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Performance Analysis and QoS Assessment of Queues over Multi-Hop Networks

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Abstract: In the field of computer networks the implementation, management and performance analysis of queues is one of the foremost issues. The selection of the various queues is totally depends upon the need of transmission of data. Safe and Reliable propagation of data is a basic requirement of any computer network. In presents scenario, there is a strong requirement of standardization, testing, and widespread deployment of active queue management [AQM] in routers, which is further responsible for the improvement of performance of today's Internet. Queues performance assessment requires a concrete research effort in the measurement and deployment of router mechanisms, which advances to protect the Internet from flows that are not sufficiently responsive to congestion notification. In this paper, we evaluate the performance of Drop tail, DRR, RED, SFQ, and FQ by varying the number of hops. We are representing the detailed performance analysis & comparison of the various queues in terms of parameters like throughput, average delay and packet loss. These queues have been analyzed on various traffics like FTP and CBR, by varying the number of hops and the various conclusions have been drawn accordingly.

Keywords*:* CBR, Drop tail, DRR, RED, FTP, Linux, NS2, Queue, SFQ

1. Introduction

In this digitalized era of computer network, the networking is a practice in which by establishing the link between two computer terminals, the sharing of data packets takes place. The importance of Computer Networks has been immensely increased out in the recent years. The imagination of modern, digitalized era cannot takes place without Computer Networks. Confidentiality and integrity are the foremost parameter; that have been required for the data transmission. In most of the IT Industry, the computer networking is one of the complex processes, which have been used out for the establishment of the communication between two computers.

2. Concepts of Queues

The transmission of packet over a medium at any instance of time requires a packet processing routine. Thus, to maintain a proper processing of the packets over a node an interface must be deployed. This interface object must be able to accept the request from node objects to transmit a packet, even when the medium is busy transmitting a previous packet. The various queues, which were implemented, are

- Drop Tail Queue
- Random Early Detection (RED Queue)
- Stochastic Fair Queuing
- Deficit Round Robin (DRR)
- Fair Queue (FQ)

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3. NS2 Simulation Environment

The simulator is a tool for demonstrating the various protocols, algorithms and to serve as an aid in the better understanding of the protocols. In this paper the, simulation of the various network topology is done by using the NS2. The NS2 is an object oriented discrete event simulator.

3.1. Simulation Environment and Parameters

The version NS 2.33 has been used out for the simulation study and analysis. The various simulation parameters for each node have been specified in the Table 1.

- DEMONSTRATION OF SPECIFICATIONS USED FOR SIMULATION MODEL

Parameter	Setting
*Channel Type	Wired Channel.
*Queue Type.	Drop Tail/DRR/RED/SFQ/FQ.
*Maximum Packet in Queue.	10.
*Number of Hops.	Varied from 1 to5.

3.2. Comparison Metrics

The throughput, average delay and packet-loss are the three quantitative metrics used to compare.

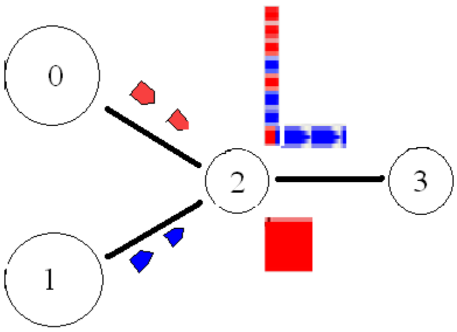

Fig.1: Simulation Diagram

3.2.1 Throughput

The Throughput is defined as number of bits received by the destination per second.

*Throughput (kbps) = (Total_data_received / Simulation_time) × (8/1000)

3.2.2 Average End-to-End Delay

Route discovery latency, retransmission by the packets by intermediate nodes, processing delay, queuing delay, and propagation delay are the parameters that cause the average end-to-end delay.

*Average_EndtoEnd_Delay = Σ (Time_recvd – Time_sent) / Total_Data_packets_recvd)

3.2.3 Packet loss

The packet loss is defined, as difference of data packet send by all nodes and number of received packets at the destination nodes. The bigger this fraction is the less efficient the Protocol.

*Packet loss = Total_packets_sent -Total_Data_packets_recvd

4. Results and Discussions

When we varies the number of hops and keeps the number of transmission source constant, than at that time we have got 5 different scenarios for every queue. Simulation is carried out for 5 different scenarios with the traffic source CBR and FTP on five queues. It gives us 25 trace files. After analyzing those 25 trace files with corresponding ***awk*** scripts plotting of the graphs is done. Results are shown down below in tabular and graphical format for each of the scenario.

4.1. Throughput

TABLE 2 THE COMPARISON BETWEEN THROUGHPUTS OF QUEUES, WHEN NUMBERS OF HOPS ARE VARIED

No. of Hops	Drop Tail		RED		SFQ		DRR		FQ	
	FTP	CBR	FTP	CBR	FTP	CBR	FTP	CBR	FTP	CBR
1	470.922	999.352	366.613	973.931	538.514	961.282	532.578	961.282	598.284	995.117
2	450.155	972.124	403.159	961.282	534.411	486.827	577.875	926.951	578.53	974.017
3	379.257	981.158	340.666	986.579	565.98	916.109	555.615	934.179	555.615	979.719
4	374.867	988.386	329.349	988.376	544.053	919.723	533.674	943.213	534.283	984.69
5	325.772	992	204.215	986.579	515.688	930.565	507.268	954.055	507.268	991.173

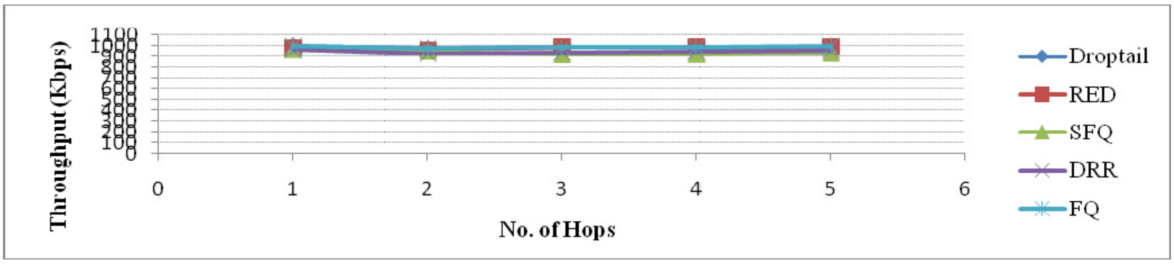

Fig. 2 Graph between Throughput v/s No. of Hops of CBR

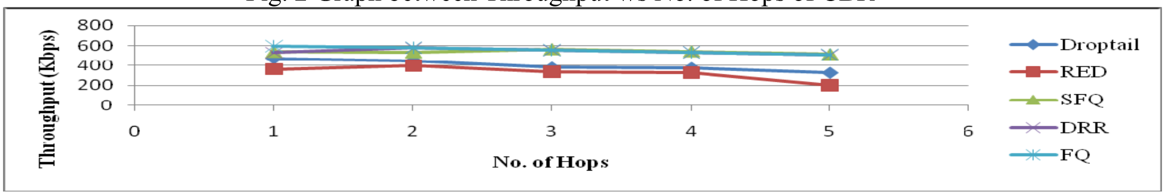

Fig. 3 graph between Throughput V/s No. of Hops of FTP

The above figures have been plotted out in between throughput v/s No. of Hops for the FTP and CBR. In FTP the increment in number of Hops decreases the throughput constantly. While in case of CBR, the throughput has been decreases due to the increase of simulation time. Here FQ shows the maximum throughput while the RED shows worst performance case.

TABLE NO3 PERCENTAGE CHANGE IN THROUGHPUT OF DIFFERENT QUEUES, WHEN NUMBERS OF HOP ARE VARIED

Queue	Droptail		RED		SFQ		DRR		FQ	
Traffic Type	CBR	FTP	CBR	FTP	CBR	FTP	CBR	FTP	CBR	FTP
Percentage change(Decrease)	30.82	0.035	44.35	0.237	4.23	3.19	4.69	0.75	15.21	0.396

4.2. Average Delay

TABLE 4 THE COMPARISON BETWEEN AVERAGE DELAYS OF DIFFERENT QUEUES, WHEN NUMBERS OF HOPS ARE VARIED

No. of Hops	Drop Tail		RED		SFQ		DRR		FQ	
	FTP	CBR	FTP	CBR	FTP	CBR	FTP	CBR	FTP	CBR
1	0.0938	0.0517	0.0833	0.0435	0.1248	0.0744	0.1436	0.0848	0.1856	0.2097
2	0.1182	0.0650	0.1089	0.0582	0.1496	0.0934	0.1873	0.1084	0.1874	0.2074
3	0.1411	0.0766	0.1298	0.0727	0.1863	0.1182	0.1896	0.1280	0.1896	0.2104
4	0.1633	0.0907	0.1539	0.0856	0.1887	0.1314	0.1920	0.1669	0.1921	0.2125
5	0.1795	0.0996	0.1785	0.0969	0.1931	0.1426	0.1959	0.1611	0.1963	0.2047

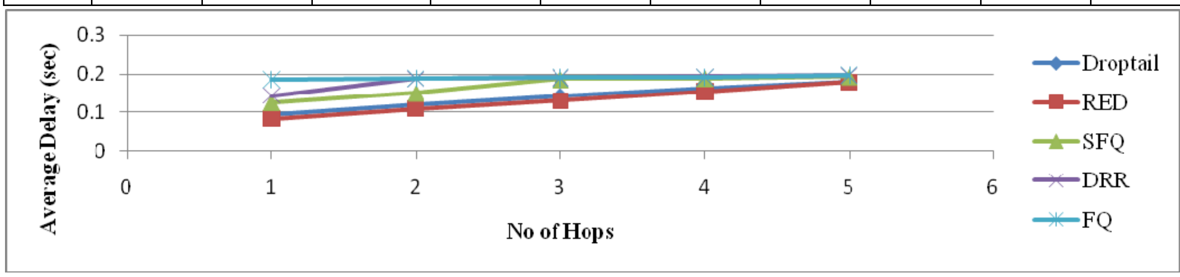

Fig. 4: The graph drawn between Average Delay Vs No. of Hops

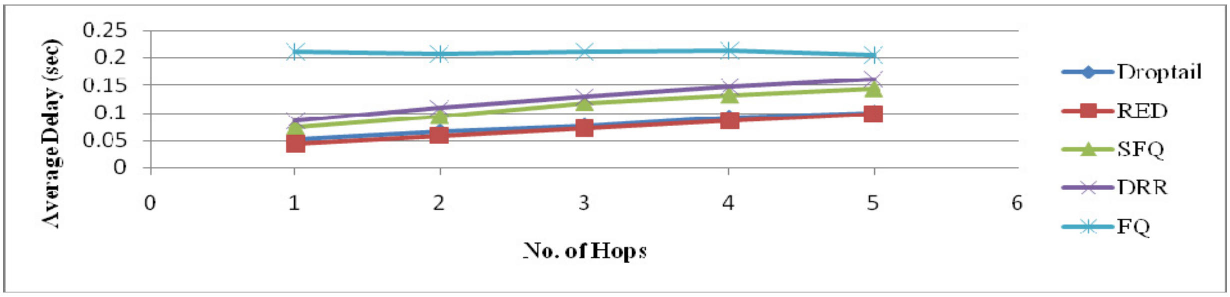

Fig. 5: The graph between Average Delay Vs No. of Hops for CBR

The above figure shows the variation of the concerned metric i.e. *Average Delay* with respect to the variable parameter *Number of Hops* for the five different queues. Now, by increasing the number of hops the average delay increases. On increment of number of hops, the simulation time and length get increases, so proportionally the average delay also been increases for all queues. But in case of FQ, it is almost constant because Fair Queue (FQ) ensures the flow for an equitable share of bandwidth. We have found that, the FQ causes the maximum delay, among all queue for two different traffics of CBR and FTP. At last, the RED shows the minimum delay among all queues for both traffic i.e. CBR and FTP.

4.3. Packet Loss

TABLE 5 THE COMPARISON BETWEEN PACKET LOSS OF QUEUES, WHEN NUMBER OF HOPS IS VARIED

No. of Hops	Drop Tail		RED		SFQ		DRR		FQ	
	FTP	CBR	FTP	CBR	FTP	CBR	FTP	CBR	FTP	CBR
2	10	8	12	11	3	18	2	18	0	6
3	7	12	8	18	2	26	0	37	0	2
4	6	7	0	4	0	43	0	33	0	0
5	6	3	7	3	0	41	0	28	0	0
6	3	1	6	4	0	35	0	22	0	0

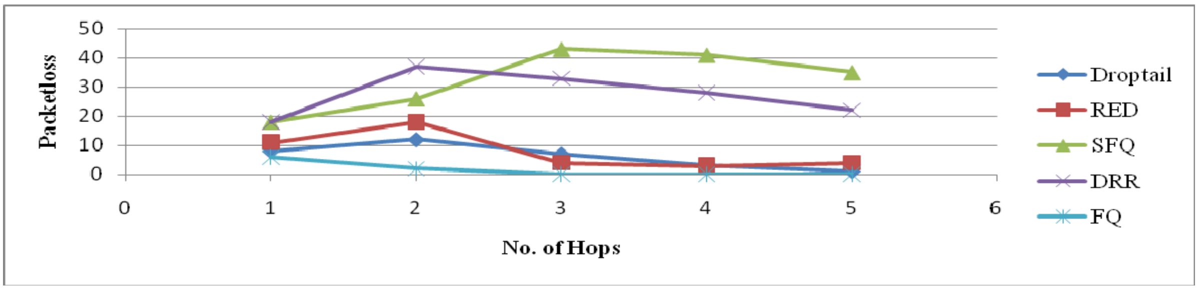

Fig. 6: The graph drawn between Packet Loss Vs No. of Hops of CBR

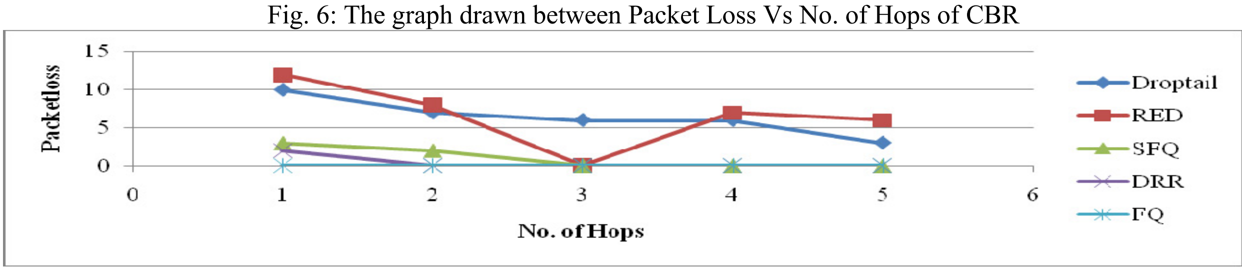

Fig. 7: The graph drawn between Packet Loss Vs No. of Hops of FTP

The above figure shows the variation of the concerned metric i.e. *Packet loss* with respect to the variable parameter *number of hops* for five different queues. Now, as the Number of Hops increases the time duration also increases. Thus, the time period of all the incoming traffic at a particular node has also increases. It generally ensures the delivery of the packet over the transmission channel. During the data propagation, some delays have been provided out for the maintenance of the buffer capacity over a longer period of time. Hence, the Packet loss has been decreases out. The SFQ shows the maximum packet loss for CBR traffic. We have also found that, the RED is shows the maximum packet loss for FTP traffic. While the FQ, ensures the minimum packet loss for both CBR and FTP traffic.

5. Conclusions and Future Work

Each of the queues has been studied for different cases. By taking all the cases & figures in the consideration, we can be able to conclude that the performance of the queues is mostly affected due to increment in number of hops. Various parameters like Average Delay, Throughput and Packet loss is directly or indirectly affected by the variation in number of hops. Due to the increment in hops, simulation time & average delay increases. In case of SFQ, flows are hashed into a fixed set of queues. Whenever multiple flows result into same hash value, then the flow will be placed in a single queue, which is considered as a single flow collision. When the number of hops is equal to 3 the packet loss increases, after that as the simulation time increases the packet loss decreases. For RED data packets get discarded before the repletion of the queue. In FQ, it ensures that each flow will obtain equal share of bandwidth. It is just like assigning a separate queue for each flow, so it can provide comparative better result for each parameter. The FQ performs quite predictably; it delivers all the data packets, with the increment in no. of hops. On increasing the numbers of hops the average delay got increases, each increment in the number of hop increases the simulation time, while the throughput and packet loss got decreases. These parameters further ahead become responsible for the decrement of throughput.

The FQ can be used out for the faith full delivery of data; because it shows the minimum loss but its average delay is more compare to other queue. For voice or live video transmission, we would like to prefer RED. Because it provides minimum delay, but it's packet loss is more. Now, for the average performance [i.e. acceptable delay and max delivery] Drop Tail or DRR can be used out. In the future prospective, we are working to extend our work over the performance assessment of queues in wireless & satellite network. By implementing the complex topologies in different scenarios the performance evaluation of traffic types like VBR can be drawn out.

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