A NOVEL TOKEN BASED APPROACH TOWARDS PACKET LOSS CONTROL

Ravindra Ramchandra Sonawane[1], G Varalaxmi[2]

[1]Student, [2]Associate professor, Department of CSE, ATRI, Andhra Pradesh, India
ravindrasonawane0681@gmail.com**, **varacse@gmail.com

Abstract

Due to the advent of technologies like Web 2.0, the Internet applications are able to support transmission of multimedia content to end users. In such applications the transmission might result in packet loss as well. In this context, it is essential to have packet loss control mechanisms that can avoid deterioration of quality of services while rendering media rich content. The quality of service in this case depends on congestion control. Many protocols have been introduced in order to supplement the standard TCP protocol in order to control network congestion. The CSFQ which was built for fair service with open – loop controller has started deterioration in quality as P2P flows dominated Internet traffic of late. One of the closed loop congestion control known as Token-Based Congestion Control (TBCC) was able to restrict consuming resources and provide best service to end users. It monitors inter-domain traffic for trust relationships. Recently, Shi et al. presented a new mechanism known as Stable Token-Limited Congestion Control (STLCC) for controlling inter-domain congestion and improve network performance. In this paper we implement the STLCC mechanism. We built a prototype application that demonstrates the proof of concept. The experimental results revealed that the proposed application is able to control network congestion by controlling packet loss thus improving performance of network.

Keywords – *Networking, packet loss control, data gram, packet, TCP, congestion control*

---***---

1. INTRODUCTION

Networks of all kinds support certain protocols. IP is one such protocol which is open for many networks. As it became very popular due to the success of Internet and its applications, IP is used in transferring voice data over Internet instead of traditional telephone networks. Voice over IP (VoIP) has become a well known technology for this purpose. It allows transferring voice and also data over IP protocol in Internet. However, congestion is the problem in all networks. Congestion control mechanisms play important role in all networks for quality of service. In case of packet switching networks, congestion control is like cornerstone in such applications [1]. The congestion control mechanisms can prevent congestion collapse, loss of packets and delay in service. Lot of research was found in the literature in this area [2], [3], and [4]. There are many network architectures that are used in various networks [5], [6], [7], [8], [9], [10]. In case of telecommunication networks, congestion control mechanisms suffer from two problems which have not yet been completely. The first problem is time-varying delay while he second one is that the feedback signals are not strictly followed by traffic sources. This is because the traffic sources are silent when they have nothing in hand for data transmission. In this case, the congestion control is best effort service available over networks to avoid problems like packet loss, congestion and delay in service.

Internet was originally built for cooperative communications. The communications over Internet depend on the congestion control mechanisms provided by TCP [11]. Terminal Dependent Congestion Control is the model used in the Internet. The routers over Internet are provided with Active Queue Management (AQM) [12] which can improve transport performance. However, they are not able to control congestion properly. There was a need for improving fairness in high speed networks [13]. The open loop control system inserts label of flow arrival into packet header which helps in routing process. The Core-Stateless Fair Queuing (CSFQ) is the mechanism which achieved the first solution to allocate fair bandwidth allocation at core routers based on the label in order avoids congestion. Over Internet 60% traffic is flows as per the survey made in 2004. Out of that only Bit-Torrent [14] caused 30%. This is because P2P networks are overlay networks that became very popular over Internet. These networks provide targeted services to meet the specific requirements of end users. Congestion control is very essential in such applications for many reasons.

Many congestion control mechanisms came into existence. In this paper we implement Stable Token Limited Congestion Control which will make use of limited tokens in order to reduce congestion. We built a prototype application that demonstrates the proof of concept. The empirical results are encouraging. The remainder of the paper is structured as follows. Section II reviews literature. Section III provides details of the propose work in this paper. Section IV presents results of experiments while section V concludes the paper.

2. RELATED WORKS

Token Based Congestion Control was explored in [15] which restrict the tokens consumed by end users while making communications over network. Later on in [16] self – Verifying CSFQ extended CSFQ in order to improve the performance. It chooses a flow and estimates the flows and then takes steps to retransmit data without causing delay. In [17] and [18] congestion control architecture is built which is based on Re-feedback with fixed cost. It reduces congestion over network to improve performance of the network. However, very high level of complexity is required by the Re-feedback approach in order to apply it. Inter-domain interconnection policies are of three types. They include transit, private peering and Internet Exchange Points. The sender keep all concept is used in private peering policies. Congestion charges are the based for Re-feedback. For congestion control in this paper a better approach is followed. The aim of this paper to control packet loss by reducing congestion thereby improving overall performance of network In the new method, quality is guaranteed while transmitting data. The core and edge routers are used in the application. The routers write a digital number in the option field of packet. This is known as token. However, the tokens are limited. This token is important and used by the routers in order to interpret edge point of given source and will organize the traffic based on the source. This will reduce the congestion on the path. In case of Token-Limited Congestion Control (TLCC) [19] there is restriction imposed by inter-domain routers. When the threshold is exceeded by the output token rate, the token level of output packets is decreased by TLCC thus increasing output token rate. TLCC is similar to TBCC and CSFQ congestion control is estimated for long period to find out a stable rate. When there is bad configuration, TLCC may cause the traffic to be deteriorated so as to make bad performance. The TCP window size flows when packets are received and therefore the level of congestion increased in the link. When there is congestion the flows lose packets. Once that is over the link is kept idle as the congestion level decreases.
The two steps might be repeated and may cause the congestion control not to reach the stability state.

3. PROPOSED CONGESTION CONTROL MECHANISM

In order to overcome the problem specified in the previous section, the STLCC has been introduced. It makes uses of algorithms such as XCP and TLCC together. As per the algorithm the rate of output is controlled in case of STLCC. Access token resources are allocated by edge routers for flows coming into network. When there is congestion, the incoming rate increases at core router thereby increasing congestion level. STLCC can measure the level of congestion automatically and take necessary steps to reduce congestion. For doing this, the network resources are allocated by STLCC and keep the congestion stable. In order to achieve congestion control, the inter-domain routers limit the number of tokens by monitoring the incoming token rate. IN order to restrict the output token rate, the tkbackdown, tkdown, and tkprev are the elements used in order to keep additional data into the header field. The tkprev is set at the source edge router who value is same as that of tklevel. This value can't be altered by routers. The tkdown is used to represent decrements in token level at the routers as part of the transmission in the path. When packets arrive at destination, the tkpath and tkdown are combined and the congestion index is found. In order to return the elements the tkbackdown is kept in reverse packet and the tkdown is kept in forwarding packet header that goes to the source edge router.

4. IMPLEMENTATION AND RESULTS

We built a prototype application in order to demonstrate the proof of concept which controls the congestion and improves the overall performance of the network. The environment used to build the application is a PC with 4 GB RAM, core 2 dual processor running Windows 7 operating system. The application is a simulation of the concept of edge routers, core routers and peers that involved in communication. The STLCC mechanism has been implemented for reducing packet loss and delay. Figure 1 shows the typical peer in the network which is capable of sending data to other peers.

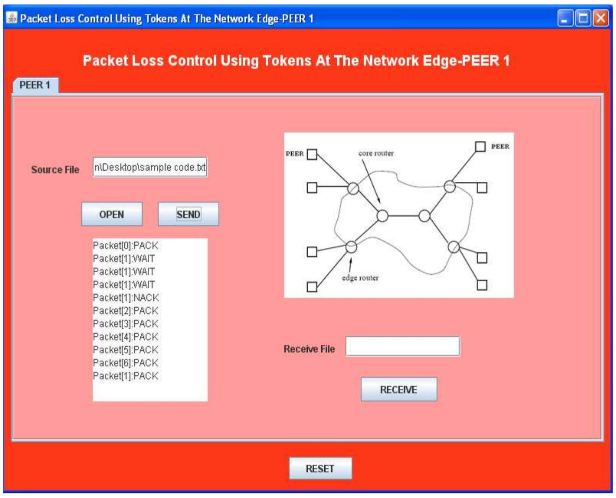

Fig. 1 – Peer interface

As can be seen in figure 1, the peer is capable of choosing data and divides the data into various packets and sends it to destination. It also can receive the response and present it to the end user. First of all the data goes to core router. The core router sends the data through edge routers.

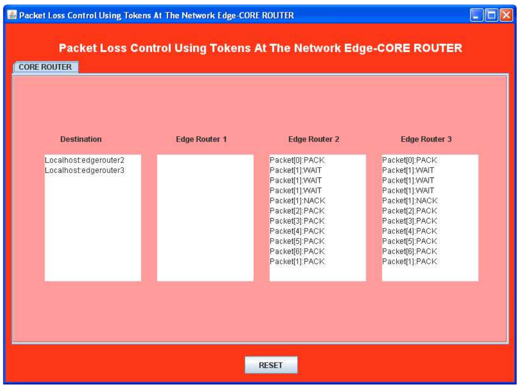

Fig. 2 – Core Router Interface

As can be seen in figure 2, the core router interface which sends data though edge router 2 and edge router 3. The packets are sent through these routers before reaching the destination node.

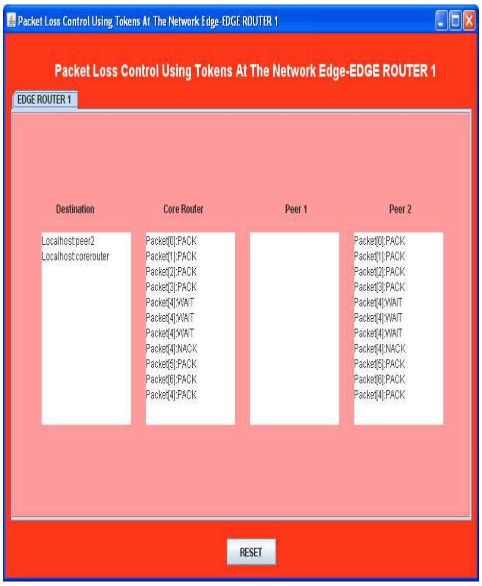

Fig. 3 – Typical Edge Router Interface

As can be seen in figure 3, the edge router is sends data to other peers. The data can go to many peers and the intended peers can get the information. The response can go back to the original peer which has originated the communication.

CONCLUSIONS

In this paper we focused on the problem of network congestion. As the networks are supposed to support multimedia content, congestion is very important area of research. Many solutions came into existence to reduce congestion, to increase network performance and reduce delay in communication. Reducing packet loss is the main aim of this work. We use the technique known as STLCC [6] which monitors inter-domain congestion rate and controls it in order to improve the performance of network. The congestion control mechanism implemented in this paper is better than previous methods such as TBCC. We built a prototype application that demonstrates the proof of concept. The experimental results revealed that the proposed application is able to control network congestion by controlling packet loss thus improving performance of network.

REFERENCES

[1] Z. Shi, D. Ionescu and D. Zhang , “Packet Loss Control Using Tokens at the Network Edge ”, IEEE LATIN AMERICA TRANSACTIONS, VOL. 10, NO. 1, JAN. 2012.
[2] S. H. Low and D. E. Lapsey, “Optimization flow control—I: Basic al- gorithms and convergence,” IEEE/ACM Trans. Networking, vol.7, pp. 861–874, Dec. 1999.
[3] L. Benmohamed and S. M. Meerkov, “Feedback control of congestion in packet switching networks: The case of a single congested node,” IEEE/ACM Trans. Networking, vol. 1, pp. 693–708, Dec. 1993.
[4] E. Altman, T. Basar, and R. Srikant, “Control methods for communica- tion networks,” in Proc. 36th Conf. Decision and Control, San Diego, CA, 1997, pp. TA 31774–1809, TM3 2368–2404, TP3 2903–2945.
[5] S. Mascolo, D. Cavendish, and M. Gerla, “ATM rate-based congestion control using a Smith predictor: An EPRC implementation,” in Proc. IEEE INFOCOM’96, San Francisco, CA, 1996, pp. 569–576.
[6] Z. Shi, D. Ionescu and D. Zhang, “Packet Loss Control Using Tokens at the Network Edge”, IEEE, vol. 10, no. 1, Jan 2012
[7] Y. Zhao, S. Q. Li, and S. Sigarto, “A linear dynamic model for design of stable explicit-rate ABR control schemes,” in Proc. IEEE INFOCOM, Kobe, Japan, Apr. 1997, pp. 283–292.
[8] N. Ghani and J. W. Mark, “Enhanced distributed explicit rate allocation for ABR services in ATM networks,” IEEE/ACM Trans. Networking, vol. 7, pp. 710–723, Oct. 1999
[9] S. J. Golestani and S. Bhattacharyya, “A class of end-to-end congestion- control algorithms for the Internet,” in Proc. Int. Conf. Network Protocols (ICNP), Austin, TX, Oct. 1998, pp. 137–150.
[10] S. Kalyanaraman, R. Jain, R. Goyal, S. Fahmy, and B. Vandalore, “The ERICA switch algorithm for ABR traffic management in ATM networks,” IEEE/ACM Trans. Networking, vol. 8, pp. 87–98, Feb. 2000.
[11] Andrew S. Tanenbaum, Computer Networks, Prentice-HallInternational, Inc.
[12] S. Floyd and V. Jacobson. Random Early Detection Gateways for Congestion Avoidance, ACM/IEEE Transactions on Networking, August 1993.
[13] Ion Stoica, Scott Shenker, Hui Zhang, "Core-Stateless Fair Queueing: A Scalable Architecture to Approximate Fair Bandwidth Allocations in High Speed Networks", In Proc. of SIGCOMM, 1998.

[14] D. Qiu and R. Srikant. Modeling and performance analysis of BitTorrent-like peer-to-peer networks In Proc. of SIGCOMM, 2004
[15] Zhiqiang Shi, Token-based congestion control: Achieving fair resource allocations in P2P networks, Innovations in NGN: Future Network and Services, 2008. K-INGN 2008. First ITU-T Kaleidoscope Academic Conference
[16] I. Stoica, H. Zhang, S. Shenker , Self-Verifying CSFQ, in Proceedings of INFOCOM, 2002.
[17] Bob Briscoe,Re-feedback:Freedom with Accountability for Causing Congestion in a Connectionles ethttp://www.cs.ucl.ac.uk/staff/B.Briscoe/ projects/e2ephd/e2ephd_y9_cutdown_appxs.pdf
[18] Bob Briscoe, Policing Congestion Response in an Internetwork using Refeedback, In Proc. ACM SIGGCOMM05, 2005,
[19] Zhiqiang Shi, Yuansong Qiao, Zhimei Wu, Congestion Control with the Fixed Cost at the Domain Border, Future Computer and Communication (ICFCC), 2010.