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Multicast Routing for Path Establishment in Vehicular Ad Hoc Network

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Abstract - Vehicular Ad hoc Network (VANET) is a network that consists of several vehicular nodes which can enter or exit the network freely. It is challenging task to set up a secure and efficient route amid the source node and the destination node due to the higher mobility of vehicles within VANETs. Two components such as least hop count and the sequence number are considered to select the path between source and destination. This path is established using the multicasting method in this research work. The data is routed for selecting the root nodes from the network in this multicasting method. By the means of root node, the path is selected amid source and destination. The projected method is deployed on NS2 and the analytic outcomes are obtained in the evaluation of certain parametric values.

Keywords

VANET, Broadcasting, Multicasting, LAR

Introduction

It is very important to ensure safety, comfort, mobility and quality of enormous traffic that is found in smart cities. The ITSs are put forward for offering these kinds of facilities in these applications. On the basis of VANET (Vehicular Ad Hoc Network), the Intelligent Transport Systems are constructed for all applications [1]. This newest study field achieves the consideration of a number of researchers all around the world. The vehicles travelled on road along with obtained safety and traffic efficiency and a level of comfort is offered to the individuals through Vehicular Ad Hoc Network. The V2V communication aids in distributing the information in VANET. The figure 1 represents this scenario. In this, the V2I and I2I communications are included. Diverse kinds of information sharing possible in these scenarios are depicted through the roadside infrastructure presented in the diagram.

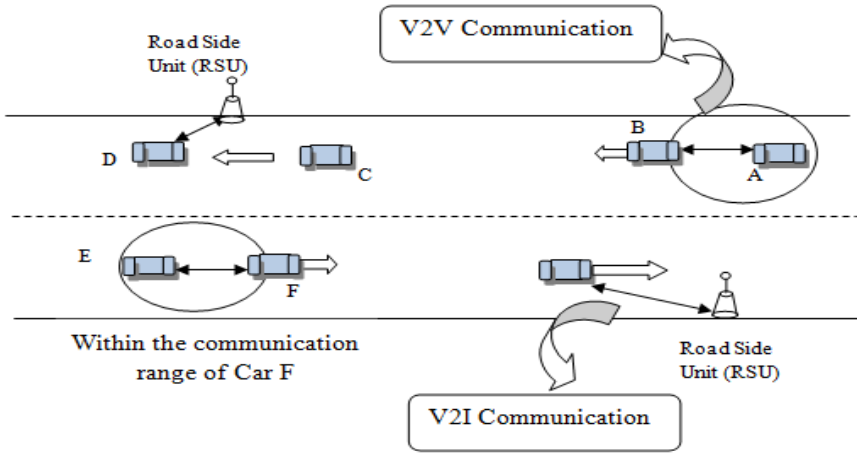

Figure 1: Vehicular Ad Hoc Networks

In the above diagram, the vehicles denote the nodes and the distance between the vehicles represents the edges of the network. The wireless sensor nodes are deployed to transmit and receive the data from one node to another within100 to 500 meters. The

data is worked together and communed with one another. In case, the vehicle goes beyond 500 meters, it will be dropped out of the network. In case of coming back of vehicle in the signal range, the network joins through that vehicle. The well-run wireless communication machines are adopted for equipping the vehicles. This process is called OBUs. There is lack of sink in such devices and the vehicle to vehicle and vehicle to infrastructure to converse among the network are also offered. This is a noteworthy function of Vehicular Ad Hoc Network. To construct a dynamic routing algorithm is the major issue occurred in case of the formulation of VANETs. In the end, different from the conventional techniques, diverse changes are made in this network due to the rapid change in the topology at highly dynamic and continuous way. Earlier, various algorithms are developed for Mobile ad hoc Networks whose implementation and testing is done in the VANET scenarios. The most important challenge here is to reduce the delay related to message transmission from a particular vehicle to other vehicle. If such challenges from the protocols of MANET are overcome, these protocols can be applied within real time VANET applications. Examining the implications carefully is important here [5]. Through the examination of dynamic properties of VANETs, it is possible to control the unpredicted and mobile character of vehicular network topologies using routing protocol. The identification and maintenance of optimal paths of communication is the most difficult task to perform in VANET routing. In the routing of VANET, Identifying and maintaining best communication routes is an extremely complex job. It is possible to connect the routing protocols of VANET depending upon the framework being utilized in the designing of the network. This is one of the straight routing advances of VANETs. The broadcast routing mechanism is applied so that the message that is outside the range of a vehicle can be forwarded. For transmitting the packets, flooding techniques are applied. This routing advance ensures the deliverance of information across the system. This approach however, needs to include extensive resources of bandwidth [7]. This approach is applicable in several well established routing protocols particularly within the route discovery process followed towards the destination. Within BROADCOMM, it is doable to replicate the hierarchical construction of freeway. The complete region is divided with the help of virtual cells. In case when Cell Reflector (CR) behaves as sink, it is possible to collect the information from some specific call and neighboring calls. CR is used to make judgments when the messages are to be forwarded to individual vehicles. In context of certain metrics like delay, routing cost and broadcasting, the performance of protocol is found to be improved as compared to rest of the broadcasting protocols. A probabilistic broadcasting approach is designed in NPPB in order to mitigate the communication tempest in the congested VANET. This assists to make sure proficient information distribution in critical circumstances. The accessibility of the node that is farthest is shown with the help of a weighted p-persistent routing approach. The performance of this algorithm can be measured on the basis of vehicles' amount chosen reasonably within one particular scenario.

Literature Survey

Yangyang Xia et al. (2018) presented [11] a novel routing protocol. This procedure is named as greedy traffic light and queue aware routing protocol. There are certain benefits provided by applying this approach by performing the clustering of vehicle during connection and balance the traffic load among the vehicles. The simulations performed provide results which prove that the designed approach provides better results in comparison to TLRC and GLSR-L. Therefore, the researcher concludes that the simulation performed provides effective results as compared to the other position-based routing protocols.

Zhiwei Yang et al. (2017) presented a novel approach for clustering which provides information about the vehicular navigation systems [10]. The author designed a remaining route time function. This approach assesses the overlapping time amid the nodes as per route information. The researchers too intended a machinery future cluster head, which assist to evade the trading of messages at junction and preservation of cluster head is reduced. The comparison is made between the existing algorithms and proposed clustering approach, the outcomes shows that the presented methodology may improve the stability of cluster, in terms of various parameters like lifetime of clusters, number of changed status and so on. Therefore, the researcher illustrates termination from the simulation results that clustering algorithm attains more stability and in turn decreases the price.

Abdul Kareem Basil et al. (2017) proposed OSLR routing protocol in which AODV values are evaluated using NS3 simulator [12]. A common geographical topology is used within these applications. There are certain important properties provided within the congestion region. Hence, the researcher concludes that OSLR performs much better than other protocols in terms of the throughput values, PDR values and latency. The proposed approach reduces the mass crossroad scenarios.

Wenxiao Dong et al. (2017) presented a routing algorithm called cluster-based recursive broadcast (CRB) which is used to solve the issues and problems faced by other scientists in this field [13]. The re-broadcasting is executed only by the chosen vehicles. By taking in consideration the traffic light signal, the CRB is able to achieve the broadcasting along with improvement in efficiency of the forwarded message. The simulations were performed which show that the proposed approach outperform flooding one at a time, in delivery time and delivery ratio. Thus, it is determined that the presented approach avoids the storm related issues but outperforms the flooding at the time of higher vehicular density and message rate.

Seung-Seok Kang et al. (2017) proposed a simulator called SUMO which is a road traffic simulator and part of NS3 computer based simulator [14]. This proposed simulator is used in monitor the real time traffic of roads and vehicles. The result of this simulation proves that the DSDV routing protocol delivers message to the network. However, this influences the execution of the packet deliverance ratio. Hence, the researcher concludes that the presented simulator performed well and drives at very high speed.

Harinder Kaur et al. (2017) presented two novel routing algorithms. These algorithms are called A-STAR and GPSR. These algorithms are used to analyze the real city map [15]. A simulation performed on real map scenario gives precise outcomes and helps in designing and deployment of VANET in real life. Several parameters are taken into account to assess the performance of the on hand approach. Simulations were performed by using variable density nodes. Therefore, the simulations of planned algorithms offer improved piece on Bathinda city's map, which in turn also shows that A-STAR technique is better. Therefore, the presented algorithms prove their supremacy over other traditional routing protocols and show effective and satisfactory results.

A. Malathi et al. (2017) presented new multicast routing algorithm for VANET which meets the challenges of multicasting [16]. The planned approach centers on the examined VANET's cluster based routing performance. The proposed optimized protocol is utilized to establish an effective routing trail. It is driven that the presented algorithm performs much better than the already existed routing protocols like ACO, AODV and GA-ACO etc. The experiments were performed which concludes the effectiveness of presented algorithm by considering different performance parameters. These factors comprise deliverance packet ratio, end-to-end delay, bandwidth and energy consumption.

Rajesh Kumar M et al. (2016) proposed [17] quantities like movement of vehicles, vehicular density, and velocity by implementing the Ant Colony Technique. This algorithm reacts to the routing protocol having active foundation routing and enhances the functioning of the MANET. The mutual form of algorithm displays a lot improved outcomes than other presented algorithms. The researcher focuses on the use of ACO technique and provides good routing adaptability at various VANET network. Also, the proposed approach characterizes the dynamic topology, calculation of link quality and so on.

Awos Kh. Ali et al. (2016) proposed routing protocols like AODV, OSLR and GPSR [18] and provides in-depth evaluation of the MANET. This performance is contrasted in terms of three parameters which are DEL, delay and PDR. The simulations were conducted on NS2 and SUMO and the platforms are configured with the real time situations. Hence, the researcher concluded that the proposed approach OSLR achieves less drop burst length and provides increased PDR results in comparison to the AODV and GPSR load of network. Also, GPSR shows much better results in terms of high node of network and delivers the packets through shortest path.

Arohi Gupta et al. (2016) presented the revision of VANET and their routing protocols. The paper also compares several routing algorithms for VANETs alongside with their compensation and drawbacks [19]. The existing ad hoc routing protocol was also reviewed and elaborated in the respective paper. The paper displays the comparison between the routing protocols. Every protocol has certain advantages and disadvantages. Therefore, the outcomes of every protocol are compared with one another. Hence, the projected algorithm is efficient and offers improved outcomes.

Research Methodology

A novel algorithm will be presented in this study. The projected algorithm will use the multicast method to create the trail. This technique makes the implementation of vehicle nodes for establishing the path so that RREQ packets can be received. The concept of multicasting is deployed using the zonal based routing in order to construct the route in minimum time span. When the multicasting approach is implemented in the network, the alleviation in the network routing overhead is found. The source node is incapable of transmitting and receiving the RREQ packet to the nodes which are not assisted in established the route to the destination. The multicasting technique also leads to mitigate the path establishment period. In this research work, we will suggest system for the path creation using the idea of multicasting. Varied phases are executed to establish the path, which are defined as:

1. We use a number of vehicle nodes to develop the VANET. The RSUs are utilized in this network to create V2V and V2I communications.

2. The second stage focuses on transmitting the control message to every node using RSUs in the network. The vehicles are permitted to receive that message and for inspecting the number of nodes in their direct range.

3. In the third stage, each vehicle node is utilized to depict the amount of nodes in their range with the other nodes. The selection of vehicle node having the highest number of nodes in their range is done as the zonal head node.

4. The message is broadcasted by the source node to its zonal head and verifies that whether it is in its zone or not. When the requesting node is in its zone in that case route will be directly created from source to the desired address and when requesting node is not in its zone than the zonal head passes the request to the next zonal head. The process is repetitive unless the desired path is created.

This research projects a multicasting mechanism in order to construct a route. This mechanism assists in enhancing the process of establishing a path that is adaptable for the broadcasting approach. The multicasting network consists of limited vehicle nodes. The partition of entire network is done into certain zones on the basis of two metrics such as speed and distance. The vehicle node having lesser speed and distance is chosen as best node. The best zone is chosen to be the zonal head in the network. The route is established by transmitting the information to zonal head from all the nodes available in zone. The multicasting method results in lessening the overhead and also least time is consumed by this method to establish the path.

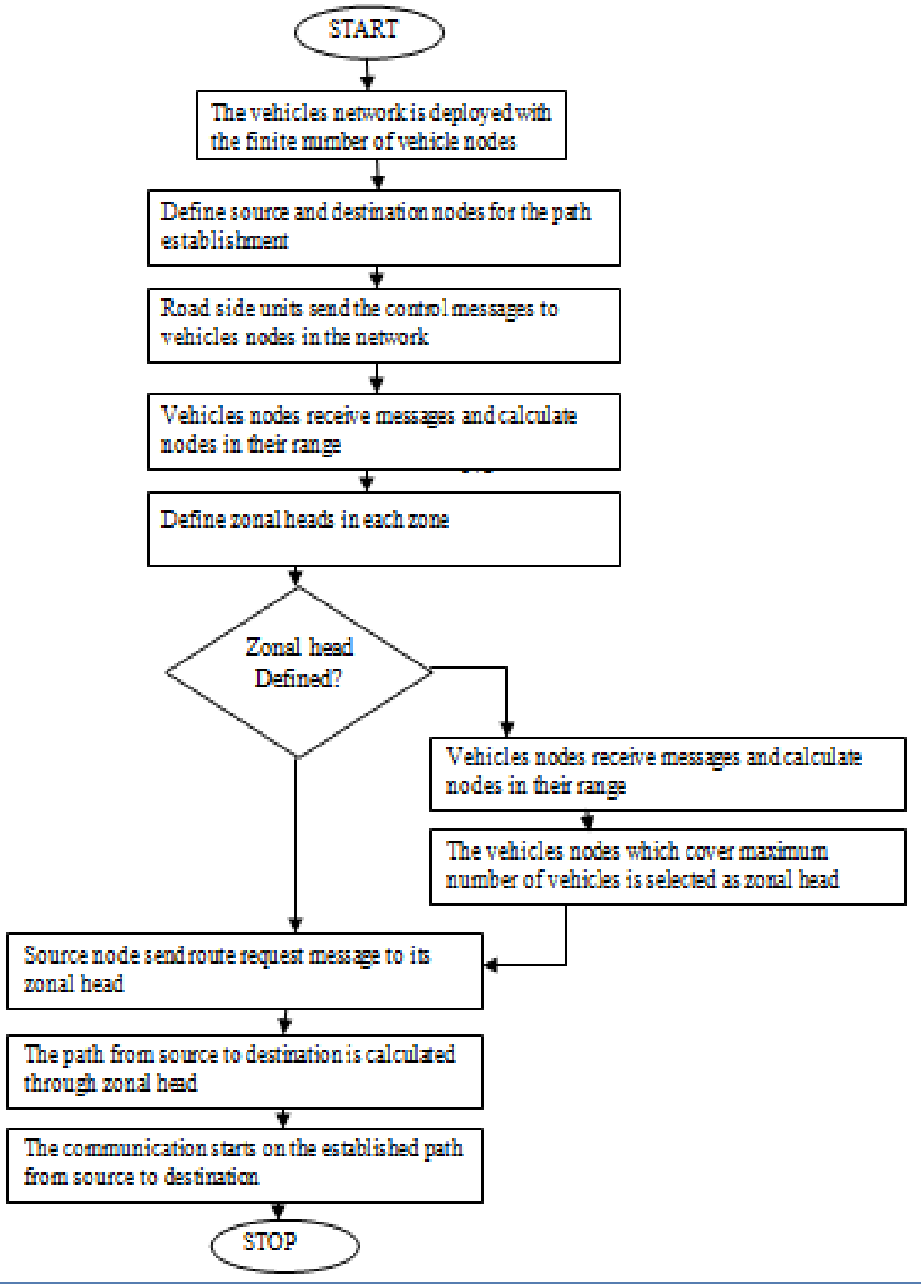

Fig 2: Proposed System's Flowchart

Result and Discussion

Vehicular ad hoc network creates the implementation of vehicular nodes whose positions are often altered. In a specific area, the simulation is carried on the projected framework using specified nodes.

The projected framework is deployed on NS2 simulator and this scenario considers certain evaluation metrics that are listed in the table 4.1 as:

Table 1: Research Parameters

Number of Nodes	41
Antenna type	Omi-directional
Queue type	Priority queue
Standard	802.11
Packet size	1000
Queue size	50

Table 1 defines the standard parameters incorporated in the simulation of projected technique. The parameters utilized in the simulator setting are highlighted here.

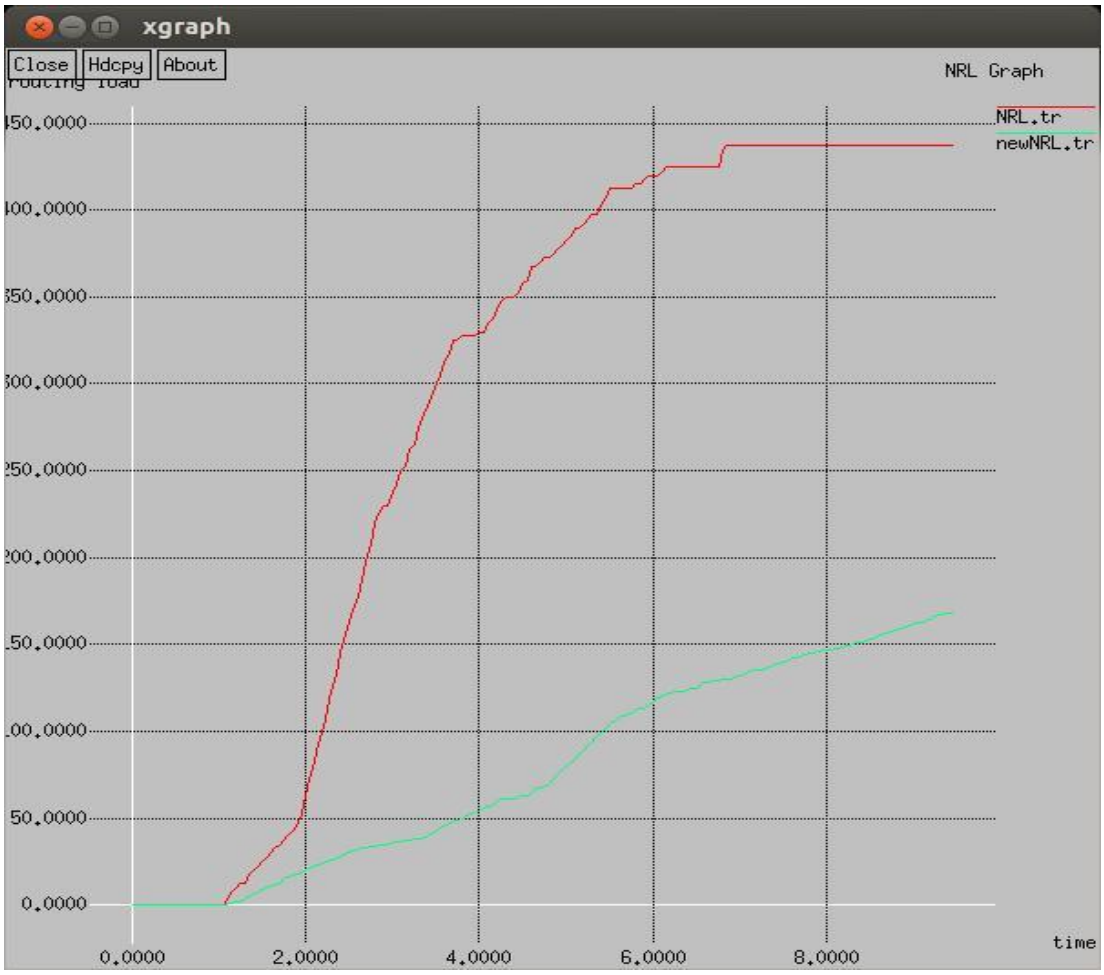

Fig 3: NRL Comparison

Figure 3 shows the comparison of presented and projected method with respect to NRL value. The output shows that in comparison to existing technique, the NRL is higher for proposed technique.

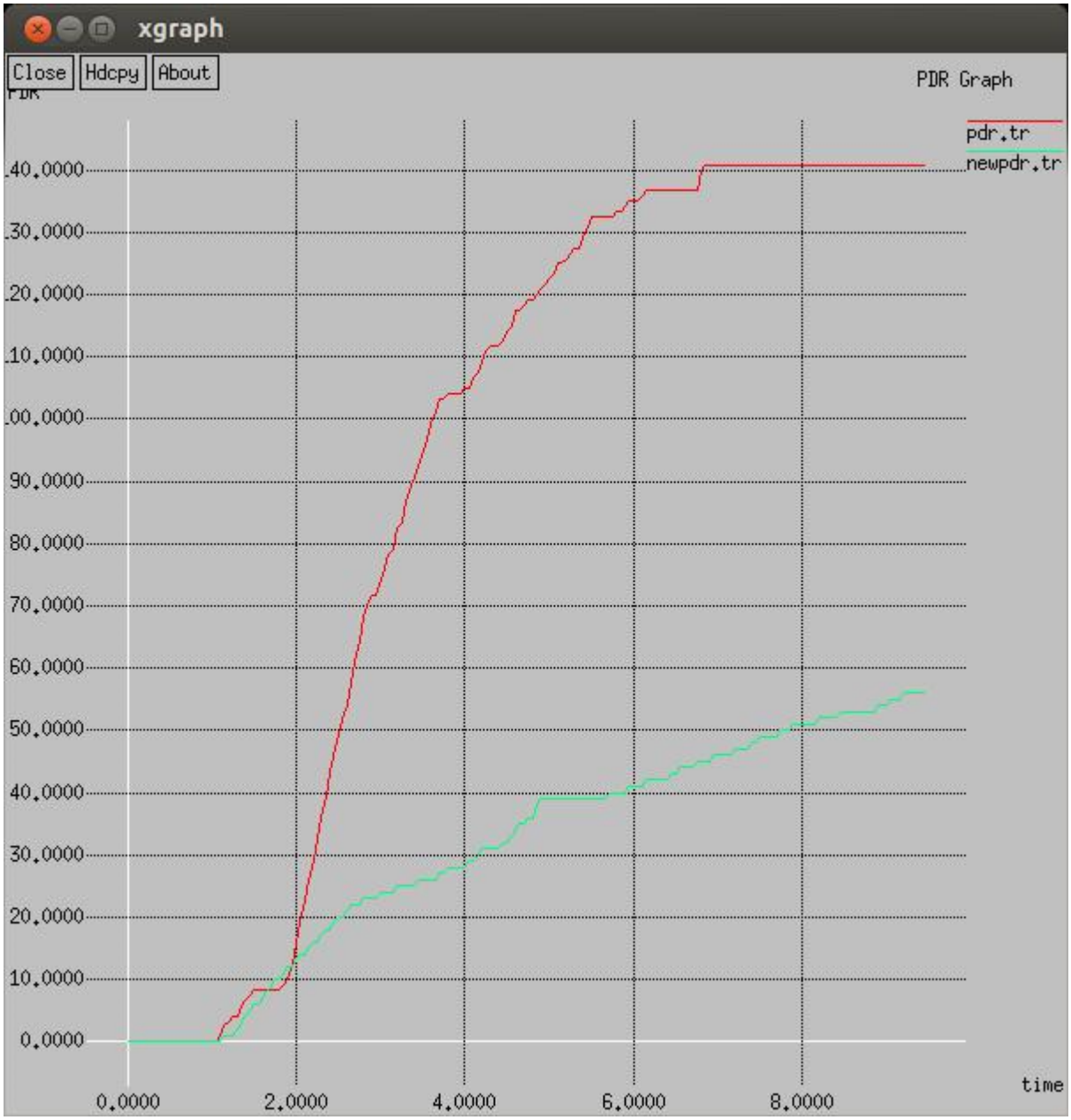

Fig 4: PDR comparison

Figure 4 displays the comparison between the present and projected methods with respect to the packet delivery ratio attained by them independently. The outcomes show that the PDR is higher for projected method. This directs to enhance throughput of the network.

Fig 5: Route lifetime

Figure 5 shows the comparative analysis of proposed and existing techniques with respect to the routing lifetime of network when applying both separately. The outcomes show that due to the improvements made in this research, the lifetime of network is increased when applying proposed approach.

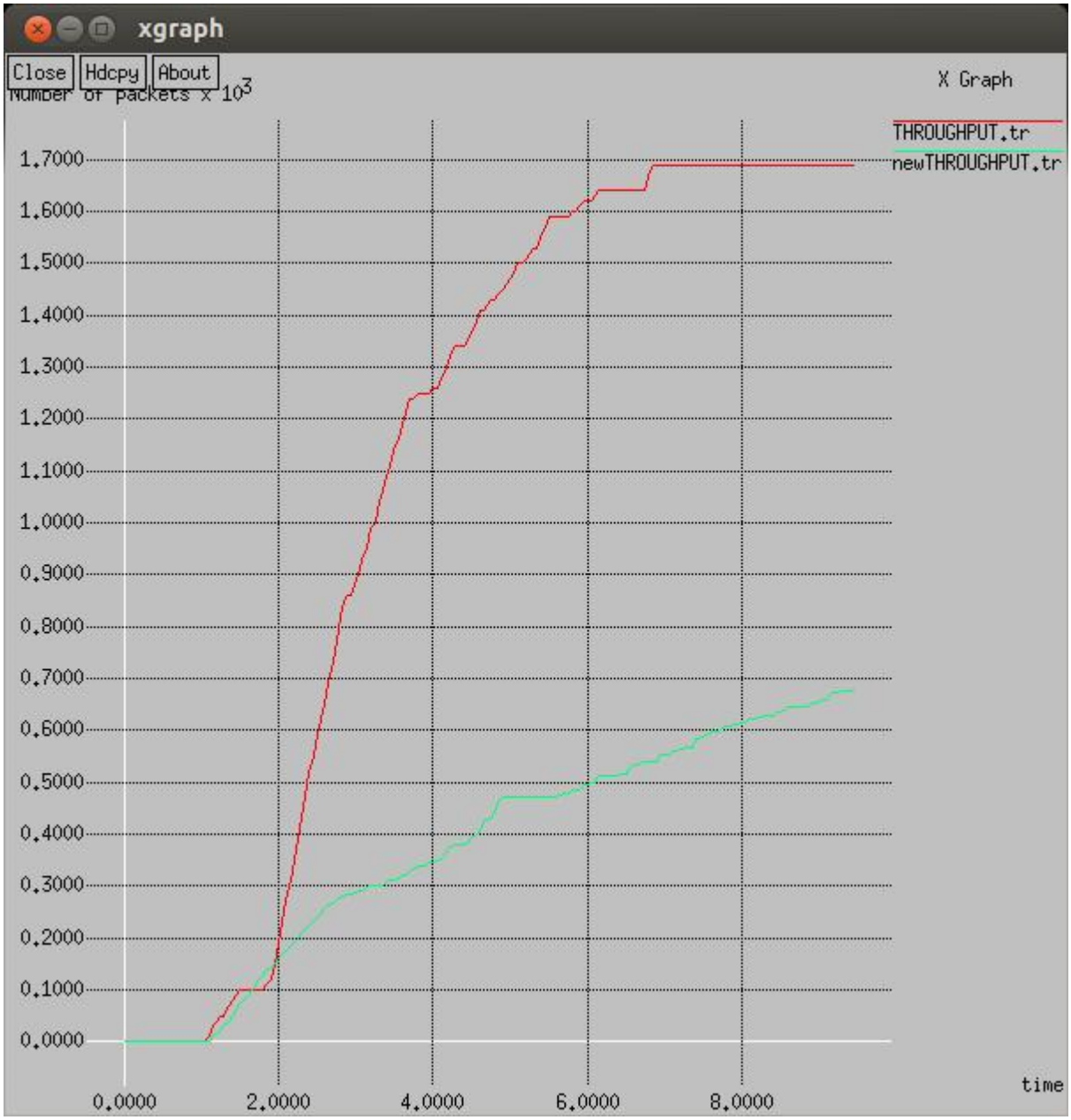

Fig 6: Throughput Comparison

Figure 6 displays the relative study of established and lately designed methods with respect to their throughput value. It is analyzed that proposed approach has high throughput due to apply of multicasting technique as compared to existing technique

Conclusion

The Vehicular Ad-Hoc Network (VANET) plays a crucial role in developing the ITS for all applications. Several researchers from all over the world have been paying attention to this research domain. VANETs not only guarantee the security of on-road automobiles, but also provide a certain degree of traffic efficiency and ease to people. The crucial test here is to decrease the setback related to passing the information from one node to another. If these challenges from MANET protocols are overcome, these protocols can be applied within real time VANET applications. The research carried out in the past adopted a broadcast strategy to create the route. To conclude, this approach exhausts considerable bandwidth for creating route. To create a time-efficient and minimal bandwidth exhausting route, this research proposed a multicasting method.

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