Performance Evaluation of RED and REM Algorithms in TCP/IP Networks

التقييم الادائي لخوارزميتي RED & REM في شبكات TCP/IP

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Abstract:-

The new of internet applications and the traffic coming with it are rapidly growth, the developer of the internet infrastructure needs a high level of quality of services. The high quality of service (QoS) makes main problem with uncontrollable amount of traffic (Congestions) on the internet.

Usually, the internet routers are content two types of queue management mechanisms reactive and proactive mechanism, this paper focus on two important proactive mechanisms these are Random Early Detection (RED) and Random Early Marking (REM), and how to improve the performance of the internet routers by chose the suitable proactive queue management algorithm, these selections are helping the TCP protocol to given guarantee to delivered the packets to the destination.

This paper going to design performance evaluation modelfor examining the RED,REM technique to mitigate the effectiveness of the congestion in the internet routers,and to identify the key parameters to decrease the packet drop in the way to destination by exam many factors such as throughput, packet loss, link utilization, and windowsize by using Network Simulation 2 (NS2). The result shows a good performance for the REM algorithm when compared with RED algorithm in the same scenario.

الخلاصة :

التطبيقات المستحدثة على الانترنت والازدحامات الناتجة عنها في تنامي مستمر، والشخص الذي يطور البنى التحتية للانترنت يحتاج الى مستوى عالي من الخدمات، هذا المستوى العالي من الخدمات يصنع مشاكل رئيسية تاتي من الازدحامات الغير مسيطر عليها والموجودة على شبكة الانترنت.

عادة موزعات الانترنت (Routers) تحتوي على نوعين من تقنيات ادارة طوابير وهما:تقنية تفاعلية وتقنية استباقية . والمقالة تركز على اثنين من التقنيات الاستباقية الهامة وهما (REM ,RED)

وكيفية تحسين الاداء الوظيفي لموزعات الانترنت (Router) لأختيار الخوارزمية المناسبة في التفعيل الاداري لتعطي هذه الاختيار ات تساعد قوانين ال (TCP)الظمان لأرسال الحزم الى وجهتها الصحيحة.

هذه المقالة سوف تصمم تقييما أدائيا لأجل دارسة وأختبار تقنية ال (REM & RED) لتخفيف حدة تأثير التظار باتفي موزعات الانترنت، وكذلك لتقليل فقد ان بيانات الحزمة في الطريق الى المقصد، مع دراسة العديد من العوامل مثل الانتاجية، فقدان الحزمة ،حجم الاطار بأستخدام محاكي الشبكة من الجيل الثانيNS2

1. Introduction

A computers network are a collection of resources which has a finite capacity that causes users to compete for the network resources such as buffers, transmission bandwidth and processing time. As stated by [1], the limitation of capacity can result in a degradation of performance of the system to the point that the throughput of the system goes to zero. If the network is overloaded, the throughput degradation becomes unavoidable. Networks cannot afford to accept all the traffic that is offered, unless there is a control system. Therefore, there must be regulations which regulate the receipt of traffic from outside and manage the flow inside the network.

Congestion problems can appear when the load on the network is greater than the network capacity. These problems cause large delays in data transmission, frequent buffer overflows, and high packet loss. Congestion collapse happens when capacity is wasted sending packets through the network that are dropped before they reach their destination—for example, because of congestion at intermediate nodes.

As the Internet is implemented based on TCP/IP protocol, it has become crucial to operate a queue management mechanism that can improve Quality of Service (QoS). According to Mahbub[2]), the performance of TCP applications relies on the selection of a queue management mechanism in the network.[3]have defined a queue management mechanism as the algorithm that controls the router's queue by dropping packets when necessary

In TCP/IP networks, packet loss is used as a sign of network congestion. When congestion happens, TCP sender controls its sending rate by reducing its congestion window size (cwnd). The TCP window size is determined by the rate of received acknowledgments (ACKs) to the packets sent earlier. The rate of ACK arrival is in turn determined by the presence or absence of congested link(s) along the path between a source and its destination as stated by Ryu[4]

2. The Importance of the Router Buffer

According to Braden [3], it is necessary to have a buffer in the network routers buffer temporary increases in the packets arrivalin order to avoid packet loss, and to transmit the buffered packets during the ensuing silence periods to utilize the link in the network.

Therefore, buffer is important for the transport of unpredictable traffic patterns which in turn contributes to the improvement of network utilization in terms of increasing the outgoing transmission link utilization and the network performance in terms of decreasing the packet loss. The buffer capacity at the router plays an important role in treating the sudden increase in the data traffic as stressed by Srihari[5]. Furthermore, Mahbub[2])mentioned that buffers are used to absorb the difference between the required and available transmission capacity. Even higher the throughput can be gained when using large buffer sizebut the delays will be more. Thus, it is necessary to maintain small steady state queues in routers to guarantee the continuous availability of capacity at the router and low queuing delays. Hence, it is better to think of buffer limits as reflecting the increase lengths this paper like the routers to be able to absorb rather than the desired steady state queue lengths at the routers as stated by Braden [3].

3. Random Early Detection (RED)

RED'S main goals include:

- Minimizing the packets delay jitter by controlling the average queue size.
- Avoiding global synchronization for TCP traffic.
- Supporting bursty traffic without bias.

Strictly enforcing the upper limit on the average[6].RED aims to control the average queue size by indicating to the end hosts when they should temporarily slow down transmission of packets.

The internet router usually contain several queues that hold packets scheduled to go out on that interface ,and this queue used several algorithms such as DROPTAIL ,RED and REM .There are two approaches depending on the quality of services ; Congestion management and congestion avoidance, the first is done by rearrange the packets arrive to the queue depending on its priority to serve the packet with high priority in the beginning, the second approach (congestion avoidance)

which is dropping packets before congestion on the link occurs. RED is work as a congestion avoidance signaling mechanism.

The RED (also called Random Early Drop) algorithm takes a proactive approach to congestion. There is a threshold In order to use RED, you must decide on three parameters: Min, Max, and burst. Min sets the minimum queue size in bytes before dropping will begin, Max is a soft maximum that the algorithm will attempt to stay under, and burst sets the maximum number of packets that can 'burst through', when a packet arrives, the RED algorithm computes the average queue length (avg) If it is less than Min threshold then there is no congestion or assumed to be minimal, and the packet is queued[7]. If Avg is greater than the upper threshold, congestion is assumed to be serious and the packet is dropped. If Avg is between the two thresholds, this might indicate the onset of congestion. The probability of congestion is then calculated. A drop probability ensures that RED randomly drop packets from only a few flows avoiding global synchronization [6]RED tells the packet source to decrease its transmission rate until all the packets reach their destination.[8]

4. REM Algorithm

The suggestion an optimization based flow control for the Internet called random early marking (REM). The algorithm however requires communication between network links and sources that is not achievable on the current Internet. That adapts source rate to observed marking that probabilistically marks packets inside the network.

In this paper discuss propose a new price computation algorithm for REM and evaluate performance an enhancement that attempts to speed up the convergence of REM in the face of large feedback delays.

REM aims to achieve both high utilization and negligible loss and delay in a simple and scalable manner,Rem improved drop tail adopts random packet drop to avoid global synchronization and deadlock of traffic flows,it also try to keep the instantaneous queue size around the predefined value.

The feature is essential in a network where users typically go through multiple congested links.

REM gateways are designed to accompany a transport-layer congestion control protocol such as TCP

The basic idea in achieving this is to decouple congestion measure from performance measure such as loss, queue length or delay. While congestion measure indicates excess demand for bandwidth and must track the number of users. Sources do not constantly probe the network for spare capacity, but settle around a globally optimal equilibrium, thus avoiding the perpetual cycle of sinking into and recovering from congestion.

This algorithm translates into an enhanced REM schemeand this paperillustrate the performance improvement through

5. Scenario in NS2

To be able to run a simulation scenario, a network topology must first be created. In ns2, the topology consists of a collection of nodes and links.

Creating queue management scenario is important for evaluating the performance of RED/REM Algorithm. In this post a simple scenario will be created.

First this paperwill create eight nodes and generate tcl script. Then this paperwill run the tcl file on NS2.

These eight nodes are as following:

One client, two routers and five servers, Attach a **TCP** agent with the nodes which will works as the source (servers) from which data will be transmitted. Now, attach a **FTP** agent with the node which will work as a sink node (client). Connect the TCP agent to FTP agent for data flow.

After this paperrun the simulation, figure 1 illustrate the NAM for the topology which used in this scenario.

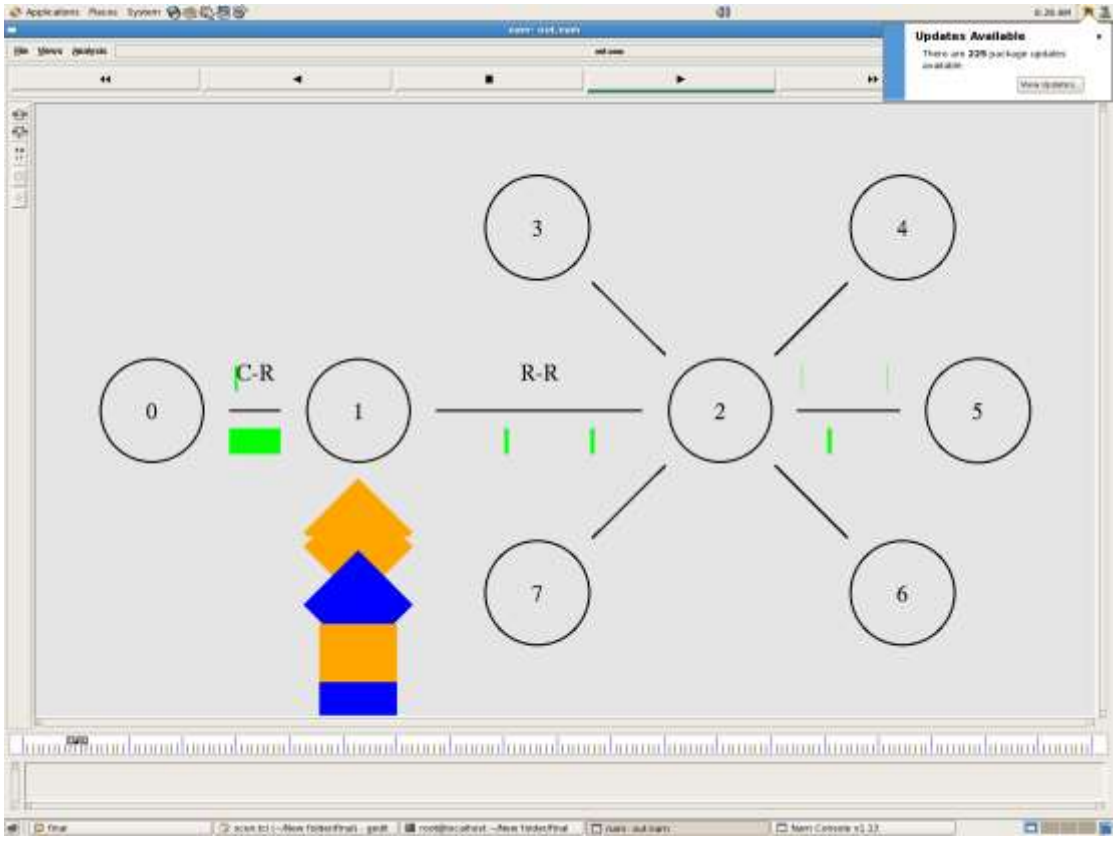

Figure 1: snapshot for the NAM

6. EVALUATION & RESULTS

The design and implementation issues of the performance evaluation model developed to study the performance of the common packet scheduling algorithms used in TCP/IP networks, namely Drop Tail, RED, and REM. .this section compares the performance of the RED/REM algorithms. The performance is compared in terms of the Windows size, packet loss, link utilization, and throughput.

6.1.Packet Loss Comparison

This section evaluate the performance of the RED/ REM algorithms in terms of the packet loss to investigate which one of them is better than other and control over the packet arrival rate. Then this paperfinds that REM algorithm in number of packet drop is better than RED algorithm, next figure shows that:

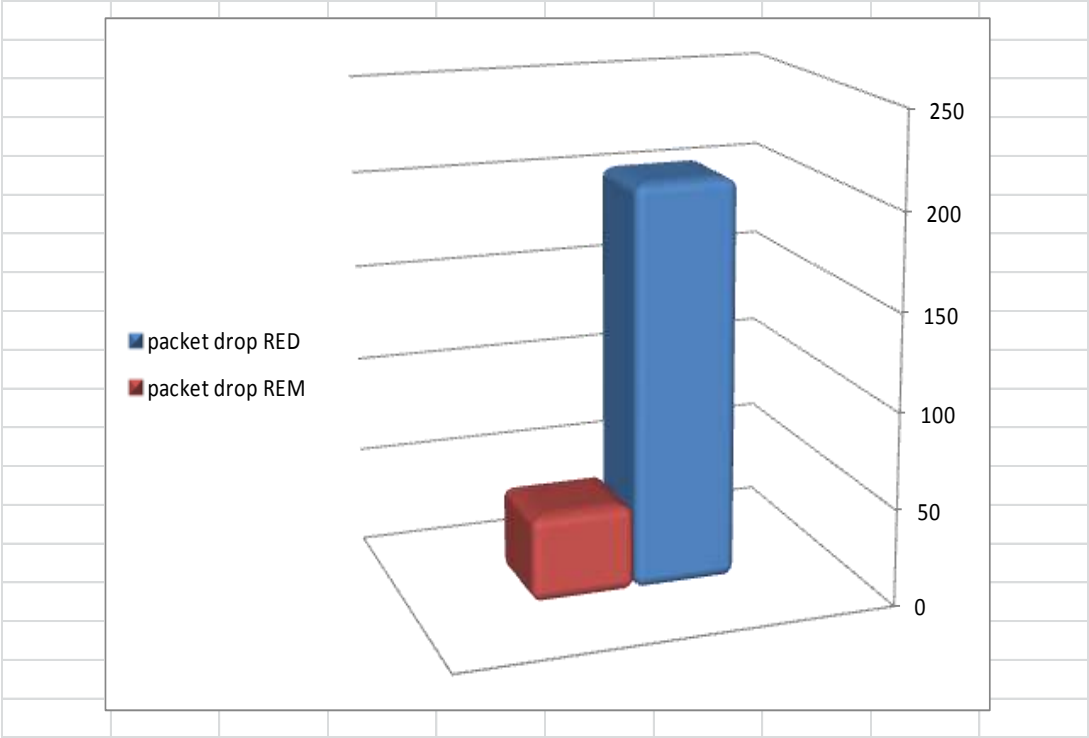

Figure 2: Packet Drop for RED and REM algorithms

6.2. ThroughputComparison

This section evaluates the performance of the RED/ REM algorithms in throughput. this paperfind that RED/REM algorithm have asymptotic average, this figure 3 shows the throughput

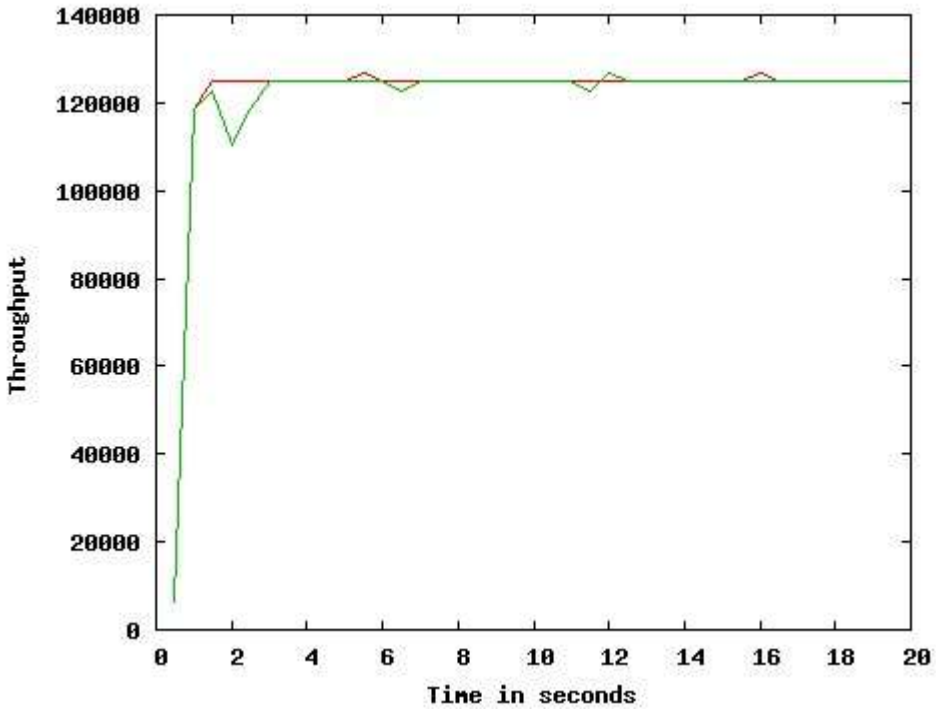

Figure 3: throughput for RED and REM

6.3.WINDOW SIZE

The goal of congestion control is to prevent the effect of congestion collapse, usually by controlling the rate of the sender in some way, and to use the network as efficiently as possible to attain the highest possible throughput while maintaining a low loss rate ratio and little delay.Next figure 4, 5 shows the window size for each algorithms TCP in scenario:

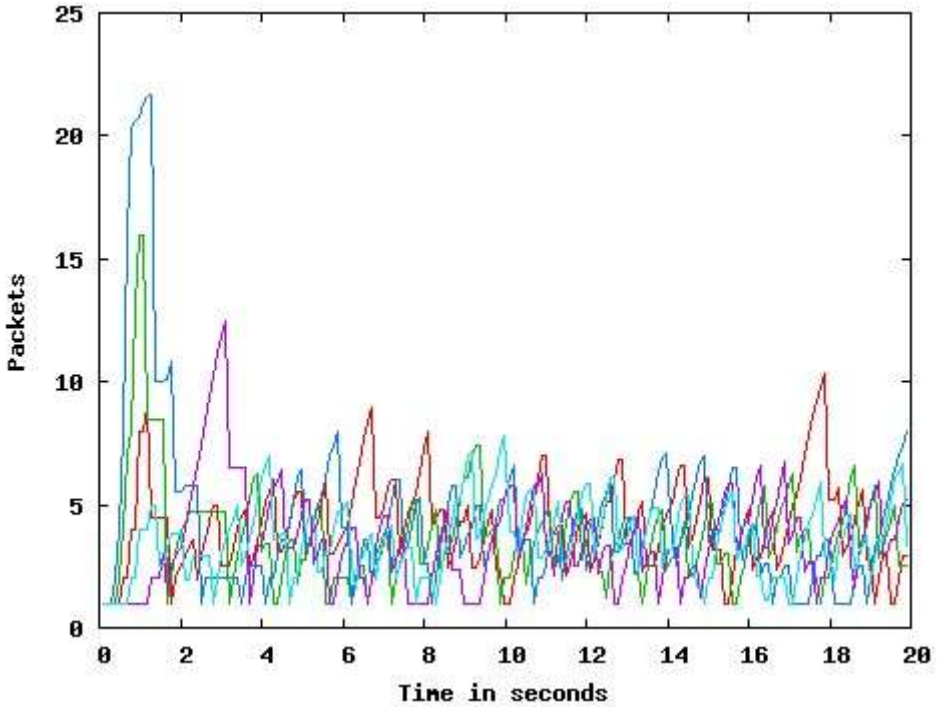

Figure 4: Windows size for RED algorithm

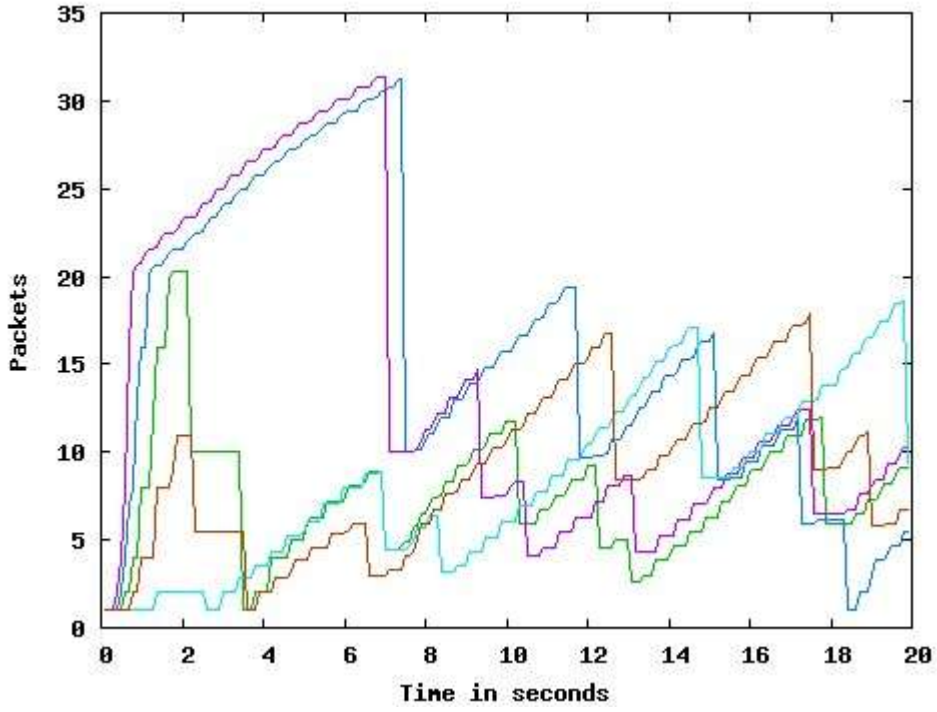

Figure 5: Windows size for REM algorithm

7. Conclusions

According to evaluation result from exist scenario can conclude many important factors that effected the performance of the RED and REM algorithms. As mentions in RED before the loss packets is four times greater than the REM this coming from the normal behavior of RED because it is depend on Drop Packet to manage the traffic or avoidance the congestions, where the REM is depend on the marked Packet to Notify the sender the may be congestion happen if the sender not decrease the windows size of the Packets.

From the throughput part can conclude that the RED algorithm stay have good performance even though the droppacket is more than REM part. This is very clear from the result the throughput performance is the same both algorithm.

The link utilization in the REM algorithm is better than RED part this coming from the more resend the packet happened in the RED algorithm and the same throughput so the RED caused heavy or load on the link to make this throughput .

In the last the windows size in the REM are very stable according in RED the windows size is unstable . SO from this scenario and our result the paper can say the REM algorithm have agood performance when compared with RED algorithm.

REFERENCES

[1] C. E Agnew, "National Networks Including Satellite Service," *International Congress on Transportation Electronics*, 1988.

[2] H Mahbub and j Raj, *High Performance TCP/IP Networking: Concepts, Issues, and Solutions.*, 2003.

[3] B. Braden et al.,"., et al. (Recommendations on Queue Management and Congestion Avoidance in the Internet," *RFC Edito*, 1998.

[4] S Ryu, C Rump, and C Qiao, "Advances in Active Queue Management (AQM) Based TCP Congestion Control.," *Telecommunication Systems*, pp. 25(3), 317-351., 2004.

[5] V Srihari, "Economics of Buffer Space Provisioning in Data-Communication Systems. ," in *the 26th Annual IEEE Conference on Local Computer Networks*, 2001.

[6] Srinivas vegesna, *IP Quality Of Service*. Indianapolis: Cisco Press, 2001.

[7] David D Clark. (1997, July) An Approach to Service Allocation in the Internet. [Online]. http://tools.ietf.org/pdf/draft-clark-diff-svc-alloc-00.pdf

[8] Jacobson. (1999) citeseerx. [Online]. http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.22.9406