typical M3U format and may provide absolute or relative path locations of the audio data file associated with playlist record 92. In the exemplary embodiment, a relative path location is provided so that playlist 90 is transportable between devices. Information segment 93 containing content information fields 93A and indexing information fields 93B that include an M3U comment format, specifically the first character of the line being a "#" character. Additionally, data header 91 also includes an M3U comment format.

Music management software that encodes and transmits the audio data files may also create and transmit playlist files 90 into data storage 32 via USB port 42 from a PC or other similar device. Such playlists generally use an M3U format that is similar to the data structure disclosed above and in Fig. 6; however, the data structure likely consists of records 92 containing only file pointer segments 94, and thus lack information segment 93 as disclosed above.

The present invention includes a method of adding information segment 93 to a standard M3U or other playlist file. While the inventive method may be executed in audio data player 10, a PC, or another data device, the exemplary embodiment includes software for adding information segment 93, including content information fields 93A descriptive of the content of each audio data file and indexing information fields 93B providing the relative location of related playlist records, to audio playlist files 90 in audio data player 10.

Fig. 7 shows a flowchart illustrating the steps for adding content and indexing information to a playlist in an audio data player 10 according to the present invention. The steps may be initiated manually by user selection via user input 26, or may be automatically initiated by the receipt of a new playlist into data storage 32 via USB port 42, or some other change in the files stored in data storage 32. In the exemplary embodiment, a software module is provided for executing the steps of Fig. 7 in audio data player 10.

In step 102, an audio data file playlist 90 located in data storage 32 is opened. For each record 92 of playlist 90, step 104 locates content information for the associated audio data file that record 92 refers to. For example, using a relative location stored in record 92 for the audio data file, audio data file located in data storage 32 may be opened and the content information read. Content information includes attributes or other descriptive information of the audio stored by the audio data file. In the exemplary embodiment, the content information includes ID3 tag information from MP3 audio data files. Alternatively, content information for an associated audio data file may be downloaded from a connected PC, the Internet, user input 26, or another source of data information.

In step 106, a content information field 93A for sorting playlist records 92 is selected. The selection of which content field on which to sort playlist 90 may be specified by the user via user input 26 or by software selection based on playlists generated to support display and browsing of audio data files on audio data player 10. For example, referring to Fig. 5A, each of the main sort-by menu categories are supported by a playlist sorted by the content category or field listed. For example, a playlist sorted by each of artist, album, title, genre, and file names.

After the content information field 93A for sorting playlist file 90 is selected, in step 108 playlist 90 is sorted and stored. Sorting may comprise more than one sorting level to support grouping and quick and efficient browsing of related audio data file records within the sorted content information field 93A. For example, a playlist file that is sorted by artist may include a second sorting level sorted by albums within each particular artist and a third sorting level sorted by track number or title for each particular album. The additional sorting levels and the supporting indexing information fields 93B support browsing of playlist 90 and audio data file content information without the need to access individual audio data files. In step 110, the selected audio data file playlist 90 is rewritten using the formatted content information 93A and indexing information 93B and sorting order specified by the user or the software.

Indexing information comprises the fields 93B disclosed in Table 2 above and provides quick and memory-efficient browsing of related playlist records 92. The indexing information fields 93B support display groupings for browsing and navigation of various sorting levels, for example, those shown in Figs. 5A through 5D. Referring to Fig. 5B, a playlist sorted by artist may include a second sorting level and associated indexing information 93B for each album of each artist, for example, the albums shown in Fig. 5C associated with artist Anna Belle. Additionally, playlist 90 indexing information 93B may include a third sorting level of tracks or songs for each album as shown in Fig. 5B for the album Another Record by artist Anna Belle.

Indexing information 93B defines the number of records included at a given sorting level and the relative location of next and previous records in the same sorting level and the relative location of the first record in the current grouping of the current sorting level. The indexing information fields 93B shown in Table 2 are exemplary, and may include other fields that provide browsing and navigation of the sorted playlist 90 with minimal memory and record 92 search time.

In the exemplary embodiment, information segment 93 including content information fields 93A and indexing information fields 93B is stored in M3U comment field format. Using the comment field format advantageously allows playlist 90 to remain compatible with other devices and software that utilize M3U playlist files.

Fig. 8 illustrates in flowchart form the steps of creating a playlist file in audio data player 10 in accordance with the present invention. In step 202, a set of audio data files to be included in playlist 90 is selected. In the exemplary embodiment, the audio data files are stored in data storage 32 and are selected by the user via user input 26 or by a software module directing generation of one or more playlist files to support browsing and navigation of the available audio data files in data storage 32. For example, playlist files may be generated for each of the content information fields 93A represented on the main sort-by menu shown in Fig. 5A, or a user playlist may be generated by user selection of particular audio data files stored in data storage 32.

In step 204, for each selected audio data file, a file pointer locating the associated audio data file relative to the location of playlist 90 is determined. For example, data storage 32 may include a folder structure for storing the audio files, thus the file pointer would include the necessary folder names and subfolder names as well as the file name for the associated data file. Alternatively, an absolute file pointer may be used that specifies device name and supports remote location of audio data files, for example, on a connected PC or the Internet.

In step 206, content information is located and read for each selected audio data file. In the exemplary embodiment, content information for MP3 files is included in ID3 tags. In step 208, one of the content information fields is selected for sorting playlist 90. For example, and as discussed above, a separate playlist file may be generated and sorted for each of the content information fields 93A displayed by the main sort-by menu shown in Fig. 5A. Additionally, further sorting levels may be used to further group and sort associated playlist records 92 within each previous sorting level. The content information fields 93A used for sorting may be selected by the user via user input 26 or by a software module for generating audio playlists 90. In step 210, DSP 12 sorts records 92 including file pointers 94 and content information fields 93, by the selected content information sorting field 93A.

In step 212, indexing information fields 93B are generated and content and indexing information 93 and file pointers 94 are formatted and stored in a playlist file. As discussed above for the method disclosed in Fig. 7, indexing information 93B provides for efficient and

quick browsing and navigation of content information stored in playlist 90. In step 214, playlist file 90 is written to data storage 32.

In the exemplary embodiment, playlist files 90 having content and indexing information 93 stored in M3U comment fields are generated by a software application. The application, referred to as a profiler, may be implemented in a PC connected to audio data player 10, or as part of the software in non-PC-based audio data player 10. The profiler software locates each available audio data file stored in data stores 32 and reads its content information, for example, ID3 tag fields in MP3 files. The software profiler may then create several M3U playlists 90 including content and indexing information 93. Each playlist 90 may be sorted by one or more of the content information fields 93A, for example, title, artist, genre, album, and file name. Using one playlist 90 for each content information sorting field reduces the memory and processing power requirements of audio data player 10 required to display the available audio data files in specific orders and groupings.

Figs. 2-4 illustrate an exemplary embodiment of the displays, buttons, switches, indicators, and ports which may be disposed on housing 13 of audio data player 10. Referring to Fig. 2, user input 26 comprises a plurality of buttons 44 (Fig. 3), 46 (Fig. 4), and 60-77 disposed on housing 13 of audio data player 10 for allowing a user to sort and select particular audio data files for playback, and to control playback settings. User input 26 may also comprise other input devices known in the art, for example, keyboard, voice activated touch pad, and touch screen input devices. Two multi-way switches comprise buttons 62-66 and 68-72. Soft keys 74-77 are multi-function buttons whose function change for various user interface menu displays. Audio data player 10 also includes display 21 disposed on housing 13. Display 21 displays the audio data files and playlists stored in data storage 32, the function of soft keys 74-77, and various status information associated with audio data player 10, such as the playback status shown in Fig. 2 and the top-level menu shown in Fig. 5.

Referring again to Fig. 2, STOP/POWER button 60 allows the user to stop playback and to turn audio data player 10 on and off. PLAY/PAUSE button 62 allows the user to start playback and to pause playback. Left arrow button 63 allows a user to move a highlight left when using the menu, and to skip back to the previous audio data file or scan backward in the present audio data file when playing music. The right arrow button 65 allows the user to move a highlight right when using the menu, skip forward to the next audio data file, and scan forward in the current audio data file when playing music. Up arrow button 64 allows the

user to move the highlight up when using the menu. Down arrow button 66 allows the user to move the highlight down when using the menu.

Referring still to Fig. 2, SELECT button 68 allows the user to select a highlighted item. Volume up button 69 increases the playback volume level for headphones 18 and volume down button 71 decreases the volume level. MODE button 70 allows the user to select a particular playback mode, including NORMAL, REPEAT, REPEAT ONE, REPEAT ALL, SHUFFLE, and REPEAT ALL SHUFFLE. SAVE button 72 allows a user to create a new playlist or add audio data files to an existing playlist. Soft keys 74-77 select the menu item that appears just above each button at the bottom of display 21.

Referring to Fig. 3, POWER indicator 78 lights when audio data player 10 is on. CHARGE indicator 79 lights when the power source 47 is charging. In the exemplary embodiment, power source 47 is a rechargeable battery pack. DC IN jack 48 provides 5 volt DC from an AC adapter to power audio data player 10 and recharge power source 47. RESET button 44 allows the user to reset all of the audio data player settings to the factory defaults.

Referring now to Fig. 4, OFF/LOCK switch 46 allows the user to make buttons 60-77 inactive when switch 46 is slid to the locked position. LINE OUT jack 41 allows a user to connect the audio data player to a separate audio system. Headphones jack 17 allows the user to play the decoded audio on headphones 18. USB port 42 provides connection of audio data player 10 to a PC or other similar device using a USB cable.

When the user selects a particular audio data file for playback via user input, DSP 12 loads the appropriate decoder file associated with the selected audio data file from data storage 32 into DSP memory 11. Referring again to Fig. 1, DSP 12 then streams the selected audio data file along buses 33 and 29 into buffer memory 25 as a skip-protection buffer.

After streaming of the selected audio data file begins, DSP 12 decodes the audio data file using an associated decoder file. Various decoder files may be stored in data storage 32 to allow audio player 10 to be adapted to process the various encoding formats associated with the audio data files stored in data storage 32. In effect, portable audio player 10 can be software upgraded, as necessary, by the decoder files stored in data storage 32 when the user selects a particular audio data file stored in data storage 32.

After powering up, DSP 12 of audio data player 10 loads the system configuration file from data storage 32. DSP 12 identifies the various file formats that need to be supported for the data files stored in data storage 32. The configuration file also includes information that equates the file extension of the audio data files with particular decoder files stored in data

storage 32. If the configuration file is valid, DSP 12 reads the file attribute table stored in data storage 32 and causes display 21 to display a menu-driven listing of the file/folders stored in data storage 32.

Referring to Fig. 5A, the main menu displayed on display 21 allows the user to navigate and display audio data files according to groupings or identifying characteristics, such as, for example, artist, album, title, genre, playlist, and all audio data files. From the main menu, the user may operate user input 26, as described above, to navigate sorted lists and select a desired one of the displayed audio data files or playlists for playback.

When an audio data file or playlist is selected for playback, DSP 12 perform a number of steps, including several concurrent steps, to provide audio playback. First, DSP 12 identifies and transfers the corresponding decoder file from data storage 32 to DSP memory 11. For example, if the user selects an MP3 file, microcontroller 22 transfers the MP3 decoder file from data storage 32 to DSP memory 11. The MP3 decoder file is used to control the decoding operation of DSP 12.

DSP 12 begins streaming the selected audio data file from data storage 32 to buffer memory 25. DSP 12 uses the decoder file to decode and decrypt, if applicable, the audio data file in buffer memory 12 in accordance with the appropriate encoding format. The decoded audio data is provided to D/A converter 14 and headphone amp 16 and line out pre amp 40 for reproduction.

In the present embodiment, the necessary decoder files are stored in data storage 32 along with the audio data files. As such, audio player 10 may be updated to play different encoding formats by software updating of the DSP via decoder files stored along with the audio data files in data storage 32. Thus, audio data player 10 is capable of playing back data files encoded using a variety of encoding formats, including encoding formats that become available in the future.

During playback display, shown in Fig. 2, displays various information about the audio data file and the audio data player settings. For example, display 21 in Fig. 2 shows the file name, artist name, album title, genre, current track being played out of total files being played, volume level indication, elapsed play time of audio data file, playback mode indication, bit rate, and selected DSP mode selection.

In the exemplary embodiment, suitable DSP 12 include, but are not limited to, TMS320DA250 manufactured by Texas Instruments Inc., of Dallas, Texas. Associated with DSP 12 is memory 23, in this case, 48 KB of ROM, and buffer memory 25 comprising 8 MB

of RAM, providing 7 minutes of buffered play time at 128 kbps and 14 minutes of buffered play time at 64 kbps. DSP 12 also includes associated memory 11, in this case 64 KB of RAM. Suitable hard drives for data storage 32 include, but are not limited to, Microdrive™ manufactured by IBM Corporation of Armonk, New York. A 10 GB hard drive, for example, provides approximately 150 hours of audio at MP3 bit-rate of 128 kbps, or 300 hours at a bit-rate of 64 kbps.

It will be apparent to those skilled in the art that although the present invention has been described in terms of an exemplary embodiment, modifications and changes may be made to the disclosed embodiment without departing from the essence of the invention. For example, although the present invention has been described with reference to data storage 32 that is fixedly disposed within audio player 10, the present invention may be implemented using flash memory, another fixed storage device, optical device, or a memory card that is adapted to be removably coupled to audio player 10, wherein the decoder program and audio data files are loaded onto the memory card by the music management software. Also, it is herein recognized that the present feature of loading the appropriate decoder programs and the audio data files may be implemented in the music management software using any one of a number of conventionally known programming methods, or combination of programming methods. Also, although the above is described in reference to an audio data player, the present invention may be extended to any portable data processing device, for example, video display devices, wherein the data may be encoded using one of a plurality of data encoding formats. Therefore, it is to be understood that the present invention is intended to cover all modifications as defined in the appended claims

CLAIMS

1. A computer-readable medium (32) having stored thereon a data structure (90) including a playlist record (92) for each audio data file, each playlist record (92) including a file pointer segment (94), characterized by each playlist record (92) including an information segment (93) having a content information field (93A) descriptive of the content of the audio data file and including at least one indexing information field (93B) indicating the location of related playlist records, and the playlist file including a data header indicating a first content information field (93A) upon which the playlist records are sorted.

2. The data structure of Claim 1, characterized in that the playlist records include an M3U format.

3. The data structure of Claim 2, characterized in that said information segment includes an M3U comment format and said content information field includes an ID3 tag.

4. The data structure of Claim 1, characterized in that the playlist records are sorted according to at least a second content information field.

5. The data structure of Claim 1, characterized in that the location of said related playlist records is a relative location.

6. A method of adding to an audio data file playlist (90) content and indexing information for each playlist record (92), characterized by: locating content information (93A) descriptive of the content of each audio data file; determining for each playlist record indexing information (93B) providing the location of related playlist records; and formatting the content and indexing information (93) for storage in the playlist (90).

7. The method of Claim 6, characterized by sorting the playlist according to the content information.

8. The method of Claim 6, characterized in that the content information includes an ID3 tag, the playlist records include an M3U format, and the content and indexing information is stored in M3U comment field format.

9. In an audio data player having a user interface including an output device (17, 21, 41) and a user input (26), a method of browsing audio data file content information by providing at least one playlist (90) including at least a first and second record (92) relating to audio data files available for playback, each record (92) stored in a predetermined sequence and including a content and indexing information segment (93), characterized by said content information including a field (93A) descriptive of the content of the related audio data file,

and said indexing information having fields (93B) providing the location of related playlist records (92); outputting via the output device (17, 21, 41) said content information field (93A) for at least a first record; receiving a playlist navigation signal from the user input (26); and in response to said playlist navigation signal, using at least one of said indexing information fields (93B) to locate and output said content information field (93A) of at least a second record, said second record related to said first record by said predetermined sequence and said navigation signal.

10. The method of Claim 9, characterized in that said playlist records include an M3U format, said content and index information segment includes an M3U comment field format, and said content information field includes an ID3 tag.

11, The method of Claim 9, characterized in that said predetermined sequence includes said playlist records sorted by at least one of said content information fields.

12. The method of Claim 9, characterized in that the location of said related playlist records is a relative location.

13. An audio data player (10) comprising a DSP (12) coupled with data storage (32) capable of storing audio data files and playlist files (90), the audio data files each having attributes descriptive of the audio content of each said audio data file; characterized by the playlist files (90) including records (92) for each of at least a portion of the audio data files, said records (92) in a predetermined order based on at least one said attribute; said records including a content information field (93A) storing said attributes of each said audio data file, and indexing information fields (93B) indicating the relative location of related playlist records (92); and the microcontroller (22) having software capable of reading said playlist records (92) and outputting a navigable list of at least a portion of said content information field (93A) according to said predetermined order.

14. The audio data player according to Claim 13, characterized by the DSP (12) having software capable of generating playlist files.

15. The audio data player of Claim 14, characterized in that said playlist file generating software is capable of sorting each playlist file according to said content information fields.

16. The audio data player of Claim 15, characterized in that said playlist file generating software is capable of locating audio data files stored on the data storage device.

17. The audio data player of Claim 16, characterized in that said playlist file generating software is capable of generating at least one additional audio data file playlist,

said additional audio data file playlist sorted according to at least a second content information field.

18. The audio data player according to Claim 13, characterized in that said attributes include an ID3 tag, and said playlist file records include an M3U format.

19. The audio data player according to Claim 14, characterized in that said playlist file generating software is capable of determining file pointers locating each audio data file in the data storage; reading said attributes for each audio data file; formatting said attributes and said file pointers for storage in the audio data file playlist.

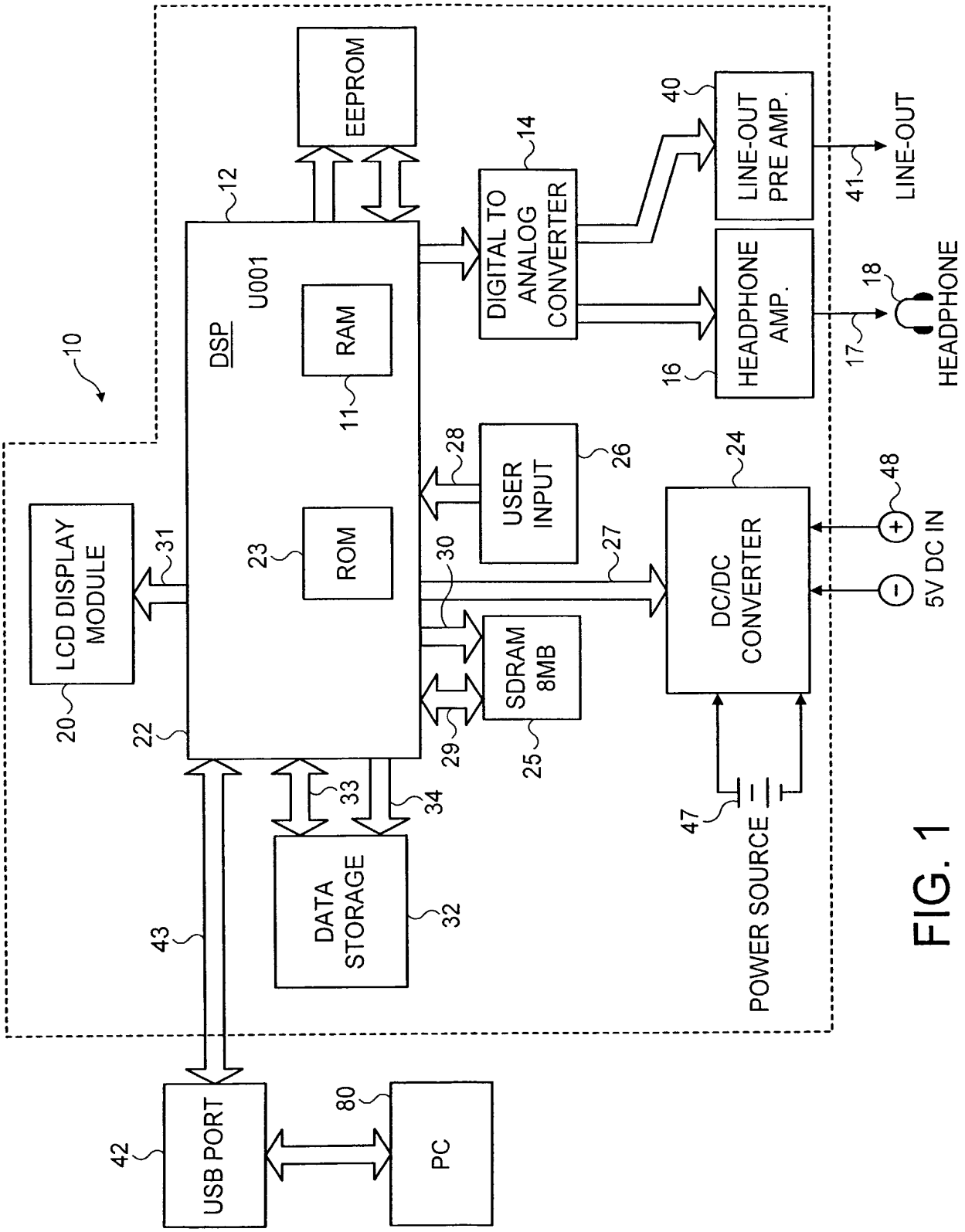
10
DSP
U001
12
EEPROM
RAM
11
ROM
23
LCD DISPLAY MODULE
20
31
22
DIGITAL TO ANALOG CONVERTER
14
LINE-OUT PRE AMP.
40
41
LINE-OUT
HEADPHONE AMP.
16
17
18
HEADPHONE
USER INPUT
26
28
30
27
SDRAM 8MB
25
29
DC/DC CONVERTER
24
48
5V DC IN
POWER SOURCE
47
DATA STORAGE
32
33
34
43
USB PORT
42
80
PC

FIG. 1

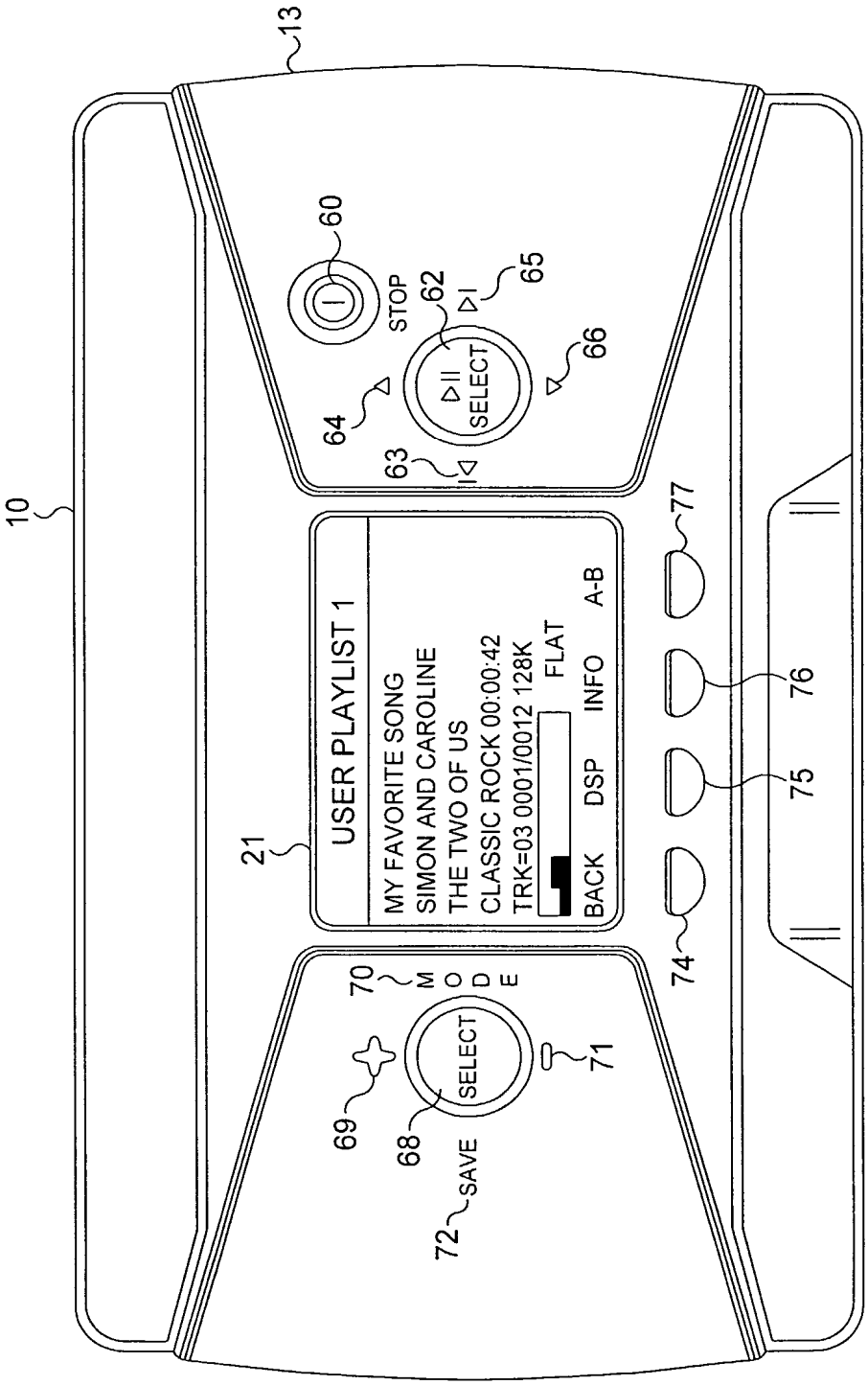

FIG. 2

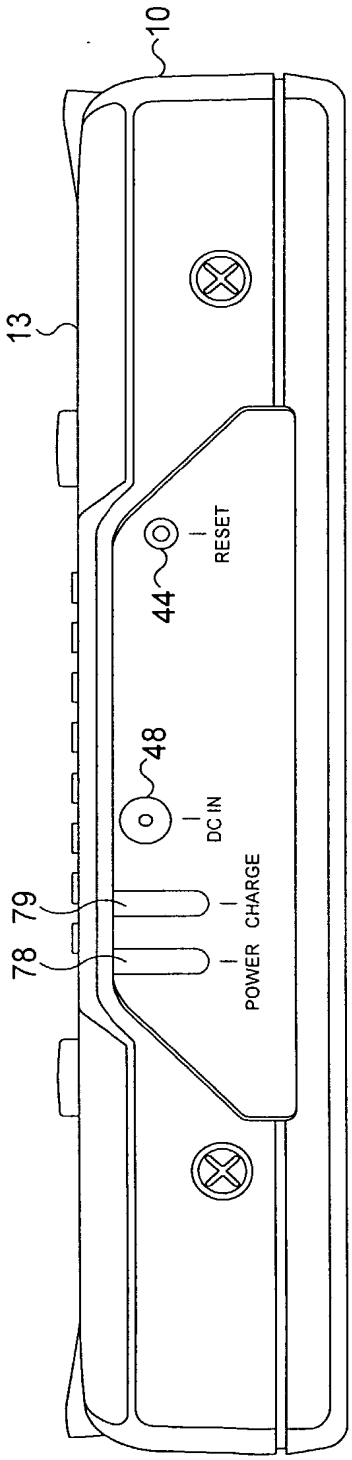
10
13
RESET
44
48
DC IN
79
78
CHARGE
POWER

FIG. 3

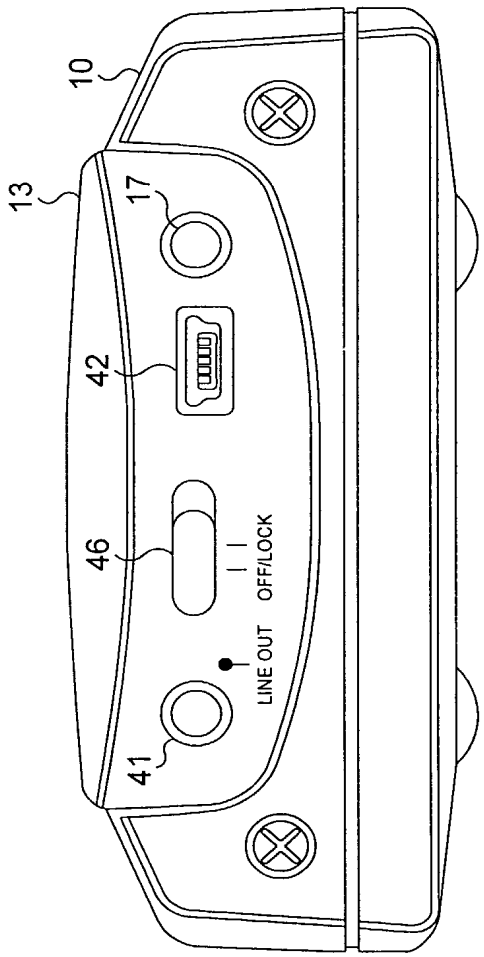
10
13
17
42
46
OFF/LOCK
LINE OUT
41

FIG. 4

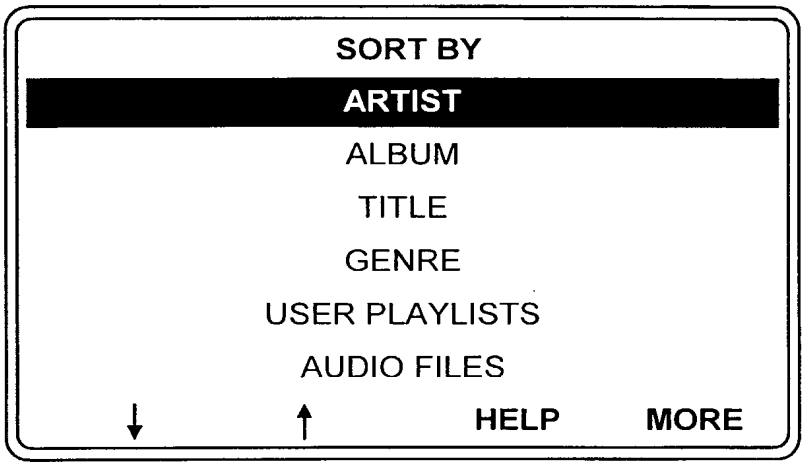
SORT BY
ARTIST
ALBUM
TITLE
GENRE
USER PLAYLISTS
AUDIO FILES
HELP
MORE

FIG. 5A

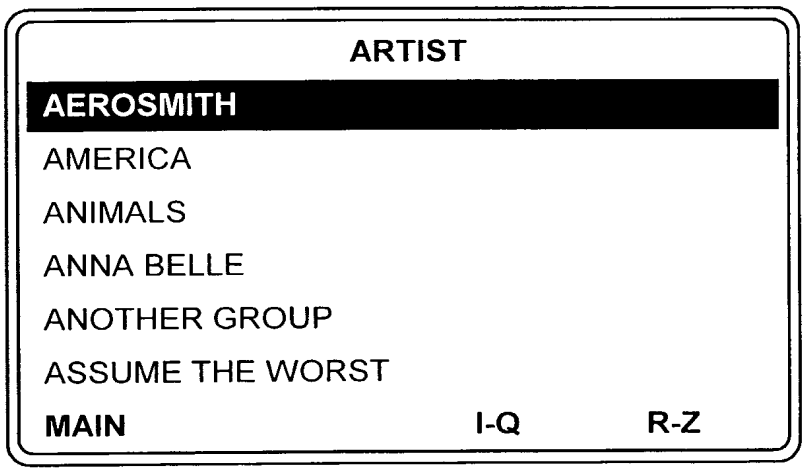
ARTIST
AEROSMITH
AMERICA
ANIMALS
ANNA BELLE
ANOTHER GROUP
ASSUME THE WORST
MAIN
I-Q
R-Z

FIG. 5B

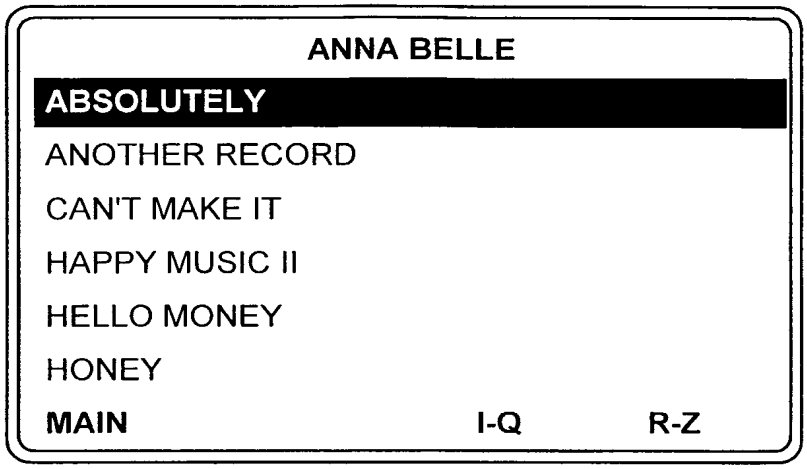
ANNA BELLE
ABSOLUTELY
ANOTHER RECORD
CAN'T MAKE IT
HAPPY MUSIC II
HELLO MONEY
HONEY
MAIN
I-Q
R-Z

FIG. 5C


ANOTHER RECORD
01 A SONG FOR YOU
02 BE YOURSELF
08 ASSUME THE WORST
09 DO YOUR BEST
10 ANOTHER SONG
BACK
PG↓
PG↑
INFO

FIG. 5D

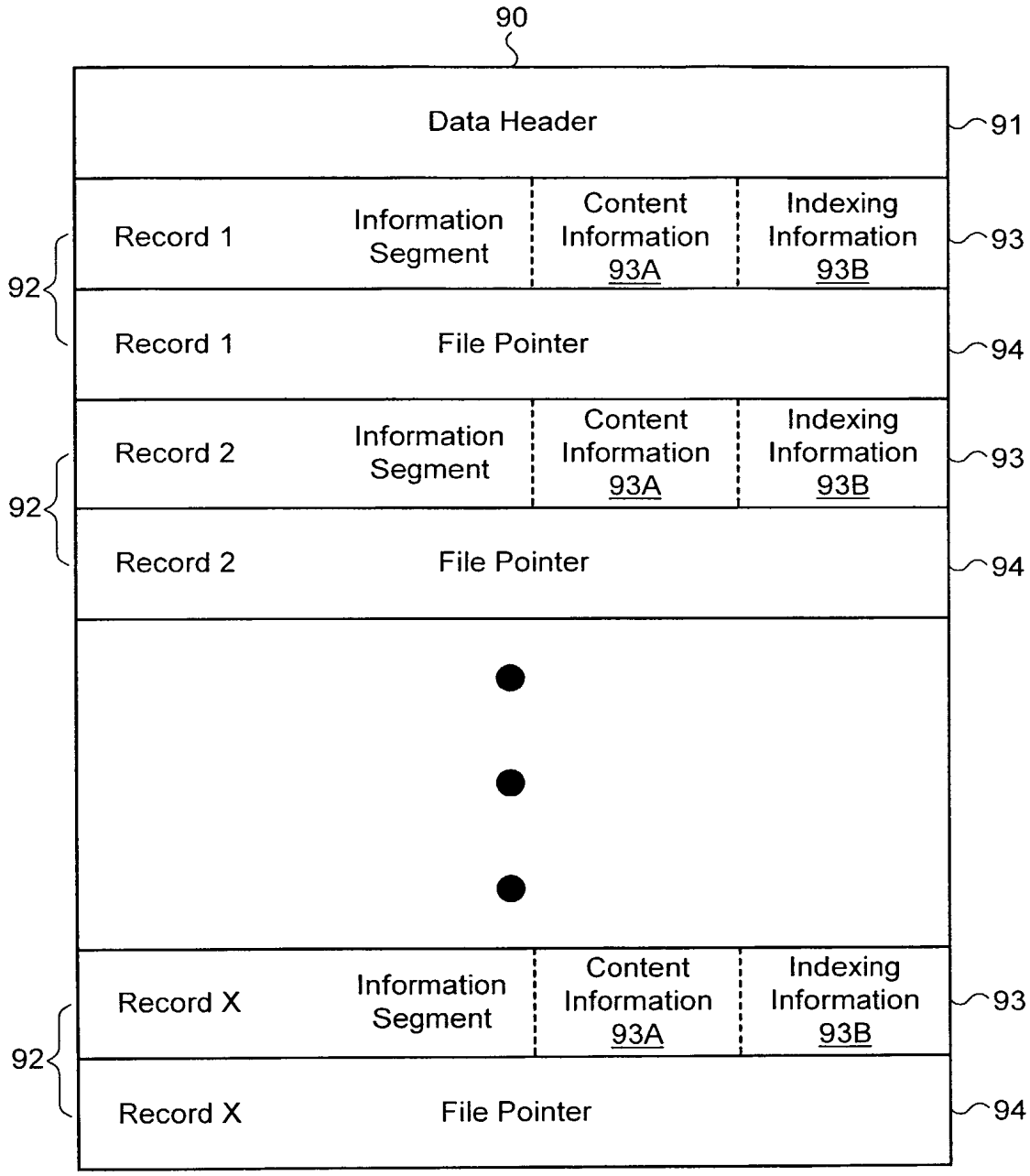
90
Data Header
91
Record 1
Information Segment
Content Information 93A
Indexing Information 93B
93
92
Record 1
File Pointer
94
Record 2
Information Segment
Content Information 93A
Indexing Information 93B
93
92
Record 2
File Pointer
94
Record X
Information Segment
Content Information 93A
Indexing Information 93B
93
92
Record X
File Pointer
94

FIG. 6

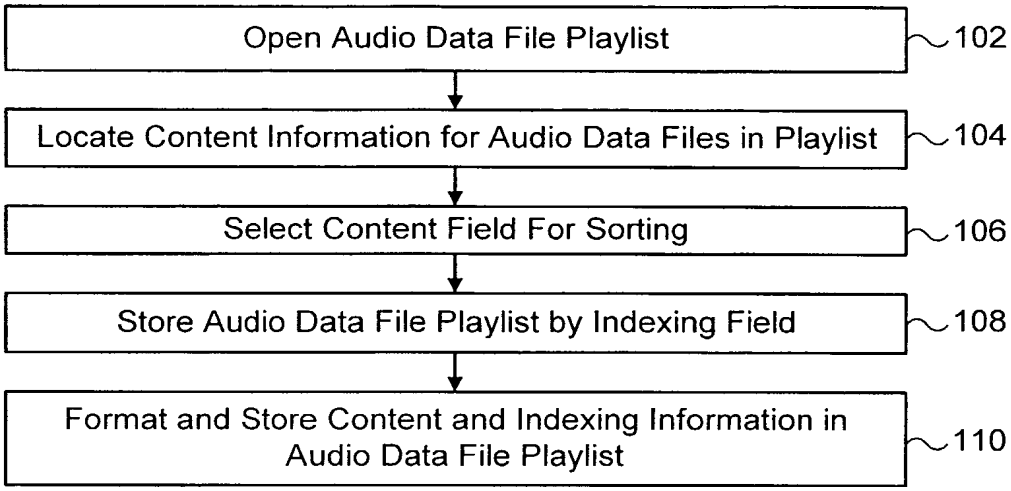
Open Audio Data File Playlist
102
Locate Content Information for Audio Data Files in Playlist
104
Select Content Field For Sorting
106
Store Audio Data File Playlist by Indexing Field
108
Format and Store Content and Indexing Information in Audio Data File Playlist
110

FIG. 7

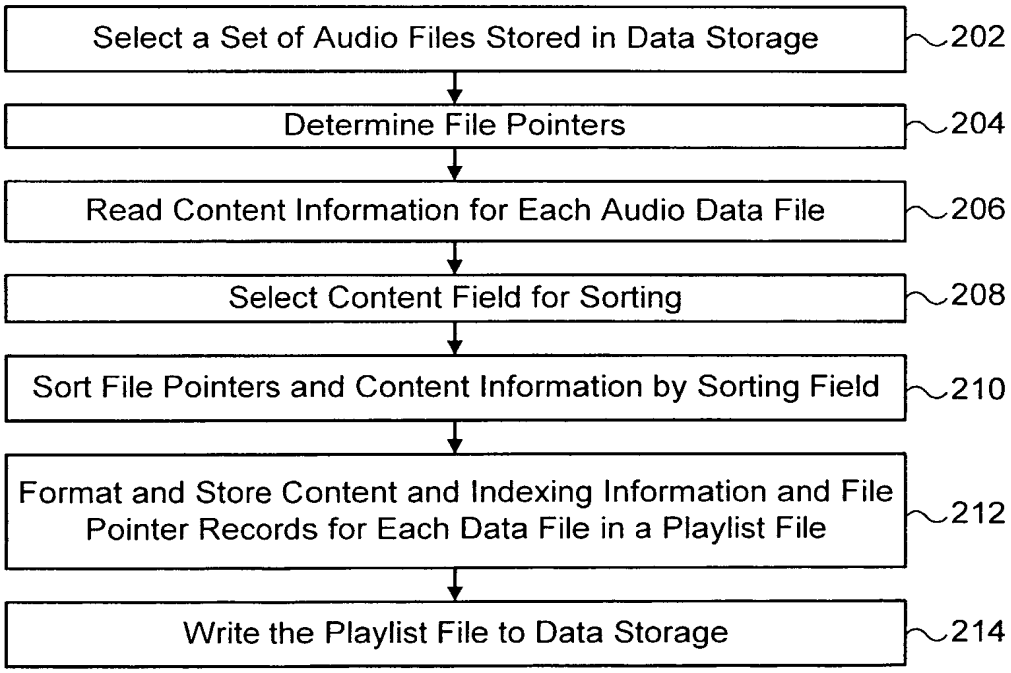
Select a Set of Audio Files Stored in Data Storage
202
Determine File Pointers
204
Read Content Information for Each Audio Data File
206
Select Content Field for Sorting
208
Sort File Pointers and Content Information by Sorting Field
210
Format and Store Content and Indexing Information and File Pointer Records for Each Data File in a Playlist File
212
Write the Playlist File to Data Storage
214

FIG. 8

INTERNATIONAL SEARCH REPORT

Int[illegible]al Application No
PCT/US 02/28485

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 G11B27/10 G11B27/32

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 G11B G11C G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, INSPEC, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 01 28222 A (TANG JIMMY TAI KWAN ;LAI SAI KIT (CN); NG KIN PING (CN); TSUI CHI) 19 April 2001 (2001-04-19) page 27, line 15 -page 30, line 17	1,6,9,13
A	EP 1 056 093 A (MATSUSHITA ELECTRIC IND CO LTD) 29 November 2000 (2000-11-29) sections '0237! - '0269!	1,6,9,13
A	WO 01 33569 A (IOMEGA CORP) 10 May 2001 (2001-05-10) page 10, line 5-11	1,6,9,13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
6 January 2003	13/01/2003

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Mourik, J

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Int[illegible]al Application No
PCT/US 02/28485

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0128222 A	19-04-2001	AU 2018201 A	23-04-2001
		WO 0128222 A2	19-04-2001
EP 1056093 A	29-11-2000	BR 0006168 A	17-04-2001
		BR 0006882 A	07-08-2001
		CA 2338634 A1	07-12-2000
		CA 2338695 A1	07-12-2000
		CA 2338725 A1	07-12-2000
		CN 1321319 T	07-11-2001
		CN 1318196 T	17-10-2001
		CN 1318197 T	17-10-2001
		CN 1353853 T	12-06-2002
		EP 1056096 A1	29-11-2000
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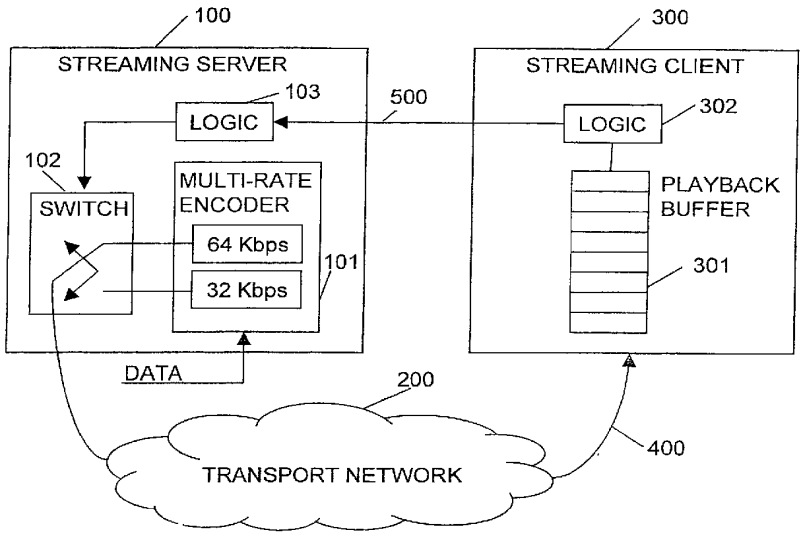
(54) Title: SYSTEM AND METHOD FOR REDUCING INITIAL BUFFERING TIME FOR A STREAMING APPLICATION



(57) Abstract: A method and system in a communications network for reducing the time length of an initial buffering phase of a streaming application. A streaming server sends data at a transport bit rate to a playback buffer in a client. A multi rate encoder initially encodes the data at a first encoding bit rate that is lower than the transport bit rate. The playback buffer begins playing back the data at a lower quality level determined by the first encoding bit rate when the playback buffer level reaches a first threshold level. When the buffer level reaches a second, higher, threshold level, the encoding bit rate is increased to a second encoding bit rate, preferably equal to the transport bit rate. Finally, the playback buffer plays back the data at a higher quality level determined by the second encoding bit rate after the buffer level reaches the second threshold level.

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SYSTEM AND METHOD FOR REDUCING INITIAL BUFFERING TIME FOR A STREAMING APPLICATION

Field of the Invention

The present invention relates to real-time data communications. In particular, and not by way of limitation, the present invention is directed to a system and method for reducing the time-length of an initial buffering phase of a streaming application.

Background Art

A streaming application enables an end-user to enjoy the content (audio, video, or combinations) before the content is completely downloaded. Unlike a conversational application, such as talking on the phone, there is no direct connection between the moment a piece of information is sent and the moment it is played back for the end user. In such a single-directional communication, the coherence of the information is important. Therefore the absolute delay between the transmission moment and the playback moment can be increased in order to preserve the relative time-relation within the information content. This may be necessary if data must be retransmitted, or if the propagation time of the different data packets is not the same, as may happen in a packet-switched network.

The variation in the propagation time is usually called delay jitter. Once the playback is started, the absolute delay between the (first) transmission moment and the playback moment is not critical for the end user because a playback buffer is used in the streaming client to reduce the effect of the delay jitter introduced by the transport network.

Playback starts when a sufficient amount of data is contained in the playback buffer. If the transport bit rate decreases below the playback bit rate due to delays in the transport network, the amount of bits in the playback buffer decreases. When the delayed data arrives, the playback buffer is filled again.

A problem with downloading a streaming application is that the end-user has to wait for a considerable time while the content is being buffered before the stream can be played back. Unlike a completely downloaded file (which can be

immediately utilized through an ftp application), a streaming application is utilized by the end-user (audio, video, or both) before the content is completely downloaded. When the buffer reaches a target level, playback begins. The target level is selected as a level that provides a predefined amount of playback time (for example, 1 second) if no additional data is delivered.

As mentioned before, the absolute delay is not important once the playback is started. However, the absolute delay is important in the initial buffering phase since it influences the time elapsed from the moment the end user requests access to a stream until the playback starts. A delay in the range of one to a few seconds is not normally objectionable, but longer delays may be perceived by the end-user as a lack of response from the application, i.e., as a lack of access to a desired service.

The time elapsed from the moment the end user requests the stream until the playback starts can be roughly modeled by three components:

$$T_{init} = T_{propagation\text{-}1} + T_{propagation\text{-}2} + T_{buffering} \qquad (1)$$

The first term represents the time needed for the client's request message to reach the streaming server; the second term is the time needed for the data from the server to reach the client; and the last term is the time needed to fill the playback buffer with the initially required amount of data. The first two terms will be ignored in the following description because they do not depend on the application and are negligible when compared to the third term.

Minimizing T_{init} is an object of the present invention. The following explanation concentrates on the minimization of T_{init} by minimizing the initial buffering time since $T_{init} \cong T_{buffering}$. The buffering time depends on the amount of data to be buffered and on the transport bit rate used in the buffering phase.

The optimum size of the playback buffer depends on the delay variation, i.e., on the size of the delay jitter. A straight forward way to define the buffer size is to indicate "how much play-time the buffer should contain, i.e., for how long a time should the application play back if no more data is received from the transport network. This time period may be designated by $T_{playback}$. This design

parameter depends on the design of the streaming client (for example, in some RealPlay versions there is a default value that the user may modify).

In the simple case in which a constant bit rate encoder (bit rate B) is used, the initial buffer size L needed for playing back $T_{playback}$ seconds is given as:

$$L = T_{playback} \cdot B \qquad (2)$$

If a variable bit rate encoder is used instead, the value of B in the above equation is replaced with an estimated average bit rate.

Once the value of $T_{playback}$ is decided (and therewith the value of L), the time needed for initial buffering is:

$$T_{init} = \frac{L}{R_{transport}} = \frac{B\,T_{playback}}{R_{transport}} \qquad (3)$$

In the above equations, B denotes the bit rate with which the application encodes data. If the encoder is not a constant bit rate encoder, the quantity will vary in time B(t), most often around a target value B. The application may also employ several encoding modes, which means that it may switch between several bit rates $\{B_1, B_2, \ldots B_n\}$ in case of constant bit rate encoders, or bit rate targets $\{\widetilde{B}_1, \widetilde{B}_2, \ldots \widetilde{B}_n\}$ in case of variable bit rate encoders.

The transport bit rate, $R_{transport}$, depends on characteristics of the underlying transport network. When the network is affected by delays or retransmissions due to errors, the transport bit rate varies in time and the equation (3) is valid in some statistical sense. In a packet switched network, $R_{transport}$ can be at times very high, as is the case when a large amount of data previously buffered in a routing node is delivered at once. However, the transport network may have some inherent limitations on this transport bit rate (i.e., $R_{transport} \leq R_{max}$) as is the case when the last link is a slow modem or a radio connection, i.e., when the over provisioning typical to a modern LAN is not available.

FIG. 1 is a graph of the number of buffered bits as a function of time when a constant bit rate encoder is utilized in a known buffering procedure. The initial delay (T_{init}) 10 is a function of the bit rate 12 at which the buffer is filled, and the

target level (L_{target}) 14 that must be reached before playback begins. The rate at which the buffer is filled is a function of the transport bit rate from the application server to the end-user's buffer. In the example illustrated, the transport bit rate 12 is shown as 64 kbps. L_{target} may be set at a level that is sufficient for the end user to play back data for a predefined time period $T_{playback}$ (for example $T_{playback}$ = 1 second). Once the buffered level reaches L_{target}, the first frame of data 16 is played back. Buffering then continues until the buffered level again reaches L_{target}, and then the second frame 18 is played back. This process continues throughout the playback period.

If the entire content of the data to be streamed is available at the server, the server could send the data encoded at B with a higher bit rate $R_{transport} \geq B$. This difference between the transport bit rate and the encoding rate is typically exploited for reducing the initial buffering time.

In some cases, however, in which the transport network is not over-provisioned (for example dial-up or radio link), it is not possible to obtain transport bit rates higher than the encoding bit rate B. As a reference, the case may be considered in which the data is streamed from the server with the same bit rate as the encoding bit rate (i.e., R = B). For the sake of simplicity, it is assumed that the transport bit rate R is fitted to the capabilities of the transport network such that the transport bit rate is same as the streaming rate (i.e., $R_{transport}$ = R). In this case, the time needed to fill the initial buffer (T_{init}) is exactly the playback time $T_{playback}$.

FIG. 2 is an illustrative drawing of a known procedure for reducing the initial time delay, T_{init}. In this procedure, assuming that data is available at the streaming server, T_{init} is reduced by speeding up the transport bit rate. During the initial buffering phase, an additional bearer connection 20 is established in addition to the normal connection 22 in order to effectively double the transport bit rate from 64 kbps to 128 kbps. This, of course, reduces the initial delay period by one-half.

FIG. 3 is a graph of cumulated data as a function of time, which more clearly illustrates the effect achieved by the procedure of FIG. 2. For the sake of simplicity, a constant rate encoder (for example 64 kbps) is used to illustrate this

approach. It is assumed that the transport network can support bit rates as high as R_{max} = 128 kbps, and the client application is designed so that the playback time $T_{playback}$ = 1 sec. Thus, the amount of data to be buffered before the playback can start is L = 64 kbit. If the server streams this amount of data at a bit rate R = 64 kbps (illustrated by solid line 30), the initial time T_1 to start playback is 1 second. If the server streams this amount of data at a bit rate of 128 kbps (illustrated by dotted line 32), the initial buffering time T_2 is reduced to 0.5 sec.

This approach is possible only if the transport network is capable of streaming data at a higher bit rate than the encoding bit rate. This is the case with most of the current Internet connections since bandwidth is generally not an issue. A problem may occur with links where bandwidth is a scarce resource, as is the case with radio links. A bandwidth-efficient approach is to provide a transport link that is matched to the encoding rate, since most of the transmission is expected to be at that rate.

When the transport bit rate is limited to the encoding rate, a known solution for reducing the buffering time is to temporarily provide an additional connection during the buffering period. Using the 3rd Generation Partnership Project (3GPP) terminology, a "temporary bearer" is used for sending data at higher bit rates during the start-up phase. However, this approach has disadvantages because additional connections are not always available. For example in a radio network, the additional bearer 20 in FIG. 2 might not be provided due to a lack of radio channels. Another disadvantage of the known approach is an increased need for signaling and a rather complicated process of establishing and removing the additional connection. There is no straightforward solution according to the 3GPP standard that avoids the disadvantages raised by the prior art.

Summary of the Invention

The present invention trades off quality of the application at the beginning of the session for a reduced initial delay period. By reducing the encoding bit rate at the application server during the first part of the session, and beginning

the playback at a lower threshold level in the playback buffer, the application may be presented initially to the end-user with lower quality, but the delay period is reduced. The delay period is reduced because fewer bits need to be buffered in order to provide the predefined amount of playback time. During the period of reduced quality, the buffer continues to fill. Once the buffer reaches a target level that provides the predefined amount of playback time at a normal (higher) quality level, the playback quality can be increased to a normal level.

Thus, in one aspect, the present invention is directed to a method of reducing the time length of an initial buffering phase of a streaming application in a communications network having a streaming server with an encoder, a streaming client with a playback buffer, and a transport network. The method includes the steps of determining a transport bit rate for the transport network; encoding data with the encoder at an encoding bit rate that is lower than the transport bit rate; and transporting the encoded data through the transport network from the streaming server to the playback buffer in the streaming client at the transport bit rate. The method also includes beginning playback of the data when the level of data in the playback buffer reaches a first predefined threshold level; and increasing the encoding bit rate to equal the transport bit rate when the level of data in the playback buffer reaches a second predefined threshold level that is higher than the first predefined threshold level.

In another aspect, the present invention is directed to an alternative method of reducing the time length of an initial buffering phase of a streaming application. The method includes the steps of determining a transport bit rate in the transport network between the streaming server and the playback buffer in the streaming client; encoding data with the encoder during an initial buffering period at a first encoding bit rate that is lower than the determined transport bit rate; and transporting the encoded data through the transport network from the streaming server to the playback buffer in the streaming client at the transport bit rate. The method also includes beginning playback of the data at a first quality level determined by the first encoding bit rate when the level of data in the playback buffer reaches a first predefined threshold level; increasing the first encoding bit rate to a second encoding bit rate when the level of data in the

playback buffer reaches a second predefined threshold level that is higher than the first predefined threshold level; and playing back the data at a second quality level determined by the second encoding bit rate when the level of data in the playback buffer reaches the second predefined threshold level.

In yet another aspect, the present invention is directed to a method of reducing the time length of an initial buffering phase of a streaming application in a communications network having a streaming server with a variable rate encoder, a streaming client with a playback buffer, and a transport network. The method includes the steps of determining a transport bit rate in the transport network for transporting a plurality of frames of data between the streaming server and the playback buffer in the streaming client; encoding data with the variable rate encoder during an initial buffering period at a first average encoding bit rate that is lower than the determined transport bit rate; and transporting the encoded data through the transport network from the streaming server to the playback buffer in the streaming client at the transport bit rate. The method also includes beginning playback of the data at a first quality level determined by the first average encoding bit rate when the level of data in the playback buffer reaches a predefined threshold level; and varying the instantaneous encoding bit rate for each data frame to make the plurality of data frames more equal in size.

In yet another aspect, the present invention is directed to a system in a communications network for reducing the time length of an initial buffering phase of a streaming application. The system first includes a streaming server comprising a multi-rate encoder that encodes data at an encoding rate selected from a plurality of encoding rates; a switching mechanism for selecting the encoding rate; and server logic that controls the switching mechanism. Secondly, the system includes a streaming client comprising a playback buffer that stores data received from the server; and client logic that reports buffer parameters to the server. Thirdly, the system includes a transport network for transporting data at a transport bit rate from the server to the client. The multi-rate encoder initially encodes the data at an encoding bit rate that is lower than the transport bit rate. The playback buffer begins playing back the data at a first quality level determined by the first encoding bit rate when the level of data in the

playback buffer reaches a first predefined threshold level. The client logic reports to the server logic when the level of data in the playback buffer reaches a second predefined threshold level that is higher than the first predefined threshold level. The server logic controls the switching mechanism to increase the first encoding bit rate to a second encoding bit rate when the level of data in the playback buffer reaches the second predefined threshold level. Finally, the playback buffer plays back the data at a second quality level determined by the second encoding bit rate after the level of data in the playback buffer reaches the second predefined threshold level.

Brief Description of the Drawings

FIG. 1 (Prior Art) is a graph of the number of buffered bits as a function of time when a constant bit rate encoder is utilized in a known buffering procedure;

FIG. 2 (Prior Art) is an illustrative drawing of a known procedure for reducing the initial time delay;

FIG. 3 (Prior Art) is a graph of cumulated data as a function of time, which more clearly illustrates the effect achieved by the procedure of FIG. 2;

FIG. 4 is an illustrative drawing of a procedure for reducing the initial time delay in accordance with the teachings of the present invention;

FIG. 5 is a graph of the number of buffered bits as a function of time when utilizing a constant bit rate encoder with the procedure of FIG. 4; and

FIG. 6 is a simplified block diagram of the preferred embodiment of the system of the present invention.

Detailed Description of Embodiments

FIG. 4 is an illustrative drawing of a procedure for reducing the initial time delay in accordance with the teachings of the present invention. The present invention trades the quality of the stream at the beginning of the session for a reduced buffering time. If the total experienced satisfaction of the end user is seen as a function of the annoyance for waiting for the session to start and the quality of the session once it started, then the proposed solution can be used to increase the total satisfaction by trading off the two terms against each other.

The present invention reduces the user's annoyance by reducing the buffering time, at the expense of temporarily reducing the quality of the stream by temporarily reducing the encoding rate.

As shown in FIG. 4, the initial waiting time is reduced from a reference waiting time 40 (the waiting time that would be experienced if the data was encoded at the transport rate) to a new waiting time 42. However, once the application playback starts, there is a period of decreased quality 44 due to the lower encoding rate. Once the playback buffer level reaches the target level, the encoding rate is increased to equal the transport rate, and the streaming quality is consequently increased to a normal level 46.

The invention may be utilized for both a constant bit rate encoder and a variable bit rate encoder. In both cases, it is assumed that the target (average) encoding bit rate can be changed. The invention also protects the receiver buffer fullness from overflow and underflow using known techniques. However, the invention may also be applied to cases in which the receiver buffer does not have a practical upper bound (for example when the client has a hard disk).

The invention utilizes a multi-rate encoder of a known type. A multi-rate encoder is an encoder that is able to generate encoded data with different average bit rates. When data is encoded with a high bit rate, the high bit rate generally leads to a higher perceived quality, as perceived by the end-user. A lower quality will be perceived when the encoder uses a lower bit rate mode. However, the lower quality in this instance may not be as low as that experienced by the end-user when the transmission is affected by errors, or when some of the data is lost in the network. If there are long delays, or data is lost in the network, the quality perceived by the end-user may be dramatically degraded. Thus, the lower quality level proposed by the present invention is generally better than the low quality that results from transmission errors and\or losses, even when a higher bit rate mode is utilized.

The multi-rate encoder also provides a way to gracefully degrade the quality of the stream when network conditions dictate. When the available transport rate is high, an encoding mode with a high bit rate can be used. However, if the transport bit rate decreases, for example due to congestion in the

network, the encoder can be switched to a lower bit rate that is fitted to the reduced transport bit rate. By doing so, the end user quality is gracefully degraded in a controlled manner.

As noted above, the present invention may be utilized with both constant rate encoders and variable rate encoders. The main difference between a constant rate encoder and a variable rate encoder is the amount of bits used to encode each application frame. For example, in a video application that generates video frames with a constant time-period, a constant rate encoder uses the same amount of bits for encoding each frame regardless of the content of the frame. A variable rate encoder, however, may use different amounts of bits for each frame, depending on the content of the frame. The multi-rate encoder discussed above may be implemented as a constant rate encoder or a variable rate encoder. If the multi-rate encoder is a constant rate encoder, it is capable of switching between at least two constant, but different, encoding rates. If the multi-rate encoder is a variable rate encoder, it is capable of determining average encoding rates and switching between at least two different average encoding rates.

Embodiment Using a Constant Bit Rate Encoder

In an exemplary scenario in which a constant bit rate encoder is utilized, the encoder operates at B_1 = 64 kbps, and the initial playback buffer size is large enough for the client to play back data for $T_{playback}$ = 1s without receiving any more data. This corresponds to a buffer size L_{target} = 64 kbits. Given a transport bit rate of $R_{transport}$ = 64 kbps, the time needed to buffer L_{target} is:

$$T_{init} = \frac{L_{target}}{R_{transport}} = \frac{B_1 \, T_{playback}}{R_{transport}} = \frac{64 \text{ kbps}}{64 \text{ kbps}} \cdot T_{playback} = 1s \qquad (4)$$

FIG. 5 is a graph of the number of buffered bits as a function of time when utilizing a constant bit rate encoder with the procedure of FIG. 4. The streaming server initially sends application frames encoded at B_2 = 32 kbps. Under the same buffering constraint (i.e., that the client should be able to playback for $T_{playback}$ = 1s without receiving any more data), the amount of data to be buffered is only L = 32 kbits. Data is buffered for T_{init} i.e. until L bits have been buffered.

T_{init} in this case is equal to the new waiting time 42 in FIG. 4. Since a 64 kbps transport channel is used, the initial 32 kbits is downloaded to the client in T_{init} = 0.5 s. Notice that the initial buffering time is reduced to half since $B_1 / B_2 = 2$.

At time T_{init}, the first frame of the application is played back. More data is then buffered until the second frame is played. Since the encoding rate is lower than the transport bit rate, the amount of data buffered in the client will increase even after playback is started. During N application frames, the extra amount of buffered data is:

$$\Delta L = L_{target} - L(R - B_2) \cdot N \cdot t_{\text{frame}} \approx (B_1 - B_2) \cdot N \cdot t_{\text{frame}} \qquad (5)$$

All the application frames have the same size, since a constant bit rate encoder is used. In the example shown, the period of decreased quality 44 comprises the period of time in which frames 1-4 are played back. Thereafter, frame 5 and subsequent frames are played back with normal (higher) quality 46.

The transport bit rate is assumed in this example to be constant and therefore the buffer fullness varies between two fixed limits 50 and 51. In practice, the transport bit rate will have variations, for example due to RLC retransmissions, which means that the buffer fullness will also have variations.

Since $L_{target} = T_{playback} \cdot B_1$ and $L = T_{init} \cdot B_1 = T_{playback} \cdot B_2$, it can be shown that the number of frames that have to be encoded with the lower rate is:

$$N \cdot t_{frame} = T_{playback} \qquad (6)$$

This means that the amount of data (D_2) that must be encoded with B2 is:

$$D_2 = N \cdot t_{frame} \cdot B_2 = T_{playback} \cdot B_2 \equiv L \qquad (7)$$

Concluding the example, when a constant bit rate encoder with multiple rates is available, the pseudo code algorithm to be used to set the initial buffering time to T_{init} is:

```
% get the input parameters
T_playback
T_init
B_1
```

% select the initial encoding rate
B_2 = B_1 * T_init / T_playback

% stream
send data encoded at B_2 for T_init % send B_2*T_playback bits
thereafter send data encoded at B_1

The input parameter $T_{playback}$ should be selected according to the receiver buffer size. The above pseudo code assumes that the encoder can encode data at any rate B_2, and therefore it uses T_{init} as an input parameter. If this is not the case, and a limited number of encoding rates $\{B_2\}_{i\in[1:N]}$ are available, T_{init} is selected from a set of N-1 values. It should also be noted that the shorter the input T_{init}, the lower the initial quality level due to the lower value of B_2.

FIG. 6 is a simplified block diagram of the preferred embodiment of the system of the present invention. The preferred embodiment includes a streaming server 100, a transport network 200, and a steaming client 300. The streaming server includes a multi-rate encoder 101, so that it can selectively encode the data utilizing one of two or more encoding rates (for example, 32 kbps or 64 kbps). The encoding rate may be selected, for example, with the help of a switch 102 if a constant bit rate encoder is used. The transport network provides a transport channel 400 whose transport bit rate is fitted to the highest encoding rate of the streaming server.

The streaming client 300 has a playback buffer 301 characterized by a playback time. The amount of data to be buffered in the playback buffer depends on the playback time and on the encoding rate. The streaming client also includes logic 302, which controls the playback buffer and provides access to the buffer by a decoder (not shown). The logic also uses a control channel 500 to inform a logic device 103 in the server about parameters such as transport channel bit rate R, initial (target) buffering time T_{init}, the time period for lower quality, and other parameters controlling playback buffer fullness. In an alternative embodiment, the information about the buffering time is apriori known by the server so that the control channel 500 is not needed.

The logic device 103 in the streaming server 100 also triggers the switch 102 to switch between different encoding modes in order to minimize the initial buffering rate. At the beginning of a streaming session, the logic device 103 selects the lower encoding mode (rate). After the time period for lower quality, the logic device switches the mode to the higher encoding rate. The exact implementation of the logic device 103 depends of the characteristics of the system. In the case of a constant rate encoder with a simple switch, the implementation is a straightforward algorithm for switching from one constant rate to another. The algorithm has only two input parameters: T_{init} controlling the waiting time, and $T_{playback}$ controlling both the buffer fullness level and the time played back at the lower encoding rate.

Embodiment Using a Variable Bit Rate Encoder

A variable rate encoder may be utilized to provide for more efficient transmission of data. For the same amount of transmitted data, the quality perceived by the end user is better when a variable rate encoder is used than when a constant rate encoder is used. However, the use of a variable bit-rate encoder on transport channels with limited (upper bounded) bit rates may cause problems in the client, because use of the variable bit-rate encoder may lead to an overfilled or underfilled condition in the receiver buffer. The receiver buffer may overfill when the client decoder extracts fewer bits from the receiver buffer than the amount of data entering the receiver buffer. The receiver buffer may underfill when the decoder attempts to consume more bits than are available in the receiver buffer. In order to cope with this kind of problem, the amount of bits used to encode each frame has to be planned according to the size of the receiver buffer, the bandwidth of the transport channel, and so on. Techniques for varying the instantaneous encoding bit rate around an average bit rate are known, and are shown, for example, in the published U.S. Patent Application No. US 2002/0012395 A1 (Song et al.), and in "Long Window Rate Control for Video Streaming," (Varsa et al.), Proceedings of the 11th International Packet Video Workshop, 30 April – 1 May 2001, Kyungju, Korea, pages 154-159. Both of these references are hereby incorporated by reference herein in their

entireties.

The rate control process described in these references, while varying the instantaneous encoding bit rate for each frame, maintains an average (target) encoding bit rate that is constant in time. It should be recognized that although this process may be effective in trading-off quality for a more constant frame size (thereby providing greater protection against overflow or underflow), the process does not affect the initial delay time. Therefore, this known process should not be confused with the novel process described herein for switching between different average encoding bit rates in order to reduce the time-length of the initial buffering phase.

This embodiment of the present invention utilizes a procedure similar to the constant bit rate encoder case to achieve similar results for the variable bit rate encoder case. However, instead of switching between two constant encoding rates (and handling frames of constant sizes), this embodiment switches between two average encoding bit rates. Since a variable bit rate encoder is being utilized, the frame sizes and encoding rates may vary. Because of this, if the initial buffering time is reduced, several adverse consequences are possible. A first possible consequence would be that a number of frames with relatively few bits of data are received, and the target buffer fullness decreases, making the client application more sensitive to delay jitter. Additionally, receiving frames with relatively few bits of data may cause the receiver buffer to run the risk of underflowing. Conversely, another possible consequence is that a number of frames with a relatively large number of bits are received, causing the receiver buffer to run the risk of overflowing. As noted above, the invention may avoid this risk by varying the instantaneous encoding bit rate for each frame so that the frame sizes become more equal, which is done at the expense of slightly decreased quality over the entire video window.

Although the present invention has been described in detail with reference to only a few exemplary embodiments, those skilled in the art will appreciate that various modifications can be made without departing from the invention. Accordingly, the invention is defined only by the following claims, which are intended to embrace all equivalents thereof.

WHAT IS CLAIMED IS:

1. A method of reducing the time length of an initial buffering phase of a streaming application in a communications network having a streaming server with an encoder, a streaming client with a playback buffer, and a transport network, said method comprising the steps of:

determining a transport bit rate for the transport network;

encoding data with the encoder at an encoding bit rate that is lower than the transport bit rate;

transporting the encoded data through the transport network from the streaming server to the playback buffer in the streaming client at the transport bit rate;

beginning playback of the data when the level of data in the playback buffer reaches a first predefined threshold level; and

increasing the encoding bit rate to equal the transport bit rate when the level of data in the playback buffer reaches a second predefined threshold level that is higher than the first predefined threshold level.

2. The method of claim 1, wherein the first threshold level is a quantity of buffered data sufficient to provide a playback period of a predefined duration when the data is played back at the encoding bit rate, given that no further data is received.

3. The method of claim 2, wherein the second threshold level is a quantity of buffered data sufficient to provide a playback period of the predefined duration when the data is played back at the transport bit rate, given that no further data is received.

4. The method of claim 1, further comprising matching the encoding bit rate to the transport bit rate if the transport bit rate changes, thereby gracefully degrading the quality of the streaming application when network conditions dictate.

5. The method of claim 1, wherein the encoder is a variable bit rate encoder, and the step of encoding data at an encoding bit rate that is lower than the transport bit rate includes encoding the data at an average encoding bit rate that is lower than the transport bit rate, and the step of increasing the encoding bit rate includes increasing the average encoding bit rate to equal the transport bit rate when the level of data in the playback buffer reaches the second predefined threshold level.

6. A method of reducing the time length of an initial buffering phase of a streaming application in a communications network having a streaming server with an encoder, a streaming client with a playback buffer, and a transport network, said method comprising the steps of:

determining a transport bit rate in the transport network between the streaming server and the playback buffer in the streaming client;

encoding data with the encoder during an initial buffering period at a first encoding bit rate that is lower than the determined transport bit rate;

transporting the encoded data through the transport network from the streaming server to the playback buffer in the streaming client at the transport bit rate;

beginning playback of the data at a first quality level determined by the first encoding bit rate when the level of data in the playback buffer reaches a first predefined threshold level;

increasing the first encoding bit rate to a second encoding bit rate when the level of data in the playback buffer reaches a second predefined threshold level that is higher than the first predefined threshold level; and

playing back the data at a second quality level determined by the second encoding bit rate when the level of data in the playback buffer reaches the second predefined threshold level.

7. The method of claim 6, further comprising matching the encoding bit rate to the transport bit rate if the transport bit rate changes, thereby

gracefully degrading the quality of the streaming application when network conditions dictate.

8. The method of claim 6, wherein the encoder is a variable bit rate encoder, and the step of encoding data during the initial buffering period includes encoding the data at a first average encoding bit rate that is lower than the transport bit rate, and the step of increasing the first encoding bit rate to a second encoding bit rate includes increasing the first average encoding bit rate to a second average encoding bit rate when the level of data in the playback buffer reaches the second predefined threshold level.

9. The method of claim 6, wherein the step of increasing the first encoding bit rate includes increasing the first encoding bit rate to equal the transport bit rate.

10. The method of claim 6, wherein the first threshold level is a quantity of buffered data sufficient to provide a playback period of a predefined duration when the data is played back at the first encoding bit rate, given that no further data is received.

11. The method of claim 10, wherein the second threshold level is a quantity of buffered data sufficient to provide a playback period of the predefined duration when the data is played back at the second encoding bit rate, given that no further data is received.

12. A method of reducing the time length of an initial buffering phase of a streaming application in a communications network having a streaming server with a variable rate encoder, a streaming client with a playback buffer, and a transport network, said method comprising the steps of:

determining a transport bit rate in the transport network for transporting a plurality of frames of data between the streaming server and the playback buffer in the streaming client;

encoding data with the variable rate encoder during an initial buffering period at a first average encoding bit rate that is lower than the determined transport bit rate;

transporting the encoded data through the transport network from the streaming server to the playback buffer in the streaming client at the transport bit rate;

beginning playback of the data at a first quality level determined by the first average encoding bit rate when the level of data in the playback buffer reaches a predefined threshold level; and

varying the instantaneous encoding bit rate for each data frame to make the plurality of data frames more equal in size.

13. The method of claim 12, wherein the predefined threshold level is a quantity of buffered data sufficient to provide a playback period of a predefined duration when the data is played back at the first average encoding bit rate, given that no further data is received.

14. The method of claim 12, further comprising the step of increasing the first average encoding bit rate to a second average encoding bit rate when the level of data in the playback buffer reaches a second predefined threshold level that is higher than the first predefined threshold level.

15. A system in a communications network for reducing the time length of an initial buffering phase of a streaming application, said system comprising:

a streaming server comprising:

a multi-rate encoder that encodes data at an encoding rate selected from a plurality of encoding rates;

a switching mechanism for selecting the encoding rate; and

server logic that controls the switching mechanism;

a streaming client comprising:

a playback buffer that stores data received from the server; and

client logic that reports buffer parameters to the server; and

a transport network for transporting a plurality of data frames at a transport bit rate from the server to the client;

wherein:

the multi-rate encoder initially encodes the data at an encoding bit rate that is lower than the transport bit rate;

the playback buffer begins playing back the data at a first quality level determined by the first encoding bit rate when the level of data in the playback buffer reaches a first predefined threshold level;

the client logic reports to the server logic when the level of data in the playback buffer reaches a second predefined threshold level that is higher than the first predefined threshold level;

the server logic controls the switching mechanism to increase the first encoding bit rate to a second encoding bit rate when the level of data in the playback buffer reaches the second predefined threshold level; and

the playback buffer plays back the data at a second quality level determined by the second encoding bit rate after the level of data in the playback buffer reaches the second predefined threshold level.

16. The method of claim 15, wherein the server logic is adapted to control the switching mechanism to increase the first encoding bit rate to equal the transport bit rate when the level of data in the playback buffer reaches the second predefined threshold level.

17. The system of claim 16, wherein the first threshold level is a quantity of buffered data sufficient to provide a playback period of a predefined duration when the data is played back at the first encoding bit rate, given that no further data is received.

18. The system of claim 17, wherein the second threshold level is a quantity of buffered data sufficient to provide a playback period of the predefined duration when the data is played back at the transport bit rate, given that no further data is received.

19. The system of claim 18, wherein the multi-rate encoder is adapted to match the encoding bit rate to the transport bit rate if the transport bit rate changes, thereby gracefully degrading the quality of the stream when network conditions dictate.

20. The system of claim 15, wherein the multi-rate encoder is a variable bit rate encoder that initially encodes the data at a first average encoding bit rate that is lower than the transport bit rate, and the server logic controls the switching mechanism to increase the first average encoding bit rate to a second average encoding bit rate when the level of data in the playback buffer reaches the second predefined threshold level.

21. The system of claim 20, wherein the variable bit rate encoder varies the instantaneous encoding bit rate for each data frame to make the plurality of data frames more equal in size.

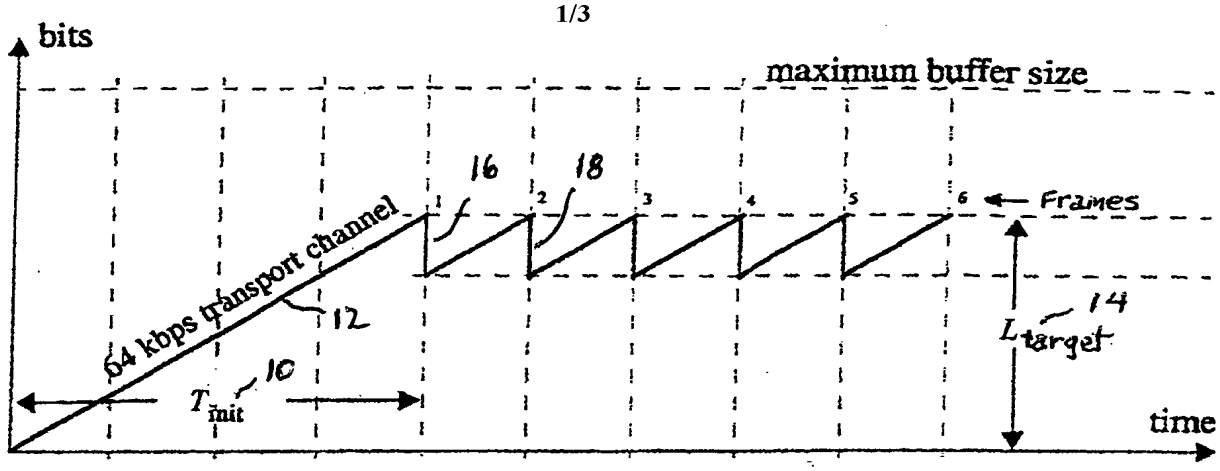

FIG. 1
(Prior Art)

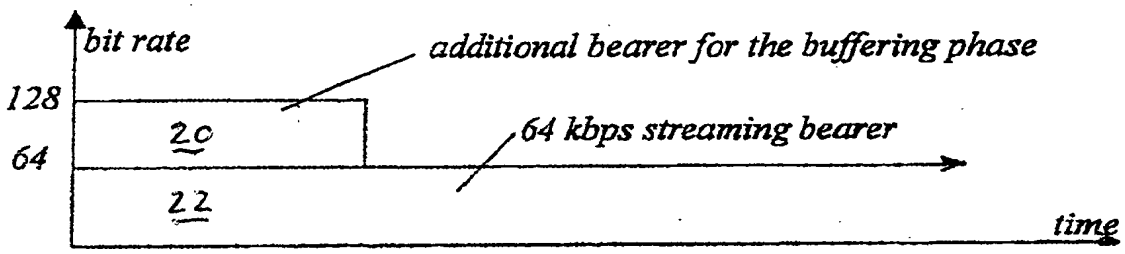

FIG. 2
(Prior Art)

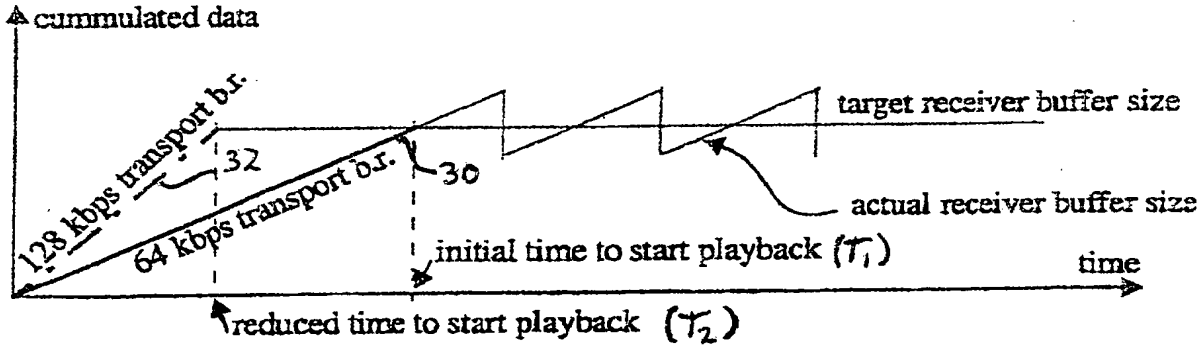

FIG. 3
(Prior Art)

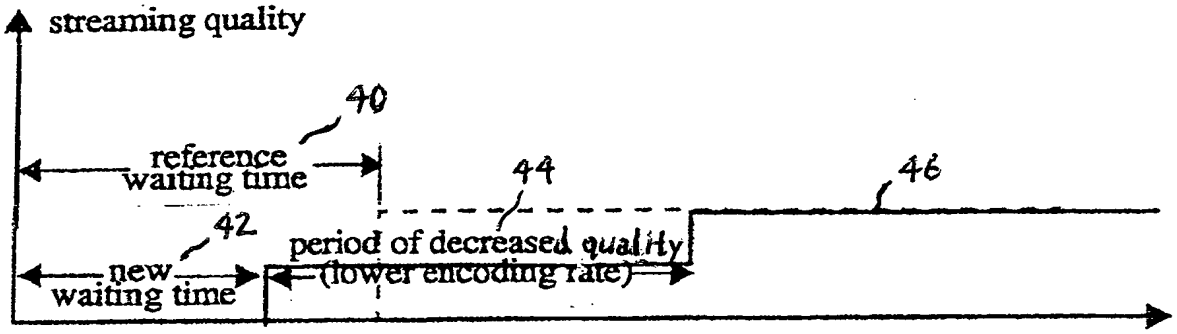
streaming quality
40
reference waiting time
44
46
42
new waiting time
period of decreased quality (lower encoding rate)

FIG. 4

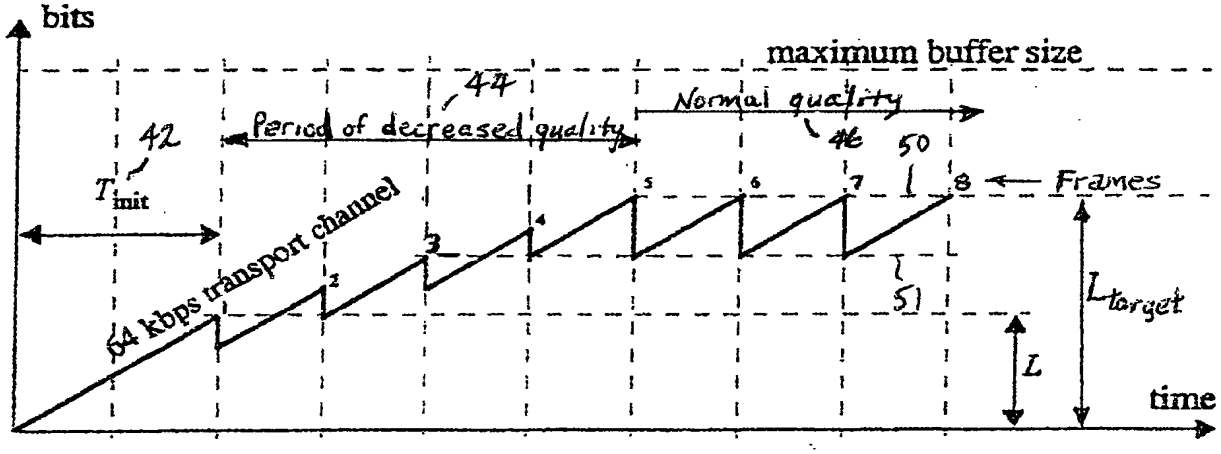
bits
maximum buffer size
44
Normal quality
Period of decreased quality
42
46
50
T_{init}
Frames
64 kbps transport channel
1
2
3
4
5
6
7
8
51
L_{target}
L
time

FIG. 5

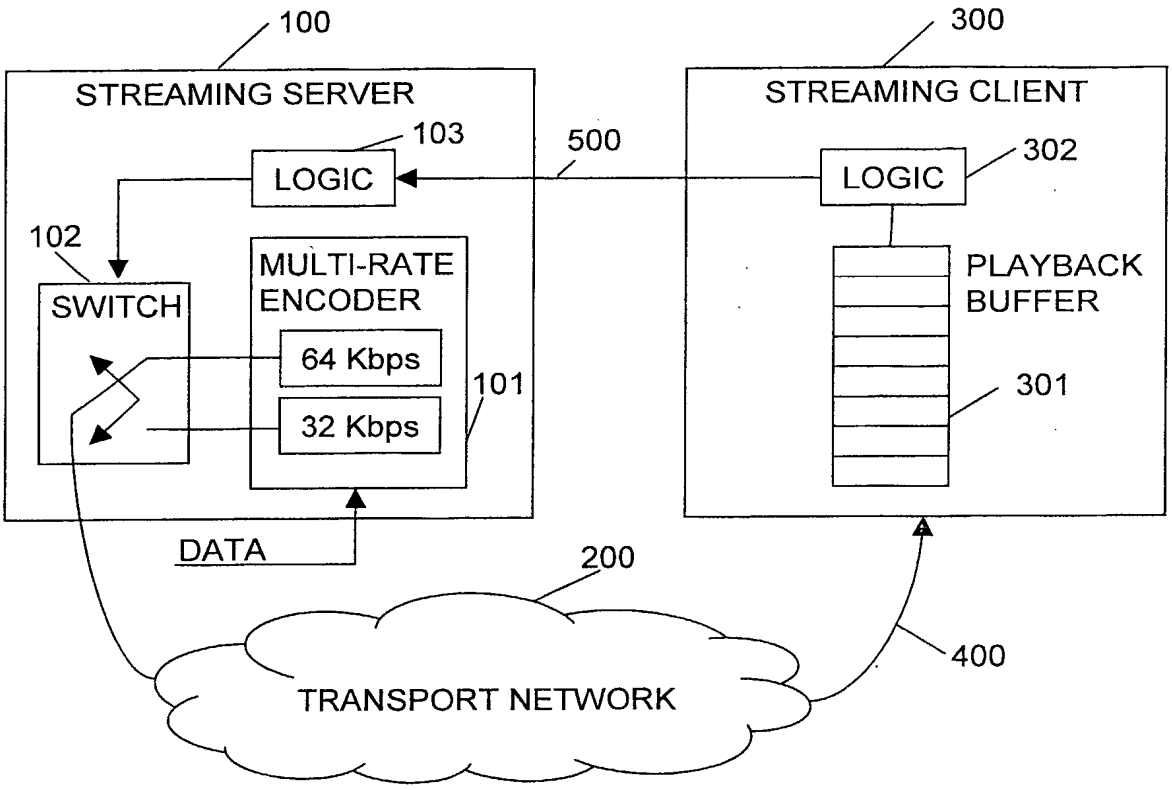
100
STREAMING SERVER
103
LOGIC
500
300
STREAMING CLIENT
LOGIC
302
102
SWITCH
MULTI-RATE
ENCODER
64 Kbps
32 Kbps
101
PLAYBACK
BUFFER
301
DATA
200
TRANSPORT NETWORK
400

FIG. 6

INTERNATIONAL SEARCH REPORT

PCT/IB 03/04675

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L29/06 H04N7/24

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04L H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 02 45372 A (BRITISH TELECOMM ;JACOBS RICHARD JAMES (GB); NILSSON MICHAEL ERLIN) 6 June 2002 (2002-06-06) page 1, line 6-10,21-24 page 1, line 26 -page 2, line 23 page 3, line 10-14 page 4, line 15 - line 21 page 8, line 32,33 page 9, line 9-14 figures 1-4 ---	1-21
A	EP 1 043 877 A (LUCENT TECHNOLOGIES INC) 11 October 2000 (2000-10-11) the whole document figure 1 --- -/--	1-21

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 January 2004	09/02/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Foti, G

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	WO 00 35201 A (MICROSOFT CORP) 15 June 2000 (2000-06-15) the whole document figures 2,3,4A-E	1-21

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0245372 A	06-06-2002	AU 2209702 A	11-06-2002
		CA 2428325 A1	06-06-2002
		EP 1338131 A2	27-08-2003
		WO 0245372 A2	06-06-2002
EP 1043877 A	11-10-2000	CA 2300757 A1	08-10-2000
		DE 60000319 D1	19-09-2002
		DE 60000319 T2	13-03-2003
		EP 1043877 A1	11-10-2000
		JP 2000349825 A	15-12-2000
WO 0035201 A	15-06-2000	US 6637031 B1	21-10-2003
		WO 0035201 A1	15-06-2000

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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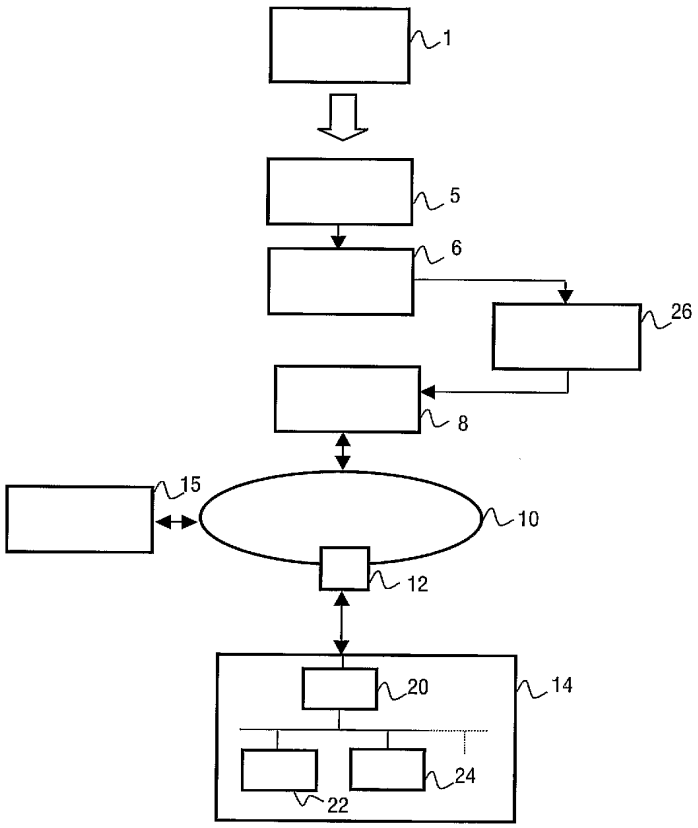
[Continued on next page]

(54) Title: METHOD OF BROADCASTING MULTIMEDIA CONTENT VIA A DISTRIBUTION NETWORK



(57) Abstract: The invention proposes to divide a content to be transmitted via a network into a set of slices and to generate a set of files from this set of slices. The slices (or the files) are encrypted before downloading in such a way that the client cannot use the slice (or the file) before having acquired the associated decryption key. The invention thereby allows protecting a downloaded content on a slice-by-slice basis (or on a file-by-file basis) rather than protecting a downloaded content as a whole. The transmission (in download mode) between the server and the client is ruled by the HTTP protocol that is accepted by all firewalls and NAT. Consequently, the transmitted content is accessible for any client device that has access to the Web without restriction. Advantageously, the slices can be decoded independently of each other.

WO 2005/004485 A1

GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declaration under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

Published:

— *with international search report*

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.

METHOD OF BROADCASTING MULTIMEDIA CONTENT VIA A DISTRIBUTION NETWORK

FIELD OF THE INVENTION

The present invention relates to a method of transmitting a multimedia content to a client device. The invention also relates to a system, a content server, and a client device specifically designed to implement such a transmission method.

The invention has interesting applications for the transmission of pay content to client devices via the Internet, in particular for the transmission of live content (live events, live shows, broadcast TV programs and the like).

BACKGROUND OF THE INVENTION

European patent application n°1 187 423 describes methods of transmitting on- demand information whose content varies with time, like music or video. In particular, it describes a so-called buffering distribution method that consists in dividing a single piece of content into a plurality of files and in downloading the content file by file, starting from the first file. This buffering distribution method is described as providing the advantage of reducing the waiting time before starting playback (while part N is being downloaded, part N-1 can be played).

One of the objects of the invention is to propose improvements for such a distribution method.

SUMMARY OF THE INVENTION

This is achieved with a system as defined in claims 1 to 3, a content server as defined in claims 4 to 7, a client device as defined in claims 8 and 9 and a method as defined in claim 10.

A system according to the invention comprises:

- a source for acquiring a multimedia content,
- an encoder for encoding said multimedia content,
- a slicer for slicing said encoded multimedia content into at least one set of slices, and for providing at least one set of files from said at least one set of slices, said slicer implementing an encryption algorithm, such that at least the slice contained in a file cannot be used without

a decryption key associated therewith,

- a distribution network,

- an access provider for providing a client device with an access to said distribution network,

- a content server linked to said distribution network and having access to said set or sets of files for downloading at least one of said files to said client device via said distribution network upon reception of a request from said client device, and

- a key server linked to said distribution network for providing said client device with the decryption key or keys that are associated with the downloaded files.

With the invention, the content is divided into a set of slices and a file is generated for each slice. The slices (or the files) are encrypted before downloading in such a way that the client device cannot use the slice (or the file) before having acquired the associated decryption key. The invention thereby allows protecting a downloaded content on a slice-by-slice basis (or on a file-by-file basis) rather than protecting a downloaded content as a whole.

This is advantageous for the following reason: when the downloaded content is protected via encryption, the decryption key is usually provided after the download has been completed so as to make sure that the download was successful (thereby eliminating the risk that the client pays for something that he will eventually not receive) and to avoid that the client may watch the content and disconnect before being charged. Protecting the slices (or the files) one by one (or group by group) allows the client to decrypt and therefore start playing the content before all the files are downloaded while making sure that the client received correctly what he paid for, and cannot use what he did not pay for.

With the invention, the client does not have to pay for the whole content beforehand. Payment is progressive as playing goes along. The client can start playing a content and disconnect before the whole content has been downloaded if he wishes to do so. In such a case he will only pay for what he eventually received.

The invention safeguards the interests of both the content provider and the client.

According to the invention, the file-based content is downloaded from the content server to the client device via a point-to-point connection. On IP networks, point-to-point connections are usually ruled by the HTTP protocol (Hyper Text Transfer Protocol, defined in the RFC2616 of the IETF). The HTTP protocol is the basis for the World Wide Web and therefore has the great advantage of being accepted by all firewalls and Networks Address Translators (which is not the case with the RTP/UDP transport protocol). This

means that the transmitted content will be accessible for any client device having access to the World Wide Web without restriction. Another advantage of using a downloading distribution mode is that it is highly reliable.

However, using a downloading distribution mode of the type described in European patent application n°1187423 has the drawback that all files have to be transmitted, starting from the first file. With such a downloading distribution mode, the client cannot access the content at random. Transmission of a live content (that is, a content made available in real-time, like live events, live shows, broadcast TV programs,...) cannot be achieved.

In an advantageous embodiment of the invention, the slices are generated in such a way that they can be decoded independently of each other. This means that the client does not need to receive the content from its beginning. It can start receiving the content from any slice. When a client sends an initial request directed to a live content, he will receive either the previous file (which means he will receive slightly outdated information) or he will have to wait for the next file to get ready.

With the invention, it is also possible to download one file only, upon reception of a request by a client device. This is advantageous for certain applications, for example, to allow clients to get a quick overview of the results during championships.

When a plurality of files is to be downloaded, the files can be either fetched one by one by the client device or sent one by one by the content server upon reception of an initial request. In practice, it is not certain that all client browsers will support reception of several files in response to one single request. Therefore, it will usually be preferred that the client device fetches the files one by one (i.e. sends a fetching request for each file to be downloaded). The client device can be designed specifically so as to automatically send the fetching request at the appropriate time. Alternatively, the content server can send a document to the client device, said document causing the client device to repetitively send a fetching request. Advantageously, said document comprises an instruction for the client device to send a subsequent fetching request a certain amount of time before the end of the playback of the previous file. In such a way, it is ensured that the next file will reach the client device early enough, and that the client will not experience any gap in the playback process.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the invention are further described with reference to the following drawings:

- Fig. 1 is a schematic representation of a first example of a system according to the invention,
- Fig.2 is a schematic representation of a second example of a system according to the invention,
- Fig. 3 is a schematic representation of a set of files generated by a slicer according to the invention,
- Fig. 4 is a first example of a protocol to be implemented for the client device to acquire the decryption key associated with a specific file,
- Fig. 5 is a second example of a protocol to be implemented for the client device to acquire the decryption key associated with a specific file,
- Fig. 6 is a block diagram of a first example of a method according to the invention for downloading a live multimedia content,
- Fig. 7 is a block diagram of a second example of a method according to the invention for downloading a live multimedia content.

DESCRIPTION OF EMBODIMENTS

Fig.1 is a schematic diagram of a first example of a system according to the invention. The system of Fig. 1 comprises:

- a source 1 for acquiring a multimedia content;
- an encoder 5 for encoding a received multimedia content,
- a slicer 6 for slicing an encoded multimedia content into a set of slices and for providing a set of files, each file containing a slice of said encoded multimedia content, said slicer implementing an encryption algorithm, such that at least the slice contained in a file cannot be used without a decryption key associated therewith,
- a content server 8 having access to said files,
- a distribution network 10, the content server 8 being linked to the distribution network 10,
- an access provider 12 for providing a client device 14 with an access to the distribution network 10,
- a key server 15 linked to the distribution network 10 for providing the client device 14 with the decryption key or keys that are associated with the downloaded files.

In the system of Fig.1, the source 1, the encoder 5 and the slicer 6 may be physically located in one or in several devices.

Fig. 2 is a schematic representation of a second example of a system according to the invention. In addition to the elements described above with reference to Fig.1, the system of Fig.2 comprises:

- a broadcasting system 16 for broadcasting the multimedia content provided by the source 1; and
- a receiver 17 for receiving the broadcast multimedia content, and forwarding the received multimedia content to the slicer 6.

The client device 14 has (amongst other means not represented in Fig.1) a communication unit 20 for transmission/reception to/from the access provider 12, a player 22 for playing an encoded multimedia content, and a display 24 for displaying a multimedia content. The client device 14 may be either a mobile device (like a mobile phone), in which case the communication unit 20 is a radio communication unit, or a wired device (like a PC), in which case the communication unit 20 is a wired communication unit. The distribution network 10 is typically the Internet network.

The broadcasting system 16 is, for instance, a satellite broadcasting network and the receiver 17 is a satellite receiver. This is not restrictive: any other broadcasting means could be used instead of satellite broadcasting means. The broadcast multimedia content may be any multimedia content that is transmitted and can be received by a number of receivers including the receiver 17. The broadcast multimedia content may be, for instance, a television program, a pre-recorded event/program, a live event, etc. The encoder 5 is responsible for encoding the received multimedia content. The encoder 5 is compliant with, for instance, one of the MPEG standards, or with H263.

The encoder 5 and the slicer 6 are either implemented in a single device or in two separate devices. In both cases, what is transmitted from the encoder 5 to the slicer 6 is an encoded video stream. Advantageously, this encoded video stream is transmitted from the encoder 5 to the slicer 6 over IP by using the RTP protocol. This is not restrictive. By way of example, the transport layer of the MPEG-2 standard, known as MPEG-2 TS, could be used as well.

In practice, the files generated by the slicer 6 are stored in a storage unit 26 to which the content server 8 has access. The storage unit 26 is shared by the slicer 6 and the content server 8. The storage unit 26 may be part of the content server 8 or can be located remotely.

The slicer 6 has the following functions:

a) It slices the encoded content generated by the encoder 5 into a plurality of slices, where each slice comprises a given amount of time of the encoded multimedia content.

b) It generates a file from each slice.

c) It implements an encryption algorithm, such that at least the slice contained in a file cannot be used without a decryption key associated therewith. This can be achieved by encrypting the slice or encrypting the file. Encrypting the files has the advantage of simplicity. Encrypting the slices is more complex. However, it allows accessing the file information contained in the file structure (for example, in the headers) at the client side without having to decrypt the file first. By way of example, the encryption algorithm used by the slicer 6 is AES (Advanced Encryption Standard). Encryption is done by using an encryption key. An associated decryption key is needed to achieve decryption of the encoded entity (the slice or the file). The key server 15 is responsible for delivering the encryption key to the slicer 6 and the decryption key to the client device 14.

The slicer 6 can generate a plurality of sets of files for the same multimedia content. By way of example, when the slicer 6 generates a plurality of sets of files, a plurality of sets of slicing positions can be used, each set of slicing positions being shifted in time as compared with the other sets of slicing positions. Generating a plurality of sets of files is advantageous because it allows reducing the delay experienced by the client when he sends a request for a live content.

Fig.3 is a representation of a set S_i of files $F_{i,j}$ (j=1,…,N) generated by the slicer 6 by slicing an encoded multimedia content at slicing positions $T_{i,j}$ (j=1,…,N-1).

In an advantageous embodiment, the slices are generated in such a way that they can be decoded independently of each other. In practice, any encoded multimedia content generated by a multimedia encoder comprises so-called Random Access Points (RAP). In order to produce slices that can be decoded independently of the others, the slicer 6 slices the encoded multimedia content in such a way that each slice starts with a Random Access Point. For instance, when the encoder is compliant with the MPEG-2 or MPEG-4 standard, the random access points are the I-frames of the MPEG-encoded multimedia content, and the slicing positions are chosen in such a way that the first frame of each slice is an I-frame.

Optionally, the size of the slices is adjustable. It may be identical for all slices or it may vary from one slice to another (for instance, the size of the slices may increase with

time). The best efficiency is obtained with files that are relatively long because the more files are transported, the more overhead due to file headers is obtained.

Each file generated by the slicer 6 is stored as a file in the storage unit 26. The storage unit 26 has to be "cleaned" on a regular basis to ensure that there is room available for storing the newly generated files. A way of cleaning the storage unit is to re-use file names on a regular basis. An alternative way is to use different file names for each file, and to delete the aging files on a regular basis.

The content server 8 and the key server 15 are linked to the distribution network 10. The client device 14 has access to the distribution network 10 via the access provider 12. Typically, the client device 14 can load, through the distribution network 10, a page containing at least one link to one encoded multimedia content that the content server 8 offers to download. When a user clicks on said link, an initial request R_0 directed to said encoded multimedia content is sent automatically to the content server 8. There are several possible ways for the content server 8 to handle the initial request R_0.

In a first embodiment, the content server 8 downloads a single file in response to the client request. This implementation can be used for specific applications, for instance, for applications offering the client to pick up information regarding a live event. It can also be used with a player 22 specifically designed to cause the client device 14 to send the initial request R_0 repetitively.

In a second embodiment, the content server 8 downloads the files one by one as soon as they are ready at the server side. This embodiment has the advantage of being easy to implement. However, there is a risk that certain client browsers will not support reception of several files in response to one single request.

In a third embodiment, the content server 8 sends a document to the client device 14 upon reception of the initial request R_0. This document causes the client device 14 to repetitively send a fetching request designating the encoded multimedia content.

By way of example, the document sent by the content server 8 may be a page comprising an automatic refresh command. An example of such a page is given below:

```
<html>
<head>
<META meta http-equiv="Refresh" content="134" ;
url='http://www.yoursite.com/live2download.html'"
</head>
<embed src="live2download.mp4" width="240" height="240">
```

```
</embed>
</html>
```

Such a page causes the client browser to reload the file "live2download.mp4" every 134 seconds (which is the duration of a file in this example).

Alternatively, the document sent by the content server 8 may be a standard description of the multimedia content, said standard description being intended to be processed by the player 22 in a standard way. Such a description may be, for instance, an SMIL description (SMIL is a W3C standard defining XML-based audio/video scene descriptions). An example of such an SMIL description is given below:

```
<smil>
<head>
<layout>
<root-layout width="240" height="240" background-color="white"/>
<region regionName="im" left="0" top="0" width="240" height="240"/>
</layout>
</head>
<body>
<seq repeatCount = "indefinite" >
<video id="vid" src="live2download.mp4"  region="im" />
</seq>
</body>
</smil>
```

The effect of this SMIL document is to cause the player 17 to play the file "live2download.mp4" repetitively. As a result, the client device will repetitively send fetching requests directed to the file "live2download.mp4".

Advantageously, the SMIL document sent by the content server 8 comprises a command indicating that the files have to be fetched some time in advance (that is, some time before the end of the playback of the previous file). This ensures that the next file will arrive at the client device 14 in time so that the client will not experience a gap in the rendering of the multimedia content. An example of an SMIL description having such a command is given below:

```
<smil>
<head>
<layout>
```

```
<root-layout width="240" height="240" background-color="white"/>
<region regionName="im" left="0" top="0" width="240" height="240"/>
</layout>
</head>
<body>
<seq repeatCount = "indefinite" >
<video id="vid" src="live2download1.mp4"  region="im"    clipBegin = "0s" dur =
"25s" />
<par>
<prefetch src="live2download2.mp4" mediaTime ="5s" />
<video id="vid" src="live2download1.mp4"  region="im"  clipBegin = "25s" />
</par>
<video id="vid" src="live2download2.mp4"  region="im"    clipBegin = "0s" dur =
"25s" />
<par>
<prefetch src="live2download1.mp4" mediaTime ="5s" />
<video id="vid" src="live2download2.mp4"  region="im"  clipBegin = "25s" />
</par>
</seq>
</body>
</smil>
```

This document is written for slices containing 30s of content. It causes the player 17 to execute the following operations in sequence:

a) playing the first 25s of a first source (live2download1.mp4);

b) playing the last 5s of the first source and in parallel fetching the first 5s of a second source (live2download2.mp4);

c) playing the first 25s of the second source (which can be done without delay since the first 5s have been pre-fetched).

Using two different sources is an implementation trick. The content server 8 must be designed to recognize that the first and the second source correspond to the same encoded multimedia content.

When the content to be downloaded is a live content, the server has to select which file to download upon reception of the initial request R_0 or upon reception of the fetching requests. The content server 8 can either select the most recent file or the first file to

get ready. The consequence of selecting the most recent file is that the client will receive outdated data. The consequence of selecting the first file to get ready is that the client will have to wait a certain time before getting a response. In Fig.2, an arrow A indicates the reception of the initial request R_0 by the content server 8. If the downloaded file is file $F_{i,1}$, the client will not experience any delay; however he will receive data that will be late by a time equal to $a_{i,1}$. If the downloaded file is file $F_{i,2}$, the client will not receive outdated data; however, he will experience a delay equal to $b_{i,2}$.

When the download of a file is achieved, the client device 14 has to acquire the associated decryption key in order to be able to play the content of the file. Two ways of acquiring this decryption key will now be described with reference to Fig. 4 and Fig.5, respectively.

In Fig.4, the client device 14 sends an acknowledgment 30 to the content server 8 indicating that the download was successfully completed. Upon reception of the acknowledgement 30, the content server 8 sends a notification 32 to the key server 15. Upon reception of the notification 32, the key server 15 sends a message 34 containing the appropriate decryption key to the client device 14.

In Fig.5, the client device 14 sends an acknowledgment 40 to the content server 8 indicating that the download was successfully completed and a request 42 to the key server 15. Upon reception of the acknowledgement 40, the content server 8 sends a notification 43 to the key server 15. Upon reception of the notification 43 and the request 42, the key server 15 sends a message 44 containing the appropriate decryption key to the client device 14.

The transmissions via the distribution network 10 are ruled by the HTTP protocol.

A first example of a method according to the invention of transmitting a multimedia content M to a client device 14 will now be described with reference to Fig.6. It comprises:

- a step X1 of producing an encoded multimedia content E(M) from the multimedia content M,
- a step X2 of slicing the encoded multimedia content E(M) into a set of slices Si,
- a step X3 of encrypting a slice Si (or a group of slices) with an encryption key KXi by applying an encryption algorithm X, thereby providing encrypted slices X(Si, KXi),
- a step X4 of providing a set of files Fi, where each file Fi contains an encrypted slice X(Si, KXi),

- a step X5 of downloading at least one of said files Fi to the client device 14 via the distribution network 10 upon reception of an initial request R_0 directed to the multimedia content M from the client device 14.

A second example of a method according to the invention of transmitting a multimedia content M to a client device 14 will now be described with reference to Fig.6. It comprises:

- a step X10 of producing an encoded multimedia content E(M) from the multimedia content M,
- a step X20 of slicing the encoded multimedia content E(M) into a set of slices Si,
- a step X25 of providing a set of files Fi, where each file Fi contains a slice Si,
- a step X30 of encrypting a file Fi (or a group of files) with an encryption key KXi by applying an encryption algorithm X, thereby providing encrypted files X(Fi, KXi),
- a step X50 of downloading at least one of said files X(Fi,Kxi) to the client device 14 via the distribution network 10 upon reception of an initial request R_0 directed to the multimedia content M from the client device 14.

These steps are implemented by way of specific hardware and/or software comprised in one or several devices. For instance, steps X1 and X10 are implemented by the encoder 5, steps X2, X3, X4 and X20, X25, X30 are implemented by the slicer 6, and steps X5 and X50 are implemented by the content server 8.

With respect to the described network, server, system, slicer, client device, and downloading method, modifications or improvements may be proposed without departing from the scope of the invention. The invention is thus not limited to the examples provided.

File transfer protocols other than HTTP may be used (for example, FTP).

The content server and the key server may be the same physical entity. The encryption may be either applied to the slices or to the files. The encryption key and the associated decryption key may be different or identical, depending on the encryption algorithm that is used.

Use of the verb "comprise" and its conjugations in the description and in the claims does not exclude the presence of elements or steps other than those stated in the description and in the claims.

Use of the article "a" or "an" to designate an element or a step does not exclude the presence of a plurality of such elements or steps.

CLAIMS

1. A system comprising at least:
- a source (1) for acquiring a multimedia content,
- an encoder (5) for encoding said multimedia content,
- a slicer (6) for slicing said encoded multimedia content into at least one set of slices, and for providing at least one set of files from said at least one set of slices, said slicer implementing an encryption algorithm, such that at least the slice contained in a file cannot be used without a decryption key associated therewith,
- a distribution network (10),
- an access provider (12) for providing a client device (14) with an access to said distribution network,
- a content server (8) linked to said distribution network and having access to said set or sets of files for downloading at least one of said files to said client device via said distribution network upon reception of a request from said client device, and
- a key server linked to said distribution network for providing said client device with the decryption key or keys that are associated with the downloaded files.

2. A system as claimed in claim 1, wherein a decryption key is provided to said client device upon successful downloading of the file or files it is associated with.

3. A system as claimed in claim 1, wherein slices are generated in such a way that they can be decoded independently of each other.

4. A content server (8) having access to at least one set of files (S_i) generated by slicing an encoded multimedia content into at least one set of slices and providing at least one set of files ($F_{i,j}$) from said at least one set of slices by implementation of an encryption algorithm, such that at least the slice contained in a file cannot be used without a decryption key associated therewith,
said content server having means for downloading to a client device (14) at least one of said files upon reception of a request from said client device.

5. A content server as claimed in claim 4, wherein said files originate from slices that can be decoded independently of each other.

6. A content server as claimed in claim 4, having means for sending a notification to a key server upon successful downloading of a file to said client device so that said key server provides said client device with the decryption key associated with said file.

7. A content server as claimed in claim 4, wherein said downloading means comprise:
- means for sending a document to said client device upon reception of said request, said document causing said client device to repetitively send a fetching request designating said encoded multimedia content,
- means for selecting which file is to be downloaded amongst said set or sets of files, upon reception of said fetching requests from said client device,
- means for downloading the selected file.

8. A client device having:
- means for connection to a content server, said content server having access to at least one set of files (S_i) generated by slicing an encoded multimedia content into at least one set of slices, each file containing a slice, and by implementing an encryption algorithm, such that at least the slice contained in a file cannot be used without a decryption key associated therewith, said content server offering to download at least part of said encoded multimedia content on a file-by-file basis,
- means for repeatedly sending to said content server a request directed to said encoded multimedia content,
- means for receiving one of said files in response to each request,
- means for acquiring the decryption key associated with each file,
- means for decrypting and playing said files.

9. A client device as claimed in claim 8, further comprising means for sending a subsequent request before the end of the playback of the current file.

10. A method of transmitting an encoded multimedia content to a client device, said method comprising the steps of:
- encoding a multimedia content,

- slicing said encoded multimedia content into at least one set of slices and providing at least one set of files from said at least one set of slices, said slicing step including an encryption step, such that at least the slice contained in a file cannot be used without a decryption key associated therewith,

- downloading at least one of said files to said client device via said distribution network upon reception of a request from said client device.

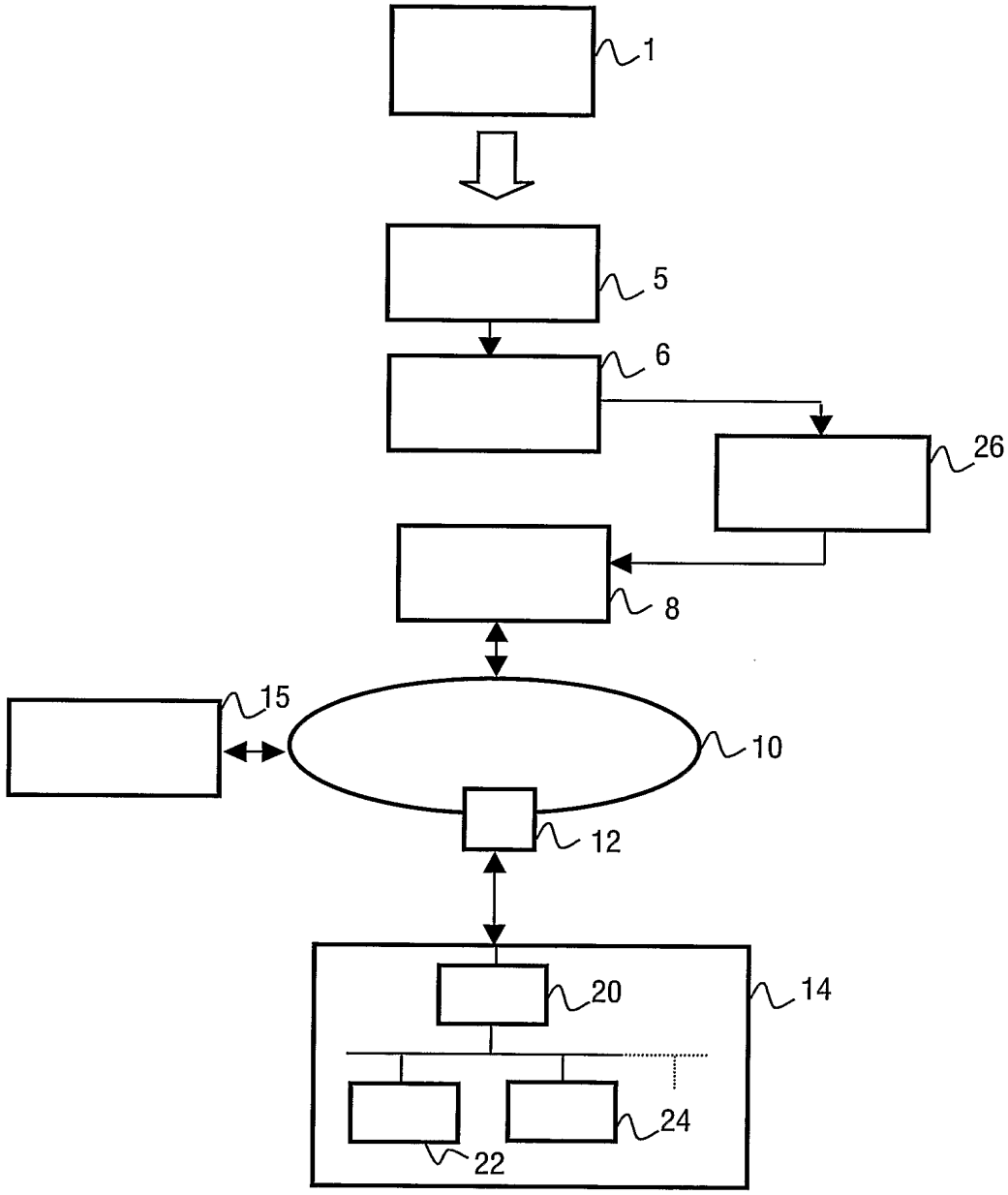


FIG.1

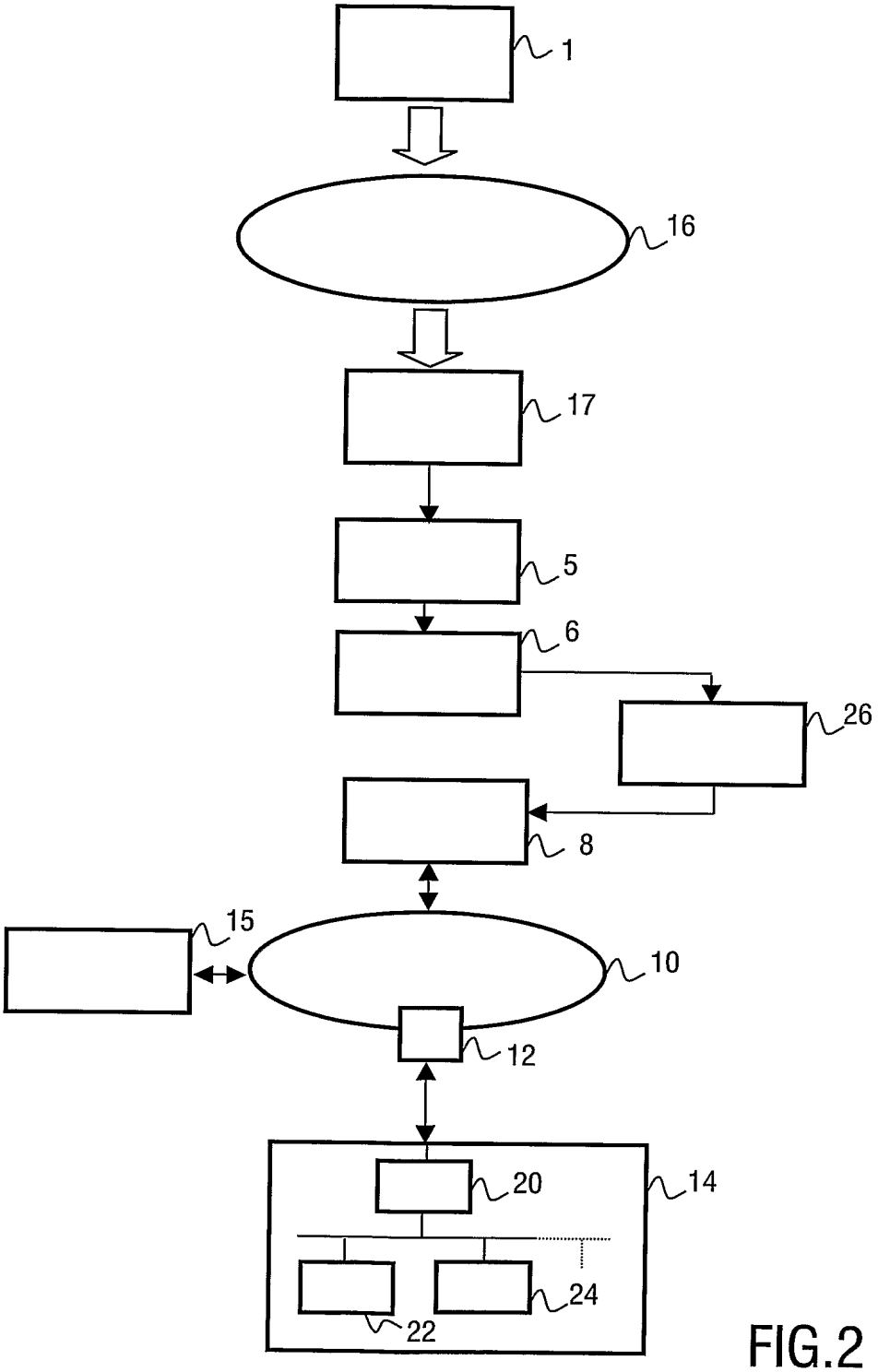


FIG.2

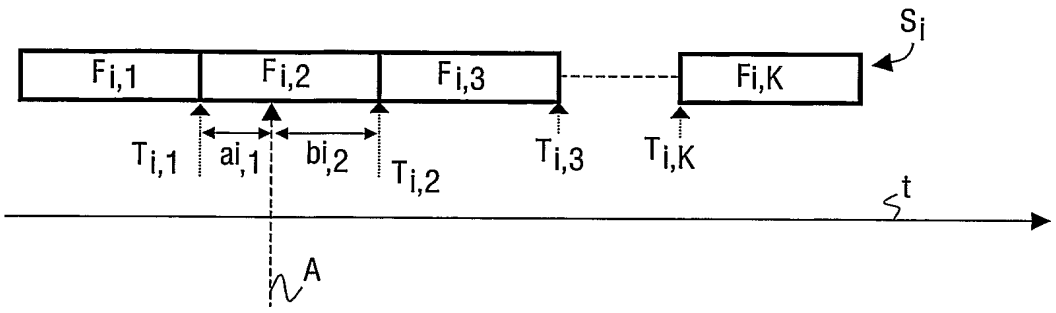


FIG.3

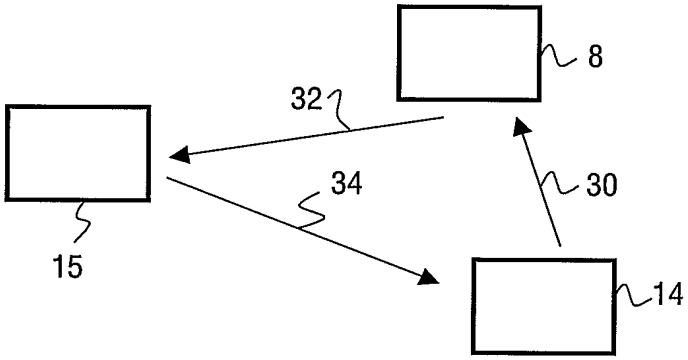


FIG.4

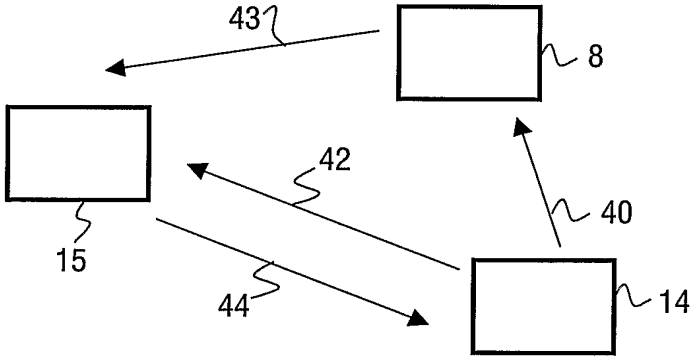


FIG.5

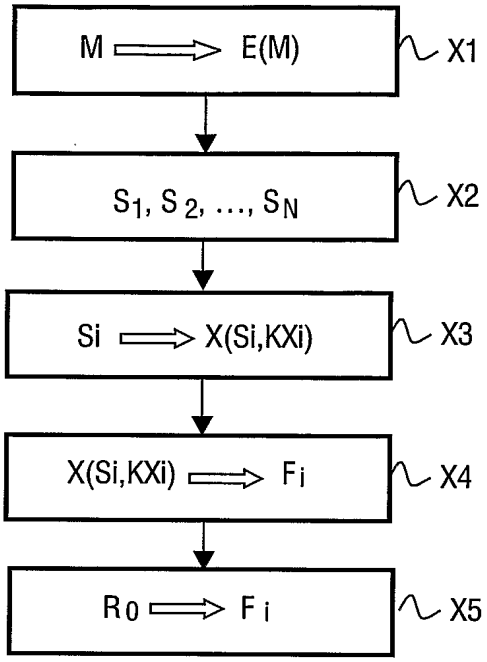

M ⟹ E(M)
X1
S1, S 2, ..., S N
X2
Si ⟹ X(Si,KXi)
X3
X(Si,KXi) ⟹ Fi
X4
R0 ⟹ F i
X5

FIG.6

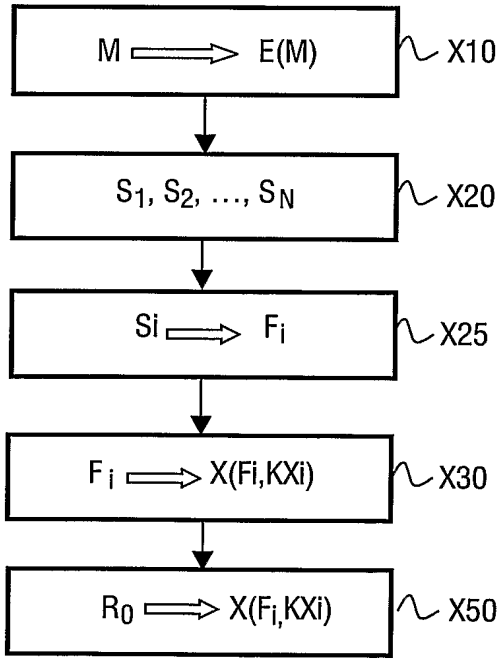

M ⟹ E(M)
X10
S1, S2, ..., S N
X20
Si ⟹ Fi
X25
F i ⟹ X(Fi,KXi)
X30
R0 ⟹ X(Fi,KXi)
X50

FIG.7

INTERNATIONAL SEARCH REPORT

onal Application No
[B2004/002140

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04N7/173 H04N7/167

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 September 2004	15/10/2004

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Schoeyer, M

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
IB2004/002140

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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 3

Complete if Known	
Application Number	15/283,544
Filing Date	10/03/2016
First Named Inventor	Harold Edward Price
Art Unit	2447
Examiner Name	N/A
Attorney Docket Number	0021-49-CON4B

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 2 of 3

Complete if Known	
Application Number	15/283,544
Filing Date	10/03/2016
First Named Inventor	Harold Edward Price
Art Unit	2447
Examiner Name	N/A
Attorney Docket Number	0021-49-CON4B

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Examiner Signature		Date Considered	

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[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Application Number	15/283,544
				Filing Date	10/03/2016
				First Named Inventor	Harold Edward Price
				Art Unit	2447
(Use as many sheets as necessary)				Examiner Name	N/A
Sheet	3	of	3	Attorney Docket Number	0021-49-CON4B

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	/Ernest D. Buff/	Date (YYYY-MM-DD)	2016-11-13
Name/Print	Ernest D. Buff	Registration No.	25,833

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.**

Electronic Patent Application Fee Transmittal

Application Number:	15283544
Filing Date:	03-Oct-2016
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM
First Named Inventor/Applicant Name:	Harold Edward Price
Filer:	ERNEST D BUFF/Ernest Buff
Attorney Docket Number:	0021-49 CON4B

Filed as Small 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:				
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**70**

Electronic Acknowledgement Receipt

EFS ID:	27564770
Application Number:	15283544
International Application Number:	
Confirmation Number:	5655
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM
First Named Inventor/Applicant Name:	Harold Edward Price
Customer Number:	25901
Filer:	ERNEST D BUFF/Ernest Buff
Filer Authorized By:	ERNEST D BUFF
Attorney Docket Number:	0021-49 CON4B
Receipt Date:	20-NOV-2016
Filing Date:	03-OCT-2016
Time Stamp:	13:59:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	EFT
Payment was successfully received in RAM	$70
RAM confirmation Number	112116INTEFSW14013400
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.)
1	Information Disclosure Statement (IDS) Form (SB08)	002149CON4BUSPatentIDS.pdf	2750720 f5503324f02c12b5c40f2d84852fdfe2be776416	no	12
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3	Foreign Reference	ForeignReferencesPart1of6.pdf	19569134 fc31e066f13c47fc583908ef19eadf135657e530	no	415
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4	Foreign Reference	ForeignReferencesPart2of6-part1-embcut.pdf	4777664 22675c9c69bd9f03488aa57a70553d0540c6bbe4	no	100
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6	Foreign Reference	ForeignReferencesPart3of6-embcut.pdf	19400637 df49bf5a66dc05f0d61627d536e5a0f22e0ee38b	no	144

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7	Foreign Reference	ForeignReferencesPart4of6-part1-embcut.pdf	21307399 5b6d8af66c580a485d65a7a45b7629f1c65292fc	no	179
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8	Foreign Reference	ForeignReferencesPart4of6-part2-embcut.pdf	18670354 f035f8742457b1f1ba2f5d3c7dab78dcc97d66d7	no	282
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9	Foreign Reference	ForeignReferencesPart5of6.pdf	15579568 ff455217cbc434dae8843ffc782545908d1aeac0	no	445
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47	Non Patent Literature	NPLPart11of20-embcut.pdf	22557686 87ab49132aada29826c749e40085b146c362bc05	no	119
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48	Non Patent Literature	NPLPart12of20.pdf	9129395 118574128289b82a04f3ccef5c78544971bf9ca2	no	98
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50	Non Patent Literature	NPLPart14of20-part1-a-embcut.pdf	16728715 cc844fa35a0477418c49418dad9db04768563fbc	no	100
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54	Non Patent Literature	NPLPart16of20-part1-embcut.pdf	18175510 499c278f978766a761d8d243e53ffeecdd4c3e55	no	150
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55	Non Patent Literature	NPLPart16of20-part2-embcut.pdf	18407580 58b86d908e35ef6838f0ab4a0514e1675eb6c69f	no	150
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56	Non Patent Literature	NPLPart16of20-part3-embcut.pdf	13987380 891a246ddc42a6f85836bc6912d30e139831b999	no	150
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57	Non Patent Literature	NPLPart16of20-part4-embcut.pdf	15323134 73b8b3a7e1e8b65af8ad2723ddb2d4e4cb080da2	no	170
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58	Non Patent Literature	NPLPart16of20-part5-embcut.pdf	16256325 9f54c993346a02a63e36d723207b8ab196014855	no	170
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59	Non Patent Literature	NPLPart16of20-part6-embcut.pdf	17635249 5a0e6ad85f8a0b6668ea40a08eb0521fdbd13811	no	200
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60	Fee Worksheet (SB06)	fee-info.pdf	30576 81fc5e465c7188f26507814c0b9e8dd4432a00fe	no	2
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Information:					
		Total Files Size (in bytes):	981663500		

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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.

Electronic Acknowledgement Receipt

EFS ID:	27564806
Application Number:	15283544
International Application Number:	
Confirmation Number:	5655
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM
First Named Inventor/Applicant Name:	Harold Edward Price
Customer Number:	25901
Filer:	ERNEST D BUFF/Ernest Buff
Filer Authorized By:	ERNEST D BUFF
Attorney Docket Number:	0021-49 CON4B
Receipt Date:	20-NOV-2016
Filing Date:	03-OCT-2016
Time Stamp:	14:44:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	NPLPart16of20-part7-embcut.pdf	24192231 cba26d2a969d2424f32278330cf06ba7a3d6a735	no	250

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		Total Files Size (in bytes):	543160817		

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New Applications Under 35 U.S.C. 111

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National Stage of an International Application under 35 U.S.C. 371

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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.

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Doc Code: TRACK1.GRANT

Decision Granting Request for Prioritized Examination (Track I or After RCE)	Application No.: 15/283,544

1. THE REQUEST FILED October 3, 2016 IS **GRANTED.**

The above-identified application has met the requirements for prioritized examination

A. ☒ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;
B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims**, or a multiple dependent claim;
C. filing a **request for continued examination**;
D. filing a notice of appeal;
E. filing a request for suspension of action;
F. mailing of a notice of allowance;
G. mailing of a final Office action;
H. completion of examination as defined in 37 CFR 41.102; or
I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to Brian W. Brown at 571-272-5338.

/Brian W. Brown/
[*Signature*]

Petitions Examiner, Office of Petitions
(Title)

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/283,544	10/03/2016		730	0021-49 CON4B	12	3

CONFIRMATION NO. 5655

FILING RECEIPT

25901
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231 SOMERVILLE ROAD
BEDMINSTER, NJ 07921

OC000000088315471

Date Mailed: 10/17/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Harold Edward Price, Bethel Park, PA;

Applicant(s)

WAG ACQUISITION, L.L.C., Flanders, NJ;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 13/815,040 01/25/2013
which is a CON of 13/385,375 02/16/2012 PAT 8364839
which is a CON of 12/800,177 05/10/2010 PAT 8185611
which is a CON of 10/893,814 07/19/2004 PAT 7716358
which is a CIP of 09/819,337 03/28/2001 PAT 6766376
which claims benefit of 60/231,997 09/12/2000

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 10/14/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/283,544**

Projected Publication Date: 01/26/2017

Non-Publication Request: No

Early Publication Request: No
**** SMALL ENTITY ****
Title

STREAMING MEDIA DELIVERY SYSTEM

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

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NOT GRANTED

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/283,544	10/03/2016	Harold Edward Price	0021-49 CON4B

CONFIRMATION NO. 5655

25901
ERNEST D. BUFF
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231 SOMERVILLE ROAD
BEDMINSTER, NJ 07921

INFORMAL NOTICE

OC000000086515472

Date Mailed: 10/17/2016

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

A new inventor's oath or declaration that identifies this application (e.g., by Application Number and filing date) is required. The inventor's oath or declaration does not comply with 37 CFR 1.63 in that it:

- does not state that the above-identified application was made or authorized to be made by the person executing the oath or declaration.

  Harold Edward Price

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/mgabre/

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/283,544

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	70		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	300		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	360		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	12 minus 20 =	*	x 40 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*	x 210 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	730		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/283,544	10/03/2016	Harold Edward Price	0021-49 CON4B

CONFIRMATION NO. 5655

IMPROPER CFR REQUEST

25901
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BEDMINSTER, NJ 07921

OC000000086515513

Date Mailed: 10/17/2016

RESPONSE TO REQUEST FOR CORRECTED FILING RECEIPT

Continuity, Priority Claims, Petitions, and Non-Publication Requests

In response to your request for a corrected Filing Receipt, the Office is unable to comply with your request because:

- One or more of the benefit claims under 35 U.S.C. § 120 cannot be included on the Filing Receipt since applicant did not specify whether the application is a continuation, divisional or continuation-in-part of the prior application. Applicant must submit a new application data sheet (ADS) that sets forth the relationship, and the ADS must be accompanied by a petition under 37 CFR 1.78 if filed after the time period set forth in 37 CFR 1.78.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/lphan/

STREAMING MEDIA DELIVERY SYSTEM

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. patent application Ser. No. 13/815,040, filed Jan. 25, 2013 (published on Jun. 13, 2013 as U.S. patent publication number 2013/0151724 A1), which was a continuation of U.S. patent application Ser. No. 13/385,375, filed Feb. 16, 2012 (published on Jun. 28, 2012 as U.S. patent publication number 2012/0166669 A1 and now U.S. Pat. No. 8,364,839, issued Jan. 29, 2013), which was a continuation of U.S. patent application Ser. No. 12/800,177, filed May 10, 2010 (published on Sep. 2, 2010 as U.S. patent publication number 2010/0223362 A1 and now U.S. Pat. No. 8,185,611, issued May 22, 2012), which was a continuation of U.S. patent application Ser. No. 10/893,814, filed Jul. 19, 2004 (published on Dec. 9, 2004 as U.S. patent publication number 2004/0249969 A1, and now U.S. Pat. No. 7,716,358, issued May 11, 2010), which was a continuation-in-part of U.S. patent application Ser. No. 09/819,337, filed Mar. 28, 2001 (now U.S. Pat. No. 6,766,376, issued Jul. 20, 2004), which was a nonprovisional of U.S. provisional patent application Ser. No. 60/231,997, filed Sep. 12, 2000 and now abandoned; and it claims the benefit, under 35 U.S.C. §120, of the respective filing dates of said nonprovisional applications, and the benefit under 35 U.S.C. §119(e) of said provisional application, as well as benefit under 35 U.S.C. §§120 and 119(e) (as applicable) of the filing dates of: copending U.S. patent application Ser. No. 10/825,869, filed Apr. 16, 2004 (published on Dec. 23, 2004 as U.S. patent publication number 2004/260828 A1), which was a continuation of said U.S. patent application Ser. No. 09/819,337, which was a nonprovisional of said provisional patent application Ser. No. 60/231,997; and hereby incorporates by reference the entire disclosure of each of said prior applications. This application further incorporates by reference the entire disclosure of U.S. patent application Ser. No. 13/374,942, filed Jan. 24, 2012 (published on Jun. 14, 2012 as U.S. patent publication number 2012/0151083 A1, and now U.S. Pat. No. 8,327,011, issued Dec. 4, 2012, which was a continuation of U.S. patent application Ser. No. 12/800,152, filed May 10, 2010 (published on Sep. 16,

2010 as U.S. patent publication number 2010/0235536 A1, and now U.S. Pat. No. 8,122,141, issued Feb. 21, 2012), which was also a continuation of said U.S. patent application Ser. No. 10/893,814.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to multimedia computer communication systems; and more particularly, to systems and methods for delivering streaming media, such as audio and video, on the Internet.

Description of the Related Art

[0003] Prior to the development of Internet streaming media technologies, audio and video were formatted into files, which users needed to download in their entirety to their computers before the files could be heard or viewed. Real time, continuous media, as from a radio station, was not suitable for this arrangement, in that a file of finite size must be created so it could be downloaded. The advent of streaming media technologies allowed users to listen to or view the files as they were being downloaded, and allowed users to "tune-in" to a continuous media broadcast, or "stream", such as from a radio station.

[0005] Sending audio or video files via a network is known in the art. U.S. patent number 6,029,194 to Tilt describes a media server for the distribution of audio/video over networks, in which retrieved media frames are transferred to a FIFO buffer. A clock rate for a local clock is adjusted according to the fullness of the buffer. The media frames from the buffer are sent in the form of data packets over the networks in response to interrupts generated by the local clock. In this manner, the timing for the media frames is controlled by the user to assure a continuous stream of video during editing. U.S. patent number 6,014,706 to Cannon, et al. discloses an apparatus and method for displaying streamed digital video data on a client computer. The client

computer is configured to receive the streamed digital video data from a server computer via a computer network.

[0006] The streamed digital video data is transmitted from the server computer to the client computer as a stream of video frames. U.S. patent number 6,002,720, to Yurt, et al. discloses a system for distributing video and/or audio information, wherein digital signal processing is employed to achieve high rates of data compression. U.S. patent number 5,923,655, to Veschi et al. discloses a system and method for communicating audio/ video data in a packet-based computer network, wherein transmission of data packets through the computer network requires variable periods of transmission time. U.S. patent number 5,922,048 to Emura discloses a video server apparatus having a stream control section that determines a keyframe readout interval and a keyframe playback interval, which satisfy a playback speed designated by a terminal apparatus. Finally, U.S. patent number 6,014,694 to Aharoni, et al. discloses a system and method for adaptively transporting video over networks, including the Internet, wherein the available bandwidth varies with time.

[0007] Despite these developments, users viewing or listening to streaming content over Internet connections often encounter interruptions, due to the frequency of unanticipated transmission delays and losses that are inherent in many Internet protocols. These interruptions are commonly referred to as “dropouts”, meaning that the data flow to the user has been interrupted (i.e., the audio “drops out”).

[0008] Dropouts can be extremely annoying--for example, while listening to music. The current state-of-the-art solution to the problem uses a pre-buffering technique to store up enough audio or video data in the user’s computer so that it can play the audio or video with a minimum of dropouts. This process requires the user to wait until enough of the media file is buffered in memory before listening or viewing can begin. The media data is delivered by a server computer, which has available to it the source of the media data, such as by a connection to a radio station. When the user connects to the server via the Internet, audio/video output at the user’s system is delayed while the user’s

buffer is filled to a predetermined level. Typical pre-buffering wait times range from ten to twenty seconds or more, determined by the vendor providing the audio or video media. Even with this pre-buffering process, interruptions in playback still occur.

[0009] In this process, the user has a software application on the computer commonly called a "media player". Using the features built into the media player, the user starts the audio or video stream, typically by clicking on a "start" button, and waits ten to twenty seconds or so before the material starts playing. During this time data is being received from the source and filling the media player's buffer. The audio or video data is delivered from the source at the rate it is to be played out. If, for example, the user is listening to an audio stream encoded to be played-out at 24,000 bits per second, the source sends the audio data at the rate of 24,000 bits per second. Provided that the user waits ten seconds, and the receipt of the buffering data has not been interrupted, there is enough media data stored in the buffer to play for ten seconds.

[0010] Gaps in the receipt of audio/video data, due to Internet slowdowns, cause the buffer to deplete. Because transmission of audio/video media data to the user takes place at the rate it is played out, the user's buffer level can never be increased or replenished while it is playing. Thus, gaps in the receipt of audio/video media data inexorably cause the buffer level to decrease from its initial level. In time, extended or repeated occurrences of these gaps empty the user's buffer. The audio/video material stops playing, and the buffer must be refilled to its original predetermined level before playing of the media resumes.

[0011] By way of illustration, if, in a ten second pre-buffering scenario, data reception stopped the instant that the media started playing, it would play for exactly ten seconds. Once the media data starts playing, itplays out of the buffer as new media data replenishes the buffer. The incoming data rate equals the rate at which the data is played out of the user's buffer, assuming the receipt of data across the Internet is unimpeded. If there are no interruptions in the receipt of the media data for the duration of the time the user listens to or watches the material, the buffer level remains

constant and there will still be ten seconds of data stored in the media player's buffer when the user stops the player.

[0012] On the other hand, if the media player encounters interruptions totaling six seconds while playing the material, there would only be four seconds of media data remaining in the buffer when the user stopped it. If data reception interruptions at any time during the playing exceed ten seconds, the user's media player buffer becomes exhausted. There is no media data to play, and the audio or video stops--a dropout has occurred. At this point a software mechanism in the media player stops attempting to play any more of the material, and starts the buffering process again. The media player remains silent until the buffer refills, at which time the media player will once again start playing the material. This pattern has brought about considerable consumer frustration with streaming media over the Internet.

BRIEF SUMMARY OF THE INVENTION

[0013] There is a need for improved systems and methods for delivering streaming content over the Internet or other communications medium, which facilitate continuous transmission of streaming content, respond on demand without objectionable buffering delay, and perform without disruption or dropouts.

[0014] To address these objectives, various embodiments for delivering streaming content are provided, which envision that both the server and user systems involved in the content delivery may have buffering capacity. The embodiments make varying uses of this capacity to facilitate continuous content transmission on demand. Nearly instantaneous playback is achieved, while maintaining protection against playback interruption.

[0015] In one aspect, the server and user-sides of the transmission are coordinated, by (a) sending initial streaming media elements to the user system at a sending rate more rapid than the playback rate, to fill the user buffer; and (b) after the user buffer has

been filled, sending further streaming media data elements to the user system at about the playback rate.

[0016] In another embodiment, the user system may be used to regulate transmission of streaming media to it, by a streaming media server. In such embodiment, the server may operate by (a) assigning identifiers to the sequential media data elements comprising the program; (b) receiving requests from the user system for media data elements corresponding to specified identifiers; and (c) sending media data elements to the user system responsive to said requests. A user system used in connection with such an embodiment may operate by (i) maintaining a record of the identifier of the last sequential media data element that has been received by said player; (ii) requesting transmission of the next sequential media data elements following said last sequential media data element, as said media player requires for continuous and uninterrupted playback.

[0017] Other aspects and advantages of the invention will be apparent from the accompanying drawings and the detailed description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The invention will be more fully understood and further advantages will become apparent when reference is had to the following detailed description and the accompanying drawings, in which:

[0019] FIG. 1 is a schematic/block diagram illustrating the elements of a streaming media buffering system in accordance with one embodiment of the present invention;

[0020] FIG. 2 is a schematic/block diagram of an alternative embodiment of the system shown by FIG. 1; and

[0021] FIG. 3 is a flowchart illustrating a method employed in one embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] The following is a detailed description of certain embodiments of the invention chosen to provide illustrative examples of how it may preferably be implemented.

[0023] Audio and video media must play out over a period of time. Thus, in considering the delivery of such media, it is more appropriate in certain respects to think of bandwidth requirements than file size. The bandwidth requirement of audio or video media refers to the data rate in bits per second that must be transmitted and received in order to listen to or view the material uninterrupted.

[0024] Transmitting the audio or video material over a connection slower than the bandwidth requirement results in unsatisfactory viewing or listening, if viewing or listening is possible at all. The connection available may, for example, be by dialup modem, which has a maximum receive data rate of 56,000 bits per second. Audio and video encoded for distribution over the Internet may be compressed to be listenable or viewable within such a 56,000 bits per second bandwidth. Requirements for achieving adequate audio and video over the Internet may consume a considerable portion of the listener's available bandwidth.

[0025] There are two types of encoding schemes used for audio and video material -- "Variable Bit Rate" (VBR), and "Constant Bit Rate" (CBR). CBR encoding represents the encoded media with a constant bit rate per second, regardless of the complexity of the material being encoded. For example, if an audio source is encoded at 20 kilobits per second at a Constant Bit Rate, the media data being produced from the encoding is at 20 kilobits per second, whether the audio material is complex (e.g., symphonic) or silence. Variable Bit Rate encoding uses a variable number of bits to represent sounds or video, with more bits required for complex material (e.g., symphonic sounds or action scenes) than for simple sounds, silence, or still scenes. The most usual encoding scheme used for streaming media is CBR, because the resulting data rate is more predictable than for VBR. Statements in this specification concerning "constant" data rates and the like should be understood as subject to appropriate variation where VBR-encoded data may be involved.

[0026] Even if a user's Internet connection has the requisite average bandwidth capacity to allow reception of the program, the actual rate of delivery of data to the user can fluctuate widely above, and more particularly, below, this average, as a function of the quality of the user's connectivity at any given time. Internet connection quality can vary rapidly over time, with two primary factors responsible for degradation of the instantaneous bandwidth actually available to the user. These factors are the quality of the user's Internet connection, which can have periods of interference causing reduced available bandwidth, and momentary Internet congestion at various points along the route over which the user's data flows. Each of these factors can cause delays and interruptions in the transmission of data to the user. Internet data communications devices such as routers are designed to drop data packets if they get overloaded. For material that is not time sensitive, these dropped packets will usually be resent, and the user will eventually be presented with the material. However, since streaming media is time sensitive, dropped packets can have a significant impact on the receipt and playback of an audio or video stream. Such degradation in the receipt of Internet data is very common, and prevent most users from being able to listen to or view streaming media without interruption unless some special provisions have been incorporated into the user's computer software to accommodate data transmission interruptions.

[0027] There are two fundamental types of streaming media, which affect, in some respects, the requirements for smooth and continuous delivery: (i) material that originates from a source having a realtime nature, such as a radio or TV broadcast, and (ii) material that originates from a non-real-time source such as from a disk file. An example of non-real-time material might be a piece of music stored as a disk file, or a portion of a broadcast that originally was realtime, perhaps yesterday's TV evening news, and was recorded into a disk file. For purposes of clarity within this document, streaming media of type (i) will be referred to as "real time" or "broadcast" media, and streaming media of type (ii) will be referred to as "file based" media.

[0028] In many respects, both streaming media types are handled similarly in conventional systems, and both are handled similarly (in a number of respects) by the streaming media delivery system of the present invention. Nevertheless, the two streaming media types are readily distinguished. Broadcast streaming media has as its source a system or arrangement that by definition can only be transmitted to users as fast as the material is generated; for example, a disk jockey speaking into a microphone. File based media, on the other hand, can be transmitted to users at any available data rate, since in the context of data communications, the time required for reading a small portion of data from a file residing entirely on a locally accessible, random access storage device may be considered negligible.

[0029] In conventional systems for streaming media over the Internet, media data (whether real-time or file based) is simply transmitted from the server to the user at the rate at which it will be played out (the "playback rate"), regardless of the data rate capabilities of the connection between the server and the user.

[0030] Conventional streaming media systems may incorporate server-side buffering systems for programmatic purposes. For example, the system may buffer media data at the server for the purpose of packet assembly/disassembly. Media data may also be buffered at the server to permit programming conveniences such as dealing with blocks of data of a specific size. However, conventional streaming media systems have not utilized server-side buffering for the purpose of mitigating long term Internet performance degradation. Rather, prior art systems, in which data is continuously transmitted at the playback rate, have performed buffering for continuity purposes solely on the user side, with the consequences discussed above of startup delays and dropouts. The present invention addresses such shortcomings.

[0031] The present invention provides a system and method for delivering streaming media, such as audio or video media, via the Internet or other communications medium. Immediate playing of the media on a user's computer is afforded, while reducing interruptions in playback due to Internet congestion, and temporary modem delays due

to noisy lines. Nearly instantaneous playback is achieved, while maintaining protection against playback interruption. Delayed starts, heretofore required to provide protection against interruption, are avoided. Data lost due to interruptions in the receipt of media data by the media player can be recovered while the player continues to play out the audio or video material. If the interruptions are so severe as to deplete the user's buffer and stop the play out, the media player can quickly recover as well, by beginning to play out again without waiting to first build up the buffer, as soon as the media player begins to receive media data elements.

[0032] In one embodiment, the invention provides a system for distributing via the Internet streaming media composed of a plurality of time-sequenced data elements. As shown in FIG. 1, the system is provided with a server 12 connected to the Internet 10 for transmitting the streaming media data elements. Associated with the server 12 is a server buffer 14 for storing at least one of the data elements for transmission, and a buffer manager 16. Buffer 14 is a conventional computer storage mechanism such as a hard disk, as shown for convenience of illustration, or, preferably, an electronic storage arrangement such as Random Access Memory (RAM).

[0033] The media may come from a live source, shown as 26 in FIG. 1, or from a stored file on the server 12, or another storage device, such as a hard drive.

[0034] A number of different implementations of such a server, involving different ways of handling server buffer 14, will be discussed.

[0035] In the various implementations, there is in each case at least one user computer 18 (or similar device) connected to the server 12 via the Internet 10 or other data communications medium. User computer 18 is associated with media player software incorporating user buffer 20. The user buffer 20 is provided with means for storing a predetermined number of the data elements. User buffer 20 is a conventional computer storage mechanism such as a hard disk, or, preferably, an electronic storage arrangement such as Random Access Memory (RAM) as suggested by the illustration. A buffer manager 22 is also associated with the user computer 18. The buffer manager 22,

having the form of software or firmware, is provided with means for receiving and storing a predetermined number of media data elements which are received sequentially by the media player, playing the data out sequentially as audio and/or video, and deleting media data elements from the buffer as they are played out (or displacing them by newly arrived elements). As data is played out, the next sequential data elements are received from the server in such a fashion as to approximately maintain the predetermined number of data elements in the user's buffer. It should be understood that data might arrive at the media player out-of-sequence and that processes in the media player or the media player buffer manager are responsible for properly arranging this data.

[0036] Alternatively, user computer 18 may be replaced by an Internet radio or Internet Appliance, which is comprised of a dedicated processor for receiving Internet radio or audio/video material. Examples of such devices might range from familiar computing devices such as palmtops, PDAs (Personal Digital Assistants), and wireless phones, to devices that appear and operate similarly to conventional consumer electronic devices such as radios and televisions, but with the additional capability of Internet access.

FIFO Server Buffer Implementation

[0037] There are a large number of ways of managing server buffer 14 in order to implement the systems and methods described in this specification. In one implementation, buffer manager 16 is adapted to effectively render server buffer 14 a FIFO device. In this implementation, buffer manager 16 is provided in the form of software or firmware that provides means for: receiving the media data; supplying media data in order to the FIFO buffer; supplying the buffer 14 with a predetermined number of data elements; maintaining pointers 24a through 24n into the buffer, one for each user computer indicating the last media data element that has been sent to that user, thus indicating the next element or elements to be sent; and, once the FIFO buffer is full, deleting (or displacing) the oldest data element in the buffer as each new data element is received. These means are arranged to maintain the pre-determined number

of data elements in the FIFO buffer. Buffer Manager 16 may also comprise means for digitizing, encoding, and packetizing the media data, and formatting media data according to the requirements of buffer 14.

Data Window Buffer Implementation

[0038] If the media source is file based, such as a music clip stored as a disk file, and if the disk file is stored on the server or an associated server computer, the server's connection to the source could be considered to be near instantaneous. In this case, rather than audio/video data filling and depleting the buffer 14, an amount of audio/video data equivalent to the desired buffer size may be logically constituted as a FIFO buffer. Such a construct is commonly called a data window. The data window moves on a time-sequenced basis through the media data file, thus defining the contents of the buffer on a moment-by-moment basis and performing the equivalent functions to receiving a new data element and deleting the oldest data element.

Example Buffering Methods

[0039] In an arrangement that receives media data directly or indirectly from a real-time source, such as a radio station, server buffer 14 might be set to hold (for example) 30 seconds of media data. Because the source produces media data in real time, the media data is delivered to the server approximately at the rate it is generated.

[0040] Of course, there can be variability in this data delivery process due to networking, disk accesses, and so on, causing the delivery rate of the media data to be variable over short periods of time, typically measured in seconds. But over a longer period of time measured in minutes or tens of minutes or longer, the media data is delivered from source to server at the rate it is generated, and the server in turn provides that media data to the FIFO buffer at that same rate. Since CBR encoding is typically used for streaming media, the media data is generated, received by the server, and provided to the buffer approximately at a fixed rate.

[0041] The server buffer 14 is filled the first time the media source connection is established or a disk file is read. The amount is preferably adequate to bridge gaps typical of Internet and modem delays to the user. This buffer may, for example, hold enough data elements for about one minute of play.

[0042] Once server buffer 14 is full, for each new data element received into the buffer the oldest data element is deleted (or displaced) from the buffer. In some implementations, requests from user computers to connect may not be accepted until server buffer 14 is full.

[0043] Once a connection is made to a user's computer (e.g., user computer 18), server 12 sends the media data to the user computer in the following manner. First, media data is sent to the user computer at a rate faster than the playback rate, which may be the highest rate that the data connection between the server and the user computer will support, or any lower rate that is a higher rate than the playback rate (referred to herein as a "higher than playback" rate), until the predetermined amount of data that had been stored in the server buffer has been transferred to the user's computer. Once the contents of server buffer 14 has been transferred, a steady state condition is reached wherein as each media data element arrives at server 12, it is immediately sent out to the user computer. In this steady state condition, the media data is sent at a rate that matches the constant fill rate of the server buffer, and is received at the same rate by the user computer if there are no interruptions in the transmission of media data between the server and the user's computer (with some variation in the case of VBR content). If interruptions have interfered with the arrival of sent media data to the user's computer, that data may have been "dropped" by routers in the Internet and needs to be resent. This causes data to "back up" into the server FIFO for that user.

[0044] A data communications transport mechanism, such as the TCP protocol, may be used for the reliable delivery of data in an ordered sequence from the source of the media data to the server, or from the server to the media player software of the user computer. Resending missing data is the responsibility of the reliable transport

mechanism. The server buffer 14 "sends" data by delivering it to the transport mechanism. The transport mechanism actually manages transmission of the data across the communications medium, and has processes to determine if all the data that has been sent has been received by the destination. If not, missing pieces of data are automatically resent to the destination, and are arranged to be delivered to the target software on the destination system in an ordered fashion. In this example, the destination is user computer 18, and the target software on the destination system is the media player. If the transport mechanism determines that data is missing, it retransmits that data to the destination at a higher than playback rate. In another method of operation, server 12 can use an unreliable transport mechanism, such as UDP, and rely on a streaming software process to manage data delivery and the resending of data elements not received by the media player.

[0045] All media data to be delivered to a user computer may be sent at a higher than playback rate, either by the server buffer 14 passing media data to the transport mechanism, or by the transport mechanism delivering or redelivering the media data to the user computer.

[0046] This is enabled by buffering data at the server 12, and is distinctly different from prior art, in which media data is only sent from the server 12 to the user computer 18 at the rate at which it is to be played out.

[0047] As an example of the preceding description, if the server had been set to store 30 seconds of audio in its buffer, when a user connects, that 30 seconds worth of media data is transferred to the user's media player buffer at a higher than playback rate. The media player can begin playing as soon as it has received a very minimum amount of data, perhaps comprising only a single packet of media data.

[0048] For ease of understanding, consider the server buffer and the media player buffer to be an elastic system that between the two stores (for example) up 30 seconds of audio data. The server starts with 30 seconds of buffered audio data which it transfers to the media player until the server has no buffered media data and the media

player has 30 seconds of buffered media data. Regardless of how much of the buffered media data has been transmitted to the media player, there always is 30 seconds of media data being buffered between the two locations. Consequently, the audio being played out by the media player will always be 30 seconds behind the audio at the source. If there were a media player in the radio station studio, an announcer would hear themselves through the media player with a 30 second delay.

[0049] Connections from the server 12 through the Internet 10 commonly are much faster than the data rate required for audio or video playback. This fact is insignificant for conventional servers because, not having a FIFO buffer or a buffer pointer for each user, audio/video data can only be sent as fast as it becomes available, or as fast as the pace at which it must be delivered to the user in order to be properly replayed. The user, typically interacting with media player software on the user's computer, selects a media source requiring a data rate slower than that available by the user's connection to the Internet. For example, if the user's connection to the Internet is made via a 56,000 bits per second modem, the user might select a media source encoded for playback at 24,000 bits per second.

[0050] With the present invention, as soon as a user connects to the server 12, the server 12 transmits audio/video data as sequential data elements from its buffer 14 to the buffer 20 of the user, at a higher than playback rate. Unlike the prior art, media begins to play on the user computer 18 as soon as the user connection is made to the audio server 12 and a minimal amount of data elements have been received and stored in the user's buffer 20. The user's buffer 20 is built up while the media is playing. As each data element is played, it is deleted or displaced from the user's buffer 20.

[0051] Initially, the user buffer manager 22 requests the server 12 to send media data elements to start the playback stream, such as by selecting a radio station from a list. The server 12 responds by sending data elements to the user computer 18 at higher than the playback rate, until the entire FIFO buffer 14 has been sent to the user computer. Upon receipt of the initial data elements, the user buffer manager 22 begins

playback. Because (with reference to CBR content) this is a synchronous system with the source, server, and user computer operating by the same playback clock rate as determined by the encoding rate of the media, as each data element is played out and is deleted or displaced from the user buffer 20, another data element has been deposited into the server buffer 14 and is available to be sent to the user computer. Server 12 sends the newly available data elements at a higher than playback rate.

[0052] Since the connection from the Internet to the user is faster than that required for media playback, audio/video data is transmitted from the server faster than it is played out by the user system, thus building up audio/video data in the user buffer. For example, if the user's connection to the Internet is at 56,000 bits per second, and the data rate encoded for the media to be played is 24,000 bits per second, the buffer level of the user buffer 20 will fill at the rate of 32,000 bits per second (56,000 bits per second receive rate, minus 24,000 bits per second playout depletion rate).

[0053] If, for example, the server buffer 14 held one minute of audio/ video data, eventually the user buffer 20 will hold one minute of audio/video data. The effect is that, over a brief period of time, the server buffer 14, or a designated portion of it, is transferred to the user buffer 20. In one embodiment, the number of data elements in the server buffer 14 actually never changes, it always maintains one minute of audio/video data. However, for the particular user under discussion, a copy of all the data held in the buffer has been sent to the user. Since the user buffer 20 now holds one minute of audio/video data, it can play continuously despite data reception interruptions of less than a minute.

[0054] Where some media data has been resent by the reliable transport layer, there may be more data to be sent than would be sent at the routine constant fill rate, and in such a case the server transport mechanism will again send the buffered media data at higher than the playback rate. Similarly, if the media player buffer begins to deplete or becomes depleted due to networking interruptions, the server will attempt to send as much data as is necessary to rebuild the user computer's buffer to the proper level,

again at higher than a playback rate. This allows for rebuilding the user's computer buffer under circumstances wherein Internet interruptions have blocked the normal flow of data.

[0055] Thus, as soon as the interruption ceases, the user buffer 20 can begin to rebuild, which will take place at higher than the playback rate. The media player can continue to play out the audio/ video material while the user buffer 20 rebuilds. When compared to conventional systems, which provide no capability to rebuild the user's computer buffer when data is lost, the streaming media buffering system of the present invention provides for recovery of lost data elements and the restoration of the user's buffer, even while the user media player continues to play.

[0056] Under conditions in which interruptions have interfered with the arrival of sent media data to the user's computer, data loss exceeding certain levels will cause the transport mechanism software to stop accepting data for transmission from the application software, namely the streaming media server software. Although other arrangements are possible within the scope of this invention, in preferred embodiments, the streaming media server software keeps track of the last data element in the FIFO buffer that has been sent to each user, using a software pointer. Alternatively, or in addition, a feedback manager may be associated with user computer 18, including means for sending to the source server the serial number of the last data element received, or for requesting more data. An interruption in the ability to send media data to a user results in the "last element" pointer "backing up" in FIFO buffer 14 in such a way that the server knows from what point in the buffer to restart sending data when the transport mechanism again requests data to send. When the server software receives that notification, it will begin sending data to the user starting from the next data element to send as indicated by the pointer, and sending as much data as the transport mechanism will accept. The transport mechanism will again send this data as fast as it can to the user. This process continues until the steady state condition is again reached wherein each data element is sent to the user as soon as it arrives from

the media source, and a pre-determined number of data elements are maintained in user buffer 20.

[0057] The predetermined buffer level in the user buffer 20 may be set at less than the predetermined buffer level of the server buffer 14 if desired. For example, the server buffer 14 might be set to hold one minute of media data, and the user buffer 20 might be set to hold thirty seconds of media data. In another embodiment, a feedback manager 62 is associated with the user computer 18. The feedback manager 62 is provided with means for sending to the source server 12 the serial number of the last data element received. Feedback manager 62 has the form of software or firmware that tracks the last data element received and loaded into the user buffer. In addition, feedback manager 62 is adapted to send the serial number to the source server 12. In this manner, the source server 12 sends the media as sequential data elements at a rate dependent on the quality of the connection with each user computer 18. The media may come from a live source, shown as 25 in Fig. 1, or from a stored file on the source server 12, or another storage device, such as a hard drive.

Implementation with Feedback Manager

[0058] The buffer manager at the source server effectively renders the source buffer 14 a FIFO device holding a fixed amount of data with a constant, time-sequenced fill rate and a constant, time-sequenced depletion rate. Each audio/video data element carries a sequential serial number. Once the buffer 14 is full, each new audio/video data element, identified by a higher serial number, displaces the oldest audio/video data element, identified by the lowest serial number in the buffer 14. In the case of an instantaneous media source, rather than audio/video data filling and depleting the buffer, the top and bottom pointers spanning an amount of audio/video data equivalent to the desired buffer duration move synchronously on a time-sequenced basis to the next higher serial number of the audio/video data available in the system, thus defining the contents of the buffer on a moment-by-moment basis. Thus, if the buffer is capable of holding 100 audio/video data elements, constituting one minute of audio playback, the audio/video

data elements within the buffer would hold serial numbers of B (baseline) + Tr (transmitted) + (0-99), wherein, starting at some arbitrary value B for the baseline, the serial number count would have been incremented by the number Tr representing the total number of data elements that have been transmitted, and the buffer at any point in time would hold the audio/video data elements in the range B+Tr+O to B+Tr+99. On the next clock tick, the buffer holds B+(Tr+I)+O to B+(Tr+I)+99.

[0059] The unique pointer assigned to each user identifies by serial number either the last data element that was sent to that user, or the next data element to be sent. The selection of either mode is arbitrary; but whichever mode has been selected, that mode is systematically implemented. For purposes of this document, we will use the "last data element that was sent." Thus, for any user, the pointer represents the serial number B+Tr+x, where x represents some value between 0 and 99, as being the serial number of the last audio/video data element that had been sent to the user. Each time a data element is transmitted to the user, x is incremented, pointing to the next higher value in the buffer. Each time a new data element is deposited in the buffer by the audio source, x is decremented. Since audio/video data elements are transmitted to the user faster than they are deposited into the buffer, x will increment faster than it decrements and over time will equal the maximum value of 99, pointing to the most recently deposited audio/video data element.

[0060] The amount of data stored in the source server buffer 14 remains the same, regardless of the pointer value associated with any individual user. The pointer indicates the last data element that has been transmitted to the user, and thus also identifies the next data element to be transmitted to the user.

[0061] When the user's pointer equals B+Tr+99, which is the most recently deposited audio/video data element, the user computer 18 receives audio/video data in real time from the media source. The moment the next audio/video data element is deposited into the source server buffer 14, a copy of that data element is transmitted to the user. The user buffer 18 will now contain 100 audio/video data elements, representing one

minute of audio/video data, that will be played on a FIFO basis. In effect, the source server buffer 14 has been moved to the user buffer 20.

[0062] Since the user buffer 20 now holds one minute of audio/video data, it can play continuously despite data reception interruptions of less than a minute, and as soon as the interruption ceases the user buffer 20 can begin to rebuild.

[0063] The user computer 18 and the media server 12 are synchronized by a feedback manager in which the user computer 18 either acknowledges the receipt of the serialized audio/video data packets, or requests the next increment of audio/video data packets. This feedback enables the source server to keep track of the buffer pointer on each user's system.

[0064] Interrupts or delays in the flow of data from the source server to the user will cause the user's system to play audio out of the buffer without the buffer being replenished at the same rate. Consequently, the user buffer pointer will decrement at a faster pace than it increments, and the feedback mechanism will keep the source server buffer pointer for that user synchronized. All of the users' source server buffer pointers also decrement with each tick of the clock, as data flows in and flows out of the fixed size buffer. Thus, as a user buffer drains down, the user's source server buffer pointer indexes down as well, in lockstep. Since new audio/video data is continuously placed into the source server buffer from the source, this has the effect of rebuilding the user's buffer at the server.

[0065] Once this system is set in motion, a buffer of a preset duration is constantly maintained for each user, partially or completely at either source server or the listener's system, or ebbing and flowing between them as a result of moment-to-moment circuit conditions.

Distribution Fed From a Separate Source

[0066] In another embodiment, the buffer concept of this invention can be daisy-chained between multiple Servers. For example, a system might include a source server

computer co-located in a radio station studio, which transmits to a network distribution server resident in a data center, to which users would connect. The source server would fill its buffer, transfer the buffer to the network distribution server using the process just described for transferring a buffer from a source server to a user, and then the network distribution server would transfer its buffer to the user, again, using the process just described except now with the network distribution server replacing the source server in delivering audio/video data to the user system.

[0067] Such an embodiment is shown in FIG. 2. In this embodiment, the media source may be separate from the server 12, such as computer system 28 located at a broadcast media source , such as a radio station studio. Computer system 28 is a logical element in a data network, and can be physically collocated with the audio source, such as a computer resident in a radio station studio, or it can be remote from the audio source, such as a computer in a data center receiving digitized audio from a distant radio station.

[0068] This computer system 28 includes a source manager 30 which may be implemented in software or firmware. The source manager 30 comprises means for: receiving media data elements as they are generated by the audio and/or video source, formatting media data according to the requirements of server 12, buffer 14, and buffer manager 16; and, for transmitting that media data to server 12 as they are generated. Source manager 30 may, as part of such formatting, include means for digitizing, encoding, and packetizing the media data. Media data typically is generated in real time such as by a speaker talking into a microphone or by playing a CD.

[0069] Generally, computer system 28 transmits media data to server 12 in real time as the media data is generated. Buffering of media data might occur at computer system 28 for convenience of programming, but such buffering is incidental to the operation of the end-to-end system being described. Computer system 28 connects via the Internet 10, or other suitable data communications medium, to a server 12, wherein server buffer manager 16 receives the media data for input into the FIFO buffer 14 as

described previously, and maintains the pre-determined number of data elements in the FIFO buffer.

[0070] Server 12, in turn, transmits the media data to one or more user computers 18, also as previously described.

Example Methods

[0071] In another embodiment, shown in FIG. 3, the invention provides a method for distributing from a server via the Internet streaming media composed of a plurality of time-sequenced data elements.

[0072] Time-sequenced data elements are generated or received 32. Next, a predetermined number of the data elements is sequentially loaded 34 into a server buffer, which process of 32 and 34 continues indefinitely as long as there is media data available. Next, a group of the data elements is sequentially sent 36 via the Internet from the server buffer to a user computer connected to the Internet, more rapidly than they are played out by the user system. Upon receipt by the user computer, the sent group of data elements is loaded 38 into a user buffer associated with the user computer. The user computer immediately plays 40 the received portion of the media on the user computer. At 42, if the user buffer is not full, then additional data elements are sent to the user computer 36, again more rapidly than it is played out by the user system. And also at 42, if the user buffer is full, the system waits until new media data is delivered to the server buffer 34. This process is repeated until the entire media file is played at the user computer.

[0073] In another embodiments, the steps depicted in Figure 3 could be modified as follows. A serial number is assigned 30 to each of the plurality of time-sequenced data elements. Next, a predetermined number of the data elements is sequentially loaded 32 into a source buffer, and a group of the data elements is sequentially sent 34 via the Internet from the source buffer to a user computer connected to the Internet. Upon receipt by the user computer, the sent group of data elements is loaded 36 into a user

buffer associated with the user computer. Then, the user computer sends 38 to the source server the serial number of the last data element received by the user computer. The user computer immediately plays 40 the received portion of the media on the user computer. This process is repeated until the entire media file is played at the user computer. Unlike conventional buffer arrangements, audio begins to play on the user system as soon as the user connection is made to the audio source server. The user's buffer is built up while the audio is playing. Advantageously, the system and method of this invention create a faster than real time connection. That is to say, audio/video data is transmitted from the server faster than it is played out by the user system, thus building up audio/video data in the user buffer.

[0074] In another embodiment, the server is connected to the Internet and provisioned as initially described, and has available to it file based media data as the source material. The file based media data can be read by the server which can deliver media data elements to the server FIFO buffer to the same effect as if the data had arrived from a broadcast media source. As before, the server provides a buffer manager and a FIFO buffer, and provides a means for receiving the sequentially arranged media data elements from the file based media source and storing those data elements in the FIFO buffer.

[0075] The buffer manager comprises means for: receiving the media data; supplying media data in order to the FIFO buffer; supplying the FIFO buffer with a predetermined number of data elements; maintaining a pointer into the buffer for each user computer indicating the last media data element that has been sent to that user, thus indicating the next element or elements to be sent; and, once the FIFO buffer is full, deleting the oldest data element in the buffer as each new data element is received, said means arranged to maintain the predetermined number of data elements in the FIFO buffer. The server buffer manager, or a separate process on the server, or a process on another computer having access to the file based media data, provides for reading the media data file and making available to the FIFO buffer sequentially arranged media data

elements. At least one user computer is connected to the server via the Internet. The user computer is associated with a media player software incorporating a user buffer and comprises means for receiving and storing a predetermined number of media data elements which are received sequentially by the media player, playing the data out sequentially as audio and/or video, and deleting media data elements from the buffer as they are played out. As data is played out, the next sequential data elements are received from the server in such a fashion as to approximately maintain the predetermined number of data elements in the user's buffer.

[0076] In another embodiment, the server is connected to the Internet and provisioned as initially described. The server buffer manager, or the media source, provides for sequentially numbering the media data elements. The server buffer manager does not maintain a pointer into the server buffer for each user. Instead, the media player buffer manager in the user computer maintains a record of the serial number of the last data element that has been received.

[0077] Via the use of standard data communications protocol techniques such as TCP, the user computer transmits a request to the server to send one or more data elements, specifying the serial numbers of the data elements. The server responds by sending the requested data elements, and depends upon the reliable transmission protocol to assure delivery. The user computer then continues with additional data requests for the duration of playing the audio/video material. In this manner, the user computer, not the server, maintains the record of the highest data element number stored in the user computer buffer. The media data will be transmitted to the user computer as fast as the data connection between the user computer and the server will allow. As before, the server provides a buffer manager and a FIFO buffer, and provides a means for receiving the sequentially numbered media data elements from a broadcast media source or a file based media source, and storing those data elements in the FIFO buffer. The buffer manager comprises means for: receiving the media data; supplying media data in order to the FIFO buffer; supplying the FIFO buffer with a predetermined number of data

elements; and, once the FIFO buffer is full, deleting the oldest data element in the buffer as each new data element is received.

[0078] Such means is arranged to maintain the pre-determined number of data elements in the FIFO buffer. At least one user computer is connected to the server via the Internet.

[0079] The user computer is associated with a media player software incorporating a user buffer and comprises means for receiving and storing a predetermined number of media data elements which are received sequentially by the media player, playing the data out sequentially as audio and/or video, and deleting media data elements from the buffer as they are played out. As data is played out, the next sequential data elements are requested from the server in such a fashion as to approximately maintain the predetermined number of data elements in the user's buffer.

[0080] In yet another embodiment, the invention provides a method for distributing from a server via the Internet streaming media composed of a plurality of time-sequenced data elements. A predetermined number of the data elements are sequentially loaded into a FIFO buffer. Additional data elements continue to be received.

[0081] As each new data element is input to the buffer, the oldest data element is deleted from the buffer, maintaining in the buffer the same predetermined number of data elements. At the request of a user computer for connection to a media stream, a group of the data elements is sequentially sent via the Internet from the FIFO buffer to the user computer connected to the Internet. Upon being received by the user computer, the sent group of data elements is loaded into a user's buffer associated with the user computer.

[0082] The user's computer immediately begins to play the audio/ video streaming media material. The server continues to send the next data elements in sequence until the contents of the FIFO buffer have been sent. The data elements are sent by the

server as fast as the connection between the server and user computer will allow. Once the contents of the FIFO buffer have been sent to a user computer, as each new data element is received into the FIFO buffer it is immediately sent to the user computer in such a manner as to keep the user computer buffer full. The process repeats for substantially the entire time that the audio/video material is played.

[0083] Unlike conventional buffering systems, audio begins to play on the user system as soon as the user connection to the audio server is effected and a small amount of data has been transferred-conventional systems required many seconds of data. Audio/video media data is initially transmitted from the server more rapidly than it is played out by the user system, until the server buffer has been transferred to the user computer. The user's buffer is built up while the audio is playing, and can be restored if it is diminished by data transmission interruptions. Advantageously, the system and method of this invention afford faster data transmissions than the playback data rate of the media data. Audio/video data is transmitted from the server more rapidly than it is played out by the user system under conditions wherein the user's computer buffer is not full.

[0084] The audio/video data in the user buffer accumulates; interruptions in playback due to temporary Internet and modem delays are avoided. It should be realized that, although the invention has been described hereinabove in connection with a process wherein the server sends buffered media data to the user "as fast as the network connection will permit", it is adequate, as mentioned in this paragraph, that the buffered data be transferred from the server to the user at a rate faster than the playback rate.

[0085] Although the preferred embodiment utilizes a reliable transport mechanism to move data between the server and the user, alternative embodiments could incorporate this invention's buffering system in combination with an unreliable datagram-based transport mechanism.

[0086] Thus, it can be seen that the present invention provides a system and method for sending streaming media, such as audio or video files, via the Internet. Immediate playing of the media on a user's computer is afforded while reducing interruptions in playback due to Internet congestion and temporary delays. Delayed starts, heretofore required to provide protection against interruption, are avoided. Data loss due to interruptions in the receipt of media data by the media player can be recovered while the player continues to play out the audio or video material. If the interruptions are so severe as to deplete the user's buffer and stop the play out, the media player will begin to play out again as soon as the media player begins to receive media data without waiting to first build up the buffer.

[0087] Having thus described the invention in detail, it should be understood that various changes, substitutions, and alterations may be readily ascertainable by those skilled in the art, and may be made herein without departing from the spirit and scope of the invention as defined by the claims.

I claim:

1. A method for distributing a live audio or video program over the Internet from a server system to a plurality of user systems, the method comprising:

receiving at the server system a continuous digitally encoded stream for the audio or video program, via a data connection from a live source, in real time, the server system comprising at least one computer;

upon receipt of the stream by the server system,

supplying, at the server system, media data elements representing the program, each media data element comprising a digitally encoded portion of the program and having a playback rate,

serially identifying the media data elements, and

storing the media data elements in a data structure under the control of the server system;

receiving requests at the server system via one or more data connections over the Internet, for one or more of the media data elements stored in the data structure, each received request specifying one or more serial identifiers of the requested one or more media data elements, each received request originating from a requesting user system of a plurality of user systems; and

responsive to the requests, sending, by the server system, the one or more media data elements having the one or more specified serial identifiers, to the requesting user systems corresponding to the requests; wherein

the data connection between the server system and each requesting user system has a data rate more rapid than the playback rate of the one or more media data elements sent via that connection;

each sending is at a transmission rate as fast as the data connection between the server system and each requesting user system allows;

the one or more media data elements sent are selected without depending on the server system maintaining a record of the last media data element sent to the requesting user systems;

all of the media data elements that are sent by the server system to the plurality of user systems are sent in response to the requests; and

all of the media data elements that are sent by the server system to the requesting user systems are sent from the data structure under the control of the server system as the media data elements were first stored therein.

2. The method of claim 1 wherein the serial identifiers are sequential.

3. The method of claim 1, wherein the sending is via a reliable transmission protocol.

4. The method of claim 3, wherein the reliable transmission protocol is TCP.

5. A server system for distributing a live audio or video program over the Internet to a plurality of user systems, the server system comprising:

at least one computer having a connection to the Internet;

a machine-readable, executable routine containing instructions to cause one of the at least one computers to receive a continuous digitally encoded stream for the live audio or video program, via a data connection from a live source, in real time;

a machine-readable, executable routine containing instructions to cause one of the at least one computers, upon receipt of the stream by the server system,

to supply, at the server system, media data elements representing the program, each media data element comprising a digitally encoded portion of the program and having a playback rate,

to serially identify the media data elements, and

to store the media data elements in a data structure under the control of the server system;

a machine-readable, executable routine containing instructions to cause one of the at least one computers to receive requests at the server system via one or more data connections over the Internet, for one or more of the media data elements stored in the data structure, each received request specifying one or more serial identifiers of the requested one or more media data elements, each received request originating from a requesting user system of a plurality of user systems; and

a machine-readable, executable routine containing instructions to cause one of the at least one computers to send, responsive to the requests, the one or more media data elements having the one or more specified serial identifiers, to the requesting user systems corresponding to the requests; wherein,

the data connection between the server system and each requesting user system has a data rate more rapid than the playback rate of the one or more media data elements sent via that connection;

each sending is at a transmission rate as fast as the data connection between the server system and each requesting user system allows;

the one or more media data elements sent are selected without depending on the server system maintaining a record of the last media data element sent to the requesting user systems;

all of the media data elements that are sent by the server system to the plurality of user systems are sent in response to the requests; and

all of the media data elements that are sent by the server system to the requesting user systems are sent from the data structure under the control of the server system as the media data elements were first stored therein.

6. The server system of claim 5 wherein the serial identifiers are sequential.

7. The server system of claim 5, wherein the sending is via a reliable transmission protocol.

8. The server system of claim 7, wherein the reliable transmission protocol is TCP.

9. A computer program product for distributing a live audio or video program over the Internet from a server system comprising at least one computer to a plurality of user systems, the computer program product comprising a non-transitory computer readable storage medium having program instructions embodied therewith, the program instructions comprising:

instructions executable to cause one of the at least one computers to receive a continuous digitally encoded stream for the audio or video program, via a data connection from a live source, in real time;

instructions executable to cause one of the at least one computers, upon receipt of the stream by the server system,

to supply, at the server system, media data elements representing the program, each media data element comprising a digitally encoded portion of the program and having a playback rate,

to serially identify the media data elements, and

to store the media data elements in a data structure under the control of the server system;

instructions executable to cause one of the at least one computers to receive requests at the server system via one or more data connections over the Internet, for one or more of the media data elements stored in in the data structure, each received request specifying one or more serial identifiers of the requested one or more media data elements, each received request originating from a requesting user system of a plurality of user systems; and

instructions executable to cause one of the at least one computers to send, responsive to the requests, the one or more media data elements having the one or more specified serial identifiers, to the requesting user systems corresponding to the requests; wherein,

the data connection between the server system and each requesting user system has a data rate more rapid than the playback rate of the one or more media data elements sent via that connection;

each sending is at a transmission rate as fast as the data connection between the server system and each requesting user system allows;

the one or more media data elements sent are selected without depending on the server system maintaining a record of the last media data element sent to the requesting user systems;

all of the media data elements that are sent by the server system to the plurality of user systems are sent in response to the requests; and

all of the media data elements that are sent by the server system to the requesting user systems are sent from the data structure under the control of the server system as the media data elements were first stored therein.

10. The computer program product of claim 9 wherein the serial identifiers are sequential.

11. The computer program product of claim 9, wherein the sending is via a reliable transmission protocol.

12. The computer program product of claim 11, wherein the reliable transmission protocol is TCP.

ABSTRACT

Streaming media, such as audio or video files, is sent via the Internet. The media are immediately played on a user's computer. Audio/video data is transmitted from the server under control of a transport mechanism. A server buffer is prefilled with a predetermined amount of the audio/video data. When the transport mechanism causes data to be sent to the user's computer, it is sent more rapidly than it is played out by the user system. The audio/video data in the user buffer accumulates; and interruptions in playback as well as temporary modem delays are avoided.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM
First Named Inventor/Applicant Name:	Harold Edward Price
Filer:	ERNEST D BUFF/Ernest Buff
Attorney Docket Number:	0021-49 CON4B

Filed as Small Entity

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	70	70
UTILITY SEARCH FEE	2111	1	300	300
UTILITY EXAMINATION FEE	2311	1	360	360
REQUEST FOR PRIORITIZED EXAMINATION	2817	1	2000	2000
Pages:				
Claims:				
Miscellaneous-Filing:				
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2730**

Electronic Acknowledgement Receipt

EFS ID:	27100430
Application Number:	15283544
International Application Number:	
Confirmation Number:	5655
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM
First Named Inventor/Applicant Name:	Harold Edward Price
Customer Number:	25901
Filer:	ERNEST D BUFF/Ernest Buff
Filer Authorized By:	ERNEST D BUFF
Attorney Docket Number:	0021-49 CON4B
Receipt Date:	03-OCT-2016
Filing Date:	
Time Stamp:	11:35:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$2730
RAM confirmation Number	15073
Deposit Account	061448
Authorized User	Ferrigno, Juliette

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	TrackOne Request	Track1Request.pdf	134628 a23e88a24007ad5ed9e73b224ee0ac9a72e6865f	no	2
Warnings:					
Information:					
2	Drawings-other than black and white line drawings	DRAWINGS.pdf	191318 0f381145104ffca4fb4a3a61a7d35919c0234e12	no	3
Warnings:					
Information:					
3	Oath or Declaration filed	Declarations.pdf	268217 21583fcc00f16b1a0cd2da6d78b5f2301d58525f	no	2
Warnings:					
Information:					
4	Application Data Sheet	ApplicationDataSheet.pdf	116488 45599aafaf7a2d685348f8f85b9432fa93d2407a	no	9
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
5	Transmittal of New Application	Application.pdf	188457 d81936ac7d43e6f4d27eca833c4a6a26d4ff513e	no	34
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	38538 17c8452c9619de99652ba908d137eeb721e3ae48	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	937646

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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.

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/SB/424 (12-11)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Harold Edward PRICE	Nonprovisional Application Number (if known):	
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i), the prioritized examination fee set forth in 37 CFR 1.17(c), and if not already paid, the publication fee set forth in 37 CFR 1.18(d) have been filed with the request. The basic filing fee, search fee, examination fee, and any required excess claims and application size fees are filed with the request or have been already been paid.

2. The application contains or is amended to contain no more than four independent claims and no more than thirty total claims, and no multiple dependent claims.

3. The applicable box is checked below:

I. ☑ **Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)**

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed oath or declaration under 37 CFR 1.63 is filed with the application.

II. ☐ **Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)**

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature	/Ernest D. Buff/	Date	October 3, 2016
Name (Print/Typed)	Ernest D. Buff	Practitioner Registration Number	25,833

Note: *Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature. If necessary, submit multiple forms for more than one signature, see below*.*

☑ *Total of 1 forms are submitted.

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.

Fig. 1

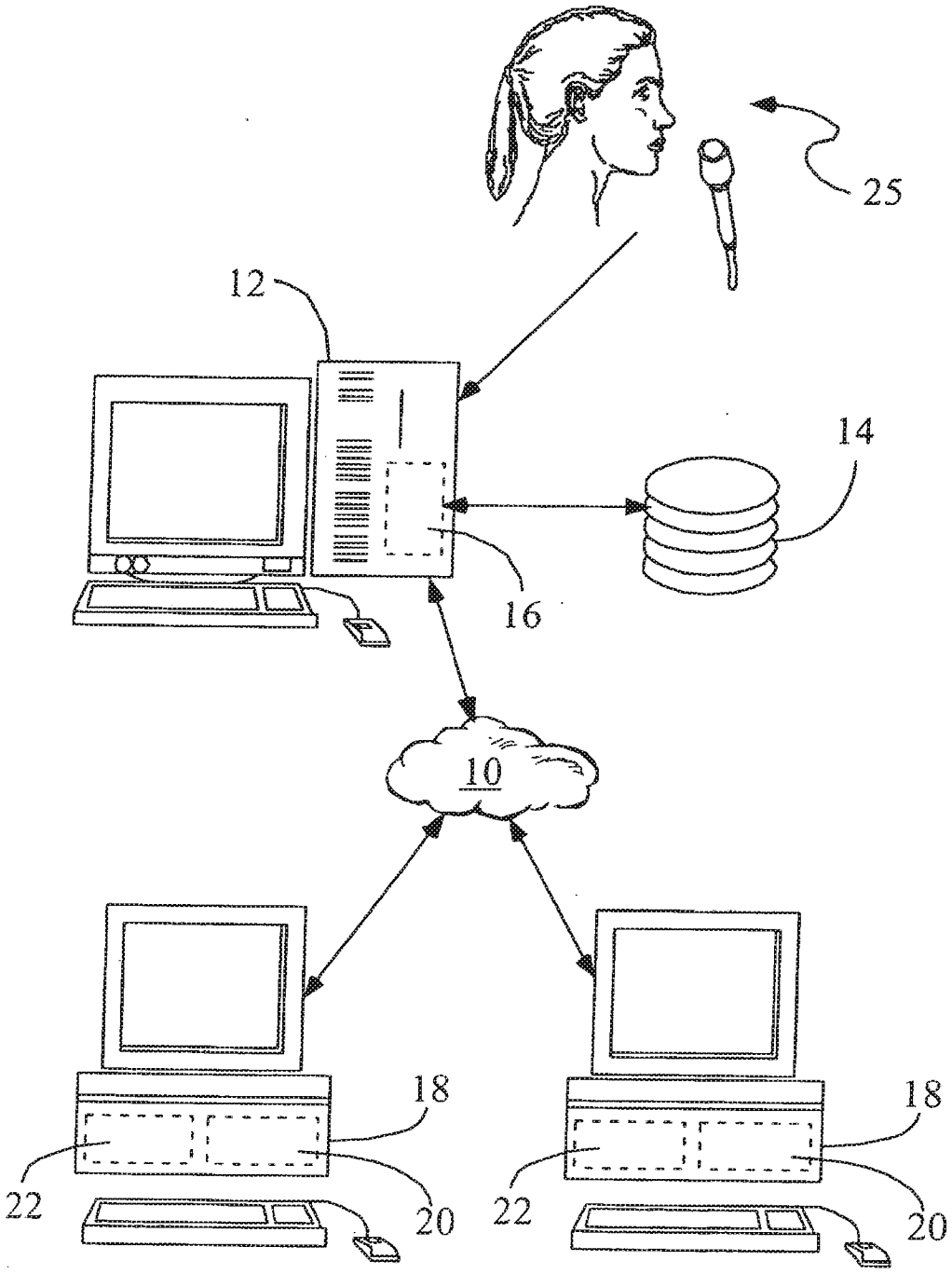


Fig. 2

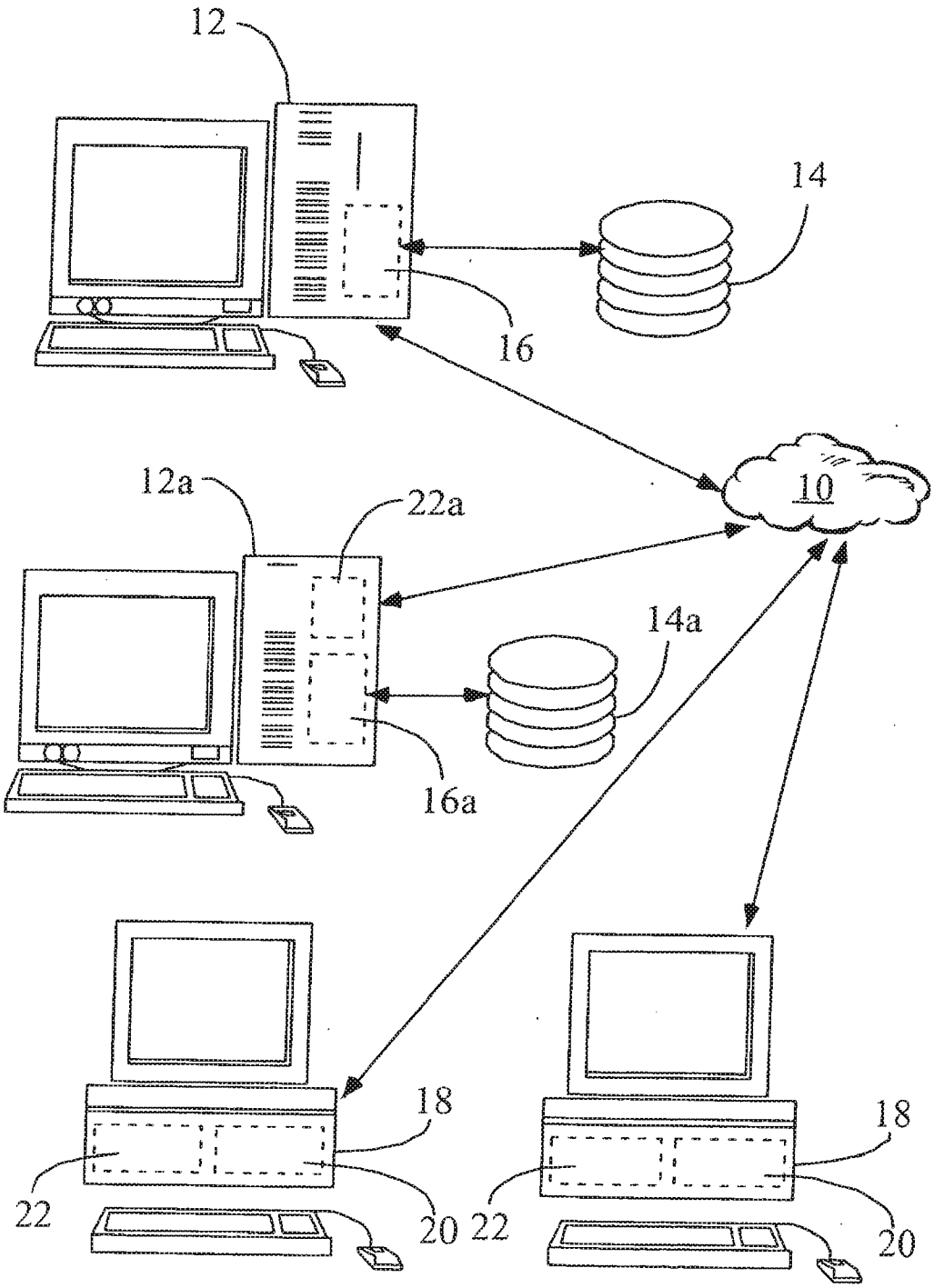
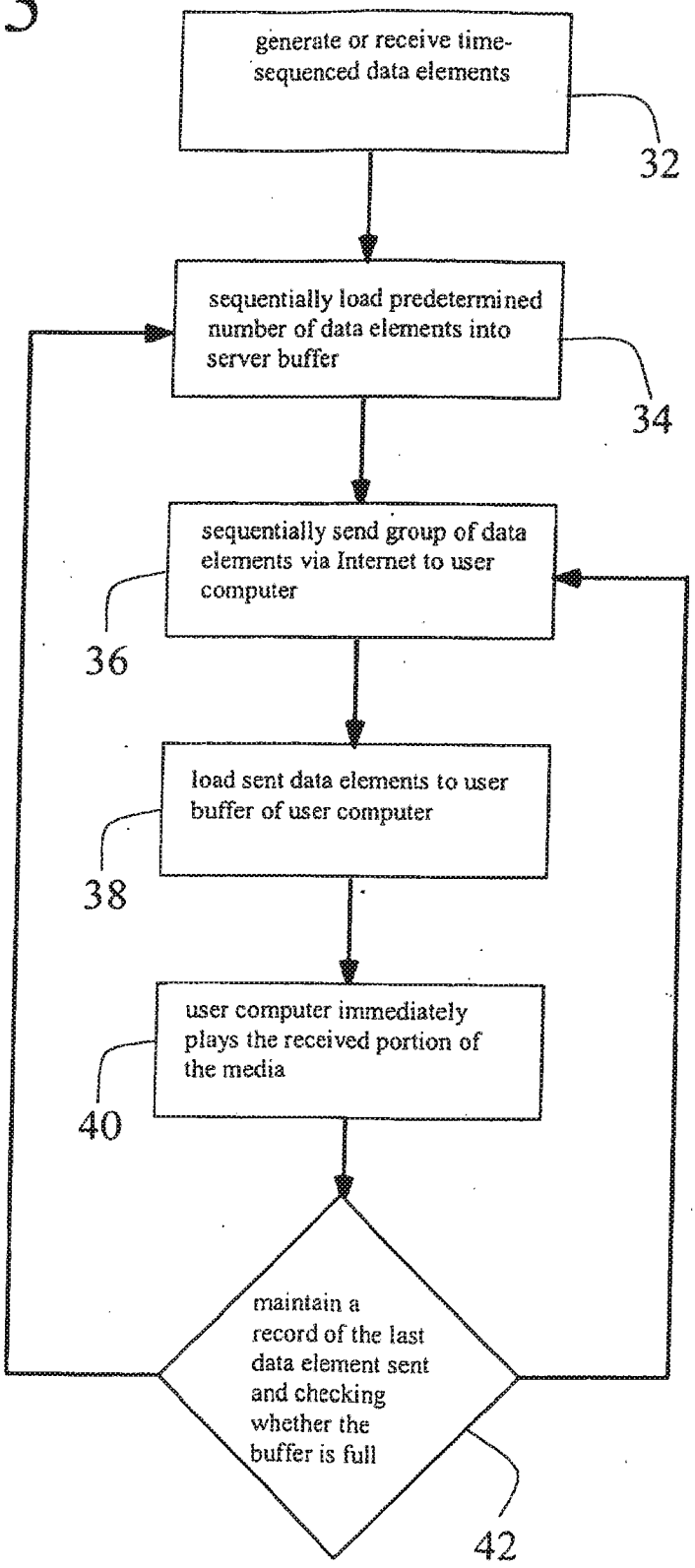


Fig. 3


generate or receive time-sequenced data elements
32
sequentially load predetermined number of data elements into server buffer
34
sequentially send group of data elements via Internet to user computer
36
load sent data elements to user buffer of user computer
38
user computer immediately plays the received portion of the media
40
maintain a record of the last data element sent and checking whether the buffer is full
42

Attorney's Docket No.: 0021-49 CIP

DECLARATION FOR PATENT APPLICATION
SOLE OR JOINT

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention titled:

STREAMING MEDIA BUFFERING SYSTEM

the specification of which is attached hereto.

I HEREBY STATE THAT I HAVE REVIEWED AND UNDERSTAND THE CONTENTS OF THE ABOVE-IDENTIFIED SPECIFICATION, INCLUDING THE CLAIMS.

I ACKNOWLEDGE THE DUTY TO DISCLOSE INFORMATION WHICH IS MATERIAL TO THE EXAMINATION OF THIS APPLICATION IN ACCORDANCE WITH TITLE 37, CODE OF FEDERAL REGULATIONS, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)

(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed Yes	Priority Claimed No
			☐	☐
			☐	☐
			☐	☐

I hereby claim the benefit under Title 35, United States Code, §120 of any United States applications listed below and, INSOFAR AS THE SUBJECT MATTER OF EACH OF THE CLAIMS OF THIS APPLICATION IS NOT DISCLOSED IN THE PRIOR UNITED STATES APPLICATION IN THE MANNER PROVIDED BY THE FIRST PARAGRAPH OF TITLE 35, UNITED STATES CODE, §112, I ACKNOWLEDGE THE DUTY TO DISCLOSE MATERIAL INFOMATION AS DEFINED IN TITLE 37, CODE OF FEDERAL REGULATIONS, §1.56(a) WHICH OCCURRED BETWEEN THE FILING DATE OF THE PRIOR APPLICATION AND THE NATIONAL OR PCT INTERNATIONAL FILING DATE OF THIS APPLICATION:

(Application Serial Number)	(Filing Date)	(STATUS: Patented, Pending, Abandoned)
60/231,997	September 12, 2000	Pending
09/819,337	March 28, 2001	Pending

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected herewith (List name and registration number).

(LIST SENIOR PATENT COUNSEL AND ATTORNEY HANDLING CASE WITH PATENT OFFICE REGISTRATION NUMBERS.)

Name	Name	Name
Ernest D. Buff		
Registration Number	**Registration Number**	**Registration Number**
25,833		

SEND CORRESPONDENCE TO: Ernest D. Buff, Esq.
Ernest D. Buff & Associates, LLC
231 Somerville Road
Bedminster, NJ 07921

DIRECT TELEPHONE CALLS TO: Ernest D. Buff
(908) 901-0220

DECLARATION FOR PATENT APPLICATION—SOLE OR JOINT (Continued) Attorney's Docket No.: 0021-49 CIP - Page 2

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

FULL NAME OF SOLE OR FIRST INVENTOR Harold Edward Price

INVENTOR'S SIGNATURE _____ Date 7/19/04

RESIDENCE Bethel Park, Pennsylvania (County Of Allegheny)

CITIZENSHIP USA

POST OFFICE ADDRESS 5949 Pudding Stone Lane

Bethel Park, Pennsylvania 15102

FULL NAME OF SECOND JOINT INVENTOR _____

INVENTOR'S SIGNATURE _____ Date _____

RESIDENCE _____

CITIZENSHIP _____

POST OFFICE ADDRESS _____

_____

FULL NAME OF THIRD JOINT INVENTOR _____

INVENTOR'S SIGNATURE _____ Date _____

RESIDENCE _____

CITIZENSHIP _____

POST OFFICE ADDRESS _____

_____

FULL NAME OF FOURTH JOINT INVENTOR _____

INVENTOR'S SIGNATURE _____ Date _____

RESIDENCE _____

CITIZENSHIP _____

POST OFFICE ADDRESS _____

_____

FULL NAME OF FIFTH JOINT INVENTOR _____

INVENTOR'S SIGNATURE _____ Date _____

RESIDENCE _____

CITIZENSHIP _____

POST OFFICE ADDRESS _____

_____

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Harold	Edward	PRICE	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Bethel Park	State/Province	PA	Country of Residence	US

Mailing Address of Inventor:

Address 1	5949 Pudding Stone Lane		
Address 2			
City	Bethel Park	**State/Province**	PA
Postal Code	15102	**Country**	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☒ **An Address is being provided for the correspondence Information of this application.**

Name 1	Ernest D. Buff	**Name 2**	
Address 1	Ernest D. Buff & Associates, LLC		
Address 2	231 Somerville Road		
City	Bedminster	**State/Province**	NJ
Country	US	**Postal Code**	07921
Phone Number	908-901-0220	**Fax Number**	908-901-0330
Email Address	EBuff@edbuff.com	Add Email	Remove Email

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

Application Information:

Title of the Invention	STREAMING MEDIA DELIVERY SYSTEM		
Attorney Docket Number	0021-49-CON4B	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	3	**Suggested Figure for Publication (if any)**	1

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	○ Customer Number	◉ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix	
Mr.	Ernest	D.	Buff		Remove

Registration Number	25833

Additional Representative Information blocks may be generated within this form by selecting the **Add** button.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	13815040	2013-01-25

Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13815040	Continuation of	13385375	2012-02-16	8364839	2013-01-29

Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13385375	Continuation of	12800177	2010-05-10	8185611	2012-05-22

Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12800177	Continuation of	10893814	2004-07-19	7716358	2010-05-11

Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
10893814	Continuation in part of	09819337	2001-03-28	6766376	2004-07-20

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
09819337	Claims benefit of provisional	60231997	2000-09-12

Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
10825869	Continuation of	09819337	2001-03-28	6766376	2004-07-20

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.

Foreign Priority Information:

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	WAG ACQUISITION, L.L.C.

Mailing Address Information For Applicant:

Address 1	3 Gold Mine Road, Suite 104		
Address 2			
City	Flanders	**State/Province**	NJ
Country	US	Postal Code	07836
Phone Number	973-691-8717	Fax Number	973-691-7427
Email Address	bill@surfernetwork.com		

Additional Applicant Data may be generated within this form by selecting the Add button.

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Ernest D. Buff/			Date (YYYY-MM-DD)	2016-10-03
First Name	Ernest	Last Name	Buff	Registration Number	25,833

Additional Signature may be generated within this form by selecting the Add button.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	0021-49-CON4B
	Application Number	
Title of Invention	STREAMING MEDIA DELIVERY SYSTEM	

This collection of information is required by 37 CFR 1.76. 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 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet 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 records.

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 CooperationTreaty.

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.

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 15283544 Document Date: 10/03/2016

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

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- Drawing

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Form Revision Date: August 26, 2013

Electronic Patent Application Fee Transmittal

Application Number:	15283544
Filing Date:	
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM
First Named Inventor/Applicant Name:	Harold Edward Price
Filer:	ERNEST D BUFF
Attorney Docket Number:	0021-49 CON4B

Filed as Small 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:				
PROCESSING FEE, EXCEPT PROV. APPLS.	2830	1	70	70
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**70**

Electronic Acknowledgement Receipt

EFS ID:	27107222
Application Number:	15283544
International Application Number:	
Confirmation Number:	5655
Title of Invention:	STREAMING MEDIA DELIVERY SYSTEM
First Named Inventor/Applicant Name:	Harold Edward Price
Customer Number:	25901
Filer:	ERNEST D BUFF
Filer Authorized By:	
Attorney Docket Number:	0021-49 CON4B
Receipt Date:	03-OCT-2016
Filing Date:	
Time Stamp:	16:35:29
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$70
RAM confirmation Number	3346
Deposit Account	061448
Authorized User	Ferrigno, Juliette

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

Charge any Additional Fees required under 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Fee Worksheet (SB06)	fee-info.pdf	30192 6cc70c134a8e1af9de8ddf31641ee5b424c8fd01	no	2

Warnings:

Information:

Total Files Size (in bytes):	30192

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.