

DECLARATION OF MARY STEELE

I, Mary Steele, pursuant to 28 U.S.C. § 1746, hereby declare as follows:

1. I am a Translator at TransPerfect, Inc.
2. I submit this declaration to certify the accuracy of the English translation of JP2004172830A.
3. My statements are based on personal knowledge and my review of JP2004172830A and its Japanese to English translation. If called as a witness about the facts contained in these statements, I could testify competently based on such personal knowledge and the investigation I have conducted.
4. Attached as Exhibit A is a true and accurate copy of JP2004172830A.
5. Attached as Exhibit B is a true and accurate copy of an English translation of JP2004172830A ("the JP2004172830ATranslation").
6. The JP2004172830ATranslation is a true and accurate translation of JP2004172830A from Japanese to English.
7. All statements made herein of my own knowledge are true, and all statements made on information and belief are believed to be true. Further, I am aware that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. § 1001. I declare under penalty of perjury that the foregoing is true and correct.

I declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct. Executed on July 20, 2023, at New York, New York.



Mary Steele

(19) Japan Patent Office (JP)

**(12) Japanese Unexamined Patent
Application Publication (A)**(11) Japanese Unexamined
Patent Application Publication
Number**Japanese Patent
Application Laid-Open
No. 2004-172830
(P2004-172830A)**(43) Publication date: **June 17, 2004 (6/17/2004)**(51) Int.Cl.⁷

FI

**Theme codes
(reference)
5CO59****H04N 7/24****H04N 7/13****Z**

Number of unclaimed claims for review

5 OL (8 pages in total)

(21) Application number	Japanese Unexamined Patent Application No. 2002-335035 (P2002-335035)	(71) Applicant	000208891
(22) Date of application	November 19, 2002 (11/19/2002)		
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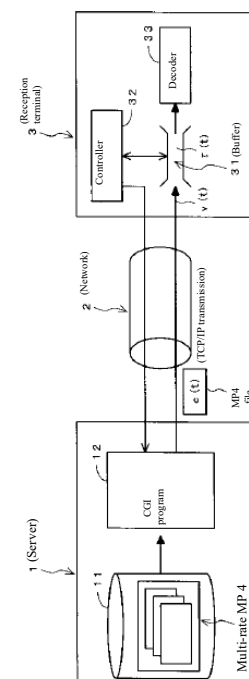
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(54) [Title of invention] Moving picture encoding bit rate selecting system**(57) [ABSTRACT]**

[Problem to be solved] To provide a moving picture encoding bit rate selecting system capable of being controlled to automatically select an optimum bit rate.

[Means for solving the problems] : A server 1 being a transmitter side stores moving picture contents at a plurality of encoding bit rates to a storage device 11. A controller 32 of a reception terminal 3 adaptively selects a moving picture encoding bit rate $c(t)$ in response to the object value of a storage amount of a reception buffer 31 at the end of reception up to a next synchronous point or a synchronous point ahead by a plurality of points. Since the bit rate $c(t)$ is decided to take any of predetermined discrete values $c[n]$ ($n=0, 1, 2, \dots$), the controller 32 selects a maximum bit rate $c[n^*]$ not in excess of the $c(t)$ in the values $c[n]$, and the reception terminal informs the server 1 about the bit rate via a network 2. The server 1 switches moving picture contents indicated by the informed bit rate $c[n^*]$ at the synchronous point to send the contents to the reception terminal 3.

[Selection drawing] FIG. 1



[Scope of Claims]

[Claim 1]

A method for selecting a single encoded bit rate from a group of moving picture data with synchronization points that can be switched between multiple types of encoded bit rate moving pictures, and for selecting a single encoded bit rate each time the reception up to the synchronization point is completed, and for transmitting and receiving the moving picture data, the method comprising:

A moving picture coding bit rate selection method according to claim 1, the receiving terminal that receives the moving image receives the data and temporarily stores the data, and according to the target value of the reception buffer storage amount at the end of the reception to the next or a plurality of synchronization points, adaptively, a means for selecting a moving picture coding bit rate and a means for requesting the selected moving picture coding bit rate to a transmission side. 10

[Claim 2]

The method of claim 1, wherein the moving image encoding bit rate selection method comprises:

A moving image coding bit rate selection method characterized in that the target value of the storage amount of the reception buffer is a decoding available time of data stored in the reception buffer, and the target value is obtained using an average value of the most recent transmission throughput.

[Claim 3]

The method of claim 1, wherein the moving image encoding bit rate selection method comprises:

A moving picture encoding bit rate selection method characterized in that the target value of the reception buffer storage amount is the decoding available time of the data stored in the reception buffer, and the target value is calculated using the smaller one of the short-term average value and the long-term average value of the latest transmission throughput. 20

[Claim 4]

The method of claim 2 or 3, wherein the moving picture encoding bit rate selection method comprises:

A moving picture encoding bit rate selection method characterized in that when calculating an encoded bit rate of the moving picture data such that a decryption time of data accumulated in the receiving buffer becomes a predetermined target value and selecting a discrete encoded bit rate that is applied in practice from the calculated value, the encoded bit rate that does not exceed the calculated value is selected.

[Claim 5]

A moving picture coding bit rate selection method according to any one of claims 1 to 4, wherein the method comprises:

A moving picture coding bit rate selection method, wherein the stepwise change from the first coding bit rate to the closest coding bit rate is adaptively switched when selecting the encoding bit rate, the current selection value is changed to the encoding bit rate that does not exceed the calculated value at once, and the current selection value is changed from the current selection value to the encoding bit rate that does not exceed the calculated value. 30

[Detailed description of invention]

[0001]

[Technical field to which the invention pertains]

The present invention relates to a moving picture coding bit rate selection method, and more particularly to a moving picture content suitable for being applied to a method in which moving picture contents stored in a server are packetized and transmitted, and received via a mobile phone network.

[0002]

[Prior art]

Description of the Related Art Conventionally, there has been known a technique in which the same content created at a plurality of bit rates is stored in a server in advance, and the server switches the bit rate according to an instruction from a receiving terminal, for example, a mobile phone, and distributes the content. In this prior art, the receiving terminal can instruct the bit rate to be changed from the beginning of the reception, and can also instruct the bit rate to be changed during the reception. The receiving terminal is provided with, for example, a button for instructing the server on the bit rate to be received, and the user can instruct the server on the bit rate to be received by operating the button. Then, when the user wants to receive a high-quality image for a part of the reception screen, for example, the user can operate the button to give an instruction to increase the bit rate. 40

[0003]

In addition, publicly known literature related to the present invention includes, for example, 11-6 "A Study on Design of a Mobile Phone Video Streaming System" of the 2002 Annual Meeting of the Institute of Image Information and Television, August 2002, and 11-7 "TCP Study of Dynamic Coding Rate Control in Video Streaming".

[0004]

[Problem to be solved by the invention]

However, in the above-mentioned prior art, there was a problem that the receiving terminal could only select the bit rate manually, so that it was not possible to select an optimal bit rate suited to the circumstances of the line communication. Also, if the bit rate is manually selected, the receiving buffer may underflow.

[0005]

The present invention has been made based on the above-described problems of the related art, and it is an object of the present invention to provide a moving picture coding bit rate selection method capable of automatically controlling an optimum bit rate to be selected.

[0006]

[Means for solving the problem]

In order to achieve the aforementioned objective, the present invention is characterized in that it includes a method of selecting a single encoded bit rate each time the reception of the moving picture data is terminated, from a group of moving picture data having a synchronization point that is switchable between the multiple types of encoded bit rates, and a method of selecting the moving picture encoded bit rate of a system that transmits and receives the moving picture data, wherein a receiving terminal that receives the moving picture includes means for selecting the reception buffer and adaptively the moving picture encoded bit rate according to a target value of the received buffer storage amount at the end of reception of the next or multiple future synchronization points, and means for requesting the selected moving picture coding bit rate from the transmission side.

[0007]

According to the present invention, it becomes possible to adaptively select a moving picture encoding bit rate according to a target value of a reception buffer storage amount at the end of reception up to the next or a plurality of synchronization points, and an encoding bit rate as high as possible can be selected as long as the buffer does not underflow.

[0008]

[Embodiments of the present invention]

Hereinafter, the present invention will be described in detail with reference to the drawings. FIG. 1 shows a schematic configuration diagram of a system to which the present invention is applied.

[0009]

As shown in the figure, the system includes a server 1 which is a transmitting side of moving picture content, a network (network) 2 such as a mobile phone network, and a receiving terminal 3 such as a mobile phone. The server 1 is connected to a wired information network (not shown) as is well known.

[0010]

The image data storage device 11 of the server 1 stores a plurality of files in which image data having the same contents are created at a plurality of bit rates. As shown in FIG. 2, the image data has the same contents as a plurality of discrete bit rates $c[n]$ ($n = 0, 1, 2, \dots$). For example, bit rates $c[0]$. The bit stream is formed by a bit stream A and a bit stream B at a bit rate $c[1]$, and each bit stream periodically with synchronization points $a_1, a_2, a_3, \dots$ B1, b2, b3, is set. The bit rate $c[n]$ is notified to the receiving terminal 3 in advance.

[0011]

The synchronization points are set at intervals of Δt , for example, at intervals of 10 seconds. At the synchronization point, it is possible to switch data between different bit rates at this point. Hereinafter, a data unit between the synchronization points is referred to as a "fragment".

[0012]

The image data storage device 11 is accessed by a common gateway interface (CGI) program 12, which is a distribution program, and provides a file at a bit rate requested by the CGI program 12.

[0013]

On the other hand, the receiving terminal 3 includes a receiving buffer 31 for temporarily storing received data, a controller 32 for determining an optimum bit rate and notifying the server of the bit rate via the network 2, and a storage for the buffer 31. A decoder 33 is provided for reading data from the reception buffer 31 and starting video decoding when the amount becomes equal to or more than a predetermined amount. 10

[0014]

The operation of this embodiment will then be described with reference to the flowchart of FIG. 3. The controller 32 first notifies the server 1 of the minimum encoding bit rate in step S1. Thereby, the receiving terminal 3 starts receiving and reproducing at the minimum coding bit rate. In step S2, it is determined whether reception has been completed up to the boundary of the fragment. For example, in FIG. 2, if the bit stream A is received first, it is determined whether the reception has reached the synchronization point a1. If this determination is negative, data reception is continued until the synchronization point a1 comes. If the determination in step S2 is affirmative, the process proceeds to step S3, where the controller 32 observes the accumulated amount $\tau(t)$ of the reception buffer 31 and the transmission throughput $v(t)$ of the network 2. The reason why the amount of accumulation in the reception buffer 31 is evaluated based on the decodable time is that the buffer margin varies depending on the bit rate of the video data in the buffer 31 even for the same data size. For example, suppose that the arrival of data from the network is suddenly interrupted when 100 bits are stored in the buffer. In this case, if the data is 10 bit / second video, there is a margin of 10 seconds, but if the data is 100 bit / second video, there is only 1 second of margin. The reason for setting the synchronization point interval of the bit stream to Δt is the same as above. 20

[0015]

Next, in step S4, starting from the current buffer storage amount $\tau(t)$, the encoding bit of the next fragment is set so that the buffer storage amount at the end of the next fragment reception becomes the target value or the expected value T. The rate $c(t)$ is determined from the following equation (1).

$T = \tau(t) + \Delta t - c(t) \Delta t / v(t) \dots (1)$ Here, Δt (second) represents the interval of one fragment as described above.

[0016]

In step S5, $c(t)$ is determined to take a predetermined discrete value $c[n]$ ($n = 0, 1, 2, \dots$). Among them, the maximum bit rate $c[n^*]$ not exceeding $c(t)$ is selected. In step S6, the maximum bit rate $c[n^*]$ is requested to the server 1. Then, the CGI program 12 of the server 1 reads the file of the bit rate $c[n^*]$ from the image data storage device 11, packetizes the file, and sends it to the network 2. As a result, for example, in FIG. 2, the bit stream is switched to the bit stream B at the synchronization point b1, and one fragment of the bit stream B is transmitted to the receiving terminal 3. 30

[0017]

The transmission throughput $v(t)$ of the (1) formula is the average bit rate while receiving the next fragment that will require transmission, and its value is unknown before it is received, so an estimate must be used. The estimated value can be obtained using the following two methods.

Method 1: A moving average of throughput instantaneous values for the most recent Δt seconds is used.

Method 2: The smaller one of the moving averages of the instantaneous throughput values for the most recent $t1$ seconds and $t2$ seconds ($t1 < t2$) is used. 40

[0018]

The method 2 has the effect of detecting an abrupt decrease in throughput from observation in a short time ($t1$ second), reduces the encoding bit rate, and converges the encoding bit rate to an average throughput in a long time ($t2$ seconds).

[0019]

Next, a second embodiment of the present invention will be described with reference to the flowchart of FIG. 4. Since the same steps in FIG. 4 as in FIG. 3 have the same functions as in FIG. 3, the description thereof will be omitted. In the first embodiment, in some cases, the encoding bit rate is switched every time a fragment is received, and the image quality of a reproduced image may frequently change. In this embodiment, the following restrictions are set in order to eliminate this fear.

(1) When increasing the encoding bit rate, the encoding bit rate is increased stepwise. In other words, it does not raise more than two steps. 10

(2) When reducing the encoding bit rate, there is no restriction. In other words, even if there are two or more steps, it is reduced at a stretch.

[0020]

Due to the restriction (1), it is possible to prevent a significant change in image quality and an increase in the risk that the receiving buffer suddenly underflows. Further, the risk of underflow of the receiving buffer can be eliminated in a short time due to the restriction (2). Due to the above restriction, a coding bit rate as high as possible can be selected as long as the receiving buffer does not cause underflow.

[0021]

FIG. 4 satisfies the conditions (1) and (2), and in step S7, it is determined whether or not the bit rate $c[n^*]$ selected in step S5 is smaller than the previous $c[n^*]$. If it is smaller, the process proceeds to step S6 to request the server for $c[n^*]$. When the determination in step S7 is negative, the process proceeds to step S8, and it is determined whether the bit rate $c[n^*]$ selected in step S5 is higher than the previous $c[n^*]$ by two or more steps. If the determination is negative, the process proceeds to step S6. If the determination in step S8 is affirmative, that is, if it is larger than the previous $c[n^*]$ by two or more steps, the process proceeds to step S9, where $c[n^*]$ is one step higher than the previous $c[n^*]$. Then, the process proceeds to step S6. 20

[0022]

Next, a third embodiment of the present invention will be described. In this embodiment, when the encoding bit rate is increased, a constraint that the increased rate can be continuously maintained for n fragments is imposed. By imposing this restriction, underflow of the receiving buffer can be prevented as much as possible.

[0023]

Specifically, the equation (1) in step S4 of FIGS. 3 and 4 is changed to the following equation (2). 30

$$T = \tau(t) + \Delta t \times n - c(t) (\Delta t \times n) / v(t) \dots (1)$$

[0024]

[Effects of the present invention]

As can be seen from the above description, according to the inventions of Claims 1 to 5, it is possible to select an encoding bit rate as high as possible within a range that does not cause the receiving buffer to underflow. In addition, there is an effect that an encoding bit rate is adaptively selected in response to a change in transmission throughput of a network, and an image having the highest image quality can be provided within a range permitted by the conditions.

[0025]

In addition, according to the inventions of Claims 2 and 3, in addition to the above effects, it is possible to adaptively determine the average bit rate during reception of the next fragment that requires transmission.

[Brief Description of Drawings]

[FIG. 1] is a block diagram showing a schematic configuration of a transmission / reception system suitable for applying the present invention. 40

[FIG. 2] is a diagram showing a configuration of a bit stream according to the present invention.

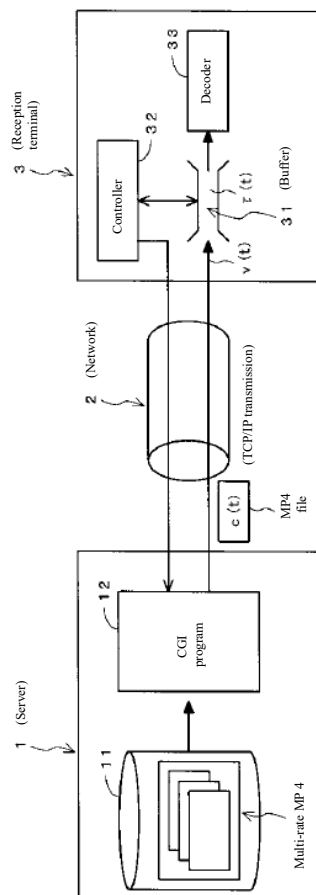
[FIG. 3] is a flowchart showing the operation of the first and third embodiments of the present invention.

[FIG. 4] is a flowchart showing the operation of the second and third embodiments of the present invention.

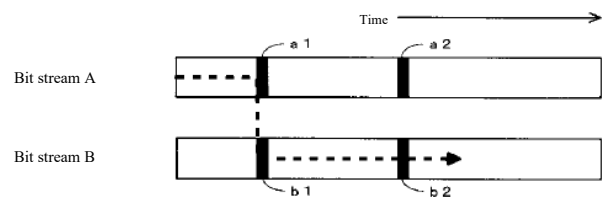
[Reference Signs List]

1 ... Server, 2 ... Mobile telephone network, 3 ... Receiving terminal, 11 ... Image data storage apparatus, 12 ... CGI program, 31 ... Receiving buffer, 32 ... Controller 33 ... Decoder.

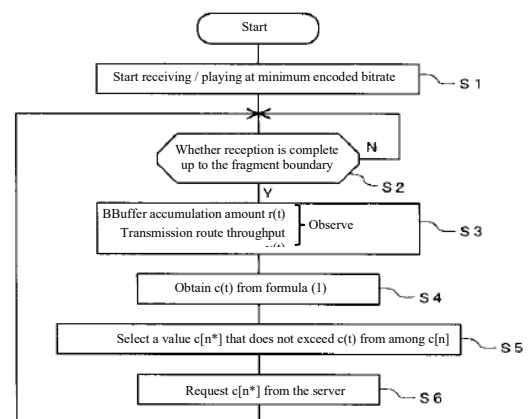
[FIG. 1]



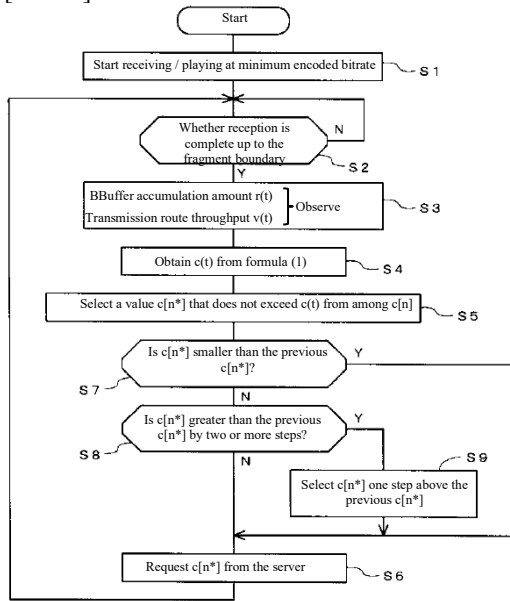
[FIG. 2]



[FIG. 3]



[FIG. 4]



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F term (reference) 5C059 KK35 PP04 RE01 RE16 SS06 SS10 TA60 TA71 TC15

TC37 TD03