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A Hexagonal Topological and Hop-Count based Geographic Routing Protocol for WMNS

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Abstract*— *Wireless Mesh Network (WMN) is a convincing theme to many net researchist because of its minimal effort in sending, straightforwardness in the establishment and heartiness in activity. Notwithstanding, current routing protocols intended for MANET, can't work productively in WMN on the grounds that spine in WMN shaped by Mesh Router has low portability and are not put under power and memory duress. In this paper, we are coming with a new idea of routing using geographic multipath, which will be beneficial for an Infrastructural WMNetwork and also don't depend on node's location. The proposed protocols has awareness, about the node's congestion and the node's location of all next neighbors, and utilize Hop-Count array technique. Furthermore, with help of a procedure of congestion-cognizant, nodes can select the perfect connection with adequate bandwidth for the requirement of comer traffic. In the proposed protocol for routing we accomplish various remarkable characteristics of Hop-count array (metric) depend on routing algorithm: straightforwardness, durability and feasibility of affectation. Results demonstrate that throughput increments extraordinarily with our proposed protocol when contrasted with unadulterated AODV and AOMDVin heavily loaded traffic situation.

Index Terms: Wireless Mesh Network (WMN), congestion-awareness, multipath, hop-count matrix, routing, metric.

I. INTRODUCTION

AThe applications, which are used in WMN, first and foremost Internet oriented, therefore, the data travelling in WMN are either from the end users towards the Internet Gateway (IG) or vice-versa**.**This is the opposite of MANETs behavior, where traffic is uniformly distributed, among any pair of nodes. Intuitively speaking, the WMN's routing algorithm aim is deciding the best link while finding the routes from router to IGW. Therefore, certain node or links can be intensely stacked while a few nodes/links are only from time to time utilized. However, this may prompt a bothersome circumstance wherein the best path may corrupt because of the load, thus coming about in problematic execution.

Indeed, the WMN's routing protocol which is responsible for regular monitoring of links cannot help in this situation due to excessive number of motions, networks go into an unstable situation. In addition, in a WMN, the traffic that is heterogeneous in ethos and containing significant multimedia subject matter, supporting the ideal Quality of Service (QoS) turns into a significant prerequisite. Thus, reviewing the main accountability of a WMN as the methods for broadening web availability, any proposed arrangement should proficiently adjust the traffic in the system but then fulfill the application needs. Our fundamental thought for this methodology is to plan a geographic routing protocol by utilizing our graph's pathway characteristic. [1 Suraj paper] We inspired for proposed routing protocols, by Hop-count based routing and bandwidth approximation System. In our perusal, we plan a component to allow Mesh Routers to assess their devoured bandwidth to help Hop-Count based routing while at the same time monitoring blockage hazard. With the help of congestion-aware system, hubs can pick links which have enough accessible transmission capacity for incoming flow's necessity.Our proposed methodology can ameliorate the real-time systems as well as transportation engineering.Our proposal likewise allows to change how a packet is sent, without influencing the routing algorithm, as it were, packets will change their path without conjuring path calculation to insubordinate down the old way and underlie the upgraded one so it can save spare time and overhead. We additionally propose a route splitting algorithm to give load balancing in WMN. In simulation part, we demonstrate that our proposal can improve network performance one might say that it can maintain a strategic distance from blockage, give preferred execution over unadulterated AODV [45] and AOMDV [44] convention. The rest of the paper is organized as follows: Section II present a brief review of studies related to routing protocols, whereas Section III explain the details of our proposed coordinate base routing design and algorithm for WAN Section IV shows the experimental results and their comparative evaluations are reported using NS2. Section V concludes our paper.

II. RELATED WORK

After the observed study, the greater part of the protocol depends on topology control near the characteristics of the resulting graph and skirt the detail routing, enlist plans, which may impact the throughput and concede execution in WMN frameworks. The conventional routing protocol has made such a significant number of problem areas, which lead subordinate execution, extraordinarily plan for MANETs, for example, AODV [11], DSR [12] routing protocols for Ad Hoc Networks, which gradually settle path dependent on expectation tally. Nowadays works are characterized in [13, 14] demonstrated that courses with a little jump, stop up the systems from performing with higher rates while the remote interface has Multi-rate capacity.

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For multi radio and channel WMNs, [15] has thought of a source routing convention, which utilizing a novel routing measurement, Weighted Cumulative Expected Transmission Time (WCETT). This measurement engages the nodes to pick the best way that has an extraordinary mix of channel variety bounces with high information transmission rate.

Anyway, they don't think about burden adjusting for their convention, for example, traffic obsession and blockage on explicit ways.A variant matter is if a node has an extraordinary associate with the accompanying jump, anyway, it is vivaciously arranged by then there is no use in picking an approach to IGW through such a center point. Yang et al. [16] showed that WCETT can in assurance make directing loops in explicit conditions. Moreover, they come up with different directing convention (LIBRA) opine the intra and interflow deterrent. In any case, this convention does not focus on traffic blockage improvement along extraordinary ways. Ramachandran et al. [17] propose AODV-ST protocol, which depends on spreading over the tree and incorporate Expected Transmission Time (ETT) with a few adjustments of the AODV convention as the routing measurement.

The topology control issue has additionally been concentrated widely in the previous twenty five years, for the current wireless ad hoc systems and WSNs. The primary reason for topology command is to recognize a subsidiary of conceivable wireless connects to give availability of wireless systems, with fix structure standard have been considered, including power utilization, impedance, communicate [14], quality-of-service (QoS) [15], antennas [16] and credibility [17]. The majority of research on topology control attention around the qualities of the subsequent graph and skirt the detail routing, arrange plans, which may influence the throughput and postpone execution in wireless systems. Contrasting with the current research, our concentration in this paper is to plan a topology to such an extent that it is profoundly dependable as far as network and diminishes transmission delay by picking the best way as far as separation and load. In this way, it very well may be considered as a reasonable routing protocol.

In Geographic routing [6] node just save the conditions of neighbors, justification a work correspondence, utilized address, which is the location of the node, advances packets towards the goal in the unquenchable way. These cause guidance this directing as is flexible. Notwithstanding, Geographic routing has genuine expanding, especially when we have impasses, snags and how to keep running at exceptionally low solidity. Overseeing voids is a truly familiar matter with algorithm, for instance, GFG/GPSR [7], and even more starting late GOAFR+ [13], which is gave off an impression of being both typical affair capable and greatest critical situation perfectly. Installation of those issues isn't our fixation here. Or maybe, our target here is basically to examine whether one can apply the geographic routing perspective, with the some its characteristics and its deficiencies.

Our philosophy incorporates consigning virtual coordination to each node and a short time later applying well-established geographic routing over these coordinates. Surajet. al[] comes up with new strategy of hexagonal topology and coordinate system, and again we have extened this thing with hope count and geography.

III. PROPOSED GEOGRAOHIC ROUTING PROTOCOL

We send packets towards targeted node in greedy fashion, as the proposed algorithm uses the locations of nodes as their addresses.To uniquely identify each address, the coordinates of the node along with the gateway's IP Address is sent. We have developed these virtual coordinates utilizing just neighborhood availability data.As we know that neighborhood connectivity information is always at hand, So this idea can be good-becoming in majority circumstances. Packets contain virtual coordinates for the destination.

Lightly loaded node location, which is present in x-y direction, is used in our protocol as the destination. In the event that node isn't gently loaded, at that point the node next closer to it with lighter node is selected for sending. The way once chose can be changed next time if a portion of the intermediate node comes fail or is vigorously loaded.

Propose idea has two phased:

a) Route quest Phase
b) Route preservation Phase

A. Route Quest Phase

Determination of the location of the destination is the starting of this phase. Lightly loaded destination node, in the same direction, is used for packet sending. The way once built is reserved for further correspondence. Prior to send any packet on the trained path, every node investigates the connection status and encumbrance of the next node in the way.On the off chance that connect to a node in the trained path comes up short or is vigorously stacked at that point, the mesne node sends the packets to the enduring node through a similar procedure, i.e. load and direction checking of the node.On the off chance that the target is a Gateway, at that point the selected node has the minimum hop count as well as load should be minimum.Location information is important, if the network is heavily loaded, and used for packet transmission. Just early connect disappointment notice is utilized by taking input from physical layer of OSI model.

We opine the origin on the gateway and every node is provided coordinates with respect to the origin. The goal of Algorithm is to utilize shortest path, load adjustment and fault tolerant conveyance of packets with less probability of crashes. With all points, algorithm additionally deals with congestion and sharing of the load among nodes, in a manner that nodes, in surroundings of gateway, never be heavily loaded.

(i)Congestion aware routing

In the network, with the idea of threshold " α " of congestion level, we decided about node that the node is congested or not. If level of congestion is higher than the threshold then mesh router will be in congested state, i.e. $\frac{QLi}{tr} \geq \alpha$, where QLi, in the way of a particular path and *"i"* is the node number, is the av. queue length over a node *"i"* and tr is rate of transmission over a node.

In the correspondence with neighbors, we used a threshold to control the recurrent broadcasting of information about congestion, network bandwidth is exterminatory if node is not really congested.

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In proposing algorithm node, itself determine its level of congestion, decreasing correspondence overhead. With the assistance of all six flags, node monitors the information about congestion of its six neighbors. At initial stage all F_C_i (Flag Congestion for node *"i"*) are sets "0" i.e. free from congestion.From there on, every node, periodically, figure out its $\frac{QLi}{tr}$.

The ratio between $\frac{QLi}{tr}$ and "α" decided that node is lightly loaded or heavily loaded. If it is less than then lightly loaded, otherwise its heavily loaded. If the node is heavily loaded, then the node will send the information about congestion to its six neighbors. After receiving this important information, neighbors set their F_C_i to 1 for the node *"i"*, i.e. node is tagged as congested node and no forth intimation communication will done by this node till again its node reduced its threshold by half. Node again starts sending the information to all its neighbors, after reaching the threshold by half, i.e. transmission have been started for that node *"i"*. Hence, all neighbors set F_C_i to 0 in the routing information table, after receiving the message from node *"i"* and this is the indication of availability of the route for further communication.

Our proposed algorithm 1 shows that every mesh router has fixed two states: congested state and load-balanced state. Node *"i"* is in congested state if it satisfies the condition $\frac{QLi}{tr} \geq \alpha$ over node i. at this point we send this information to all its six neighbors and the congested node call a procedure "**congested_state_procedure(i)**", which is used to check load again and again till it will not reached by half of its "α". If it reached on desired condition, then it will be in normal state and return to its normal load, and mesh router multicast this realization from congested state to all its prevenient offspring nodes.

Algorithm 1

main()

Step: 1 Calculate $\frac{QLi}{tr}$from time to time

Step: 2 if $(\frac{QLi}{tr} \geq \alpha)$

then node is congested i.e. $F\_C_i = 1$, send this information to its all six neighbors and call **congested_state_procedure(i).**

else

The load is in a balanced state, the node is not congested and go to step 1.

congested_state_procedure(i)

Step: 1 Calculate $\frac{QLi}{tr}$from time to time

Step: 2 if $(\frac{QLi}{tr} \leq \frac{\alpha}{2})$

Then node is not congested i.e. $F_C_i = 0$and send this information to its all six neighbors.

Return to main ( );

Else

then node is congested, send this information to its all six neighbors and go to step 1.

(ii)**Load Balancing**

In a communication network system, somewhat nodes or connections running over a heavy load while a few nodes can be only from time to time utilized. This may prompt an unwanted circumstance where the best ways in the end debase because of over the top batten, subsequently coming about in problematic execution. This situation might be maintained a strategic distance from if multipath directing is utilized to adjust traffic among numerous ways that may exist to arrive at the passages. We have done this balancing of the load by the tow type:

At every instant node goes into congestion state and send message to all its neighbors, its documentation puts in its log sheet table, which contain the status of its neighbors. In the proposed algorithm, the mesh router sets another way for communication of packets, until congestion level does not come into the satisfactory situation, i.e. not reached by half of its "α" or less or we can say it does not obtain flag with $F\_C_i = 0$. In choosing the new way it its call a congested_state_procedure (i), yet it picks the following best exchange way put away with it at the time of Route Discovery. After improvement of congestion state of the node, its neighboring nodes can either remain on the present path or turn around to the preceding way. The choice depends on the examination of the load and hop-count of both nodes, whatever is superior, will be selected for ahead communication. After getting any heavy load respective sign, Algorithm 2 will be worked.

Algorithm 2

At jth mesh router:

Step:1 if node 'j' acknowledged by flag value "1" i.e. $F_C_i = 1$for node 'i',

then

i. node 'j' put this information in record of log sheet table and pause any further communication with node 'i' till next improvement.

ii. "j" select the optimum path among the available one in the log sheet.

Step:2 Else-If node 'j' acknowledged by flag value "0" i.e. $F_C_i = 0$for node 'i'

then

i. node 'j' put this information in record of log sheet table, and this is a signal that the node "i" is available for further communication.

ii. Calculate the load of node "j" and node "i".

iii. Examine of the load and hop-count of both nodes "i" and "j", whatever is superior, will be selected.

After obtaining any flag, algorithm 2 has been started and scan flag value. If a flag value is "1" obtain by some node through node "i", at that point it implies that the node "I" load is heavy and it stop for all further communication through this node. If a flag value is "0" obtain by some node through node "i", at that point it implies that the node "i" load is normal, i.e. less than its threshold by half and this node is now available for the further communication.Now the question is raised about, which node is used for communication the current one or the previous one. For this purpose first examine the load and hop-count of both nodes, whatever is superior, will be selected for ahead communication. So load over node is appropriately equated.

B. Route preservation Phase

In this section, we discussed about theroute-maintenance issue. The motivation behind route preservation is to endorse existing route and search reaso nable substitutions, when one of the current route fall foul

(i) Fault Tolerance in WMN

In WMN, the main cause of route disappointment has been most likely brought about by power-off, system disappointment or indigent signals. In this situation, as keep the paths in reserve in Route Discovery stage, we are ready to rearrange the route from available substitute paths.

Meanwhile, in a stage of route discovery, source node can set up an essential path as well as few reinforcement paths to the desideratum target. Multipath system can be utilized to diminish the deferral in recouping from a disappointment, hence utilizing the reinforcement paths to switch the on-going traffic to these substitutes paths, rather than shooting down the start to finish association, when the essential paths falls down.

In our proposed technique, we focused to use as low as reasonably achievable power level. Despite the fact that power with a high level can achieve more distance without used of more nodes. It will likewise prompt more obstruction with different nodes, raise the collision likelihood.In an extraordinary circumstance, when every node is very close to each other, a number of collisions will occur, and should be settled with an any longer back-off time, particularly in substantial rush traffic circumstances.There is constantly an exchange off between throughput and system competence. In this manner, we attempt to use a low power level. At the point when there is no bottleneck, forwarding multiple packet at gateway with less impacts can improve throughput of the network. In the event that there exists a circumstance where all neighbor nodes fails around the current node, then it is known as an isle node. As appeared in Figure 1.

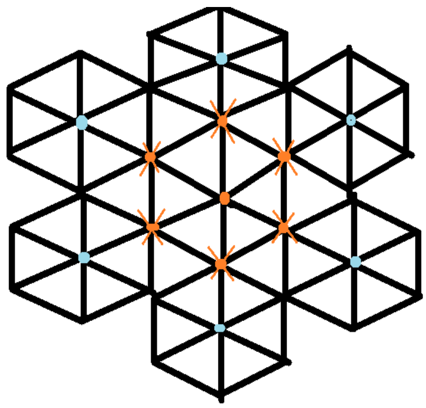

Figure: 1 Isle Node

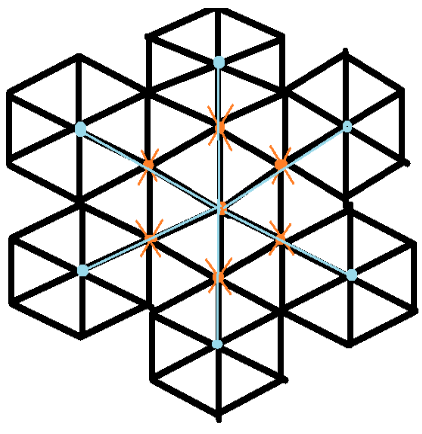

Figure: 2 New Neighbors of Isle node

Meanwhile, if a station can't arrive at different nodes, it should raise its power capacity level to discover somewhat new neighbors. This circumstance is shown in Figure 2, where red color nodes exhibit unsuccessful neighbors and with blue color nodes exhibit new neighbors, found by expanding the power capacity level of an isle node. Some isle nodes may reestablish their power capacity upon another node's feature, which could associate them to passages in a typical work. Algorithm 3 is used to calculate this proposed technique.

(ii) Algorithm 3

At each node

1. If the flag value "0" i.e. $F_C_i = 0$for node 'i', then
    a. Increase power capacity level, to to discover somewhat new neighbors
    b. After recognizing new neighbors, denotes their flag values in its log sheet table and utilize these neighbors for ahead communication.

At the point when the unsuccessful nodes recuperate back, the power capacity level of isle node must be re-balanced again to reset to the prime neighbors.

IV. EXPERIMENTAL RESULTS AND ANALYSIS

The proposed technique, in NS2 2.29 version [19, 20], is put into effect on LINUX operating system with few revisal to justify about congestion aware routing depicted in the previous section. We opine the WMN with nodes and systematize these nodes in 1000 * 1000 m2 zone. The concerned topology is hexagonal, which include 36 nodes which are connected to next 6 neighbor nodes and so on. For the data acknowledgement mode 802.11 MAC is utilized. Moreover, reproduction utilizes a UDP traffic mode along with Constant Bit Rate (CBR) traffic. Each mesh router has a certain range of 250 m for transmission.

For our simulation perusal, we look at our convention that utilizations Hop-Count Metric with the current AODV and AOMDV convention. So as to contrast and the other two conventions, a similar traffic model were utilized. Starting node is arbitrarily chosen among the regular nodes at every phase. In this recreation, the multi channel isn't considered.

We fundamentally perusal when load of traffic is increasing over a particular path, how the traffic is directed from the source of mesh router to IGWs. We opine the mesh router 'Y', 'O', 'L' and 'D' where every mesh router begins and advances the traffic to the Default Gateway. We pick packets under UDP along 1024-byte stream to represent real time experiments. At the point where the load is 160 packets for every second from the nodes 'Y, 'O', 'L', and 'D', it pursues the path DG-R-E-D, DG-J-L, DG-R-N-O, DG-R-S-Y as appeared in Figure 3. They are the shortest distance path in the midst of mesh router to DG. Figure 4 demonstrates the way of traffic where every node's load is 310 packets/Sec. At node Y, the traffic is presently redirected to DG-U-S-Y, at node 'D', the traffic is redirected to DG-F-E-D and at node 'O', DG-F-E-N-O. The cause behind that where the rate was 310 packets/Sec, the traffic over connection DG-R has arrived at the fragile threshold "µ". Therefore, the mesh router 'R' sent a flag of link_congestionF_C_i to every one of its neighbors with the goal that no anymore future traffic will be run by the current node.

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Afterward, when node 'R' forwarded its flag F_C_i as general status to its six neighbors, neighbor nodes contrasting the present node's load and load through 'R', picks the path which is superior as appeared in Fig 5.

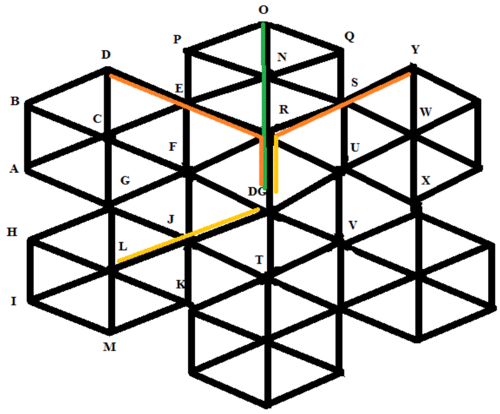

Fig 3 Congestion aware technique: Directed traffic in the midst of mesh router and Gateway before congestion message

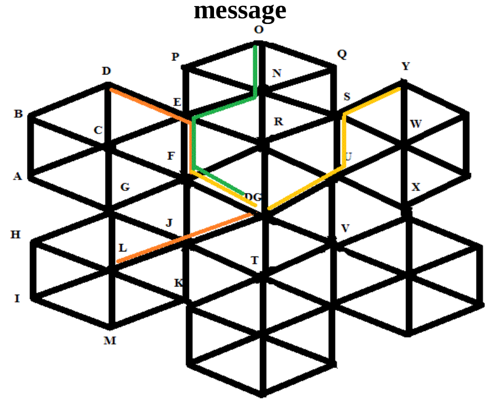

Fig 4 Congestion aware technique: Directed traffic in the midst of mesh router and Gateway after obtain congestion message

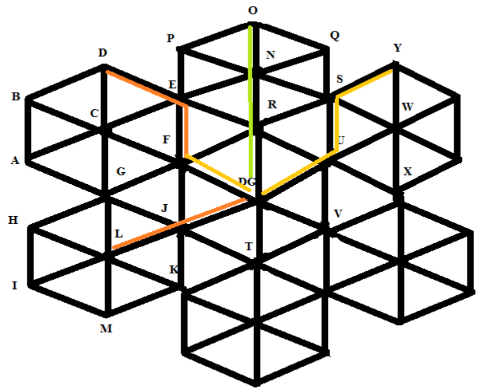

Fig 5 Directed traffic in the midst of mesh router and Gateway after examine the load of current and previous node

Forthcoming, for admeasure throughput of mesh router, we shift the traffic frequency by expanding the number of flux alongside them. In proposing technique, We measured a major advancement in the throughput of node, the result appeared in Figure 19 when contrasted with AODV which is simply found on the Hop Count to locate the briefest path. In our proposed technique, every inspected mesh router can acquire at its most extreme throughput because of the ability of foreseeing congestion hazard and sharing the node's load among multiple paths to shield joins from over-burden.

With pure AODV, the mesh router 'Y', ‘R’, ’E’, and ’D’ ’S’ utilize the convergence the shortest path DG-R-E-D and DG-R-S-Y to send own traffic to a default gateway. However, if there is an increment in traffic, then the longer path will be blocked around default gateway.

Table 1: Supervision of Proposed technique

S. No.	No. of pkt. Sent	No. of pkt. Received	No. of Pkt. lost	Sending Time	Receiving Time
1	100	100	0	.00122	.00131
2	200	200	0	.00325	.00345
3	300	300	0	.00527	.00557
4	400	400	0	.00689	.00711
5	500	500	0	.13310	.15310
6	600	600	0	.14810	.17210
7	700	697	3	.16013	.19014
8	800	795	5	.21891	.24672

Table 2 : Supervision of AODV protocol

S. No.	No. of pkt. Sent	No. of pkt. Received	No. of Pkt. lost	Sending Time(sec)	Receiving Time(sec)
1	100	100	0	.00100	.00110
2	200	200	0	.00340	.00370
3	300	300	0	.00560	.00600
4	400	400	0	.06890	.07300
5	500	490	10	.12300	.12400
6	600	570	30	.16800	.16920
7	700	660	40	.20012	.20112
8	800	750	50	.21890	.22900

Table 3: supervision of AOMDV Protocol

S. No.	No. of pkt. Sent	No. of pkt. Received	No. of Pkt. lost	Sending Time	Receiving Time
1	100	100	0	.01213	.01250
2	200	200	0	.23322	.23454
3	300	300	0	.33444	.33567
4	400	400	0	.53430	.54788
5	500	500	0	.63341	.64580
6	600	600	10	.89930	.99004
7	700	700	10	.90099	.98010
8	800	800	15	.10230	.13233

OBSERVATION

With respect to AOMDV, the throughput of the nodes which are away from IGW likewise debases enormously in light of the fact that these nodes simply send packets hop by hop and don't know about congestion when traffic is heavy. In the Figure 6, we can see that AOMDV give a vastly improved execution than unadulterated AODV yet lower execution than our proposed protocol.

In proposing protocol, we achieve better performance in the term of throughput in the entire network. As shown in the network graph, after increment in the congestion, Sample Rate is influenced due to damage of packets related to the congestion problem, along these lines, starts to utilize lower information rates.

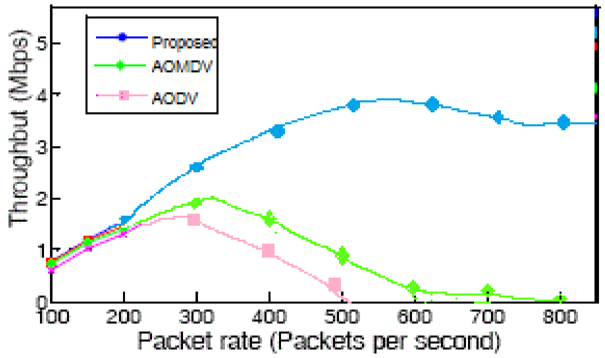

Fig. 6: Result analysis: comparison of Throughput of different protocols

In any case, our proposed protocol inspection of congestion in related paths and changes to a backup path to go, which lessens these packets misfortunes and expands the general throughput.

V. CONCLUSION

Routing is the most important work in any network, which will be significant impact on the performance in whole network. Therefore, the algorithm for routing and WMN should be design discreetly with consideration of exclusive features. In this manner, the proposed protocol for WMN used shortest path and balancing of load under multipath routing. The primary thought is on the investigation of steering with quick path revelation and Redesign, least hops, least delay, less error rate and most extreme route durability. The proposed algorithm has the accompanying key commitments:

(i) We characterized an approach to relegate coordinates to every one of the nodes in a system and find any node utilizing those coordinates.

(ii) We characterized an approach to transmit a packet utilizing shortest path.

(iii) We planned a multi-way Hop-Count based routing protocol that can be adequately connected to WMN design because of its effortlessness, solidness and practicability.

(iv) We plan a system that can justify our Hop-Count based routing to anticipate congestion and maintain a strategic distance from it.

REFERENCES

1. Ian F. Akyildiz ,Xudong Wang, Weilin Wang, “Wireless mesh networks: a survey”, (Sept. 2005), Computer Networks 47 (2005) 445–487
2. Nagesh S. Nandiraju, Deepti S. Nandiraju, and Dharma P. Agrawal, ”Multipath Routing in Wireless Mesh Networks”, 1-4244-0507-6/06/$20.00 ©2006 IEEE
3. N. Nandiraju, D. Nandiraju, L. Santhanam, B. He, J. F. Wang, D. P. Agrawal, "Wireless mesh networks: current challenges and future directions of web-in-the-sky," IEEE Wireless Commun., vol. 14, no. 4. pp. 79-89, August 2007.
4. Koksal, C., Balakrishnan, H., ” Quality-aware routing metrics for time-varying wireless mesh networks”. Selected Areas in Communications, IEEE Journal on 24(11) (Nov. 2006) 1984-1994
5. Lei Chen, Heinzelman W.B, "QoS-Aware Routing Based on Bandwidth Estimation for Mobile Adhoc Networks", IEEE Journal on Selected Areas in Communications, 2005
6. Jian Tang, GuoliangXue, Weiyi Zhang, ”Interference-aware topology control and QoS routing in multi-channel wireless mesh networks,” Proceeding, MobiHoc '05 Proceedings of the 6th ACM international symposium on Mobile ad hoc networking and computing.
7. IshitaBhakta, KoushikMajumdar, Ayan Kumar, “Incorporating QoS Awareness in Routing Metrics for Wireless Mesh Networks”, In the proceedings of World Congress on Engg. 2010 Vol I.
8. Richard Draves, JitendraPadhye, Brian Zill, “Hop-Count Based Congestion-Aware Multi-path Routing in Wireless Mesh Network”, Hung QuocVo, ChoongSeon Hong, IITA-2006-(C1090-0602-0002)
9. “Comparison of Routing Metrics for Static Multi-Jop Wireless Mesh Networks”, Proc of SIGCOMM 2004
10. S.Waharte, B.Ishibashi, R.Boutaba, “Performance Study of Wireless Mesh Networks Routing Metrics”, 978-1-4244-1968-5/08/$25.00 ©2008 IEEE.
11. C. Perkins, E. M. Royer, and S. Das, “ Ad-hoc On-demand Distance Vector (AODV) Routing”, IETF RFC 3561, 2003
12. J. Broch, D. Johnson and D. Maltz, “The dynamic source routing protocol for mobile ad hoc networks”, IETF Internet Draft, Oct. 1999
13. Richard Draves, JitendraPadhye, Brian Zill, “Comparison of Routing Metrics for Static Multi-Jop Wireless Mesh Networks”, Proc of SIGCOMM 2004
14. Douglas S. J. De Couto, “A High-Throughput Path Metric for Multi-Hop Wireless Routing, “Proc.Of ACM MOBICOM, 2003.
15. “Routing in Multi-Radio, Multi-Hop Wireless Mesh Networks,” Proc of MOBICOM 2004
16. Y. Yang, J. Wang and R. Kravets, “Designing Routing Metrics for Mesh Networks,” IEEE Workshop on Wireless Mesh Networks, WiMesh, 2005
17. K. Ramachandran*et al.*, “On the Design and Implementation of Infrastructure Mesh Networks,” IEEE Workshop on Wireless Mesh Networks (WiMesh), 2005.
18. Guoqing Li, L. Lily Yang, W. Steven Conner, BaharehSadegh. ”Opportunities and Challenges for Mesh Networks Using Directional Antennas”,
19. On NS2 information available at “ http://www.isi.edu/nsnam/ns/”.
20. The *ns* Manual, formerly *ns* Notes and Documentation

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