A Reliability-Based Routing Protocol for Vehicular Ad-hoc Network

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Abstract— Vehicular ad hoc networks (VANETs) are a special form of wireless networks which is formed by vehicles which are communicating among themselves on roads. The conventional routing protocols proposed for mobile ad hoc networks (MANETs) are not suitable for VANETS they work poorly in VANETs. As communication links break more frequently in VANETs than in MANETs, the routing reliability of such highly dynamic networks needs to be pay special attention. A very little research has focused on the routing reliability of VANETs on highways. In this paper, we use the evolving graph theory to model the VANET communication graph on a highway. This paper is to propose an evolving graph-based reliable routing scheme for VANETs to provide quality-of-service (QoS) which support in the routing process.

Key words: Evolving graph (EG), most reliable journey (MRJ), mobile ad hoc networks (MANETs), quality of service (QoS), vehicular ad hoc network (VANET)

I. INTRODUCTION

Every day, a lot of people die, and many more are injured in traffic accidents around the world. The desire to provide road safety information among vehicles to prevent accidents and improve road safety. The main aim of VANETs is to avoid such accidents and provides road safety information & quality-of-service. So there is need of communication to know traffic condition monitoring, dynamic route scheduling, emergency-message dissemination and, most importantly, safe driving. Vehicular Ad hoc NETworks (VANETs) are special form of MANETs.it is an emerging technology, which allow vehicles to form a self-organized network without the aid of a permanent infrastructure. Vehicular ad hoc networks (VANETs) are a promising technology to enable the communications among vehicles on one hand and between vehicles and road side units on the other hand. These are highly mobile, thus the network topology is frequently changing. The conventional routing protocols proposed for mobile ad hoc networks (MANETs) work poorly in VANETs ,as communication links break more frequently in VANETs than in MANETs, VANETs tend to operate without an infrastructure;

The ad hoc network connectivity is equipped with wireless communication which is provided by each and every vehicle. Each vehicle in the network can send, receive, and relay messages to other vehicles in the network. In this way, vehicles can exchange real-time information, and drivers can be informed about road traffic conditions and other travel-related information. VANETs have attractive & unique feature than MANET such as normally higher transmission power, higher computational capability, The special behavior and characteristics of VANETs raise important technical challenges that should be considered to deploy these networks effectively. So this is the to propose an evolving graph-based VANETs to provide quality-of-service (QoS) which support in the routing process. Here a new algorithm is developed to find the most reliable route in the VANET evolving graph from the source to the destination.

II. LITERATURE REVIEW

J. Monteiro, "The use of evolving graph combinatorial model in routing protocols for dynamic networks," , 2008 [1] this paper focuses on the evolving graph model to design and evaluate least cost routing protocols for MANETs with known connectivity patterns. The NS2 network simulator is used to first implement an evolving graph-based routing protocol, and then, it is used to provide a benchmark when comparing four major ad hoc routing protocols. Monteiro showed that an evolving graph-based routing protocol is well suited for networks with known connectivity patterns and that the model, as a whole, may be a powerful tool for the development of routing protocols.

G. Pallis, D. Katsaros, M. D. Dikaiakos, N. Loulloudes, and L. Tassiulas, "On the structure and evolution of vehicular networks," 2009 [2] the objective of this system focuses on providing a thorough study of the topological characteristics and statistical features of a VANET communication graph. Specifically, answers are provided for some critical questions such as the following: How do VANET graphs evolve over time and space? What is the spatial distribution of these nodes? Which are the critical link duration statistics in a VANET when the vehicles move in urban areas? How robust is a VANET? The obtained results could have a wide range of implications for the development of high performance, reliable, scalable, secure, and privacy-preserving vehicular technologies.

J. Monteiro, A. Goldman, and A. Ferreira, "Performance evaluation of dynamic networks using an evolving graph combinatorial model," 2006 [3] The highly dynamic behavior of wireless networks make them very difficult to evaluate, e.g. as far as the performance of routing algorithms is concerned. However, some of these networks, such as intermittent wireless sensors networks, periodic or cyclic networks, and low earth orbit (LEO) satellites systems have more predictable dynamics, as the temporal variations in the network topology are somehow deterministic. Recently, a graph theoretic model the evolving graphs was proposed to help capture the dynamic behavior of these networks, in view of the construction of least cost routing and other algorithms. The algorithms and insights obtained through this model are theoretically very efficient and intriguing. However, there is no study on the uses of these theoretical results into practical situations. Therefore, the objective of this work is to analyze the applicability of the evolving graph theory in the construction of efficient routing protocols in realistic scenarios.

M. Rudack, M. Meincke, K. Jobmann, and M. Lott, "On traffic dynamical aspects of inter vehicle communications (IVC),",2003 [4] This system focuses on the impact of vehicular traffic dynamics on protocols for ad hoc networks. Based on analytical treatment of vehicular traffic and on realistic traffic scenarios, they deduce requirements and their interdependencies for the developed ad hoc networking protocols, and verify them by simulation. They showed that the proposed MAC and RRM protocols are suitable for Inter Vehicle Communication with its high dynamics in freeway environments.

III. METHODOLOGY

A. VANET-Oriented Evolving Graph (VOEG) Model

We proposed VoEG to model and formalize the VANET communication graph. So We associate a model considering the time & link reliability value at that time. In the VoEG model, the communication link between two vehicles is not available if its reliability value is equal to zero & the communication link between two vehicles is available if its reliability value is not equal to zero. Thus the VoEG model is used to find out whether the communication link between two vehicles is possible or not. where Link reliability is defined as the probability that a direct communication link between two vehicles will stay continuously available over a specified time period. The objective is to find the most reliable journey (MRJ) instead of using the conventional approaches of finding the foremost, shortest, or fastest journey. The MRJ has the highest journey reliability value among all possible journeys from the source to the destination.

B. Evolving Graph Reliable Ad Hoc On-Demand Distance Vector Routing (EG-RAODV) Protocol

We extend the well-known ad hoc on-demand distance vector (AODV) routing protocol with evolving graph theory to propose reliable routing protocol EG-RAODV. But first A new routing algorithm to find the MRJ is needed. Then, this algorithm will be applied to design the route discovery process for our proposed EG-RAODV routing protocol.

1) EG-Dijkstra Algorithm

The normal Dijkstra algorithm cannot be directly applied in this context. We modify it and propose the evolving graph Dijkstra's algorithm (EG-Dijkstra) to find the MRJ based on the journey reliability definitions. EG-Dijkstra algorithm maintains an array called the reliable graph (RG) that contains all vehicles and their corresponding MRJ values.

C. Route Discovery Process in EG-RAODV

It is assumed that the source vehicle has information on the current status of VoEG. When the source vehicle has data to send at time t, it calculates the reliability value for each link in the current VoEG. At this stage, the source vehicle knows the most reliable valid journey to the destination. It will create a routing request message (RREQ) and assign the hops of the MRJ as extensions to this RREQ. Note that this extension field in the RREQ is not used in the traditional ad hoc routing protocols and was left for future use.

In EG-RAODV, by utilizing the extension information in the RREQ, intermediate nodes are able to forward the routing request to the next hop without broadcasting. At each vehicle along the route, when an RREQ is received, the information about from which vehicle it heard is recorded. Then, the RREQ will be forwarded to the next hop based on the extension's information. Intermediate vehicles are not allowed to send a routing reply message (RREP) to the source vehicle, even if they have a valid route to the destination. Since the time domain is incorporated in the routing process and the mobility of nodes is highly dynamic, the reliability values at intermediate vehicles might be out dated. An RREP will be sent back to the source vehicle to start data transfer.

Sr. No	Simulation Parameter	Value
1	Protocol	AODV/EGRAODV
2	Simulation Time	150s
3	Antenna Type	Omni directional
4	Varying No. of Vehicles	10-50
5	Packet Size	150
6	Mac layer Protocol	802_11
7	NS2 Version	2.35

Table 1:

IV. WORKING FLOW CHART

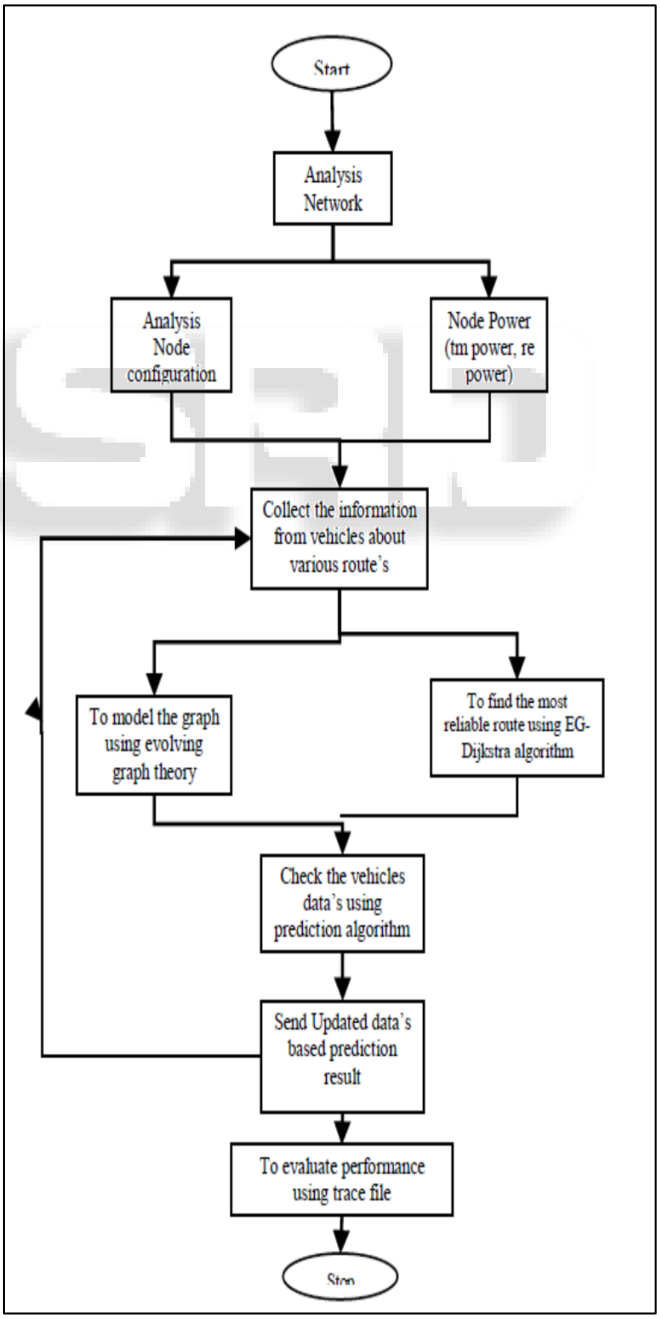

Fig. 1: Working Flow Chart

No. of Nodes	AODV	EGRAODV
10	0.2386	0.2982
20	0.2797	0.3397
30	0.3285	0.3755
40	0.3948	0.4606
50	0.4300	0.4852

Table 1: For calculating End to End Delay

A. Simulation Results

1) End to End Delay

When we conducted experimental analysis for END to END Delay, we found that we obtain lower E2E delay value for EGRAODV compared with AODV. The experiment is conducted for both protocols by taking same no of nodes such as 10, 20,30,40,50. The graph is plotted for E2E delay with respect to no. of nodes

No. of Nodes	AODV	EGRAODV
10	06814	0.5451
20	1.0144	0.8622
30	1.0492	0.8919
40	1.0701	0.9783
50	1.4806	1.2493

Table 2: For calculating Packet Delivery Ratio

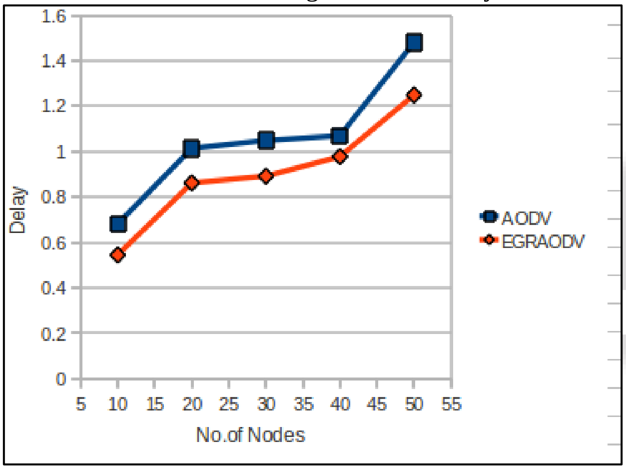

Fig. 2: End to End Delay for AODV & EGRAODV

2) Packet Delivery Ratio

This experiment is conducted for analysis of Packet delivery ratio. we found that we obtain highest packet delivery ratio for EGRAODV than compared with AODV. The experiment is conducted for both protocols by taking same no of nodes such as 10,20,30,40,50. The graph is plotted for PDR against no of nodes

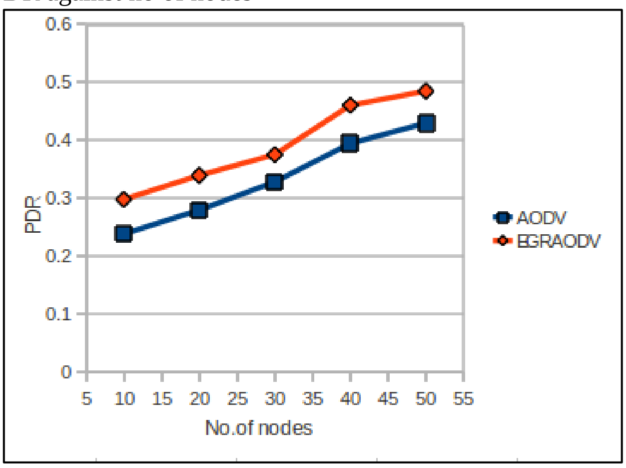

Fig. 3: Packet Delivery Ratio for AODV & EGRAODV

3) Throughput

This experiment is conducted for analysis of Throughput. we found that we obtain highest throughput for EGRAODV than compared with AODV. The experiment is conducted for both protocols by taking same no of nodes such as 10, 20,30,40,50. The graph is plotted for throughput against no of nodes.

No. of Nodes	AODV	EGRAODV
10	932.713	991.008
20	941.6095	1006.5481
30	992.634	1074.3811
40	1039.049	1096.774
50	1042.9909	1100.934

Table 3: For calculating Throughput

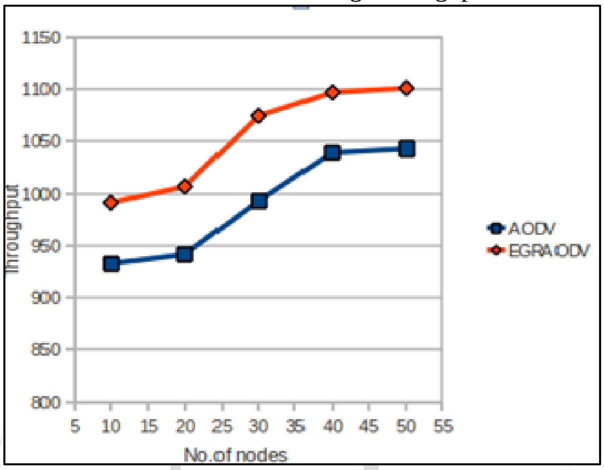

Fig. 3: Throughput for AODV & EGRAODV

V. CONCLUSION

Above graph show the simulation parameter for proposed system EG-RAODV which evaluate the Throughput, Average End-to-End to delay, PDR for 10,20,,30,40,50 numbers of nodes. Comparing outcome of EG-RAODV and AODV it is clear that throughput & PDR increase as compare to AODV and average end to end delay reduce. Figure 1, 2, 3 shows comparisons of throughput, average end to end delay and normalized routing overhead.so we obtain better results for EGRAODV compared to AODV.

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