Performance improvement on TCP with fuzzy theory

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ABSTRACT

TCP is one of the most popular protocols used in the Internet. In order to detect the capacity of a TCP connection, the TCP Reno algorithm increases the transmit packets that are not acknowledged during a round trip time when there is no loss packet during the last round trip time. However, when a lost packet was detected by the TCP Reno transmitter, the TCP Reno algorithm will decrease the congestion window by half. This behavior results in the performance degradation of a TCP Reno connection periodically. In order to improve the performance of TCP Reno, this thesis proposes a congestion window control algorithm based on the fuzzy theory, which is termed Fuzzy Reno. Fuzzy Reno modifies the operations of slow start and congestion avoidance phases. In the slow start phase, Fuzzy Reno calculates the slow start threshold with the round trip time and the arrival times of ACK packets. In congestion avoidance phase, Fuzzy Reno adopts the fuzzy theory to control the congestion window. Two parameters are as the inputs of fuzzy machine. One is the ratio of the difference between the congestion window and the slow start threshold, the other is the difference between the last two round trip times. The simulation results show that our proposed Fuzzy Reno algorithm can increase the throughput faster than that of TCP Reno and Vegas algorithms in the slow start phase. It also maintains a stable congestion window size which is almost the same as that of TCP Vegas. Therefore, Fuzzy Reno outperforms the other TCP algorithm. Meanwhile, the Fuzzy Reno algorithm can distribute the bandwidth to multiple TCP connections fairly.

Keywords : TCP Reno、Congestion control、Congestion Window、Fuzzy Theory

Table of Contents

REFERENCES

[1]W. Stevens, “ TCP Slow Start, Congestion Avoidance, Fast Retransmit, and Fast Recovery Algorithms, ” RFC 2001, Jan. 1997.

[2]M. Mathis, J. Mahdavi, S. Floyd, A. Romanow, “ TCP Selective Acknowledgment Options, ” RFC 2018, Oct. 1996.

[3]M. Allman, V. Paxson, W. Stevens, “ TCP Congestion Control, ” RFC 2581, Apr. 1999.

[4]J. Postel, “ Transmission Control Protocol, ” RFC793, Sep. 1981.

[5]V. Jacobson “ Congestion Avoidance and Control ”, ACM SIGCOMM ‘ 88, 1988, Page(s) : 273-288.

[6]S. Floyd and T. Henderson, “ The NewReno Modification to TCP ’ s Fast Recovery Algorithm, ” RFC 2582, Apr. 1999.

[7]L. Brakmo, L. Peterson, “ TCP Vegas: End to End Congestion Avoidance on a Global Internet ”, IEEE Journal on Selected Areas in Communication, Vol.13, No.8, 1995, Page(s) : 1465 – 1480.

[8]H. Vahdat Nejad and M. Hossien Yaghmaee and H. Tabatabaee, “ Fuzzy TCP: Optimizing TCP Congestion Control ”, Asia-Pacific Communications Conference, 2006, Page(s) : 1 – 5.

[9]L. Hongfei and H. Jiuchuan and Z. Hongke, “ A TCP congestion control mechanism based on fuzzy logic for wireless LANs ”, Signal Processing International Conference, Vol.3, 2004, Page(s) : 1837 – 1840.

[10]W. Neng-Chung and H. Yung-Fa and L. Wei-Lun, “ A Fuzzy-Based Transport Protocol for Mobile Ad Hoc Networks ”, IEEE SUTC International Conference, 2008, Page(s) : 320 – 325.

[11]L. Fu and L. Xuefei and L.Wenhai, “ Research on TCP Protocol in Wireless Network and Network Simulation ”, Wireless Communications

Networking and Mobile Computing 4th International Conference, 2008, Page(s) : 1 – 4.
[12]H. Weina and H. Feifei and G. Pu and L. Yun and C. Qianbin, “ Improved TCP Reno Protocol based on RTT ”, Wireless Communications Networking and Mobile Computing 5th International Conference, 2009, Page(s) : 1 – 4.
[13]L. Zadeh, A., “ Fuzzy Sets ”, Informational and Control, Vol.8, 1965, Page(s) : 338 – 353.
[14]Network Simulator 2（NS2） http://www.isi.edu/nsnam/ns/ [15]王進德、蕭大全，類神經網路與模糊控制理論入門，第一版，台北市，全華科技圖書股份有限公司，1994 , 199-206頁。
[16]林泰邑，TCP Vegas-AQ:改善TCP Vegas效能的壅塞迴避演算法，大葉大學資訊工程研究所論文，民國96年。