4

STB

RESOURCE LOCATOR

FIRST VOD SERVER

SECOND VOD SERVER

PLANNED OR UNPLANNED FAILOVER

610

602 RTSP "setup" MRL = RealLocMove

604 RTSP "redirect multiple choices"
LOCATION - FirstVoCServer
LOCATION - SecondVoCServer

606 RTSP "setup" MRL = FirstVoCServerMove

608

RTSP "ok" AND
MPEG streaming

612

STB DETECTS NO MPEG OR TCP DOWN

614 RTSP "setup" MRL = SecondVoCServerMove,
rtpt = <played time offset>

616 RTSP "ok" AND MPEG STREAMING

FIG. 6

(PS) SYSTEMS AND METHODS FOR REDUCING LOSS OF SERVICE USING PROTOCOL REDIRECT FUNCTIONS

Abstract: Systems and methods according to these exemplary embodiments provide for methods and systems for failover recovery of received streaming multimedia. A set-top box can store state information associated with streaming media, as well as server addresses associated with redundant servers. If the streaming media stops being received, the set-top box can forward a request to one of the redundant servers to start streaming that media at the point in time at which the earlier stream terminated.

Title: SYSTEMS AND METHODS FOR REDUCING LOSS OF SERVICE USING PROTOCOL REDIRECT FUNCTIONS

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Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, 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, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization

International Bureau

(43) International Publication Date

29 April 2010 (29.04.2010)

(51) International Patent Classification:

H04N 7/173 (2006.01) H04L 29/14 (2006.01)

(21) International Application Number:

PCT/IB2008/002844

(22) International Filing Date:

24 October 2008 (24.10.2008)

(25) Filing Language:

English

(26) Publication Language:

English

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(54) Title: SYSTEMS AND METHODS FOR REDUCING LOSS OF SERVICE USING PROTOCOL REDIRECT FUNCTIONS

(57) Abstract: Systems and methods according to these exemplary embodiments provide for methods and systems for failover recovery of received streaming multimedia. A set-top box can store state information associated with streaming media, as well as server addresses associated with redundant servers. If the streaming media stops being received, the set-top box can forward a request to one of the redundant servers to start streaming that media at the point in time at which the earlier stream terminated.
Published: — with international search report (Art. 21(3))
Systems and Methods for Reducing Loss of Service Using Protocol Redirect Functions

TECHNICAL FIELD

[0001] The present invention relates generally to communications systems and in particular to methods and systems for improving the delivery of multimedia services.

BACKGROUND

[0002] As the level of technology increases, the options for communications have become more varied. For example, in the last 30 or so years in the telecommunications industry, personal communications have evolved from a home having a single rotary dial telephone, to a home having multiple telephone, cable and/or fiber optic lines that accommodate both voice and data. Additionally cellular phones and Wi-Fi have added a mobile element to communications. Similarly, in the entertainment industry, 30 years ago there was only one format for television and this format was transmitted over the air and received via antennas located at homes. This has evolved into both different standards of picture quality such as, standard definition television (SDTV), enhanced definition TV (EDTV) and high definition TV (HDTV), and more systems for delivery of these different television display formats such as cable and satellite. Additionally, services have grown to become overlapping between these two industries. As these systems continue to evolve in both industries, the service offerings will continue to merge and new services can be expected to be available for a consumer. Also these services will be based on the technical capability to process and output more information, for example as seen in the improvements in the picture quality of programs viewed on televisions, and therefore it is expected that service
delivery requirements will continue to rely on more bandwidth being available through the network including the "last mile" to the end user.

[0003] Another related technology that impacts both the communications and entertainment industries is the Internet. The physical structure of the Internet and associated communication streams have also evolved to handle an increased flow of data. Servers have more memory than ever before, communications links exist that have a higher bandwidth than in the past, processors are faster and more capable and protocols exist to take advantage of these elements. As consumers' usage of the Internet grows, service companies have turned to the Internet (and other IP networks) as a mechanism for providing services. These multimedia services include Internet Protocol television (IPTV, referring to systems or services that deliver television programs over a network using IP data packets), Internet radio, video on demand (VoD), live events, voice over IP (VoIP), and other web related services received singly or bundled together.

[0004] The quality of service of received from traditional programming over a network, e.g., a television broadcast over a cable network, has created a certain expectation for a level of service quality. Many users may use that level as a baseline for quality of service comparisons to newer, expanding forms of service, such as, VoD. While VoD has been in existence in certain places quite awhile, in many ways VoD can still be considered to be in its infancy based on the relatively lower volume of use of VoD as compared to a typical television broadcast over a cable network. As the use of VoD, and other types of multimedia, expands over both traditional networks and newer networks, e.g., networks using IP data packets, it is believed that people will expect at least the same quality of service as they receive today for more traditional programming over a more traditional network.
Accordingly methods and systems for improving the delivery of services, e.g., multimedia services, are desirable.
SUMMARY

[0006] Systems and methods according to exemplary embodiments address this need and others by providing systems and methods for improving the delivery of services.

[0007] According to one exemplary embodiment a device includes a communications interface for transmitting multimedia selection information and receiving a streaming multimedia based on the multimedia selection information, a decoder for decoding the received streaming multimedia, wherein the decoder includes a state tracker for keeping track of a state of the streaming multimedia, and a memory device for storing at least one reference to each of at least two servers capable of streaming the multimedia.

[0008] According to another exemplary embodiment a method for failure recovery of a streaming multimedia includes the steps of transmitting multimedia selection information, receiving the streaming multimedia based on the multimedia selection information, decoding, by a decoder, the received streaming multimedia, tracking a state of the received streaming multimedia, and storing, at least one reference to each of at least two servers capable of streaming the multimedia.
BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The accompanying drawings illustrate exemplary embodiments, wherein:

[0010] Figure 1 illustrates an Internet Protocol Television (IPTV) video on demand (VoD) system according to exemplary embodiments;

[0011] Figure 2 shows exemplary signaling used in the system of Figure 1 according to exemplary embodiments;

[0012] Figures 3 depicts an IPTV VoD system with multiple servers according to exemplary embodiments;

[0013] Figure 4 shows exemplary signaling used in the system of Figure 3 according to exemplary embodiments;

[0014] Figure 5 depicts a set-top box (STB) according to exemplary embodiments;

[0015] Figure 6 shows exemplary signaling for failover recovery according to exemplary embodiments;

[0016] Figure 7 shows a communications node according to exemplary embodiments;

and

[0017] Figure 8 shows a method flowchart for failure recovery of a streaming multimedia according to exemplary embodiments.
DETAILED DESCRIPTION

[0018] The following detailed description of the exemplary embodiments refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Also, the following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.

[0019] As mentioned above, it is desirable to provide systems and methods for improving the delivery of services, more particularly, for the delivery of services following the failover of a multimedia server. The following exemplary embodiments describe using real time streaming protocol (RTSP) with a streaming multimedia application. However, other protocols that are capable of controlling media, e.g., hypertext transport protocol (HTTP) and session initiation protocol (SIP), can be used either as they currently exist or with minor modifications as would be understood by one of ordinary skill in the art. Additionally, the term "multimedia" as used herein, describes any media that can be streamed over a network. For example, multimedia can include video on demand (VoD) which is a stream, typically a unicast stream, from a source server to an end user device, streaming audio and the like. In order to provide some context for this discussion, an exemplary communications framework is shown in Figure 1 for requesting and receiving streaming video from a single set-top box (STB) 4.

[0020] According to exemplary embodiments, Figure 1 shows a television (TV) 2 in communications with STB 4. The end user has notified the STB 4 that a desired VoD product, e.g., a movie, is desired. STB 4 exchanges communications 12 for obtaining the desired movie information using, for example, HTTP signaling with a movie portal 6. Based on the information received in communications 12, e.g., a VoD server 8's address, the STB 4
sends movie setup information 14 using RTSP to the VoD server 8. A response 16 is sent using RTSP which includes transport data from the VoD server 8 to the STB 16. This is then followed by the VoD server 8 transmitting the desired movie as a MPEG stream 18 to the STB 4. While not shown, various communication networks, e.g., an operator network and the Internet, and nodes, e.g., a digital subscriber line access multiplexer (DSLAM), can exist between the STB 4 and both the VoD server 8 and the movie portal 6.

[0021] Expanding upon this exemplary description of Figure 1, the TV 2 and the STB 4 can be located at a customer’s premises. The STB 4, which can include a web browser and a media decoder, is connected to the Internet or, via a smaller intranet, to an Internet Protocol Television (IPTV) service provider. The movie portal 6 and a VoD streaming server 8 can be disposed at an IPTV service provider or server hosting location. The movie portal 6, which can act as a web server, contains lists of available movies and controls the purchase and rental of movies. The VoD streaming server 8 stores and streams the movies towards the STB 4.

For communication interactions, in this example, the communications between the STB 4 and the movie portal 6 are typically based upon HTTP while the communication interactions between the STB 4 and the VoD streaming server 8 are typically based upon RTSP (for control information) and MPEG (for the media data).

[0022] Based upon the exemplary communications framework shown in Figure 1, an exemplary signaling diagram will now be described with respect to Figure 2 which depicts how an STB 4 can request and receive a VoD program (this assumes that approval and purchasing requirements have been met, as needed). Initially according to exemplary embodiments, an HTTP "get" message 22 is sent from the STB 4 to the movie portal 6. The movie portal 6 responds with an HTTP "ok" message 24 which includes a field which
includes, for example, the value "MRL = VodServer/Movie". The media resource locator (MRL) received is for a specific movie and uniquely points out, or references, both a VoD server 8 and the user selected movie. The STB 4 has the ability through hardware and/or software based systems and methods to recognize that the HTTP "ok" message 24 includes an MRL and issues an RTSP "setup" message 26, which includes the MRL, towards the identified VoD server 8. The VoD server 8 then finds the selected movie in its storage and starts to stream the movie towards the STB 4 using MPEG. Additionally the VoD server 8 responds to the RTSP "setup" message 26 with an RTSP "ok" message. Both the RTSP "ok" message and the streaming movie using MPEG sent from the VoD server 8 are represented in Figure 2 by message 28.

[0023] Video streaming can be a very demanding application which, in large deployments, can require a multitude of streaming servers, e.g., hundreds of streaming servers, to store up to hundreds of thousands of movies and stream out potentially millions of streams simultaneously. Storage and cost issues, coupled with the potential quantity of movies, limit the number of movies a single streaming server can hold. Therefore, a specific movie is expected to be stored on (and streamed from) only a subset of the total number of streaming servers that a service provider has in service. At the same time, some redundancy may be desirable in case a server fails or is otherwise unable to stream movie content to users. Under such circumstances it would be desirable for users to continue to receive, e.g., their requested VoD programs, with little or no service interruption.

[0024] According to exemplary embodiments, multiple VoD servers for redundantly providing large quantities of movies can be deployed as shown in Figure 3. As before, TV 2 is in communications with STB 4 and STB 4 transmits an HTTP message 302 for obtaining
the movie information to the movie portal 6. Upon receipt of the desired information, STB 4 exchanges RTSP messages 304 for movie setup information with the resource locator 306. The resource locator 306 has a database which includes information linking movies and streaming servers. This linking information can be stored in the resource locator 306 as a table or in any other usable format. At this point the STB 4 exchanges RTSP messages with the identified VoD server (312, 314, 316, 318 or 320) as directed during the message exchange 304 with the resource locator 306. This leads to the selected VoD (312, 314, 316, 318 or 320) transmitting the streaming multimedia as an MPEG stream 310 to the STB 4 for decoding and distribution to TV 2.

[0025] According to exemplary embodiments, a signaling diagram for receiving streaming multimedia based on the scenario of multiple VoD servers which are capable of streaming the same movie or program will now be described with respect to Figure 4. Initially, STB 4 transmits an HTTP "get" message 402 for selecting a multimedia product, e.g., a VoD movie, to movie portal 6. Movie portal 6 responds with an HTTP "ok" message 404 which includes an MRL to the specific multimedia product selected. In this case, the MRL describes the location of a resource locator 306 instead of a VoD server (312, 314, 316, 318 or 320). Since the STB 4 understands that it has received a MRL in the HTTP "ok" message 404, the STB 4 transmits an RTSP "setup" message 406 which includes the selected multimedia information towards the resource locator 306. Upon receipt of the RTSP "setup" message 406, the resource locator 306 looks up the selected multimedia product in its database and retrieves the set of servers which have the movie stored and available for streaming. The resource locator 306 then lists the retrieved servers in an order and includes the address of these servers as a parameter in an RTSP "multiple choices redirect" response.
message 408. The order selected for these servers can be based on a round robin format or using other criteria, e.g., other load balancing techniques, as desired.

After receiving the RTSP "multiple choices redirect" response message 408, the STB 4 can store information associated with the servers which are able to deliver the user's selected VoD movie and issue an RTSP "setup" message 410 towards the selected server, e.g., first VoD server 312. The first VoD server 312 then finds the selected multimedia in its storage and begins to stream the selected multimedia towards the STB 4 using MPEG, as well as an RTSP "ok" response as shown by communications 412. As used herein, "multiple choices redirect" generally refers to the inclusion of the locations of multiple servers capable of streaming a particular multimedia in multiple "location" fields in the protocol message for storage and future use as needed. For more information regarding RTSP, the interested reader is directed towards RFC 2326 and RTSP 2.0, which can be found at the Internet Engineering Task Force (IETF) website (www.ietf.org). Also, more information regarding HTTP can be found in RFC 2616, which can also be found online at the Internet Engineering Task Force (IETF) website (www.ietf.org).

As mentioned above, availability of service in case of failures can be obtained by having copies of the various multimedia stored on at least one redundant server than. Then, in the case of an outage by a streaming server, the resource locator 306 becomes aware of the particular server that is down and no longer includes the location of the failed server in future RTSP reply messages. However when a server goes down from which users are currently watching various streaming multimedia products, service is lost for that specific movie. For example, if the VoD server 312 goes down, the STB 4 would lose the connection and stop showing the movie since no incoming stream is being received, i.e. To start the
movie again, the user may need to restart the entire process by reselecting the movie, exchanging communications with the appropriate portals and then, upon receipt of the stream, fast forwarding to the point in the movie when service was lost. This can be a relatively slow and inefficient process.

One solution to service retention is to duplicate every server internally and keep the state of every active multimedia stream replicated in order to be able to transparently restart the stream from the operational duplicate server. Alternatively, another solution is to keep similar state information in an RTSP proxy device disposed between the STB 4 and the streaming server, which in turn would need to be duplicated. However, for both of these solutions, the state for each movie is highly dynamic which greatly increases the requirements of the serving with high availability which, in turn, leads to both of these solutions to be rather impractical at a reasonable cost.

According to exemplary embodiments, another solution is to keep the state of each stream stored in each STB 4, i.e., at each customer premises, and use the multiple choice redirect parameters to facilitate a transparent failover by the STB 4. This reduces the need for maintaining large amounts of state information as well as reducing the need for large amounts of redundant equipment, such as servers, at the service provider location. An exemplary STB 4 which is capable of storing the desired state information will now be described in more detail with respect to Figure 5.

According to exemplary embodiments, STB 4 includes a video interface 502, a web browser 504, an RTSP state function 506, a network interface 508 and a decoder 510. The video interface 502 communicates with web browser 504 and decoder 510 as well as interacting with a TV for various functions, such as, viewing a received decoded streaming
multimedia. Web browser 504 is capable of interfacing with various portals for selecting desired content and communicates with both the video interface 502 and the network interface 508. Network interface 508 transmits and receives communications from the network side as well as providing state information to the RTSP state function 506 for storage. Decoder 510 includes a monitor 512 for monitoring incoming transmissions and a timer 514 which can dynamically update and store play length information. RTSP state function 506 includes rapid recovery response instructions 516 and numerous memory fields indicated by Srvl 518, Srv2 520 and Srvn 522. These memory fields can be used to store information regarding which servers are capable of playing the currently desired streaming multimedia. Also, other state information as desired can be stored in memory within RTSP state function 506 (while this memory for storing all of the state information is not explicitly shown in Figure 5, it can be seen in Figure 7 as memory 704 and/or secondary storage 706).

According to exemplary embodiments, when a resource locator 306 responds to a movie setup message, the location of multiple servers capable of streaming the movie can be provided in the response message and stored in memory in the STB 4, e.g., stored in memory locations Srvl 518 up to Srvn 522. Upon detection of a server failure by the monitor 512, the STB 4 can request a new stream of the movie from one of the server locations (different from the server that failed) stored in memory. Additionally, the new movie stream can be started at the time stored by timer 510 for a more efficient recovery process. Moreover, to assist in minimizing the downtime associated from receiving a new multimedia stream, buffering of the multimedia in a memory can occur at the customer premise using, for example, STB 4.
According to exemplary embodiments, other methods for updating the MRLs for a specific streaming multimedia can be used. Initially, the resource locator 306 is in communications with the service provider and/or the cluster of servers providing the streaming multimedia. When a server goes down, or prior to a server going down in the case of planned downtime, the service provider and/or the cluster of servers informs the resource locator 306 of the unavailability of the server. Alternatively, the resource locator 306 could query the service provider as desired to update the status of the servers and their streaming multimedia capabilities. Additionally, information regarding servers and movies can be transmitted between the resource locator 306 and the various STBs 4 (for their respective streams) in various ways. For example, the resource locator 306 could notify the respective STBs 4 when a server either goes down or comes on line for their respective streaming multimedia. Alternatively, the STB 4 could query the resource locator when the number of stored servers in the RTSP state function 506 is lower than desired, e.g., down to one server.

According to exemplary embodiments, a signaling process for recovering from a server failure will now be described with respect to Figure 6. Initially, the STB 4 transmits an RTSP "setup" message 602 which includes an MRL with the resource locator/movie information to resource locator 306. The resource locator 306 looks up the desired movie in its database and finds a set of servers storing the movie which are also able to take over the streaming duties in case of a failure by another server. The resource locator 306 responds with an RTSP "redirect multiple choices" message 604 which includes, as parameters, the addresses of multiple VoD servers capable of streaming the movie. STB 4 then stores the location information for all of the listed VoD servers and issues an RTSP "setup" towards one of the potential streaming servers, e.g., the first VoD server 312. The first VoD server 312
then finds the movie and commences streaming the movie using MPEG, for example, and transmits an RTSP "ok" message as communication 608 to the STB 4.

[0034] At some future point in time, in this example, while receiving the streaming movie, the first VoD server 312 fails. This server failure 610 can be an unplanned failure, e.g., a hardware failure, or a planned failure, such as regular maintenance or a software upgrade. This failure is noticed by the STB 4 by monitoring the loss of the MPEG stream, a loss of a transmission control protocol (TCP) connection or the like, where the loss equals or exceeds a predetermined amount of time, e.g., 0.5 seconds. The STB 4 also knows, based on timer 510, the current time in the movie when the failure was detected. Using this information, and the information stored in the RTSP state function 506, the STB 4 issues a new RTSP "setup" message 614 towards one of the alternative VoD servers, e.g., the second VoD server 314, whose location has been previously stored. Also included in this RTSP "setup" message 614 is the desired position in the movie for which the stream should commence stored as a value in the "npt" parameter in the RTSP "setup" message 614. The second VoD server 314 then finds the appointed movie and commences streaming of the movie from the desired start point. Depending upon the communication path, which is expected to be short due to not having the resource locator in the path, the interruption time noticed by the end user could be as short as 1/100 of a second.

[0035] The exemplary embodiments described above, illustrate methods and systems for improving failover response while receiving streaming multimedia. An exemplary communications node 700, representing a STB 4 capable of receiving streaming media content will now be described with respect to Figure 7. Communications node 700 can contain a processor 702 (or multiple processor cores), memory 704, one or more secondary
storage devices 706, a communication interface unit 708 to facilitate communications, e.g. a video interface and a network interface, and a decoder 710. The memory 704 (or secondary storage devices 706) can be used for storage of the rapid recovery instructions, the multiple streaming server options and for buffering of streaming multimedia. Thus, a communications node 700, according to exemplary embodiments, is capable of determining when a received multimedia stream has stopped unexpectedly, transmitting a request for a continuation of the stream at the unexpected stopping point, and playing the new stream so as to present a relatively seamless multimedia experience to an end user.

[0036] Utilizing the above-described exemplary embodiments, a method for failure recovery for streaming multimedia will now be described with respect to Figure 8. Initially, a method for failure recovery of a streaming multimedia includes: transmitting multimedia selection information in step 802; receiving the streaming multimedia based on the multimedia selection information in step 804; decoding, by a decoder, the received streaming multimedia in step 806; tracking a state of the received streaming multimedia in step 808; and storing at least one reference to each of at least two servers capable of streaming the multimedia in step 810.

[0037] The above-described exemplary embodiments are intended to be illustrative in all respects, rather than restrictive, of the present invention. All such variations and modifications are considered to be within the scope and spirit of the present invention as defined by the following claims. For example, multimedia streaming formats other than MPEG could be used. Additionally, the STB 4 could include other hardware and controls for determining the point at which the streaming media has stopped being received. For example instead of using a timer, a frame counter or the like could be used to keep track of the state of
the streaming media, e.g., the point in a movie at which the stream was terminated.

Moreover, the functionality of the monitor which monitors continued delivery of the streaming multimedia in the afore-described exemplary embodiments could be combined with the functionality used to track the point at which streaming media has stopped being received, e.g., failure to increment a timer or frame counter can be used as an indication that the media has stopped streaming as well as keeping track of where in the media stream the viewer was interrupted. All of these elements are generically referred to herein as "state tracking elements" or "state trackers", whether they combine these functions or perform them separately. Additionally, while shown as a separate element, the resource locator 306 could be co-located with the cluster of servers or as part of each server. No element, act, or instruction used in the description of the present application should be construed as critical or essential to the invention unless explicitly described as such. Also, as used herein, the article "a" is intended to include one or more items.
WHAT IS CLAIMED IS:

1. A device comprising:
   a Communications interface for transmitting multimedia selection information and receiving a streaming multimedia based on said multimedia selection information;
   a decoder for decoding said received streaming multimedia, wherein said decoder includes a state tracker for keeping track of a state of said streaming multimedia; and
   a memory device for storing at least one reference to each of at least two servers capable of streaming said multimedia.

2. The device of claim 1, further comprising:
   a real time streaming protocol (RTSP) function which includes instructions for a rapid recovery process, wherein when said state tracker detects a lack of received streaming multimedia for a pre-determined time, said instructions are initiated.

3. The device of claim 2, further comprising:
   a processor for initiating said rapid recovery instructions, wherein said instructions for said rapid recovery process instruct said communications interface to transmit a message to one of said plurality of servers capable of providing said streaming multimedia, further wherein said message includes instructions to begin streaming said streaming multimedia at a point based upon said state of said streaming multimedia.

4. The device of claim 3, wherein said streaming media is a video on demand (VoD)
5. The device of claim 2, wherein said lack of received streaming multimedia for a predetermined time is caused by a planned failure.

6. The device of claim 2, wherein said lack of received streaming multimedia for a predetermined time is caused by an unplanned failure

7. The device of claim 1, wherein said device is a set-top box (STB).

8. The device of claim 1, further comprising:
   a web browser for making said multimedia selection.

9. The device of claim 1, wherein said reference is a media resource locator (MRL).

10. The device of claim 1, wherein said state tracker includes at least one of: a timer for tracking a play time of said streaming multimedia and a frame counter for counting a frame of said streaming multimedia.

11. The device of claim 1, wherein said state tracker includes a monitor for determining when said streaming multimedia is no longer being received.

12. A method for failure recovery of a streaming multimedia comprising:
transmitting multimedia selection information;
receiving said streaming multimedia based on said multimedia selection information;
decoding, by a decoder, said received streaming multimedia;
tracking a state of said received streaming multimedia; and
storing, at least one reference to each of at least two servers capable of streaming said multimedia.

13. The method of claim 12, further comprising:
detecting a lack of received streaming multimedia for a pre-determined time and
initiating instructions for a rapid recovery process, wherein said instructions are included in a
real time streaming protocol (RTSP) function.

14. The method of claim 13, further comprising:
transmitting a message to one of said at least two servers capable of providing said streaming multimedia, further wherein said message includes instructions to begin streaming said streaming multimedia at a point based on said state.

15. The method of claim 14, wherein said streaming media is a video on demand (VoD) movie.

16. The method of claim 13, wherein said lack of received streaming multimedia for a pre-determined time is caused by a planned failure.
17. The method of claim 13, wherein said lack of received streaming multimedia for a pre-determined time is caused by an unplanned failure.

18. The method of claim 12, wherein said method for failure recovery of a streaming multimedia occurs at a set-top box (STB).

19. The method of claim 12, further comprising:

   making said multimedia selection with a web browser.

20. The method of claim 12, wherein said reference is a media resource locator (MRL).

21. The method of claim 12, wherein said step of tracking a state of said received streaming multimedia further comprises the step of:

   tracking a play time of said streaming multimedia.

22. The method of claim 12, wherein said step of tracking a state of said received streaming multimedia further comprises the step of:

   counting a frame of said streaming multimedia.

23. The method of claim 12, wherein said step of tracking a state of said received streaming multimedia further comprises the step of:

   determining when said streaming multimedia is no longer being received.
FIG. 1
FIG. 3
FIG. 4
FIG. 5
FIG. 6
FIG. 7
START

TRANSMITTING MULTIMEDIA SELECTION INFORMATION

RECEIVING THE STREAMING MULTIMEDIA BASED ON THE MULTIMEDIA SELECTION INFORMATION

DECODING, BY A DECODER, THE RECEIVED STREAMING MULTIMEDIA

TRACKING A STATE OF THE RECEIVED STREAMING MULTIMEDIA

STORING AT LEAST ONE REFERENCE TO EACH OF AT LEAST TWO SERVERS CAPABLE OF STREAMING THE MULTIMEDIA

END

FIG. 8
### A. CLASSIFICATION OF SUBJECT MATTER

INV. H04N7/173 H04L29/14

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

### B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04N H04L

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, COMPENDEX

### C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No</th>
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[See patent family annex]

**Further documents are listed in the continuation of Box C**

### Date of the actual completion of the international search

24 June 2009

### Date of mailing of the international search report

01/07/2009

### Name and mailing address of the ISA/

European Patent Office, P B 5818 Patentlaan 2 NL- 2280 HV Rijswik Tel (+31-70) 340-2040, Fax (+31-70) 340-3016

Authorized officer

Bertrand, Frederic
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<td>GUANGZHI LI, DONGWEI WANG: &quot;On IPTV Network Design&quot; SPIE, PO BOX 10 BELLINGHAM WA 98227-0010 USA, 31 December 2007 (2007-12-31), XP040248735 the whole document</td>
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