International Journal of Future Generation Communication and Networking
Vol.14, No. 1, (2021), pp. 3086–3095

Congestion Avoidance Methods Using Caching Information Technique in Iot and Manets

O. V. Sowmya[1], Z. Shobha Rani[2]

[1]Assistant Professor, Department of CSE, K. S. R. M College of Engineering, Kadapa

[2]Assistant Professor, Department of CSE, K. S. R. M College of Engineering, Kadapa

Abstract

MANET (Mobile Ad hoc Network) is a type of ad hoc network, which consists of mobile devices as the nodes in the network. There will not be any centralized infrastructure. It has many features like multihop communication, dynamic topology. But it has limited resources and limited security. The limitations in resources may cause congestion in the network. Congestion may occur in any intermediate nodes and results in high packet loss, high delay which lead to performance degradation of the network. So congestion control is one of the importance tasks in the MANET. This paper presents a review of different techniques used for the congestion control in the MANET. It can cause congestion that results in increasing transmission delay and packet loss. This problem is more severe in larger networks with more network traffic and high mobility that enforces dynamic topology. To resolve these issues, we present a bandwidth aware routing scheme (BARS) that can avoid congestion by monitoring residual bandwidth capacity in network paths and available space in queues to cache the information. The amount of available and consumed bandwidth along with residual cache must be worked out before transmitting messages. The BARS utilizes the feedback mechanism to intimate the traffic source for adjusting the data rate according to the availability of bandwidth and queue in the routing path

Keywords— MANET, Multi-hop, Topology change, Congestion Control, Packet loss, , data rate, link capacity, MANETs, IoT

I. INTRODUCTION

MANET's were earlier named as packet radio. MANET is a collection of mobile devices that are connected over various wireless links. It is a infrastructure less networks of mobile devices connected without wires. Each device in a MANET is free to move in any direction, and will therefore change its links to other devices frequently. A node in the network can communicates directly with other nodes within its wireless communication range. If the destination node is beyond the communication range of the source node, then the intermediate nodes act as routers to forward the packets from the source to destination. Each node in the MANET act as both router and host. That is it is autonomous in behaviour. MANET has many features like dynamic topology, selfconfigurability, flexibility and multi-hop communications. Due to these features they are used in various kinds of applications like military applications, rescue operations, vehicular networks etc. But MANET has limited resources and security.

The internet is one of the most important and transforming technology ever invented. Internet is like a digital fabric that affects our life in one way or others. The internet of people changed the world but there is a new internet emerging which is about connecting things and so its name is the internet of things (IoT), here the things share their experience and communicate with one another [1]. It is like take things and add sense and communication power to them. Here the things interact and collaborate with other things. For example our smartphone, it has many sensors, it knows where we are, it knows what we are saying to it (through Google), it knows how close it is to our face, it knows how much light around

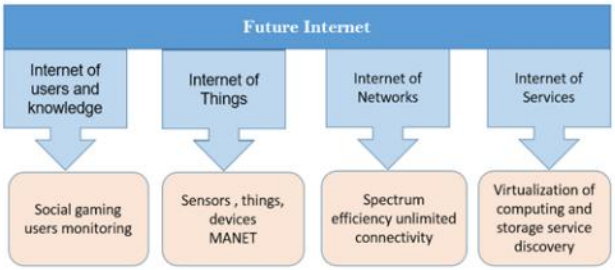
ISSN: 2233-7857 IJFGCN

us, it knows how we are holding it, it knows if we are moving, even it has an eye (camera) so it can see our surroundings and has the power to communicate in a wireless and mobile network. Smart cloud environment and hence achieve effective utilization of devices learn and track pattern to ensure our comfort and save energy and it communicates in the network and we can control them. Because they can communicate in the network so they know how to listen, we can tell them or other smart things can tell them to turn on, off or play. We can take the example "armband". If we have armband on our hand during night, it senses the sleep cycle and know when to wake up people by gently vibrating and blinking light with the same time send message to other smart things at home and a chain of event starts, because now things are talking to one another for example, house fan startup and draw all the morning air in the house, which cools the home and coffee maker starts up automatically etc. We all want to live a better life and technology like IoT has the ability to sense, communicate and provide new levels of comfort for us. It is a perfect technology to collect raw data and turn it into knowledge and then wisdom and move the human race forward. Technology is accelerating force. The smart things can send information in MANET across all active things without any centralized scheme [2]. The mobile (sensor) network is the backbone of smart environment. The smart things act as router under the IoT environment. In the Smart World ahead, we will see how physical things will be able to automatically exchange data among themselves. IoT (Internet of things) is a technology that facilitates the interlinking of physical things with the digital world. MANET is a set of nodes, which are basically distributed spatially and communicating each other wirelessly and here smart things can communicate with each other remotely. Every intelligent gadget is able to change its location by using the MANET mobility feature. The MANET in IoT is a combination of portable autonomous smart things that can transfer data to each other through a wireless network

Safety emergency requires quick and clear communication. Emergency medical technician, Fireman, a Police officer, and dispatch team all rely heavily on the mobile communication system and if tragedy strikes in rebel area, the current wireless communication technology is not always available, when it is available it is not reliable or fast enough, especially for time sharing sensitive information. So how can we improve the wireless mobile network to help first responders? We need to develop a new protocol or a new scheme that can eliminate unnecessary communication between devices, so by eliminating this overhead they can actually forward the data in a timely manner without incurring any penalty, where each node can make its decision locally, and then mobility would not be a problem. We should develop Technology for public safety and first responders deployed in the area. Where there is no cellular coverage or even if there is a cellular coverage in cases of disasters and catastrophic, then that network can be highly congested. So in that case, the ad-hoc mobile Technologies comes in handy. Our vision should be to develop some wireless devices such as “helmet-mounted camera” streaming live video for the rescue team along with “wrist-mounted touch screen watch” streaming data across the team. Technologies playing a vital role in the case of HD video transmission and emergency response communication. One example of a safety emergency is road accidents. Road accidents illustrate a major issue and one of the main cause of death. Most of the road accidents due to human error and 70% of this accident could have been stop if the driver had been worn at least half a second beforehand. Here, VANET is established to minimize the risk of road accidents and to maximize passengers comfort by permitting automobile to exchange various kind of information. The safety-related applications and MANET protocols represent the main objective of communication when the accident occurs, a vehicle can continuously broadcast data about this critical situation to the approaching vehicles. When a vehicle brakes suddenly, it send data about its current status, which is used by surrounding vehicles to quickly detect the sudden breaking and to strengthen the quality of service requirement and efficient routing protocol that can give a broadcast service with bounded access delays and low transmissions collisions are needed. A new Mobile Network should be there to support issues related to IDM with several personal attributes and mobility. So we can say that mobile ad hoc network protocols can play a major role during communication in this network. MANET-IoT Internet

concept shown in the below figure

Fig 1: MANET-Iot Internet Concepts



One of the major problems in the MANET is the congestion. Due to the limited availability of the resources and the nature of the network the congestion become the common issue in the MANET. Congestion occurs in some part of the network when the traffic is too heavy. This problem arises when a router can receive packets on multiple input ports at a higher rate than that it can forward. Due to shared wireless channel and dynamic topology, packet transmissions suffer from interference and fading. Congestion causes packet loss, bandwidth degradation, and time and energy wastage. So congestion should be controlled.

II LITERATURE SURVEY

In this section different method for congestion control in MANET is discussing. In 2019 Navneet Kaur and Rakesh Singhai proposed a fuzzy controlled data rate based and hello interval based congestion control method [1]. The data rate and control packets such as Hello packet interval is selected according to the channel conditions depending on the node mobility and energy consumed by the nodes in transmission. Depending on the transmission power and current speed of the nodes, the method enables nodes to adjust their data rate and frequency of their Hello messages. This improved protocol detects and reacts to the congestion parts of the network. This will reduce the congestion and improve the throughput. The proposed method enhances the performance of mobile network in terms of parameter throughput, end to end delay, jitter, queue length. In the same year a novel cross layer approach called congestion adaptive and delay sensitive multi-rate (CADM) routing protocol in MANET [2]. CADM protocol find the route through less congested nodes and congestion is actively handled when it occurs. This method consists of rate adaptation and congestion aware optimization to improve the performance in terms of throughput, packet delivery, and latency. CADM finds a less congested, high throughput route based on QoS metrics data rate, packet forwarding delay and buffer queuing delay. JiashuaiWang et al. proposed a contention-based hop-byhop bidirectional congestion control algorithm (HBCC) in 2019 [3]. In this method the congestion is detected using queue length as a parameter. By determining the queue length of current node and next hop node the congestion conditions are divided into four categories. The algorithm adaptively adjusts the contention window of the current node when at least one of the two nodes is congested and also changes the priority of the current node to access the channel. The buffer queue length of the congested node is reduced in this way. A method called Bandwidth Aware Routing Strategy (BARS) is introduced by Nousheen Akhtar et al. in 2019 to avoid congestion in MANET [4]. In this method the congestion is avoided by monitoring the residual bandwidth capacity in the network paths and the available space in the queue.

The calculation of these parameters are calculated before the transmission of messages. According to the availability of the bandwidth and queue, method will adjust the data rate. In 2018 Mohsen Yaghoubi Suraki et al. proposed a Fuzzy Cross-Layer congestion Control (FCLCC) [5]. In this paper to avoid the congestion problem a cross-layer approach is proposed in transport, network, and MAC layers in which

Fuzzy Logic System is used in intermediate and destination nodes. DSR routing algorithm is used in the network layer and messages that are exchanged among nodes are put into the ACK packets. Detection, notification, and adjustment of the transmission rate are the three features of this method. From the buffer conditions and the number of times that the buffer becomes full, the congestion is detected. In notification step, the congestion level is determined by the fuzzy controller and informed to the upstream nodes.

Finally in the transmission rate step, according to the congestion level transmission rate is adjusted. Saurabh Sharma et al. in 2018 proposed a Mobile Random Early Detection method to control the congestion [6]. The method is based on hybrid approach that uses clustering and queuing techniques. In general cluster head transfers the data and follows a queuing method based on RED (Random early Detection). The mobile environment will make it Mobile RED (MRED). It mainly depends on mobility of nodes and mobile environment which leads to unpredictable queue size. In 2018 Yefa Mai et al .propose An Effective Multiple Paths Congestion Control AODV (CC-AODV) [7], which lower the performance degradation caused by the packets congestion while the data is delivered using AODV. The method uses a congestion counter label to determine the path for the data. This can be done by checking how stressed the current node in a table. The congestion counter adds one to the counter, once the RREP package is generated and transmitted. The keystone to achieve multiple routing paths is the implementation of the congestion counter in the routing table. CC-AODV will outperform AODV in throughput, packet delivery ratio and packet loss. A Combined TCP-friendly Rate control (TFRC) with WFQ Approach is proposed by Y. Narasimha Reddy et al. in the year 2018 [8]. In this paper an integrated TFRC with weighted fair queue (WFQ) approach is introduced to overcome the congestion in the network and to minimize the RTTs. The WFQ mechanism will manage the incoming heavy traffic. This is done to ease the data rate control for smooth data flow to improve throughput. This proposed method is mainly based on buffer queue management. It reduces router congestion through proper scheduling of data packets based on packet weights. Astha Mishra et al. proposed a methodology in 2018 to overcome the congestion and interference in MANET [9]. The congestion and interference is avoided using the multichannel energy based routing approach. This method uses the multichannel-based communication that is single or multiple senders will use more than one channel to send the data. While the multiple senders simultaneously demands the channel from the intermediate nodes, the interference, collision and delay of the network can be minimized by the multichannel wireless mobile ad hoc network. In 2018 Y. Narasimha Reddy et al. proposes a method for data rate and congestion control [10]. Propose method is a routing delay prediction based on packet loss and Explicit Delay Acknowledgement (EDA) mechanism. The packet rate is controlled through determining the buffer length of each intermediate node in the route to destination. The destination node that receives each data packet, transmit an EDA message with updated buffer length during the current traverse. The method will efficiently control data rate for streaming application to minimize the loss of packets and improve the throughput. This mechanism deals with inconvenience of TCP congestion over MANET.

A. Amuthan et al. [11] in 2018 proposed a Dynamic multistage Tandem Queue modeling-based Congestion Adaptive Routing (DTQCAR). The method is based on the estimations of average threshold level of congestion. It is an effective and efficient congestion control method, because it considers current level of congestion level for dynamic packet routing depending on the amount of packets need to be forwarded instantaneously. It has a warning module that sends alert message to interacting neighbouring node for dynamic adjusting of packets that are forwarding. In 2017 R.Vadivel et al.[12] proposed an adaptive reliable and congestion control routing protocol to avoid congestion and route errors using bypass route selection in MANETs. On the basis of utilization and capacity of link and paths the congestion is detected. Here multiple paths are constructed and among that shortest path is selected for data transmission. When a node detects congestion on outgoing link, it will calculate the multiple paths to the destination. Then some portion of the traffic to the node is shifted to alternate path. The distribution of traffic over alternate path is done by considering the path availability threshold and using

a traffic splitting function. The main objective of this method is to minimize the utilization to a more acceptable level by shifting a portion of the traffic to the alternative paths and this part of traffic. Whenever a local link congestion is detected or receives an Explicit Congestion Indication (ECI) bit from a neighbour, then node calculates a set of alternative paths and distributes the bypass traffic over these paths. If one node cannot resolve the congestion, then it signals its neighbors using the congestion indication bit. During the same year Varun Kumar Sharma et al. [13] proposed an effective cross-layer adaptive transmission method to handle the congestion in mobile wireless ad-hoc networks. The method mainly focuses on minimizing the effects of congestion on the network performance. It based on the estimation of congestion intensity experienced by a node. The proposed method successfully classifies packet losses in the network to prevent unnecessary adaptations of transmission rates. The method also identifies the contribution of each flow in congestion intensity and selectively makes significant congestion contributors to adapt their transmission rates.

Sujata V. Mallapur et al. [14] I 2017 proposed an efficient routing technique called the multipath load balancing technique for congestion control (MLBCC) in MANETs. It efficiently balance the load among the multiple path by reducing congestion. MLBCC introduces two mechanisms called congestion control mechanism and load balancing mechanism during the transmission of data. Arrival rate and outgoing rate in a particular interval are used to detect congestion in the congestion control mechanism. By using the link cost and the path cost the load balancing mechanism selects a gateway node that efficiently distribute the load by selecting the most desirable paths. The selection of gateway node is done such that it possesses good link status while minimizing the total path cost. When candidate node detects a load, the packets are immediately fragmented and the load is distributed through the selected gateway node. The gateway node efficiently distributes the traffic by selecting three useful paths. Here a node availability degree standard deviation parameter is introduced for an efficient flow of distribution. In 2017 Nousheen Akhtar et al. [15] proposed AODV based mechanism to avoid congestion before happening. The available bandwidth is adjusted according to the estimated current bandwidth consumption. Available bandwidth is predicted using the HELLO messages. A feedback is provided to the source node about the current network state. According to this current network state the source node adjusts its data rate

III. EXISTING ANALYSIS

Existing techniques for route discovery rebroadcast route request packets until the desired path is established to destination node. But these scheme results in broadcast storm problem when data is transmitted from source to destination. It causes congestion at intermediate nodes. Early detection of congestion and self-cure AODV routing protocol (EDCSCAODV) is an enhancement of traditional AODV on the basis of active queue management where routes are computed on individual node. This scheme is able to detect congestion on early stages and transmits an alerts message to all neighbor nodes. On receiving network information neighbor nods detect a congestion free path is selecte While solving the problem of attack in the network, we cannot ignore the delay factor. Delay is a key parameter while measuring the performance of the ad-hoc network. Delay is the time consumed by the data to reach the target node. Delay in the smart environment gets affected by a number of nodes connected and mobility of nodes present in the network. Our aim is to minimize the value of the delay factor in the mobile network for the active protocol. Methodology: The delay is measured by taking a large number of nodes. A number of connections and pause time between the nodes (devices) helps to minimize the delay. We have used fuzzy Logic to maintain low delay in the mobile network. The proposed work is about the evaluation of the delay parameter in the mobile network. Intelligent nodes present in the network save the data about neighboring or adjacent nodes and make decisions based on this collected data. Nodes Keep checking whether the adjacent nodes are effectively responding in the system or not. The decision

is taken on the basis of delay parameters. Response time of the adjacent node is checked against the expected time and accordingly, exclude the particular node from the network. We also use an algorithm to send the information with true decision making. The whole process is repeated until the target node is not achieved.

IV. PROPOSED WORK

The buffer queue length of the congested node is reduced in this way. A method called Bandwidth Aware Routing Strategy (BARS) is introduced by Nousheen Akhtar et al. in 2019 to avoid congestion in MANET [4]. In this method the congestion is avoided by monitoring the residual bandwidth capacity in the network paths and the available space in the queue. Congestion is a condition in the networks when there are too many data packets are present in the subnet. Congestion occur when network carries more load (i.e. number of packets sent to the network) then its capacity (number of packets handed by the network). Congestion leads to packet loss and bandwidth degradation. In case of MANETs and IoT, congestion does not overload mobile nodes but it effects overall coverage area. If the selected routing protocol is unable to handle congestion, following issues can arise within the network [14]–[16].

i) Increase in delay: It detects the occurrence of congestion by estimating the expected time to deliver. If there is long delay, then network congestion might be one of the reason. In such kind of situations, it is better to select some alternate path but again selection of new path and searching process depends on routing protocol selected.

ii) High overhead: in case of multipath routing more processing is required. For the selection of alternate path in case of congestion, it requires more retransmission attempts that increases network overhead.

iii) Increase in packet loss: congestion control techniques try to minimize network load by either reducing its sending rate or drops packets at intermediate node. This process increases the number of packet drop ratio that ultimately decreases network throughput [17]. Figure 2 illustrates congestion scenario among multiple senders nd receivers.

This paper presents a bandwidth aware routing scheme that cache the information in queue to adjust data rates and hence congestion. Our main contributions are as follows;

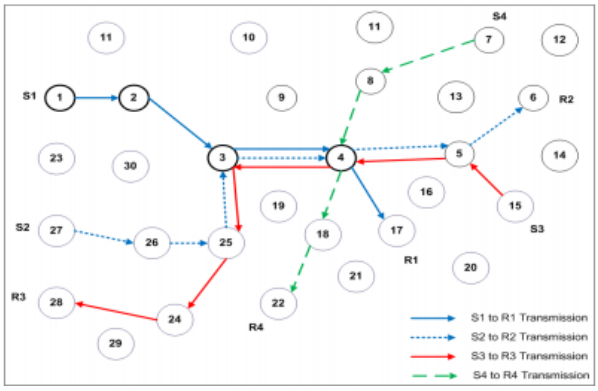


Fig 2: Congestion Scenario with multiple senders and receivers

1) The scheme allows source to adjust its sending rate whenever network is near to congestion. We modify existing AODV as per available bandwidth in the path and residual queue sizes of each node in path.

2) The proposed routing mechanism modifies the RREQ and RREP messages of AODV by embedding path bandwidth and queue size in it. Moreover, RERR message is also modified to handle path break.

3) In order to provide quality of service to the routing we have used bandwidth and queue size as a metric for

ISSN: 2233-7857 IJFGCN

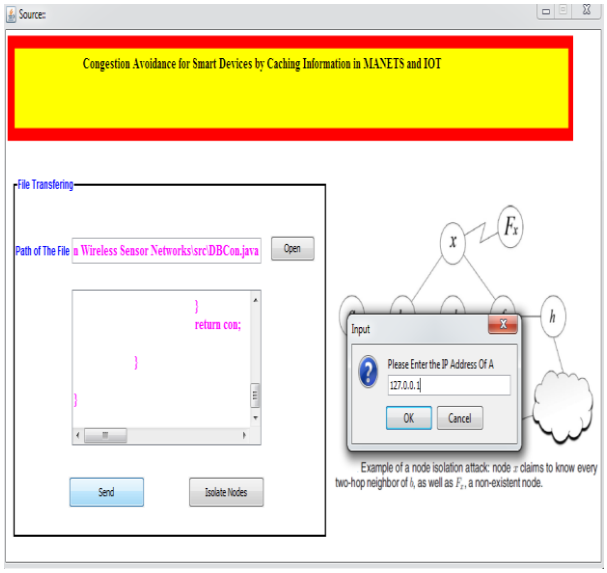
route selection.

4) To test the performance, we implemented our proposed technique in NS2 simulator. Results shows that proposed routing mechanism outperforms in comparison with most recent technique named, mitigation of packet loss using data rate adaptation scheme

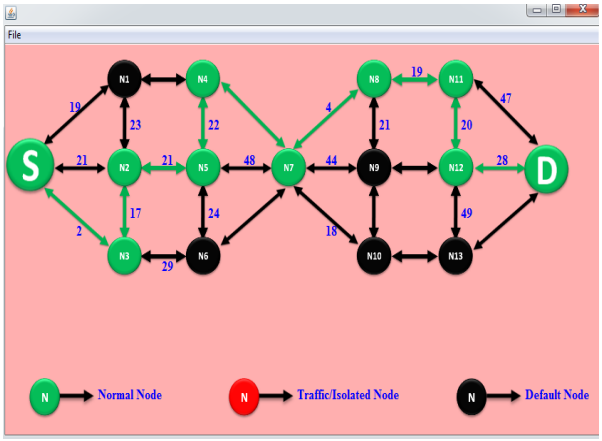
V. METHODOLOGY

Focussing on the protocols has become essential in order to strengthen the smart network. Combination of IoT and MANET routing mechanism enhances the lifetime of nodes in the overall smart environment and such networks may help people especially in a critical situation. After a detailed literature survey, we have learnt as how the MANET works in IoT and what are the benefits of the convergence of MANET with IoT

In this section, we have presented an efficient Bandwidth Aware Routing Strategy (BARS) for identifying path between sender and receiver. We have analyzed the available bandwidth and residual queue size to decide about recommending a suitable bandwidth value for data exchange. We have worked for following new features in the AODV. 1) Ability to estimate the residual bandwidth. All nodes along the path are capable to know their available resources in terms of bandwidth 2) Informs source node about current network conditions in terms of residual bandwidth so that source node can adjust its transmission rate accordingly. 3) The route recovery process immediately performs route recovery whenever there is a broken route in network. To accommodate the above mentioned features, the packet format is changed. For example, to implement quality of service, some new fields are added into packet format. These fields are added to RREQ and RREP packets in order to carry out the bandwidth information. The major difference between the proposed methodology and other mechanisms based on AODV is the implementation of adaptive feedback method. Because of this, the source node easily finds out the current network state, links capacity and adjusts its data rat accordingly. To implement this, all nodes along the path must know their available bandwidth on the links. We have divided our proposed work in two phases as illustrated in figure 3 and a list of notations is presented algorithm. In this section, we also discuss simulation setup, working of proposed algorithm and results.



Screen 1: Data Transfer Window



Screen 2: Routing Window

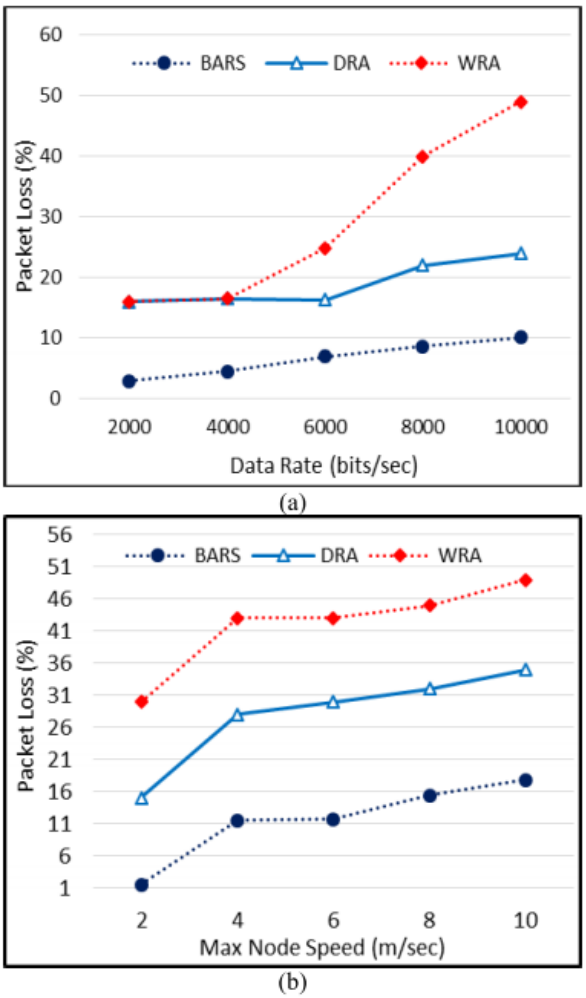
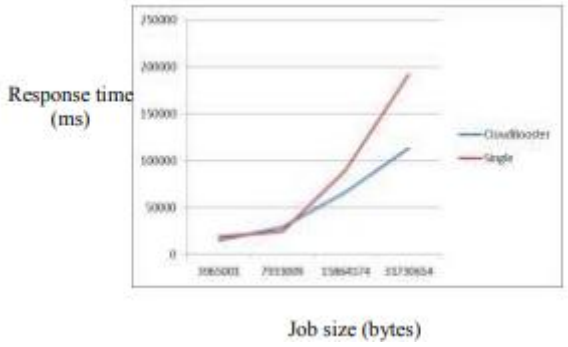


Figure 4: Packet Loss Percentage for a) Data rate variations and b) Maximum speed of node

ISSN: 2233-7857 IJFGCN



VI. CONCLUSION

This paper gives an overview of different methods used for the congestion control in MANET. In ad-hoc networks congestion is the main issue. In MANET the nodes are moving so that there will be topology changes, these types of features results in the congestion of the network. The congestion mainly occurs when the packets arriving to the network exceeds the capacity of the network. Due to congestion there will be performance degradation of the network. Different types of mechanisms are introduced to control the congestion. Each mechanism improves the overall performance of the network, enhances the throughput, packet delivery ratio and decreases the packet loss and delay. The algorithm detects route break during neighbor discovery when Hello message is not received at neighbor node. Results show that the proposed BARS scheme outperforms counterparts in terms of packet delivery ratio, end-to-end delay, packet loss and throughput and probability for existence of congested node for static and dynamic scenarios. In future, we shall include quality of service factors like energy aware route selection in combination with bandwidth estimation

.

REFERENCE

1) Navneet Kaur and Rakesh Singhai “MINIMIZING CONGESTION IN MOBILE AD HOC NETWORK USING ADAPTIVE CONTROL PACKET FREQUENCY AND DATA RATE” in 2019 Springer Computing, Communication and Signal Processing

2) Mahadev A. Gawas , Lucy J. Gudino and K. R Anupama “CONGESTION-ADAPTIVE AND DELAYSENSITIVE MULTIRATE ROUTING PROTOCOL IN MANETS: A CROSS-LAYER APPROACH” in 2019 Journal of Computer Networks and Communications.

3) JiashuaiWang, Xiaoping Yang, Ying Liu and Zhihong Qian “A CONTENTION-BASED HOP-BYHOP BIDIRECTIONAL CONGESTION CONTROL ALGORITHM FOR AD-HOC NETWORKS” in 2019 journel of sensors.

4) Nousheen Akhtar, Muazzam A. Khan, Ata Ullah , and Muhammad Younus Javed4 “CONGESTION AVOIDANCE FOR SMART DEVICES BY CACHING INFORMATION IN MANETS AND IOT” in June 2019 IEEE Special Section On Smart Caching, Communications, Computing And Cybersecurity For Information-centric Internet Of Things volume 7 .

5) Mohsen Yaghoubi Suraki, Abolfazl Toroghi Haghighat, Majid Gholipour “ FCLCC: FUZZY CROSS-LAYER CONGESTION CONTROL IN MOBILE AD HOC NETWORKS” in January 2018 IJCSNS International Journal of Computer Science and Network Security, VOL.18

6) Saurabh Sharma, Dipti Jindal, Rashi Agarwal “ANALYSING MOBILE RANDOM EARLY DETECTION FOR CONGESTION CONTROL IN MOBILE AD-HOC NETWORK” in june 2018 International Journal of Electrical and Computer Engineering (IJECE) Vol. 8.

7) Yefa Mai, Fernando Molina Rodriguez and Dr. Nan Wang “CC-AODV : AN EFFICIENT

ISSN: 2233-7857 IJFGCN

MULTIPLE PATHS CONGESTION CONTROL AODV" in 2018 IEEE Annual Computing and communication workshop and conference.

8) Y. Narasimha Reddy, P V S. Srinivas " A COMBINED TCP-FRIENDLY RATE CONTROL WITH WFQ APPROACH FOR CONGESTION CONTROL FOR MANET" in June 2018 I. J. Computer Network and Information Security.

9) Astha Mishra and Ashish Singh Baghel "INTERFERENCE AND CONGESTION CONTROL USING MULTICHANNEL ENERGY-BASED ROUTING IN MANET" in 2018 Springer Proceedings of International Conference on Recent Advancement on Computer and Communication.

10) Y. Narasimha Reddy and P V S. Srinivas " A ROUTING DELAY PREDICATION BASED ON PACKET LOSS AND EXPLICIT DELAY ACKNOWLEDGEMENT FOR CONGESTION CONTROL IN MANET" in Dec 2018 International Journal of Communication Networks and Information Security (IJCNIS) vol.10.

11) A. Amuthan , N. Sreenath, P. Boobalan, K. Muthuraj "DYNAMIC MULTI-STAGE TANDEM QUEUE MODELING-BASED CONGESTION ADAPTIVE ROUTING FOR MANET" in 2018 Elsevier

12) R. Vadivel, V. Murali Bhaskaran "ADAPTIVE RELIABLE AND CONGESTION CONTROL ROUTING PROTOCOL FOR MANET" in 2017 Springer Science.

13) Varun Kumar Sharma and Mahesh Kumar "ADAPTIVE CONGESTION CONTROL SCHEME IN MOBILE AD-HOC NETWORKS" in 2017 Springer Science.

14) Sujata V. Mallapur, Siddarama R. Patil, Jayashree V. Agarkhed "LOAD BALANCING TECHNIQUE FOR CONGESTION CONTROL MULTIPATH ROUTING PROTOCOL IN MANETS" in 2017 Springer Science.

15) Nousheen Akhtar, Muazzam A.Khan Khattak, Ata Ullah,Muhammad Younus Javed "EFFICIENT ROUTING STRATEGY FOR CONGESTION AVOIDANCE IN MANETS" in 2017 International Conference on Frontiers of Information Technology

ISSN: 2233-7857 IJFGCN