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Effective Scheduling in Networks - TRUMP

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Abstract—Due to the growth of internet, there arises the need for large amount of data transactions in the Network. Making the best uses of resources is the most important thing. Resources like bandwidth should be used effectively to make sure that the packets reaches on time. Issues like loss of packets, packet delay should be addressed. Scheduling and Routing have to be perfect enough so that the data transactions in network takes place at ease. Number of routing and scheduling algorithm do exists and its necessary to choose the best routing path and to schedule it. When there are n number of packets ready to be scheduled, scheduling algorithms like FCFS, Time to live, Priority based , Adaptive double ring scheduling etc can be considered according to the needs. To make effective use of resources backlogs can be considered while Scheduling. Issues like packet loss are expected because of the importance over the larger queue. Solutions are discussed.

Keywords— Backlog, Packets, Scheduling

I. INTRODUCTION

Large amount of data are transferred from 1 node to another in the Network . These packets pass through n number of intermediate nodes before reaching the destination. There is a necessity to make sure that the packets reach the destination without much delay and there is no loss of packets. Time slots are needed to be provided in the nodes, thereby collision doesn't occur. Nodes which requests 1st can be given priority. Bandwidth utilization and Collision avoidance has to be considered. Scheduling and Routing of Packets comes in to picture. Scheduling algorithms like FCFS, Priority based are a common one to schedule the packets in the network.. In the case of FCFS the packet which arrives 1st is given importance. But there are possibilities that it is not a high priority packet or a real time packet. Priority based Scheduling overcomes this issue. Each packet is assigned a Priority and accordingly the packets are Scheduled. Generally Real time Packets are given more importance. Backpressure technique can be used in Scheduling the packets in the network The Backpressure algorithm finds out the optimal commodity ie the differential between the sender and receiver and accordingly decides the transfer rates. It is considered to provide good throughput. But it still suffers from Packet delay during the starting Phase. And packet loss is also a possibility. A variant is suggested to overcome these issues. The optimal commodity is chosen for each link in the case of Backpressure. The optimal commodity is calculated between the sender and receiver. N number of flows are possible in the case of Networks. Backpressure algorithm works fine in the case of Large queues. When there are large queues it has enough pressure to schedule the packets. As it involves slot based scheduling, there is a possibility for few packets to be backlogged on their paths which results in end to end delivery.

In the case of short lived flows, loss of packet is also a possibility. Backpressure algorithm based on the differential between the sender and the receiver, calculates the optimal commodity of the link. According to the optimal commodity, a matrix is generated and the transfer rates are calculated. Backpressure algorithm provides enough stability and necessary throughput. But this technique does not consider the number of flows in the Link. Importance is given to length of the queue. If there is no enough packets in the queue, this technique doesn't seem to have enough pressure to forward the packets to destination. Here in this variant we give importance to length of the queue as well as the number of flows in the link. Thereby improvement in results can be achieved. Backlog algorithm with additional considerations on weights can be used to solve the shorter queue issues in Networking.

II. BACKGROUND AND RELATED WORK

Back pressure technique suffers from Packet Delay.
Table 1 : Simulation results [1]

Time Length of Simulation (slots)	Packet Delivery Number of Packets Ratio (%)
300	0
500	40

Back pressure algorithm takes time to stabilize. For the 1st 300 slots, the delivery ratio is 0% as it dint have enough pressure. Where as in the next slots, the packet delivery ratio gradually increases. To overcome this lots of packets should be available in the Network. To overcome this issue "A virtual Gradient based Back pressure technique was proposed" [1] , a virtual queue gradient was set based on the length to destination to provide enough pressure in the network configuration phase.. While scheduling of packets both real and virtual queue was considered . Such that delay in Packets can be reduced to some extent. The link weight can be assigned based on delay packets, rather than length of the queue, to overcome packet Loss too. The short flow often suffers from packet loss. Also there is an overhead as setting of virtual gradient queue is necessary. Based on the Timeslot activates set of non interference link. Backpressure algorithm tries every path. So there is a possibility in delay. Shortest Routing Algorithm should be considered.

Consider 2 nodes m,n. To avoid delay in packets at the starting time, Route loop Punishment Factor can be worked out. Per flow queue or the per destination queue is considered as a drawback. An attempt to reduce number of queue has to be carried out. Per Neighbor queue can be considered. [2]

The backpressure algorithm works on the principle of calculating weight. The weight of Link is calculated by finding the maximum weight of all the Flows in the Link.

Steps In Back Pressure Algorithm

1. Calculating the Differential Value between Sender and the Receiver. Ie Optimal Commodity value is found out.
2. A Matrix is formed based on the Commodity value
3. Transfer rate is calculated
4. Packet is sent according to the transfer rate Slot.

When calculating the transfer rate of the Link, only the length of the queue is considered in Back Pressure Technique. The queue which has a large number of packets will not suffer. Whereas there is a possibility to have n number of flows with small queue. In such a case Backpressure Algorithm suffers from Packet delay or Packet Loss.

To overcome that the transfer rate can be calculated considering the length of the queue and also the number of Flows in the link. Thereby the Flows with less packets need not suffer.

Optimal Commodity is calculated based on number of packets in the node. It is been calculated between 2 nodes. The highest differential value is assigned as the Weight of the Link through which the transfer rate is calculated.

Node 1 **Node 2**

Node 1
1
2
3

Node 2
1
2

The difference between Node 1 and Node 2 is (3-2)1 here. For all the commodities, the difference is calculated and the optimal commodity is selected.

Back-Pressure algorithms maintain per-flow queues, i.e., each node maintains a FIFO queue for every flow passing through the node. N number of Flows are available for a node.

III. SCHEDULING ALGORITHM WITHIN A QUEUE FIFO

FIFO Scheduling Algorithm works on the principle that the 1st Packet which entered should be scheduled to the Destination 1st. But there are n number of drawbacks in the case of FIFO. If the 1st packet which came in is not a high priority process, but still it will be processed 1st. In that case, the high priority process will have to suffer.

Eg. Table 2 Packet Arrival

PACKET	ARRIVAL TIME
P1	0
P2	2
P3	1

As of FIFO the priority is P1 -> P3 -> P2

Priority Based Scheduling Algorithm

To overcome the drawbacks of FIFO priority based Scheduling algorithm can be made use of. Each packet is assigned with a priority and accordingly the packet with highest priority is 1st sent to the destination. The real time process are given more importance than the non real time processes

Eg. Table 3 Scheduling based on Pririty

PACKET	PRIORITY	ARRIVAL TIME
P1	2	0
P2	1	2
P3	3	1

Eg.

As of Priority based Algorithm the order is

P2 - > P1 - > P3

But as arrival has to be considered, the order is

P1 - > P2 -> P3

IV. PROPOSED BACKLOG BASED ALGORITHM- TRUMP

Steps

1. N number of queues are maintained based on the destinations
2. Backlog is compared with the neighbors for each queue
3. Based on differential backlog, weight can be allocated to each flow
4. Congestion can be avoided using this.
5. If the neighbor has a backlog of 12 and if the current node has a backlog of 10. Then 10 - 12 = -2
6. A negative backlog is not given any preferences, as the backlog is already too heavy
7. The problem is, often the larger queue is given preference when a flow is selected based on Backlog
8. Pbm = > Shorter queues suffer from Packet Loss/ Larger Delay
9. When allocating the weight for each flow, the arrival time of the packet can also be taken in to considerations along with the Backlog.
10. On possibility of congestion , choke point method is used.

DIFFERENTIAL BACKLOG

N no. of queues are available for a node. Packets are stored in the queue until the scheduling decisions are made. Importance are generally give to large queues. For each destination, a queue is maintained namely (PDQ) = > Per Destination Queues. |Qu| = > Denote Size of Queue. Every node will have to share the size of queue information to its neighbor Nodes.

Every node calculates Differential Backlog with respect to its neighbor. At Node u, $D_{l(u,v)}(t) = |Qu(t)| - |Qv(t)|$. Differential backlog is calculated for all flows.

And the Maximum Differential Backlog is selected for Scheduling.

$$l_{(u,v)}(t) = \max (D_{l(u,v)}(t)$$

Back pressure algorithm helps in Congestion Control. Back pressure selects the transmission rates at which packets can be scheduled. The goal is to limit the size of the Queue. Based on the State of the Queue, the rate control can be determined.

Variations to Existing Algorithm - TRUMP method

Backpressure based Technique can be used to schedule the packets in the Network. It suffers from Packet Loss. In the case of the Proposed algorithm, weight for each flow is calculated based on the backlog of the flow. To solve the problem with Packet loss, no queue is made to wait for large amount of time. In the case of backlog based approach, the shorter flow is eventually made to wait.

To solve this, in the weight calculation, arrival time can also be considered as an important factor, for deciding the flow that has to be scheduled.

Backlog approach helps in less traffic in the Network. Because of changes made to the weight calculation, Traffic is expected in the Network. Congestion control Algorithm can also be added to the Algorithm.

Among the n number of Packets available in the particular flow selected, an algorithm has to be chosen. Normal FCFS may delay the short Packets further. Dynamic Multilevel Priority Based Scheduling Algorithm within the Queue

Eg. Table 4 : Weight Calculation with Avg Arrival Time

FLOW	Backlog	Avg Arrival Time of Packets of Flow
FLOW 1	8	3
FLOW 2	7	2
FLOW 3	4	1

Though the Backlog of the 3rd Flow is less, it has a good Arrival Time scenario. So on weight calculation, this flow will have chances to have an upper hand.

Weight Calculation

Differential Backlog + Ranking based on Arrival Time. The flows are ranked based on the Arrival Time of the different Packet it holds.

Eg. Table 5 : Mean Arrival Time

FLOW	Packets	Arrival Time	Mean Arrival Time of Flow 3
Flow 3	P1	0.5	0.6
	P2	0.7	

The flow with less Mean Arrival Time, as of the current scenario is given the highest Ranking as of Arrival Time. So the weight can be Backlog + Ranking as of Arrival Time of the Packets of the Flow.

This way flow need not suffer from longer waiting time and also shorter queues will be given a chance to get transmitted in the Network. And Trump algorithm with efficient Routing algorithm will be apt in the case of scheduling Packets in the Network.. On usage of virtual queue to increase the size of the shorter queues, we have to

take measures to send them too. Here in this method additional overhead in not involved. So definitely a feasible and a good Algorithm for considerations.

V. CONCLUSION

Back Pressure Algorithm is quite Famous, which can be applied to Schedule Packets in Network. It works on the basis of Differential Backlog. It gives importance to the one with higher Backlogs. In our Paper even the Shortest Queue are taken in to Considerations. No queue for its length is affected. Packet loss can be treated , which happens because of Time to live and congestion in the Network. For scheduling Packets of a Particular Queue, Dynamic Multilevel Priority Scheduling Algorithm is Used. As it solves Packet Delay of Shorter Queues, this method can be considered.

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