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Development of Video On Demand Server Based on LiveMedia and Improved Cycle Patch Algorithm

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Abstract

The disadvantage of patching algorithm is that the generating multicast flow disorder and cycle patch algorithm solved the above problems. Improved Batch processing cycle patch algorithm has better treatment effect for large scale emergency request, and has a good effect in demand on demand for hot programs or prime time, can effectively increase the number of users. The main function of the LiveMedia library is implemented on a variety of media types and coding format support. The paper presents development of video on demand server based on LiveMedia and improved cycle patch algorithm. The test curve showed that patch cycle algorithm can provide service for more users in the same bandwidth, can effectively increase the number of concurrent users.

Keywords: *LiveMedia, video on demand server, cycle patch*

1. Introduction

Research on streaming media scheduling algorithm mainly refers to the research of data stream transmission mode, the basic flow is sent unicast, multicast or broadcast, these basic transmission modes have their own advantages and disadvantages, their combination may constitute a new scheduling algorithm.

The core problem of mathematical model of video on demand is: formal description of user behavior of large-scale video on demand system, distribution pattern of user behavior, content and time, and establish corresponding mathematical model. Stream scheduling algorithm is essentially on-demand resources analysis and distribution of user command process. Video on demand mathematical model is the theoretical basis of VOD stream scheduling algorithm.

In this paper, the research achievements on oneself, sort out the development context of video on demand streaming media scheduling algorithm, the advantages and disadvantages are compared and analyzed, and proposes a new scheduling algorithm, and the construction of a video on demand server based on open source code [1]. The main work includes: the structure of VOD system at present, analyzes their advantages and disadvantages; network transmission and control protocol for streaming media are described in detail, analyzes their characteristics; the multimedia coding format is studied, analyzed their respective scope of application; scheduling algorithm for streaming media to do an in-depth analysis, comparison of their respective characteristics, and proposes a new scheduling algorithm, and the algorithm was simulated and the results.

LiveMedia can be divided into three parts: the RTP library, LiveMedia library and streaming media applications, the main function of RTP database is using RTP protocol to complete the data transmission, the main function of the LiveMedia library is implemented on a variety of media types and coding format support, application example is mainly used for shows such as RTP library development of streaming media applications.

The cycle patch algorithm is designed to disorder to avoid Patching Algorithm in a multicast stream generation, limiting the maximum number of multicast stream. However, the number of multicast flow reduces; the patch stream number is bound to greatly increase. How to effectively reduce the patch stream number will be the focus of this improved algorithm. The

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paper presents development of video on demand server based on LiveMedia and improved cycle patch algorithm.

2. The Research of Improved Cycle Patch Algorithm

Patch algorithm into the user buffer and patch solve user joins the multicast stream and cause loss of data flow two policy problems. In video frequency program was first on demand, generating a complete video stream, namely normal flow; when the user making the request behind the normal flow, the user use the buffer cache the normal flow of data, at the same time, the regeneration system into a unicast stream, namely patching stream, to compensate for the loss of data.

Patching algorithm greedy to the total length of the video program as patch window, a complete video stream from the server only exist in the system, all in the video stream duration reaches the requests were using the normal flow, but only by the unicast transmission patching stream. Patching Algorithm elegant to the user buffer size as patch window, there are one or more from the server complete video streaming system, only when the user buffer has enough space to cache the skew offset, to new users to send the patch stream, otherwise it will transfer the routine flow.

A reasonable patch window patching algorithm improved to set, if the difference between the normal flow of playing time and the request arrival time is less than the window if the patch size, patch stream is generated, if the difference between the size of the window size of the patches, it generates a new routine flow. Each generation of just one type of flow, and it is either the normal flow, either the patch stream [2]. So regardless of patch algorithm or patch algorithm did not consider the effect of using the VCR operation and VCR operation on system efficiency. In fact, the user VCR operation directly affect the resource scheduling of video server, thus affecting the efficiency of the system, so it is necessary to user VCR operation considering the design of patching algorithm.

In the patch algorithm, there are two types of stream media multicast stream and patching stream: MS PS. Two kinds of media flow in spite of different functions, but there is no difference in the consumption of resources [3]. Two kinds of flow representation method for multicast flow: MS{MID, ST, MT}, MID film ID, ST said the system time generating flow, MT said the program start time in the stream. The patch stream PS{MID, ST, MT, ET}, MID, ST and MT definition and multicast streams of the same program, ET said the final flow.

The core idea of cycle patch algorithm for different multicast: a media program has a certain interval must be between streams. We define cycle constant PERIOD, multicast flow interval must be integer times of PERIOD. Figure 1 can reflect different multicast stream scheduling strategies in a media program.

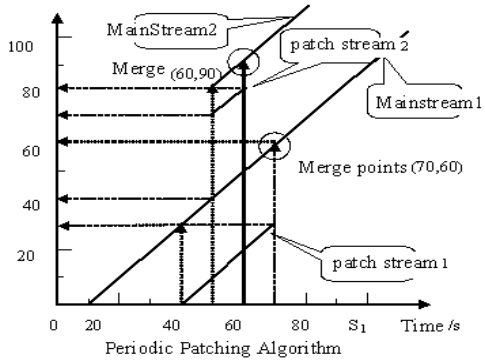

Figure 1. The Main Idea of Periodic Patching Algorithm

Request Req1 (40,0) in system time 40s into the system and from the program time of 0 requests for data, system requirements, the request into the multicast flow MainStream1, and generate patch stream PatchingStream1 to data compensation. Request Req2 (50,70) in system time 50s into the system and request data from program 70s, the multicast stream Mainstream1 player to program 40s, the new request cannot be incorporated into the current

MainStreaml must generate a new multicast stream. But in order to ensure a certain interval between multicast flow, system generates a multicast from the beginning of time 80s flow MianStream2. Here, Mainstream1 and MainStream2 interval to 40s. Obviously, if Req2 and MainStream2 the loss of l0s program of data. At this time, the system then generates PatchingStream2 to data compensation.

Either find or rebuild a multicast satisfy the conditions of the flow in the system, if the user requests the same multicast flow time (Difference), the system to create the patch stream data compensation, the compensation of T flow PS{MID, ST, MT, ET} must satisfy the Equation (1).

$$\begin{cases} PS.MID=AS.MovieID \\ PS.ST=T \\ PS.MT=AS.MovieTime \\ PS.ET=MS.MT \end{cases} \quad (1)$$

The disadvantage is that the patching algorithm generating multicast flow disorder, cycle patch algorithm solved the above problems. In general, for the same user access sequence, cycle patch algorithm with fewer multicast streaming service, thereby saving system resources occupied by the multicast stream generation.

Experiments show that, for a typical user access model, performance is better than the patching algorithm cycle patch algorithm, fairness is also significantly better than patching algorithm [4]. But in some special cases, the performance cycle patch algorithm is not better than that of patching algorithm. For example, when the user access frequency is high, better performance and cycle patch algorithm; but when the system user access frequency is low, the system of unpopular program (we use the popularity of definition unpopular, popular program) system performance, patching algorithm but beyond cycle patch algorithm.

When the system receives the ApplyStream (AS) command, first does a search for multicast can be combined flow. Set the size of the user buffer is Tbuf, the command AS (MovieID, MovieTime) reach the system time in system T, MS{MID, multicast can then be incorporated into the current ST, MT} must meet the following formula (2).

$$\begin{cases} MS.MID=AS.MovieID \\ AS.MovieTime?MS.MT<AS.MovieTime+T_{buf} \\ MS.ST=MS.MT\ (\mathrm{mod}\ T_{buf}) \end{cases} \quad (2)$$

The performance of the system patches and cycle patch algorithm only under certain conditions is better than the other; it is because these algorithms have not in-depth study of various factors that influence the performance of the system. These parameters include: multicast flow period constants, popularity and user buffer size on the multicast flow constant PERIOD value influence, system resources to priority allocation strategy and flow generation strategy.

In the periodic patching algorithm, multicast flow cycle constant PERIOD describes the minimum spacing of different multicast flow of a program. In the above algorithm, it is a system constant, general value for the minimum length of all users in the buffer. If the PERIOD is 0, then cycle patch algorithm degenerates into patching algorithm.

Popularity reflects a program is how frequently users demand, it is the quantitative criterion for judging a program belongs to the popular or unpopular program. Research shows that, in a typical VOD system program popularity obeys Zipf distribution.

For the different popular programs, PERIOD value also affects the performance of the system. On the popular show users a lot, if PERIOD is too small or takes the value of PERIOD algorithm for patch 0, Yi Shengcheng is very much a multicast stream, resulting in transmission redundancy, reduce system performance. In this case, should be appropriate to increase the value of PERIOD. On demand unpopular show fewer users, the number of users less multicast flow energy merger, if the value of PERIOD is greater, a lot of patching system resources consumption, has a significant impact on the efficiency of the system. In this case, we should reduce the value of PERIOD.

In the period of the periodic constant Buding algorithm, PERIOD value is the minimum size of all in the user buffer. Due to the possible presence of a large number of users in the video on demand, video on demand terminal the user may vary greatly, can be high memory computer, also can be low memory of the computer, or even a set-top box. So here's PERIOD and client buffer size to establish contact, dynamic adjustment of PERIOD.

Research and statistics, on demand service approximately obeys the Zipf distribution. The program according to the popularity of the order of M1, M2,... , Mn, the VOD probability pi=P{X=Mi} (i=1, 2, 3,... , n) satisfy Equation (3) [5].

$$p_i = \left(1/i^{1-\theta}\right)/\sum_{j=1}^{n}(1/j^{1-\theta}), 0 \le \theta \le 1 \quad (3)$$

Generate a multicast stream and patching stream is required to consume system resources, on the premise of limited system resources, the resource allocation problem (Resource Allocation). Patches and cycle patch algorithm based on resource allocation strategy is relatively simple, namely the multicast stream and patching stream sharing all the system resources.

Improvement of the batch cycle patch algorithm is: batch algorithm is introduced into the generation process to the patch stream; different users patching stream is bound to a multicast patching stream, the waiting time increase the user's cost to improve the utilization of system resources. Suppose now that 30 users simultaneously on a popular program in 30 seconds, you need to send the 30 patch, if the 30 users were divided into 3 groups, each group delay of 10 seconds, can be added to the flow is reduced to 3.

Algorithm description:

If the batch maximum delay time TM, batch cycle patching algorithms are described as follows:

(1) Each program requests into the request queue, VCR operation in VCR operation request queue, VCR operation request queue first response;

(2) Every time the timer TM, see the VCR operation request queue is empty, if not empty, return, if empty, step (3);

(3) To process the request queue of requests, each request to find the appropriate multicast flow information respectively; to create the patch stream, is first calculated with no resource was available, if any, will be associated with the creation of the patch stream information to be created multicast patching stream queue waitPatch. A program stream only one object queue queue at a patch, the object flow over time is equal to the same programs need to maximum flow end time of creation; if there is no available resources, or the request queue is empty, then stop processing the request, go to step (4);

(4) The processing object queue in the waitPatch, according to the patch stream information to create a patch patch stream flow; create waitPatch queue, empty;

(5) Repeat steps (2).

Algorithm analysis:

(1) The largest patch each program flow number: batch cycle patch algorithm uses the stream merging strategy, for the same program patching stream merging, to reduce the patch stream number. In order to merge the patch stream, request to delay the response on the server side, the delay is longer, can be combined with patch stream number, but the delay time should be controlled in the range of tolerance within the user's [6]. The delay is small, can be combined with patch stream number less, but the response time is smaller, the most extreme case, the delay is zero, then the batch cycle patch algorithm becomes periodic patching algorithm. Now assume that the waiting time for the TM, periodic multicast stream is T, then the number of each program patching up to T/tm to round up the fare.

(2) the waiting time: the number of user if the user requests the same program in TM time is n, then the cycle patch algorithm requires patching stream into N in TM time, batch cycle patch algorithm is the need to patch stream number is 1, occupy resources batch cycle patch algorithm and cycle patch the algorithm of the ratio is 1/n, if n>1, will be able to play the role of combined flow. So the TM according to the actual situation is to dynamically adjust the user.

Through the above analysis, the batch cycle patch algorithm has better treatment effect for large requests, such as in the demand for hot program or on demand for prime time has good effect, can effectively increase the number of users.

3. The Whole Architecture of LiveMedia

A video on demand server received the client playback request, read the multimedia data from disk, and corresponding treatment according to different formats, package and then according to the protocol of RTP, is sent to the client. Package processing of RTP protocol of data is a complex process. Now foreign media development library is for RTP protocol.

LiveMedia is one of the more powerful a, has been applied in some hardware and software products, for example, the current VLC and MPlayer player higher visibility. LiveMedia not only provides the RTP protocol development base, but also for the development of Library in the video on demand, live applications also gives the corresponding reference examples, which have higher for streaming media developers to reference value [7]. The database files are written in standard C++ language, cross platform operation, suitable for constructing streaming media application system with low cost, and is also suitable for embedded system.

According to the time order, set into the system user for U1, U2,... , Un,... Enter the system, its time for T1, t2,... , tn,... So, t0=0, then Ti (i=0, 1, 2,..., N,...) for the lambda form strength (T) of variable intensity of Poisson flow. Let Ti=ti-ti-1 (i>=1), which Ti said adjacent users enter the system time difference, the Ti satisfy such as formula (4) probability distribution function is shown.

$$F_{T_i|T_{i-1}}(t_i \mid t_{i-1}) = 1 - e^{-\lambda(t)t} \tag{4}$$

The RTP library can be divided into three parts: the UsageEnvironment library, Groupsock library and BasicUsageEnvironment library. In order to distinguish these three parts, in the source directory has three sub directory to place the three base, the three sub directory names are three library name, namely UsageEnvironment, Groupsock and BasicUsageEnvironment.

The UsageEnvironment library includes three main classes: class UsageEnvironment, class TaskScheduler and class HarshTable, these classes are abstract base class, are finished in the subclass. The HarshTable class defines the interface of Hash table, mainly for other kinds of services. Storage of Hash table object is a class of objects such as Socket handle, once the program needs, can realize the fast search. Class UsageEnvironment and class TaskScheduler is mainly used for processing delay events, asynchronous read event and the output of the error or warning messages.

So, in order to realize the Edge Transport server will play, in the file read, according to the speed of playback of multimedia files, every other period of time, to send a data transmission task, since these are broadcast instructions in the document, are constantly circulating, to automatically until the document is sent, or stop instruction. Asynchronous read event processing refers to the asynchronous receive instructions via Socket, and the corresponding treatment [8]. Output error or warning information refers to the program is running, if the error or warning information, this part is responsible for the output.

The library also has a corresponding subdirectory in the code directory, the directory name is LiveMedia. This part is the core of LiveMedia, can be achieved RTP and RTSP session establishment, all kinds of RTP Payload packing and parsing and RTSP control. It defines a base class Medium, other and streaming media types and encoding related classes inherit from this class. Figure 2 is a diagram of the base Medium class.

Here, MediaSink is used to receive the data from the other module and processing. MediaSource is used to generate the data or receive other module data, and can be output. Mpeg1or2Demux for Mpeg1 or Mpeg2 format program stream files sound, image separation. RTSPServer is used to build RTSP server based on RTSP protocol. RTSPClient is used to build the room side based on RTSP protocol. There are many other sub classes can be found in the source code and help files.

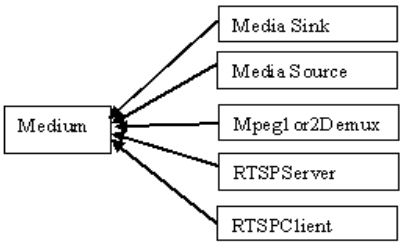

Figure 2. The Diagram of the Base Medium Class

LiveMedia libraries are powerful, not only to support a variety of formats, and supports a variety of functions, including the establishment of a VOD server, server and client. The library also has extended great, to expand the server to support the format can be inherited through FramedSource, to extend the client supported formats can be inherited through MultiFramedRTPSource, to realize their own media through the above way of succession.

Program called testOnDemandRTSPServer, this program can establish a RTSP server on startup, and to establish the corresponding sub session according to the specified file, to establish the corresponding unicast stream in the received request command [9]. The program supports video media types are mainly basic flow file MPEG1, MPEG2 and MPEG4 format, MPEG1, MPEG2 format of the program stream and transport stream file. Based on this procedure, can set up a video on demand server, and can be based on an existing class on the server to support the format was expanded.

Program called testMPEG1or 2Audio Video Streamer, the program can continue to read from the specified MPEG1 or MPEG2 program stream files on startup, and put them into independent voice and video elementary stream base flow, then the flow, to send data packets to a multicast group 239.255.42.42, port is 6666/6667 (voice) and 8888/8889 (video). Based on this procedure, it can build a live video server.

4. Development of Video On Demand Server Based on LiveMedia and Improved Cycle Patch Algorithm

Based on the above analysis, LiveMedia can be established on the basis of the video server based on RTSP protocol, a complete video on demand server should include VOD service system and management system two parts. On demand service function of the system including the establishment and the client RTSP session, send to the client need media information management system, is responsible for user authentication, billing and other tasks. The core part of this is a media service system; the performance of the server is determined largely by it. A video on demand server establishment procedure, and it is described below the server procedure establishment process.

1. Establish environment

The code TaskScheduler* scheduler = BasicTaskScheduler:: createNew ();

Env=BasicUsageEnvironment:: createNew (*scheduler); to create an object of class BasicUsageEnvironment, establish the basic use of the environment.

2. Access control

Using the code UserAuthenticationDatabase* authDB = NULL; authDB = new UserAuthenticationDatabase;

AuthDB->addUserRecord ("username1", "password1"); implementation of access control can prevent users without access to video on demand. No access control needs can omit this part.

3. The establishment of RTSP server

Using the code RTSPServer* rtspServer = RTSPServer:: createNew (*env, 8554, authDB); the establishment of RTSP server, interactive and client complete the server, client implementation of VCR operation, namely in the client to complete the program play, pause, fast forward, backward, operation. 8554 is the RTSP server port, can also be changed to other non occupied ports, the IP address of the server is not specifically set, it is run on demand service

program to the IP address of the computer. The server creates only once, a server to respond to all user demand.

4. Execution loop method

Through the code (.DoEventLoop); (env->taskScheduler) to execute the loop method, to read event socket and delay sending operation on the media files are completed in this cycle.

A video server service system must implement functions such as: the specified directory will be on file in the server, the client input protocol name, the address of the server and the file name can be realized on demand, such as input RTSP://192.168.0.1/test.vob in the specified directory server client, only to the existence of test.vob, can be normal play. In order to facilitate the dynamic creation of a media server session, can let the current name and file name consistent.

After the basic function of video on demand server implementation, can be further improved on the basis of it, adding a batch cycle patch algorithm on streaming media scheduling [10]. When the client requests to play the program through the RTSP protocol, the request latency response, put in the queue queRequest, also set a timer queTimer, timer intervals of time triggered once, processing queue queRequest request, you will need to create the patch stream delay to create, add the patch stream container mapWaitPatch, until the depletion of resources or the queue is empty, then processing the patch stream queue data in mapWaitPatch, after the treatment, empty patch stream queue, the end of the treatment.

Use DirectShow achieve client based on openRTSP. Application of this procedure mentioned above can be open, receive and record a media stream, and then the received media stream decoding operation, reducing the video images and sound. OpenRTSP implementation process is as follows:

(1) Sockets initialization;

(2) To parse the input parameters;

(3) To create the RTSP client: create a RTSP client mainly through to create instances of the RTSPClient class to achieve, RTSPClient is realized by the successor to the Medium.

(4) RTSP client sends a request to RTSP server and OPTION, can be obtained by the method from the RTSP service: first to create a socket, establishes a connection with the server, and then sends a OPTION string, the response sent successfully after waiting for server;

(5) To obtain the SDP description information from server: first to create a socket, establishes a connection with the server, and then sends a DESCRIBE string, the response sent successfully after waiting for server;

(6) According to the above description information obtained from the SDP, create a media session;

(7) Create the output file;

(8) Began broadcasting stream;

(9) Circular receiving.

The video server is tested against a short time large-scale request occurs when the user changes the average response time, validation batch cycle patch algorithm can increase the number of concurrent users role. Here the batch cycle patch algorithm for delay time of 3 seconds.

Server: CPU using P4, frequency recovery is 2.93GHZ, memory using the 512M operating system, using WindowsXP. Client: CPU using Celeron, frequency is 1.0GHZ, with 64 M of memory, the operating system using WindowsXP. Switch: D-Link, 10M. The server to switch, switch to the client using 10Mbps lines, and it is network structure using star shaped structure. Figure 3 Schematic as shown in fig.. A number of video files are 60, the length of time for 30 minutes, the format for the MPEG-1.

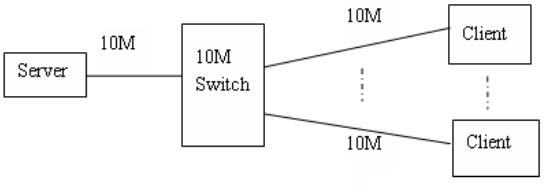

Figure 3. The Test Environment Structure

Figure 4 is the graph curve results, the horizontal axis represents the average number of users per second, the vertical axis represents the response time. Solid triangle where the curve represents the response curve cycle patch algorithm, a hollow triangle where the curve represents the response curve of the batch cycle patch algorithm.

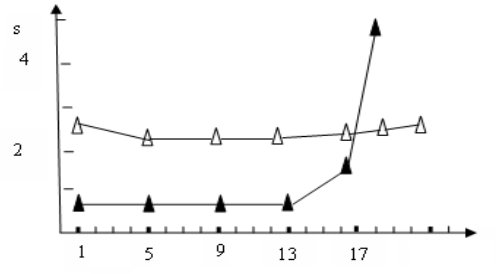

Figure 4. Test Results Bight

The test curve showed that patch cycle algorithm can provide service for more users in the same bandwidth, can effectively increase the number of concurrent users.

5. Conclusion

This paper made a thorough research on streaming media scheduling algorithm used in video on demand system, analyzes on the advantages and disadvantages of patching algorithm, periodic building algorithm, and the cycle patch algorithm is improved, the batch cycle patch algorithm, the algorithm simulation. The paper presents development of video on demand server based on LiveMedia and improved cycle patch algorithm. According to the requirement of VOD system, some theory and combined with the preceding chapters research, this paper implements a basic video on demand system, the system can run in Linux, Windows platform. These achievements, to solve the user in video on demand system of a large number of concurrent users to seize the resource and construction of VOD system cross platform has certain reference significance.

References

[1] Qi Wang, Feng Wu, Shipeng Li, et al. Fine-granularity spatially scalable video coding. *IEEE Int'l Conf on Acoustics, Speech and Signal Processing (ICASSP'2001)*. Salt Lake City, USA. 2001.
[2] GUO Ke you. The Application of Normalized Covariance in Video Mosaicing. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2012; 10(7): 1567-1572.
[3] J van der Meerk, D Mackie. RTP Payload Format for Transpor to MPEG-4 Elementary Streams [EB/OL]. *RFC3640*. 2003.
[4] Cai Y, Tavanapong W, Hua KA. *Enhancing Patching Performance through Double Patching.* Proc. of 9th Intel Conf. on Distributed Multimedia Systems. 2003; 09: 72-77.
[5] Dan A, Sitaram D, Multimedia caching strategies for heterogeneous application and server environments. *Multimedia Tools and Applications*.1997; 4(3): 279-312.
[6] KA Hua, Y Cai, S Sheu. *Patching: a multicast technique for true video-on-demand services*. Proceedings of the 6th ACM International Conference on Multimedia (Multimedia'98). New York: ACM Press.1998; 191-200.
[7] Yue Hou, Yuemei Mai. Chaotic Prediction for Traffic Flow of Improved BP Neural Network. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(3): 1682-1690.
[8] H Schulzrinne. RTP profile for audio and video conferences with minimal control [EB/OL]. *RFC 3551*. 2003.
[9] Yun Liu. Panoramic technique in the video monitoring system and Implementation. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(1): 91- 96.
[10] Yueqiang LI. Breaking the Digital Video Steganography. *TELKOMNIKA Indonesian Journal of Electrical Engineering*. 2013; 11(3): 1691-1696.