A Study on the Performance Enhancements of Video Streaming Service in MPLS Network

Kyoung-Hwan Kwak, In-Kap Park and Chung-Hyun Kim
Dept of Electronics Engineering, KonKuk University, Seoul City,143-701, Korea
Tel : +81-2-450-3495 Fax : +81-2-3437-5235
E-mail : {khkwak, ikpark, chkim}@konkuk.ac.kr

Abstract : This paper used OPNET to simulate video streaming service a test IP network and MPLS network with the traffic shaping that have with CQ_LLQ algorithm, LSP of fixed bandwidth, policy of limitation users and measures parameters such as delay, throughput, packet loss. To verify the performance of video streaming service in IP network and MPLS network, two scenario that have same topology and traffic source. One is the simulation for best-effort service in pure IP network. The other is the simulation for QoS-enabled service in MPLS Network. Based on simulation result, the MPLS network with CQ_LLQ algorithm and fixed LSP show advantage of the video streaming service QoS, specially delay and packet loss.

1. INTRODUCTION

As the increase of usage of computers, the number of computer users has increased dramatically. As a sequence, the type of services the users demand also grew a lot. Specially, Internet broadcasts, VOD etc like services became one of important services the users demand, and also it is enlarging its territory. However. as the increase of usage of Internet, the traffic is lowering the quality of the service. This trend is getting more and more serious. It is even effecting the services that needs QoS guarantee, like video streaming. IP network is very expandable and also cheap. However the QoS and the embodiment of traffic engineering is difficult. On the other side, the ATM is very proper for QoS and the embodiment of traffic engineering and not so good at expanding and the price of the network. [1] Not to mention the complication of the network. So that means, there should be new routing way that can handle the IP's expanding skill and the ATM's QoS and the embodiment traffic engineering. So the model which Network switch works as IP routing is offered and this is called unification of routing model. IETF offers Multi Protocol Label Switching(MPLS) as the base notion for the unification of routing model. By using shim headers MPLS offered better expansion of the network, overcame the overlay models short comings of ATM. And also by using simple swapping of label header, it became also possible for the high speed data transmission. Also the classification of traffic and the traffic engineering made the QoS possible.[1][2][3]

It offers better service than the current network. MPEG, which is the most representabe service in the video streaming, is the way of compressing the video films, the data can be compressed 100 times between the I frame and B,P. Due to the characteristic of the video, the size of the frame can be different. So to please the QoS, the bandwidth becomes different. And this rapid difference of the bandwidth will lead to the interfere of the video, that will stop the movie(or make it slow). And also the traffic increases at the same time, the video can't be seen at all. Therefore, the offering of bandwidth and the traffic engineering due to the characteristic of MPEG is went through. Also if you go through the usage time and the dates carefully, you might notice the patterns. By setting the LSP it can give steady traffic's bandwidth. To fix LSP, reduces the delay and increase the transmitting data rate, it needs to adjust the CQ_LLQ in the traffic shaping process in routing and the differing the usage due to the characteristic. This will lead to the satisfying QoS and by the simulation the ability and the results will be shown. The structure of this paper is as follows. The second chapter handles the short comings of video streaming when current IP network is used. The Third chapter handles MPLS network to overcome the situation and the forth chapter talks writes about the simulation and the discussion about the results. And lastly the fifth chapter is conclusions with some few complements.[3][4]

2. VIDEO STREAMING FROM THE IP NETWORK

MPEG data traffic, due to the characters of the MPEG, shows unbalanced looks. Video streaming data traffic shows differences from other traffics. As the data shows unbalanced characteristic since it is occurred, it is different from others that have fixed data traffic flows. The current IP network handles all the traffic at the same level. Therefore, every traffic doesn't concern about the characteristic but just handles it in 'best effort service'. In IP network, before sending the packets, OSPF and BGP decide the route and then send the packets. However, it decides the shortest path by counting hops or speed.

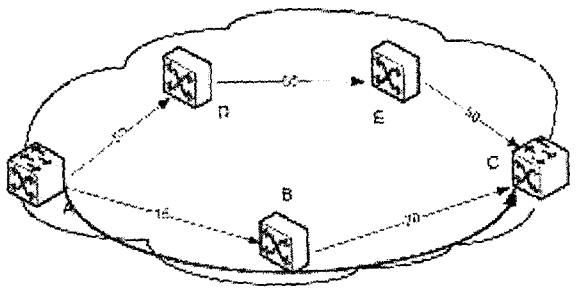

Fig.1. Problem of the shortest path

Therefore, problems like the figure 1 might occur. The bandwidth through A-D-E-C is much bigger, but in the shortest routes, A-B-C, which the bandwidth is very low, is selected. Therefore, the A-B-C route is overly used, and A-D-E-C will not be used that a lot. This will bring unbalance to the entire network. Also, since it doesn't care about classification of the characteristics of traffic, it just sends all the data in same way.[4]

In the case of the video streaming it is handled same as other traffic, the delay and the traffic accuracy can't be confirmed, which will lead to no QoS. Also, in the IP network. even if it is same traffic the routes can be changed since it is sent due to the shortest routes. This meaning that the part of data can be lost or sent to other routes. Talking about the part of the packets sent in other routes, this is not a big problem to other traffics but in the matter of video streaming, which needs to be sent right on time, this becomes a big problem. Because of the process in real time, late packets are useless.[4][5]

3. VIDEO STREAMING IN MPLS

The programs that are serviced through internet ask for different QoS due to the application. For example, in FTP, it demands less error than time delays when video streaming prefers high data transmitting rate and no delay. FTP's goal is to have no errors, it re-sends the data that isn't reached, so delay is likely to occur. On the other hand, in the video streaming, even if there is error while sending the packets, it will be recovered with forwarding error correcting code. (However, if the errors are too big, the packets will be thrown away, since there is no way to recover the packets.) Also, before all the received packets are broadcasted, the next packets should arrive, so the delay and the transmission rate are very important points in the QoS.

Before setting the LSP, the bandwidth that will satisfy the MPEG data traffic should be decided. By looking at the MPEG size by its frames using histogram types, there are lots of frame sizes. To guarantee the bandwidth perfectly, one can configure the size to the biggest frame size. But this wastes a lot of bandwidth. Which will bring down the usage of the network.[5][6]

In video streaming, the application called 'buffering' is used. It receives amount packets before playing the movie. Therefore, while buffering, some delay wont matter. CIF size(320 240), which is used at the internet broadcasts, shows not much different at the quality of the movie, but if about 100Kbps ~250Kbps is guaranteed, the normal playing is possible. LSP should be fixed due to the type of video streaming and the size of it, and it should be classified in traffics. LSP does same role as the virtual line in ATM. This is the route for the same traffics, so there is no effect from other traffic. If the LSP is set at the routes between the routers, same value of traffic will be transferred only through that fixed LSP. Therefore, the change of packet sequence nor the delay will happen. The traffic engineering in MPLS, as RFC2702 tells us, satisfy the right QoS for the network, so the focus is to set at the measuring and the control of the traffic. By supporting the network data by classified traffic, one fulfills the users demand for the QoS. Even if the QoS, in video streaming, is high, the entire network can't be serviced in video streaming, the limit should be configured.[3][5][6][7]

Therefore, this paper set some user limits.

video streaming user control

entire bandwidth - B

- video streaming user limit by policy N : N >= N_vs
- each video streaming data bandwidth Bvs
- each video streaming Nodes : N-vs
- other traffic bandwidth = Betc
- available bandwidth = Ba

Ba = B–(Bvs×N_vs)–Betc, B>Bvs×N_vs comes out.

If Ba < Bvs and Betc > Bvs, no other video streaming data can be received, so by reducing Betc to Betc – (Bvs - Ba) , one can service the video streaming.

4. SIMULATION RESULT.

Fig. 2 is the network we will simulate. The link between router A and B is E1(2.048Mbps) and the rest other links are 10Mbps. In the matter of MPLS simulation, between the switch A and B becomes the MPLS domain and switch A and B becomes edge LSR.

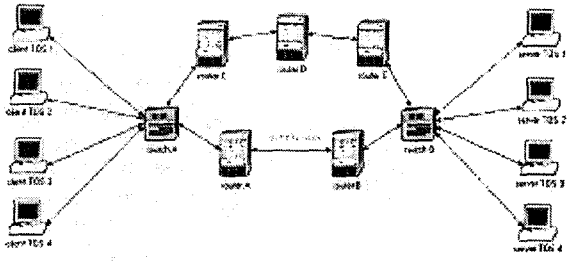

Fig. 2. Network for the simulation

For the IP network, it handles entire network same, every traffic is given the priority.(WFQ). However in MPLS, the video streaming gets the priority, so the CQ_LLQ service is set to give no delay and best transmitting process.

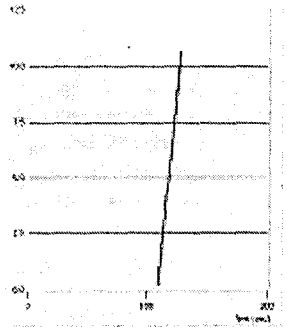

Fig. 3. Delay of IP Network

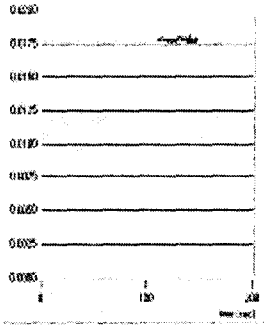

Fig. 4. Delay of MPLS

The figure 5 is comparison between the IP and MPLS network. As the traffic increase the MPLS transmission rate is also increased while IP network reduces.

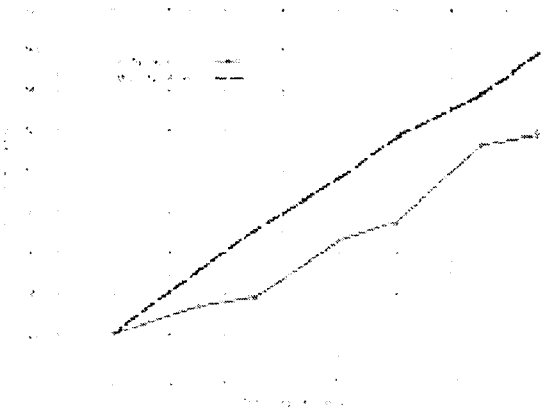

Fig. 5. Comparison of the rate between IP and MPLS

Figure 6 is the lost packets of both the MPLS and the IP network. Increased traffic is from the TCP and the packets after the buffering was set lost. Since it is TCP based, the errors were re-sent, so even at the increase of traffic the MPLS network has no lost of packets. However, the IP network, as the traffic increases bigger than the bandwidth can handle, the lost packets getts bigger rapidly.

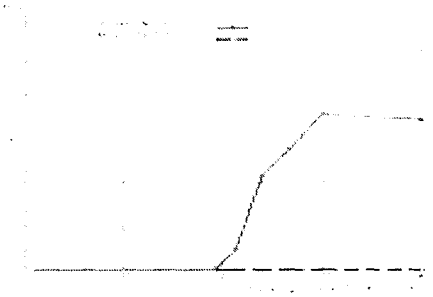

Fig. 6. Comparison of the lost packet between IP and MPLS

The figure 7 is the delay of the MPLS, As shown, even with bigger traffic there are no delays other than the buffering delays. However, in the IP network, as shown, the lost packets are getting a lot.

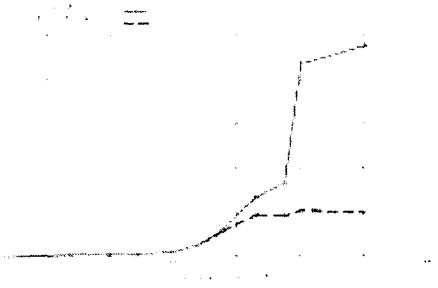

Fig. 7. Comparison of the delay between IP and MPLS

The figure 8 is comparing different policies in MPLS, High user policy sets lots of users and the low user policy sets less users. As shown in the figure if there are less users they show same progress but as the number of users increase the high user policy is better.

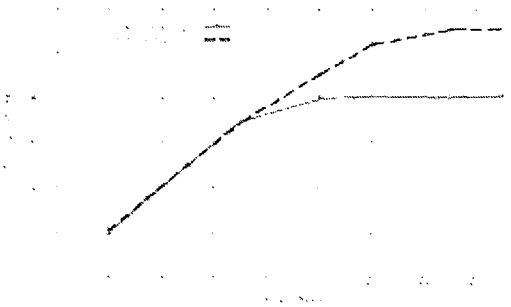

Fig. 8. Comparison different polices in MPLS

6. CONCLUSION

This paper talked about the better QoS in the traffic engineering and the traffic engineering in the transmission ways between the LSR. In MPLS, by analysing the traffic the bandwidth was set, and the right LSP for the bandwidth was set. Comparing to IP network, MPLS guaranteed better service in delays. Therefore the video streaming problem could be handled. The current IP network devides the bandwidth with no consideration of the character stic which brings the entire QoS down, but in MPLS by setting the users by policy, the QoS is guaranteed and by adjusting from other traffic the way to handle new users were told.

This paper showed answers to the delays but showed some waisting of the traffic. Also if the video streaming itself becomes different every time, the policies will bring problems. Therefore, the way to satisfying both the QoS guarantee and the bandwidth will be the next research subject

References

[1] A.Viswanathan, N.Feldman, Z.Wang, R.Callon, "Evolution of Multiprotocol Label Switching", *IEEE Communications Magazine*, p165~173, May 1998

[2] Xipeng Xiao, Alan Hannan, Brook Bailey, Lionel M. Ni, "Traffic Engineering with MPLS in the Internet" proceeding, *2000 IEEE*, March 2000

[3] R.Callon, P.Doolan, N.Feldman, A.Fredette, G.Swallow, A.Viswanathan, "A Framework for Multiprotocol Label Switching", *IETF Draft draft-ietf-mpls-framework-02.txt*

[4] Koushik Kar, Murali Kodialam, T.V.Lakshman, "Mininum Interface routing of Bandwidth Guaranteed tunnels with MPLS Traffic engineering Applications" , *Bell labs*, November 2000

[5] Tamrat Bayle, Reiji Aibara, Kouji Nishimura, "Performance Mesurements of MPLS Traffic Engineering and QoS", *isoc conferences 2001*

[6] Murwan Krunz, Satish K. Tripathi , "On the Characterization of VBR MPEG Streams", *ACM Sigmetrics conference May, 1997*

[7] D. Awduche, J. Malcolm, J. Agogbua, M. O'Dell, J. McManus "Requirements for Traffic Engineering Over MPLS", *RFC2702.*