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Research Article

ENHANCING NETWORK PERFORMANCE USING RANDOM EARLY DETECTION IN VIRTUAL QUEUE

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ABSTRACT

The sender host is sends data to destination host through intermediate nodes or directly sometime in wired network. It is rarely possible the sender and receiver are directly connected in same network. The role of route is to collected data from the different hosts and according to route of destination data packets are delivering to destination router. The problem of congestion is occurring in network due to not handling load properly. The Traditional congestion control schemes help improve the performance after congestion has occurred. Throughout congestion data packets are drop in network and network throughput may also degrades and the end to end delay may become very high. Congestion control technique facilitates the network to recuperate from the congestion situation. In this paper we proposed the congestion control multipath virtual queue management technique with RED protocol in wired network. In this technique the congestion is handled by properly by applying RED mechanism with AVQ in multipath network. The multipath path routing is provides the alternative path that's why it is better than the unipath routing protocol. The throughput is improve and delay is minimizes that enhance network performance. The proposed scheme performance is compare with the protocol performance of Droptail, Unipath, RED Unipath and AVQ in wired network. The performance all protocol are measured through performance metrics and the proposed performance is showing the better results and better data enhancing in wired network. The proposed mechanism is not completely removes the congestion but handle it properly that shows reduction in packet dropping.

INTRODUCTION

Active Queue Management (AQM)[1-3] is the most widely used research areas in the field of networking for congestion detection and avoidance. The idea used in AQM is to detect early congestion by dropping or marking packets before queue overflow. Router where congestion occurs provides a prior congestion indication to sources to avoid the large queuing delay and reduce packet losses by adjusting their packet transmission rate timely. Active Queue Management (AQM)[2][3] is an algorithm that detects and reacts to incipient congestion to avoid queue from overflows. There are in general two ways to detect congestion: first it can give congestion signal to traffic sources explicitly by setting Explicit Congestion Notification (ECN) bits, second it can be congestion signal to traffic sources implicitly by dropping packets.

The new mechanism is called Adaptive Virtual Queue (AVQ) algorithm maintains two queues a virtual queue and an actual queue. Virtual queue capacity (called *virtual capacity*) is less than the capacity of the actual queue. When a packet arrives in the real queue, the virtual queue is also updated by inserting a fictitious packet to reflect the new arrival. When the congestion occurs and packet is dropped if packet transmission rate is higher than the packet handling capacity of node/link. Packet drop is treated as congestion by the source thus source reduce packet transmission rate to eliminate congestion. Packets in the real queue are marked/dropped when the virtual buffer overflows.

Related work

In this section describe about the existing work those provide AQM and virtual queue mechanism for congestion free communication against wired network.

Srisankar S. Kunniyur[4] *et al* proposed a mechanism called Adaptive virtual queue in 2004. The basic idea of developing the AVQ algorithm is to design an AQM scheme that results in a low-loss, low-delay and high utilization operation at the link.

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From authors point of view the AVQ mechanism out performs a number of other well-known AQM schemes in terms of losses, utilization and average queue length. In particular, this mechanism is able to maintain a small average queue length at high utilizations with minimal loss at the routers.

Anand Rao [5] *et al* presented a mechanism Compound TCP (C-TCP) is presently the default transport layer protocol in the Windows operating system. In which study a non-linear fluid model of Compound TCP along with Virtual Queue (VQ) management schemes in network routers. Objective of this mechanism is to driving the link utilization to a desired level. Analysis of the AVQ policy shows that the system is liable to losing local stability with higher feedback delays, high link capacities, and with variations in the AVQ damping factor.

K.Chitra [6] *et al* presented a mechanism called FAVQCHOKe. In this title, arrival rate at the network link is maintained as a principal measure of congestion to improve the transient performances of the system and ensures the entire utilization of link capacity. This characteristic is particularly beneficial to real-time multimedia applications. Further, FAVQCHOKe achieves the above while maintaining high link utilization and low packet loss.

Mr. A.Chandra [7]*et al* presented a mechanism called Adaptive Virtual Queue with Choke Packets (AVQCP). In this mechanism choke packets are sent to the source when the virtual buffer overflows. Then source reduces its traffic sent to a particular destination by some percentage when it receives a choke packet. Sources ignore repeating choke packet for a fixed interval of time. If no further choke packets arrive after a certain time, the source will again increase the traffic. This mechanism gives better throughput than other AQM scheme.

Chin-Ling Chen[8] *et al* presented a mechanism called Proportional Rate based Control (PRC), is proposed to maintain the queue length as the level 1 by adjusting maximum desired rate if arrival rate exceeding the maximum desired rate by dropping the; at level 2 virtual queue to control packet transmission if arrival rate above minimum desired rate. The performance of PRC is compared with several well-known AQM, the proposed scheme is more effective which stabilize the queue and has lesser loss rate.

Qian Yanping *et al* presented a rate-based stable enhanced adaptive virtual queue (EAVQ) algorithm [9]. The concepts of this algorithm are measures of congestion, as well as desired link utilization ratio. Arrival rate at network was maintained as a principal measure of congestion. the specified link utilization magnitude relation was used as a subordinate measure and a rate-based adaptive mechanism that resolve the issues, like hardness of parameters setting, poor ability of anti-disturbance, and a little link capability loss. EAVQ improved the transient performances of the system and ensured the complete utilization of link capability.

Hao Wang *et al* propose effective AQM algorithm, named adaptive real queue control (ARQC) [10]. In which an explicit congestion indicator, virtual regulating time, is meant to detect network congestion. This title provides the tuning rules for the control parameters support the discrete model of TCP dynamics. Simulation results demonstrate that ARQC outperforms the other AQM schemes in terms of stability, responsiveness and robustness in dynamic networks.

Prasant Kumar *et al* [11] explore the impact of buffer size and round trip time (RTT) on AQM router where TCP Reno is used as transport protocol in single bottleneck dumbbell topology. Among several AQM techniques, this title considered random early detection (RED), random exponential marking (REM), proportional integral (PI) and adaptive virtual queue (AVQ). Simulation results shows that the RED and AVQ obtain better stability than REM and PI by regulating queue length around its expected value. However RED and AVQ techniques drop more packets than REM and PI.

Manoj Kumar Prajapati, Divakar Singh[12] "Verifying Queue Length Scheme in Wired Communication for Congestion Control" in this title they discuss with the continuous increasing demand of internet applications. Network`s are expressing a serious congestion problem. In very large networks with heavy load traffic, Internet routers play an important role during congestion. All the internet routers have some buffers at input and output port which holds the packets in the time of congestion. Many queue management algorithms have been proposed but they mainly focus on fixed queue limit. Recognizing the fact that drop tail algorithm has fix maximum queue limit ,they direct our attention to variable Length queue limit for Combined Input and Output queued (CIOQ) switches. They propose a simple modification to the drop tail algorithm in which a generic queue management controls methodology in TCP/IP networks, that case they dynamic change queue length in our wired network.

Proposed Work

Communication medium solve the problem of intercontinental communication in real time from voice and video data exchanging, that field repaid growing the network backbone and also increases the challenges to the network researcher day-by-day. Some challenges are security, congestion, deadlock, clock synchronization etc. out of these challenges congestion is a measure challenge because that generate deadlock problem, so from the past decades of time to nowadays, many researchers apply the knowledge and overcome the congestion problem through various long term as well as short term technique. In long term mechanism communication cable are modified i.e. coaxial, unshielded cable, shielded twisted pair, fiber optic communication, wireless communication. Out of which fiber optic communication provides maximum bandwidth and reliable connection in worldwide in that era. Due to growth of worldwide internet, prepositional users, wired communication faces the problem of congestion because network internet backbone is extremely complex and also day-to-day traffic load are raise, that increases the network congestion in vice versa time. Long term congestion resolving is practically not possible, because it takes lots of time to formation new idea and its deployment. In this proposed approach solve the congestion problem using short term technique i.e. memory utilization (queue deploy) of the devices/routers, those are drop tail, red, virtual queue (vq) etc. but in previous work all the existing queue are implemented, Nowadays Random Early Detection queue are most widely used for adaptive queue

management (AQM) techniques [4][5]. RED prevents global synchronization deadlocks, and bias against massive flows to overcome limitation of Drop Tail queue. RED technique detects incipient congestion by using two important parameters i.e. minimum threshold (min_{th}) and maximum threshold (max_{th}). The average queue size (avg_q) is calculated for every packet arrived at the router. Then it compares the avg_q with two defined threshold value min_{th} and max_{th}. If avg_q is less than min_{th} then no packets are dropped or marked. If avg_q is in between min_{th} and max_{th} arriving packet is marked with probability P_a, where P_a is function of avg_q. if avg_q is greater than max_{th} then it drops all incoming packets to lower the queuing delay. If packet drop/mark is occurred in queue source reduce packet transmission rate to reduce packet loss and improve packet delivery ratio. So out of which random early detection (based on adaptive queue management) efficient in contrast of reliability as well as usability, from random early detection queue we proposed a mechanism and to enhanced RED through Adaptive Virtual Queue (EAVQ).

Proposed Adaptive Virtual Queue (EAVQ) implemented in every router whose provide connectivity to multi user environment, every router create individual RED queue for different senders and all the queue size initially equals, while the multiple sender sends the data to the routers than queue utilization are diverse for different users that depends on sender data rate. So in our proposal, based on queue utilization of the router, for set of s sender fetch the data to set of n queue in the router, and some situation queues like n_1 and n_2 utilization are differ because sender s_1 data rate higher than the sender s_2 it means n_1 utilization greater than n_2. Those queue utilization create the wastage memory requirement because one sender demand extra queue and another under load utilization condition, so resolve this condition through threshold based queue detection, if the n_1 queue greater than the threshold utilization and n_2 queue less than the threshold than ∂ queue size share by the n_1 from n_2 queue. That done virtually so it's provides better utilization of queue and provides reliable, less congested communication as compare to existing methodology to the wired network.

AVQ-RED performance is better than the AVQ-Drop tail mechanism in terms of better queue utilization, higher throughput and low packet loss rate. Thus proposed mechanism EAVQ will utilize the queue better and gives the higher performance than existing AVQ.

Proposed Algorithm

Random early detection (RED) is a adaptive queue management mechanism are used, so that RED provide adaptability of queue according to data sends by sender and minimized the data drop from the network. In this section we enhanced RED queue using proposed adaptive virtual queue sharing algorithm, that algorithm describe in three parts input parameter, output and steps uses for execution. In the input parameter initialized all the required constraint for network design i.e. router, sender, receiver, queue, data rate etc. and execution steps those input needed algorithm runs. In our proposed algorithm distance vector multipath routing are uses that search the route from source to end server and sends data through multiple paths. Multipath routing balance the network load based on channel capacity and sends data, in the data transmission while two sender share the common routers than independently queue are created in the router, those queue are share by both senders based on data within the queue, i.e. q1 utilization larger than the q2 and utilization threshold than q1 increases by ∂ and q2 decrease by ∂ that virtually adopted for both senders and minimized data drop as compare to RED technique and gives better output respect of network performance.

Algorithm: Random Early Detection with Adaptive Virtual Queue

Input

W: wired nodes
R: routers
S: Sender nodes
E: end server
q: $\{q_1, q_{2.....} q_n\}$ set of queue
q_u: $\{q_{u1}, q_{u2.....} q_{un}\}$
q_{th}: queue threshold
∂: queue change
d_r: initial data rate
λ: data rate change
I,O: input/output link capacity
Red, Drop Tail: queue type
DM: Distance vector multipath

Output: data drop, pdr, throughput, end-to-end delay, data send, data receives analysis
Steps: Initiate route-search (DM, S, E)
If R in network **than**
R_{table}← generate routing table
R_f← forward packet to next R or E
If E found by DM **than**
E← receives routing packet by different path
E← Send Ack to S by reverse multipath path
Send (data, S, E)
Else
E← receives routing packet
E← Send Ack to S by reverse path
End if
Else
E not found or R not exist
End if
Send (data, S, E)
Identifies link capacity from s to R
i_1← store for s_1 to R
i_2← store for s_2 to R
Identifies link capacity from R to E
o_1← store for R to E
o_2← store for R to E
If $i_1 > o_1$ && $i_2 > o_2$ **than**
Router R create respective q for respective s
q_1← assign to s_1
q_2← assign to s_2
q_{type}← RED/Drop tail
End if
s_1, s_2 send data to E
For path 1 to n **do**
While $d_{r1} > d_{r2}$ && $q_{u1} > q_{th}$ && $q_{u2} < q_{th}$ **do**
q_1← $q_1 + \partial$
q_2← $q_2 - \partial$

$d_{r1} \leftarrow d_{r1} - \lambda$
$d_{r2} \leftarrow d_{r2} + \lambda$
End while
End for

Proposed Functional Architecture

In this section describe about the functional architecture of our proposed work, that architecture divided into four parts these are queue implementation, router configuration, design wired communication and analysis of network. In this architecture adaptive virtual queue share the queue based on utilization of queues and share the virtual space from other queue whose utilization less than the threshold utilization of queue. The connectivity is described in the diagram.

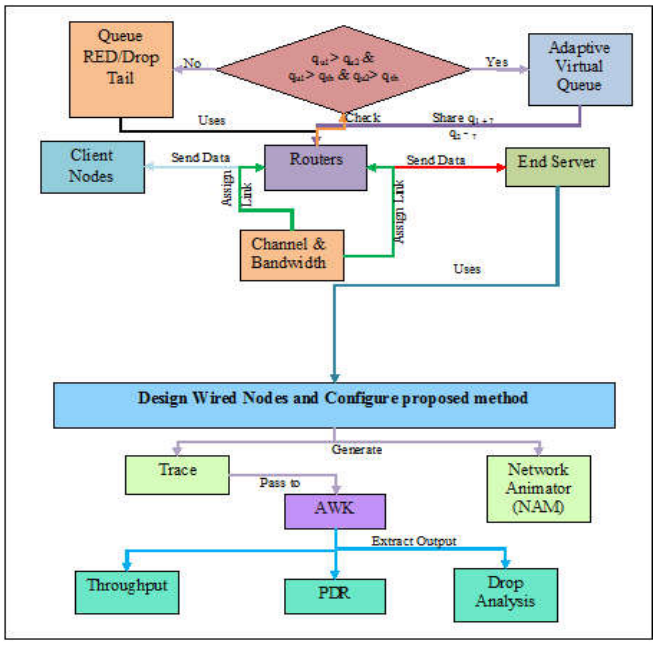

Figure 1 Proposed Functional Architecture for AVQ-Red Method

Simulation Parameters

The simulation parameters are considered for simulation of wired network is mentioned in table 1. In this wired network the number of devices for communication is considered 20 in network. The router is taking routing decision connected with duplex link in network.

Table 1 Network Simulation Parameters

Parameters	Type
Network Type	Wired
Nodes/Devices	20
Physical Medium	Wired
Number of Router	8
End Server	2
Queue Type	Red, Drop Tail, AVQ-Drop Tail, AVQ-Red
Simulation Time	100 seconds
Link Type	Duplex Link
MAC Layer	802.3
Routing Protocol	DV (Uni-path), DM (multipath)
Link Capacity	5MB (from node to Route), Route-Router (50Kb to 5Mb)
Traffic Type	CBR
Agent Type	TCP/UDP

The performance of four protocols is measures on the basis of these performance metrics and the performance of proposed virtual queue method of handling congestion is better in network. These parameters are common in all scenarios for exact measurement of performance in network.

Simulation analysis

In this section describe about simulation analysis result through various parameters, for those analysis apply the network simulator-2 and generate network depended analysis etc.

Packet Delivery Ratio Analysis

The measurement of packets receiving on the respect of sending in percentage ratio is calculating through PDR performance metrics. In this graph the PDR performance of four protocols like Drop tail Uni-path, RED Uni-path, AVQ with Drop tail Multipath and proposed AVQ with RED Multipath is measured and recognized that the performance of proposed scheme is provides better performance due to handle congestion problem efficiently. The better packet receiving provides efficient data delivery in network. The PDR performance w.r.t is mentioned in given graph of all existing protocols in wired network. The PDR performance of proposed AVQ with RED in Multipath is provides better results as compared to AVQ with Droptail in multipath packet receiving up to end of simulation time. The proposed performance has shows better results as compare to all existing three of them shown in figure 2.

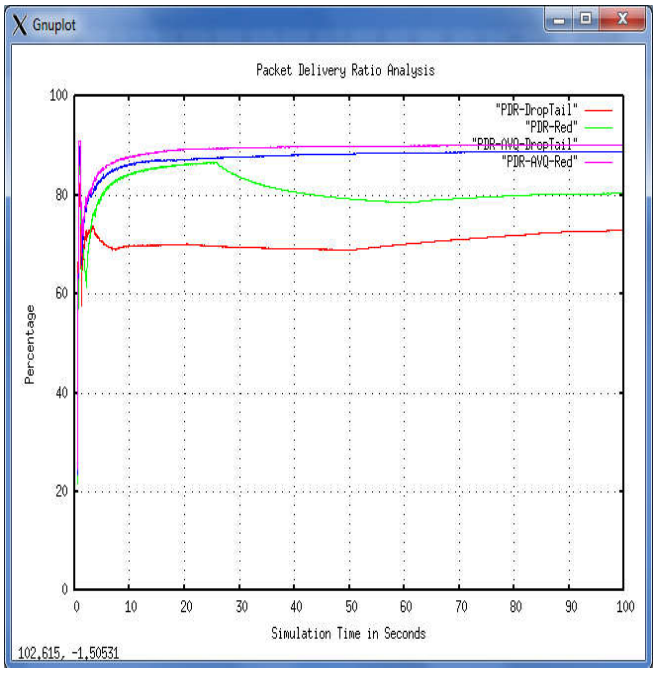

Figure 2 PDR Analysis during simulation

Average e-e Delay (ms)

The reason of delay in network has many reasons like loss of link, lack of synchronization in between sender and receiver, data dropping and many more. The delay in network is also reduces data packets receiving. The number of nodes in wired network is directly connected through physical link and these links are directly connected through neighbours. The delay analysis of all four protocols is measure and observes that

proposed protocol performance is shows minimum delay because of better data receiving shown in table 2.

Throughput analysis

The number of sender and receiver in wired network are connected through routers and these routers are decided the route according to destination availability in network. The function of router is to routed data packets in between sender to receiver. In this graph throughput performance of all protocols including existing and proposed is evaluated and scrutinize that the performance of proposed scheme is give better results because of handle load in wired network efficiently. The proposed protocol throughput is about 260 packets/seconds in network and rest of them performance is very poor as compare to proposed shown in figure 6.

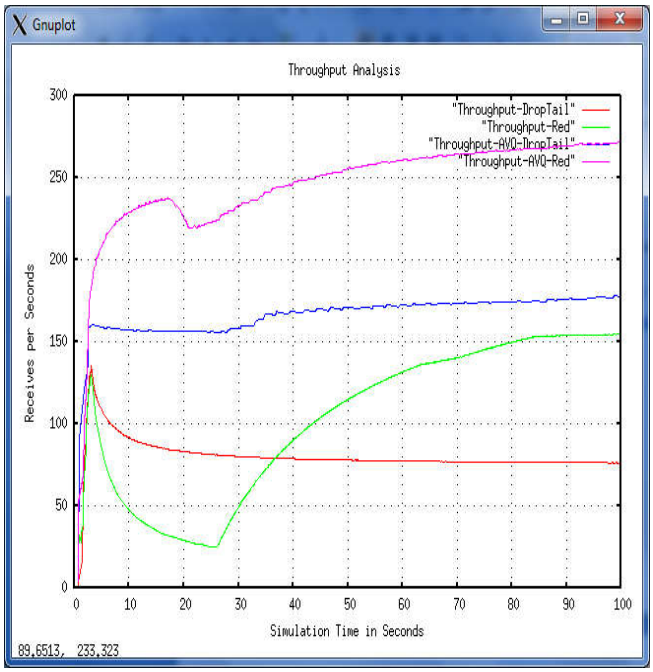

Figure 3 Throughput Analysis during simulation

Table 2 Overall summery

	DropTail Unipath	RED Unipath	AVQ-DropTail Multipath	AVQ-RED Multipath
PDF	71.61	70.25	88.75	89
Average e-e delay(ms)	1963.9	697.95	1826.35	1006.31
No. of dropped data (packets)	1297	907	173	155

CONCLUSION AND FUTURE WORK

The congestion is the major problem in network and their anticipation and avoidance is only possible if identified the congestion is occur in network. The number of senders is sending data according to available bandwidth and nodes processing capability. In wired network the link is reliable because directly connection to another node that is nearest to destination or router that is forwarded data to destination host area. In this research we proposed the congestion control scheme to handle the extra load in network properly. The proposed mechanism is work is limited bandwidth that is considered in all scenario with limited processing capability of sender and receiver host. The multipath routing is always provides better result than unipath routing but it is also possible to improves multipath routing performance. The Unipath Droptail and Unipath RED performance is performing unipath routing in wired network. The multipath routing is the advance routing mechanism of unipath routing and in this multipath the concept of AVQ is showing better network performance. But the proposed protocol is enhance the performance by applying AVQ with RED in multipath routing and their performance is showing best result as compare to rest of three protocols considered in this research. The load in network is detected by RED that's why it is better with AVQ. The proposed protocol is minimizes the delay and packet dropping and due to that the packet receiving, throughput and PDR is provides better results shown in Table 2. The proposed protocol handles the congestion state more efficiently and provides better communication in between sender and receiver.

The multipath routing is able to handle congestion with AVQ and RED mechanism in wired network. In future we proposed the congestion control scheme based the route selection having minimum load in network. It means just predict the load on the route on the basis of their historical information in wired network. And also possible if lightly loaded route is not available then to maintain synchronization in between sender and receiver before data sending in network.

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