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Comparison Analysis of Different Queuing Mechanisms Droptail, RED and NLRED in Dumb-bell Topology

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Abstract: Congestion is one of the major problems in today's internet. So for managing traffic and to keep the network stable, Congestion Control algorithms are used. Queuing is one of the important method in traffic management system. This paper gives a comparative analysis of three queuing mechanisms Droptail, Random Early Detection and Non Linear Random Early Detection on the basis of various performance parameters like throughput and packet drop. The simulation results show that NLRED has a superior quality than other mechanisms.

Keywords: DT, RED, NLRED, T_{min}, T_{max} , NS2.

I. INTRODUCTION

In today's internet different types of data flow from one end to another and number of users are also increased. So there is a need of congestion control algorithms. Queuing is of the important congestion control mechanisms. Every router must maintain a queuing mechanism that governs how packets are buffered while waiting for the transmission. There are various queuing mechanisms such as droptail, random early detection queue, fair queues, weighted fair queue and many more. In this paper three queuing mechanisms are studied and analysed i.e. droptail, Random early detection (RED), non linear random early detection (NLRED). Droptail is passive queue management technique while RED and NLRED are active queue management techniques. Droptail is most commonly used in networks and is based on FIFO. RED and NLRED are the improvement over droptail. These queuing mechanisms are compared on the basis of various performance parameters throughput and packet drop.

II. QUEUING MECHANISMS

.DropTail Queuing Mechanisms

Droptail is the common algorithm of passive queue management. It drops all the new packets when the buffer is full, and does nothing when buffer still has space. The figure below shows the dropping probability of packets. The only two dropping probabilities are 0 and 1. When the number of packets arreived to the queue larger than the buffer size, the probability of packet dropping is 1. Otherwise the dropping probability is 0.

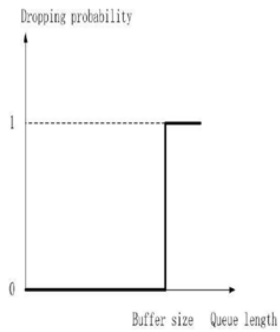

Fig.1 Dropping probability of droptail

A. RED Queuing Mechanism

RED comes under active queue management techniques. This algorithm has been proposed in order to alleviate the problems of simple droptail queue management. [2] RED was designed with the objectives to (1) minimize packet loss and queuing delay, (2) avoid global synchronization of sources, (3) maintain high link utilization and (4) remove biases against busty sources.[7] When the average queue length exceeds a minimum threshold (T_{min}), packets are randomly dropped or marked with an explicit congestion notification (ECN) bit. When the average queue length exceeds a maximum threshold (Tmax), all packets are dropped or marked. When the average queue length exceeds a maximum threshold (T_{max}) all packets are dropped or marked. RED is an algorithm of active queue management and it is developed for TCP only. It starts to drop packets when the average queue size is larger than the minimum threshold, and changes the dropping probability to 1 when the average queue size is larger than the maximum threshold. The dropping probability varies from 0 to p when the average queue length is between the two thresholds. The figure below presents the dropping probability of RED (Drop-tail in red line). [1]

B. NLRED Queuing Mechanism

RED represents a class of queue management mechanisms that does not keep the state of each flow. That is, they put the data from the all the flows into one queue, and focus on their overall performance. It is that which originate the problems caused by non-responsive flows. To deal with that, another congestion control algorithms have tried i.e non linear random early detection (NLRED).

Unlike existing RED enhancement schemes, we propose to simply replace the linear packet dropping function in RED by a judiciously designed non linear quadratic function. The rest of the original RED remains unchanged.

We call this new scheme Nonlinear RED or NLRED. The underlying idea is that, with the proposed nonlinear packet

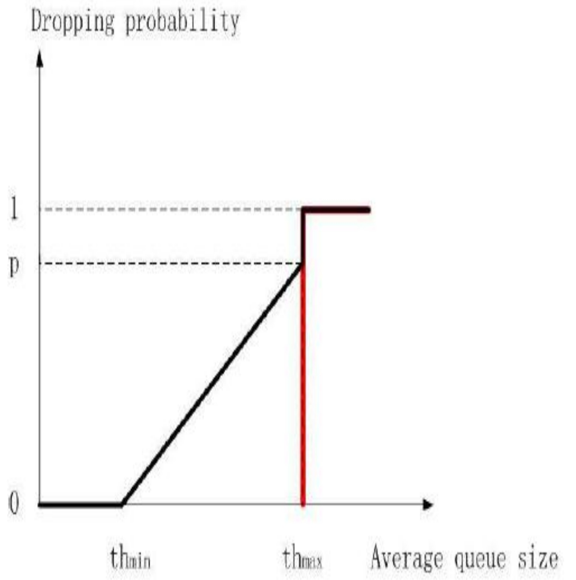

Fig. 2. Dropping probability of RED

dropping function, packet dropping is gentler than RED at light traffic load and NLRED encourages the router to operate in a range of average queue size approaches the maximum threshold T_{max} an indicator that the queue size may soon get out of control, NLRED drops more aggressive packets. Also it is less sensitive to parameter setting. In NLRED throughput performance is more stable.[5] In fig. 3 max_p is maximum dropping probability. Comparing this to the dropping function of original RED, if the same value of P_{max} is used, NLRED will be gentler than RED for all traffic load. This is because the packet dropping probability of NLRED will always be smaller than that of RED. [3]

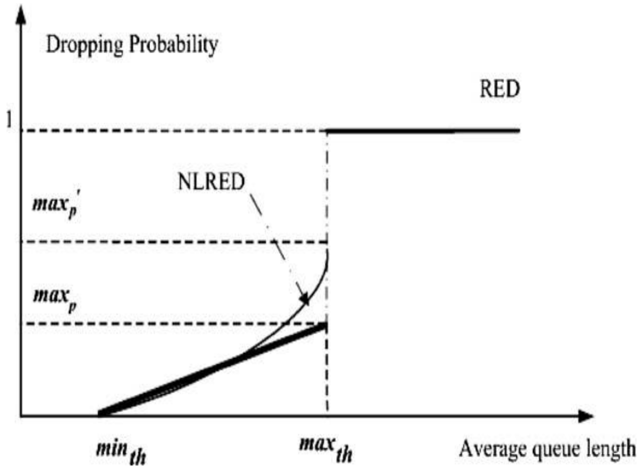

Fig. 3 Dropping probability of NLRED and RED

III. MODEL AND SIMULATION SETUP

As different algorithms have different preferences or assumptions for the network configuration and traffic pattern, one of the challenges in designing our simulation is to select a typical set of network topology and parameters (link bandwidth, delay and queue limit) as well as load parameters. The decision is being made by reading all related papers and extracting and combining the key characteristics from their simulations.

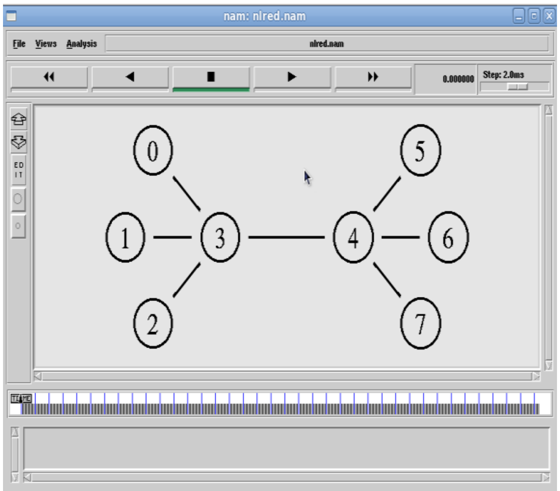

Fig. 4 Simulation Topology

For this simulation, a simple topology is created, where many persistent TCP flows share a bottleneck router with AQM schemes or DT, which consists of three senders and three receivers connected together via two nodes 3 and 4 as shown in the fig. 4.This simple topology consider a single bottleneck link (3-4) traversed by multiple TCP flows. In order to analyze the performance experiment is doe using packet level ns-2 simulator. We simulate this network on ns2 for different queuing mechanisms Drop-Tail, RED and NLRED. It is easy to set parameters for drop tail queue.

For RED, we also need to choose values for min_{th} and max_{th} In the following experiment, we set them as 6 and 25 packets. Also exponential weighted moving average constant is .001; maximum drop probability is set to be 0.75. Bytes and queue in bytes indicate calculations of average queue size in bytes. Setting them to false indicate average queue size will be calculated in packets (not in bytes). Gentle RED mode is set to be false indicates Gentle mode is OFF. Average size of a packet arriving at the router is also made equals to 1500. Bandwidth at bottleneck link 3-4 is 2.0MB. CBR flow rate is 1Mbps and packet size is 1500 bytes. Queue limit is 15 packets.

IV. RESULTS

A. Throughput Analysis

Throughput is the main performance measure characteristic, and most widely used. The throughput of each flow is used to illustrate the fairness among different flows, and the total throughput can be compared with the bottleneck bandwidth as an indicator of resource utilization. This measure how soon the receiver is able to get a certain amount of data send by the sender. It is the ratio of the total data received to the end to end delay. Throughput is an important factor which directly impacts the network performance. [4]

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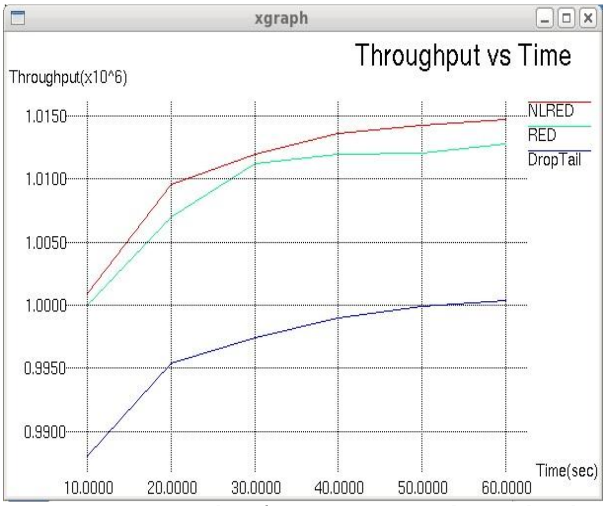

Fig. 5 Comparison analysis for NLRED, RED and Droptail with Throughput.

From fig. 5 it is clear that throughput is high for NLRED as compared to RED. Also throughput of RED is greater than that of Droptail. The graph is drawn between simulation time (x axis) and throughput (y axis).

B. Packet Drop Analysis

Packet loss means packets drop when queue overflows. Packets can be lost in a network because they may be dropped when queue in the network node overflows. The amount of packet loss during steady state is another important property of a congestion control scheme. The larger the value of packet loss, the more difficult it is for the protocols of transport layer to maintain high bandwidths, sensitivity to loss of individual packets as well as to frequency and patterns of loss among longer packet sequences is strongly dependent on the application itself. This characteristic can be specified in a number of ways, including loss rate, loss patterns, loss.

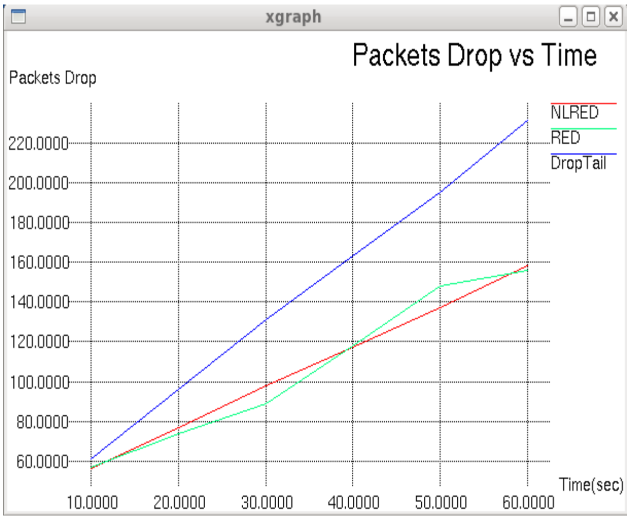

Fig. 5 Comparison analysis for NLRED, RED and Droptail with Packet Drop.

From Fig. 5 it is clear that packet drop is high for NLRED as compared to RED. Also Droptail has lowest packet delivery ratio. The graph is drawn between packet drop (y axis) and simulation time (x axis).

V. CONCLUSION

Here we analyze the performance of some queuing techniques namely Drop-tail, RED and NLRED based on simulation results. Result shows that, NLRED performs better than RED and Droptail because it maintains good link utilization (always higher than 90%) and small queue size. Also it maintains low delay, high throughput, low packet drop and high packet delivery ratio than others. NLRED achieves fairness significantly better than RED and Drop-tail between flows. NLRED is comparatively less sensitive to parameter like max_p. Also, RED performed better than Drop-tail. But NLRED Performs better than both the mechanisms.

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BIOGRAPHY

Shubhangi Rastogi has completed her B.Tech from Shri Ram Murti Smarak College of Engineering and Technology, Bareilly (U.P.) in 2011 with Computer Science and Engineering stream. Currently she is pursuing M.Tech from Kamla Nehru Institute of Technology, Sultanpur with Computer Science and Engineering stream. Her areas of interest are Computer Networks, Cryptography, Mobile Computing, Software engineering and Parallel Algorithm.