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Effective Impact of ECN with RED to Control Heavy Congestion

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***Abstract*-A Mobile ad-hoc network (MANET) is a self configuring infrastructure less network of mobile devices connected by wireless links. In MANET the proper maintenance of resources and link to avoid congestion is main issues. In this paper our motive is to get better utilization of resources and avoid congestion. For communication system uses queuing techniques, Traditional queuing techniques like Drop tail has been defeated due to their limitations. Therefore we use AQM i.e., RED queue, our focus is to illustrate the strong constrain for entry of packets in queue buffer. In contrast pure RED also has bugs like it does not accommodate Quality of service (QoS). Considering this we use RED with ECN (Explicit Congestion Notification) which marks the packets instead of dropping, it prevents from tremendous packets dropping and overcome from the drawbacks of traditional methods.**

***Keywords*- MANET, Traditional queue management, Drop-tail, Active queue management, RED, ECN.**

1. INTRODUCTION

A network can be characterized as wired or wireless. Wireless can be distinguished from wired as no physical connectivity between nodes is needed. MANET is wireless networks where nodes communicate with each other using multi-hop links [17]. There is no permanent infrastructure or base station for communication. Each node itself acts as a router for forwarding and receiving packets to/from other nodes. Routing in mobile ad-networks (MANET) has been a challenging task ever since the wireless networks came into existence. The major reason for this is the constant change in network topology because of high degree of node mobility. A number of protocols have been developed for accomplish routing in Ad-hoc network. Each station in MANET is free to move independently in any direction. The main challenge in building a MANET is equipped each device to regular maintain the information required to accurate route traffic. One of the challenge in MANET is to handle the congestion comes when the requirement of resource is much higher than the available resources (i.e. congestion occurs when sending more data than the network devices can accommodate), thus causing the buffer almost about to be overflow. Network congestion is somewhat similar to road traffic. Congestion leads to congestion collapse, is the situation in which the congestion becomes so great that throughput drops to low level and thus little useful communication occurs. Typical effects of congestion collapse include queuing delay, packet loss or the blocking of new connection with node, which leads to packet unacceptable condition known as causes packet drop. One more reason may also cause packet losses is due to mobility (e.g., the next-hop node has moved). Although, a mobility loss is a loss that comes when the next-hop node is out of transmission range of node while a congestion loss is a loss that occurs when the next-hop node is still within the transmission range. Unfortunately, neither the MAC layer nor the routing layer is able to differentiate between mobility and congestion losses. As a result, the outing layer treats both types of losses as a sign of a "permanent" route break even though congestion may be short lived. Therefore, even though the current route may still be valid, congestion losses may force on-demand routing protocols into performing superfluous route discoveries that can add significant and unnecessary overhead to the network, So that in this paper we use AODV (Ad-hoc On Demand Distance Vector) protocol [1].

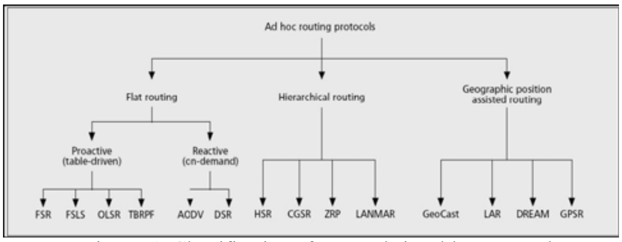

Figure: 1. Classification of protocols in ad-hoc network.

In ad-hoc networks, nodes are not familiar with the topology of their networks. Instead, they have to discover it. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbours. Each node learns about nodes nearby and how to reach them, and may announce that it, too, can reach them. An ad-hoc network has two types of routing protocols-Pro-active (table driven) and Reactive (on demand) shown in figure 1. Static routing is the alternative to dynamic routing, is the process within which the system network administrator would manually configure network routers with all the information necessary for successful packet forwarding. The administrator constructs the routing table in every router by putting in the entries for every network that could be a destination. Static routes to network destinations are unchangeable.

AODV is a very simple, efficient, and effective routing protocol for Mobile Ad-hoc Networks which do not have fixed topology. This algorithm was motivated by the limited bandwidth that is available in the media that are used for wireless communications. It borrows most of the advantageous concepts from DSR and DSDV algorithms. The on demand route discovery and route maintenance from DSR and hop-by-hop routing, usage of node sequence numbers from DSDV make the algorithm cope up with topology and routing information. Obtaining the routes purely on-demand makes AODV a very useful and desired algorithm for MANETs [2]. A common and effective approach for reducing network congestion (and therefore congestion losses) is to use a congestion control transport protocol such as TCP that mediates between competing unicast application-level flows[15]. Unfortunately, broadcasts caused by on-demand routing can still cause significant congestion. In this paper, we argue that route discovery broadcasts are strongly correlated with network congestion and congestion losses. Route broadcasts causes congestion losses which, in turn, trigger new route discoveries, leading to a destructive cycle where congestion be gets more congestion. This cycle is reinforced because after a congestion loss, instead of backing off, a node becomes more aggressive as it injects a large number of route discovery packets into the network. This paper describes extensions to on-demand routing protocols that break the congestion cycle by differentiating between mobility and congestion losses.

II. Related Work

In the communication networking, packets are queued up into the memory buffers of network devices like routers and switches. Packets are arranged in buffer of device in a specific manner which is known as queuing techniques. A queue is also a collection of request waiting to be executed, one at a time. Packets in a queue are usually arranged in according to some specific priority like shortest task first, first in first out, but various techniques may be used to prioritize packets or ensure that all packets are handled in proper way, rather than allowing one source to grab more than its share of resources.

A. Traditional queuing technique

The traditional way for controlling queue length at routers, known as Drop Tail in the literature, is still one of the popular configurations used due to its simplicity. Drop tail sets a maximum length for each queue at the router and accepts every packet until the maximum queue length is reached. Once the maximum queue size is reached, the algorithm drops packets until the queue size is again below the maximum.

DropTail: TCP is the traditional congestion detection protocol used in transport layer. This Transmission control protocol (TCP) uses traditional queuing techniques like Drop-tail and detects congestion only after a packet has been dropped and it would be undesirable to have large queue because it would significantly increase the average delay in the network [2]. Due to these unaccepted conditions of network, regular Transmission Control Protocol (TCP) is not able to fully control and utilize the limited resources and distinguish packet loss from congestion loss and random loss. Because of such feature, the performance of TCP will be degraded severely if it runs on wireless networks, such as multi-hop ad hoc networks [3]. Packets may arrive at queues in bursts from multiple devices, and a device may temporarily receive more packets than it can process. Buffers hold packets until a device can catch up. If the device cannot catch up, buffers fill up and new incoming packets are dropped. This is called "tail drop".

Drop-tail discipline: a packet is put onto the queue if the queue is shorter than its maximum size (measured in packets or in bytes), and dropped otherwise. The gateway uses a congestion indication bit in packet headers to provide feedback about congestion in the network. With tail drop, when the queue is filled to its maximum capacity, the newly arriving packets are dropped until the queue has enough room to accept incoming traffic. Drop tail queue has some drawbacks like Low global powers accommodate transient congestion periods, queue must be large, thus causes delay, Global synchronization i.e., When queue overflows, several connections decrease congestion windows simultaneously. By dropping packets probabilistically, AQM disciplines typically avoid these both of the issues [18]. By providing endpoints with congestion indication before the queue is full, AQM disciplines are able to maintain a shorter queue length than drop-tail queues, which reduces network latency ("ping time").

B. Active queue management

Active queue disciplines drop or mark packets before the queue buffer is about to be full. Typically, they operate by maintaining one or more drop/mark probabilities, and probabilistically dropping or marking packets even when the queue is short. RED: RED is one of the popular congestion avoidance mechanisms [10][16]. In this mechanism, it monitors the average queue size for each output queue and using randomization it can reduce the congestion .

```
Initialization
avg ← 0
count ← -1
For each packet arrival
if the queue is non-empty
drop the incoming packets
else
If minth ≤ avg < maxth
Increment count
with probability pa :
mark the arriving packet
count ← 0
Else if maxth < avg
mark the arriving packet
count ← 0
Else count ← -1
When queue become empty
q_time ← time
Notations:
[1] Saved Variables:
avg: average queue size
q_time: start of the queue idle time
count: packets since last marked packet
[2] Fixed Parameters:
ωq : queue weight
minth: minimum threshold for queue
maxth: maximum threshold for queue
maxp: maximum value for pb
```

Random drop [11] is one of the oldest techniques which drop the packet from the queues with some probability. This probability is decided by the traffic measured in the connection. In random drop gateways, when a packet arrives at the gateway and the queue is full, the gateway randomly chooses a packet from the gateway queue to drop. RED algorithm is given in figure 2. RED maintains an “average queue length” (ave) which is heavily weighted with the past queue length history to cope with bursty traffic. When the average queue length exceeds a minimum queue length threshold (minth), packets are randomly dropped or marked. When the average queue length exceeds a maximum threshold (minth), all packets are dropped. While RED does improve over the traditional drop-tail queues [11] which have a drawback in high queuing delay and may lead to unwanted global synchronization at congested routers, several shortcomings of it have been identified and well-studied. One of the fundamental problems with RED is that it relies on the heavily biased average queue length (ave) as an estimator of congestion which leads to potential problems of overflow and under-utilization when a large discrepancy arises between the actual queue length and the maintained average queue length for a long period of time.

III. PROPOSED WORK

According to the related work which discussed about the Traditional queuing technique and active queue technique we have faced some bugs which are not tolerable, so we now proposed an Explicit Congestion Notification (ECN) mechanism with the existing system (RED) to overcome the obstacles.

A. *RED with ECN*

TCP/IP network has most of the routers who have no provision for the incipient congestion notification. When a buffer queue overflows, packets are dropped. And when the TCP source detects the packet drop, the tcp source infers the congestion presence in the network.

This paper propose router to have more developed mechanisms for the detection of incipient congestion. Gateways with the ECN mechanism for detecting incipient congestion before the queue overflows are not limited to packet drops also make known to the source of congestion to the gateways[16]. ECN plays two beneficial roles for the effective and reliable communication, first is for communicating network with mechanism for the detection of incipient congestion i. e. use of ECN mechanism for the notification of congestion to the end station prevents from the undesirable, unnecessary packet drops, and the second is ECN mechanism is that with RED, source can be informed of congestion rapidly and unambiguously, without any delay introduced by either a retransmit timer or three duplicate acknowledgement (ACK) to infer a dropped packets. ECN messages could be generated either by an IP router or by a boundary router for an ATM network that carries TCP/IP traffic. In our simulation using RED gateway set the ECN field in the packet header. If ECN mechanisms are included to a gateway, it makes sense two events at the same time i.e. congestion detection as well as mechanism to monitor the average queue size. It is noticed that the use of ECN mechanisms are most benefit in a network when it notifies connections of incipient congestion before the queue actually overflows. Thus with our simulation result we get the ECN as a better combination mechanism for congestion control.

B. *Simulation experimental parameter*

The scenario was simulated using network simulator 2 (NS2) [13] Based on network topology. 13 wireless nodes were deployed onto 500*500 m^2 grid as shown in figure 3. Each link is bidirectional and weighting values of the link depends on the resources consumption.

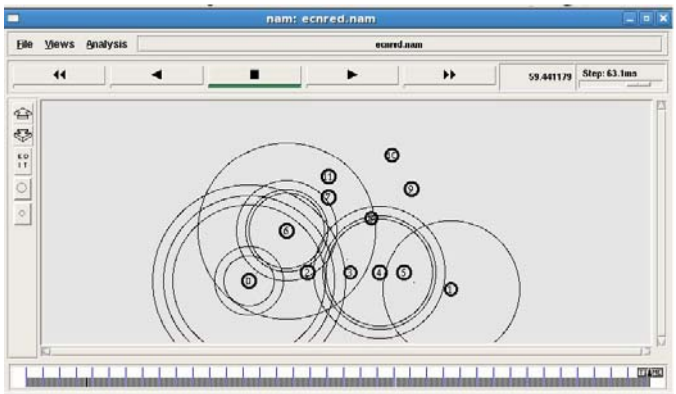

Figure: 3.Simulation animation of RED+ECN

After the source node produces a quantity of packets, the destination nodes are randomly chosen by average probability. When any packet passes through a node takes the first step to capture space into the buffer storage and then selects the optimal route from the routing table to transfer packets. A fixed size of one packet is considered in our simulation. The experimental parameter values used to configure the system in our simulation are listed in TABLE I.

TABLE I SYSTEM PROPERTIES

Parameter	**Values**
Transmission range	250 m
Topology size	500*500
Simulation time	60 Sec
Packet size	2000 bytes
Traffic type	FTP
Routing protocol	AODV
No. of node	13
Antenna type	Omni antenna
MAC protocol	MAC/802_11
Max. Speed	30
Min. Speed	20
Propagation Model	Two Ray Ground model
Queue size	50
No. Of Source	2
No. Of Destination	2

IV. SIMULATION RESULT

According to this scenario the systems deployed with the discussed experimental parameter shown in the above table. Results are calculated and shown in the figure 4

The simulation results shows that the number of packets dropped is much greater than the combinational RED and ECN. This shows that the performance of the proposed method is better than the traditional method even with heavy traffic.

Combination of RED and ECN is quite complex method comparatively simple Drop-tail method but it is concluded that combinational RED with ECN is much efficient method for congestion control with heavy traffic against the traditional queuing technique.

```
[root@localhost Desktop]# awk -f e2edelay.awk namfiledrop.tr


GeneratedPackets              = 2476
ReceivedPackets               = 2195
Packet Delivery Ratio         = 88.6520
Total Dropped Packets         = 281
Average End-to-End Delay      = 96.0067  ms


[root@localhost Desktop]# awk -f e2edelay.awk ecnred.tr


GeneratedPackets              = 2624
ReceivedPackets               = 2623
Packet Delivery Ratio         = 99.9619
Total Dropped Packets         = 0
Average End-to-End Delay      = 104.0002  ms
```

Figure: 4.Simulation result during heavy traffic

System simulation result shows that traditional queuing techniques are best only for the small/light traffic but as packet traffic grows the performance of the traditional Drop-tail queue is degraded tremendously, which is not suited for an ideal communication system. The performance of the both method is compared on the behalf of time v/s delay and is shown in the X-graph given below.

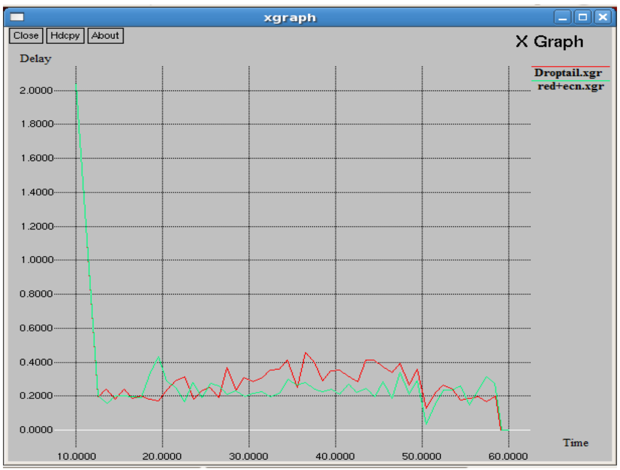

Figure: 5.Comparative X-Graph of droptail and RED+ECN during less Traffic

V. CONCLUSION

We have proposed the combinational effect of ECN with RED. The simulation in this paper suggests the ECN mechanism would give a clear, effective, reliable, desirable and mathematical mechanism to prevent from the congestion. ECN has many advantages; one of the main advantages of ECN is in avoiding unnecessary packet drops with early and explicit congestion notification, and therefore avoiding unnecessary delay for packets from low bandwidth. This advantage will be most preferable for heavily congested network where a high frequency in much amount of packet drop is needed to control congestion.

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