An Implementation of Designing Media Streaming System for Live Broadcast

Hsieh-Hua Yang
Oriental Institute of Technology
No.58, Sec. 2, Sichuan Rd., Banqiao City, Taipei County 220, Taiwan
Republic of China
yansnow@gmail.com
&
Jui-Chen Yu
National Science And Technology Museum
#720 Ju-Ru 1st Rd., Kaohsiung
Taiwan
raisin@mail.nstm.gov.tw
&
Yeong-Diann Wang, Hung-Jen Yang, Hsueh-Chih Lin,
Department of Industrial Technology Education
National Kaohsiung Normal University
No.116, Heping 1 st Rd., Lingya District, Kaohsiung City 802, TAIWAN(R.0.C.)
t1179@nknucc.nknu.edu.tw, hjyang@nknucc.nknu.edu.tw,
linhsiaochih@yahoo.com.tw
&
Wei-Yuan Dzan
Department of Naval Architecture, National Kaohsiung Marine University,
Kaohsiung , Taiwan, R.O.C.
dwydanel@mail.nkmu.edu.tw

Abstract: In this study, we designed and constructed a live media streaming system to broadcast important activities such as: graduation ceremonies, sport games, and banquets. There are many different streaming systems and coding formats. In this study, the selecting procedure would be conducted to find suitable and stable technology for implementing live broadcast service, and evaluate the feasibility of system. This article had three parts, including of introductory the streaming technologies, designing and constructing the streaming system and implemented the streaming system.

Key-words□ design, broadcast, live, streaming system, feasibility.

1 Introduction

Since 1990s up to now, the network has become more popular in the world. The Internet supports popular services such as World Wide Web □www□, e-mail, file transfer and file sharing, web search, VoIP, BBS, Telnet, gaming, commerce, streaming technology, publishing, video on demand, and etc.

Functions of Internet also offers file sharing and transferring. It is generally believed that bandwidth is limited, and network resources are increasing more and more.

If clients download huge media files directly, would make this problem even worse. In order to resolve the problem of bandwidth limitation, many network technologies have been developed in recent years, such as streaming technology.

Nowadays, streaming media has already become very popular. There are many streaming media services, for instance YouTube and Yahoo video.

The characteristics of streaming systems can reduce the server loading, and rapidly synchrony presented the media. The technology of streaming allows users or clients to view or hear media objects without having to wait until the entire media is downloaded [3], instead of downloading media files directly and entirely. Based on above characteristics, streaming technology would reduce the bandwidth requirement and provide solution of this problem.

2 Outline of Research Problem

Since 1990s, the network has become more popular. The Internet is a global system of interconnected computer networks that use the standardized Internet Protocol Suite, such as: TCP/IP, to serve billions of users worldwide.

The Internet supports popular services such as World Wide Web □www□, e-mail, Telnet, file transfer and file sharing, web search, BBS, streaming technology, gaming, E-commerce, VoIP, social networking, publishing, video on demand, and telecommunications, and etc.

In recent years, streaming video has already become very popular Internet applications, such as YouTube, yahoo video.

Streaming media technologies makes use of "Streaming" to deliver media content. Streaming means the client render content while that content is being received over network without downloading it first. Streaming is superior to downloading multimedia files because it greatly reduces the waiting time and storage requirements of the client computer [1]. Streaming media systems transmit media such as video, audio or any additional data over wired and wireless networks, but the main difference between these kinds of systems relies on the nature of the distribution: real-time or on-demand [2].

The characteristics of streaming systems can allow users or clients to view or hear media objects without having to wait until the entire media is downloaded. Based on above characteristics, in this study we examine to design and construct a system for important activities broadcast actually.

Because the system designed for the major events, the focus of the design is suitable, practical and stability, instead of latest technology, expensive equipment, novel design and fancy interface.

The organization of the section follows: streaming technologies, system, components and functions.

In this study, a live streaming system was designed and implemented for important activities broadcast, such as graduation ceremonies, sport games, and banquets. Some guests and students who live far away, unable to participate in the activity would be able to watch the activity instantly.

There exist different streaming systems and coding formats. In this study, the selecting procedure would be conducted to find suitable and stable technology for implementing live broadcast service. A feasibility evaluation procedure was also conducted after implementing the streaming system.

Besides, multimedia streaming services are challenge for server and network. In order to make sure the streaming system is feasibility, In Section 4 would analyze the feasibility of technology.

This paper is organized as follows. Section 2 Outline of Research Problem, while in Section 3 design and construct the system, Section 4 includes Results of design field test and Feasibility Analysis, finally in Section 5, where we analyze and discuss the streaming system we constructed.

2.1 streaming technologies

In this section, the broadcast streaming technologies will briefly introduce.

Streaming means the client render content while that content is being received over network without downloading it first. Streaming is superior to downloading multimedia files because it greatly reduces the waiting time and storage requirements of the client computer [1].

In general, a streaming based multimedia system has two constituents: unicast and multicast. Each service has its own characteristics and drawbacks.

2.11 Unicast

Unicasting and multicasting are two ways for transmitting signals on the internet, the technology of unicasting refers to networking in which computers establish two-way, point-to-point connections. Most networks operate in this

fashion....users request a file, and a server sends the file to those clients only [11].

2.12 Multicast

The technology of multicasting adopts point to multipoint communication. Multicast allows the source to send a single copy of data, using a single address for the entire group of recipients. Routers between the source and recipients use the group address to route the data. The routers forward duplicate data packets wherever the path to recipients diverges [12].

Multicasting is one of the most important mechanisms in large-scale multimedia systems, which greatly reduces network traffic and improves the network-I/O bandwidth utilization [4].

For efficiency reason, multicasting is very cost-efficiency, it would alleviate server loading and reducing the network bandwidth requirement. But the multicasting adapted streaming technology selected the enable multicast-routing would be needed.

2.2 streaming system overview

In order to provide live streaming media on the Internet, a streaming media consequently consisted of videos and audios, converting them into a streaming format, and setting up a media server to provide real-time media transmitted through the Internet. A streaming format means that the requested media signals are transmitted step by step from server to client. In the following section, we will discuss several media servers and the media products of streaming will introduced.

The famous media products for providing streaming are the Microsoft Windows Media Server, Real Networks Real-Media Server, Adobe flash media server and Apple QuickTime streaming server. And will be introduced as following.

2.21 Microsoft □Windows Media Server

The system components including of Media Encoder and Windows Media Services. Windows Media Encoder is a tool for content producers who want to capture audio and video content, including high-quality multichannel sound, high-definition video quality, and support for mixed-mode voice and music content [5].

Windows Media Services is an industrial-strength platform for streaming live or on-demand audio and video content over the Internet or an intranet [6].

2.22 ADOBE □FLASH Media Server

The system components including of Flash Media Encoder and Flash Media Services.

Flash Media Encoder is a media encoder that streams audio and video in real time to Flash Media Server or Flash Video Streaming Service (FVSS).

This server works with the Flash Player runtime to create media driven, multiuser RIAs (Rich Internet Applications).

The server can send and receive data to and from the connected users with live web FLV player installed. Connected clients can make Remote procedure calls (RPC) on the server-side and the server can call methods on specific clients.

A Shared Object can be used to synchronize complicated data structures and call remote methods on multiple clients in one go by having clients subscribe to a shared object. Standard Action Script objects are transported across the Net Connection using the Action Message Format (AMF) which is handled transparently by the server and flash client [7].

2.23 Real □RealPlayer Media Server

Helix Server is a software solution for delivery of audio and video streaming content to PC or mobile devices. The Server supports platforms including Linux, Windows 2003 and Solaris. And Helix Server supports multiple formats including Real Media, Windows Media, QuickTime, MP3, H.264, AAC and others.

Helix Proxy is a software solution for reducing bandwidth costs associated with media content entering your network by eliminating redundant requests for streaming media.

By caching and splitting content closer to the end-user, Helix Proxy reduces transmission problems that degrade the quality of the playback experience. Helix Proxy also masks the IP address of your internal users and authenticates every client request at the origin, there by controlling content and increasing content security [8].

2.24 Apple Mac □Quick Time Media Server

QuickTime Streaming Server is Apple's commercial streaming server delivered as part of

Mac OS X Server. QTSS provides users with enhanced administration and media management tools as a result of the tight integration with Mac OS X Server.

Using the RTP/RTSP open standard, QuickTime Streaming Server lets live or prerecorded content in real time over the Internet instead of waiting for the file to download. And QTSS supports the latest global multimedia standards, including H.264, MPEG-4 and 3GPP [9].

2.25 streaming systems compare overview

The following will be a comparison of streaming systems, and the system components including of companies, formats, player, encoder and server are described as follows:

Table 2.25 streaming systems compare overview

company	Microsoft	Real Networks	Apple	Adobe
Streaming format	Wmv	Rm	Mov	Flv
Media player	Windows Media Player	Basic Real Player	QuickTime Player	Flash player
Encoding side	Windows Media Encoder	Real Producer Basic	QuickTime Pro	Flash Media Encoder
Server side	Windows Media Server	Basic Real Server	QuickTime Streaming Server	Flash Media Server

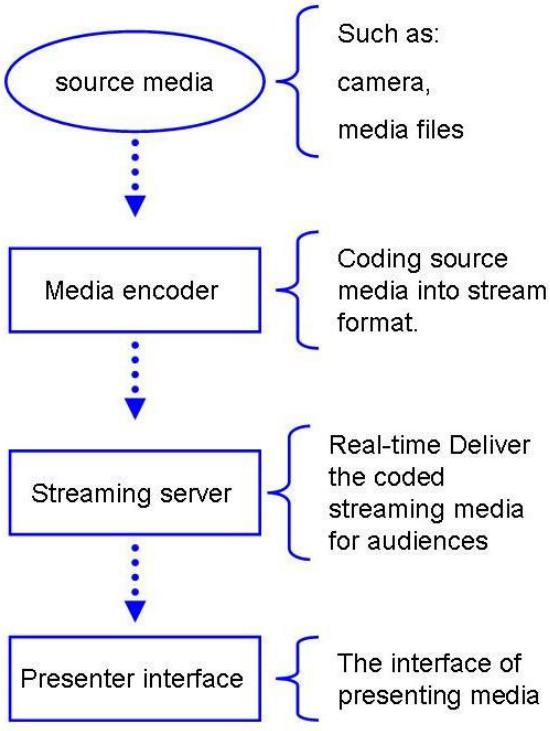

Fig 2.3 streaming system components

2.3 streaming system components

The technology of multimedia streaming allowing clients to view media contents without waiting data download, and it support real-time video presenting for the client. In this section, streaming system has tree components will be described, and construction map is presented as figure 2.3.

2.31 Media encoder

Code the source media into one specific stream format [3]. After coding the source media, and transmitted stream media to the server. In this part, the types of compression, video size, streaming format will be determined.

2.32 Streaming server

In this study, streaming server deliver the real-time media to client side. In server setting, the types of transmitting, trans-point will be determined.

2.33 Presentation interface

Presentation interface refer to decode and present media streams on the client side for the audiences to view the contents.

2.4 streaming system functions

Our purpose in this paper is to design system model and implemented the streaming system. In this section, the streaming system main functions will be described as follows, and Figure 2.4 presented the general streaming system model.

- Provide live streaming format of broadcast: general streaming system will be designed for broadcast, so real-time streaming functionality is needed.
- Support modes of transmission: general streaming system has transmitted the advertises and videos requirements, so support real-time broadcast, regular radio and on-demand video of transmission is needed.
- Support multiples transmission bit rates: considering the home-user broadband connection are different, so this systems must support multiple transmission rates.

Fig 2.4 general streaming system model

3 Design and construct the system

In this section, we present design of live streaming system, system model and experimental setup.

3.1 Design of live streaming System

In this section, we present streaming System technologies of selection, included of selection of media source, selection of media data coding, selection of signal transmission, client side interface.

3.11 Selection of media source

In order to capture high quality video and provide vivid content in broadcast, this study use High-end digital camera, such as: beta-cam or HDV with zoom in & out functions to capture live video, instead of web cam or network-cam.

3.12 Selection of media data coding

Although the source side of data is digital, the activity location may not suitable for erecting the encoder. In this study, the distance between camera and encoder is around 100 meters. So, we decided transmitting signals through video cable to the encoder location and using ADC convert signals to media encoder. Scene is presented as followed figure 3.12

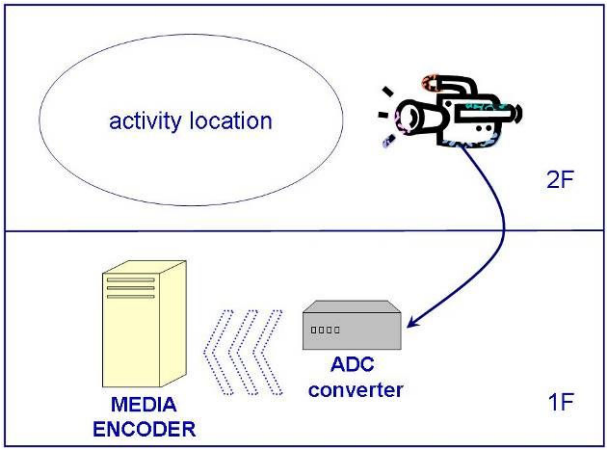

Fig 3.12 Scene of signal transmitting

3.13 Selection of Signal transmission

In the selection of signal transmission, consider the many users of the operating system are Microsoft Windows families, and the home-user habits of operation system, so in this study windows media sever streaming services are selected.

In the other hand, the transmission bit rates must be decided, According Statistical Report □year 207-2009□ of Taiwan National Communications commission, Broadband accounts are around 4.4~5.0 millions [10], with per family 4 persons as the standard to calculate, the average family of 76.5%~87% using Broadband (Populations of Taiwan are around 23 millions). So in this study, streaming media bit rates are set at 148K, 282K, 548K bps.

3.14 Selection of client side interface

In this study, signal transmission using windows media sever streaming services, and streaming media transmission bit rates are set at 148K, 282K, 548K bps.

On the client side interface, we provide two choices for clients to view the live broadcast. Types are presented as follows:

- Windows media player: network user can start Windows media player, and using MMS protocol linking to streaming server publishing point, such as: mms://140.127.56.31/live. Image is presented as followed figure 3.14.

Fig 3.14 Image on the windows media player

- Browser: streaming server provide an ASX file. In this study, we embed the ASX file into browser. Network user can link the website to view the live broadcast. Image is presented as followed figure 3.15.

Fig 3.15 Image on the website

3.2 Constructing Live streaming system model for live broadcast

In this section, we present streaming system model. Model is divided into four parts included of media source, data coding, signal transmission and client interface. Model is presented as followed figure 3.2.

- Audio-Video media source: Using High-end digital camera to capture video and send to media encoder.

- Media data coding: Using windows media encoder to code the signal of capture video, and the streaming media bit rates are fixed at 148K, 282K, 548K bps.

- Signal transmission side: Using multicast streaming technology and transmitting streaming media for network clients.

- Client side: clients refers to the people who can not participate the activity, such as: parents graduates and other friends.

- Interval 1&2: Interval 1&2 in the model, interval 1 is the distance of camera and ADC converter is around 100 meters, and interval 2 is the distance of media encoder and streaming server is around 150 meters. Special attention the connection status and bandwidth.

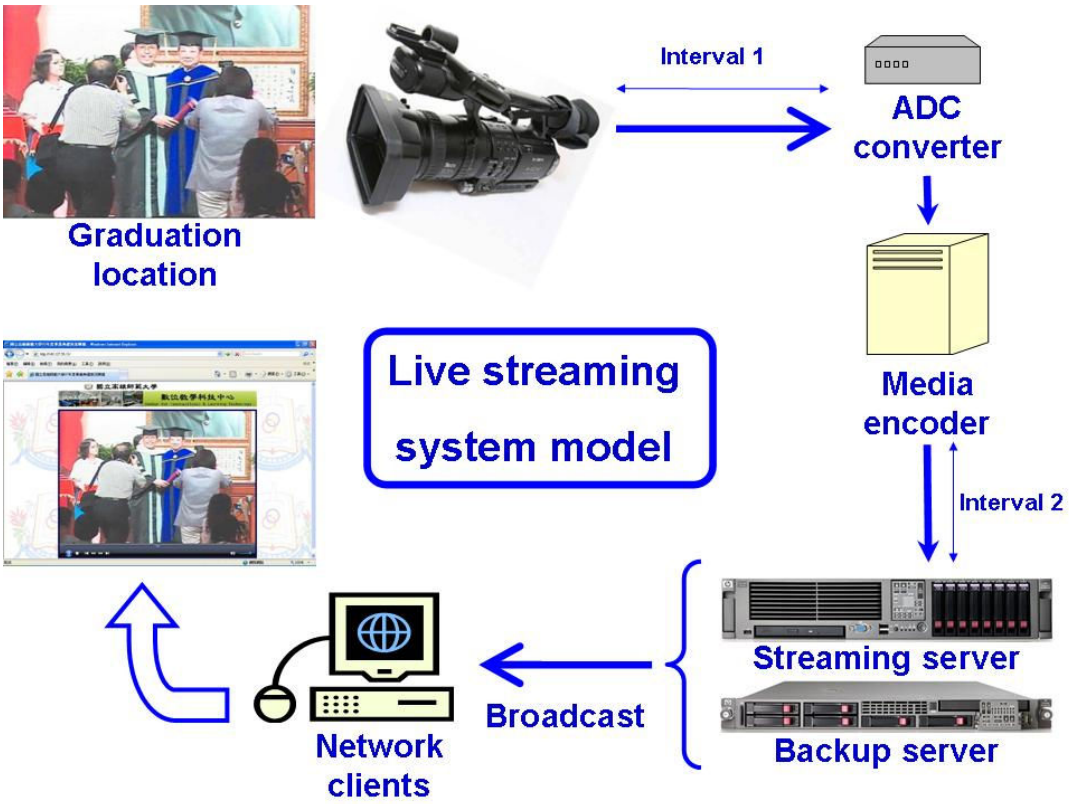

Fig 3.2 Live streaming system model

3.3 Experimental pre-testing

In order to simulate real-time traffic of the experiment, we conducted simulation to verify before the formal experiment, the test sequences are listed as follows:

1. Whether the bandwidth of Interval 2 is large enough for media encoder to transmit streaming media?
2. Is the stream bit rate of connection speed equal to the setting?
3. Whether the system is able to carry over 40 clients?
4. Whether the loading of CPU is less than 50% at 40 client-loading?
5. Whether the loading of network interface is less than 50 % at 40 client-loading?

3.31 The simulations

The simulations are two servers, the one with double AMD Opteron CPU Core 2 2.4G, 2048MB RAM and 1000MB Network card. Another simulation with double AMD MP CPU 1.5G, 1024MB RAM and 100MB Network card. Previous machine is the main streaming server, another just for the backup machine. And OS of simulations are both windows 2003 server edition.

3.32 Testing setting

We must test the bandwidth between media encoder and streaming server (Interval 2). To know the real environment network connection speed and mark sure the bandwidth is enough for media encoder to transmit streaming media.

On the other hand, this testing is in order to know the system performance of the streaming server. In the experiments, we use camera capture video by coding animation, and using a WMV CBR coding algorithm at the coding rate of 548bps. Video data of 6400×480 pixels and 30 fps and audio data of 54 Kbps are multiplexed into a WMV stream. The bit rates are fixed at 148K, 282K, 548K bps.

Finally, in this study the activity of the host has two campuses, so we will test in both two campuses.

3.33 Testing results

In this section, we present detail data of test. And the results also described as followed table.

Table3.331: Testing results in one campus

Sequence	status	Standard	Pass/Fail
1.	above 10Mbps	above 548Kbps	Pass
2.	548K bps	548K bps	Pass
3.	46 clients	40 clients	Pass
4.	less than 2%	less than 50%	Pass
5.	less than 3%	less than 50%	Pass

Table3.332: Testing results in another campus

Sequence	status	Standard	Pass/Fail
1.	above 10Mbps	above 548Kbps	Pass
2.	548K bps	548K bps	Pass
3.	41 clients	40 clients	Pass
4.	less than 2%	less than 50%	Pass
5.	less than 3%	less than 50%	Pass

Table3.333: Testing results of backup server

Sequence	status	Standard	Pass/Fail
1.	above 10Mbps	above 548Kbps	Pass
2.	548K bps	548K bps	Pass
3.	46 clients	40 clients	Pass
4.	less than 4%	less than 50%	Pass
5.	less than 22-23	less than 50%	Pass

- Test1: The testing is pass, the results of bandwidth between media encoder and streaming server is very well, the network is fiber backbone, and the download speed is above 10Mbps.

- Test2: In one Campus, we specify 46 clients link to the streaming server, the results are all pass, the server CPU usage is less than 2% for 46 clients, network loading around 22-23Mbps.

- Test3: In another campus, we specify 41 to clients link the streaming server, the results are all pass, the server CPU usage is less than 2% for 41 clients, network loading around 20-21M bps (with 100MB Network card).

- Test4: In one Campus, we still specify 46 clients link to the backup streaming server, the results are all pass, the server CPU usage is less than 4% for 46 clients, network loading around 22-23M bps.

4. Results and Findings

In this section, we present feasibility Analysis, and the results of live broadcast.

4.1 Feasibility Analysis

In order to make sure the live streaming system is possible; the technology feasibility analysis was conducted. We analyzed the feasibility of technology in three parts, input (media source), processes (streaming transmitting), output (presentation interface).

Table 4.11 Specifications of ADC converter

ADC converter	Specifications
System require	CPU: P4 2.0 GHz or higher RAM: 256MB or higher
Output	NTSC DVD NTSC VCD NTSC SVCD NTSC PC MPEG NTSC DVD Hi-Q PAL DVD PAL VCD PAL SVCD PAL PC MPEG PAL DVD Hi-Q
Up most Resolution	MPEG-2 720*480 pixels

Table 4.12 Specifications of media encoder

media encoder	Specifications
support media format	Asf, Avi, Wmv, Mpg, Wav Mp3, Wma, Bmp, Jpg
Output	High definition quality video Multiple bit rates video Main video profile Pocket pc standard video
Source from	Devices Files Both device and file

- Input (media source): In this study, we propose to design a streaming system for activity broadcast, so media source is camera. Whether data of camera is analog or digital, the ADC converter can convert analog source into digital data. In this study, Specifications of ADC converter and media encoder are presented in Table 4.11 and Table 4.12. According the data of specifications, the ADC converter can convert analog data into

MPEG format and the media encoder also support the format. So in this part input media source is available and feasible.

- Process (streaming transmitting): About media processing must first confirm that media encoder can produce the streaming media that video data of 6400×480 pixels WMV stream and the highest bit rates are fixed at 548K bps. According the data of Table 4.12, the encoder supports the format and bit rates. Second, the connection speed and status must be confirmed, as the 3.33 testing results the connection speed and status is pass, the network between media encoder and streaming server is fiber backbone, and the download speed is above 10M bps. Finally, in this study the activity of the host has been building high-end server with software of Windows 2003 server. The WMS built into Windows 2003 server. The specifications of WMS are presented in Table 4.13. According the data of Table 4.13, the function of live broadcast is available. So in this part, streaming transmitting is available and feasible.

Table 4.13 Specifications of WMS

WMS	specifications
Services	Broadcast Video on demand
Support service	Live streaming Playlists Files
Setting of streaming	Connection number of limited Bandwidth of limited Provide buffer handling

- Output (presentation interface): About media present, in this study the clients must use windows media player or browser to view the live streaming video. In Taiwan most users of the operating system are Microsoft Windows families, windows media player is embedded in the operating. And about browser, after tested of the different browsers, such as: Internet Explorer, Firefox and Chrome, the results are all pass. Browsers can view the live streaming video, the results also described in table 4.12. So in this part streaming present is available and feasible.

Table 4.12 Results of test in different browsers

company	browsers	version	result
Microsoft	Internet Explorer	8.0	Pass
Mozilla	Firefox	3.0	Pass
Google	Chrome	3.0	Pass

Based on the above three parts of feasibility analysis, it can be make sure this streaming system is feasible, in the assessment of technology feasibility.

4.2 Results of design field test

In this study, the result is the same as the feasibility analysis that system is work and feasible. We present detail data of field test, the results also described in table 4.2.

Table 4.2: Results of design field test

ITEM	status
Bandwidth of Interval 2	above 10Mbps
clients	Around 100 clients
CPU loading	less than 10-20%
Network loading	less than 3-4%

- In this section, we present the results of design field test. In the processing of activity, peak times around 100 clients, the server loading around 10-20%, network loading around 30-45M bps. Image of activity is presented as followed figure 3.2.

Fig 4.2 Activity image

And the backup machine did not come in handy, so in activity, the backup machine broadcast the advertisement of enroll students. Image of

advertisement video is presented as followed figure 4.3

Fig 4.3 advertisement video

In this paper we propose to design a streaming system for live broadcast, including constructing system model, techniques selected, system testing, and practiced. As the 4.1 feasibility analysis and 4.2 results of live broadcast proof the model of streaming system can practical work and feasible.

5 Discussions

In summary, we provide an overview of the streaming system, developed the live streaming system model and system had also practiced.

The contributions of this paper are:

(1)Design the streaming system model.

(2)Provide practical experience for live broadcast.

(3)Verify the feasibility of implementing streaming service for activity.

On the other hand, the network interface loading of this study was around 30-45M bps. This amount of loading would be considered as light. If the bandwidth becomes insufficient in the future, the strategy of solving is to set additional mirror/edge servers in other network segment.

Beside live media broadcast, video on demand broadcast can use Internet application such as: YouTube or yahoo video. At present, many universities use this service for advertising such as: Yale, UCLA, Harvard, Dartmouth, UCBerkeley, Cambridge, MIT and etc.

Nowadays, mobile devices have become popular, in the next step of this research will continue to study live broadcast via mobil device.

References:

[1] QingTang Liu, Constructing Virtual Learning Environment With Streaming Media, In Proceedings of WSEAS 2002, December. 2002.

[2] M. Esteve, C.E. Palau, J. Martinez-Nohales and B. Molina, ”A video streaming application for urban traffic management", Computer Applications vol.30, 2007, pp. 479–498

[3] Sheng-Tun Li, "A platform- live IP/TV presentation system", Information sciences, vol.140, 2002, pp. 33-52

[4] Zhonghang Xia, Wei Hao, I-Ling Yen, “Adistributed integrated request processing algorithm for QoS assurance in large-scale media-based systems”, J. Parallel Distrib. Comput, vol.67, 2007, pp. 863 – 875

[5] Windows Media Encoder. Available at http: //http://www.microsoft.com/windows/windowsmedia/forpros/encoder/default.mspx/.

[6] Windows Media Services 9 series for Windows Server 2003. Available at http: //www.microsoft.com/downloads/details.aspx?FamilyID=84523682-DE49-4448-AEF6-962B9FEA6479&displaylang=en/.

[7]Flash Media Live Encoder 3. Available at http: //www.adobe.com/products/flashmediaserver/flashmediaencoder/.

[8] Real Networks RealPlayer. Available at http: //www.realnetworks.com/products-services/helix/media/server_proxy.aspx/.

[9]Quicktime streaming server, Available at http: //developer.apple.com/opensource/server/streaming/index.html/.

[10] Taiwan National Communications commission. Available at http: //www.ncc.gov.tw/.

[11] M. C. NICULESCU and E. NICULESCU, Control of Streaming Multimedia Data in Remote Labs, In Proceedings of the 5th WSEAS International Conference on E-ACTIVITIES”, ISSN: 1790-5095, pp 136-141 (November 2006)

[12] MOHSEN M. TANTAWY, A Proposed IP Multicast Hardware-Routing Algorithm using Partitioned Lookup Table, In Proceedings of the 7th WSEAS International Conference on TELECOMMUNICATIONS and INFORMATICS, ISSN: 1790-5117, pp 31-36 (May 2008)