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A survey on TCP-Vegas congestion control mechanism over wireless link

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Abstract- *TCP(transmission control protocol)is called as transport layer reliable protocol. Bigger challenge for TCP is to keep the updated protocol in the communications network with large bandwidth and delay. When TCP used in wireless network will suffer from performance degradation . Among all TCP Variants like TAHOE, RENO, NEW RENO only TCP-VEGAS has better throughput and stability than other TCP variants. Vegas estimation procedure of the propagation delay i.e. BaseRTT for each packet in the network. We can improve Vegas performance using estimating threshold value for heterogeneous network. In our work we analyze how TCP-VEGAS better than other using NS2 network simulator.*

Keywords: *congestion control, TCP variants ,TCP-Vegas,heterogeneous network*

I. INTRODUCTION

Internet performance is depending on transmission control protocol (TCP) congestion control mechanism. When total number of packets sent to the network is greater than the network capacity, congestion occurs in the network so packets are dropped. TCP congestion control aims to moderate the sending rate in order to avoid congestion. Several versions of TCP are improving the performance of the basic TCP algorithm. TCP variants can be classified as packet loss based algorithms are TCP-RENO and TCP-NEWRENO. Second is delay based algorithm like TCP-VEGAS[1].mainly TCP provide connection between two nodes and also take decision about in which way transmission ,formation and routing perform on packet data at receiver side[1].

TCP LAYERS:

1) Link layer :-mostly used in local communication network.

2) Internet Layer:-used in LAN and wide area network.

3) Transport layer:- used for communication among all nodes.

4) Application layer :- for transmits application, messages and more .provide communication between clients and server[2].

II. CONGESTION AVOIDANCE ALGORITHM

Congestion means overflow of network. Where a link carries more data resulting in queue delay, packet loss and blocking of new connections. Congestion occur when bandwidth is not sufficient [2].

There are many algorithm that given ensure about our packets are not lost.

(a) AIMD(additiveincrease/multiplicative decrease):-

This is a feedback control algorithm used in Congestion Avoidance. Remain constant. It is stable. Simple Congestion Control Method used timeouts. b for that retransmissions required because of that hosts have perfect estimation of round trip time RTT[2].

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cwnd is increased by 1 with each packet sent. cwnd incremented with each ACK. Window not allow bellow packet size[2].

Step 2: then retransmit the lost packets.

Step 3: Set as congestion window= ssthresh + 3.

step 4. if same dupACK received set cwnd++ and send new packet.

Step 5: if we get non-dupACK for that set cwnd = ssthresh. Increment cwnd[2].

(b) Slow start :-This slow start algorithm used for controlling congestion in the communication network.

Algorithm:

1:First initialize cwnd by one.

2: Then increment cwnd with each acknowledgement received.

$$cwnd \leftarrow cwnd + 1$$

3: Change value of cwnd with RTT:

$$cwnd \leftarrow 2 * cwnd$$

4:Enter in to the phase of congestion avoidance mechanism,

$$cwnd >= ssthresh$$

It increment window size each time the packet is received. it stop when loss occur or reach at the size of receiver's congestion window[2].

(c)Fast retransmission:-This is one of the improvement in TCP which reduce the senders waiting. TCP give dupACK when data is unordered at receiver side[2].

Some time TCP does not find the reason of packet loss and dupACK generation, it waits for some amount of time of dupACK. If there is just reordering of a packets for that only one or two dupACK. If three or more dupACK are received at send side. it show the packet is lost and required retransmission of that packet[2].

(d)Fast recovery:-

step 1: Set ssthresh to the current cwnd size.

III. TCP-VEGAS

The founder of TCP-Vegas was Brakmo, O'Malley & Peterson in 1994.TCP-Vegas uses the estimated difference between the EXPECTED and ACTUAL throughput. It shows the total available bandwidth in the network, regulate the transmission rate based on this value avoid congestion.

Basic algorithm says that when the network is free from congestion actual and expected diff is close.If network is congested then actual throughput smaller than actual. TCP-Vegas adjust its cwnd by following equations.

$$cwnd = \begin{cases} cwnd + 1 & diff < \alpha \\ cwnd - 1 & diff > \beta \\ cwnd & \text{otherwise} \end{cases} \qquad (1)$$

$$diff = ExpectedRate – ActualRate \qquad (2)$$

ExpectedRate = cwnd(t) / BaseRTT (3)

ActualRate = cwnd(t) /RTT (4)

BaseRTT is the minimum encountered RTT of the connection, cwnd (t) is used for current congestion window size and the actual RTT called round trip time. α and β are parameters whose values are typically set to 1 and 3 respectively.

TCP-Vegas is capable to detect congestion in the network early level and to prevent periodic packet losses that usually happen in TCP Reno[1].

- When diff < α it means the actual throughput is less, hence sender consider underutilization the available bandwidth and linearly increase the window size.
- When diff > β in case Vegas will decrease window linearly and when diff is between α and β congestion window remain unchanged.

TCP-VEGAS calculate the time difference for every packet sent and calculate round trip time on each acknowledgment received .if the difference between current and last packet time is large then it retransmits the packet by avoiding 3dupACK[1].

(a) *Estimate threshold value of TCP-vegas for heterogeneous network[11]:-*

Vegas perform better on wired network. But when used in heterogeneous wireless link some unfairness and packet-loss problem faced by network operator[11]. Few changes required in basic Vegas mechanism of congestion avoidance for getting higher throughput and stability[11]. For that we take two threshold value and adjust dynamically based on current network condition from that we can adjust total queue length of vegas that contain total number of packets[11]. calculate changing value for RTT from that packet size define as a

packet size=rate*baseRTT+Q

rate is sending rate and q is number of packets within queue in the network[11].

IV. RELATED WORKS

Many works have been done for making Vegas performance more better over wireless link. But they have some disadvantage like rerouting and fairness problem in Vegas. So that in [1] authors have tried to solve the rerouting and fairness problem. When connection is changed this type of problem faced by the network operator. In [3] author realize Vegas increase its congestion window when delta < α without considering the quantity of the delta. When delta value is either 0.1 or 0.9, it behaves same. in that proposed modified algorithm that adjust cwnd using modified congestion avoidance method. In [4] author propose different mechanism to adjust the window size, this allows TCP to provide much better fairness regardless the large variation of RTT's. Instead of using the rate difference, we convert the delay variable into virtual queue occupancy (VCQ) [4]. In [5]identify the cause of performance decreasing in TCP-Vegas for that sender side mainly number of three modifications are perform and propose algorithm as TCP New Vegas like packet pacing, packet pairing, rapid window convergence [5]. In [6] author observes that TCP-VEGAS not perform well on multi-hop ad hoc network and for that propose new algorithm VEGAS-W by changing the probing mechanism of legacy TCP-VEGAS. Improve the throughput up to 87% AND 27% OVER few [6]. In [7] result show that adjust the parameters adaptively based on different network condition over wireless link. Adaptive Vegas improve bandwidth allocation called TCP adaptive Vegas[7].In[8]when congestion identified in backward path in that situation Vegas cannot able to remove degradation in throughput of network[8]. Provide enhanced TCP VEGAS improves the throughput when backward path is congested[8].From the Receiver side one acknowledgment denoted as ACK generate for every data packet received for that TCP throughput decrease due to large number of ACK generation[9]. In [9] result improves the throughput with less delayed ACK. In [10] another improvement of TCP-VEGAS as Quick Vegas used increment in history and estimated latently[10]. This algorithm improves fairness and stability on delay product network [10].

V. RESULT OF SIMULATION

The intention of this modification to TCP Vegas has been the achievement of better fairness while preserving throughput approximately the percent of increment in fairness has been observed show that the performance improvement in Fig 1. Show comparison between TCP-ArtaVegas and TCP-Reno and Fig 2 show TCP-Vegas and TCP-Reno [4]. In Fig 3 show variation of fairness of the two connections with bottleneck bandwidth [4].

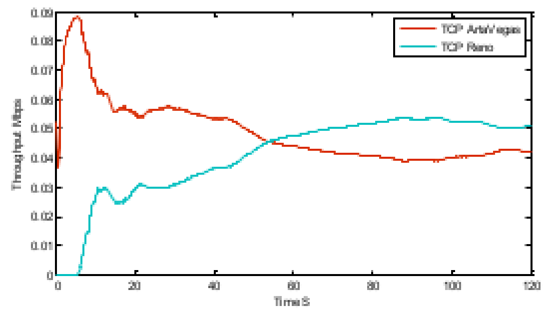

Fig 1. Tcp-Arta Vegas and TCP-RENO

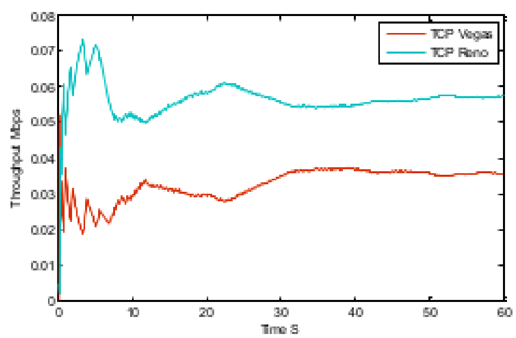

Fig 2. TCP-Vegas AND TCP-Reno

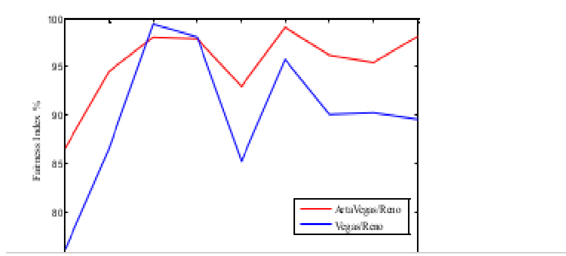

Fig 3.variation of different fairness

Above figures show that the throughput of TCP-RENO and TCP-NEW RENO. In Fig 6 show TCP-Vegas throughput improvement. Next simulation shows PDF variation and improvement over wireless link.

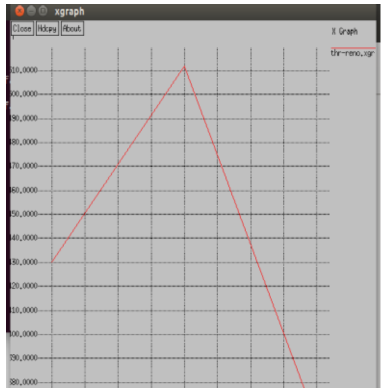

Fig 4.TCP-Reno throughput

Fig 5. TCP-New reno throughput

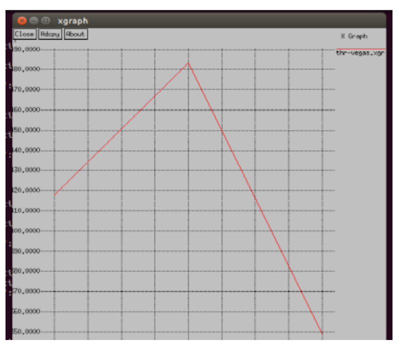

Fig 6. TCP-Vegas throughput

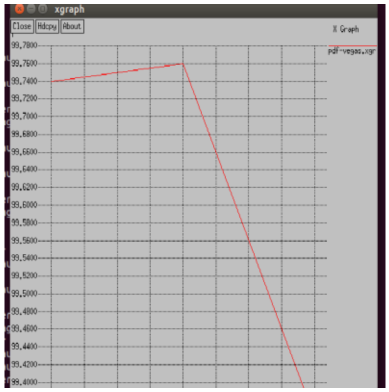

Fig 7. TCP-Vegas PDF

VI. CONCLUSION/FUTURE WORK

This paper shows comparison among congestion Avoidance mechanism. Mainly in that we show congestion avoidance depend on network performance. By studying these literatures we know that TCP-VEGAS have better throughput and stability than other TCP variants.

In future we can adjust TCP-VEGAS parameters dynamically and identified the causes of packet loss rather than congestion.

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