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Evaluation of Network Performance Using Upper Threshold RED

[1]***Jai Mungi***, [2]***Prof. Aishwarya Mishra***

1,2Computer Technology & Application
IES Institute of Technology & Management, Bhopal
jaimungai14@gmail.com

ABSTACT

Random Early Detection [RED] algorithm achieves high throughput, packet delivery and low average end to end delay by stabilizing the average queue size through mapping the congestion into packet drop probability and detection and avoidance of incipient congestion. This paper includes the research work done in recent and modified mechanism to control the network congestion by maintaining the average queue length in acceptable range. This mechanism will avoid congestion, so that overall network performance will improve. Goal of this research paper is to gain higher throughput and low end to end delay in highly congested network.

1. INTRODUCTION

A mobile ad hoc network (MANET) is a wireless network model without the need of central base stations. MANETs can be applied in medical emergencies, during natural catastrophes, for military applications and to conduct geographic exploration. Mobile and wireless devices belonging to a MANET are usually called mobile nodes. These nodes are characterized by high mobility, low power, limited storage, and limited transmission range. Mobile nodes communicate through bi-directional radio links and data transmission is a key challenge. MANET communication events are called sessions. The two communicating parties, namely the source node and the destination node comprise a session pair (or source destination pair). A mobile can directly communicate with other nodes if such a link exists within their radio transmission range. If the distance between a session pair is too large to establish direct contact, then the data must be sent via intermediate nodes connecting the two parties. At least one valid routing path must be established before the source node of a session pair can send data to its destination node. MANET routing protocols can be roughly categorized into three categories [1], namely table-driven routing, source-initiated on demand routing, and hybrid routing. Well known source-initiated on demand routing protocols include AODV [2] and DSR. These protocols are based on the strategy of only find valid routes once they are needed by the source node. This procedure is known as route discovery. Route discovery involves the route request phase (RREQ) and the route reply phase (RREP). These protocols all construct a single-path route between a source node and a destination node. Backup routing protocols are usually designed to provide data salvation capabilities for the previously mentioned protocols, and they are classified as a special type of single-path routing protocols. A multipath routing protocol usually establishes several valid paths for a session pair during a successful protocol run. A backup routing protocol mainly establishes one valid primary path together with several other alternative paths during a successful protocol run.

2. RANDOM EARLY DETECTION

Floyds and Jacobson presented a mechanism called Random Early Detection (RED) [3] in 1993. The idea of Random Early Detection is that the router will detect incipient congestion by regular monitoring of the average queue length. If incipient congestion is being detected, router will select the source terminal to inform about the incipient congestion. So the source terminal can be reduced the packet transmission rate before the queue overflow, and it will try to reduce the network congestion. RED [4][5] algorithm congestion detection consists of two steps: in first step this mechanism calculate the average queue length, and in the second step it calculate the packet drop probability. Packet drop probability is used to take decision whether to drop the packet or not to drop; packet drop is taken as the signal of congestion.

A. Calculation of Average Queue Length

RED algorithm average queue length (Avg), calculation is done by using the following formula:

$$Avg = (1-W_q) * Avg + q * W_q \text{ ……………… (1)}$$

Here, W_q represents the weighted value generally in negative power of two, and q represents the actual queue length in the sampling interval.

B. Calculation of Packets Drop Probability

RED algorithm calculates packet drop probability by using two thresholds Min_{th} and Max_{th}, to detect the incipient congestion. Whenever the packet reaches any of the router, it calculates the average queue length (Avg) and then it calculates the packet drop probability based on Avg , and takes decision to packet drop based on Min_{th} and Max_{th}. Whenever avg is greater than Max_{th}, all incoming packets at the router are discarded; at that time packet loss rate is 1. Whenever Avg lies between Min_{th} and Max_{th}, it has the following formula to calculate Packet Drop Probability (PDP):

$$P_b = Max_p * (Avg-Min_{th}) / (Max_{th}-Min_{th}) \text{…. (2)}$$

$$P = P_b / (1 – count * P_b) \text{……………………..(3)}$$

Packet drop probability is used to take decision whether to drop the packet or not to drop packet, packet drop is taken as the signal of congestion.

3. RELATED WORKS

Several solutions have been proposed in the literature for the Queue Management in Mobile Ad hoc Networks (MANET's). Some of them are as follows:

Zhenyu et al presented a mechanism with dynamic reference queue threshold named ARTAQM [7], which offers stable and flexible queue length which reduces packet loss and increases link utilization.

K. Dinesh Kumar et al presented a mechanism called predictive queue management strategy PAQMAN [8], this mechanism reduces Packet loss, Increases packet transmission efficiency.

Torres Rob et al proposed an innovative TCP flow control method [9]. This algorithm combines RED with TCP window adjustment for improving the network performance. The result of the algorithm achieves higher network stability with desired latency and packet dropping rate during fully utilizing the network resource.

Guan-Yi Su et al presented a mechanism called MRED [10], it is modified from RED; this algorithm avoids the sensitivity of RED performance to its parameter setting and it also provides higher transmission throughput. Progressive Random Early Detection (PRED) algorithm has improved by the progressive adjustment mechanism is proposed.

4. NETWORK PERFORMANCE PARAMETERS IN MANET

The following metrics are used in varying scenarios to calculate performance of network

1) Throughput – Throughput or network throughput is calculated as the average rate of successful delivery of message over a communication channel.

2) End-End Delay - The end-to-end delay is the time interval of generation of a packet by the source up to the destination reception. So this is the time that a packet takes to go through the network.

3) Packet delivery rate – This is the ratio of number of data packets received to the total number of data packets originated.

4) Data Dropped – This is the difference between numbers of packet transmitted by source to the numbers of packet received by receiver at receiver end.

5) Network load – this is the ratio of total number of routing messages transmitted to the total number of data packets received.

5. SOLUTION APPROACH

In our proposed algorithm, we have added an additional Threshold for better use of queue space, to enqueue more packets with less packet drops drop rate, when average queue size is greater than max_{th} but lesser than additional threshold named Upper threshold (Uth). As in conventional RED and other enhanced RED algorithm Packet Drop probability increases linearly from 0 to max_p whenever avg reaches between Min_{th} and Max_{th}, If average queue size goes greater than max_{th} then P is set to 1 and all incoming packets are dropped. In order to reduce packet loss and enqueue more packets in buffer, packet drop probability is calculated by another linear function when average queue size reaches between max_{th} threshold and Uth threshold.

6. SIMULATION AND RESULTS

Description of experimental network topology used to calculate the results we have used 20 mobile nodes moving in 500*500 Sq meter area with average speed of 10 m/s in Mobile ad hoc network scenario. Simulation is done in five different scenarios with different thresholds setting. Using the threshold setting Scenario 1 (Minth 10 Maxth 30 Uth 60), Scenario 2 (Minth 18 Maxth 32 Uth 64), Scenario 3 (Minth 12 Maxth 36 Uth 72), Scenario 4 (Minth 16 Maxth 32 Uth 64), and Scenario 5 (Minth 25 Maxth 40 Uth 60). All the simulations are done with RED and UTRED algorithm. Results are compared in terms of Packet Delivery Ratio and Throughput in the mobile ad network using AODV and DSR protocol.

a. Throughput using AODV protocols

Throughput or network throughput is calculated as the average rate of successful message delivery over a communication channel. Throughput is generally measured in kbps.

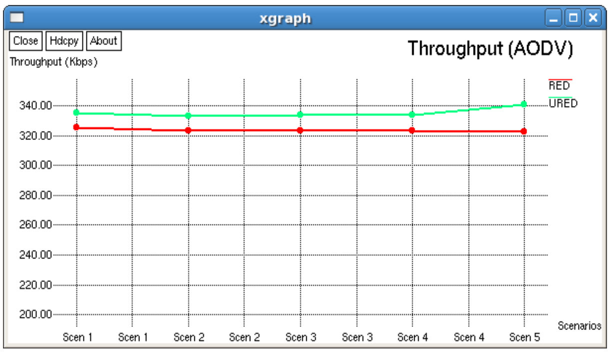

Figure 1: Throughput of AODV Protocol

Figure 1, shows that the throughput is consistently above in each case of using different scenario with different parameter setting. Quantitative measures of throughput between RED and UTRED are given in table 1.

	Throughput (kbps)	
Scenarios	**RED**	**UTRED**
Scenario 1	325.46	335.02
Scenario 2	323.19	332.93
Scenario 3	323.19	333.53
Scenario 4	323.19	333.56
Scenario 5	322.45	340.78

Table 1: Throughput of AODV Protocol

b. Throughput using DSR protocols

Throughput or network throughput is calculated as the average rate of successful message delivery over a communication channel. Throughput is generally measured in kbps.

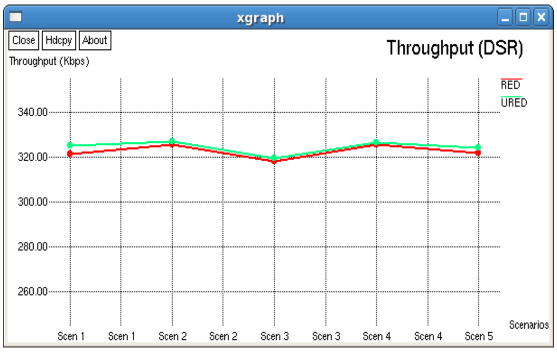

Figure 2: Throughput of DSR Protocol

Figure 2, shows that throughput is consistently above in each case of using different scenario. Quantitative measures of throughput between RED and UTRED are given in table 2.

	Throughput (kbps)	
Scenarios	**RED**	**UTRED**
Scenario 1	321.21	325.0
Scenario 2	325.42	327.17
Scenario 3	318.03	319.56
Scenario 4	325.42	326.65

Scenario 5	321.81	324.25

Table 2: Throughput of DSR Protocol

c. Packet delivery Ratio of AODV protocol

This is the ratio of number of data packets received to the total number of data packets originated.

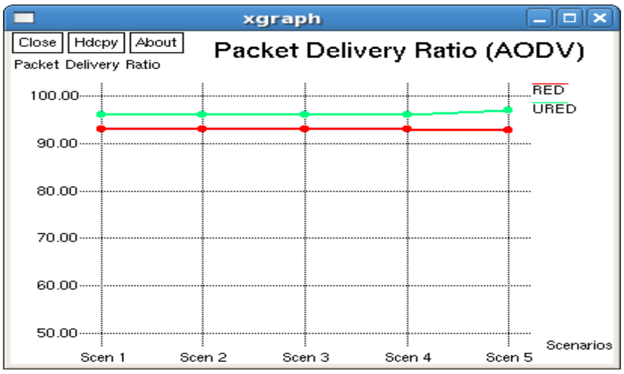

Figure 3: Packet Delivery Ratio

Figure 3, shows that the packet delivery ratio is consistently above in each case of using different scenario. PDR in RED is consistently around 92 and 93 and in proposed UTRED mechanism PDR is around 95 to 96. Quantitative measures of PDR between RED and UTRED are given in table 3.

	Packet Delivery Ratio	
Scenarios	**RED**	**UTRED**
Scenario 1	92.98	96.09
Scenario 2	92.98	95.93
Scenario 3	92.98	95.90
Scenario 4	92.98	95.86
Scenario 5	92.8	96.96

Table 3: Packet delivery Ratio

d. Packet delivery Ratio of DSR protocol

Packet Delivery Ratio is calculated as the number of packets delivered at destination to the number of packet transmitted by the source.

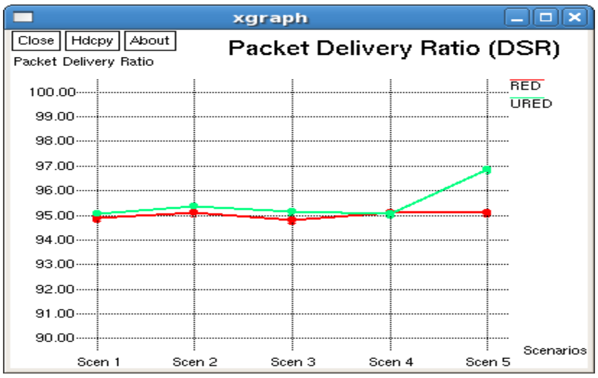

Figure 4: Packet Delivery Ratio

Figure 4, shows that the packet delivery ratio is consistently above in each case of using different scenario with different parameter setting. PDR in RED is consistently around 92 and 93 and in proposed UTRED mechanism PDR is around 95 to 96. Quantitative measures of PDR between RED and UTRED are given in table 4.

	Packet Delivery Ratio	
Scenarios	**RED**	**UTRED**
Scenario 1	94.88	95.08
Scenario 2	95.12	95.35
Scenario 3	94.82	95.15
Scenario 4	95.12	95.08
Scenario 5	95.09	96.85

Table 4: Packet delivery Ratio

7. CONCLUSION

Upper Threshold RED performance is better than traditional RED algorithm in both AODV and DSR protocol. Proposed algorithm has introduce the new threshold for reducing the parameter sensitivity of Random Early Detection and it also decrease the congestion level, this work has been reduced the congestion in Mobile Ad hoc Network and improved the throughput and packet drop probability and packet delivery hence proposed mechanism has improved the network performance.

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