

A QSPS-PSR APPROACH ON DIFFERENTIATED TCP FLOWS FOR INTERNET TRAFFIC

S.Arumugam¹, M.Chandrasekaran², Y.Suresh³, J.Senthilkumar⁴ & V.Mohanraj⁵

According to the recent Internet traffic measurements the majority of the TCP flows are short lived. Use of short flow highest priority scheduling provides the performance improvement in the internet traffic. However, long lived flows competing against the short flows starve at some point. We propose a novel two class Queue State Packet Scheduling mechanism, namely QSPS which treats long flows fairly without degrading the performance of short flows. We studied the performance of long flows competing against short flows and our results are more efficient than the short flow highest priority scheduling. We observe that the mean transmission time and the loss rate of short flows are significantly reduced.

Keywords: Internet Traffic, TCP Flows, QSPS-PSR

1. INTRODUCTION

TCP is the most widely used dominant protocol in the internet. TCP carries 95% of the today's internet traffic and constitutes 80% of the total number of flows in the internet [1]. A Flow is defined as a packet with the common set of attributes such as source address, destination address, source port and destination port. One of the most important mechanism to provide service guarantee is scheduling. From the queuing theory point of view, it has been shown choosing an appropriate scheduling policy may significantly improves the performance of the system. Scheduling determines the order in which the packets from the different flows are served. Most of the user interactions with a network or with applications varying across the network consist either entirely of short interchanges or of short interchanges followed by a long flow. Long lived flows have been to hurt short lived flows in terms of throughput and end to end delay. Long lived flows occupy most of the buffer space and hence create large queuing delay.

Empirical studies[2] shows that the internet traffic consist of many short flows 10-20 packets on average and few very large flows that contain a large fraction of packets. The studies in [3-6] show that short flows should be given highest priority over the long flows. The goal of our work is to study the alternating scheduling policy in order to improve the overall performance of TCP flows without degrading the performance of short flows.

2. LITERATURE SURVEY

Threshold based two queue approaches has been proposed [3],[7] that gives highest service priority to the short flows only. TCP flows are differentiated as short and long flows using a threshold value and short flows are enqueued in one queue and remaining long flows are enqueued in the second queue. Service priority is given to the first queue in First In First Out (FIFO) discipline and the second queue are only served if the first queue is empty. This approach reduces the mean transfer time however leads to starvation of long flows. In RuN2C[4], using TCP sequence number the packets are put in first queue or second queue. Limitation of this protocol is TCP sequence number should start from a set of possible initial numbers and would lead to security problems such as IP address spoofing and session hijacking[3].

In LAS[5], the next packet to be served is one belonging to the flow that has received the least amount of service. The long lived TCP flows competing against short TCP flows shows starvation in LAS. LAS reduces the loss rate for the short flows and approximately doubles the loss rate of long flows as compared with the loss rate under FIFO.

Another protocol Context Aware Transport/Network Internet protocol (CATNIP) [8] requires application layer information, the web document size to provide explicit context information to the TCP and IP protocol. Aiming at these issues, a novel two class Queue State Packet Scheduling (QSPS) is proposed. In this we use Packet Scheduling Ratio (PSR) to schedule short and long flows respectively. Packets are differentiated as short flow and long flow using a threshold value and placed in two separate queues. Using PSR value, service assignment is given to the packets in the two queues. This shows that the long flows in the second queue would not be starved since the queue does not have strict priority over the second queue.

¹CEO, Nandha Engineering College, Erode, India

²Professor / ECE, Govt. College of Engineering , Salem, India.

^{3,4,5}Asst.Professor / IT , Sona College of Technology Salem, India
Email: shuresh_22@yahoo.co.in, jsen_thil@yahoo.co.in, mohanarveen@hotmail.com

3. PROPOSED APPROACH

Proposed scheduling mechanism QSPS is suitable across varying traffic flows. Differentiation between short and long flows is as follows. Short flows are those with flow size less than threshold th and long flows otherwise. Flow size is the total packets or bytes of the flows. First th packets of a flow are placed in one queue and remaining packets are placed in another queue. Unlike short flow highest priority scheduling, we use Packet Scheduling Ratio (PSR) to schedule packets in two queues. PSR decides the number of packets or bytes to be served in each queue. PSR schedules a packet of short flow when scheduling one packet of long flow. Although QSPS with PSR will always gives highest priority to short flows by offering them larger speedup, the long flows still hold a fraction of service thus flows would not be starved. Short flow highest priority scheduling approach degrades the performance of long flows too much while QSPS still treats them fairly.

3.1. Illustration of Our QSPS –PSR Approach

For our illustration, we considered the threshold value th as 3 packets and Packet Scheduling Ratio as 3. At the time of scheduling, router checks number of flows and here we assumed the number of flows as 4 with flow label F_1 (3 packets), F_2 (2 packets), F_3 (4 packets) and F_4 (4 packets). First, router checks the number of packets available in each flow and classifies them and en queues to either First Priority Queue or Fair Priority Queue based on the threshold value. The figure 1 shows the Queue State at time point T_1 .

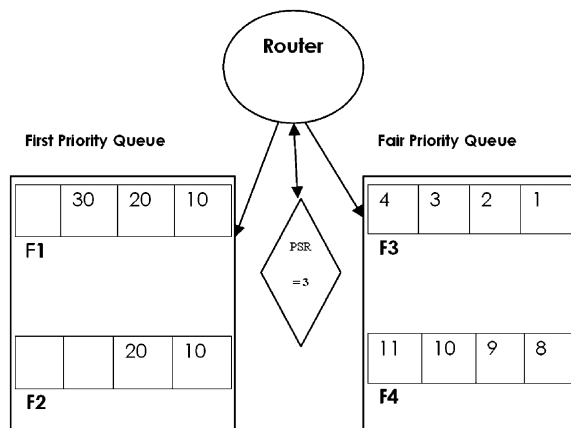


Fig. 1: Queue State at T_1 with PSR = 3 and $th = 3$

In the next step, Router de queues the packet from First Priority Queue and Fair Priority Queue based on the packet scheduling ratio. Here it is taken as 3. i.e Router delivers one packet from long flow for every 3 packet delivery of short flow. So, router de queues 3 packet of F_1 and one packet of F_3 . Now, consider the Queue State at time point T_2 as shown in Fig.2. Here, We observed that F_1 and F_2 short flows in time point T_1 are become long flows in time point T_2 .

Similarly, F_3 and F_4 are short flows in time point T_2 . So, same flow can participate in First Priority Queue as well as Fair Priority Queue at different time point. This is the reason why our approach achieves excellent mean transmission time and also treats the long flow fairly.

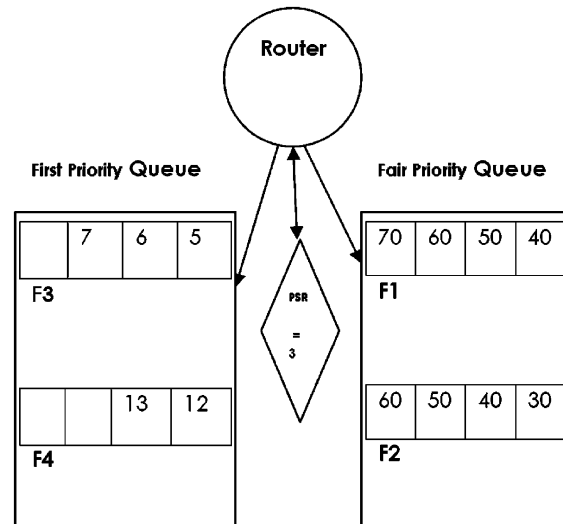


Fig. 2: Queue State of 12 with PSR = 3 and $th = 3$

For our implementation, we implement Flow List for each queue group. For each flow, we maintain 3 tuple of information such as Flow Label, Number of packets in buffer and number of bytes scheduled when that flow is in First Priority Queue in the flow list.

4. SIMULATION

The network topology shown in figure 3 is used to evaluate QSPS-PSR. This model was first introduced in [12].

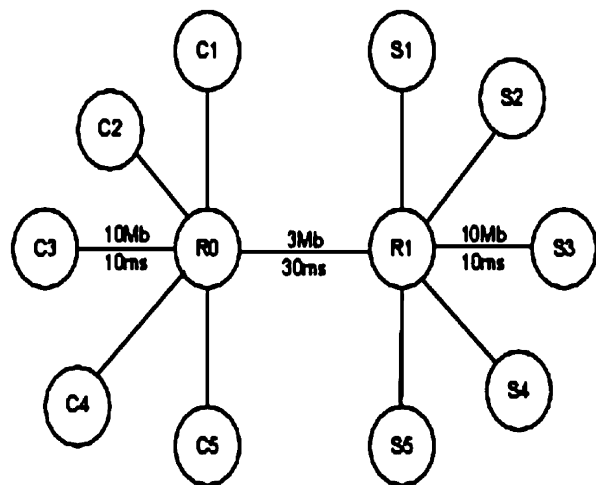


Fig. 3: Network Topology

Here a pool of clients requests web objects from a pool of servers. During each request a new TCP connection is established. Here we refer to the packets that belonging to

one TCP connection as a flow. During Similar to the previous studies [10],[11]. We use 60 second flow time out to decide that if an idle flow has terminated and to clear the state flow information.

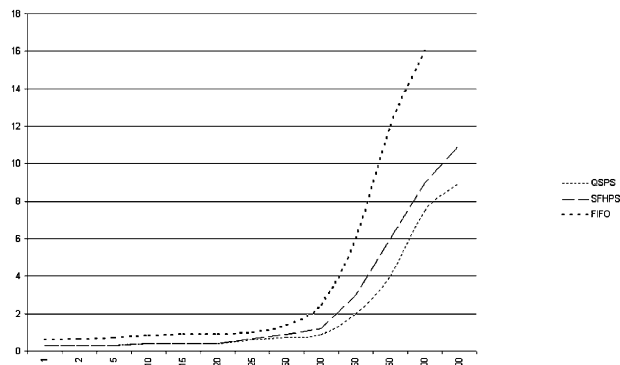


Fig.4: FlowSize Vs Mean Transmission Time

The transmission time of a flow is the time interval starting when a first packet of a flow leaves a server and ending when the last packet of the flow is received by the corresponding client. It is evident from the figure 4 that QSPS approach reduces the mean transmission time compared to the simple FIFO and Short Flow Highest Priority(SFHP) scheduling. The transmission time of short flow highest priority scheduling and QSPS are almost same upto the threshold and QSPS approach improves the performance for the larger flows.

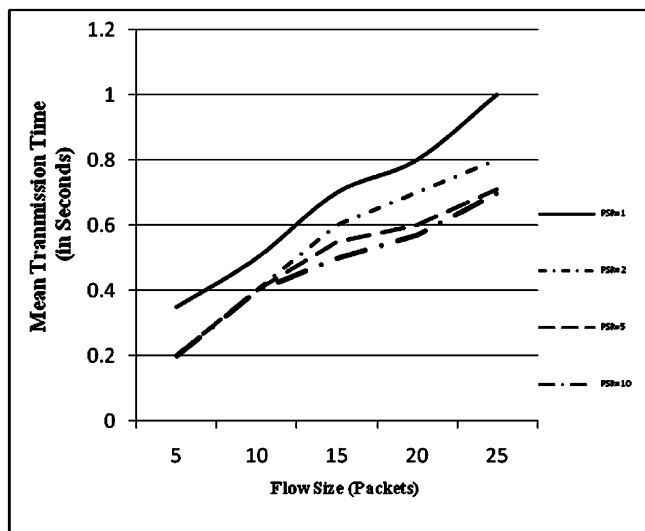


Fig.5: Flow Size Vs Mean Transmission Time

Figure 5, depicts the mean transmission time of flows using various Packet Scheduling Ratio (PSR) values. PSR =1 increases the mean transmission time because the packets in two queues are served with equal priority. When PSR value is increased to 2, the mean transmission time reduces and it is for PSR=5 also. But when PSR=10, the mean transmission time is almost same as PSR=5. This shows that

by selecting an optimal value of PSR, the mean transmission time reduces which treats the flows fairly.

5. CONCLUSION

Scheduling has been known for several years and attention has been given to use scheduling for the packet switched networks. This paper presented a Queue State Packet Scheduling QSPS approach to treat long flows fairly. Unlike other scheduling approaches, the TCP flows are scheduled with the Packet Scheduling Ratio and an optimum value of this ratio treats the long flows fairly without hurting the short flows performance. In the future, we would like to tune the packet scheduling ratio dynamically based on how many times a particular flow participated in the first priority Queue.

REFERENCES

- [1] M. Mellia, I.Stocia, and H.Zhang, "TCP Model For Short Lived Flows", IEEE Communications Letters, Feb2002.
- [2] K. Claffy, G. Miller, and K. Thompson. "The Nature of the Best: Recent Measurements from an Internet Backbone", In Proceedings. of INET, July, 1998.
- [3] X. Chen and J. Heidemann, "Preferential Treatment for Short Flows to Reduce Web Latency," Computer Networks: The International Journal of Computer and Telecommunications Networking, 41, No. 6:779-794, 2003.
- [4] K. Avrachenkov, U. Ayesta, P. Brown, and E. Nyberg, "Differentiation between Short and Long TCP Flows: Predictability of the Response Time," in Proc. IEEE INFOCOM, March 2004.
- [5] I. A. Rai, E. W. Biersack, and G. Urvoy-Keller, "Size-based Scheduling to Improve the Performance of Short TCP Flows," IEEE Network, January/February 2005.
- [6] M. E. Crovella and A. Bestavros, "Self-similarity in World Wide Web Traffic: Evidence and Possible Causes," IEEE/ACM Trans. Networking, 5, No. 6, pp. 835-846, December 1997.
- [7] L.Guo and I.Matta, "The War between Mice and Elephants", In Proc. 9th IEEE International Conference on Network Protocols (ICNP), Riverside, CA, 2001.
- [8] C. Williamson and Q. Wu, "A Case for Context-. Aware TCP/IP", ACM Performance Evaluation Review, 29, No. 4, pp. 11-23, March 2002.
- [9] A. Broido, Y. Hyun, R. Gao, and K. Claffy, "Their Share: Diversity and Disparity in IP Traffic," in Proc. PAM, 2004.
- [10] C.Estan and G.Varghese, "New Directions in Traffic Measurement and Accounting", In Proceedings of ACM SIGCOMM Internet Measurement Workshop 2001, SanFrancisco Bay Area, Nov 2001.
- [11] Yin Zhang, Lee Breslau, Vern Paxson and Scott Shenker "On the Characteristics and Origins of Internet Flow Rates". In SIGCOMM, Pittsburgh, PA, USA, Aug 2002. IEEE.
- [12] A.Fedelman, A.Gilbert, P.Huang, and W.Willinger, "Dynamics of IP Traffic: A Study of the Role of Variability and the Impack of Control", In. Proceedings of ACM SIGCOMM, August1999.