Improvement in Congestion Control in Mobile Ad Hoc Network using Weighted Fair Queuing

1Pooya Tripathi, 2Krishna Kumar Joshi (H.O.D)
Department of Computer Science & Engineering
Maharana Pratap College of Technology
Gwalior, India
1Pujatripathi798@gmail.com, 2hodcs@mpct.org

Abstract—Congestion occurs on the network when the weight on the network is larger than its volume and also congestion ensues in system that includes waiting. If traffic presents on the network then communication between the devices are stopped and deadlock occurs. So techniques which provide prevention and avoidance of the congestion are very significant. Congestion control is a technique to control the traffic and always possess the weight below the volume of the network. This paper, we examined numerous congestion control methods in the n/w. These strategies are utilized to avoid & eliminate congestion. These systems are extremely valuable for communication between sender & receiver. Queuing is the most general queue scheduling discipline that has been generally examined in the references. It acts as standard measure for comparing the performance of various queue scheduling disciplines. In this paper, WFQ verifies to be a fair method to avoid congestion & to improve the n/w presentation. The design goals of WFQ is to allocate fair bandwidth to each flow without considering the packet size and thereby providing better Quality of Service. NS-2 simulation outcomes to contrast their relative performance depend on through-put, PD ratio in percentage & routing over-head for the proposed strategies.

Keywords—MANET, Routing, Protocols, Congestion, Weighted Fair Queuing.

I. INTRODUCTION

The Mobile Ad Hoc Network (MANET) is a wireless network, where the network nodes are moveable from one location to another. The nature formed in MANET is highly dynamic, connected with one another nodes for communication. MANET has occupied a lot of courtesy of academics & industry. A MANET [1] is a self-configuring, self cooperating and infrastructure less wireless network in which each device either act as participant or router. An emerging MANET is relying upon the communication b/w the mobile nodes. Routers have freedom to shift haphazardly & place themselves promptly. [2] MANET is an auto-nomous grouping of mobile users communi-cating over a almost b/w constrained wire-less link with limited battery power in extremely dynamic environments. MANETs can be used in Battle fields, Disaster Areas, Conferences and elsewhere, because of their capability of handling link failure and fast topology changes. B/2 of High mobility (HM) of nodes, every node is assumed to function as a transmitter, host & a router. Routing in Ad-hoc n/w is extremely challenging as nodes are shifting, topology of the n/w changes dynamically. So a good route will be unavailable after a short time. Hence there is a need to design. A routing protocol for MANET which utilizes cross layer plan & which is aware of HM of nodes. This protocol must decrease losses due to mobility and should also reduce Overhead of extra packet exchanges due to route failure. In Order to reduce effects introduced due to mobility, we propose technique to forward packets to more stable and efficient routes by using cross layer approach. [3]

A. MANET

MANET is a group of mobile nodes which broadcast over radio. These types of networks are malleable I nature, so that they do not need any current framework. Therefore, MANETs are proper for temporary communi-cation links. The key challenge in this kind of n/ws is to decide a path among communi-cating end points, what is aggravated through the node mobility.
MANET has distinct application such as static network that is fulfilled by power sources, mobile, dynamic networks. Use of Ad-hoc networking was in military domain. Ad-hoc networking allows battle-field units to collaborate any-where & any-time, with-out require of a few rigid frame-work. Examples of military applications are the tactical internet. Dynamic ad-hoc networks are the requirement of current and future. This extremely adaptive networking tools, however, still faces several limitation such that b/w constraints, processing cap-ability, high latency, transmission errors & etc. [2]

B. Routing

The most liked method to categorize the MANET routing protocol is depending on how the nodes sustain & acquire the information. Using this way, MANET routing protocol (RP) can be classify into pro-active, re-active & hybrid routing. Pro-active RPs keeps up routing tables & hence they are called as table-driven. These protocols facilitate the nodes in MANET to analyses and evaluate routes all destinations nodes and periodic update routing information. This allows source node to get an immediate route path when required & pro-active RP act according to n/w topolo-gy. When there is alter in the topology it collects most recent route path information by periodic updates. Using this pro-active RA, nodes requires up-dating all pro-active information like route path, n/w’s traffic plan despite of traffic presence. Here are some the pro-active RPs such as WRP, DSDV, & FSR protocol. [4] RPs of MANETs can be separated into distinct kinds relying on the diverse criteria. commonly, these protocols are classify into three types, Pro-active, Re-active & Hybrid RPs. Following fig. Shows different MANET RP. [5]

1. Pro-active Protocols:

PPs are typically known as table-driven protocols in which, the route to the whole nodes is main-tained in routing table. Packets are transfer over the pre-defined route precise in the RT. In this idea, the packet forwarding is done more fast but the routing over-head are greater. Since all the routes have to be identified before transferring the packets. PPs have lower latency since all the routes are retained at all the times. Again, these kinds of RPs are spited into two sorts, link state & distance vector RPs. In LSRPs all node continuously observe the n/w topology, stores the cost of all out-going link & send this information periodically to all participating nodes. This method is known as flooding. In DVPRP, all nodes maintain tabular history of all other node in the n/w, each node to reach the destination, the total no. of nodes to reach the destination & this tabular information is sent to all neighboring nodes in the n/w. Here, we discuss the DSDV, OLSR, WRP, CHGSR proactive routing protocols. Table 1 gives comparison of characteristics of pro-active protocols. [5]
ii. **Reactive Protocols:**

These sorts of protocols are also called as On Demand RPs where the routes aren’t pre-defined for routing. A Source node calls for the route discovery phase to determine a latest route when-ever a transmission is required. This route discovery way is depends on flooding algo which employs on the system that a node just broad-cast the packet to all of its neighbors & inter-mediate nodes just fwd that packet to their neighbors. This is a recurring system un-til it reaches the destination. Re-active strategies have smaller routing over-heads but higher latency.

E.g. Protocols: DSR, AODV etc.[5]

iii. **Hybrid Protocols:**

**Temporarily Ordered Routing Algorithm Protocol:**

TORA also keeps a DAG by means of an ordered Quin-tuple with the follow information:

A. Time \( t \) of a link crash
B. \( o \) id originator id
C. \( r \) reflection bit point to, \( 0=\)original level, \( 1=\)reflected level
D. \( d \) integer to order nodes comparative to reference level e. I the nodes id.

The triplet \((t, o, r)\) is known the reference level (RL). And the tuple \((d, i)\) is said to be an off-set in that RL. The heights of the nodes for a given destination to each other determine the direction of the edges of the directed acyclic Graph. The DAG is desti-nation oriented (routed at the destination) when the quin-tuples which re-present the heights are maintained in lexicographical order, the destination having the smallest height, traffic constantly flowing down-stream. Heights are but not required for route discovery; instead a mechanism as in LMR is used. Also nodes which don’t recently require maintaining a route for themselves or for others won’t alter a height value. All nodes has a Route required flag for that purpose, as well the time since the last UPD (Update) packet was sent is recorded. Each node maintains a Neibgour table containing the height of the neighbor nodes. Primarily the height of all the nodes is NULL. (This is not zero “0” but NULL “-”) so their quin-tuple is \((-,-,-,-,i)\). The height of a destination neighbor is \((0, 0, 0, 0, \text{dest})\). E.g. ZRP: The Zone RP is either a Pro-active or re-active protocol. It is a hybrid RP. It joins the advantages from pro-active (for e.g. AODV) & re-active routing (OLSR). It takes the benefit of pro-active discovery in a node’s local locality (Intrazone RP (IARP)), & utilizing a re-active Protocol for communication b/w this neighborhood (Interzone RP (IERP)). The Broad-cast Resolution Protocol (BRP) is responsible for the forwarding of a route request. ZRP splits its n/w in distinct zones. That’s the nodes limited neighborhood. Every node may be in lots of over-lapping zones, & all zone may be of a dis-similar size. The size of a zone isn’t established by geo-graphical measurement. It is given by a radius of length, where the no. of hops is the perimeter of the zone. Every node has its own zone. [5]
Table 1: Comparison of DSR, ABR, SSA, AODV, LAR

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Route</th>
<th>Route Selection Criteria</th>
<th>Beacon Maintenance</th>
<th>Route Discovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSR</td>
<td>Multiple</td>
<td>Shortest path</td>
<td>No</td>
<td>Global, notify source</td>
</tr>
<tr>
<td>ABR</td>
<td>Single</td>
<td>Link Stability</td>
<td>Yes</td>
<td>Local, bypass broken link</td>
</tr>
<tr>
<td>SSA</td>
<td>Single</td>
<td>Signal Strength</td>
<td>Yes</td>
<td>Global, notify source</td>
</tr>
<tr>
<td>AODV</td>
<td>Single</td>
<td>Shortest path</td>
<td>Yes</td>
<td>Global, notify source</td>
</tr>
<tr>
<td>LAR</td>
<td>Multiple</td>
<td>Shortest path</td>
<td>No</td>
<td>Localized</td>
</tr>
</tbody>
</table>

C. Congestion:-

Congestion is one of the major vital issues in ad-hoc N/wws. In general, is defined as the clause when the traffic flowing over the n/w surpassed the ability of the n/w. In traditional approaches, the congestion is avoided over the n/w by limiting the rate of the traffic sent over the n/w by the sender. A further way of controlling & reducing congestion is to re-route the packets over the n/w to those areas with less congestion status. In traditional wired n/wws, the reasons & the con-sequences of the congestion are well known. However controlling the congestion in mobile ad-hoc n/wws poses new & dis-similar tests that limit the usage of traditional ways for solving the problem. Congestion in the n/w’s isn’t uniformly distri-buted over some region, but it depends on the location of nodes over the n/w. Congestion can become high or low with the alters in the point of the nodes [6]. Even if some other factors are also present which leads to Packet loss, such as mobility, link failures, inter-ferences, etc., but congestion is the key cause. It is supposed that packet loss during trans-mission since to harm is less. Thus the probable reason of packet loss in the n/w is congestion. So, if no suitable congestion control is performed, it can lead to a n/w collapse due to congestion, and so no data is effectively delivered [7]. MANETs utilize shared broad-cast medium for trans-mission. While delivering data to many destinations, multi-cast Communication is of great concern in these n/wws, since it helps saving resources. While trans-mission, there are chances that the route gets busy due to larger traffic or some node may fail which rush the traffic to other nodes which can be the motive of congestion. So, it is important to avoid congestion collapse in wire-less multi-hop n/wws in order to perform efficient CC [8].

Measures have been taken by author to free the network from congestion and repair the damaged routes as is illustrated in [9]. For this cause, many authors have proposed different congestion control algorithms in an try to avoid packet losses & to ensure consistent delivery of packets from source to destination. In this paper, the CCPs based on AODV will be discussed. Since AODV hasn’t much of CC mechanisms, congestion may happen due to routing. It may also lead to lengthy delays, packet losses & low through-put. Also it is costly to recover from congestion in terms of time & over-head. So, packet failures are to be reduced which involves CC running on top of mobility & failure adaptive routing protocols at the n/w layer [10].
Ruo Jun Cai, et al. [2018] In this paper, we plan an ESCT scheme that imitates human cognitive process & relies on trust-level information to stop different routing disruption attacks. In this system, mobile nodes will swap trust information & analyze received trust information based on their own cognitive judgment. Finally, all nodes dynamically evolves its cognition to exclude malicious entities. The most attractive element of ESCT is that they cannot compromise the system even if internal attackers know how the security mechanism works. In this paper, we approximate the performance of ESCT system under a range of routing disruption attack positions. Simulation outcomes affirm that ESCT scheme promotes n/w scalability & ensures the routing effectiveness in the existence of routing disruption attackers in MANETs. [11]

Rashmi Chaudhary, et al. [2017] Due to dynamic nature of MANET, the Quality of Service (QoS) based Routing is a difficult but essential task to achieve. With bigger n/w size, this issue becomes NP-hard. Therefore, the Meta heuristics are most excellent appropriate for solving this type of issues. Efforts have been made by incorporating the existing On-demand AODV RP with meta-heuristics based approaches in the direction of improving QoS routing, but could not focus on the impacts of scalability and mobility jointly. Thus, a novel Swarm intelligence algo inspired by the hunting actions of the Seals has been planned in this paper. The algorithm computes the optimal path on the basis of multiple metrics such as residual energy, hop count and routing load and overcomes the limitations of the accessible algorithms. Simulation results show that the proposed SEAL-AODV algorithm improves the conventional AODV routing protocol based on the QoS metrics such as networks throughput and end-to-end delay as compared to existing meta-heuristics based routing algorithm.[12]

Raid Zaghal, et al. [2018] In this paper, we propose a novel device to enhance QoS in multi-path RPs in MANETs depend on the InfiniBand (IB) QoS design. The essential idea of our approach is to enhance the load balancing & thus decrease congestion on over-loaded links. This mechanism has enabled us to (1) give critical applications higher priority when routing their packets across the network, (2) effectively manage frequent connections and disconnections and thus reduce link failures and packet loss rates, and (3) reduce the overall power consumption as a consequence of the previous gains. We have tested the scheme on the (IBsim) simulator and achieved significant improvements in QoS parameters compared to two well-known routing protocols: AODV & AOMDV.[13]

Salman Al-Shehri, et al. [2018] MANETs are deployed & function in infra-structure-less environments. However, when the nodes in such networks are aware of their locations, a shared grid of virtual cells can be defined. It is then probable to pre-assign these cells with communication channels & other radio resources to facilitate distributed RRM & to bound the exchange of control messages. The channel allocations in virtual cells can assume similar channel reuse schemes as those used in the legacy cellular networks. Supposing that the node clusters coincide with the virtual cells, the average SINR is numerically compared for a RWM model with a deter-ministic element, and two sample designs of the orthogonal frequency hopping patterns allocated to the clusters of 3 & 7 virtual cells, respectively.[14]

Neha Kumari, et al. [2017] In this research paper, we proposed the the radiation pattern using a directional antenna to evaluate the energy consumption in rendezvous phase and full scanning phase. Implement genetic optimization for evaluating the optimize energy consumption in all directions based on path losses and received signal strength. To compare the performance in terms of energy consumption and the collision rate with the base technique. [15]

Dr. G. Manoj Someswar, et al. [2017] earlier researches were concentrated on designing new protocols or updating the existing protocols to make MANET routing more efficient. Keeping in mind the end goal to address the issues in multicasting over MANETs, this theory proposed an Upgraded Scalable Virtual structures based Geographic Multicasting (USVGM) Protocol, which would extent be able to an expansive gathering size and substantial system size and this convention will give effective multicast parcel trans-missions in a dynamic versatile especially appointed system provision. USVGM convention is actualized with the two layer design to dodge the participation administration problem. In this paper we propose USVGM protocol which successfully handles the administration issues in MANETS.[16]

Dr. J. Vellingiri et al. [2017] In this work, we have tried to im-prove the energy efficiency at the node level & to increase the n/w life-time by proposing model called CoCoWa based on diffusion of selfish nodes when a contact arises, so that information is quickly pro-pagated. The experimental works are carried over by n/w simulator. The experimental outcomes & analyses for reducing the overhead and improved other metrics such as delay and throughput.[17]
Hui Xia, et al. [2018] In this study, we conceptual a novel light-weight subjective trust inference frame-work, which is split into trust assessment & trust prediction. The method of node trust assessment is based on node’s historical actions. Then utilizing the obtained trust data sequence, we introduce the SCGM (1, 1)-weighted Markov stochastic chain measure to predict node’s trust for future DM. Experimental outcomes have been conducted to estimate the effectiveness of the proposed trust model. As an important security application, based on the standard ODMRP, we make four main upgrading which take the issue of trust into consideration, & propose a novel trust-based RP called ODTMRP. And lastly, convincing experimental outcomes are presented using three routing evaluation metrics.

### III. PROPOSED WORK

The main concept behind the Weighted Fair Queuing (WFQ) algorithm is to combine Priority Queuing (PQ) and Fair Queuing (FQ) algorithms. Advantage in FQ method is that all queues are served fairly so that there is no bandwidth starvation. But some queues have more weight so that they may receive more service. In other words, weight is assigned to all queue to give dis-similar priorities to the queues. Packets are entering into the suitable queue according to their categorization & they are serviced based on their weight.

WFQ supports flows with completely dis-similar information measure needs by giving every queue a weight that allots. It a special share of output port information measure. WFQ additionally supports variable-length packets, so flows with larger packets are not allotted a lot of information measure than flows with smaller packets. Supporting the truthful allocation of information measure once forwarding variable-length packets, adds significance to the procedure complexity of the queue programming algorithmic program.

In the existing work, extra RREQ packets send over the link to check the available bandwidth. They did not mention any accurate way to evaluate the bandwidth and sometime it is also responsible to increase the bandwidth of the link. This can be overcome by the proposed strategy.

In the proposed work, WFQ technique used to recover the performance of the n/w. WFQ is queuing system which is utilized for schedule the packets & fairly allot distinct b/w to each & every flow. It’s also allocate weight to each flow so larger packet can’t take advantage & there is no issue of starvation & delay. Firstly, the establishment of nodes performed and they broadcast the Hello packet to discover their neighbors. To avoid the congestion, WFQ technique applied by splitting the network into flows. Assign weight to each flow by calculating the cost of data link. Then evaluate the data rate and transmit the data with the link which has highest data rate. This way avoids the congestion & transmits the data twd the destination. This way is very efficient for the data transmission from the source to destination using queuing model. The proposed algorithm show the step by step process of the working and it is described in the detail:

Proposed Algorithm:

Step:1 Initialize network
Step:2 Broadcast Hello Packet
Step:3 Apply weighted fair queuing technique to send packet
Step:4 Assign some weight to each and every flow of network
Step:5 Divide the network into various flows
Step:6 Each flow is I is given as weight w
Step:7 Calculate weight of each flow

\[ w_i = \frac{1}{c_i} \]

 where is the cost per data bit of data flow

Step:8 Data rate received by flow i is

\[ R_i = R \times \frac{w_i}{(w_1 + w_2 + \ldots + w_n)} \]

Where R is channel rate in bps

Step:9 Transmit the packet with higher data rate using the queue

Step:10 Forward the data until it reach to destination

Step:11 Exit
IV. RESULT ANALYSIS

The outcomes has been gained by using the NS-2.34 simulator & outcomes shows that our proposed algorithm performed improved than existing algorithm in term of throughput, packet delivery ratio & routing over-head.

Throughput

It may be defined as the total data received by destination from the source node split by time taken to obtain the last packet.

![Throughput Graph](image1)

**Fig.5 Throughput**

Routing Over-head

The control over-head is classified as the total no. of routing control packets normalized by the total no. of received data packets.

![Routing Overhead Graph](image2)

**Fig.6 Routing Overhead**
Packet Delivery Ratio

PDR is computed by splitting the no. of packets received by the destination to the no. of packets originated by the application layer of distinct sources. It specify the packet loss rate, which limits the max throughput of the n/w. The better the real delivery ratio, the more complete & correct is the RP.

![Fig.7 PDR Graph](image)

CONCLUSION

Generally real time uses need rapid data trans- mission in the n/w. The show can be ensured by systems which gives performance by shaping & policing of packet traffic. Additional im-prove the performance of the n/w by fair allotment of resources. Many congestion control techniques provide good fairness and throughput, which decreases the loss of packet. In this paper, we have proposed the WFQ approach for providing better transmission of packet in MANET. After comparison of the outcomes it is clear that WFQ shows superior performance than other queuing strategies. But when compared with WFQ group in case of throughput, routing overhead and Packet delivery ratio, the WFQ always shows the best performance among them.

References


[11] Ruo Jun Cai, Xue Jun Li, and Peter Han Joo Chong, “An Evolutionary Self-Cooperative Trust Scheme Against Routing Disruptions in MANETs” 1536-1233 (c) 2018 IEEE. Personal use is permitted, but republication/redistribution requires IEEE permission.


