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A Survey on AQM Control Mechanism for TCP/IP Flow

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Abstract— since its formal introduction to IP networks in 1993 as a viable complementary approach for congestion control, there has been a steady stream of research output with respect to Active Queue Management (AQM). This survey attempts to travel the trajectory of AQM research from 1993 with the first algorithm, Random Early Detection (RED), to current work in 2011. In this survey we discuss the general attributes of AQM schemes, and the design approaches taken such as heuristic, control-theoretic and deterministic optimization. Of interest is the role of AQM in QoS provisioning particularly in the Diff Serve context, as well as the role of AQM in the wireless domain. For each section, example algorithms from the research literature are presented.
Keywords— Network; Queue; Congestion; AQM

I. INTRODUCTION

The traditional role of Active Queue Management (AQM) in IP networks was to complement the work of end-system protocols such as the Transmission Control Protocol (TCP) in congestion control so as to increase network utilization, and limit packet loss and delay. During the earlier days of IP networks, the network traffic consisted mainly of bulk data transfers. The volume of web traffic was gradually increasing. The first formal and full proposal of an AQM scheme was Random Early Detection (RED), introduced by [4] in 1993. What followed was a plethora of AQM schemes proposed in the research literature, many of which sort to improve upon the RED algorithm itself in one aspect or another. There were, however, AQM schemes that were completely new. Additionally, there was also work that consisted primarily of a rigorous analysis of RED and which consequently highlighted its drawbacks. Queue Management in routers plays an important role in taking care of congestion. Two approaches are adopted to solve this problem. First one is Congestion Avoidance preventive technique, which comes into play before network is congested by overloading. Second is Congestion Control, which comes into play after congestion at a network has occurred and the network is overloaded.

II. ACTIVE QUEUE MANAGEMENT

Active Queue Management (AQM) policies attempt to estimate the congestion at a node and signal by dropping packet(s) before the buffer is full. A responsive congestion control strategy then reduces its transmission rate. This helps in avoiding further congestion and is expected to reduce the packet loss rate and keep the average queue size low. When packets are dropped aggressively, the capacity of the node may remain underutilized. An AQM policy thus has two components; one component estimates the congestion and another component takes the packet drop decision. The performance, therefore, depends upon how aggressive or conservative the estimation of the congestion is and also on how aggressively the packets are dropped based on this estimate. The essence of Internet congestion control is that a sender adjusts its transmission rate according to the congestion measure of the networks. In internet routers, active queue management is the controller. The task is performed by the network or packet scheduler.

III. CLASSIFICATION OF AQM SCHEMES

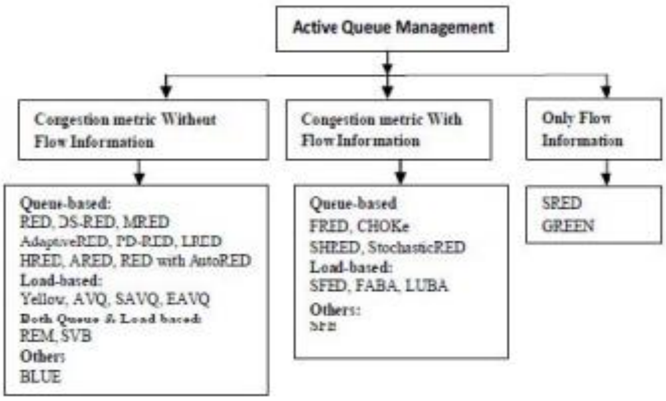

Fig. 1: Classification of AQM

IV. ACTIVE QUEUE MANAGEMENT CONTROL MECHANISM

A.) RED (Random Early Detection) - The main idea of RED is to observe the average length of the queue to detect congestion. If the congestion is coming, the congestion information is sent to any source randomly so that the rate of the source is reduced before the queue is full. There are two steps in RED. Firstly, compute the average queue length. Secondly, compute the drop probability of the packet according to first step. RED uses the weighted method like lowpass filter to calculate the average queue length avg Q. RED is an active queue management scheme that provides a mechanism for congestion avoidance. Unlike traditional congestion control schemes that drop packets at the end of full queues, RED uses statistical methods to drop packets in a "probabilistic" way before queues overflow. Dropping packets in this way slows a source down enough to keep the queue steady and reduces the number of packets that would be lost when a queue overflows and a host is transmitting at a high rate. RED makes two important decisions. It decides when to drop packets and what packets to drop. RED keeps track of an average queue size and drops packets when the average queue size grows beyond a defined threshold. The average size is recalculated every time a new packet arrives at the queue. RED uses time-averaging meaning that if the queue has recently been mostly empty, RED will not react to a sudden burst as if it were a major congestion event. However, if the queues remain near full, RED will assume congestion and start dropping packets at a higher rate.

B.) FRED (Flow based Random Early Detection) - FRED acts just like RED, but with the following additions. FRED introduces the parameters min. and max., goals for the minimum and maximum number of packets each flow should be allowed to buffer. FRED introduces the global variable avgcq, an estimate of the average per-flow buffer count; flows with fewer than avgcq packets queued are favoured over flows with more. FRED maintains count of buffered packets qlen for each flow that currently has any packets buffered. Finally, FRED maintains a variable strike for each flow, which counts the number of times the flow has failed to respond to congestion notification; FRED penalizes flows with high strike values.

C.) BLUE - The key idea behind BLUE is to perform queue management based directly on packet loss and link utilization rather than on the instantaneous or average queue lengths. This is in sharp contrast to all known active queue management schemes which use some form of queue occupancy in their congestion management.

BLUE maintains a single probability P_m, which it uses to mark (or drop) packets when they are enquired. If the queue is continually dropping packets due to buffer overflow, BLUE increments P_m, thus increasing the rate at which it sends back congestion notification. Conversely, if the queue becomes empty or if the link is idle, BLUE decreases its marking probability. This effectively allows BLUE to "learn" the correct rate it needs to send back congestion notification. Fig. 3 shows the BLUE algorithm. Note that the figure also shows a variation to the algorithm in which the marking probability is updated when the queue length exceeds a certain value. This modification allows room to be left in the queue for transient bursts and allows the queue to control queueing delay when the size of the queue being used is large. Besides the marking probability, BLUE uses two other parameters which control how quickly the marking probability changes over time

```
Upon packet loss (or Q_len > L) event:
    if ( (now - last_update) > freeze_time )
        p_m := p_m + δ1
        last_update := now
Upon link idle event:
    if ( (now - last_update) > freeze_time )
        p_m := p_m - δ2
        last_update := now
```

Fig. 2: BLUE Algorithm

D.) Adaptive CHOKe - Adaptive CHOKe enforces the concept of queue-based and flow information. It is desirable for AQM schemes to act without storing a lot of information otherwise it becomes a overhead and non-scalable. This algorithm modifies the CHOKe algorithm to remove its drawback. This algorithm also calculates the average queue size of the buffer for every packet arrival. It also indicates two thresholds on the buffer, a minimum threshold minth and a maximum threshold maxth. It reduces both the packet loss rate and the variance in queuing delay.

V. Advantages and Disadvantages of AQM Algorithms

s.no	Algorithms	Advantages	Disadvantages
1	RED	Early congestion detection. No bias against bursty traffic. No global synchronization.	Difficulty in parameter setting. Insensitivity to traffic load and drain rates.
2	FRED	Good protection from misbehaving flows.	Per – flow state. Difficulty in parameter setting. Insensitivity to traffic load and drain rates.
3	BLUE	Easy to understand. High throughput.	No early congestion detection. Slow response.
4	A-CHOKe	To protect well-behaved flows from misbehaving flow and adaptive flows from non-adaptive flows. It also obtains high utilization, low queuing delay and low packet loss with well adaptively tuned parameters.	Heavy load and unresponsive flow.

VI. Conclusions

This paper briefly surveys comparative analysis of different congestion control algorithms. The AQM algorithms are classified based on congestion metrics and the flow information. Most of the AQMs only require congestion indicators while some of them require both congestion indicator and flow information. Very few require only flow information for detecting congestion. These AQMs are compared based on the various performance metrics. This paper tries to project the desirable quality and shortcoming that exists in each of the algorithm in terms of their performance.

References

[1] Aditya, K., & Anurag, K. (2005). Performance of TCP congestion control with explicit rate feedback. IEEE/ACM Trans. Netw., 13(1), 108-120.

[2] Agnew, C. E. (1988). National Networks Including Satellite Service. Paper presented at the Transportation Electronics, 1988. Convergence 88. International Congress on.

[3] S. Athuraliya, S. Low, V. Li, and Q. Yin, "REM active queue management," IEEE Network Mag., vol. 15, pp. 48–53, May 2001.

[4] S.Dijkstra, "Modeling Active Queue Management Algorithms Using Stohastic PetriNets", Master Thesis, 2004.

[5] Dr.G.Padmavathi and K.Chitra, "Classification and Performance of AQM – Based Schemes for Congestion Avoidance", IJCSIS, Vol: 8, No: 1, 2010.

[6] Aos Anas Mulahuwaish, Kamalrulnizam Abu Bakar, Kayhan Zar Ghafoor, "A Congestion Avoidance Approach in Jumbo Frame – Enabled IP Network", IJACSA, Vol: 3, No: 1, 2012.

[7] Alshimaa H.Ismail, Zeiad Elsagheer, and I.Z.Morsi,"Survey on Random Early Detection Mechanism and Its Variants", IOSRJCE, vol.2, Issue.6, Aug-2012.

[8] G. Sasikala, E. George Dharma Prakash Raj, "P-CHOKe: A Piggybacking-CHOKe AQM Congestion Control Method", IJCSMC, Vol. 2, Issue. 8, August 2013.

