally, the step of choosing comprises the phase of reading a header field of a file, which contains at least two data sources, the header indicating the starting points of the sources and to which transmission speed rate each source is indented. Yet another option calls for the selecting step to include the phase of starting to read from the starting point of the selected source.

[0011] Other aspect of the invention provide for the step of monitoring to include the phase of monitoring a filling degree of a buffer for incoming data in the user's terminal, e.g. if the buffer is becoming empty or full, then selecting to continue to play the present media stream or to start playing another media stream. The information of the selection of the new data source may transmitted from the user's terminal to the sending terminal using a GET method of an HTTP protocol with an optional RANGE field. When a new stream is played, an optional phases of terminating the old media stream after starting to play the new media stream and creating the new media stream before playing the new media stream is also contemplated.

[0012] If a new stream is selected, according to another aspect of the invention, the step of reading timing marks in said adaptive media stream for defining the right point to start playing the new media stream is also performed. Further, the step of selecting the initial speed may comprise the phase of reading a header field of files, where each contains one data source, the header indicating the starting points of the source and to which transmission speed rate the source is indented.

[0013] An arrangement for providing an adaptive media stream between a sending terminal and a user's terminal, is also contemplated, wherein the adaptive media stream comprises at least one media stream and the arrangement comprises:

a) Means in the client terminal for choosing a transmission speed rate for the media stream,
b) A data structure in the sending terminal comprising at least two data sources containing essentially the same information, each source intended for a certain transmission speed rate,
c) Means in the client terminal and the sending terminal for selecting a suitable data source from among the sources for the media stream,
d) Means in the user's terminal for checking the suitability of the transmission speed rate when the media stream is played,
e) Means in the user's terminal for reselecting a suitable data source from among the sources for a new media stream.

[0014] An arrangement as described above may further comprise means for playing the data structure in a way that the playing is started from the right point of the data structure. Preferably, means a) comprises means for reading a message from the user's terminal, which defines alternative transmission speed rates. Further preferably, each source comprises timing marks, which indicate the corresponding point in the other sources. More preferably, the arrangement further comprises a GET method of an HTTP protocol with an optional RANGE field for transmitting the information of the reselection of the suitable data source from the user's terminal to the sending terminal. In another preferable embodiment, means d) comprises means for monitoring a filling degree of a buffer for incoming data in the user's terminal. It also preferable that the data structure is a file containing the data sources. Alternatively, the data structure may be a number of files, each of them containing one data source.

[0015] Means c) may further comprise means for reading a header of the data structure, which indicates the starting points of the sources and to which transmission speed rate each source is intended. Means c) may further comprise means for reading headers of the files, which indicate the starting point of the source and to which transmission speed rate the source is intended.

[0016] In yet another aspect, the invention teaches a method for storing adaptive media stream data comprising the steps of storing a plurality of media streams, each representing a substantially similar information content, and each adapted for a different set of information transfer conditions; and providing a plurality of pointers into a first of said media streams, said pointers associated with a source location in one of said media streams and pointing to at least one target location in a second of said media streams; wherein the information content of said target location is substantially a continuation of the information content prior to said source location.

[0017] Preferably, said plurality of media streams is contained in a single file. Said pointers are preferably embedded within said adaptive media stream data, and comprise target locations pointer comprises a byte offset into said single file. Alternatively, said target location pointer comprises an offset into said second source stream, within said single file. Another alternative teaches that said target locations pointers comprise a pointer to another file containing said second media stream or a portion thereof. Optionally in this case, said target location pointer further comprises a byte offset into said

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other file.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In the following the invention is described in more detail by means of Figs. **1 - 3** in the attached drawings where.

FIG. **1** illustrates an example of the structure of a file according to the invention,
FIG. **2** illustrates an example of a flow chart describing the function of the inventive arrangement,
FIG. **3** illustrates an example of an arrangement according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] FIG. **1** describes an example of a file structure according to the invention. The file is in the service provider's server (source server) from where users can stream it. For example the file contains a video in two different formats. At the beginning of the file there exists a header **1**, which contains starting bytes for two different media sources - the sources for the media stream. Source 1, called stream 1 contains video data in a resolution of 320*240, for a speed rate 200 kbps (kilobit per second) **2.** The starting byte **4** for that video data is byte 2000 in the file. Source 2, called stream 2 contains video data in a resolution of 160*120 optimized for a speed rate 40 kbps **3.** The starting byte of that video data **5** in the file is at byte 800000. If the network and a user's terminal support the transmission speed rate 200 kbps then stream 1 is sent to the user - otherwise stream 2 is sent. In this embodiment, all data feeds are assumed to support communication at a speed of at least 40 kbps. It should be noted that stream 1 and 2 are sources i.e. the parts of the file structures in this example, and a media stream is a continuous transmission of data of a source over a transmission protocol. The transmission protocol used can be any protocol, in this text the HTTP protocol is used.

[0020] Stream 1 is sent, i.e. streamed, to the user. Stream 1 (and the media stream for it as well) contains timing marks **6, 7, 8, 9.** The timing marks are embedded in stream 1 at a various locations, and correlate the information in the two separate resolution streams. Thus the timing marks of stream 1 in the example of Fig. 1 indicate the byte of the file where the stream is running at the time and the corresponding byte **6A, 7A, 8A, 9A,** in stream 2. If for some reason, the network can not transmit stream 1 with 200 kbps, or the user's terminal can not receive at this speed rate, the transmission of the video is changed to stream 2. For example, when the need to change the speed rate to a lower one is noticed and the most recently received (or alternatively the next) timing mark is, let's say, the mark **7** indicating time 1000 ms, it tells the corresponding byte 805000 in stream 2 to where the source of the transmission of the video transfers **11.**

[0021] Similarly, stream 2 (and the media stream for it) contains timing marks **10**, **11**, **12**, **13**, which point to the location of corresponding information in stream 1, as shown by the corresponding byte **10A, 11A**, **12A**, **13A**, in stream 1. When the capability of transmitting 200 kbps is noticed during the transmission at 40 kbps rate, the transmission of the video is changed to stream 1. For example, when the availability of the higher speed rate is noticed and the next timing mark is the mark **13** indicating time 3000 ms, the corresponding byte 77000, located in stream 1, points to the location of corresponding information in stream 1 so the source of transmission is shifted to stream 1, using data stored in location **9** onwards.

[0022] FIG. **2** shows an example of a flow chart, which illustrates a function and method of the invention. FIG. **3** shows an example of the inventive arrangement. When a user visits a home page of a service provider, he/she may find something he wants to order, such as a video show. The video player client running in the user terminal sends **34** a request message from the terminal **33** to the service provider's server **31** through the network **32**, such as the Internet, to get the show using a GET method, which is one of the methods defined in the HTTP1.1 protocol. Let the request be:

GET http://www.serviceprovider.com/video/music/song1.video. **HTTP/1.1**

[0023] Often, the connection speed rate depends on the available (and optional) connection and processing speeds of the terminal. At the beginning, the first stream which is sent works like a test stream. The test stream, i.e. the first stream preferably forms the first part of the file structure, which preferably contains data for the lowest bandwidth. Thus the first stream over the HTTP transport also contains a list of alternative speed rates. The player in the client terminal chooses **21** one of the supported speed rate from the list. (It should be noted that the server can be informed of the capability of a terminal or the available bandwidth using other techniques and the specific method of learning the link capabilities is a matter of technical choice to one skilled in the art.) In this example, the user's terminal supports speed rates of 200 kbps and 40 kbps. Let's assume that the desired file **36** is the file in FIG. **1**. If the speed rate of 200 kbps **22** is available, stream 1 is selected **24**. Otherwise, the speed rate of 40 kbps **23** is chosen and stream 2 is selected **25.** (Notice that the higher speed rate means the higher bandwidth.)

[0024] In the selection of the speed rate of 200 kbps the server starts to play **26** stream 1 beginning at byte (2000) of the file. The data and the timing marks are sent **35** to the user's terminal during the play. The terminal checks **28** frequently that the currently available bandwidth is sufficient for the selected stream. If the bandwidth is sufficient, playing stream 1 is continued. If the bandwidth becomes unavailable for stream 1, stream 2 is selected **210** and stream 2 starts to play **27**, **311** be-

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ginning at the byte of the file defined by the latest timing mark. The bandwidth of stream 2 is checked **29** similarly as the bandwidth of stream 1, and when the bandwidth is again available for the speed rate of 200 kbps, stream 1 is selected **211**.

[0025] In the selection of the speed rate of 40 kbps the server starts to play **25** stream 2 from the right byte (800000) of the file. The data and the timing marks are sent **35** to the user's terminal during the play. The terminal checks **29** frequently that the bandwidth is okay for the selected stream. If the bandwidth is still restricted to 40 kbps, playing stream 2 is continued. If the bandwidth rise to a level sufficient to support 200 kbps transmission, stream 1 is selected **211** and stream 1 starts to play **26**, and is sent **311** to the terminal **33** beginning at the byte of the file defined by the latest timing mark. The bandwidth of stream 1 is checked **28** similarly as the bandwidth of stream 2, and when the bandwidth is again too slow for the speed rate of 200 kbps, stream 2 is selected **210**.

[0026] The checking of the bandwidth of the streams can be made, for example, measuring a filling degree of a buffer for incoming data connection in the user's terminal. When the buffer is becoming empty, the required bandwidth for current stream is too high compared to what is available through the network connection, and the speed rate should be dropped. When the buffer is becoming full, bandwidth for current stream is lower than what is available through the network connection, and the speed rate can be raised. After the measurement, the suitable stream source is selected **210, 211** and a GET command with an additional field RANGE is sent **310** from the user's terminal to the server for changing the stream. For example, let the GET command be GET http://www.serviceprovider.com/video/music/song3video RANGE: bytes= 805000- when the transmission speed rate changes from 200 kbps to 40 kbps.

[0027] It is worth noting that preferably, when a stream is changed, a new HTTP transport (and naturally a new media stream) is started and the old media stream is terminated after the new media stream starts playing. From the view of the user the desired file, such as a video show, seems to continue without any break because the new stream starts playing from the byte indicated by the timing mark, thus the information continuity is maintained, despite the media stream switch. So, when the source is changed, also a new HTTP transport is created for the new stream, i.e. media stream, instance and for the new source. Thus the adaptive media stream, i. e. the adaptive stream, is made up of one media stream or several consecutive media streams. Since the consecutive media streams carry essentially the same data, a user gets a visual impression of continuous shows. In other words, the adaptive media stream comprises at least one media stream for transmitting information. The HTTP 1.1 protocol provides a feature called Persistent Connections. Persistent Connection means that several requests (such as GET), can be sent via one TCP connection. Thus one connection may carry several consecutive streams. However, it should be noted that several TCP connections may be needed or used for transmitting consecutive streams.

[0028] Furthermore, it may be said that the adaptive media stream comprises several (or one if the speed rate remains the same during the whole transmission) instances (separate streams) of the same object (the adaptive media stream containing information such as video). Naturally, there are more ways to model the adaptive media stream, but common for these models are that transmission of information of the adaptive stream, (the stream of a continuous data, such as video over one or several connections) happens in one or several consecutive media streams over a transport protocol, each media stream adapted for certain conditions, and certain links or pointers periodically connect or cross connect the media streams in essentially content coherent fashion. Thus varying transmission conditions may dictate how many suitable media streams are sent forming together the adaptive stream.

[0029] For creating the inventive arrangement an initial selection module **39** (i.e. means) for choosing an original transmission speed rate and selecting a suitable source in a service provider's server is needed. In a user's terminal another estimation module **37** (i.e. means for checking transmission rate) is needed, for checking the suitability of the transmission speed rate as reselection module **38** (i.e. means) for reselecting a suitable source are needed.

[0030] Although, the processing and network connection speed of a user's terminal is mostly the decisive element when selecting a suitable transmission speed rate, it may happen that the network itself becomes congested. In congestion, the available speed rate decreases and the transmission speed rate must be lowered. On the other hand, if the network allows a higher speed, the transmission speed rate may be increased.

[0031] Using the inventive arrangement, an adaptive media stream can be served from with a common HTTP server. Therefore, there is no need for the use of a special media stream server, or parallel devices and software. Remarkable cost savings are achieved, since usually service providers and users support the HTTP protocol. Also the reliability of the system increases because of fewer sources of faults.

[0032] It is clear that inventive arrangement can be implemented in many ways. For example, the time period between two timing marks can be different than in the example of this text. It can be any suitable period depending on the features of a solution, such as 2 or 4 seconds. The format of the inventive file can be any suitable format as well, such as MPEG or another.

[0033] The inventive file may comprise more than two different streams (containing the same content), from which the most suitable stream is selected at any given time. Therefore, timing marks must contain a number of references for the corresponding byte in the other data

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sources.

[0034] All the sources do not have to be in the same file, but each source can be a separate file. However, the use of this kind of structure is not as efficient when attempting to use as little processing power as possible compared to the use of one file structure. In the structure of several files, timing marks must indicate the right file with the corresponding byte.

[0035] Although, a sending terminal have been described to be a server in the examples above, it is clear that the sending terminal can be another terminal capable of sending information.

[0036] Similarly other mechanisms are known and suitable to measure and select the most appropriate source. Such methods may be server based or user terminal based, or even utilize intermediate network nodes to estimate network congestion and bandwidth, and similar measurements that are indicative of total node to node capacity, as well as specific node capabilities, and the selection of sources (and media streams) may be carried out in various ways that will provide the best end-user experience according to varying conditions.

[0037] According to the above-mentioned matters, it is evident that the invention is not restricted to the solutions described in this text, but it can be modified for various solutions, in the scope of the inventive idea.

Claims

1. A method for providing an adaptive media stream between a sending terminal and a user's terminal **characterized in that** the adaptive media stream comprises at least one media stream and the method comprises the steps of:

    a) choosing a transmission speed rate for the media stream,
    b) selecting a suitable data source for the media stream among sources containing essentially the same information, each source intended for a certain transmission speed rate,
    c) playing the media stream,
    d) checking the suitability of the transmission speed rate,
    e) either continuing playing the media stream if the transmission speed is still suitable or,
    f) selecting a new data source, which is suitable at the moment,
    g) as a response for the selection of the new data source, playing a new media stream,
    h) repeating steps d) to g) until the stream, which is played, stops.

2. A method according to claim 1 **characterized in that** step b) comprises the phase of reading a header field of a file, which contains at least two data sources, the header indicating the starting points of the sources and to which transmission speed rate each source is intended.

3. A method according to claim 2 **characterized in that** step c) comprises the phase of starting to read from the starting point of the selected source.

4. A method according to claim 1 or 3 **characterized in that** step d) comprises the phase of monitoring a filling degree of a buffer for incoming data in the user's terminal.

5. A method according to claim 4 **characterized in that** if the buffer is becoming empty or full, then step f) is chosen, else step e) is chosen.

6. A method according to claim 1 or 5 **characterized in that** the information of the selection of the new data source is transmitted from the user's terminal to the sending terminal using a GET method of an HTTP protocol with an optional RANGE field.

7. A method according to claim 1 **characterized in that** step g) comprises phases of terminating the old media stream after starting to play the new media stream and creating the new media stream before playing the new media stream.

8. A method according to claim 1 or 7, **characterized in that** step g) further comprises the phase of reading timing marks in the data source for defining the right point to start playing the new media stream.

9. A method according to claim 1 **characterized in that** step b) comprises the phase of reading a header field of files, where each contains one data source, the header indicating the starting points of the source and to which transmission speed rate the source is intended.

10. An arrangement for providing an adaptive media stream between a sending terminal and a user's terminal, **characterized in that** the adaptive media stream comprises at least one media stream and the arrangement comprises:

    a) means in the sending terminal for choosing a transmission speed rate for the media stream,
    b) a data structure in the sending terminal comprising at least two data sources containing essentially the same information, each source intended for a certain transmission speed rate,
    c) means in the sending terminal for selecting a suitable data source from among the sources for the media stream,
    d) means in the user's terminal for checking the suitability of the transmission speed rate when the media stream is played,

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e) means in the user's terminal for reselecting a suitable data source from among the sources for a new media stream.

11. An arrangement according to claim 10, **characterized in that** the arrangement further comprises means for playing the data structure in a way that the playing is started from the right point of the data structure.

12. An arrangement according to claim 11, **characterized in that** means a) comprises means for reading a message from the user's terminal, which defines alternative transmission speed rates.

13. An arrangement according to claim 11, **characterized in that** each source comprises timing marks, which indicate the corresponding point in the other sources.

14. An arrangement according to claim 13, **characterized in that** the arrangement further comprises a GET method of an HTTP protocol with an optional RANGE field for transmitting the information of the reselection of the suitable data source from the user's terminal to the sending terminal.

15. An arrangement according to claim 11, **characterized in that** means d) comprises means for monitoring a filling degree of a buffer for incoming data in the user's terminal.

16. An arrangement according to claim 11, **characterized in that** the data structure is a file containing the data sources.

17. An arrangement according to claim 16, **characterized in that** means c) comprises means for reading a header of the data structure, which indicates the starting points of the sources and to which transmission speed rate each source is intended.

18. An arrangement according to claim 11, **characterized in that** the data structure is a number of files, each of them containing one data source.

19. An arrangement according to claim 18, **characterized in that** means c) comprises means for reading headers of the files, which indicate the starting point of the source and to which transmission speed rate the source is intended.

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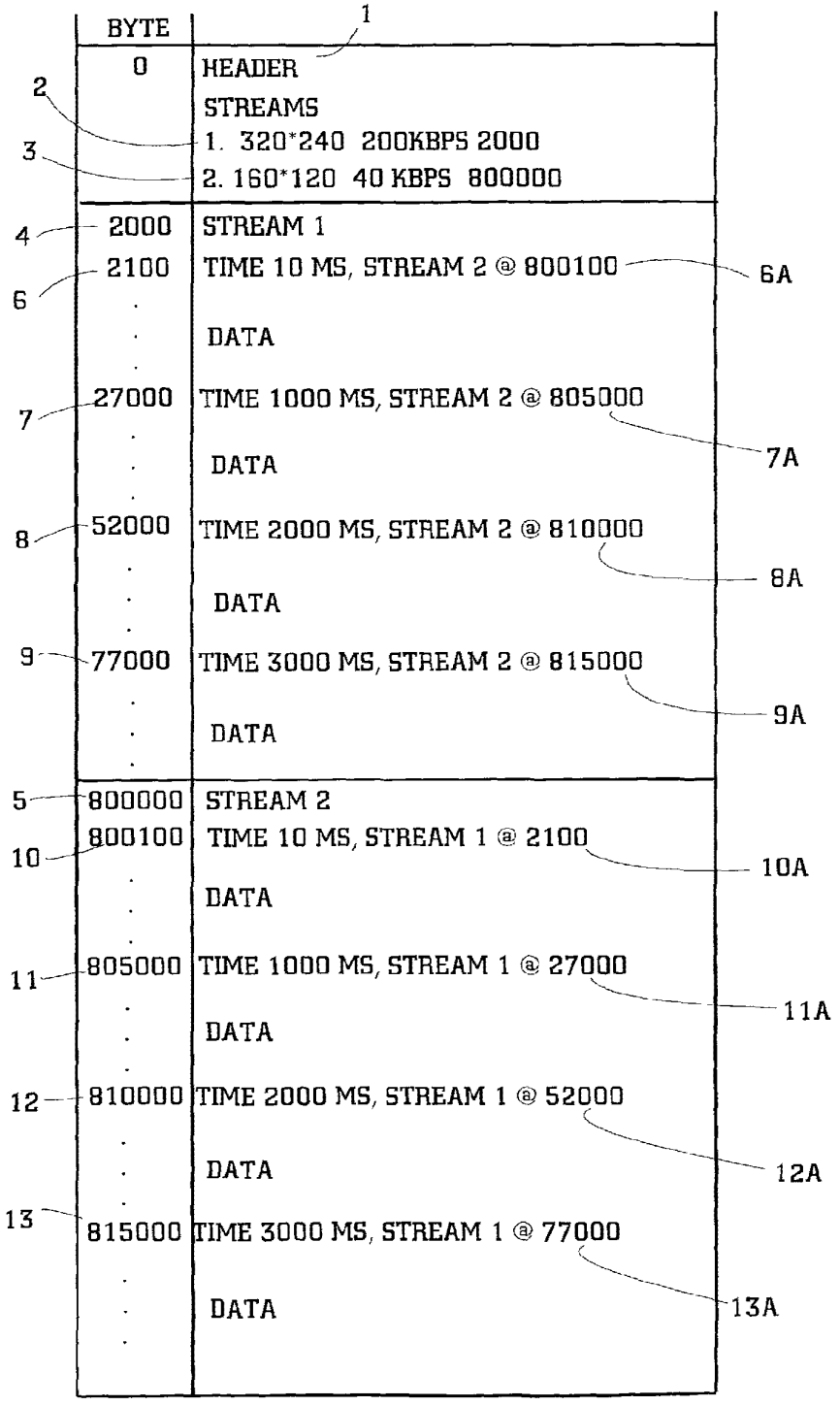


FIG. 1

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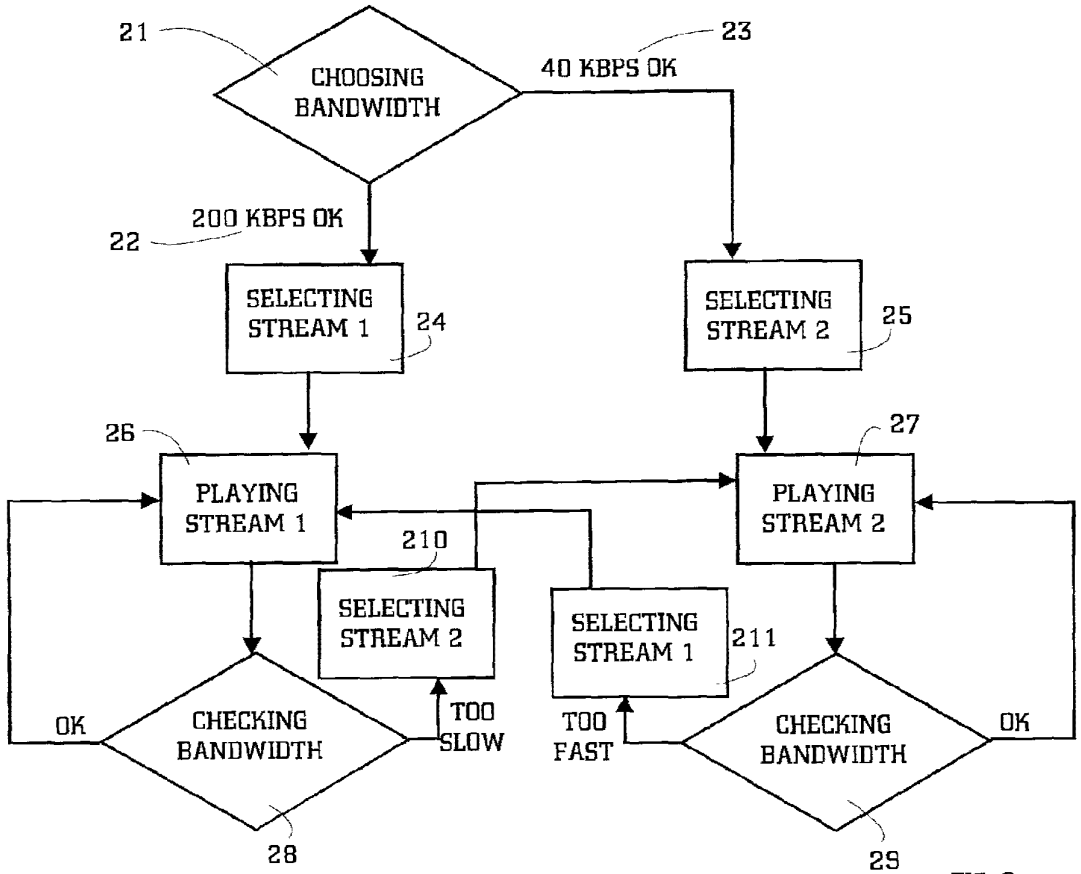


FIG. 2

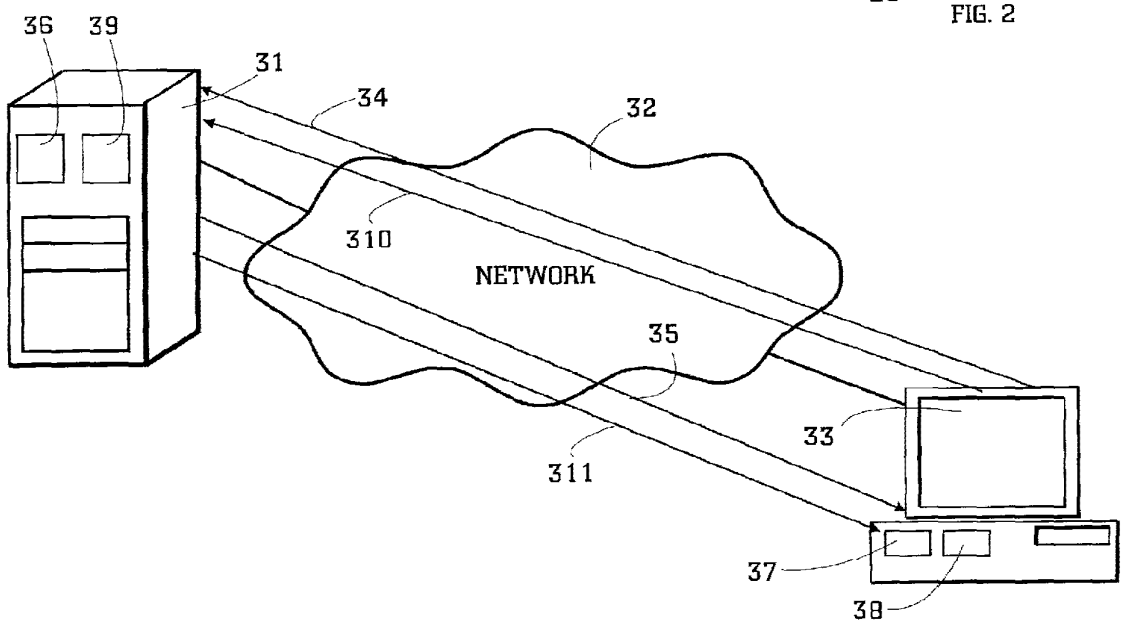


FIG. 3

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PATENT ABSTRACTS OF JAPAN

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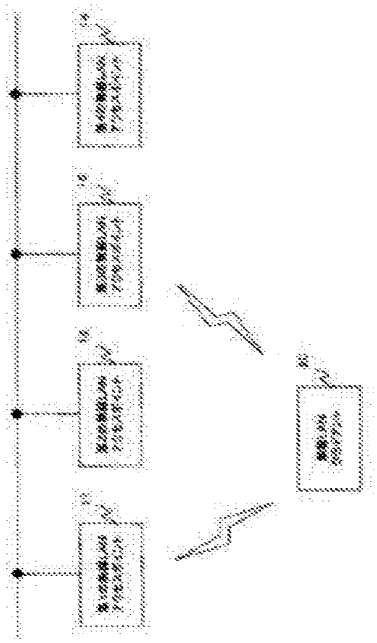
(51)Int.Cl. *H04W 48/20 (2009.01)*
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H04W 48/16 (2009.01)

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(72)Inventor : HODOSHIMA TAKESHI

(54) SYSTEM, METHOD AND PROGRAM OF HIGH-SPEED ROAMING OF WIRELESS LAN

(57)Abstract:
PROBLEM TO BE SOLVED: To attain high-speed roaming in a wireless LAN network.
SOLUTION: In a LAN system including: a plurality of wireless LAN access points; and a wireless LAN client to be connected to the wireless LAN access points, the wireless LAN access points are the ones existing on the same local area network, used channels and BSSIDS of the wireless LAN access points set to the same ESSID are recognized as wireless LAN access point information, held as data, and the wireless LAN client utilizes the wireless LAN access point information when the above connection is performed.



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H04W 84/12	(2009.01)	H04Q	7/00	630	
H04W 48/16	(2009.01)	H04Q	7/00	404	

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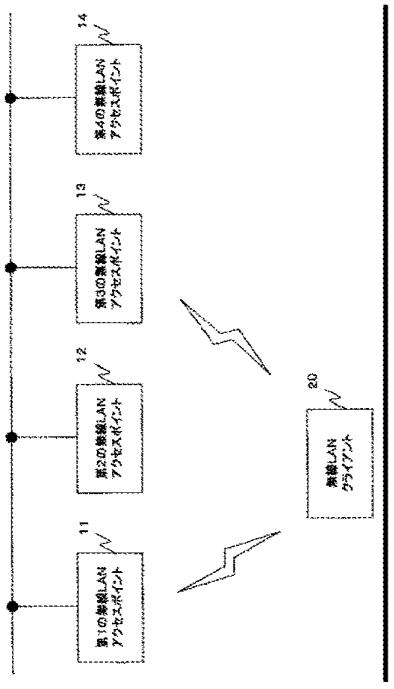
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Ｆターム(参考)　5K067 AA15 EE02 EE10 HH22 HH23 JJ72

(54)【発明の名称】無線ＬＡＮの高速ローミングシステム、高速ローミング方法及び高速ローミングプログラム

(57)【要約】
【課題】無線ＬＡＮネットワークにおいて高速ローミングを実現する。
【解決手段】複数の無線ＬＡＮアクセスポイントと、当該無線ＬＡＮアクセスポイントと接続される無線ＬＡＮクライアントと、を有する無線ＬＡＮシステムにおいて、前記無線ＬＡＮアクセスポイントは同一のローカルエリアネットワーク上に存在する無線ＬＡＮアクセスポイントであって同一のＥＳＳＩＤに設定されている無線ＬＡＮアクセスポイントの使用チャンネル及びＢＳＳＩＤを同一ネットワークの無線ＬＡＮアクセスポイント情報として認識しデータとして保持し、前記無線ＬＡＮクライアントは前記接続を行う際に前記無線ＬＡＮアクセスポイント情報を利用する。
【選択図】図１



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【特許請求の範囲】
【請求項1】
複数の無線ＬＡＮアクセスポイントと、当該無線ＬＡＮアクセスポイントと接続される無線ＬＡＮクライアントと、を有する無線ＬＡＮシステムにおける接続方法において、
前記無線ＬＡＮアクセスポイントは同一のローカルエリアネットワーク上に存在する無線ＬＡＮアクセスポイントであって同一のＥＳＳＩＤに設定されている無線ＬＡＮアクセスポイントの使用チャンネル及びＢＳＳＩＤを同一ネットワークの無線ＬＡＮアクセスポイント情報として認識しデータとして保持し、前記無線ＬＡＮクライアントは前記接続を行う際に前記無線ＬＡＮアクセスポイント情報を利用することを特徴とする接続方法。
【請求項2】
前記無線ＬＡＮアクセスポイントは、前記無線ＬＡＮクライアントと接続された際に、自らが保持している前記無線ＬＡＮアクセスポイント情報を無線ＬＡＮクライアントに受け渡すことを特徴とする請求項１に記載の接続方法。
【請求項3】
前記無線ＬＡＮクライアントは最初に前記無線ＬＡＮアクセスポイントに接続を試みる際は前記ローカルエリアネットワーク上に存在する前記無線ＬＡＮアクセスポイントの全チャンネルをスキャンし、当該スキャンをした中から最良の条件の無線ＬＡＮアクセスポイントを選択し接続し、前記無線ＬＡＮクライアントが前記無線ＬＡＮアクセスポイントと圏外から再接続を試みる際、或いは、ローミングする際には、前記受け取った無線ＬＡＮアクセスポイント情報を基に、最低限のチャンネルをスキャンし、当該スキャンをしたチャンネルの中から最良の無線ＬＡＮアクセスポイントを選択し接続することを特徴とする請求項１又は２に記載の接続方法。
【請求項4】
前記最低限のチャンネルのスキャンは、前記無線ＬＡＮクライアントが、前記無線ＬＡＮアクセスポイント情報の中から自分の接続可能なＥＳＳＩＤを持つ無線ＬＡＮアクセスポイントのチャンネルを抽出し、当該抽出したチャンネルのみを前記最低限のチャンネルと判断することにより行われることを特徴とする請求項１乃至３の何れか１項に記載の接続方法。
【請求項5】
複数の無線ＬＡＮアクセスポイントと接続される無線ＬＡＮクライアントが行う接続方法であって、
前記無線ＬＡＮアクセスポイントに最初に接続を試みる際は前記ローカルエリアネットワーク上に存在する前記無線ＬＡＮアクセスポイントの全チャンネルをスキャンし、当該スキャンをした中から最良の条件の無線ＬＡＮアクセスポイントを選択し接続し、接続された際に前記無線ＬＡＮアクセスポイントから、当該無線ＬＡＮアクセスポイントと同一のローカルエリアネットワーク上に存在する無線ＬＡＮアクセスポイントであって同一のＥＳＳＩＤに設定されている無線ＬＡＮアクセスポイントの使用チャンネル及びＢＳＳＩＤを同一ネットワークの無線ＬＡＮアクセスポイント情報として受け取り、前記無線ＬＡＮクライアントが前記無線ＬＡＮアクセスポイントと圏外から再接続を試みる際、或いは、ローミングする際には、前記受け取った無線ＬＡＮアクセスポイント情報を基に、最低限のチャンネルをスキャンし、その中から最良の無線ＬＡＮアクセスポイントを選択し接続することを特徴とする接続方法。
【請求項6】
複数の無線ＬＡＮアクセスポイントと、当該無線ＬＡＮアクセスポイントと接続される無線ＬＡＮクライアントと、を有する無線ＬＡＮ接続システムにおいて、
前記無線ＬＡＮアクセスポイントは同一のローカルエリアネットワーク上に存在する無線ＬＡＮアクセスポイントであって同一のＥＳＳＩＤに設定されている無線ＬＡＮアクセスポイントの使用チャンネル及びＢＳＳＩＤを同一ネットワークの無線ＬＡＮアクセスポイント情報として認識しデータとして保持し、前記無線ＬＡＮクライアントは前記接続を

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行う際に前記無線ＬＡＮアクセスポイント情報を利用することを特徴とする接続システム。

【請求項7】

前記無線ＬＡＮアクセスポイントは、前記無線ＬＡＮクライアントと接続された際に、自らが保持している前記無線ＬＡＮアクセスポイント情報を無線ＬＡＮクライアントに受け渡すことを特徴とする請求項６に記載の接続システム。

【請求項8】

前記無線ＬＡＮクライアントは最初に前記無線ＬＡＮアクセスポイントに接続を試みる際は前記ローカルエリアネットワーク上に存在する前記無線ＬＡＮアクセスポイントの全チャンネルをスキャンし、当該スキャンをした中から最良の条件の無線ＬＡＮアクセスポイントを選択し接続し、前記無線ＬＡＮクライアントが前記無線ＬＡＮアクセスポイントと圏外から再接続を試みる際、或いは、ローミングする際には、前記受け取った無線ＬＡＮアクセスポイント情報を基に、最低限のチャンネルをスキャンし、当該スキャンをしたチャンネルの中から最良の無線ＬＡＮアクセスポイントを選択し接続することを特徴とする請求項６又は７に記載の接続システム。

【請求項9】

前記最低限のチャンネルのスキャンは、前記無線ＬＡＮクライアントが、前記無線ＬＡＮアクセスポイント情報の中から自分の接続可能なＥＳＳＩＤを持つ無線ＬＡＮアクセスポイントのチャンネルを抽出し、当該抽出したチャンネルのみを前記最低限のチャンネルと判断することにより行われることを特徴とする請求項６乃至８の何れか１項に記載の接続システム。

【請求項10】

複数の無線ＬＡＮアクセスポイントと接続される無線ＬＡＮクライアントにおいて、

前記無線ＬＡＮアクセスポイントに最初に接続を試みる際は前記ローカルエリアネットワーク上に存在する前記無線ＬＡＮアクセスポイントの全チャンネルをスキャンし、当該スキャンをした中から最良の条件の無線ＬＡＮアクセスポイントを選択し接続し、接続された際に前記無線ＬＡＮアクセスポイントから、当該無線ＬＡＮアクセスポイントと同一のローカルエリアネットワーク上に存在する無線ＬＡＮアクセスポイントであって同一のＥＳＳＩＤに設定されている無線ＬＡＮアクセスポイントの使用チャンネル及びＢＳＳＩＤを同一ネットワークの無線ＬＡＮアクセスポイント情報として受け取り、前記無線ＬＡＮクライアントが前記無線ＬＡＮアクセスポイントと圏外から再接続を試みる際、或いは、ローミングする際には、前記受け取った無線ＬＡＮアクセスポイント情報を基に、最低限のチャンネルをスキャンし、その中から最良の無線ＬＡＮアクセスポイントを選択し接続することを特徴とする無線ＬＡＮクライアント。

【請求項11】

複数の無線ＬＡＮアクセスポイントと、当該無線ＬＡＮアクセスポイントと接続される無線ＬＡＮクライアントと、を有するシステムに搭載される無線ＬＡＮ接続プログラムにおいて、

前記無線ＬＡＮアクセスポイントは同一のローカルエリアネットワーク上に存在する無線ＬＡＮアクセスポイントであって同一のＥＳＳＩＤに設定されている無線ＬＡＮアクセスポイントの使用チャンネル及びＢＳＳＩＤを同一ネットワークの無線ＬＡＮアクセスポイント情報として認識しデータとして保持し、前記無線ＬＡＮクライアントは前記接続を行う際に前記無線ＬＡＮアクセスポイント情報を利用するシステムとしてコンピュータを機能させることを特徴とする接続プログラム。

【請求項12】

前記無線ＬＡＮアクセスポイントは、前記無線ＬＡＮクライアントと接続された際に、自らが保持している前記無線ＬＡＮアクセスポイント情報を無線ＬＡＮクライアントに受け渡すことを特徴とする請求項１１に記載の接続プログラム。

【請求項13】

前記無線ＬＡＮクライアントは最初に前記無線ＬＡＮアクセスポイントに接続を試みる

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際は前記ローカルエリアネットワーク上に存在する前記無線ＬＡＮアクセスポイントの全チャンネルをスキャンし、当該スキャンをした中から最良の条件の無線ＬＡＮアクセスポイントを選択し接続し、前記無線ＬＡＮクライアントが前記無線ＬＡＮアクセスポイントと圏外から再接続を試みる際、或いは、ローミングする際には、前記受け取った無線ＬＡＮアクセスポイント情報を基に、最低限のチャンネルをスキャンし、当該スキャンをしたチャンネルの中から最良の無線ＬＡＮアクセスポイントを選択し接続することを特徴とする請求項１１又は１２に記載の接続プログラム。

【請求項14】

前記最低限のチャンネルのスキャンは、前記無線ＬＡＮクライアントが、前記無線ＬＡＮアクセスポイント情報の中から自分の接続可能なＥＳＳＩＤを持つ無線ＬＡＮアクセスポイントのチャンネルを抽出し、当該抽出したチャンネルのみを前記最低限のチャンネルと判断することにより行われることを特徴とする請求項１１乃至１３の何れか１項に記載の接続プログラム。

【請求項15】

複数の無線ＬＡＮアクセスポイントと接続される無線ＬＡＮクライアントに搭載される接続プログラムにおいて、

前記無線ＬＡＮアクセスポイントに最初に接続を試みる際は前記ローカルエリアネットワーク上に存在する前記無線ＬＡＮアクセスポイントの全チャンネルをスキャンし、当該スキャンをした中から最良の条件の無線ＬＡＮアクセスポイントを選択し接続し、接続された際に前記無線ＬＡＮアクセスポイントから、当該無線ＬＡＮアクセスポイントと同一のローカルエリアネットワーク上に存在する無線ＬＡＮアクセスポイントであって同一のＥＳＳＩＤに設定されている無線ＬＡＮアクセスポイントの使用チャンネル及びＢＳＳＩＤを同一ネットワークの無線ＬＡＮアクセスポイント情報として受け取り、前記無線ＬＡＮクライアントが前記無線ＬＡＮアクセスポイントと圏外から再接続を試みる際、或いは、ローミングする際には、前記受け取った無線ＬＡＮアクセスポイント情報を基に、最低限のチャンネルをスキャンし、その中から最良の無線ＬＡＮアクセスポイントを選択し接続する無線ＬＡＮクライアントとしてコンピュータを機能させることを特徴とする接続プログラム。

【発明の詳細な説明】

【技術分野】

【0001】

本発明は、無線ＬＡＮに関し、より詳細には無線ＬＡＮのローミング又は再接続に関する。

【背景技術】

【0002】

近年無線ＬＡＮの機器の低価格化等の影響もあり、無線ＬＡＮが一般に広く普及している。また、無線ＬＡＮを構築する際に１つのローカルエリアネットワーク内に多数の無線ＬＡＮアクセスポイントを敷設するといったことも一般的に行われている。

【0003】

このような環境下において無線ＬＡＮクライアントは、１つのローカルエリアネットワーク内の全ての無線ＬＡＮアクセスポイントを対象として、接続可能な無線ＬＡＮアクセスポイントを検索する。

【0004】

そして、無線ＬＡＮクライアントは、検索の結果に基づいて最良と判断した無線ＬＡＮアクセスポイントに対して接続動作をする（例えば特許文献１参照）。

【図面の簡単な説明】

【0016】

【図1】本発明の実施形態における無線ＬＡＮネットワークの基本的構成の例を表す図である。

【図2】本発明の実施形態における各機器の設定の例を表す図である。

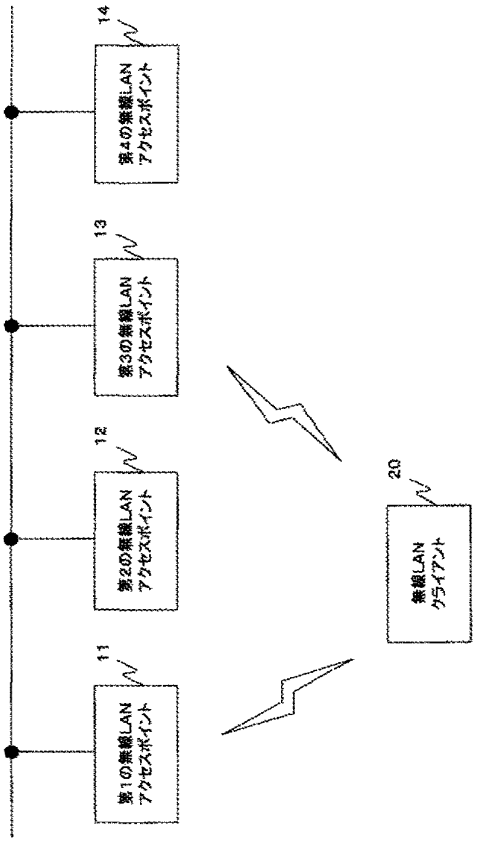
【図3】本発明の実施形態における無線ＬＡＮアクセスポイント情報の例を表す図である

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。
【図4】本発明の実施形態における無線ＬＡＮクライアントの無線ＬＡＮアクセスポイント接続動作を表すフローチャートである。
【符号の説明】
【0045】
１１　第１の無線ＬＡＮアクセスポイント
１２　第２の無線ＬＡＮアクセスポイント
１３　第３の無線ＬＡＮアクセスポイント
１４　第４の無線ＬＡＮアクセスポイント
２０　無線ＬＡＮクライアント

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【図1】



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【図2】

各機器の設定			
SYSTEM NAME	BSSID	ESSID	CH
AP11	11111−11111	Office1	1
AP12	22222−22222	Office1	4
AP13	33333−33333	Office1	7
AP14	44444−44444	Office2	14
CL20	−	Office1	−

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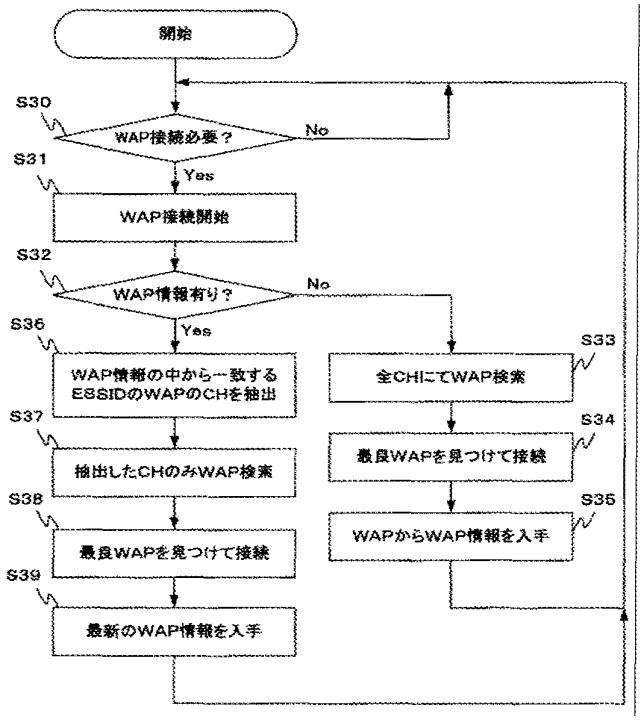
【図3】

無線LANアクセスポイント情報			
SYSTEM NAME	BSSID	ESSID	CH
AP11	11111−11111	Office1	1
AP12	22222−22222	Office1	4
AP13	33333−33333	Office1	7
AP14	44444−44444	Office2	14

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【図4】



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Electronic Patent Application Fee Transmittal

Application Number:	16252356
Filing Date:	18-Jan-2019
Title of Invention:	APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING
First Named Inventor/Applicant Name:	DAVID F. BRUECK
Filer:	Brett Carlson/Julie Graf
Attorney Docket Number:	066.0141X1C8

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**240**

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16252356
Filing Date	2019-01-18
First Named Inventor	David F. Brueck
Art Unit	2447
Examiner Name	Patel, Chirag R.
Attorney Docket Number	066.0141X1C8

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7577750	B2	2009-08-18	Shen et al.	
	2	6195680	B1	2001-02-27	Goldszmidt et al.	
	3	6449719	B1	2002-09-10	Baker	
	4	7369610	B2	2008-05-06	Xu et al.	
	5	7408984	B2	2008-08-05	Lu et al.	
	6	7523181	B2	2009-04-21	Swildens et al.	
	7	6976090	B2	2005-12-13	Ben-Shaul et al.	
	8	7240100	B1	2007-07-03	Wein et al.	

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	Art Unit	2447
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	Attorney Docket Number	066.0141X1C8

	9	6850965	B2	2005-02-01	Allen	
	10	7334044	B1	2008-02-19	Allen	
	11	7760801	B2	2010-07-20	Ghanbari et al.	
	12	7099954	B2	2006-08-29	Li et al.	
	13	6760772	B2	2004-07-06	Zou et al.	
	14	7054911	B1	2006-05-30	Lango et al.	
	15	7797439	B2	2010-09-14	Cherkasova et al.	
	16	7477688	B1	2009-01-13	Zhang et al.	
	17	7054774	B2	2006-05-30	Batterberry et al.	
	18	5168356		1992-12-01	Acampora et al.	
	19	7818444	B2	2010-10-19	Brueck et al.	

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	Attorney Docket Number	066.0141X1C8

	20	7599307	B2	2009-10-06	Seckni et al.	
	21	7093001	B2	2006-08-15	Yang et al.	
	22	6874015	B2	2005-03-29	Kaminsky et al.	
	23	6845107	B1	2005-01-18	Kitazawa et al.	
	24	6185736	B1	2001-02-06	Ueno	
	25	57685627		1998-06-16	Zhu et al.	
	26	7274740	B2	2007-09-25	van Beek et al.	
	27	7546355	B2	2009-06-09	Kalnitsky	
	28	7174385	B2	2007-02-06	Li	
	29	7376747	B2	2008-05-20	Hartop	
	30	7719985	B2	2010-05-18	Lee et al.	

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	Attorney Docket Number	066.0141X1C8

	31	7349358	B2	2008-03-25	Hennessey et al.	
	32	7194549	B1	2007-03-20	Lee et al.	
	33	6374289	B2	2002-04-16	Delaney et al.	
	34	7325073	B2	2008-01-29	Shao et al.	
	35	7609652	B2	2009-10-27	Kellerer et al.	
	36	6795863	B1	2004-09-21	Doty, Jr.	
	37	7817985	B2	2010-10-19	Moon	
	38	7788395	B2	2010-08-31	Bowra et al.	
	39	7536469	B2	2009-05-19	Chou et al.	
	40	7412531	B2	2008-08-12	Lango et al.	
	41	7295520	B2	2007-11-13	Lee et al.	

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	First Named Inventor	David F. Brueck
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	42	7054365	B2	2006-05-30	Kim et al.	
	43	6122660		2000-09-19	Baransky et al.	
	44	7391717	B2	2008-06-24	Kiemets et al.	
	45	7260640	B1	2007-08-21	Kramer et al.	
	46	7310678	B2	2007-12-18	Gunaseelan et al.	
	47	6618752	B1	2003-09-09	Moore et al.	
	48	6721723	B1	2004-04-13	Gibson et al.	
	49	6859839	B1	2005-02-22	Zahorjan et al.	
	50	7779135	B2	2010-08-17	Hudson et al.	
	51	7593333	B2	2009-09-22	Li et al.	
	52	5953506		1999-09-14	Kalra et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	David F. Brueck
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	53	6091775		2000-07-18	Hibi et al.	
	54	6091777		2000-07-18	Guetz et al.	
	55	6195680		2001-02-27	Goldszmidt et al.	
	56	6366614		2002-04-02	Pian et al.	
	57	6389473		2002-05-14	Carmel et al.	
	58	6486803	B1	2002-11-26	Luby et al.	
	59	6490627		2002-12-03	Kalra et al.	
	60	6510553		2003-01-21	Hazra	
	61	6574591		2003-06-03	Kleiman et al.	
	62	6604118		2003-08-05	Klleiman et al.	
	63	6731600		2004-05-04	Patel et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Attorney Docket Number	066.0141X1C8

	64	5732183		2004-05-04	Graham	
	65	6968387		2005-11-22	Lanphear	
	66	7075986		2006-07-11	Girod et al.	
	67	7096271		2006-08-22	Omoigui et al.	
	68	7349976		2008-03-25	Glaser et al.	
	69	7408984	B2	2008-08-05	Lu et al.	
	70	4535355		1985-08-13	Arn et al.	
	71	8036265	B1	2011-10-11	Reynolds et al.	
	72	5687095		1997-11-11	Haskell et al.	
	73	7116894	B1	2006-10-03	Chatterton	
	74	7328243	B2	2008-02-05	Yaeger et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	75	7330908	B2	2008-02-12	Jungek	
	76	7653735	B2	2010-01-26	Mandato et al.	
	77	8612624	B2	2013-12-17	Brueck et al.	
	78	8868772	B2	2014-10-21	Major et al.	
	79	8402156	B2	2013-03-19	Brueck et al.	
	80	8370514	B2	2013-02-05	Hurst et al.	
	81	8880721	B2	2014-11-04	Hurst et al.	

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	1	20020161898	A1	2002-10-31	Hartop et al.	
	2	20050055425		2005-03-00	Lango et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	3	20050015509		2005-01-00	Sitaraman	
	4	20020131496		2002-09-00	Vasudevan et al.	
	5	20040083283	A1	2004-04-29	Sundaram et al.	
	6	20080219151	A1	2008-09-11	Ma et al.	
	7	20020152318	A1	2002-10-17	Menon et al.	
	8	20060080718	A1	2006-04-13	Gray et al.	
	9	20050120107	A1	2005-06-02	Kagan et al.	
	10	20040103444	A1	2004-05-27	Weinberg et al.	
	11	20050188051	A1	2005-08-25	Sneh	
	12	20030154239	A1	2003-08-14	Davis et al.	
	13	20040030547	A1	2004-02-12	Leaning et al.	

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	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

	14	20040117427	A1	2004-06-17	Allen et al.	
	15	20030014684	A1	2003-01-16	Kashyap	
	16	20060206246	A1	2006-09-14	Walker	
	17	20050076136	A1	2005-04-07	Cho et al.	
	18	20030018966	A1	2003-01-23	Cook et al.	
	19	20040030599	A1	2004-02-12	Sie et al.	
	20	20050262257	A1	2005-11-24	Major et al.	
	21	20050033855	A1	2005-02-10	Moradi et al.	
	22	20010047423	A1	2001-11-29	Shao et al.	
	23	20030140159	A1	2003-07-24	Campbell et al.	
	24	20020176418	A1	2002-11-28	Hunt et al.	

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	25	20020169926	A1	2002-11-14	Pinckney, III, et al.	
	26	20020178330	A1	2002-11-28	Schlowsky-Fischer et al.	
	27	20050084166	A1	2005-04-21	Bonch et al.	
	28	20020091840	A1	2002-07-11	Pulier et al.	
	29	20080281803	A1	2008-11-13	Gentric	
	30	20061068295	A1	2006-07-27	Batterberry et al.	
	31	20060165166	A1	2006-07-27	Chou et al.	
	32	20020097750	A1	2002-07-25	Gunaseelan et al.	
	33	20020152317	A1	2002-10-17	Wang et al.	
	34	20030021166	A1	2003-01-30	Soloff	
	35	20040168052	A1	2004-08-26	Clisham et al.	

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	36	20050066063	A1	2005-03-24	Grigorovitch et al.	
	37	20050204046	A1	2005-09-15	Watanabe	
	38	20060059223	A1	2006-03-16	Klemets et al.	
	39	20060168290	A1	2006-07-27	Doron	
	40	20040260701	A1	2004-12-23	Lehikoinen et al.	
	41	20090055471	A1	2009-02-26	Kozat et al.	
	42	20080222235	A1	2008-09-11	Hurst et al.	
	43	20050185578	A1	2005-08-25	Padmanabham et al.	
	44	20070280255	A1	2007-12-06	Tsang et al.	
	45	20080037527	A1	2008-02-14	Chan et al.	
	46	20080205291	A1	2008-08-28	Li et al.	

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	47	20070094405	A1	2007-04-26	Zhang	
	48	20080184688	A1	2006-08-17	Ganguly et al.	
	49	20080263180	A1	2008-10-23	Hurst et al.	
	50	20080133766	A1	2008-06-05	Luo	
	51	20070079325	A1	2007-04-05	de Heer	
	52	20070067480	A1	2007-03-22	Beek et al.	
	53	20070030833	A1	2007-02-08	Pirzada et al.	
	54	20090055547	A1	2009-02-26	Hudson et al.	
	55	20090210549	A1	2009-08-20	Hudson et al.	
	56	20100098103	A1	2010-04-22	Xiong et al.	
	57	20090043906	A1	2009-02-12	Hurst et al.	

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	58	20020161911	A1	2002-10-31	Pinckney, III et al.	
	59	20060236219	A1	2006-10-19	Grigorovitch et al.	
	60	20080046939	A1	2008-02-21	Lu et al.	
	61	20060130118	A1	2006-06-15	Damm	
	62	20070204310	A1	2007-08-30	Hua et al.	
	63	20030065803	A1	2003-04-03	Heuvelman	
	64	20040049780	A1	2004-03-11	Gee	
	65	20060133809	A1	2006-06-22	Chow et al.	
	66	20020144276	A1	2002-10-03	Radford et al.	
	67	20020073167	A1	2002-06-13	Powell et al.	
	68	20020174434	A1	2002-11-21	Lee et al.	

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	69	20020188745		2002-12-12	Hughes et al.	
	70	20030005455	A1	2003-01-02	Bowers	
	71	20030067872	A1	2003-04-10	Harrell et al.	
	72	20030081582		2003-05-01	Jain et al.	
	73	20030107994		2003-06-12	Jacobs et al.	
	74	20030135631		2003-07-17	Li et al.	
	75	20030151753		2003-08-14	Li et al.	
	76	20030152036		2003-08-14	Quigg Brown et al.	
	77	20030204519	A1	2003-10-30	Sirivara et al.	
	78	20040003101	A1	2004-01-01	Roth et al.	
	79	20040030797	A1	2004-02-12	Akinlar et al.	

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	80	20040031054	A1	2004-02-12	Dankworth et al.	
	81	20040054551	A1	2004-03-18	Ausubel et al.	
	82	20040071209		2004-04-15	Burg et al.	
	83	20040093420		2004-05-13	Gamble	
	84	20040143672	A1	2004-07-22	Padmanabham et al.	
	85	20040170392		2004-09-02	Lu et al.	
	86	20050108414		2005-05-19	Taylor et al.	
	87	20050123058		2005-06-09	Greenbaum et al.	
	88	20070024705		2007-02-01	Richter et al.	
	89	20080028428		2008-01-31	Jeong et al.	
	90	20080056373		2008-03-06	Newlin et al.	

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	Attorney Docket Number	066.0141X1C8

	91	20080162713		2008-07-03	Bowra et al.	
	92	20080195744		2008-08-14	Bowra et al.	
	93	20020029274	A1	2002-03-07	Allen	
	94	20060075446	A1	2006-04-06	Klemets et al.	
	95	20080104647	A1	2008-05-01	Hannuksela	
	96	20040220926	A1	2004-11-04	Lamkin et al.	
	97	20010013128	A1	2001-08-09	Hagai et al.	
	98	20030204602	A1	2003-10-30	Hudson et al.	
	99	20040010613	A1	2004-01-15	Apostolopoulos et al.	

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	Attorney Docket Number	066.0141X1C8

	1	2011004225	JP	A	2011-01-06	Hodoshima		
	2	2001067264	WO	A1	2001-09-13	Streamcenter, Inc.		
	3	200192752	JP		2001-04-06	Hitachi Information Systems Ltd.		
	4	2006010113	WO	A2	2006-01-26	Network Foundation Technologies, LLC		
	5	2004025405	WO	A2	2004-03-25	Thomson Licensing S.A.		
	6	2466482	CA	A1	2003-05-22	MusicMatch Inc.		
	7	2000-201343	JP		2000-07-18	Toshiba Corp.		
	8	0919952	EP	A1	1999-06-02	Mattavelli et al.		
	9	1670256	EP	A2	2006-06-14	Klements et al.		
	10	1777969	EP		2007-04-25	British Telcom		
	11	1298931	EP	A2	2003-04-02	Oplayo Oy		

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	12	1202487	EP	A2	2002-05-02	Toshiba KK		
	13	1395014	EP	A1	2004-03-03	Matsushita Electric Ind. Co. Ltd.		
	14	2367219	GB	A	2002-03-27	Vintage Global		

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	1	FUJISAWA, HIROSHI ET AL. "Implementaton of Efficient Access Mechanism for Multiple Mirror-Servers" IPSJ SIG Technical Report, vol. 2004, no. 9 (2004-DPS-116), January 30, 2004, Information Processing Society of Japan, pp. 37-42.	☒
	2	LIU, JIANGCHUAN ET AL. "Adaptive Video Multicast Over the Internet" IEEE Computer Society, 2003.	☒
	3	"The meaning of performance factor---English-Japanese Weblio Dictionary", [online], February 24, 2012, [searched on February 24, 2012], the Internet <URL:http://ejje.weblio.jp/content/performance+factor>.	☒
	4	TSURU, ET AL. "Recent evolution of the Internet measurement and inference techniques", IEICE Technical Report, Vol. 103, No. 123, pp. 37-42, June 12, 2003.	☒
	5	REJAIE, REZA ET AL. "Architectural Considerations for Playback of Quality Adaptive Video OVer the Internet" University of Southern California, Information Sciences Institute, 1998.	☒
	6	ROY, SUMIT ET AL. "A System Architecture for Managing Mobile Streaming Media Services" Streaming Media Systems Group, Hewlett-Packard Laboratories, 2003.	☒

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	Attorney Docket Number	066.0141X1C8

	7	XU, DONGYAN ET AL. "On Peer-to-Peer Media Streaming" Department of Computer Sciences, Purdue University, 2002.	☒
	8	KOZAMERINK, FRANC "Media Streaming Over the Internet - An Over of Delivery Technologies" EBU Technical Review, October 2002.	☒
	9	LIENHART, RAINER ET AL. "Challenges in Distributed Video Management and Delivery" Intel Corporation, EECS Dept., UC Berkeley, 2000-2002.	☒
	10	ZHANG, XINYAN ET AL. "CoolStreaming/DONet: A Data-Driven Overlay Network for Peer-to-Peer Live Media Streaming" IEEE 2005.	☒
	11	GUO, YANG "DirectStream: A Directory-Based Peer-to-Peer Video Streaming Service" LexisNexis, Elsevier B.V. 2007.	☒

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	Examiner Name	Patel, Chirag R.
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Name/Print	Brett A. Carlson	Registration Number	39928

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Application Number:	16252356
International Application Number:	
Confirmation Number:	8631
Title of Invention:	APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING
First Named Inventor/Applicant Name:	DAVID F. BRUECK
Customer Number:	70560
Filer:	Brett Carlson/Julie Graf
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Attorney Docket Number:	066.0141X1C8
Receipt Date:	27-JUN-2019
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	2	5404446	A	1995-04-04	Bowater et al.	
	3	5841432	A	1998-11-24	Carmel et al.	

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Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16252356
	Filing Date	2019-01-18
	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	066.0141X1C8

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/BRETT A. CARLSON/	Date (YYYY-MM-DD)	2019-06-27
Name/Print	Brett A. Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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Page 614

IDS CERTIFICATION STATEMENTS

I. THIS IDS IS BEING FILED UNDER 37 C.F.R. 1.97(b): (check one box)

☐ Within three months of the filing date of a national application other than a continued prosecution application under 1.53(d).

☐ Within three months of the date of entry of the national stage as set forth in 1.491 in an international application.

☐ Before the mailing date of a first Office Action on the merits. In the event that a first Office Action on the merits has been mailed, please consider this IDS under 37 C.F.R. 1.97(c) and see the statement under 1.97(e) **or** charge deposit account 50-2091 the fee specified by 37 C.F.R. 1.17(p) if such statement is not selected in Section IV.

☐ Before the mailing of a first Office Action after the filing of a request for continued examination under 1.114.

II. THIS IDS IS BEING FILED UNDER 37 C.F.R. 1.97(c):

☑ After the period specified in 37 C.F.R. 1.97(b) and before the mailing date of any of a final action under 1.113, a notice of allowance under 1.311 or an action that otherwise closes prosecution in the application, and accompanied by:

- ☐ a statement specified in 1.97(e) as subsequently provided in this IDS; or
- ☑ the fee set forth in 1.17(p).

III. THIS IDS IS BEING FILED UNDER 37 C.F.R. 1.97(d):

☐ After the period specified in 37 C.F.R. 1.97(c) and on or after the mailing date of any of a final action under 1.113, a notice of allowance under 1.311 or an action that otherwise closes prosecution in the application, but before or simultaneous with payment of the issue fee, and accompanied by a statement specified in 1.97(e) as subsequently provided in this IDS **and** the fee set forth in 1.17(p).

IV. Statement under 37 C.F.R. 1.97(e) (check only one box)

The undersigned hereby states that:

☐ Each item of information contained in the IDS was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this IDS.

☐ No item of information contained in the IDS was cited in a communication from a foreign patent office in a counterpart foreign application, and, to knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the IDS was known to any individual designated in 37 C.F.R. 1.56(c) more than three months prior to the filing of this IDS.

V. Statement under 37 C.F.R. §1.704(d):

☐ The undersigned hereby states that each item of information contained in the information disclosure statement: (i) was first cited in any communication from a patent office in a counterpart foreign or international application or from the Office, and this communication was not received by any individual designated in § 1.56(c) more than thirty days prior to the filing of the information disclosure statement; or (ii) is a communication that was issued by a patent office in a counterpart foreign or international application or by the Office, and this communication was not received by any individual designated in § 1.56(c) more than thirty days prior to the filing of the information disclosure statement..

VI. CONCLUSION

It is respectfully submitted that the claims presently on file patently distinguish the present invention from each of the references cited in this IDS. The references cited in this IDS are being cited only in the interest of candor and without any admission that they constitute statutory prior art or contain matter which anticipates the invention or which would render the same obvious, either singly or in a combination, to a person of ordinary skill in the art. Furthermore the filing of this IDS should not be construed to be an admission that the information cited in this IDS is, or is considered to be, material to patentability as defined in 1.56(b). In addition, the filing of this IDS should not be construed as a representation that a search has been made.

If the Examiner has any questions concerning this IDS, the Examiner is requested to contact the undersigned at the telephone number associated with Customer No. 70560 . If it is determined that this IDS has been filed under the wrong rule, the PTO is requested to consider this IDS under the proper rule, with a petition if necessary, and charge the appropriate fee to Deposit Account No. 50-2091.

Bibliographic Data

Application No: 16/252,356

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CHIRAG R PATEL/ Examiner's Signature | Initials

Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
01/18/2019	709	2454	066.0141X1C8
RULE			

APPLICANTS

DISH Technologies L.L.C., Englewood, CO, UNITED STATES

INVENTORS

DAVID F. BRUECK SARATOGA SPRINGS, UT, UNITED STATES

MARK B. HURST CEDAR HILLS, UT, UNITED STATES

R. DREW MAJOR OREM, UT, UNITED STATES

CONTINUING DATA

This application is a CON of 16252188 01/18/2019

16252188 is a CON of 16004056 06/08/2018

16004056 is a CON of 15414025 01/24/2017 PAT 9998516

15414025 is a CON of 14719122 05/21/2015 PAT 9571551

14719122 is a CON of 14106051 12/13/2013 PAT 9071668

14106051 is a CON of 13617114 09/14/2012 PAT 8612624

13617114 is a CON of 12906940 10/18/2010 PAT 8402156

12906940 is a CIP of 11673483 02/09/2007 PAT 7818444

11673483 is a CIP of 11116783 04/28/2005 PAT 8868772

11116783 has PRO of 60566831 04/30/2004

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

02/07/2019

STATE OR COUNTRY

UNITED STATES

ADDRESS

LKGLOBAL (Dish Technologies L.L.C.)
7010 E. COCHISE ROAD
SCOTTSDALE, AZ 85253
UNITED STATES

FILING FEE RECEIVED

$7,320

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

70560 7590 09/09/2019

LKGLOBAL (Dish Technologies L.L.C.)
7010 E. COCHISE ROAD
SCOTTSDALE, AZ 85253

EXAMINER
PATEL, CHIRAG R

ART UNIT	PAPER NUMBER
2454	

DATE MAILED: 09/09/2019

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/252,356	01/18/2019	DAVID F. BRUECK	066.0141X1C8	8631

TITLE OF INVENTION: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	12/09/2019

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

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Page 618

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

70560 7590 09/09/2019
LKGLOBAL (Dish Technologies L.L.C.)
7010 E. COCHISE ROAD
SCOTTSDALE, AZ 85253

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/252,356	01/18/2019	DAVID F. BRUECK	066.0141X1C8	8631

TITLE OF INVENTION: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	12/09/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
PATEL, CHIRAG R	2454	709-219000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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Page 619

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/252,356	01/18/2019	DAVID F. BRUECK	066.0141X1C8	8631

70560 7590 09/09/2019

LKGLOBAL (Dish Technologies L.L.C.)
7010 E. COCHISE ROAD
SCOTTSDALE, AZ 85253

EXAMINER	
PATEL, CHIRAG R	
ART UNIT	PAPER NUMBER
2454	

DATE MAILED: 09/09/2019

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

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Exhibit 1002
Page 620

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/252,356	Applicant(s) BRUECK et al.	
	Examiner CHIRAG R PATEL	Art Unit 2454	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the response filed on June 20, 2019.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-9 and 31-48 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 6/27/19, 6/27/19, 6/27/19.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/CHIRAG R PATEL/
Primary Examiner, Art Unit 2454

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Exhibit 1002
Page 622

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16252356
Filing Date	2019-01-18
First Named Inventor	David F. Brueck
Art Unit	2447
Examiner Name	Chirag R. Patel
Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	8521836	B2	2013-08-27	Kewalramani et al.	
	2	7558869	B2	2009-07-07	Leon et al.	
	3	7707303	B2	2010-04-27	Albers et al.	
	4	7925781	B1	2011-04-12	Chan et al.	
	5	8880721	B2	2014-11-04	Hurst et al.	
	6	9344496	B2	2016-05-17	Hurst et al.	
	7	8683066	B2	2014-03-25	Hurst et al.	
	8	8686066	B2	2014-04-01	Kwampian et al.	

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	9	6708213	B1	2004-03-16	Bommaiah et al.	
	10	6757796	B1	2004-06-29	Hofmann	
	11	9462074	B2	2016-10-04	Guo et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20050033855	A1	2005-02-10	Moradi et al.	
	2	20030093790	A1	2003-05-15	Logan et al.	
	3	20030195977	A1	2003-10-16	Liu et al.	
	4	20040199655	A1	2004-10-07	Davies et al.	
	5	20040267956	A1	2004-12-30	Leon et al.	
	6	20040220926	A1	2004-11-04	Lamkin et al.	

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	7	20060010003	A1	2006-01-12	Kruse	
	8	20060277564	A1	2006-12-07	Jarman	
	9	20150058496	A1	2015-02-26	Hurst et al.	
	10	20100262711	A1	2010-10-14	Bouazizi	
	11	20050251832	A1	2005-11-10	Chiueh	
	12	20040221088	A1	2004-11-04	Lisitsa et al.	
	13	20040179032	A1	2004-09-16	Huang	
	14	20020161908	A1	2002-10-31	Benitez et al.	
	15	20030021282	A1	2003-01-30	Hospodor	
	16	20080120330	A1	2008-05-22	Reed et al.	
	17	20080120342	A1	2008-05-22	Reed et al.	

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	18	20110307545	A1	2011-12-15	BOUAZIZI	
	19	20050262257	A1	2005-11-24	Major et al.	
	20	20030236904	A1	2003-12-25	Walpole et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	Krasic et al., QUALITY-ADAPTIVE MEDIA STREAMING BY PRIORITY DROP, Oregon Graduate Institute, 2001.	☓
	2	Krasic et al., QoS SCALABILITY FOR STREAMED MEDIA DELIVERY, Oregon Graduate Institute School of Science & Engineering Technical Report CSE 99-011, September 1999.	☒
	3	Huang et al., ADAPTIVE LIVE VIDEO STREAMING BY PRIORITY DROP, Portland State University PDXScholar, July 21, 2003.	☒

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	Attorney Docket Number	066.0141X1C8

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	4	Walpole et al, A PLAYER FOR ADAPCTIVE MPEG VIDEO STREAMING OVER THE INTERNET, Oregon Graduate Institute of Science and Technology, October 25, 2012.	☒
	5	ALBANESE, ANDREW ET AL. "Priority Encoding Transmission", TR-94-039, August 1994, 36 pgs, International Computer Science Institute, Berkeley, CA.	☒
	6	BIRNEY, BILL "Intelligent Streaming", May 2003, Microsoft.	☒
	7	GOYAL, VIVEK K. "Multiple Description Coding: Compression Meets the Network," September 2001, pgs. 74-93, IEEE Signal Processing Magazine.	☒
	8	ON2 TECHNOLOGIES, INC. "TrueMotion VP7 Video Codec" White Paper, Document Version 1.0, January 10, 2005.	☒
	9	PATHAN, AL-MUKADDIM ET AL. "A Taxonomy and Survey of Content Delivery Networks" Australia, February 2007, available at http://www.gridbus.org/reports/CDN-Taxonomy.pdf.	☒
	10	PURI, ROHIT ET AL. "Multiple Description Source Coding Using Forward Error Correction Codes," October 1999, 5 pgs., Department of Electrical Engineering and Computer Science, University of California, Berkeley, CA.	☒
	11	WICKER, STEPHEN B. "Error Control Systems for Digital Communication and Storage," Prentice-Hall, Inc., New Jersey, USA, 1995, parts 1-6.	☒
	12	LIU, JIANGCHUAN ET AL. "Opportunities and Challenged of Peer-to-Peer Internet Video Broadcast," School of Computing Science, Simon Fraser University, British Columbia, Canada.	☒
	13	CLEMENT, B. "Move Networks closes $11.3 Million on First Round VC Funding," Page One PR, Move Networks, Inc. Press Releases, February 7, 2007, http://www.move.tv/press/press20070201.html.	☒
	14	MOVE NETWORKS, INC. "The Next Generation Video Publishing System," April 11, 2007; http://www.movenetworks.com/wp-content/uploads/move-networks-publishing-system.pdf.	☒

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	15	YOSHIMURA, TAKESHI ET AL. "Mobile Streaming Media CDN Enabled by Dynamic SMIL", NTT DoCoMo, Multimedia Laboratories and Hewlett-Packard Laboratories,dated May 7-11, 2002, ACM 1-58113-449-5/02/0005; http://www2002.org/CDROM/refereed/515/.	☒
	16	Nguyen, T. et al., Multiple Sender Distributed Video Streaming, IEEE TRANSACTINOS ON MULTIMEDIA, IEEE SERVICE CENTER, PISCATAWAY, NJ, US, vol. 6, no. 2, April 1, 2004, pages 315-326, XP011109142, ISSN: 1520-9210, DOI: 10.1109/TMM.2003.822790.	☒

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EXAMINER SIGNATURE

Examiner Signature	/CHIRAG R PATEL/	Date Considered	08/22/2019

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	16252356
	Filing Date	2019-01-18
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	Art Unit	2447
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	066.0141X1C8

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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/BRETT A. CARLSON/	Date (YYYY-MM-DD)	2019-06-27
Name/Print	Brett A. Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	03/19/2019	08/22/2019							
1	1	✓	=							
2	2	✓	=							
3	3	✓	=							
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Exhibit 1002
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Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

CLAIM		DATE								
Final	Original	03/19/2019	08/22/2019							
22	43		=							
23	44		=							
24	45		=							
25	46		=							
26	47		=							
27	48		=							

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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	Art Unit
	CHIRAG R PATEL	2454

CPC - Searched*		
Symbol	Date	Examiner
H04N19/34, H04N19/40, HO4N21/23427	03/14/2019	C.P.
H04N21/2662,H04N21/234327, H04N21/2393, H04L65/80, H04L67/2842, H04L65/4069, H04L65/607, H04L65/608	08/21/2019	C.P.

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

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Search Notes	Date	Examiner
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Inventor / Double patent search	03/14/2019	C.P.
EAST	08/21/2019	C.P.
IP.COM	08/22/2019	C.P.

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H04N	H04N21/2662,H04N21/234327, H04N21/2393	08/21/2019	C.P.
H04L	H04L65/80, H04L67/2842, H04L65/4069, H04L65/607, H04L65/608	08/21/2019	C.P.

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Doc description: Information Disclosure Statement (IDS) Filed

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	1	5267334	A	1993-11-30	Normille et al.	
	2	5404446	A	1995-04-04	Bowater et al.	
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	1	20020156912	A1	2002-10-24	Hurst et al.	
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	ROY, S., et al., "Architecture of a Modular Streaming Media Server for Content Delivery Networks," 2002 IEEE. Published in the 2003 International Conference on Multimedia and Expo ICME 2003.	☒
	2	BOMMAIAH, E., et al., "Design and Implementation of a Caching System for Streaming Media over the Internet," 2000 IEEE. Published in RTAS '00 Proceedings of the Sixth IEEE Real Time Technology and Applications Symposium (RTAS 2000), page 111.	☒

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EXAMINER SIGNATURE

Examiner Signature	/CHIRAG R PATEL/	Date Considered	08/22/2019

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	16252356
	Filing Date	2019-01-18
	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Chirag R. Patel
	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

None

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/BRETT A. CARLSON/	Date (YYYY-MM-DD)	2019-06-27
Name/Print	Brett A. Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	7	(("9998516") or ("9571551") or ("9071668") or ("8612624") or ("8402156") or ("7818444") or ("8868772")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/03/12 11:12
S2	1	("20180295174").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/03/12 11:26
S3	0	(("("8880721" | "20030093790" | "8686066" | "8683066" | "20080120330" | "9344496" | "20050262257" | "9462074" | "7925781" | "8683066" | "6757796" | "20050262257" | "6389473" | "6708213" | "20080120330" | "20080120342" | "7925781" | "20110307545" | "20030093790" | "20080120342" | "9344496" | "8686066" | "20030236904" | "20110307545" | "8880721" | "20020087717").PN.").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/03/12 12:07
S4	2	(("20050055425") or ("7369610")).PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/03/12 12:10
S5	68	encod$3 near3 stream with "600" near kbps	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/12 12:22
S6	11587	scalable near2 video near2 cod$3	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/12 12:27
S7	11587	scalable near2 video near2 cod$3 AND @AD<"200400430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/12 12:28
S8	525	scalable near2 video near2 cod$3 AND @AD<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/12 12:28
S10	282	enhancement adj layer AND bit-rate with encod$3	US-PGPUB; USPAT; USOCR;	OR	ON	2019/03/12 12:41

			FPRS; EPO			
S11	233	enhancement adj layer AND bit-rate with encod$3 and mpeg	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/12 12:42
S12	23	enhancement adj layer AND bit-rate with encod$3 and mbps	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/12 13:14
S13	23	("8880721" | "20030093790" | "8686066" | "8683066" | "20080120330" | "9344496" | "20050262257" | "9462074" | "7925781" | "8683066" | "6757796" | "20050262257" | "6389473" | "6708213" | "20080120330" | "20080120342" | "7925781" | "20110307545" | "20030093790" | "20080120342" | "9344496" | "8686066" | "20030236904" | "20110307545" | "8880721" | "20020087717").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/13 12:37
S14	1	("7818444").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/03/14 12:22
S15	0	client near3 request with enhancement near2 layer with switch$3 with bit-rate	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 12:37
S16	9	client with scalable with video with switch$3	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 12:40
S17	23	scalable near2 video near2 cod$3 WITH STREAM AND @AD< "20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 12:40
S18	9	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND client near2 request with streamlet	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 12:41
S19	60	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND switch$3 with enhancement near2 layer	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 12:41
S20	8	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND request with	US-PGPUB;	OR	ON	2019/03/14 12:42

		switch$3 with enhancement near2 layer	USPAT; USOCR; FPRS; EPO			
S21	118	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND request with enhancement near2 layer	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 12:42
S22	25	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND request with enhancement near2 layer and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 12:44
S23	0	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND live same chunk$3 and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 14:10
S24	5	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND live and (streamlet chunk$3) and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 14:11
S25	1	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND live and (streamlet chunk$3) and enhancement AND @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 14:12
S26	1	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND live NEAR STREAM and ENHANCEMENT adj layer and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 14:15
S27	4	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND real near2 time with chunk$3 and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 14:19
S28	4	enhancement near2 layer AND live and (streamlet chunk$3) and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 14:21
S29	36	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND timeline and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 15:23
S30	1	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND timeline and	US-PGPUB;	OR	ON	2019/03/14 15:23

		enhancement adj layer AND @ad<"20040430"	USPAT; USOCR; FPRS; EPO			
S31	8	timeline SAME enhancement adj layer AND @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 15:28
S32	0	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND VIRTUAL ADJ timeline and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 15:41
S33	9	timeline same playback AND enhancement adj layer AND @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 15:59
S34	13	timeline same playback same playlist AND @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 16:25
S35	0	timeline same playback same playlist AND scalable AND @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 16:25
S36	5	timeline same playback same playlist AND enhancement AND @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 16:25
S37	1	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND delay near2 "10" near2 second and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 19:54
S38	0	enhancement near2 layer AND live same sports and (streamlet chunk$3) and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:04
S39	394	live same sports and (streamlet chunk$3) and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:04
S40	0	scalab$3 near2 video AND live same sports and (streamlet chunk$3) and	US-PGPUB;	OR	ON	2019/03/14 20:04

		@ad<"20040430"	USPAT; USOCR; FPRS; EPO			
S41	2	scal$3 near2 video AND live same sports and (streamlet chunk$3) and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:04
S42	0	live same sports WITH EVEN SAME ENCOD$3 and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:05
S43	0	live same sports WITH EVEN SAME BIT$2RATE and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:05
S44	2	scal$3 near2 video AND EVENT NEAR3 sports and (streamlet chunk$3) and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:06
S45	0	scal$3 near2 video SAME EVENT NEAR3 sports and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:07
S46	4	((H04N19/34 OR H04N19/40 OR H04N21/234327).CPC.) AND LIVE NEAR3 SPORTS and @ad<"20040430"	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/03/14 20:09
S47	1	("7934159").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/03/18 12:27
S48	2	streamlets with live near2 stream with bitrate	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/08/20 11:16
S49	2	streamlets with live near2 stream	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/08/20 11:16
S50	15	streamlets with stream with bit$2rate	US-PGPUB; USPAT; USOCR;	OR	ON	2019/08/20 11:19

			FPRS; EPO			
S51	43	((H04N21/2662 OR H04N21/234327 OR H04N21/2393 OR H04L65/80 OR H04L67/2842 OR H04L65/4069 OR H04L65/607 OR H04L65/608).CPC.) and streamlets with bitrate	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/08/20 11:40
S52	43	((H04N21/2662 OR H04N21/234327 OR H04N21/2393 OR H04L65/80 OR H04L67/2842 OR H04L65/4069 OR H04L65/607 OR H04L65/608).CPC.) and streamlets with bitrate	US-PGPUB; USPAT; USOCR; FPRS; EPO	OR	ON	2019/08/20 11:41
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		"7116894"	"7174385"	"7194549"				
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		"7295520"	"7310678"	"7325073"				
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		"7577750"	"7593333"	"7599307"				
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EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S53	39	((H04N21/2662 OR H04N21/234327 OR H04N21/2393 OR H04L65/80 OR H04L67/2842 OR H04L65/4069 OR H04L65/607 OR H04L65/608).CPC.) and streamlets and live adj event	US-PGPUB; USPAT	OR	ON	2019/08/21 08:11
S54	42	((H04N21/2662 OR H04N21/234327 OR H04N21/2393 OR H04L65/80 OR H04L67/2842 OR H04L65/4069 OR H04L65/607 OR H04L65/608).CPC.) and streamlets with bitrates	US-PGPUB; USPAT	OR	ON	2019/08/21 08:12
S55	31	((H04N21/2662 OR H04N21/234327 OR H04N21/2393 OR H04L65/80 OR H04L67/2842 OR H04L65/4069 OR H04L65/607 OR H04L65/608).CPC.) and streamlets with bitrates and live adj event	US-PGPUB; USPAT	OR	ON	2019/08/21 08:12
S56	22	streamlet with live adj event AND LOW near quality AND medium adj quality AND high adj quality	US-PGPUB; USPAT	OR	ON	2019/08/21 08:13
S57	2	streamlet with live adj event AND different near3 bit$2rate	US-PGPUB; USPAT	OR	ON	2019/08/21 08:50
S58	2	streamlet with live adj event AND different near3 bit$2rate	US-PGPUB; USPAT	OR	ON	2019/08/21 11:39

8/ 22/ 2019 1:03:49 PM
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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

CPC						
Symbol					**Type**	**Version**
H04L	/	65	/	607	F	2013-01-01
H04L	/	47	/	801	I	2013-01-01
H04L	/	47	/	12	I	2013-01-01
H04L	/	65	/	4069	I	2013-01-01
G06F	/	16	/	71	I	2019-01-01
G06F	/	16	/	183	I	2019-01-01
H04L	/	29	/	06027	I	2013-01-01
H04N	/	7	/	24	I	2013-01-01
H04N	/	21	/	23439	I	2013-01-01
H04N	/	21	/	4331	I	2013-01-01
H04N	/	21	/	84	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	608	I	2013-01-01
H04L	/	67	/	02	I	2013-01-01
H04L	/	65	/	1069	I	2013-01-01
H04L	/	67	/	2842	I	2013-01-01
H04L	/	67	/	32	I	2013-01-01
H04N	/	21	/	2662	I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 27	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454 (Primary Examiner)	22 August 2019 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office — Part of Paper No.: 20190822

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Exhibit 1002
Page 649

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	29	/	06

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 27	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454 (Primary Examiner) 22 August 2019 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
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NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 27	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454 (Primary Examiner)	22 August 2019 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

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Part of Paper No.: 20190822

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Exhibit 1002
Page 651

Complete Main Concept Text
==========
select streamlets live video bitrates

(No Concept Modifiers)
==========

(No Filters)
==========

Options
=======
De-dup: None
Cut-off: None
Sort: Relevance

Collections (189)
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US Patents
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Bulgaria Applications
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Czech Republic Applications
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Czechoslovakia Applications
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Denmark Applications
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Australia Applications
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India Applications
Indonesia Patents
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Mongolia Patents
New Zealand Patents
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Singapore Patents
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Thailand Applications
Uzbekistan Patents
Vietnam Patents
Algeria Patents
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ARIPO Applications
Egypt Patents
Kenya Patents
Malawi Patents
Morocco Patents
Morocco Applications
OAPI Patents
South Africa Patents
Tunisia Applications
Zambia Patents
Zimbabwe Patents
EAPO Patents
EAPO Applications
Georgia Patents
Georgia Applications
Kazakhstan Patents
Kazakhstan Applications
Russia Patents
Russia Applications
Turkey Patents
Turkey Applications
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IEEE Xplore Publications: IEEE Conferences
IEEE Xplore Publications: IEEE Standards
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IEEE Xplore Publications: URSI Periodicals
IEEE Xplore Publications: VDE Conferences
IEEE Xplore Publications: Periodicals from China
IP.com Prior Art Database: The IP.com Journal
IP.com Prior Art Database: Internet Society RFC
IP.com Prior Art Database: IBM TDB Archive
IP.com Prior Art Database: Legacy Journals
IP.com Prior Art Database: Software Patent Institute
OnePetro.org: Periodicals at OnePetro.org
OnePetro.org: Conferences at OnePetro.org
OnePetro.org: Standards at OnePetro.org
Other Literature: IBM Redbooks
Other Literature: PubMed Central

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16252356
Filing Date	2019-01-18
First Named Inventor	David F. Brueck
Art Unit	2447
Examiner Name	Patel, Chirag R.
Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7577750	B2	2009-08-18	Shen et al.	
	2	6195680	B1	2001-02-27	Goldszmidt et al.	
	3	6449719	B1	2002-09-10	Baker	
	4	7369610	B2	2008-05-06	Xu et al.	
	5	7408984	B2	2008-08-05	Lu et al.	
	6	7523181	B2	2009-04-21	Swildens et al.	
	7	6976090	B2	2005-12-13	Ben-Shaul et al.	
	8	7240100	B1	2007-07-03	Wein et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	First Named Inventor	David F. Brueck
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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	9	6850965	B2	2005-02-01	Allen	
	10	7334044	B1	2008-02-19	Allen	
	11	7760801	B2	2010-07-20	Ghanbari et al.	
	12	7099954	B2	2006-08-29	Li et al.	
	13	6760772	B2	2004-07-06	Zou et al.	
	14	7054911	B1	2006-05-30	Lango et al.	
	15	7797439	B2	2010-09-14	Cherkasova et al.	
	16	7477688	B1	2009-01-13	Zhang et al.	
	17	7054774	B2	2006-05-30	Batterberry et al.	
	18	5168356		1992-12-01	Acampora et al.	
	19	7818444	B2	2010-10-19	Brueck et al.	

 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	20	7599307	B2	2009-10-06	Seckni et al.	
	21	7093001	B2	2006-08-15	Yang et al.	
	22	6874015	B2	2005-03-29	Kaminsky et al.	
	23	6845107	B1	2005-01-18	Kitazawa et al.	
	24	6185736	B1	2001-02-06	Ueno	
	25	57685627		1998-06-16	Zhu et al.	
	26	7274740	B2	2007-09-25	van Beek et al.	
	27	7546355	B2	2009-06-09	Kalnitsky	
	28	7174385	B2	2007-02-06	Li	
	29	7376747	B2	2008-05-20	Hartop	
	30	7719985	B2	2010-05-18	Lee et al.	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	31	7349358	B2	2008-03-25	Hennessey et al.	
	32	7194549	B1	2007-03-20	Lee et al.	
	33	6374289	B2	2002-04-16	Delaney et al.	
	34	7325073	B2	2008-01-29	Shao et al.	
	35	7609652	B2	2009-10-27	Kellerer et al.	
	36	6795863	B1	2004-09-21	Doty, Jr.	
	37	7817985	B2	2010-10-19	Moon	
	38	7788395	B2	2010-08-31	Bowra et al.	
	39	7536469	B2	2009-05-19	Chou et al.	
	40	7412531	B2	2008-08-12	Lango et al.	
	41	7295520	B2	2007-11-13	Lee et al.	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	42	7054365	B2	2006-05-30	Kim et al.	
	43	6122660		2000-09-19	Baransky et al.	
	44	7391717	B2	2008-06-24	Kiemets et al.	
	45	7260640	B1	2007-08-21	Kramer et al.	
	46	7310678	B2	2007-12-18	Gunaseelan et al.	
	47	6618752	B1	2003-09-09	Moore et al.	
	48	6721723	B1	2004-04-13	Gibson et al.	
	49	6859839	B1	2005-02-22	Zahorjan et al.	
	50	7779135	B2	2010-08-17	Hudson et al.	
	51	7593333	B2	2009-09-22	Li et al.	
	52	5953506		1999-09-14	Kalra et al.	

 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	53	6091775		2000-07-18	Hibi et al.	
	54	6091777		2000-07-18	Guetz et al.	
	55	6195680		2001-02-27	Goldszmidt et al.	
	56	6366614		2002-04-02	Pian et al.	
	57	6389473		2002-05-14	Carmel et al.	
	58	6486803	B1	2002-11-26	Luby et al.	
	59	6490627		2002-12-03	Kalra et al.	
	60	6510553		2003-01-21	Hazra	
	61	6574591		2003-06-03	Kleiman et al.	
	62	6604118		2003-08-05	Kleiman et al.	
	63	6731600		2004-05-04	Patel et al.	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	64	5732183		2004-05-04	Graham	
	65	6968387		2005-11-22	Lanphear	
	66	7075986		2006-07-11	Girod et al.	
	67	7096271		2006-08-22	Omoigui et al.	
	68	7349976		2008-03-25	Glaser et al.	
	69	7408984	B2	2008-08-05	Lu et al.	
	70	4535355		1985-08-13	Arn et al.	
	71	8036265	B1	2011-10-11	Reynolds et al.	
	72	5687095		1997-11-11	Haskell et al.	
	73	7116894	B1	2006-10-03	Chatterton	
	74	7328243	B2	2008-02-05	Yaeger et al.	

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	75	7330908	B2	2008-02-12	Jungek	
	76	7653735	B2	2010-01-26	Mandato et al.	
	77	8612624	B2	2013-12-17	Brueck et al.	
	78	8868772	B2	2014-10-21	Major et al.	
	79	8402156	B2	2013-03-19	Brueck et al.	
	80	8370514	B2	2013-02-05	Hurst et al.	
	81	8880721	B2	2014-11-04	Hurst et al.	

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	1	20020161898	A1	2002-10-31	Hartop et al.	
	2	20050055425		2005-03-00	Lango et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16252356
	Filing Date	2019-01-18
	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

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	3	20050015509		2005-01-00	Sitaraman	
	4	20020131496		2002-09-00	Vasudevan et al.	
	5	20040083283	A1	2004-04-29	Sundaram et al.	
	6	20080219151	A1	2008-09-11	Ma et al.	
	7	20020152318	A1	2002-10-17	Menon et al.	
	8	20060080718	A1	2006-04-13	Gray et al.	
	9	20050120107	A1	2005-06-02	Kagan et al.	
	10	20040103444	A1	2004-05-27	Weinberg et al.	
	11	20050188051	A1	2005-08-25	Sneh	
	12	20030154239	A1	2003-08-14	Davis et al.	
	13	20040030547	A1	2004-02-12	Leaning et al.	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	14	20040117427	A1	2004-06-17	Allen et al.	
	15	20030014684	A1	2003-01-16	Kashyap	
	16	20060206246	A1	2006-09-14	Walker	
	17	20050076136	A1	2005-04-07	Cho et al.	
	18	20030018966	A1	2003-01-23	Cook et al.	
	19	20040030599	A1	2004-02-12	Sie et al.	
	20	20050262257	A1	2005-11-24	Major et al.	
	21	20050033855	A1	2005-02-10	Moradi et al.	
	22	20010047423	A1	2001-11-29	Shao et al.	
	23	20030140159	A1	2003-07-24	Campbell et al.	
	24	20020176418	A1	2002-11-28	Hunt et al.	

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	25	20020169926	A1	2002-11-14	Pinckney, III, et al.	
	26	20020178330	A1	2002-11-28	Schlowsky-Fischer et al.	
	27	20050084166	A1	2005-04-21	Bonch et al.	
	28	20020091840	A1	2002-07-11	Pulier et al.	
	29	20080281803	A1	2008-11-13	Gentric	
	30	20061068295	A1	2006-07-27	Batterberry et al.	
	31	20060165166	A1	2006-07-27	Chou et al.	
	32	20020097750	A1	2002-07-25	Gunaseelan et al.	
	33	20020152317	A1	2002-10-17	Wang et al.	
	34	20030021166	A1	2003-01-30	Soloff	
	35	20040168052	A1	2004-08-26	Clisham et al.	

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	36	20050066063	A1	2005-03-24	Grigorovitch et al.	
	37	20050204046	A1	2005-09-15	Watanabe	
	38	20060059223	A1	2006-03-16	Klemets et al.	
	39	20060168290	A1	2006-07-27	Doron	
	40	20040260701	A1	2004-12-23	Lehikoinen et al.	
	41	20090055471	A1	2009-02-26	Kozat et al.	
	42	20080222235	A1	2008-09-11	Hurst et al.	
	43	20050185578	A1	2005-08-25	Padmanabham et al.	
	44	20070280255	A1	2007-12-06	Tsang et al.	
	45	20080037527	A1	2008-02-14	Chan et al.	
	46	20080205291	A1	2008-08-28	Li et al.	

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	47	20070094405	A1	2007-04-26	Zhang	
	48	20080184688	A1	2006-08-17	Ganguly et al.	
	49	20080263180	A1	2008-10-23	Hurst et al.	
	50	20080133766	A1	2008-06-05	Luo	
	51	20070079325	A1	2007-04-05	de Heer	
	52	20070067480	A1	2007-03-22	Beek et al.	
	53	20070030833	A1	2007-02-08	Pirzada et al.	
	54	20090055547	A1	2009-02-26	Hudson et al.	
	55	20090210549	A1	2009-08-20	Hudson et al.	
	56	20100098103	A1	2010-04-22	Xiong et al.	
	57	20090043906	A1	2009-02-12	Hurst et al.	

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	58	20020161911	A1	2002-10-31	Pinckney, III et al.	
	59	20060236219	A1	2006-10-19	Grigorovitch et al.	
	60	20080046939	A1	2008-02-21	Lu et al.	
	61	20060130118	A1	2006-06-15	Damm	
	62	20070204310	A1	2007-08-30	Hua et al.	
	63	20030065803	A1	2003-04-03	Heuvelman	
	64	20040049780	A1	2004-03-11	Gee	
	65	20060133809	A1	2006-06-22	Chow et al.	
	66	20020144276	A1	2002-10-03	Radford et al.	
	67	20020073167	A1	2002-06-13	Powell et al.	
	68	20020174434	A1	2002-11-21	Lee et al.	

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	69	20020188745		2002-12-12	Hughes et al.	
	70	20030005455	A1	2003-01-02	Bowers	
	71	20030067872	A1	2003-04-10	Harrell et al.	
	72	20030081582		2003-05-01	Jain et al.	
	73	20030107994		2003-06-12	Jacobs et al.	
	74	20030135631		2003-07-17	Li et al.	
	75	20030151753		2003-08-14	Li et al.	
	76	20030152036		2003-08-14	Quigg Brown et al.	
	77	20030204519	A1	2003-10-30	Sirivara et al.	
	78	20040003101	A1	2004-01-01	Roth et al.	
	79	20040030797	A1	2004-02-12	Akinlar et al.	

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	80	20040031054	A1	2004-02-12	Dankworth et al.	
	81	20040054551	A1	2004-03-18	Ausubel et al.	
	82	20040071209		2004-04-15	Burg et al.	
	83	20040093420		2004-05-13	Gamble	
	84	20040143672	A1	2004-07-22	Padmanabham et al.	
	85	20040170392		2004-09-02	Lu et al.	
	86	20050108414		2005-05-19	Taylor et al.	
	87	20050123058		2005-06-09	Greenbaum et al.	
	88	20070024705		2007-02-01	Richter et al.	
	89	20080028428		2008-01-31	Jeong et al.	
	90	20080056373		2008-03-06	Newlin et al.	

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	91	20080162713		2008-07-03	Bowra et al.	
	92	20080195744		2008-08-14	Bowra et al.	
	93	20020029274	A1	2002-03-07	Allen	
	94	20060075446	A1	2006-04-06	Klemets et al.	
	95	20080104647	A1	2008-05-01	Hannuksela	
	96	20040220926	A1	2004-11-04	Lamkin et al.	
	97	20010013128	A1	2001-08-09	Hagai et al.	
	98	20030204602	A1	2003-10-30	Hudson et al.	
	99	20040010613	A1	2004-01-15	Apostolopoulos et al.	

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	Attorney Docket Number	066.0141X1C8

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	1	2011004225	JP	A	2011-01-06	Hodoshima		
	2	2001067264	WO	A1	2001-09-13	Streamcenter, Inc.		
	3	200192752	JP		2001-04-06	Hitachi Information Systems Ltd.		
	4	2006010113	WO	A2	2006-01-26	Network Foundation Technologies, LLC		
	5	2004025405	WO	A2	2004-03-25	Thomson Licensing S.A.		
	6	2466482	CA	A1	2003-05-22	MusicMatch Inc.		
	7	2000-201343	JP		2000-07-18	Toshiba Corp.		
	8	0919952	EP	A1	1999-06-02	Mattavelli et al.		
	9	1670256	EP	A2	2006-06-14	Klements et al.		
	10	1777969	EP		2007-04-25	British Telcom		
	11	1298931	EP	A2	2003-04-02	Oplayo Oy		

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	12	1202487	EP	A2	2002-05-02	Toshiba KK		
	13	1395014	EP	A1	2004-03-03	Matsushita Electric Ind. Co. Ltd.		
	14	2367219	GB	A	2002-03-27	Vintage Global		

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	1	FUJISAWA, HIROSHI ET AL. "Implementaton of Efficient Access Mechanism for Multiple Mirror-Servers" IPSJ SIG Technical Report, vol. 2004, no. 9 (2004-DPS-116), January 30, 2004, Information Processing Society of Japan, pp. 37-42.	☒
	2	LIU, JIANGCHUAN ET AL. "Adaptive Video Multicast Over the Internet" IEEE Computer Society, 2003.	☒
	3	"The meaning of performance factor---English-Japanese Weblio Dictionary", [online], February 24, 2012, [searched on February 24, 2012], the Internet <URL:http://ejje.weblio.jp/content/performance+factor>.	☒
	4	TSURU, ET AL. "Recent evolution of the Internet measurement and inference techniques", IEICE Technical Report, Vol. 103, No. 123, pp. 37-42, June 12, 2003.	☒
	5	REJAIE, REZA ET AL. "Architectural Considerations for Playback of Quality Adaptive Video OVer the Internet" University of Southern California, Information Sciences Institute, 1998.	☒
	6	ROY, SUMIT ET AL. "A System Architecture for Managing Mobile Streaming Media Services" Streaming Media Systems Group, Hewlett-Packard Laboratories, 2003.	☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	7	XU, DONGYAN ET AL. "On Peer-to-Peer Media Streaming" Department of Computer Sciences, Purdue University, 2002.	☒
	8	KOZAMERINK, FRANC "Media Streaming Over the Internet - An Over of Delivery Technologies" EBU Technical Review, October 2002.	☒
	9	LIENHART, RAINER ET AL. "Challenges in Distributed Video Management and Delivery" Intel Corporation, EECS Dept., UC Berkeley, 2000-2002.	☒
	10	ZHANG, XINYAN ET AL. "CoolStreaming/DONet: A Data-Driven Overlay Network for Peer-to-Peer Live Media Streaming" IEEE 2005.	☒
	11	GUO, YANG "DirectStream: A Directory-Based Peer-to-Peer Video Streaming Service" LexisNexis, Elsevier B.V. 2007	☒

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	Examiner Name	Patel, Chirag R.
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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/BRETT A. CARLSON/	Date (YYYY-MM-DD)	2019-06-27
Name/Print	Brett A. Carlson	Registration Number	39928

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Filing Date	18-Jan-2019	Examiner Name	CHIRAG PATEL
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Application Number:	16252356
International Application Number:	
Confirmation Number:	8631
Title of Invention:	APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING
First Named Inventor/Applicant Name:	DAVID F. BRUECK
Customer Number:	70560
Filer:	Brett Carlson/Julie Graf
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Attorney Docket Number:	066.0141X1C8
Receipt Date:	12-SEP-2019
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Application Type:	Utility under 35 USC 111(a)

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Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	E20199BE08452573
Deposit Account	
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The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	Web85b.pdf	46440 3fda01ebad97a03342bfd4f4d68e654bb40ea320	no	2
Warnings:					
Information:					
2	Change of Address	web85correspondenceaddress.pdf	37012 f0472c2932552aeb6e8c7c054ddc799bdd3d7da7	no	1
Warnings:					
Information:					
3	Maintenance Fee Address Change	web85feeaddress.pdf	32653 0d5d3e7b7bc8d4efd5b0f8f4eb4366b88ad77bc7	no	1
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	31970 ffc8b28c203fc65b86d1f2725fd0cdc0421e53b5	no	2
Warnings:					
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		Total Files Size (in bytes):	148075		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Document Description: Issue Fee Payment (PTO-85B)

Issue Fee Transmittal Form

Application Number	Filing Date	First Named Inventor	Atty. Docket No.	Confirmation No.
16252356	18-Jan-2019	DAVID BRUECK	066.0141X1C8	8631

TITLE OF INVENTION :

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

Entity Status	Application Type	Art Unit	Class - Subclass	EXAMINER
Regular Undiscounted	Utility under 35 USC 111(a)	2454	219000	CHIRAG PATEL

Issue Fee Due	Publication Due	Total Fee(s) Due	Date Due	Prev. Paid Fee
$1000	$0	$1000	09-Dec-2019	$0

1.Change of Correspondence Address and/or Indication Of Fee Address (37 CFR 1.33 & 1.363)

Current Correspondence Address:	Current Indicated Fee Address :
70560 LKGLOBAL (Dish Technologies L.L.C.) 7010 E. COCHISE ROAD SCOTTSDALE AZ 85253 UNITED STATES 480-385-5060 dish@lkglobal.com	
☒ Change of correspondence address requested, system generated AIA/122-EFS form attached	☒ Fee Address indication requested, system generated SB/47-EFS form attached

2.Entity Status

Change in Entity Status

○ Applicant certifying micro entity status; system generated Micro Entity certification form attached. See 37 CFR 1.29.
Note: Absent a valid certification of micro entity status, issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment. If this box is checked, you will be prompted to choose a micro entity status on the gross income basis (37 CFR 1.29(a)) or the institution of higher education basis (37 CFR 1.29(d)), and make the applicable certification online.

○ Applicant asserting small entity status. See 37 CFR 1.27.
Note: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

◉ Applicant changing to regular undiscounted fee status.
Note: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

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Exhibit 1002
Page 683

Document Description: Issue Fee Payment (PTO-85B)

3.The Following Fee(s) Are Submitted:

☒ Issue Fee	☐ I authorize USPTO to apply my previously paid issue fee to the current fees due
☐ Publication Fee	☐ The Director is hereby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number _____
☐ Advance Order - # of copies _____	☒ If **in addition to** the payment of the issue fee amount submitted with this form, there are any discrepancies in any amount(s) due, the Director is authorized to charge any deficiency, or credit any overpayment, to Deposit Account Number 502091 . The **issue fee must be submitted** with this form. **If payment of the issue fee does not accompany this form, checking this box and providing a deposit account number will NOT be effective to satisfy full payment of the fee(s) due.**

4.Firm and/or Attorney Names To Be Printed

NOTE: If no name is listed, no name will be printed
For printing on the patent front page, list to be displayed as entered

1. LORENZ & KOPF LLP
2.
3.

5.Assignee Name(s) and Residence Data To Be Printed

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

Name	City	State	Country	Category
DISH Technologies L.L.C.	Englewood	COLORADO	united states	corporation

6.Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via EFS-WEB on the date indicated below.

Signature	/BRETT A. CARLSON/	**Date**	09-12-2019
Name	Brett Carlson	**Registration Number**	39928

fuboTV Media Inc.
Exhibit 1002
Page 684

FEE ADDRESS INDICATION FORM

Application Number	16252356	Art Unit	2454
Filing Date	18-Jan-2019	Examiner Name	CHIRAG PATEL
First Name Inventor	DAVID BRUECK	Attorney Doc. Number	066.0141X1C8

INSTRUCTIONS: In order for the fee address identified on this form to be effective, the issue fee must have been paid for the application listed on this form. Only an address represented by a customer number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application. For more information on customer numbers, see the Manual of Patent Examining Procedure (MPEP) § 403.

Please recognize as the Fee Address under the provisions of 37 CFR 1.363 the address associated with:

Customer Number:	000197 CPA GLOBAL LIMITED 2318 Mill Road 12th Floor ALEXANDRIA VA 22314 UNITED STATES 7037392234

Signature :

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application.

Signature	/BRETT A. CARLSON/	**Date**	09-12-2019
Name	Brett Carlson	**Registration Number**	39928

Electronic Patent Application Fee Transmittal

Application Number:	16252356
Filing Date:	18-Jan-2019
Title of Invention:	APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING
First Named Inventor/Applicant Name:	DAVID F. BRUECK
Filer:	Brett Carlson/Julie Graf
Attorney Docket Number:	066.0141X1C8

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1000**

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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16252356
Filing Date	2019-01-18
First Named Inventor	David F. Brueck
Art Unit	2447
Examiner Name	Patel, Chirag R.
Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	7577750	B2	2009-08-18	Shen et al.	
	2	6195680	B1	2001-02-27	Goldszmidt et al.	
	3	6449719	B1	2002-09-10	Baker	
	4	7369610	B2	2008-05-06	Xu et al.	
	5	7408984	B2	2008-08-05	Lu et al.	
	6	7523181	B2	2009-04-21	Swildens et al.	
	7	6976090	B2	2005-12-13	Ben-Shaul et al.	
	8	7240100	B1	2007-07-03	Wein et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

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	9	6850965	B2	2005-02-01	Allen	
	10	7334044	B1	2008-02-19	Allen	
	11	7760801	B2	2010-07-20	Ghanbari et al.	
	12	7099954	B2	2006-08-29	Li et al.	
	13	6760772	B2	2004-07-06	Zou et al.	
	14	7054911	B1	2006-05-30	Lango et al.	
	15	7797439	B2	2010-09-14	Cherkasova et al.	
	16	7477688	B1	2009-01-13	Zhang et al.	
	17	7054774	B2	2006-05-30	Batterberry et al.	
	18	5168356		1992-12-01	Acampora et al.	
	19	7818444	B2	2010-10-19	Brueck et al.	

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	Attorney Docket Number	066.0141X1C8

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	20	7599307	B2	2009-10-06	Seckni et al.	
	21	7093001	B2	2006-08-15	Yang et al.	
	22	6874015	B2	2005-03-29	Kaminsky et al.	
	23	6845107	B1	2005-01-18	Kitazawa et al.	
	24	6185736	B1	2001-02-06	Ueno	
	25	5,768,527 ~~5768527~~		1998-06-16	Zhu et al.	
	26	7274740	B2	2007-09-25	van Beek et al.	
	27	7546355	B2	2009-06-09	Kalnitsky	
	28	7174385	B2	2007-02-06	Li	
	29	7376747	B2	2008-05-20	Hartop	
	30	7719985	B2	2010-05-18	Lee et al.	

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	31	7349358	B2	2008-03-25	Hennessey et al.	
	32	7194549	B1	2007-03-20	Lee et al.	
	33	6374289	B2	2002-04-16	Delaney et al.	
	34	7325073	B2	2008-01-29	Shao et al.	
	35	7609652	B2	2009-10-27	Kellerer et al.	
	36	6795863	B1	2004-09-21	Doty, Jr.	
	37	7817985	B2	2010-10-19	Moon	
	38	7788395	B2	2010-08-31	Bowra et al.	
	39	7536469	B2	2009-05-19	Chou et al.	
	40	7412531	B2	2008-08-12	Lango et al.	
	41	7295520	B2	2007-11-13	Lee et al.	

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	42	7054365	B2	2006-05-30	Kim et al.	
	43	6122660		2000-09-19	Baransky et al.	
	44	7391717	B2	2008-06-24	Kiemets et al.	
	45	7260640	B1	2007-08-21	Kramer et al.	
	46	7310678	B2	2007-12-18	Gunaseelan et al.	
	47	6618752	B1	2003-09-09	Moore et al.	
	48	6721723	B1	2004-04-13	Gibson et al.	
	49	6859839	B1	2005-02-22	Zahorjan et al.	
	50	7779135	B2	2010-08-17	Hudson et al.	
	51	7593333	B2	2009-09-22	Li et al.	
	52	5953506		1999-09-14	Kalra et al.	

 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	53	6091775		2000-07-18	Hibi et al.	
	54	6091777		2000-07-18	Guetz et al.	
	55	6195680		2001-02-27	Goldszmidt et al.	
	56	6366614		2002-04-02	Pian et al.	
	57	6389473		2002-05-14	Carmel et al.	
	58	6486803	B1	2002-11-26	Luby et al.	
	59	6490627		2002-12-03	Kalra et al.	
	60	6510553		2003-01-21	Hazra	
	61	6574591		2003-06-03	Kleiman et al.	
	62	6604118		2003-08-05	Klleiman et al.	
	63	6731600		2004-05-04	Patel et al.	

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	64	5732183		2004-05-04	Graham	
	65	6968387		2005-11-22	Lanphear	
	66	7075986		2006-07-11	Girod et al.	
	67	7096271		2006-08-22	Omoigui et al.	
	68	7349976		2008-03-25	Glaser et al.	
	69	7408984	B2	2008-08-05	Lu et al.	
	70	4535355		1985-08-13	Arn et al.	
	71	8036265	B1	2011-10-11	Reynolds et al.	
	72	5687095		1997-11-11	Haskell et al.	
	73	7116894	B1	2006-10-03	Chatterton	
	74	7328243	B2	2008-02-05	Yaeger et al.	

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	75	7330908	B2	2008-02-12	Jungek	
	76	7653735	B2	2010-01-26	Mandato et al.	
	77	8612624	B2	2013-12-17	Brueck et al.	
	78	8868772	B2	2014-10-21	Major et al.	
	79	8402156	B2	2013-03-19	Brueck et al.	
	80	8370514	B2	2013-02-05	Hurst et al.	
	81	8880721	B2	2014-11-04	Hurst et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020161898	A1	2002-10-31	Hartop et al.	
	2	20050055425		2005-03-00	Lango et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

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	3	20050015509		2005-01-00	Sitaraman	
	4	20020131496		2002-09-00	Vasudevan et al.	
	5	20040083283	A1	2004-04-29	Sundaram et al.	
	6	20080219151	A1	2008-09-11	Ma et al.	
	7	20020152318	A1	2002-10-17	Menon et al.	
	8	20060080718	A1	2006-04-13	Gray et al.	
	9	20050120107	A1	2005-06-02	Kagan et al.	
	10	20040103444	A1	2004-05-27	Weinberg et al.	
	11	20050188051	A1	2005-08-25	Sneh	
	12	20030154239	A1	2003-08-14	Davis et al.	
	13	20040030547	A1	2004-02-12	Leaning et al.	

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	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	14	20040117427	A1	2004-06-17	Allen et al.	
	15	20030014684	A1	2003-01-16	Kashyap	
	16	20060206246	A1	2006-09-14	Walker	
	17	20050076136	A1	2005-04-07	Cho et al.	
	18	20030018966	A1	2003-01-23	Cook et al.	
	19	20040030599	A1	2004-02-12	Sie et al.	
	20	20050262257	A1	2005-11-24	Major et al.	
	21	20050033855	A1	2005-02-10	Moradi et al.	
	22	20010047423	A1	2001-11-29	Shao et al.	
	23	20030140159	A1	2003-07-24	Campbell et al.	
	24	20020176418	A1	2002-11-28	Hunt et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	25	20020169926	A1	2002-11-14	Pinckney, III, et al.	
	26	20020178330	A1	2002-11-28	Schlowsky-Fischer et al.	
	27	20050084166	A1	2005-04-21	Bonch et al.	
	28	20020091840	A1	2002-07-11	Pulier et al.	
	29	20080281803	A1	2008-11-13	Gentric	
	30	2006/0168295 ~~20061068295~~	A1	2006-07-27	Batterberry et al.	
	31	20060165166	A1	2006-07-27	Chou et al.	
	32	20020097750	A1	2002-07-25	Gunaseelan et al.	
	33	20020152317	A1	2002-10-17	Wang et al.	
	34	20030021166	A1	2003-01-30	Soloff	
	35	20040168052	A1	2004-08-26	Clisham et al.	

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	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	36	20050066063	A1	2005-03-24	Grigorovitch et al.	
	37	20050204046	A1	2005-09-15	Watanabe	
	38	20060059223	A1	2006-03-16	Klemets et al.	
	39	20060168290	A1	2006-07-27	Doron	
	40	20040260701	A1	2004-12-23	Lehikoinen et al.	
	41	20090055471	A1	2009-02-26	Kozat et al.	
	42	20080222235	A1	2008-09-11	Hurst et al.	
	43	20050185578	A1	2005-08-25	Padmanabham et al.	
	44	20070280255	A1	2007-12-06	Tsang et al.	
	45	20080037527	A1	2008-02-14	Chan et al.	
	46	20080205291	A1	2008-08-28	Li et al.	

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	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	47	20070094405	A1	2007-04-26	Zhang	
	48	20080184688	A1	2006-08-17	Ganguly et al.	
	49	20080263180	A1	2008-10-23	Hurst et al.	
	50	20080133766	A1	2008-06-05	Luo	
	51	20070079325	A1	2007-04-05	de Heer	
	52	20070067480	A1	2007-03-22	Beek et al.	
	53	20070030833	A1	2007-02-08	Pirzada et al.	
	54	20090055547	A1	2009-02-26	Hudson et al.	
	55	20090210549	A1	2009-08-20	Hudson et al.	
	56	20100098103	A1	2010-04-22	Xiong et al.	
	57	20090043906	A1	2009-02-12	Hurst et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16252356
	Filing Date	2019-01-18
	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

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	58	20020161911	A1	2002-10-31	Pinckney, III et al.	
	59	20060236219	A1	2006-10-19	Grigorovitch et al.	
	60	20080046939	A1	2008-02-21	Lu et al.	
	61	20060130118	A1	2006-06-15	Damm	
	62	20070204310	A1	2007-08-30	Hua et al.	
	63	20030065803	A1	2003-04-03	Heuvelman	
	64	20040049780	A1	2004-03-11	Gee	
	65	20060133809	A1	2006-06-22	Chow et al.	
	66	20020144276	A1	2002-10-03	Radford et al.	
	67	20020073167	A1	2002-06-13	Powell et al.	
	68	20020174434	A1	2002-11-21	Lee et al.	

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	69	20020188745		2002-12-12	Hughes et al.	
	70	20030005455	A1	2003-01-02	Bowers	
	71	20030067872	A1	2003-04-10	Harrell et al.	
	72	20030081582		2003-05-01	Jain et al.	
	73	20030107994		2003-06-12	Jacobs et al.	
	74	20030135631		2003-07-17	Li et al.	
	75	20030151753		2003-08-14	Li et al.	
	76	20030152036		2003-08-14	Quigg Brown et al.	
	77	20030204519	A1	2003-10-30	Sirivara et al.	
	78	20040003101	A1	2004-01-01	Roth et al.	
	79	20040030797	A1	2004-02-12	Akinlar et al.	

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	80	20040031054	A1	2004-02-12	Dankworth et al.	
	81	20040054551	A1	2004-03-18	Ausubel et al.	
	82	20040071209		2004-04-15	Burg et al.	
	83	20040093420		2004-05-13	Gamble	
	84	20040143672	A1	2004-07-22	Padmanabham et al.	
	85	20040170392		2004-09-02	Lu et al.	
	86	20050108414		2005-05-19	Taylor et al.	
	87	20050123058		2005-06-09	Greenbaum et al.	
	88	20070024705		2007-02-01	Richter et al.	
	89	20080028428		2008-01-31	Jeong et al.	
	90	20080056373		2008-03-06	Newlin et al.	

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Page 703

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16252356
	Filing Date	2019-01-18
	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

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	91	20080162713		2008-07-03	Bowra et al.	
	92	20080195744		2008-08-14	Bowra et al.	
	93	20020029274	A1	2002-03-07	Allen	
	94	20060075446	A1	2006-04-06	Klemets et al.	
	95	20080104647	A1	2008-05-01	Hannuksela	
	96	20040220926	A1	2004-11-04	Lamkin et al.	
	97	20010013128	A1	2001-08-09	Hagai et al.	
	98	20030204602	A1	2003-10-30	Hudson et al.	
	99	20040010613	A1	2004-01-15	Apostolopoulos et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

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Page 704

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16252356
	Filing Date	2019-01-18
	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	1	2011004225	JP	A	2011-01-06	Hodoshima		
	2	2001067264	WO	A1	2001-09-13	Streamcenter, Inc.		
	3	200192752	JP		2001-04-06	Hitachi Information Systems Ltd.		
	4	2006010113	WO	A2	2006-01-26	Network Foundation Technologies, LLC		
	5	2004025405	WO	A2	2004-03-25	Thomson Licensing S.A.		
	6	2466482	CA	A1	2003-05-22	MusicMatch Inc.		
	7	2000-201343	JP		2000-07-18	Toshiba Corp.		
	8	0919952	EP	A1	1999-06-02	Mattavelli et al.		
	9	1670256	EP	A2	2006-06-14	Klements et al.		
	10	1777969	EP		2007-04-25	British Telcom		
	11	1298931	EP	A2	2003-04-02	Oplayo Oy		

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16252356
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	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	12	1202487	EP	A2	2002-05-02	Toshiba KK		
	13	1395014	EP	A1	2004-03-03	Matsushita Electric Ind. Co. Ltd.		
	14	2367219	GB	A	2002-03-27	Vintage Global		

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	FUJISAWA, HIROSHI ET AL. "Implementaton of Efficient Access Mechanism for Multiple Mirror-Servers" IPSJ SIG Technical Report, vol. 2004, no. 9 (2004-DPS-116), January 30, 2004, Information Processing Society of Japan, pp. 37-42.	☒
	2	LIU, JIANGCHUAN ET AL. "Adaptive Video Multicast Over the Internet" IEEE Computer Society, 2003.	☒
	3	"The meaning of performance factor---English-Japanese Weblio Dictionary", [online], February 24, 2012, [searched on February 24, 2012], the Internet <URL:http://ejje.weblio.jp/content/performance+factor>.	☒
	4	TSURU, ET AL. "Recent evolution of the Internet measurement and inference techniques", IEICE Technical Report, Vol. 103, No. 123, pp. 37-42, June 12, 2003.	☒
	5	REJAIE, REZA ET AL. "Architectural Considerations for Playback of Quality Adaptive Video OVer the Internet" University of Southern California, Information Sciences Institute, 1998.	☒
	6	ROY, SUMIT ET AL. "A System Architecture for Managing Mobile Streaming Media Services" Streaming Media Systems Group, Hewlett-Packard Laboratories, 2003.	☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16252356
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	First Named Inventor	David F. Brueck
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	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

	7	XU, DONGYAN ET AL. "On Peer-to-Peer Media Streaming" Department of Computer Sciences, Purdue University, 2002.	☒
	8	KOZAMERINK, FRANC "Media Streaming Over the Internet - An Over of Delivery Technologies" EBU Technical Review, October 2002.	☒
	9	LIENHART, RAINER ET AL. "Challenges in Distributed Video Management and Delivery" Intel Corporation, EECS Dept., UC Berkeley, 2000-2002.	☒
	10	ZHANG, XINYAN ET AL. "CoolStreaming/DONet: A Data-Driven Overlay Network for Peer-to-Peer Live Media Streaming" IEEE 2005.	☒
	11	GUO, YANG "DirectStream: A Directory-Based Peer-to-Peer Video Streaming Service" LexisNexis, Elsevier B.V. 2007	☒

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/CHIRAG R PATEL/	Date Considered	10/01/2019

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	16252356
	Filing Date	2019-01-18
	First Named Inventor	David F. Brueck
	Art Unit	2447
	Examiner Name	Patel, Chirag R.
	Attorney Docket Number	066.0141X1C8

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CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☒ See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/BRETT A. CARLSON/	Date (YYYY-MM-DD)	2019-06-27
Name/Print	Brett A. Carlson	Registration Number	39928

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/252,356	01/18/2019	DAVID F. BRUECK	066.0141X1C8	8631

54583 7590 10/04/2019

DISH Technologies L.L.C.
9601 S. Meridian Blvd
ENGLEWOOD, CO 80112

EXAMINER	
PATEL, CHIRAG R	

ART UNIT	PAPER NUMBER
2454	

MAIL DATE	DELIVERY MODE
10/04/2019	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

fuboTV Media Inc.
Exhibit 1002
Page 710

Corrected ***Notice of Allowability***	**Application No.** 16/252,356	**Applicant(s)** BRUECK et al.	
	Examiner CHIRAG R PATEL	**Art Unit** 2454	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the printer rush on.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-9 and 31-48 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information , please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 6/27/19.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/CHIRAG R PATEL/
Primary Examiner, Art Unit 2454

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Page 711

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

CPC						
Symbol					**Type**	**Version**
H04L	/	65	/	607	F	2013-01-01
H04L	/	47	/	801	I	2013-01-01
H04L	/	47	/	12	I	2013-01-01
H04L	/	65	/	4069	I	2013-01-01
G06F	/	16	/	71	I	2019-01-01
G06F	/	16	/	183	I	2019-01-01
H04L	/	29	/	06027	I	2013-01-01
H04N	/	7	/	24	I	2013-01-01
H04N	/	21	/	23439	I	2013-01-01
H04N	/	21	/	4331	I	2013-01-01
H04N	/	21	/	84	I	2013-01-01
H04N	/	21	/	8456	I	2013-01-01
H04L	/	65	/	80	I	2013-01-01
H04L	/	65	/	608	I	2013-01-01
H04L	/	67	/	02	I	2013-01-01
H04L	/	65	/	1069	I	2013-01-01
H04L	/	67	/	2842	I	2013-01-01
H04L	/	67	/	32	I	2013-01-01
H04N	/	21	/	2662	I	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 27	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454 (Primary Examiner)	01 October 2019 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office — Part of Paper No.: 20191001

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

INTERNATIONAL CLASSIFICATION					
CLAIMED					
H04L	/	29	/	06	

NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	27	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	01 October 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20191001

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Page 713

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/252,356	BRUECK et al.
	Examiner	**Art Unit**
	CHIRAG R PATEL	2454

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☑ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1		10		19		28	16	37	25	46				
2	2		11		20		29	17	38	26	47				
3	3		12		21		30	18	39	27	48				
4	4		13		22	10	31	19	40						
5	5		14		23	11	32	20	41						
6	6		15		24	12	33	21	42						
7	7		16		25	13	34	22	43						
8	8		17		26	14	35	23	44						
9	9		18		27	15	36	24	45						

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	27	
/CHIRAG R PATEL/ Primary Examiner, Art Unit 2454	01 October 2019	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

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fuboTV Media Inc.
Exhibit 1002
Page 714

Bibliographic Data

Application No: 16/252,356

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /CHIRAG R PATEL/ Examiner's Signature | Initials

Title: APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
01/18/2019	709	2454	066.0141X1C8
RULE			

APPLICANTS

DISH Technologies L.L.C., Englewood, CO, UNITED STATES

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DAVID F. BRUECK SARATOGA SPRINGS, UT, UNITED STATES

MARK B. HURST CEDAR HILLS, UT, UNITED STATES

R. DREW MAJOR OREM, UT, UNITED STATES

CONTINUING DATA

This application is a CON of 16252188 01/18/2019

16252188 is a CON of 16004056 06/08/2018

16004056 is a CON of 15414025 01/24/2017 PAT 9998516

15414025 is a CON of 14719122 05/21/2015 PAT 9571551

14719122 is a CON of 14106051 12/13/2013 PAT 9071668

14106051 is a CON of 13617114 09/14/2012 PAT 8612624

13617114 is a CON of 12906940 10/18/2010 PAT 8402156

12906940 is a CIP of 11673483 02/09/2007 PAT 7818444

11673483 is a CIP of 11116783 04/28/2005 PAT 8868772

11116783 has PRO of 60566831 04/30/2004

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

02/07/2019

STATE OR COUNTRY

UNITED STATES

ADDRESS

DISH Technologies L.L.C.
9601 S. Meridian Blvd
ENGLEWOOD, CO 80112
UNITED STATES

FILING FEE RECEIVED

$7,320

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	16252356
Filing Date	2019-01-18
First Named Inventor	David F. Brueck
Art Unit	2447
Examiner Name	Patel, Chirag R.
Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

	47	20070094405	A1	2007-04-26	Zhang	
Change(s) applied to document, /J.E.B./ 9/20/2019	48	20080184688	A1	08/2008 ~~2008-08-17~~	Daly, et al. ~~Ganguly et al.~~	
	49	20080263180	A1	2008-10-23	Hurst et al.	
	50	20080133766	A1	2008-06-05	Luo	
	51	20070079325	A1	2007-04-05	de Heer	
	52	20070067480	A1	2007-03-22	Beek et al.	
	53	20070030833	A1	2007-02-08	Pirzada et al.	
	54	20090055547	A1	2009-02-26	Hudson et al.	
	55	20090210549	A1	2009-08-20	Hudson et al.	
	56	20100098103	A1	2010-04-22	Xiong et al.	
	57	20090043906	A1	2009-02-12	Hurst et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

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	Attorney Docket Number	066.0141X1C8

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

Change(s) applied to document, /J.E.B./ 9/20/2019	64	5732183		~~2004-05-04~~ 03/1998	~~Graham~~ Sugiyama	
	65	6968387		2005-11-22	Lanphear	
	66	7075986		2006-07-11	Girod et al.	
	67	7096271		2006-08-22	Omoigui et al.	
	68	7349976		2008-03-25	Glaser et al.	
	69	7408984	B2	2008-08-05	Lu et al.	
	70	4535355		1985-08-13	Arn et al.	
	71	8036265	B1	2011-10-11	Reynolds et al.	
	72	5687095		1997-11-11	Haskell et al.	
	73	7116894	B1	2006-10-03	Chatterton	
	74	7328243	B2	2008-02-05	Yaeger et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.R.P/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/252,356	11/05/2019	10469555	066.0141X1C8	8631

54583 7590 10/16/2019

DISH Technologies L.L.C.
9601 S. Meridian Blvd
ENGLEWOOD, CO 80112

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

DAVID F. BRUECK, SARATOGA SPRINGS, UT;
DISH Technologies L.L.C., Englewood, CO
MARK B. HURST, CEDAR HILLS, UT;
R. DREW MAJOR, OREM, UT;

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AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the District of Delaware on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	4/13/2021	for the District of Delaware

PLAINTIFF	DEFENDANT
DISH Technologies L.L.C. and Sling TV L.L.C.	lululemon athletica inc. and Curiouser Products Inc. (d/b/a MIRROR)

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	US 9,407,564 B2	8/2/2016	DISH Technologies L.L.C.
2	US 10,469,554 B2	11/5/2019	DISH Technologies L.L.C.
3	US 10,469,555 B2	11/5/2019	DISH Technologies L.L.C.
4	US 10,757,156 B2	8/25/2020	DISH Technologies L.L.C.
5	US 10,951,680 B2	3/16/2021	DISH Technologies L.L.C.

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above---entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1---Upon initiation of action, mail this copy to Director Copy 3---Upon termination of action, mail this copy to Director
Copy 2---Upon filing document adding patent(s), mail this copy to Director Copy 4---Case file copy

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:21-cv-00132	4/13/2021	Eastern District of Texas

PLAINTIFF	DEFENDANT
DISH TECHNOLOGIES L.L.C. and SLING TV L.L.C.	PELOTON INTERACTIVE, INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	9,407,564	8/2/2016	DISH Technologies L.L.C.
2	10,469,554	11/5/2019	DISH Technologies L.L.C.
3	10,469,555	11/5/2019	DISH Technologies L.L.C.
4	10,757,156	8/25/2020	DISH Technologies L.L.C.
5	10,951,680	3/16/2021	DISH Technologies L.L.C.

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the District of Delaware on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	4/13/2021	for the District of Delaware

PLAINTIFF	DEFENDANT
DISH Technologies L.L.C. and Sling TV L.L.C.	ICON Health & Fitness, Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	US 9,407,564 B2	8/2/2016	DISH Technologies L.L.C.
2	US 10,469,554 B2	11/5/2019	DISH Technologies L.L.C.
3	US 10,469,555 B2	11/5/2019	DISH Technologies L.L.C.
4	US 10,757,156 B2	8/25/2020	DISH Technologies L.L.C.
5	US 10,951,680 B2	3/16/2021	DISH Technologies L.L.C.

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