Forecast Function Based Congestion Control in MANET Routing

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Abstract. In a MANET, there is not necessitating arrange any structure to create nodes to transmit with every other. The recurrent updates of the topography as well as the mutual scenery of the wireless channel create important disputes. Hence, several congestion control methods have been introduced. MANETs have a numerous of approaches to encourage the routing function through inactive as well as active routing schemes. Though, there is not an enduring resolution which subsists to resolve the fundamental congestion trouble in the MANETs. This paper proposes a Forecast function based Congestion Control in MANET Routing (FFCC). In this scheme, the congestion rate is applied for measuring the highest congested node and isolates that node. Next we choose the less congested node thus the data reach the destination correctly. In addition, the Forecasts Congestion Rate is used to predict the congested node perfectly based on the five transactions. Thus transmits the data via less congested route efficiently. Network simulator is applied for examine the simulation experiments. The results demonstrate the minimized network delay as enhances the network throughput.

Keywords: MANET, Congestion Rate Forecasts Congestion Rate, traffic, healthcare, throughput.

1. Introduction

The MANETs are typically distinct as a self-governing system of nodes associated by wireless connections as well as transmitting in a multi-hop manner. The essential jobs that an ad hoc network must execute is congestion control as well as its major goal is to boundary the delay also buffer run over induced through the network congestion also it offers better function [1].

The production of novel wireless forces on a concentrated foundation has produced a growing require for strength, capability as well as throughput. Additionally, amount of restraints to function accurately are compulsory. Besides to bandwidth necessities, these restraints can be articulated include packet drop rate, latency, jitter or energy utilization [2].

For example, healthcare system requires continuous monitoring with both periodic updates as well as emergency messages flowing through the network. The major problem observed in such types of situations is the congestion occurring in the network causing unnecessary delays and hazardous effects. The causes for the occurrence of traffic congestion and methods adaptable to mitigate the traffic [3].
Congestion may appear to be a very simple issue among the networks because the delayed packets ultimately try to deliver within the allocated time period. However, healthcare applications require timely responses from the site under test to avoid the entire breakdown of the network. Figure 1 indicates the illustration of Congestion occur in Healthcare system [4].

In MANET, there are numerous sources of Congestion for example communications Competitors, packet confrontation as well as overflow of buffers. Between the troubles induced through congestion, such as delay details, packets drops which occasionally restrain details as well as extreme bandwidth [5]. These are disgraces the function of MANET. This difficulty prompts necessitate to team congestion control approach to enhance the network function.

2. Related Works

Several authors have introduced approaches depend on reactive routing that are congestion adaptative as well as compact with the congestion throughout the network. The combined procedure minimizes the energy utilization also diminishes the amount of packets being missed, hence getting better the function [6]. Inadequate bandwidth as well as altering topography affects the trouble of Congestion. Observing Congestion is hard in MANET, because there might be some causes following reducing of packets. In this network, unsuccessful release should be owing to the path break also the nodes movement. Mobile Clustering enhances the received packet rate as well as diminishing the network delay [7].

Congestion Control is additional significant dispute when leading for QoS attainment precisely with extremely movable mobile stations. The congestion control effects introduce a raised traffic method in Transmission Control Protocol (TCP) utilizing the token bucket traffic shaping method through packet transmitting at the middle nodes [8]. AD-hoc Transmission Control Protocol, the receiver notices the feasible current condition as well as communicates this detail to the sender as response [9].

Several operation factors are used detect as well as defeat the non-congestion drops [10]. The cooperative attempt of mobile nodes, lacking any preset structure. Transaction between the mobile nodes is a single hop otherwise multi-hop manner. Because of their active topography as well as imperfect bandwidth, preserving guarantee facility is a tricky job. It believes channel free period as well as obtainable bandwidths when choosing route [11].

Framework and implementation agent is applied for controlling (FIAC) the congestion in the network. This technique, the nodes are categorized into four classes depend on its traffic. It measures acquire in extent of the numerous traffic modules as well as the channel difference also approximates the congestion parameter to discover the least congestion level in the network. This parameter is utilized for electing the least congested path [12]. Agent based congestion control method that the details about congestion is gathered as well as disseminated by mobile agents. This method is utilized for choosing the least congested path [13].
3. Forecast function based Congestion Control in MANET Routing

The aim of Forecast function based Congestion Control in MANET Routing applied for isolate the more congested nodes and picked the less congested route in the network. Here, isolates the congested node based on the congestion rate (CR) and forecast the after few communication achievement rates (CAR) to enhance the network function.

Figure 2 illustrates the network structure in which numerous nodes are there. The nodes are arbitrarily distributed and moving arbitrarily in X×Y size. Routing is an active procedure assembly the essential parameters which will facilitate in the arrangement of routes since the sender to the receiver.

3.1. Congestion Rate Evaluation

The auto-functioning method is used to categorize the nodes as a CR. A CR is evaluating for every node throughout the routing procedure to mutually measure the present level of congestion also forecast the congestion level in the further some communications. A CR is considered via the incoming as well as outgoing packets for every node vigorously. This CR assists find out whether the mobile node is overcrowding or not. The more congested node has the maximum CR throughout the assessment procedure. These nodes are hence inaccessible from the routes in that way. The other usable mobile nodes are threaded into the data communication paths through that data is sent. The CR of node i is calculated for applying the expression 1 below.

$$ CR_i = \frac{\text{inco} \min_g \text{ pkts}_i}{\text{Outgoing pkts}_i} $$

Here, pkts represents the packets. The present incoming as well as outgoing packets are a middling of the previous few communications. Thus it offers additional perfect incoming as well as outgoing packets. The node with the lowest CFR value is chosen as the next hop and data is transferred to that particular node. The $CR_{Th}$ rate is set via conceiving the CR rates of entire mobile nodes here in the MANET. The computation of $CR_{Th}$ is specified in the expression 2.

$$ CR_{Th} = \frac{\sum_{i=0}^{n} CR_n}{\text{Sum of mobile nodes}} $$

Where, n represents the total number of mobile nodes.
Figure 3 illustrates the CR evaluation in MANET. Here, the node 5 is a source node and its neighbour nodes are 0, 1, 2, 3, 4. These nodes CR rates are 0.4, 0.3, 0.7, 0.6, and 0.9. The neighbouring nodes estimate the CFR using their own current incoming packets and outgoing packets. The nodes 4 and 2 CR rates are greater than the CR_{th}. Thus, these nodes are not selecting the relay node. Here, the 1 is a lowest CR than the CR_{th} value therefore that node is elected as a relay node. The series of procedures accepting position in the algorithm therefore is given in below.

3.2. Algorithm
For \{n = 0 to h\} { 
    Launch CR_{th} = 0 
} 
While \{Sender! = Destination\}
    Evaluate present incoming packet 
    Evaluate present outgoing packet 
    
    CR = \frac{\text{Incoming pkts}}{\text{Outgoing pkts}} 
    
    Separate the node with CR > CR_{th} 
    Discover adjacent node with CR < CR_{th} 
    Transmit the data 
    Eliminate high CR nodes from path 
    Attend step four till data achieves receiver 
} stop process 

The Congestion Rate Evaluation not only discovers the present CR value however in addition forecasts the following CR as Forecasts Congestion Rate (FCR) as well as it disseminates the most horrible case CR node to every other mobile node. In this approach, the node has both the highest CR as well as the highest FCR are separate from the paths. The standard deviation process is applied to calculate the CR. Standard value of the previous five outgoing communications \(0 < h \leq 5\) is taken as an outgoing packets. The standard deviation of the previous five CR from the outgoing packet is evaluated as the \(\sigma_{CR}\). Here, \(h\) indicates the neighbour nodes. The expression applied to compute \(\sigma_{CR}\) is below.

\[
\sigma_{CR} = \sqrt{\frac{1}{h} \sum_{h=0}^{h} (CR_{h} - \text{Outgoing packets})} 
\] (3)
Thus the forecasting CR is known as the FCR is evaluated as provide in the expression (4), with the alternative preservative if there is a rising packet rate subtractive in casing of a declining packet rate.

$$FCR_i = FCR_i \pm \sigma_{FCR_i}$$  \hspace{1cm} (4)

Utilizing the expression in (4) FCRi is forecast by the sender end as well as the sender not only takes out the node with the greatest FCR from its path arrangement but as well disseminates the node with a extremely elevated FCR thus alertness the other nodes concerning the congested node.

4. Simulation Analysis

The simulation analysis of the FFCC is executed utilizing the network simulator-2.35 which is expansively applied for investigation. The comparisons of factors like packet obtained ratio, packet drop ratio, latency, delay, throughput and routing overhead to establish competence. The packet traffic is yielded with variable bit rate.

4.1. Packet Obtained Ratio

POR is denoting as the ratio of packets received at receiver per particular time. POR is assessed by Equation 5. Where, n = Node count

$$POR = \frac{\sum_0^n \text{Packets Obtained}}{\text{Time}}$$ \hspace{1cm} (5)

The POR of FIAC and FFCC are diagrammed in Figure 4. It illustrates that the proposed scheme FFCC has better POR when compared to the existing strategy FIAC.

4.2. Packet Drop Ratio

PDR is denoted as the ratio of distinction among the forward packets and obtained packets in the communication MANET per particular time. PDR is measured by Equation 6.

$$PDR = \frac{\sum_0^n \text{Forward Packets} - \text{Obtained Packets}}{\text{Time}}$$ \hspace{1cm} (6)
Figure 5. Packet Dropped Ratio of FIAC and FFCC

Figure 5 shows the PDR values obtained from the simulation analysis of FIAC and FFCC. It indicates that PDR of FIAC is higher when compared with FFCC.

4.3. Throughput
Throughput denotes to an entire number of packets successfully delivered across network per unit time. Throughput is obtained using Equation 7

$$\text{Throughput} = \frac{\sum_{n=0}^{\infty} \text{Packets Received}(n) \times \text{Packet size}}{\text{Time}}$$ (7)

Figure 6. Throughput of FIAC and FFCC

Figure 6 indicate the outcomes for throughput execution of existing strategy FIAC and FFCC versus VBR traffic. It is mentioned that the FFCC approach has highest throughput while equated to the existing strategy FIAC.
4.4. Delay Analysis

Delay is represented as the time period difference among data sent and packets obtained. It is measured by Equation 8.

$$\text{Delay} = \frac{\sum_{i=0}^{n} (\text{Packet Obtained Time} - \text{Packet Forward Time})}{n}$$  \hspace{1cm} (8)

Figure 7 demonstrate the execution estimation for average delay for FFCC as well as existing strategy FIAC. It is mentioned that the FFCC approach has less delay while equated to the existing strategy FIAC. The FFCC obtains better execution owing to it select the path is less congestion.

4.5. Overhead Analysis

Routing Overhead is depicting the sum number of control packets communicated for yielding a data route per data packet. It is received through computing the ratio among the sum numbers of control packets transmit to the sum number of control packets obtained. Figure 8 depict the routing overhead based on node mobility speed.
Figure 8 illustrates the proposed strategy FFCC has lowest routing overhead than the existing strategy FIAC. Since, the FFCC choose the relay is a lesser congestion rate. So, avoid the congestion in the network. But, FIAC increase the routing overhead because of it does not select the congestion aware routing in the MANET.

5. Conclusion
In this paper, we proposed Forecast function based Congestion Control in MANET Routing directing to minimize the network congestion and minimize the network delay. In this scheme, the congestion rate is applied for measuring the highest congested node and isolates that node. Next we choose the less congested node thus the data reach the destination correctly. In addition, the Forecasts Congestion Rate is used to predict the congested node perfectly based on the five transaction. Thus the source transmits the data via less congested route efficiently. The simulation results illustrate that the FFCC offer better packet obtained rate as well as minimizes the network delay.

References
[1] Gupta H and Pandey P 2013 Survey of routing base congestion control techniques under MANET IEEE Int. Conf. on Emerging Trends in Computing, Communication and Nanotechnology (ICECCN) 241-244.
[2] Sharma N, Gupta A, Rajput SS and Yadav VK 2016 Congestion control techniques in MANET: a survey 2nd Int. Conf. on Computational Intelligence & Communication Technology (CICT) 280-282
[3] Keerthi Anand VD 2015 Power Efficient Multicast Opportunistic Routing Protocol (Pemor) To Optimize Lifetime of Manet Int. Journal of MC Square Scientific Research 7 109-127
[4] Rao EJ, Ramanjaneyulu T and Kumar KJ 2018 Advanced Multiplier Design and Implementation using Hancarlson Adder Int. Conf. on Intelligent and Innovative Computing Applications (ICONIC) 1-5
[5] Bhatia B 2015 Performance analysis of AODV based congestion control protocols in MANET Int. Conf. on Futuristic Trends on Computational Analysis and Knowledge Management (ABLAZE) 453-458
[6] Janhavi V and Yuvaraju BN 2014 A unified method to solve the energy depletion and congestion problem using mobile relay in manets 7th Joint Int. Information Technology and Artificial Intelligence Conference 330-335
[7] Yadav S and Firdaus T 2019 Congestion Aware Routing in AODV based Mobile Ad-Hoc Network (MANET) *Int. Conf. on Computing, Power and Communication Technologies (GUCON)* 452-457

[8] Rath M, Rout UP, Pujari N, Nanda SK and Panda SP 2017 Congestion control mechanism for real time traffic in mobile adhoc networks *Computer communication, networking and internet security* 149-156

[9] Sreenivas BC, Prakash G B and Ramakrishnan KV 2013 M-ADTCP: An Approach for Congestion Control in MANET *In Advances in Computing and Information Technology* 531-540

[10] Sharma N and Chakrawarti RK 2014 Simulation for congestion-less losses control over MANET using TCP scheme *Int. Conf. on Issues and Challenges in Intelligent Computing Techniques (ICICT)* 410-415

[11] Dsouza MB and Manjaiah DH 2019 Congestion Free And Bandwidth Aware Multipath Protocol for MANET *1st Int. Conf. on Advances in Information Technology (ICAIT)* 267-270

[12] Bhadauria SS and Sharma VK 2011 Framework and Implementation of an Agent Based Congestion Control Technique for Mobile Ad-hoc Network *Int. Conf. on Advances in Computing, Communication and Control* 318-327

[13] Sharma VK and Bhadauria SS 2011 Agent based congestion control routing for mobile ad-hoc network *In Trends in network and communications* 324-333