Protocols and Techniques for End to End Congestion Avoidance on a Global Internet

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ABSTRACT
The packet transmission congestion control at the network node is presented in this research study. It is increasing quickly due to the increased use of applications. It makes clogged flows unpredictable and erratic. There aren't many outdated scheduling strategies for handling network node congestion, but the ones that do exist were only for end-to-end networks, thus they couldn't prevent unfairness brought on by applications and congestion collapse. The switch-based packet transmission technique and the present packet transmission algorithm are similar. An increase in packets between nodes results in congestion control situations. in order to solve existing problems and develop a more flexible method for building a network's improved leakage control scheme. The suggested Enhanced Leaky Bucket Index Algorithm can traverse the node and receive a large number of packets from it due to packet regulations. The proposed approach computes the full packet transmission. The suggested technique demonstrates the packet switching and congestion management mechanisms in the network node in order to identify and halt unresponsive congestion flows before they enter the network node and prevent congestion within the network node. Lastly, a comparison between the suggested and the current methods is made to control packet transmission overall.

Keywords: *congestion detection, protocols, traffic, packet switching*

I. INTRODUCTION

The goal of congestion control research is to manage the congestion mechanism at the network node connected to the packet switching network via the subnet and to improve packet transmission performance. Numerous packet switching systems operate globally, transmitting billions of packets via networks every day. One important component of the international infrastructure for information sharing is the Internet. It handles more than only network node construction; in packet switched networks, it also manages congestion while packets are being passed across network links.

Congestion is the state in which a subnet's packet transmission performance deteriorates. The ratio of delivered packets to received packets is proportionate. However, if traffic volume becomes too much, routers cannot manage it all and packets will be dropped. The packet is received at each node, is momentarily stored, and then is forwarded to the next node based on the header information and additional factors, such error conditions, traffic congestion, the quickest path between two points, etc., until it reaches its destination. Packets are constructed at the destination into a coherent message that is presented to the end user.

Advantages of Packet Switching

- The alternative routing scheme improves the reliability of the network.
- Special packet switching computers and algorithms can be designed to minimise delay between end users.
- The technology can use the existing telephone network for the path, therefore provided a value-added service for the end user.
- Packets containing a portion of user data are more secure than a complete message.

The term "congestion control" describes a group of methods designed to lessen the negative effects that periods of congestion have on network performance. Congestion is a significant problem in packet switching networks. It could happen if there are more packets being delivered to the network than there is capacity for the network to process. This is known as the load on the network. It speaks about the systems and methods used to limit traffic and stay below capacity.

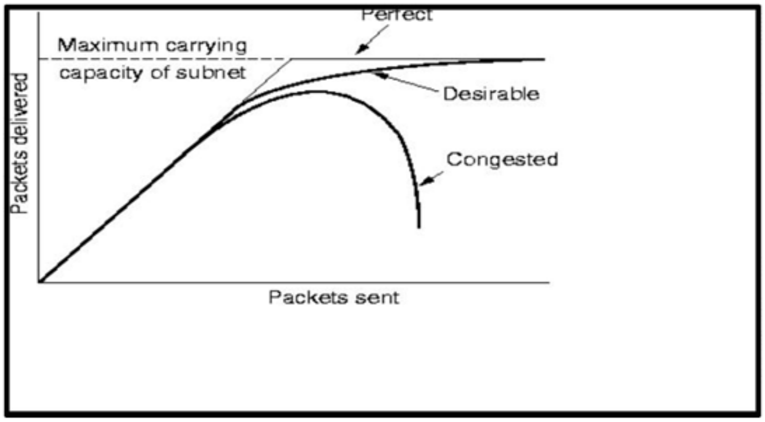

Figure 1: Concept of Congestion

An interface that deals with host and network interaction is congestion control. As a result, the links or switches start to receive free traffic. Anytime a traffic surge above the limit, it will clog the network and result in unfavourable outcomes, such as lengthy transfer delays, packet losses, or even blocking the node's path so that it cannot travel through other network nodes. Its purpose is to control and prevent a collapse of congestion. By using a simulation experiment to calculate metrics, the network is designed and packet transmission is carried out using the congestion control method. In summary, the following characteristics distinguish the packet switched network from other systems:

- It is usually to connect and supports a diverse set of nodes that are connected with the end system through the network.
- It may contain the measurement of the packet transmission which can be measured the burst length,
- delay time of the transmission, packet and link transmission delay of the packets in a network.
- It may contain the incoming and outgoing packet rate of the packets can be measured to regulate the flow of packets.

The design and analysis of a congestion control system for packet switched networks is the focus of this study. A technology used for data transfer over networks is called a packet switching network. Additionally, it is predicated on the network's resource management and congestion control.

II. LITERATURE REVIEW

In Literature review, the problem of Congestion has been studied widely in the context of high speed network, wireless network etc. The following are the review of the Literature that is related to my research work.

Year	Paper Title	Approach	Measure of congestion	Performance Metrics of the congestion
2008	A robust proportional controller for AQM based on optimized second-order system model	AOPC (control theoretic)	Queue length+packet loss ratio	responsiveness, best tradeoff between utilization and delay, convergence rate, queue oscillations, robustness
2009	Effective RED: An algorithm to improve RED's performance by reducing packet loss rate	Effective-RED (heuristic)	Queue length (both instantaneous + average)	throughput, packet drops, fully compatible with RED, easily upgrade/replace the existing RED
2011	Active Queue Management for Flow Fairness and Stable Queue Length(fairness-enforcing AQM)	P-AQM	Input rate + loss rate	Fairness (intra/inter), stable queue.
2011	Design of optimal Active Queue Management controllers for HSTCP in large bandwidth-delay product networks (HSTCP-H2 controller)	HSTCP-H2(control theoretic)	Queue length input rate	good put , intra protocol fairness
2013	A robust active queue management scheme for network congestion control	RC (control theoretic)	robustness, queue stability	

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III. THEORETICAL FOUNDATION

A. Function of Leaky Bucket Procedure

A Leaky Bucket Procedure function that employs a queue to manage output controls the flow of packets. An input variable packet is added to the queue and used as the first packet to be delivered for the purposes of the FIFO queueing [5] operation. In order to send packets over the network at a fixed rate or at a regular output rate, the queue is used for packet queuing. A leaky bucket technique is used to regulate the fixed rate of the packet during the FIFO queueing process.

B. Flowchart for Leaky Bucket Algorithm

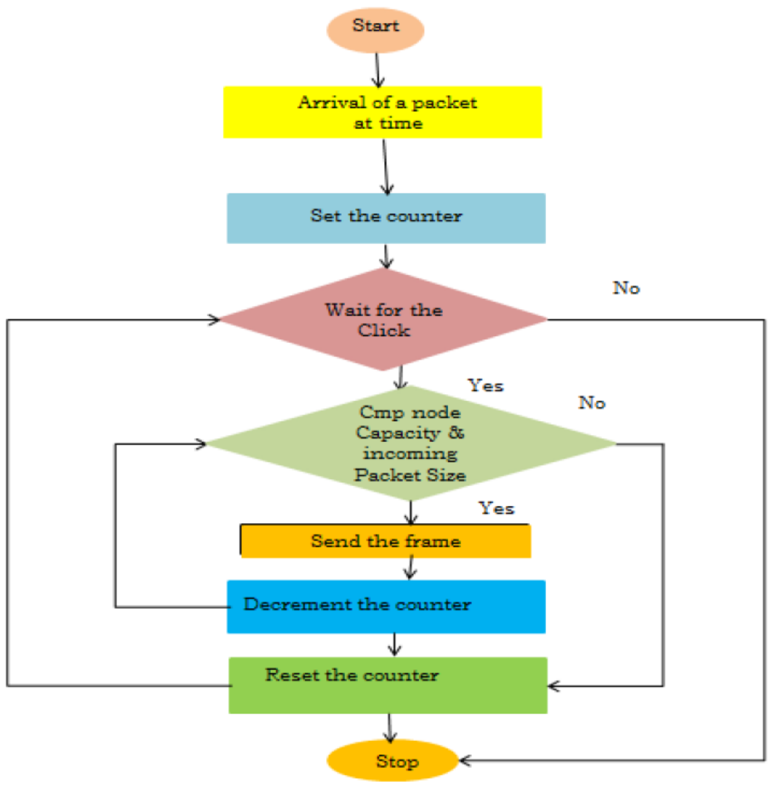

Figure 2: Flowchart

C. Function of Leaky Bucket Algorithm

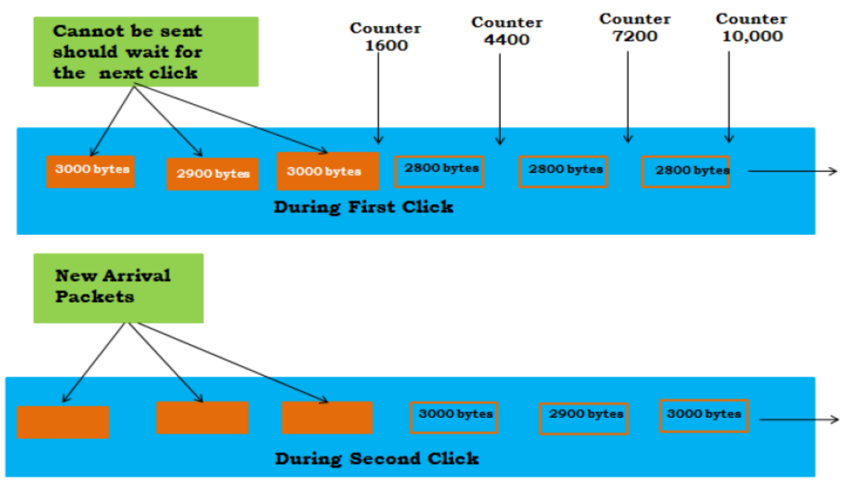

Figure 3: Flowchart

D. Existing Leaky Bucket Algorithm

- **Input:** Variable/packet size with unregulated flow
- **Output:** Fixed size packet with regulated speed rate
  - **Step 1 :** Consider large size internal buffer as a bucket (water)
  - **Step 2 :** If the buffer is empty, no output
  - **Step 3 :** If the buffer is full, outflow is at a constant rate ρ
  - **Step 4 :** If additional packet entering, the packet is discarded or stored under the safe
  - **Step5 :** Each host is connected to the network by the interface containing leaky bucket a finite internal queue
  - **Step 6 :** If variable sized packets are used, convert fixed number of bytes per click
  - **Step 7 :** If a packet arrives and it checks whether a room on the queue or not
  - **Step 8 :** If room is available, arrival packet is entered into FIFO queuing Else Packet is stored temporary buffer and transmission stops until the next click
  - **Step 9 :** Repeat step 2 to step 8 until all the transmission is over on the network
  - **Step 10 :** Stop

E. Enhanced Leaky Bucket Algorithm Using Index Management

- **Input:** Get Variable size packets from user through host computer
- **Output:** Release one packet based on the index which is generated by clock at the rate of every Δt

Step 1 : Host computer or any node gets variable size packets from source
Step 2 : Access all packets for ‘t’ time
Step 3 : Calculate Total packets and its maximum size
Step 4 : Generate Index by clock at the rate of every Δt time and store Index counter
Step 5 : Counter is incremented by one every and decrement one whenever packet is sent
Step 6 : Check whether Index counter is possible or not
Step 7 : If possible,send a packet from bucket and destroy one Index Else Wait for Index generation or packet arrival
Step 8 : Repeat Step 6- Step 7 until last Index
Step 9 : Stop

IV. EXPERIMENTAL RESULTS

The objectives of the congestion control experiments, the test design, the network model utilised for the test, and the congestion control findings are all presented in this part. Unless they are pertinent to the experimental results, no information on the construction and experience with congestion control will be discussed.

Network Modeling

A basic network model is created with the end system users, links, and nodes within the subnet for packet transfer. The network model is made up of eight nodes connected by links, and four end systems connected in a subnet to transfer source packets via the links. The packets are stored by the source system and forwarded to the subnet's associated nodes by the system.
Let us consider
X Y, Z, and R End system
A, B, C, D, E, F, G, H Nodes name

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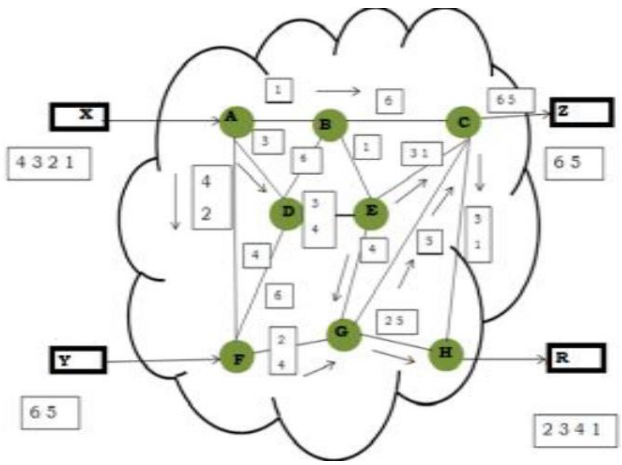


Figure 4: A Simple Network Modeling

Packet number and the Packet Size Nodes number and its Capacity

Packet Number	Packet Size(bytes)
1	10242
2	24586
3	45861
4	78423
5	36485
6	89032

Node Number	Node Capacity (Bytes)
A	**10244**
B	**20483**
C	**52382**
D	**34316**
E	**78424**
F	**98027**
G	**48663**
H	**64982**

The result of the measurement on the simple network modeling of the packet transmission is following below the table,

Packet Transmission between the Nodes

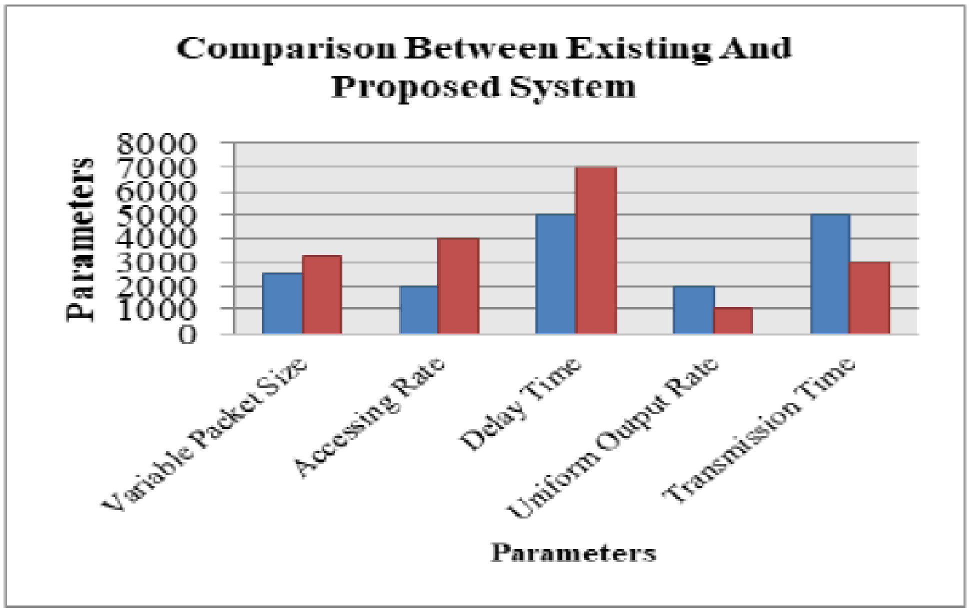
During Click Set	From Source Node	Sink Node	Total no of packets	Packet Id	Total no of Packet Size(Bytes)	Start Time (msec)	Arrival Time (msec)	Transmission Time (msec)	Delay Time (msec)
1	X	A	4	1,2,3,4	159112	10.00	10.15	0.15	10.30
2	A	B	1	1	10242	12.30	12.42	0.12	0.27
2	A	D	1	3	45861	12.30	12.59	0.29	0.41
2	A	F	2	4,2	103009	12.30	12.60	0.30	0.59
3	B	C	1	6	89032	13.80	15.98	2.18	2.48
3	B	E	1	1	10242	13.80	14.45	0.65	2.83
4	D	E	2	3,4	124284	12.86	13.94	1.08	1.73
4	F	D	2	4,6	167455	14.72	16.35	1.63	2.71
4	F	G	2	2,5	61071	14.72	15.67	0.95	2.58
5	G	H	2	2,5	61071	15.30	17.64	2.34	3.29
5	G	C	1	5	36485	17.30	17.75	0.45	2.79
5	C	H	2	3,1	56103	16.72	18.78	2.06	2.51
5	C	Z	2	6,5	125517	16.12	18.61	2.49	4.55
6	E	C	2	3,1	56103	12.78	15.86	3.08	5.57
6	E	G	1	4	78423	12.78	15.76	2.98	6.06
7	H	R	4	2,3,4,1	159112	12.89	13.78	0.89	3.87

Similarly, Y End system can be generated with the help of above transmission calculation.

Comparison between Existing and Proposed System

The comparison of the existing and proposed algorithm is to differentiate with the parameters is to prove the proposed algorithm is the best way to transmit the packet transmission to control the congestion problem in the network.

Parameters	Existing Leaky Bucket Algorithm	Proposed Index Bucket Algorithm
Variable Packet Size(MB/sec)	25	32
Accessing Rate(MB/sec)	2	4
Delay Time(msec)	500	700
Uniform Output Rate(MB/sec)	2	1
Transmission Time(msec)	5	3



The suggested system is represented in the figure by a comparison between the current and proposed systems. According to the above chart, the suggested method for reducing network congestion is effective.

V. CONCLUSION

When a node receives more packets than it can store during network transmission, some of the packets might be rejected. When congestion first appears, techniques for avoiding it are employed to reduce the impact on the network. The Enhanced Leaky Bucket Index Algorithm is used in the proposed research project to control packet flow. Variable size packets are received by the suggested algorithm, ensuring seamless packet transfer. The Leaky Bucket Index Algorithm is employed to solve the current issue. Additionally, it is done to avoid packet switching congestion. Within the suggested work, network congestion is prevented and controlled by performing a metric computation of packet transmission. FIFO Queuing is one of the ways used to control the flow of packets in the network, and the Enhanced Leaky Bucket Index procedure is another used to prevent and control congestion and eliminate overflow of packet transmission from switches linked to the network. The standard protocols for packet transmission use the suggested Enhanced Leaky Bucket Index Algorithm in the network and transport layers to achieve congestion control.

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