Enhanced distributed streaming system based on RTP/RTSP in resurgent ability

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ABSTRACT

In this paper, we propose the redirect streaming service model to enhance resurgent ability. The system consists of a redirect server, local streaming servers and clients. Redirect server searches the best streaming serve and streaming servers starts a requested service or resumes it when in a trouble. RTSP/RTP is one of the effective solutions to improve QOS in VOD, however a service can be broken off by an overloaded server or network especially in live. We designed and implemented not only a distributed streaming system that solves the broken-off service to enhance a resurgent system, but also DSSP, distributed streaming service protocol.

1. Introduction

In recent years, internet technology is surprisingly widespread, which made internet is a necessary in our life. Especially multimedia service through the internet and mobile has been progressed remarkably.

The network technologies of multimedia streaming service protocol such as RTSP [1], RTP [2], RTCP [3], TCP and UDP have been used to improve the quality of services and those are very effective. It has contributed to the progress in streaming service on demand such as VOD (video on demand) [1], network bandwidth and storage capability. A streaming service is also focused as a new media of new era due to its flexibility of service and easy implementation such as WMT (Windows Media Technology) [13], Real Media System [12], Quick time [11] in real. However it still has some problems because a service can be requested unexpectedly a lot and the amount of data is getting very huge accompanied by technology progress. When network and server system are overloaded, the quality of service is not guaranteed. To solve it, many distributed system such as scalable server, grid system and DNS are proposed and presented in [7, 8, 9, 10]. CDS (Content Delivery System) [5] is also one of the distributed streaming server solution, which consists of several local replica servers and responses the response of the client faster than before. Another study [6] also suggests the redirection mechanism which consists of a redirector and replica servers. The redirector collects the information of the replica state and reports the best replica to the client. It also improves the resistibility for the abnormal traffic but still causes the breaking service.

But little attention has been given to the point of the solution to ease the problem which streaming system has in essence. We propose not only the new model of streaming server system which consists of main redirection server and local replica streaming server system in order to enhance the resurgence of system and but also a protocol to implement it. The proposed model is that when streaming service is requested or halted, a client notifies the state to the main redirection server and asks the new replica server to start or resume the service. The main redirector polls the replica server's state and reports the best server to the client with its configuration. This model enhances the resurgent distributed streaming service when abnormal traffic or state in the replica.

2. Related works

2.1. Real time streaming Service

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When deciding the best way to deliver movies over the internet, which should you choose--Fast Start (HTTP/FTP delivery) or streaming (RTP/RTSP delivery)? For live feeds that must be transmitted in real time, streaming is the only answer, but for other types of movies, each delivery method has its pros and cons [10, 11, 12, 13].

When the Fast Start movie is sent over HTTP [11], it will call the streaming tracks from the streaming server. This can happen even while the Fast Start movie is still downloading. Use this technique to mix things that must stream, such as live feeds, with things that can't stream, such as sprites. Or you can embed streaming tracks within a Fast Start movie.

The real time streaming services using RTP/RTSP have been commercialized through the internet and mobile service, because those protocols are more stable than the other protocols for multimedia. On the internet, it is usual streaming service that a client usually gets URL information of the streaming server from the web server and connects with it. Then streaming data is served through RTP/RTSP. Quick Time of Apple [11], MPEG4IP and VLC [14] are well known applications using RTP/RTSP. Although RTP/RTSP is well designed for streaming, a network can be centralized to the server. A typical real time streaming system consists of multi client and a single server. A client requests connection to the server. After connecting, the server is requested a content by the client, it transmits the requested streaming data to the client using RTP. There can be several servers and several times of clients on the same service system network topology.

A client selects a server which can be connected. It causes a congestion of a single server and a network line, which cannot guarantee the QOS. To improve the service quality and lessen the congestion and overload, many of the distributed streaming servers like Scalable Media Server System and redirection system similar to DNS are on the consideration.

RTP/RTSP based streaming service which is different from FTP/HTTP based streaming service needs a server system. It means a server is centralized to serve the streaming against the requests. Distributed server system is the well known solution to resolve the sort of system.

2.2. The Real Time Streaming Protocol (RTSP)

RTSP [2] is an application-level protocol for control over the delivery of data with real-time properties. RTSP (RFC2326) provides an extensible framework to enable controlled, on-demand delivery of real-time data, such as audio and video. Sources of data can include both live data feeds and stored clips. This protocol is intended to control multiple data delivery sessions, provide a means for choosing delivery channels such as UDP, multicast UDP and TCP, and provide a means for choosing delivery mechanisms based upon RTP

2.3. The Real Time Transport Protocol (RTP)

RTP was designed in the Internet Engineering Task Force (IETF) [2]. The RTP (RFC 1889) based architecture is defined to enhance the transport functionality of the UDP for better real time support. Note that RTP is not a transport protocol in the common sense. That is, it offers no reliability mechanisms, has no notion of a connection and is usually implemented as part of the application and not the operation system kernel. Instead, RTP offers the application the capability of distinguishing between different media steams and keeping track of various statistics describing the quality of the session as seen by other member of the session.

Figure 1 shows RTSP, RTP and other protocols.

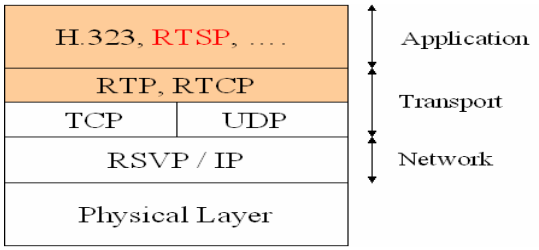

Figure 1 RTP/RTSP Layer

2.4. DNS redirect model

DNS (Domain Name System) is one of the well-known distributed systems. Even though it is different model from the streaming system, its idea that there are several and more servers to be operated identically is the basic premises of this paper [4]. It consists of a few kinds of servers such as local name servers, root name servers, intermediate name servers, authoritative servers and the web servers.

Suppose that a client's application (such as a Web browser or a mail reader) needs to translate a hostname to an IP address. The application will invoke the client side of DNS, specifying the hostname that is necessarily translated. DNS in the user's host then takes over, sending a query message into the network. DNS in the user's host receive a DNS reply message that provides the desired mapping. This mapping is then passed to the invoking application. Thus, from the perspective of the invoking application in the user's host, DNS is a black box providing a simple, straightforward translation service. But in fact, the black box that implements the service is complex, consisting of a large number of name

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servers distributed around the globe, as well as an application-layer protocol that specifies how the name servers and querying hosts communicate.

Local name servers – Each ISP has a local name server. When a host issues a DNS query message, the message is first sent to the host's local name server. The IP address of the local name server is typically configured by hand in a host.

Root name servers.- In the Internet there are a dozen or so root name servers, most of which are currently located in North America.

3. Enhanced distributed streaming system

3.1. Implementation

To implement the new proposed model based on RTP/RTSP, open source codes of Darwin Streaming Server 5.0.1.1[11] and MPEG4IP are basically used. The model consists of three components which are a root redirection server, local streaming servers and a client.

We've just implemented a single root redirection server, two distributed streaming servers and a single client, instead of the multiple steaming servers and clients in this paper.

In addition, we also studied a new protocol, DSSP (Distributed Streaming Service Protocol) in order to realize this model. It runs on the new model including RTP/RTSP and specifies connections and data process among each component. We especially divide into two parts and rename it as DSSP-SCI (servers to clients interface) and DSSP-SSI (root redirection server to local streaming server interface). The followings describe the roles of each component.

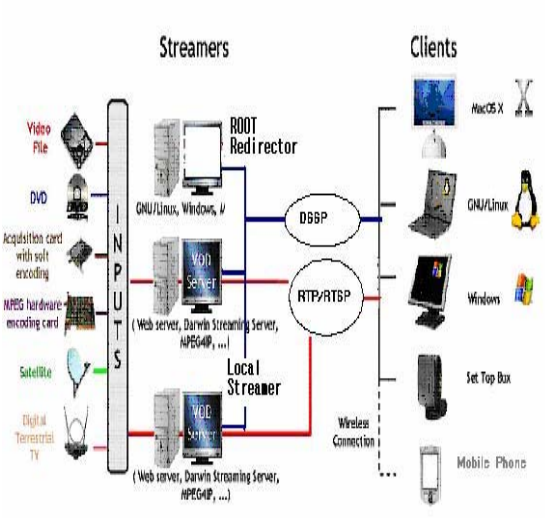

Figure 2 DSSP and RTP/RTSP system

3.2. Root redirection server

It is a kind of database server working similar to a local name server of DNS. So it has the list of distributed streaming servers at initial stage. After setting up, it starts to collect information about their own state such as performance and capability from each local streaming server over DSSP-SSI. Each streaming server has its own key which can protect itself from the unauthorized client access. Figure 3 shows that IP address and its own certification key of two local streaming servers.

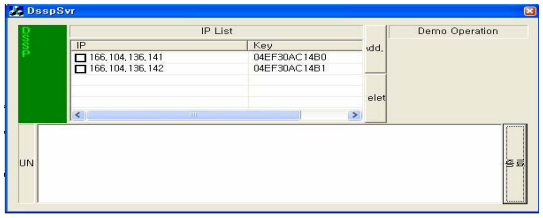

Figure 3 Redirection root server

It communicates with a client as well as streaming servers to get a service request over URL and to return IP address of local streaming servers and keys over DSSP-SCI.

3.3. Local streaming server

It is the very similar to a usual streaming server in the point of the way of streaming over RTP/RTSP. So its basic concept is originated from Darwin Streaming Server of Apple. Major differences are to transmit its own state including the number of connected clients and available contents, to the root streaming server over DSSP-SSI and to certificate the client with the key given by the root redirection server over DSSP-SCI.

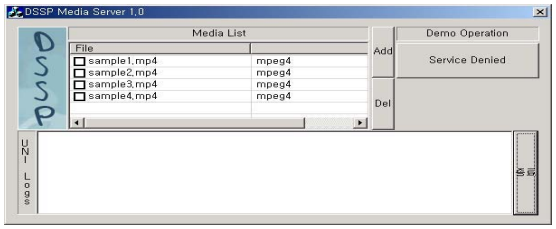

Figure 4 One of the local streaming servers

Figure 4 shows a local streaming server to display some mpeg4 video contents.

It can forcefully disconnect with a client to verity the redirection in this model.

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3.4. Client (media player)

It can decode mpeg4 video as well as mp3 audio because it fully supports RTP/RTSP. It communicates with both a root redirection server and a local streaming server over DSSP-SCI. It also has a function to monitor mpeg4 data loss from streaming server in order to decide whether streaming server should be switched. A client is shown in figure 5.

Supposed that a client is not able to get the streaming service due to the locked-up server or the abnormal traffic network, a client starts to check the transmitted data flow. When the buffered data is down to below the threshold value (2 second and 60%), a client connects the main redirection server to request the new streaming server ID and have a connection with the new. The service is resumed at the halted point of the stream because the client makes a new connection with the position of the halted service, which makes the service enhanced comparing to other systems.

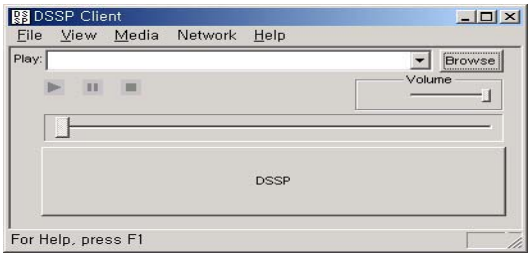

Figure 5 Client

3.5. Distributed streaming service protocol (DSSP)

DSSP is designed to implement the enhanced distributed streaming system. It consists of SCI (server to client interface) and SSI (root redirection server to stream servers interface). SCI specifies that how a client communicates with a root direction server and local streaming servers to play the requested media. SSI does that how a root redirection server communicates with local streaming servers to get information.

The flow of system to depend on the simulated scenario is the following.

① A client requests the best server to a root redirection server.

② A root redirection server returns IP and a certification key to the client.

③ Streaming service starts based on RTP/RTSP between a client and a local streaming server.

④ When service is abnormal, a client break off the service and request another server to the root redirection server

⑤ The client is given another streaming server and resumes the broken service.

Figure 6 shows the sequences of DSSP.

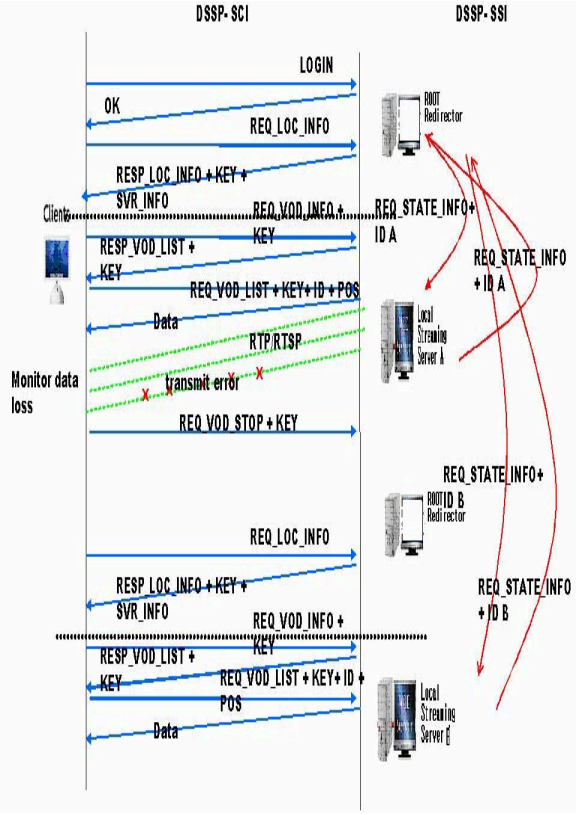

Figure 6 Flow Diagram of DSSP

3.6. Test Results

We've tested response time to vary the error video data ratio, which is the threshold of server network. Although the test is examined in intranet, the results said it is hard for a client to play the stream on demand within bearable time when the network is congested below about 60%, the threshold value of error data ratio (see 3.4).

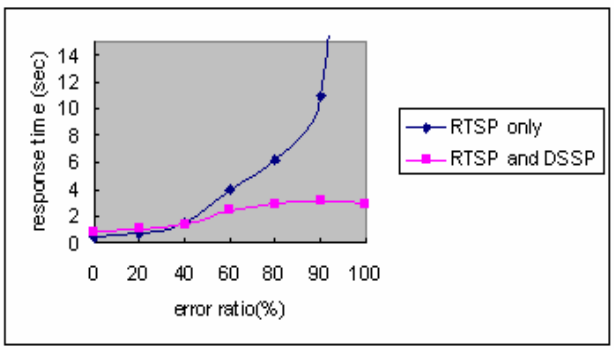

Figure 7 Response time from client request

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4. Conclusion

We've validated the distributed streaming system using RTSP/RTP and DSSP together to ensure that a service can be more stable as reducing the overloading of network and a streaming server. This makes a client get the best service in a real time service through the internet. This research has also improved the resurgent ability when a service is blocked out due to essential problems of the streaming system. It means that clients are able to continuously get a service under the unexpected situation. It is very helpful in live streaming.

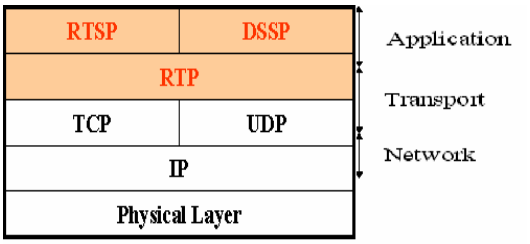

Figure 8 Protocol Layer

This paper also suggests a new protocol, DSSP, to implement the proposed system. However, DSSP is separately considered from RTSP. For the robust architecture, DSSP may be better to be merged with RTSP. Besides this implementation is more focused on the DSSP-SCI than DSSP-SSI It also should be specified more detail to be more effectively updated, when a root direction server monitors the state of streaming servers. In system, we will also investigate various combinations between many kinds of distributed file system and this model. It will confirm this paper's scalability.

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