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A Theoretical Approach to Ameliorate the Efficiency of Parameters of Performance Metrics to Sharpen the Degree of Jitteriness to Enhance the Quality of Service in MANETs

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Abstract: ***Even though Mobile ad hoc networks (MANETs) are more popular because of their cost effectiveness and instant establishment nature, they pose many challenges to the network community in terms of providing high life expectancy and improving the quality of the service. Since the available energy levels are minimum, MANETs have to be more conduce in conserving energy in order to extend the longevity of the network. To achieve this, they have to take many constraints into consideration. The aim of this paper is to show the role and impact of various parameters in providing a theoretical way of improving jitteriness in MANETs. For practical verification, Network simulator NS-2 can be used for simulation of results to show that how improved performance of various parameters increased the overall quality of service in MANETs which in turn aids to enhance the life expectancy of the network. Theoretical analysis always provides an in depth detection of ground level realities and their implications on outcomes of the entire implementation.***

Keywords: MANETs; jitter; parameters; packet delivery ratio; packet drop ratio; throughput.

I. INTRODUCTION

MANETs (Mobile ad hoc Networks) have been playing a prominent role in establishing wireless networks. They have many advantages over wired networks in terms of their low cost, less time to construct the network, any place any time constructive methodology, very less dependence on human power etc., Even though they provide very good services to the network community, they have many internal problems and threats that are to be handled very carefully for their sustainability in order to satisfy the majority features and characteristics of the network to extend the quality and life expectancy of the network by utilizing the available energy resources very efficiently[1][2][3]. MANETs are highly dynamic in nature. This is the major drawback of MANETs because nodes in the network may disappear or some new nodes may join at any time. Unlike wired networks in which mobiles nodes are static in nature (fixed) and network configuration can be predicted at any time, configuration of MANETs can't be predicted and determined over any time interval[3]. This is the reason why so much studies and research are needed in designing very efficient routing protocols for MANETs[[1][4]. Because of high mobility of nodes, network stability can't be depended upon fixed parameters and there are so many other parameters that should be taken into consideration to count the efficiency of the network. Due to the limited available battery levels, every node in the MANET has to be more conduce in conserving the power in order to assist transmissions in the network from the source node to the destination node to ensure safe and stable transmission. Improving the longevity of network is the major requirement of any MANET[4][5][6]. The network quality and stability is measured in terms of its Jitter or Jitteriness which has been an underlined parameter of the quality of service. Any network is recognized on the basis of the quality that it provides and maintaining quality has been a major challenge to the network. The quality of the network depends on many parameters and in this paper an analysis on making those parameters more effective in nature in order to make them efficient parameters to improve the degree of jitteriness of the network[1][5]. Quality of the network not only improves quality of the service but also ameliorates the overall life expectancy of the entire network and it has many positive impacts on saving the battery power, individual power utilization of nodes, efficient routing paths, good transmission packets, very few error messages, very few link failures, constructing dynamic network configurations etc., To achieve all these benefits, parameter strengthening methods are to be studied. The main concentration of this paper is on parameter strengthening methods in MANETs[3][5][6]. The Quality of service in MANETs is based upon many parameters and mainly on Packet Delivery Ratio, Packet Dropping Ratio, Throughput of the network and Average end-to-end Delay. These four parameters also known as Performance Metrics to measure the efficiency of the network.

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II. ANALYSIS OF PERFORMANCE METRICS

Looking into them individually i) Packet delivery Ratio (PDR), it is calculated for every node participating in the transmission of the network. In any network majority transmissions will be handled by intermediate nodes as once the source node forwards a data packet, it is intermediate nodes that take the responsibility of transferring data packets from one node to another node till these packets are reached the destination node. So transferring data packets is depended upon the ability of individual nodes. But this ability differs from node to node.

It is further depended upon the individual energy levels available to nodes and their ability to find strong routing paths to their next nodes. Thus PDR is a ratio of the number of packets that it received to the number of packets that it transferred to the next node[4][5][6]. It is measured in percentage. Individual packets have their individual PDRs. Thus individual

PDR = (number of packets received) / (number of packets transferred) …… (1)

Since network has many nodes finitely, average PDR is to be calculated. So equation (1) is to be

PDR = (∑ TPR) / (∑ TPT) …….. (2)

Where TPR = the total number of packets received by all nodes in the network and

TPT = the total number of packets transferred by all nodes in the network

High PDR indicates the high capability of nodes (high PDR is a desirable parameter)

Low PDR indicates the low capability of nodes (low PDR is a discouraging parameter)

ii) Packet Dropping Ratio (PDrR): it is calculated for every individual node participating in the network. It is the difference of number of packets sent and number of packets received at every node. It is to be computed for every intermediate node in the network.

PDrR = ∑ (number of packets sent - number of packets received) / 100 ……..(3)

High PDrR indicates the low capability of nodes (high PDrR is a discouraging parameter)

Low PDR indicates the high capability of nodes (low PDR is a desirable parameter)

iii) Throughput: It is a measure of how many units of data packets are transferred or processed within a stipulated amount of time. It indicates the processing capacity of the network. It is to be computed for every intermediate node as well. It decides the efficiency of the network. Throughput = ∑ (number of packets Transferred at every node) / processing time ..……(4)

High Throughput indicates the high capability of nodes (high Throughput is a desirable parameter)

Low Throughput indicates the low capability of nodes (low Throughput is a discouraging parameter)

iv)Average End-to-End Delay: It is computed for every individual node and is measured in terms of time. It is the difference between the packets received time and packets sent time at every node. It is also known as One-way-Delay.

Average End-to-End Delay=∑ (packets delivery time–packets receive time) at every node in the network ……(5)

High Average End-to-End Delay indicates the low capability of nodes (high Average End-to-End Delay is a discouraging parameter)

Low Average End-to-End Delay indicates the high capability of nodes (low Average End-to-End Delay is a desirable parameter)

In this paper, simulation parameters such as number of nodes, simulation time, packet interval, packet size, landscape, traffic size, queue length, initial energy or battery power, transmission range of nodes, mobility models, routing protocols (AODV), data traffic CBR (constant bit ratio), MAC protocol and antenna type (Omni directional) all are considered to be unchanged during the simulation process. In some exceptional cases one or more of these parameters may be changed. Jitteriness is the measurement of compactness and stability of the network which provides a solid platform for transmission of data packets which in turn improves the quality of MANETs. Enhancing the degree of jitteriness is the primary aspect in this context. Individual analysis of each performance metric is to be discussed by taking other performance metrics into consideration i.e., at any moment every single performance metric is to be discussed in the scope of the other three performance metrics.

III.IMPACT OF EVERY PERFORMANCE PARAMETER METRIC ON OTHER PERFORMANCE METRICS

The ratio of PDR ≤ 1 for every individual node in the network

=> If the ratio is 1 then it implies that all packets that are received by a node are transferred to its node in its transmission.

If the ratio is less than 1 and around 1 then it implies that a few number of packets might be dropped. As the ratio decreases from 1 gradually and moving towards zero implies that the number of packets that are dropping are increasing steadily which implies the degrading the performance of the MANET. The performance ability of the network increases as transfer rate of data packets is around 100%. Theoretically it is possible to discuss but in implementation it is very difficult to achieve this number. Making PDR approximately 1 or around 1 is the primary task in this context. As PDR increases steadily and reaches 1 implies that packet dropping ratio is decreasing. Thus the relation between PDR and PDrR is inversely proportional.

=> PDR α 1 / PDrR ……..(6)

From the relation (6)

it is clear that PDrR α 1 / PDR …….. (7)

As the packet delivery ration increases steadily the packet dropping ration decreases. Thus a network needs either high PDR or low PDrR.

The ratio of PDrR ≤ 1 for every individual node in the network

=> If the ratio is 1 then it implies that all packets that are received by a node are not transferred to its node and there is a high traffic network jam in its transmission. In this case no transmission is possible further until all its previous data packets are cleared. And at the same time collisions in data packets may occur due to heavy traffic in the network which may further lead to loss of data.

If the ratio is less than 1 and around 1 then it implies that a few number of packets might be transferred and more packets are dropped. As the ratio decreases from 1 gradually and moving towards zero implies that the number of packets that are dropping are decreasing steadily which implies the stability the MANET increases constantly. The performance ability of the network increases as dropping rate of data packets is around 0%. It is very difficult to bring this number to 0%. But in reality, reducing the dropping ratio about to zero will be the great task.

As PDrR decreases steadily and reaches 0 implies that there is no packet dropping in the MANET. Thus PDrR will be about to zero when

only when number of packets sent ~ number of packets received at every node.

From (4) it is clear that Throughput is a fraction of number of data packets are transferred within a stipulated amount of time. Here processing time is fixed for the entire transmission so Throughput is purely based upon the number of data packets that are transferred at every node. This implies that Throughput needs high PDR which indirectly states low PDrR. By recurrence relation Throughput is proportional to PDR or inversely proportional to PDrR.

Throughput α PDR or Throughput α 1 / PDrR …….(8)

Here it seems among the performance metrics PDR, PDrR and Throughput, PDR is the main performance metric. If PDR is maintained well in the network, it will safeguard all the three performance metrics. Now the last performance metric is Average end-to-end Delay of every node. It is in terms of time. It is the difference of time between the packets received and the packets transferred at every node. If packets transferred rate is high than the receiving rate then surely there will never be any delay. But this packet transfer rate is not same to all nodes and differs from node to node as per the available energy levels in the network. If the transfer rate of data packets is high, then packets will immediately be sent to its next node, this implies there is no time delay in the processing of data packets.

In general, packets delivery time > packets receiving time, over any time interval. It is not possible to have 100% delivery at any time. But in reality, every network may have small amounts of time delay. Making this time delay very small, is the main task here. If the average end-to-end delay is low, it implies that transferring rate of data packets is high and if the average end-to-end delay is high, it implies that transferring rate of data packets is low this leads to stagnation of data packets at many nodes in the network. So transferring of data packets at high rate is suggested. This is based upon high PDR. Here too, PDR plays a prominent role. Thus on an overall basis, it is really true to say that PDR makes all the remaining other performance more effective in their functionalities.

To ensure high PDR, a constant bit ratio is to be maintained throughout the network and the size of the data packets <= the stipulated size. Then every node will have a constant load overhead which is another desirable metric which provides stability to the network. The degree of Jittriness will automatically be increasing once all these performance metrics are stronger in their own aspects. Thus all intermediate nodes in the network will be in a more comfortable position to provide a standard level of service to the network. It improves the quality of service to the network. Thus a good predictable output of Jitteriness will improve the quality of service in MANETs. Increasing the efficiency of performance parameters has been the major issue in designing any MANETs. All packets are delivered from the source node so in general source node consumes more energy than all other nodes in the network. The strength of PDR of each node depends upon the energy available to each individual intermediate node. Thus continuous energy supply to every individual node is another important task of the network. Whenever there is no delivery activity, the network has to make those nodes into a sleeping mode until traffic is initialized. This mechanism helps any network to conserve more energy. And this conserved energy will be utilizing for excess delivery of packets. The network topology of MANETs always changes because of their high dynamic nature. Selecting a new route path in case of mobility of nodes every time will be a big challenge to the MANET. Selecting a more suitable route path to the destination node is highly desirable. Thus efficiency of the quality of the service of the network can be increased by making performance metrics more robust in all aspects. By controlling the PDR metric will result in improving all other performance metrics. Thus delivery processing of data packets at every node should be given higher priority.

IV. CONCLUSIONS

From this analysis it is very clear that the stability and consistency of MANETs is purely based upon its performance metrics and packet delivery ratio plays a prominent role among all the performance metrics. And this implies that the quality of service in MANETs is improved by improving the Jitteriness of the network. In turn, the degree of Jitteriness can further be improved by improving the quality of each of the performance parameters. And among all of them PDR is the main performance parameter which decides the overall performance and quality of the MANET. So in designing and implementing any MANET if much importance is assigned to PDR, then most of the quality related issues will be curtailed which will improve the average life time of the MANET.

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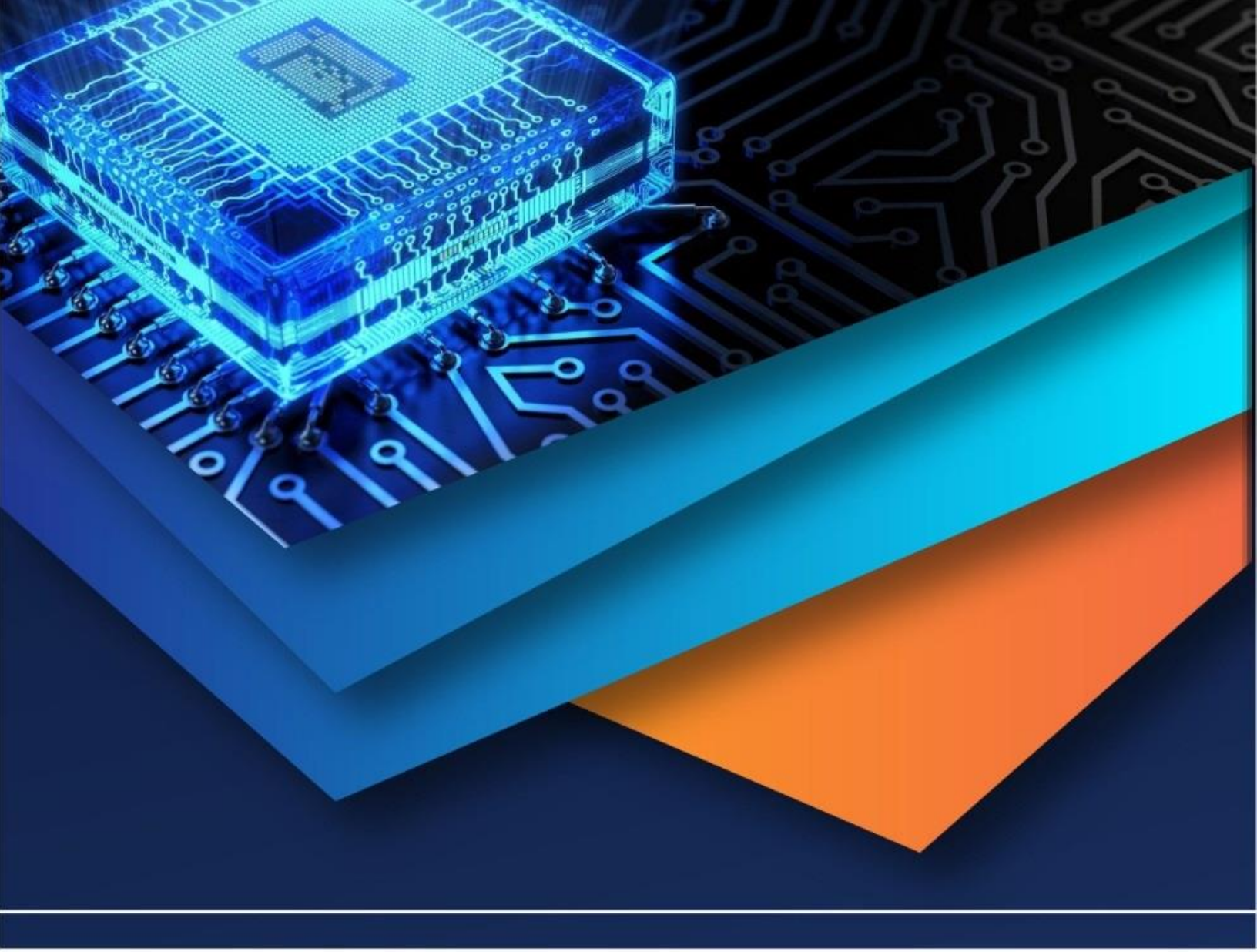

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