International Journal of Engineering & Technology, 7 (2.12) (2018) 231-233

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research Paper



Fairness analysis of TCP variants in asymmetric network

Sukantkishoro Bisoy [1] *, Pradeep Kumar Mallick [2], Anjana Mishra [3]

[1] *Department of Computer Science and Engineering, C. V. Raman College of Engineering, Bhubaneswar 752054, Odisha, India*
[2] *Department of Computer Science & Engineering, Vignana Bharathi Institute of Technology, Hydrabad, India*
[3] *Department of Information Technology, C. V. Raman College of Engineering, Bhubaneswar 752054, Odisha, India*
**Corresponding author E-mail: sukantabisoyi@yahoo.com*

Abstract

Conservative nature of Vegas creates less opportunity to get fair share of bandwidth then Reno in wired network. On the other hand, aggressive nature of Reno helps to achieve more share of bandwidth. Both Reno and Vegas assumes that congestion occurs in the forward rather than in reverse path. In asymmetric network the path characteristics of forward and backward is different.
In this work, we propose a network model and analyzed the Inter-protocol fairness between TCP Reno and TCP Vegas with some queue management techniques such as Droptail and random early detection (RED) in asymmetric network where the forward and backward path has different characteristics. The simulation experiment results using NS2 indicates that use of RED can achieve better fairness than Droptail in asymmetric network.

Keywords: *Queue Management; Asymmetric Network; Fairness and NS2.*

1. Introduction

Congestion occurs in a network due to higher demand of Internet resources such as bandwidth than the capacity. To control congestion in the network, TCP adopts the network condition dynamically so as to adjust its window size. Several research works have done on TCP and its variants [1] [2]. Each TCP protocol Tahoe, Reno, Newreno and Vegas adopt different mechanism for controlling the congestion. Reno adopts additive increase and multiplicative decreases (AIMD) [3] to update their window size. With minor modification in sender side of Reno, the protocol Newrenohas beendeveloped [4]. The fast recovery algorithm is improved and incorporated in Newreno. Through its new algorithm, it could detect multiple packet loss in a single window and able to reduce transmission timeout events [5] which helps to work better in wireless environement where huge packet loss occurs. Protocol Vegas is different from Reno in measuring the congestion. It relies on delayby measuring the RTT of each packet sent rather than packet loss. Congestion brings long delays in delivering the data packets due to dropped packet [7]. Each router has some queue management technique to manage the packet passing through them. Traditional know technique Droptail was used in router to discards the incoming packets when the queue is full. However it creates global synchronization problem under heavy load condition[8] due to its passive nature.Hence active participation of router is required to actively manage the resources so that the congestion could be avoided. This is possible through the active queue management (AQM) [9] techniques which can intelligently drop the data packets before the queue going to be overflow. Random early detection (RED) [10] is the widely used AQM techniques recommended by Internet Engineering Task Force (IETF). Transmission control protocol (TCP) has been used as protocol for congestion control through window based mechanism.
The rest of the paper is organized as follows. Section 2 presents related work and section 3 explain the active queue management techniques and section 4 presents the simulation setup and section 5 will present result and analysis. At last, the conclusion of the work is provided in section 6.

2. Related work

The author [11] developed an enhanced congestion control mechanism for TCP Vegas able to correctly remove the undesired impact of reverse traffic on bandwidth sharing. Author in [12] analyzed the performance (throughput and fairness) of a network shared by Reno and Vegas in static multi-hop wireless ad hoc network. Impact of different queue management techniques such as random exponential marking (REM), adaptive virtual queue (AVQ) along with Droptail is analyzed with TCP variant in wired-cum-wireless networks[13] and then analyzed using delayed acknowledgement (DelACK) technique. In [14] the author analyzed the Inter-protocol fairness between Reno and Vegas in wired network focusing on many issues. For analysis Droptail and random early detection (RED) techniques are used as queue management techniques.

3. Active queue management(AQM)

AQM techniques avoid congestion by sending incipient congestion notification to the source before the congestion occurs. It aims to notify source about the congestionbefore the buffer gets filled. On the other way the receiver provides feedback to the source to intimate about level of the congestion. The feedback can be provided either by dropping the packets passing through itor marking the incoming packets selected by AQM router through ECN bit[15,16] in the IP header. Author in [17] developed a mechanism named fast congestion notification(FCN) to manage the buffer space of router efficiently and send feedback signal faster. One of the most popular widely used AQM techniques is random early detection (RED) and recommended by IETF [15]. It is widely used with TCPprotocol.

Copyright © 2018 SukantKishoro Bisoy et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

4. Simulation setup

In this section, we analyzed the fairness between Reno and Vegas in proposed asymmetric network using NS2 network simulator [18]. The proposed asymmetric network model isshown in Fig. 1 having two sources (S1 and S2) and two destinations (D1 and D2) connected through common asymmetric link. The source S1 is associated with Reno and S2 is associated with S2. In this, fairness between Reno and Vegas protocol is analyzed by varying common link (R1-R2) delay (d). Moreover, we used Droptail and RED as queue management techniques at router R1. We have considered bandwidth asymmetry to analyze the performance of Reno and Vegas together in same link by varying the parameter μ_r (Reverse link capacity). By using the ratio of μ_f(Forward link capacity) and μ_r, we found out the value of $k = {}^{\mu_f}/_{\mu_r}$. The reverse link capacity is set to different values: 2 Mbps (symmetric), 8, 16, 40, 80, 160 Kbps (asymmetric). Considering forward and reverse link bandwidth, we get the value of k to 0.5, 1, 2, 5, and 10. The buffer size is set to 50 packets. The data packet generated by the sender is 1000 bytes long and simulation time is 100 sec.

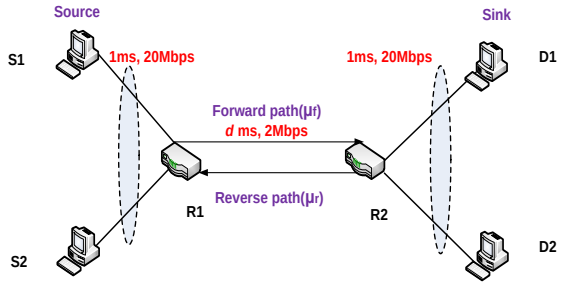


Fig. 1: Proposed Asymmetric Network Model.

5. Result and analysis

In this section, the simulation experiment results are presented using above proposed asymmetric network model shown in Fig.1. The fairness between Reno and Vegas are analyzed by finding throughput ratio between Reno and Vegas. To achieve the better fairness the through ratio is desired to be one.

In the first part, we analyzed the fairness (throughput ratio) between Reno and Vegas and the result is shown in Table 1. As depicted in Table 1,use of RED technique maintains better fairness between Reno and Vegas than Droptailtechnique for all k values. However, the better fairness can be achieved at k=1. In the second part the performance isanalyzed creating three different scenarios by measuring the total number of packet received. In the first scenario, both source S1 and S2 is associated with Reno and in the second scenario the S1 is associated with Reno and S2 is associated with Vegas. In the third scenario, both S1 and S2 are associated with Vegas. The result using for each scenariousing Doptailis shown in Fig.2 and using RED is shown in Fig.3. It is observed that when k=0.5 or 1.0 (non-asymmetric) the performance of Vegas is better than Reno. For asymmetric network (k more than 1) Reno performs better than Vegas. Moreover, use of RED technique enhances the performance in non-asymmetric network. However, performance of Vegas remains same for RED and Droptail.

Table 1: Throughput Ratio Reno(R)/ Vegas (V)

	Reno(R)/Vegas(V)					
k=10 (μ_r=8Kbps)	d=1ms	d=12ms	d=16ms	d=32ms	d=64ms	d=128ms
Droptail	9.570881	9.570881	9.501992	6.409704	4.889888	3.962376
RED	9.543933	9.543933	9.543933	9.448133	4.917647	3.962376
k=5(μ_r=16Kbps)						
Droptail	7.329412	6.8754	6.510029	4.93076	3.9801	3.976
RED	9.726496	9.726496	9.722222	4.934911	3.9801	3.976
k=2(μ_r=40Kbps)						
Droptail	4.936481	4.950547	4.9785	3.988423	3.992786	1.008444
RED	4.982322	4.981844	4.977544	3.988423	3.992786	1.008444
k=0.5(μ_r=160Kbps)						
Droptail	3.455675	3.566098	3.994021	3.996281	1.00411	1.007048
RED	1.308542	1.286492	1.103083	1.240038	1.265518	1.030227
k=1(μ_r=80Kbps)						
Droptail	3.45531	4.852067	3.994638	3.995868	1.003782	1.006281
RED	1.211017	1.327984	1.164478	1.219801	1.192909	1.029617

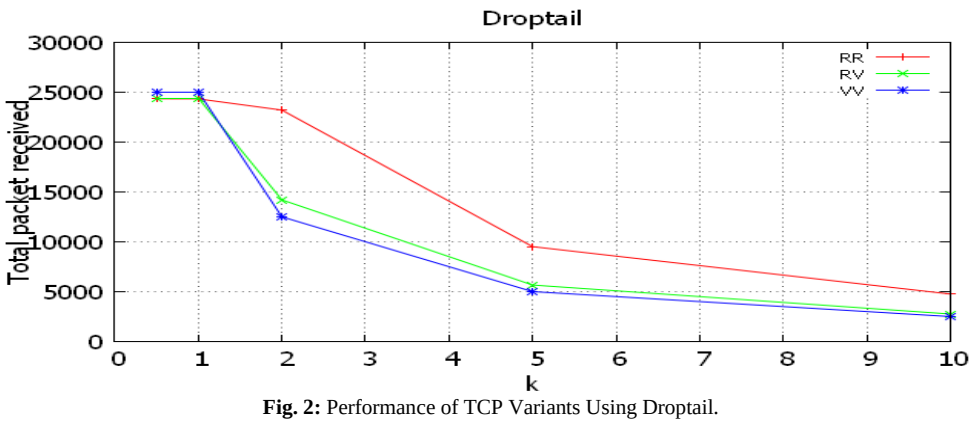


Fig. 2: Performance of TCP Variants Using Droptail.

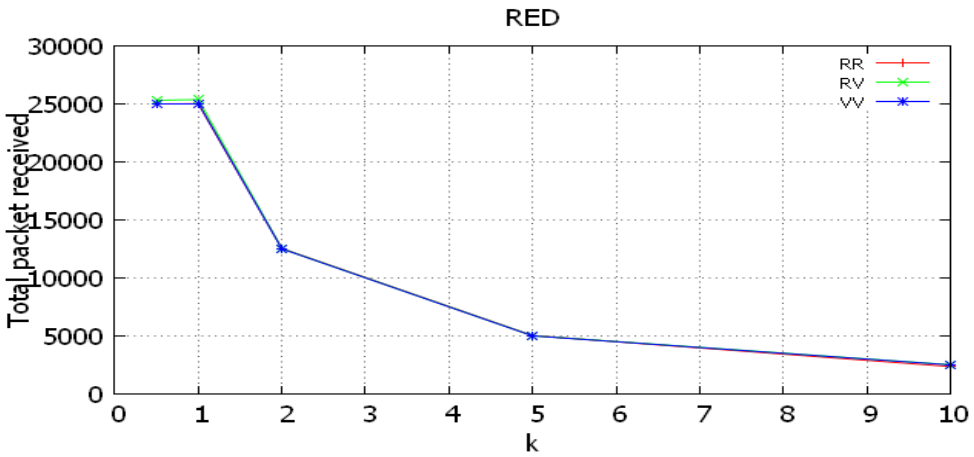


Fig. 3: Performance of TCP Variants Using RED.

6. Conclusions

In this paper, the fairness analysis of TCP variant protocols such as Reno and Vegas is analyzed in asymmetric network where forward and backward path have different characteristics. For analysis, we have considered Droptail and RED as queue management techniques. NS2 network simulator is used to analyze the performance of these protocols.

The results using NS2 network simulator shows that use of RED technique improves the fairness between Reno and Vegas in asymmetric network

References

[1] Jacobson, V.:Modified TCP Congestion Avoidance Algorithm, Technical Report, (1990).

[2] Jacobson, V.: Congestion avoidance and control. Computer Communication Review, Vol. 18, No. 4, pp.314–329 (1998).

[3] Chiu, D. and Jain, R.: Analysis of the increase and decrease algorithms for congestion avoidance in computer networks,Computer Networks and ISDN Systems, Vol. 17, No. 1, pp.1–14 (1989).

[4] Hoe, J.:Start-up Dynamics of TCP's Congestion Control and Avoidance Scheme, Dissertation in partial fulfillment ofthe requirements for the degree of Master of Science, MIT, Massachusetts Ave, Cambridge, USA (1995).

[5] Floyd, S., Henderson, T. and Gurtov, A.:The NewReno Modification to TCP's Fast Recovery Algorithm, RFC 3782 (2004).

[6] Brakmo, L.S., O'Malley, S.W. and Peterson, L.L.: TCP Vegas: new techniques for congestion detection and avoidance. In: Proc. of ACM SIGCOMM'94, ACM, New York, USA, pp.24–35 (1994).

[7] Jacobson, V.: Congestion avoidance and control. Computer Communication Review, 18 (4), pp. 314-329 (1988).

[8] Zhang, L., Shenker, S., Clark, D.D.: Observations on the dynamics of a congestion control algorithm: the effects of two-way traffic. In: Proc. of ACM SIGCOMM '91, Zurich, Switzerland, September 03–06, pp. 133–147 (1991).

[9] Braden, B., Clark, D., Crowcroft, J. et al.: Recommendations on queue management and congestion avoidance in the Internet, RFC2309 (1998).

[10] Floyd, S., Jacobson, V.: Random early detection gateways for congestion avoidance. IEEE/ACM Transactions on Networking, Vol. 1, No. 4, pp. 397–413 (1993).

[11] Alonso, S.H., P´erez, M.R, Gonz´alez, A.S., Veiga, M.F., and Garc´ıa, C.L.: Improving TCP Vegas Fairness in Presence of Backward Traffic. IEEE COMMUNICATIONS LETTERS, VOL. 11, NO. 3, pp. 273-275(2007).

[12] Bisoy, S.K., Pattnaik, P.K.: Throughput of a Network Shared by TCP Reno and TCP Vegas in Static Multi-hop Wireless Network. In: Proc. of Springer ICCIDM 2015, Vol.1, pp.471-481 (2015).

[13] Bisoy, S.K., Pati, B., Panigrahi, C.R.: Analysis of TCP Variant Protocol Using Active Queue Management Techniques in Wired-Cum-Wireless Network. In: Proc. of Springer ICCIDM2017, pp. 439-448 (2017).

[14] Bisoy, S.K., Pattnaik, P.K.: Fairness between TCP Reno and TCP Vegas in Wired and Wireless Network. International Journal of Computational Systems Engineering, Vol.3, No.1, pp.14-26 (2017).

[15] Floyd, S.: TCP and explicit congestion notification. ACM Computer Communication Review, Vol. 24, No. 5, pp. 10-23 1994.

[16] Ramakrishnan, K., Floyd, S.: A proposal to add Explicit Congestion Notification (ECN) to IP.RFC 2481, (1999).

[17] Mohammed, M., Kadhum, M., Hassan, S.: A new congestion management mechanism for next generation routers. Journal of engineering science and technology, Vol.3, No. 3, pp. 265-271 (2008).

[18] NS-2, the ns Manual (formally known as NS Documentation) available at http: //www. isi.edu/nsnam/ns/doc.