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Research Article

Efficient Bandwidth Aware Routing Scheme in Manets

S.D.Lalitha[1], Yerabolu Keerthika[2], Solleti Harshitha[3], Tanguturu Indrani[4]

[1]Assistant Professor, Department of Computer Science and Engineering, R.M.K Engineering College, R.S.M Nagar, Kavaraipettai - 601206
[2,3,4]Final Year Students, Department of Computer Science and Engineering, R.M.K Engineering College, R.S.M Nagar, Kavaraipettai - 601206

Email: salil100seth@gmail.com

Abstract

MANETs(Mobile Ad-hoc Networks) have unique features which comprises dynamic topology, self-forming, self-healing, dissymmetry, multi-hop communication, energy resources and finite bandwidth. As there is an increase in devices on the Internet of Things(IoT), these features increase complication for quality of service (QoS) allocation, and force different problems while designing the congestion control. In MANET, lots of data exchange causes increase in packet delay, decrease in performance with respect to QoS, loss of data packets can be due to congestion. To sort out these problems, we introduced an efficient bandwidth aware routing scheme (EBARS) by updating Ad-hoc On demand Distance Vector (AODV) protocol. To improve the route discovery and route maintenance in this framework by using factors path expiration time, residual energy, drain rate and delay for increasing the quality of service for the data. Efficient energy aware routing scheme is done by considering three factors: path expiration time, residual battery power and drain rate to have a better energy aware, stable route having minimum delay results the enhancement in quality of service and improved packet delivery ratio(PDR).

Keywords: *MANET, AODV, Ad hoc Network, Residual Energy, QoS parameters,IOT*

Introduction

The networks called Mobile Ad-hoc Networks (MANETs) can automatically heal, configure due to its ability to leave or added in the wireless network. As well as the mobile nodes can move easily in its network region, as there is no fixed design for the network. Within the transmission range of a node, it can communicate easily with other nodes. If the node is at a longer distance, it can communicate through intermediate nodes.

In Ad hoc new devices can be added quickly and can also leave the network. Every device follows dynamic topology, it can move freely in the network so constructing a network is challenging because there will be a lot of problems in the network. Every node can act as an intermediate node (router) which sends packets from sender to receiver. In order to transmit data from sender to receiver, intermediate mobile nodes are required. All the hosts present in the transmission range of a moving node receives its transmission by broadcasting, and if there are two wireless hosts which are not in the transmission range within the unplanned networks, then other intermediate moving nodes present between them can help them to forward the data acting as routers, which results in forming connections between the mobile hosts in that particular region. Thus, every node has an equal role in the network.

A scheme is required in order to meet the deployment problems of IoT enabled MANETs. The routing protocol's main function is to provide communication between all the nodes and to process the message from sender to receiver by choosing the efficient passage between the initial and final node. It is very hard to build a routing protocol.There is a lot of research work done by different authors on energy and stability based issues whereas these works have their pros and cons. We propose an approach to select a stable route on the basis of residual energy of node, bandwidth, path expiration time, drain rate and delay. A study was conducted which compares QMRPRNS with the available routing protocols that resulted in showing a great upgradement over MAODV and EMAODV [13]. An efficient routing protocol based on energy factor for MANET using a large number of computation techniques, which mainly focuses on the usage of interval-based membership [14]. Where, each variable such as distance and energy is used as a component of a large set of values. Fuzzy logic was used for congestion detection and routing protocol. When there is a network function, it is first recognised and every other possible route is provided by the fuzzy logic concept to transmit data and some critical components are included to control it [17]. Reinforcement learning to make the best choice among neighbours to forward the packet to the receiver at any moment[20]. Q-learning algorithms can estimate the value of the actions with more homogeneity.

The paper is classified into six sections. The section II contains review of previous literatures based on ad hoc networks and routing protocols methodologies. Section III represents the proposed work . Section IV is related to the working principle used in this paper. Result and experimental analysis is explained in Section V. At last, the conclusion is present in Section VI.

1.1 Related Work

This below content shows us a detailed literature review of bandwidth, energy aware and QoS associated work in mobile ad-hoc.

S.Deepak, H.Anand Kumar have proposed the bandwidth aware routing [1]. Here for caching the information, ongoing network status will be evaluated with regard to residual area and residual bandwidth of the queue interface. The sender node sends data packets and manages restoration of broken links in accordance with residual bandwidth by adopting capability of communication and computation. In this algorithm, route break during neighbour discovery can be detected when the Hello messages are not obtained at the neighbouring nodes. This BARS scheme surpasses counterparts regarding throughput, packet loss, packet delivery ratio, probability and end-to-end delay for existence of the clogged nodes at the dynamic static and layout.

Eko Setijadi, Mauridhi Hery Purnomo, I Ketut Eddy Purnama, Alamsyah have analyzed routing protocols of DSR, AODV, AOMDV based on Quality of Service(QoS) [2]. Parameters which are examined follow packet loss, the PDR, throughput, routing overhead and delay. The simulation results using NS2 indicate with respect to PDR, delay, packet loss parameters AOMDV performance is greater than AODV, DSR. The average increase in AOMDV for PDR is 2.59%-12.28%. packet loss is 2.59-12.28% and AOMDV is also able to reduce the delay by 41.46-91.09 ms . In terms of throughput AODV excels with an increase of 47.07-89.50 Kbps while the number of packets of 9489-162856 can be reduced by DSR. Mrs. R. D. Raut and S. K. Srivastava proposed Improved Ad hoc On-demand Distance Vector Routing Protocol (AODV+) is suggested for enhancing the performance of various parameters which are end to end of the network delay, packet delivery ratio, throughput, scalability and drop packets due to low mobility, low overhead and many more [3].With the raise in number of nodes, delay will be less due to back up routes and less packet drops for packets which makes this routing more stable. The link is set in the routing table according to the adjustments done in address files,so there is low delay and few packet drops in the less potency scenarios.

Yong Li, Chenxi Liu, Ge Shi, Wei Cheng proposed Improved routing protocol based on AODV [4]. In this it uses two channels for controlling messages and transmitting data packets separately. In the meantime, to select the optimal path Dijkstra Algorithm is used and the packet reception rate of each link is predicted. The simulation results expressthat this routing protocol can substantially improve the packet reception rate even if it is in poor network environments. This uses packet reception rate to evaluate the path's quality and then the optimal path and can be found using the Dijkstra algorithm.

Muhammad Khalid Riaz, Fan Yangyu, Imran Akhtar proposed method which minimizing the link breakages and increases the lifetime of the network by finding the paths for routing, with more accessible energy [5]. Here they proposed two schemes based on a reactive routing protocol on Ad-Hoc OnDemand Distance Vector (AODV). In these two schemes, minimal mobile nodes can participate in the routing process, for reducing the control packets overhead. Here hindrance is predicated on the received node strength. The residual energy through intermediate nodes locally
or through receiver nodes are chosen with regards to energy efficient suitable available path.

Zoulikha Mekkakia and Said Khelifa proposed an energy multipath protocol for AODV [6]. This is a routing protocol combining two methods which were implemented in basic AODV protocol. Initial mechanism tries various route responses and the other mechanism includes residual energy in the process route selection. It enhances the implementation of AODV regarding Packet Delivery Ratio, Throughput and Delay . This protocol provides better energy conservation.

Praneeth Paranavithana and Anuradha Jayakody proposed a modified AODV Protocol [7]. It mostly manages the total remaining energy of the path. The node calculates the residual energy and chooses a best route on the basis of available source and total energy at the route. The highest energy path value gets priority in selection of route procedure. This protocol has a positive impact when it comes to energy consumption and packet delivery ratio. This improved AODV protocol is mostly recommended for massive wireless infrastructure though it will give a comparatively diminished efficiency in tiny infrastructure.

Shrish Verma, S Hafizullah, Mahesh Vaidya and Alok Naugarhiya for route discovery process the hardware architecture is introduced for the performance which was handled in AODV routing protocol is formed [8].It was achieved using Verilog hardware description Language and integrated in XC4VLX25 device. It achieves a maximum operating frequency of 176MHz and the total predicted power is determined using XPower Analyzer and the result gained is 298mW. It provides good functionality regarding speed, area and power dissipation.

Rajnesh Singh and Neeta Singh provide a comparative analysis between AODV and DSDV routing Protocols using NS2 simulation tool to calculate TCPNewreno along with Gauss Markov Mobility model [9]. The counterfeit results shows that DSDV provides better functionality than AODV regarding routing overhead and miscellaneous packets obtained whereas AODV achieves better than DSDV regarding node density and unnumbered hops count.

Hua Xiao, Shulong Peng, Bin Lin and Ying Wang suggested an enhanced Ad-hoc On-Demand Distance Vector (AODV) routing protocol for MANET [10]. It proposes Automatic Identification System aided AODV which reduces the measure of inundation in the path detection process by the appropriate ship region information maintained by the shipborne AIS device. It can accurately find routes on request and hold multi-hop broadband data transportation with a minimal routing overhead.

Proposed Work

The minimum accumulated delay can be determined by this efficient bandwidth aware routing algorithm to transmit data from sender mobile node to receiver mobile node. This methodology is divided into two major parts:

(i) Route Discovery and
(ii) Route Maintenance

The route discovery method is to find all the active and efficient routes available from sender node to receiver node and storing them in the buffer. These routes are found by sending the RREQ (Route Request) packet from sender node to receiver node.

Following the receiver mobile node gets the RREQ packet and it passes the RREP (Route Reply) packet in the same path to the sender node. Then the nodes through which the packets are transmitted, that route will be stored in the buffer.

In the Route maintenance process, it selects a route from the buffer and transmits the data. As these nodes are mobile nodes, the path cannot be constant throughout the data delivery so, if there is any breakage in the path. It returns to the source node and considers another active route from the buffer list and the process is repeated.

Finally the data gets transmitted through an efficient path with minimum packet loss, maximum packet delivery ratio to the destination.

The main factors included to find the efficient path are path expiration time, delay, residual energy and drain rate.

2.1 Path expiration time

Path expiration time is based upon the amount of time the mobility node stays in the same location in a MANET.The path expiration time is calculated at each hop of the route, this further helps in the calculation of route expiration time.As the

expiration time of path is the least value of PET of all links from which that route is made up.

2.2 Residual Energy and Drain Rate

One of the disadvantages of MANETs is that the nodes are battery constrained.When less energy node is participated in route establishment may run off its power in later stages resulting in the breakdown of link.If more such nodes are selected during route establishment, network may get partitioned and route discovery process will be initiated repeatedly resulting in overhead and delay Drain rate is the measurement of the rate at which the energy dissipates.

As residual energy (Energy is consumed by these nodes during transmission and reception activities)of each node is known at each instant of time along with the total initial energy of nodes.

2.3 Delay

In Ad-hoc networks, existing AODV protocols don't consider delay for the info transmission while it is extremely important for sensitive applications like voice, video and military services.we are considering delay both during finding path and path preservation for better quality of service.

2.4 Routing Table

It contains sender and receiver IP address, source and receiver sequence number, count of hops needed to reach the receiver, next intermediate node, precursors list, life time etc.

2.5 RREQ packet

RREQ is a broadcast. It has the sender node and receiver node address, sender and receiver sequence number, number of hops, broadcast ID, acc_d, max_d etc. The source address and broadcast id together are called an RREQ packet.

RREQ packet is issued by a source and the broadcast ID is incremented.

2.6 RREP packet

RREP is unicast. It contains receiver address, receiver sequence number, sender address, number of hops, life time etc. The routing table will be updated when it receives an RREP packet and retransmits data packet to the source.

2.7 RERR

RERR is unicast.When an active route link is broken, the node which is present at the upstream of that link passes a Route Error (RERR) packet to the initial node to tell about the breakage of path.

2.8 WORKING PRINCIPLE

1. Assign accumulated delay value as zero.
2. The sender node sends the RREQ packet (broadcast) to all its neighbour mobile nodes.
3. Checks whether the RREQ packet sequence number is less than the sequence number of the node in the routing table. If it is greater go to step 4 else go to step 2.
4. Checks whether the value of the threshold is less than link lifetime. If it is lesser go to step 5 else go to step 2.

5. Checks whether the threshold value is less than remaining lifetime and residual energy. If it is lesser go to step 6 else go to step 2.
6. Checks whether the value of the threshold is less than the maximum delay and accumulated delay of the routing table of the node and RREQ packet. If it is lesser go to step 7 else go to step 2.
7. Update the values in the routing table.
8. Destination node selects the minimum accumulated delay among all the routes and the RREP packet is transmitted .
9. The mobile node which gets the RREP packet creates a forward path to the receiver.
10. Updates the accumulated delay value in that particular node routing table.
11. The RREP packet reaches the sender node and the path has been established and saved in the buffer list.
12. Data packets are transferred along the same route.
13. Checks whether the accumulated delay of the entire path is less than the maximum allowed delay. If it is greater go to step 14 else go to step 19.
14. Selects new active route available in the buffered list.
15. If the route is absent or not working go to step 15 else goto step
16. RERR packets are generated at the nodes link breakage.
17. If any intermediate node receives the RERR packet, updates the routing table by equating the destination node distance to infinity and goto step 14.
18. The new better is found from the list.
19. The data is successfully transmitted to the receiver node with minimal accumulated time delay value and loss of packets.
20. Stop the process.

2.9 Flow Diagram

There are three phases in this diagram, they are route discovery using RREQ is shown in figure 1 and route discovery using RREP shown in figure 2 and route maintenance is shown in figure 3.

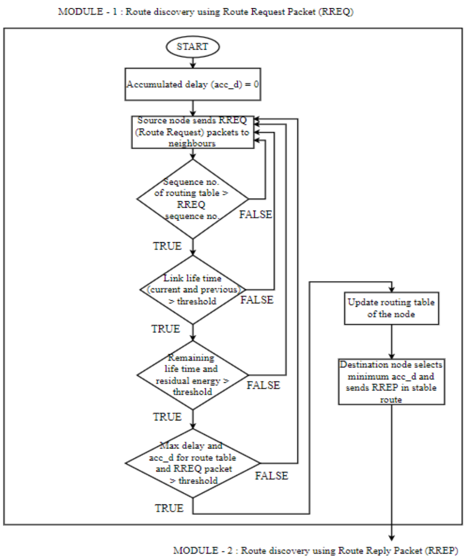

Figure 1 Route discovery using RREQ

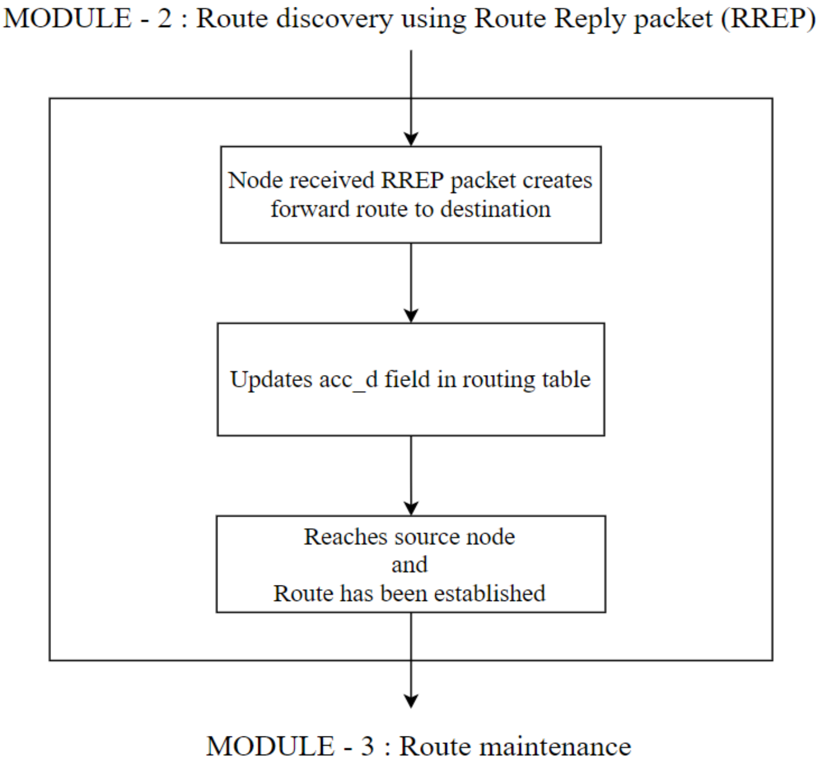

Figure 2 Route discovery using RREP

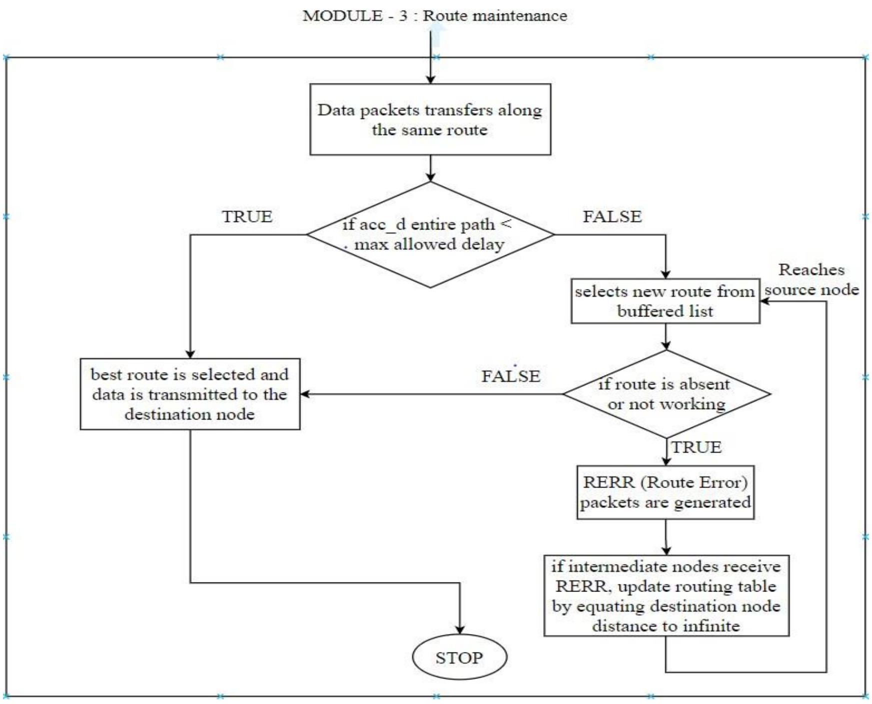

Figure 3 Route maintenance

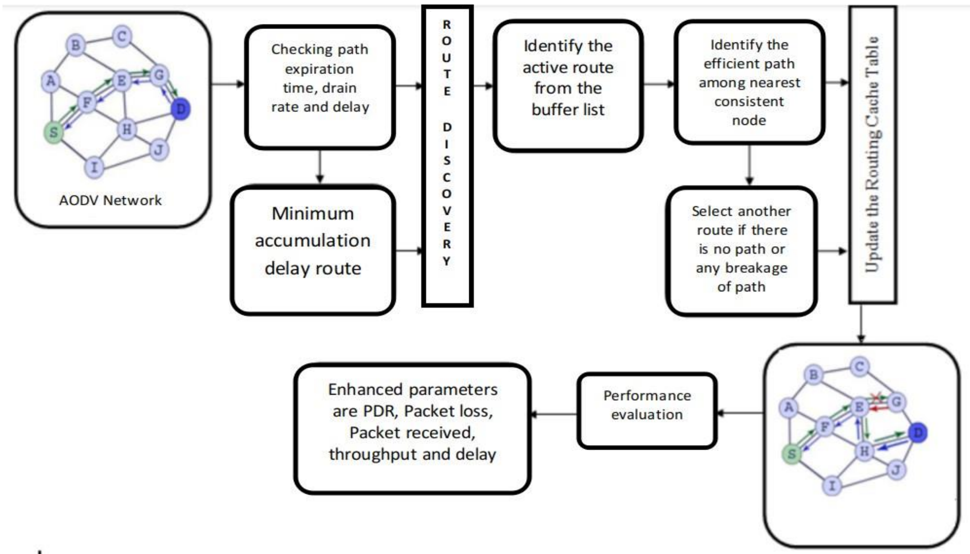

Figure 4 Architecture Diagram

2.10 Mobile Ad-HOC Network

Comprises mobile nodes that can quit from the network or connect to the network easily while it is moving which are randomly present in the network. These are connected through wireless links to exchange information and to communicate. The consequence of this arrangement of networks is called dynamic topology. Constructing a network connection is an extremely hard task as there are numerous tasks and problems in the network structure. Router (node) is used to send packets from sender to receiver.

2.11 Workflow

In the selected path, the node sends the data and in order to pass it backwards to the sender mobile node. From the routing table, the path can be obtained. Where RREP has a comment at every node. Sender node contrasts the comments received by the receiver node with the rate of request. The data rate remains the same without any changes throughout the flow received by the sender node in a single flow of data. The proposed scheme also includes decrease in loss of packets, increase in

PDR, throughput and from end to end of the network delay will be reduced.

2.12 Experimental Result Analysis

From the source by considering received signal value, for every node the area to transmit around is classified into three different zones namely inner, middle and outer zones. The control packet flooding is limited in this classification. Nodes which are inside the obtained signal value threshold that are middle region mobile nodes are considered. To limit the mobile nodes throughout outer and inner regions in the path detecting, select the upper and lower threshold values of detected signal strength.

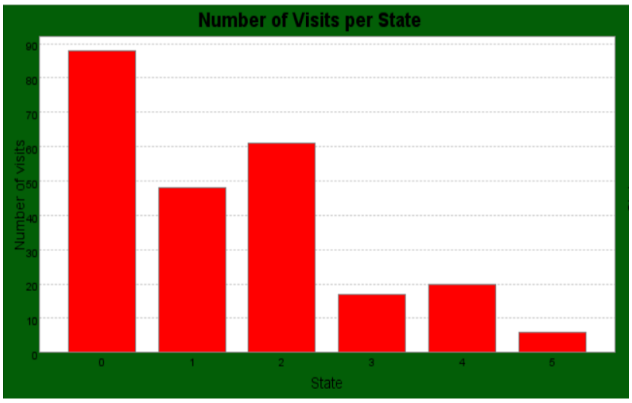

Figure 5 Number of Visits per State

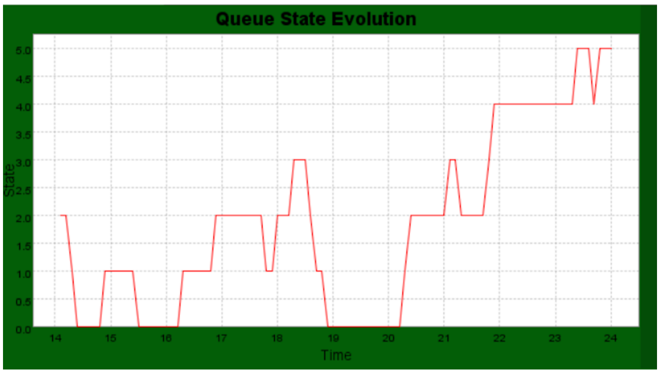

Figure 6 Queue State Evolution

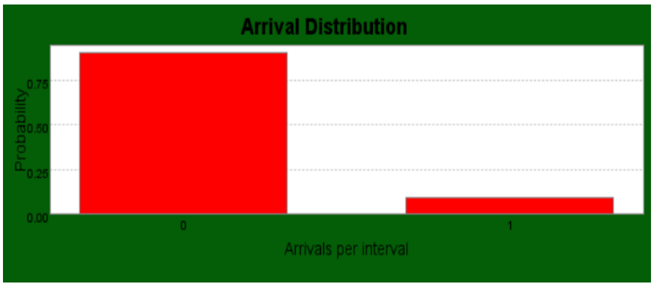

Figure 7 Arrival Distribution

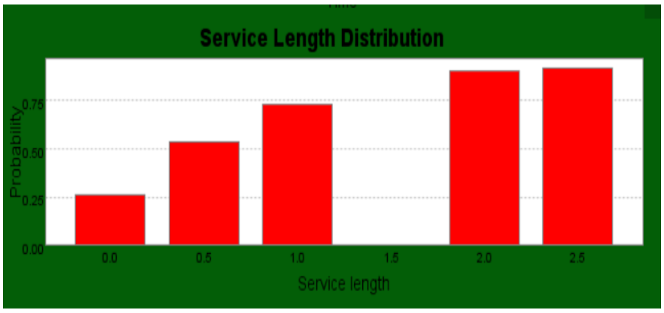

Figure 8 Service Length Distribution

For a queue state of five the values are evaluated shown in the figure 5,6,7,8. If the sender node is unable to pass data packets from initial to final node then the packet loss happens.With the packet loss there will be a change in rate of data. When rate increases, data packets are stored in the queue of the mobile nodes. The packet loss is high in DRA scheme, even though rate adaptation mechanism is tailored queues become overflow but if there is a congestion due to exceeding the capacity of the link there is no mechanism given for this. Here in this proposed scheme to stop the happening of congestion, the bandwidth is considered as the main feature. We have seen that loss of packets is much reduced when compared to DRA. From proposed methodology, results indicate that packet loss is much lesser.

Here we connect the nodes and send the data in terms of packets. It reaches the receiver through different nodes. The packet count, packet length, bandwidth, time delay and many factors are taken into consideration and passes the packets to the receiver from sender, rerouting also takes place here to avoid collision.

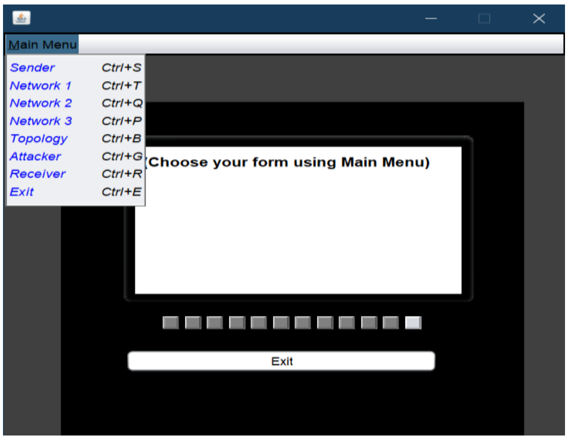

Figure 9 Main Menu

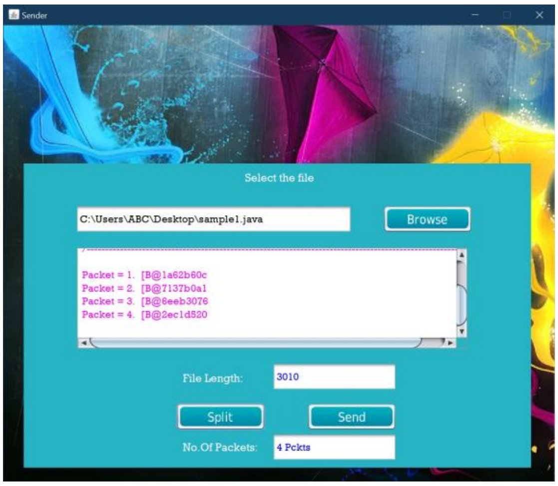

Figure 10 Sender

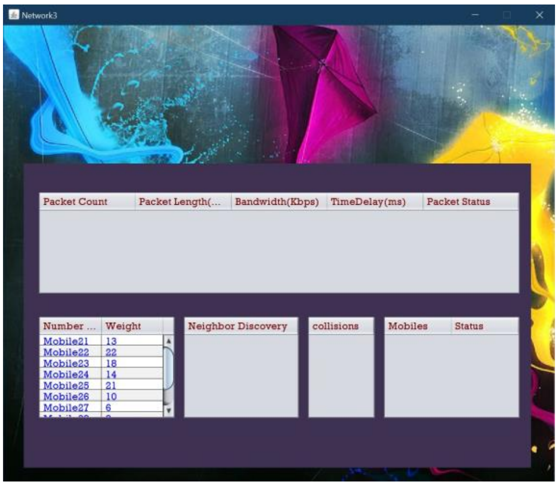

Figure 11 Network 1

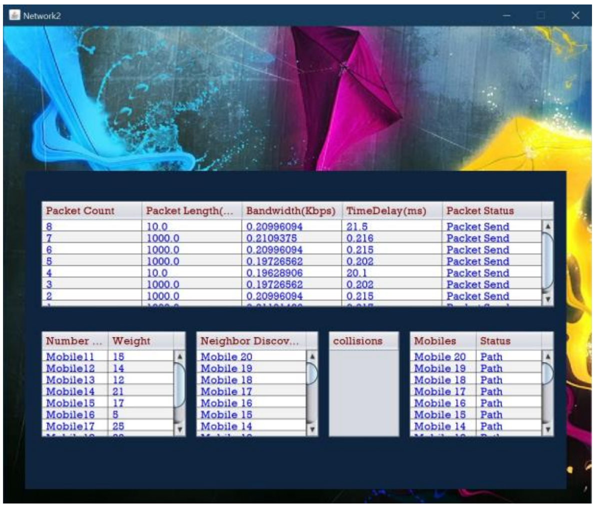

Figure 12 Network 2

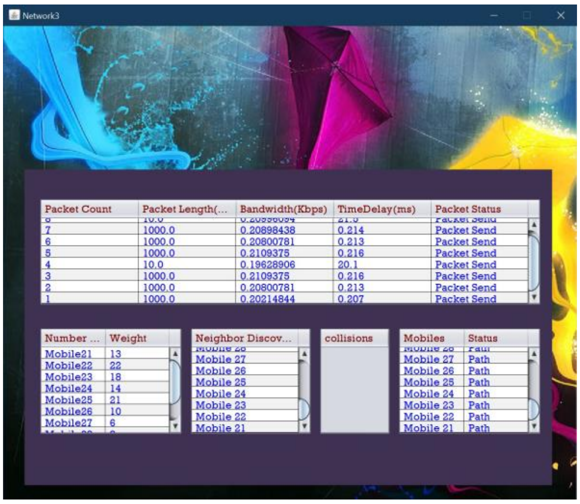

Figure 13 Network 3

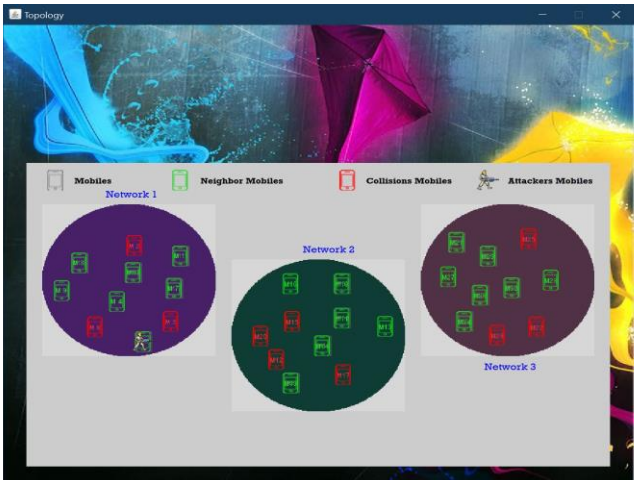

Figure 14 Topology

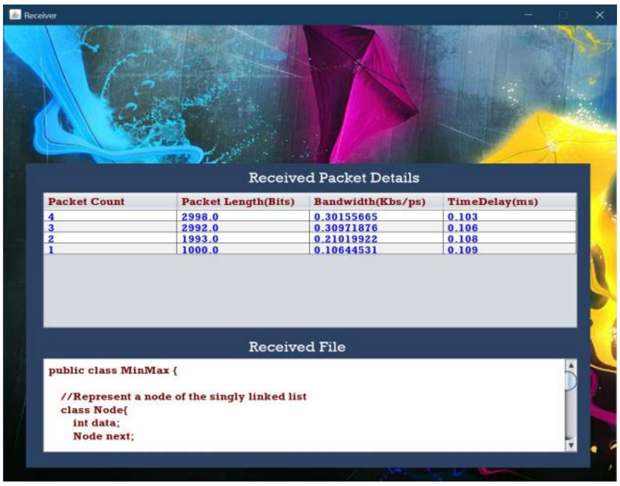

Figure 15 Receiver

Conclusion

In Ad Hoc,devices in the network can openly go in any direction it wants which give rise to dynamic topology. Congestion occurs when the packets arriving in the network exceed the capacity of the network. As there are lots of issues and challenges in design, it becomes a difficult task for designing. Every node can act as a router which sends packets from sender to receiver. A new scheme Efficient Energy Aware routing Scheme is proposed, which is changed relevant to the Ad-hoc On Demand Distance Vector(AODV) routing protocol. Here we consider some factors such as path expiration time, residual battery capacity and drain rate and delay.This method can retain energy by optimizing link energy, finding efficient bandwidth and minimum delay and improved packet delivery ratio.Here the network throughput increases and decreases the overhead and also decreases the packet loss. It shows that limited battery energy can be utilized more efficiently.

Further we are trying to implement using varying energy values instead of constant energy values.

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