HYBRID ROUTING PROTOCOL IN VEHICULAR AD-HOC NETWORK FOR HIGHLY HETEROGENEOUS TRAFFIC ENVIRONMENT

Avinash P. Ingle
Dept. of Information Technology
Priydarshini Institute of Engineering and Technology, Nagpur,India
avi007.ingle@gmail.com

***Abstract*— VANETs are a promising technology to enable communications among vehicles on roads. They are a special form of mobile ad hoc networks (MANETs) that provide vehicle-to vehicle communications. It is assumed that each vehicle is equipped with a wireless communication facility to provide ad hoc network connectivity. VANETs tend to operate without an infrastructure; each vehicle in the network can send, receive, and relay messages to other vehicles in the network. 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 and unique features, distinguishing them from other types of MANETs, such as normally higher transmission power, higher computational capability, and some kind of predictable mobility, in comparison with general MANETs. The special behavior and characteristics of VANETs raise important technical challenges that should be considered to deploy these networks effectively. The most challenging issue is potentially the high mobility and the frequent changes of the network topology. In VANETs, the network topology could vary when the vehicles change their velocities and/or lanes. These changes depend on the drivers and road situations and are normally not scheduled in advance.**

Keywords - VANET, MANET, TORA, AODV.

I. INTRODUCTION

EVERY DAY, a lot of people die, and many more are injured in traffic accidents around the world. The term vehicular Ad hoc network (VANET) is used for a subgroup of mobile Ad hoc networks (MANETs). Both VANET and MANET are characterized by the movement and self-organization of the nodes. But they are also different in some ways. MANET can contain many nodes that have un-controlled moving patterns. But since VANET is formed mainly by vehicles so node movement is restricted by factors like road course, traffic and traffic regulations. Because of the restricted node movement it is quite likely that the VANET will be supported by some fixed infrastructure that provide some services and access to stationary networks[8]. The fixed infrastructure will be deployed at critical locations like slip roads, service stations, dangerous intersections or places well-known for hazardous weather conditions. Nodes are expected to communicate by means of North American DSRC standard that employs the IEEE 802.11p standard for wireless communication [1]. Vehicles that are not subjected to the strict energy, space and computing capabilities restrictions normally adopted MANETs. The very high speed of the nodes (up to 250 km/h) and the large dimensions of the VANET are more challenging problems in recent research areas.

With the sharp increase of vehicles on roads in the recent years, driving has not stopped from being more challenging and dangerous. Roads are saturated, safety distance and reasonable speeds are hardly respected, and drivers often lack enough attention. Without a clear signal of improvement in the near future, leading car manufacturers decided to jointly work with national government agencies to develop solutions aimed at helping drivers on the roads by anticipating hazardous events or avoiding bad traffic areas [12]. One of the outcomes has been a novel type of wireless access called Wireless Access for Vehicular Environment (WAVE) dedicated to vehicle-to-vehicle and vehicle-to-roadside communications. While the major objective has clearly been to improve the overall safety of vehicular traffic, promising traffic management solutions and on-board entertainment applications are also expected by the different bodies and projects involved in this field. Nowadays it is increasingly important to be connected to the internet world. The trend is towards the wireless world, providing public access to the Internet via wireless devices at high data rates [13].

II. LITURATURE SURVEY

Despite many surveys already published on routing protocols in MANETs (Mauve, 2001; Mehran, 2004Giordano, 2003; Stojemnovic, 2004), a survey of newly developed routing protocols specific to VANETs has long been overdue. Li et al. (2007) have made an effort to introduce VANET routing protocols, yet there is still deficiency in a thorough and comprehensive treatment on this subject. A discussion of VANET topics and applications is incomplete without detailed coverage of relevant routing protocols and their impact on overall VANET architecture [9][11].

A. Routing Protocols

As shown in Figure 1, there are two categories of routing protocols: topology-based and geographic routing. Topology-based routing uses the information about links that exist in the network to perform packet forwarding. Geographic routing uses neighboring location information to perform packet forwarding. Since link information changes in a regular basis, topology-based routing suffers from routing route breaks.

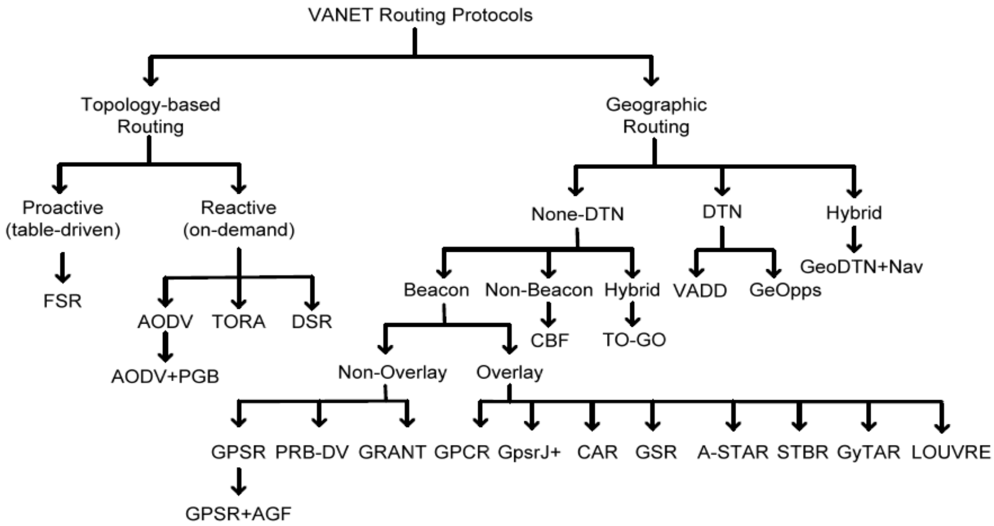

FIGURE 01: TAXONOMY OF VANET ROUTING PROTOCOLS

B. Topology-based Routing Protocols

These routing protocols use links' information that exists in the network to perform packet forwarding. They can further be divided into proactive (table-driven) and reactive (on-demand) routing [5].

C. Proactive (table-driven)

Proactive routing carries the distinct feature: the routing information such as the next forwarding hop is maintained in the background regardless of communication requests. Control packets are constantly broadcast and flooded among nodes to maintain the paths or the link states between any pair of nodes even though some of paths are never used [3][4]. A table is then constructed within a node such that each entry in the table indicates the next hop node toward a certain destination. The advantage of the proactive routing protocols is that there is no route discovery since route to the destination is maintained in the background and is always available upon lookup. Despite its good property of providing low latency for real-time applications, the maintenance of unused paths occupies a significant part of the available bandwidth, especially in highly mobile VANETs.

Fisheye State Routing (Iwata, 1999; Pei, 2000) is an efficient link state routing that maintains a topology map at each node and propagates link state updates with only immediate neighbors not the entire network. Furthermore, the link state information is broadcast in different frequencies for different entries depending on their hop distance to the current node. Entries that are further away are broadcast with lower frequency than ones that are closer [5]. The reduction in broadcast overhead is traded for the imprecision in routing. However, the imprecision gets corrected as packets approach progressively closer to the destination.

D. Reactive (On Demand)

Reactive routing opens a route only when it is necessary for a node to communicate with another node. It maintains only the routes that are currently in use, thereby reducing the burden on the network [2][6]. Reactive routings typically have a route discovery phase where query packets are flooded into the network in search of a path. The phase completes when a route is found.

E. Geographic (Position-based) Routing

In geographic (position-based) routing, the forwarding decision by a node is primarily made based on the position of a packet's destination and the position of the node's one-hop neighbors. The position of the destination is stored in the header of the packet by the source. The position of the node's one-hop neighbors is obtained by the beacons sent periodically with random jitter (to prevent collision). Nodes that are within a node's radio range will become neighbors of the node [6][12]. Geographic routing assumes each node knows its location, and the sending node knows the receiving node's location by the increasing popularity of Global Position System (GPS) unit from an onboard Navigation System and the recent research on location services (Flury, 2006; Li, 2000; Yu, 2004), respectively. Since geographic routing protocols do not exchange link state information and do not maintain established routes like proactive and reactive topology-based routings do, they are more robust and promising to the highly dynamic environments like VANETs. In other words, route is determined based on the geographic location of neighboring nodes as the packet is forwarded. There is no need of link state exchange nor route setup. Figure 1 sub-classifies Geographic routing into three categories of non-Delay Tolerant Network (non-DTN), Delay Tolerant Network (DTN), and hybrid. The non-DTN types of geographic routing protocols do not consider intermittent connectivity and are only practical in densely populated VANETs whereas DTN types of geographic routing protocols do consider disconnectivity [7]. However, they are designed from the perspective that networks are disconnected by default.

III. METHODOLOGY

A. AODV

Ad Hoc On Demand Distance Vector routing protocol [9] is a reactive routing protocol which establish a route when a node requires to send data packets. It has the ability of unicast & multicast routing. It uses a destination sequence number (DestSeqNum) which makes it different from other on demand routing protocols.

Pros

- An up-to-date path to the destination because of using destination sequence number.
- It reduces excessive memory requirements and the route redundancy.
- AODV responses to the link failure in the network.
- It can be applied to large scale adhoc network.

Cons

- More time is needed for connection setup & initial communication to establish a route compared to other
- f intermediate nodes contain old entries it can lead inconsistency in the route.
- For a single route reply packet if there has multiple route reply packets this will lead to heavy control overhead.
- Because of periodic beaconing it consume extra bandwidth.

B. Temporally Ordered Routing Protocol (TORA)

Temporally Ordered Routing Protocol [11] is based on the link reversal algorithm that creates a direct acyclic graph towards the destination where source node acts as a root of the tree. In TORA packet is broadcasted by sending node, by receiving the packet neighbor nodes rebroadcast the packet based on the DAG if it is the sending node's downward link.

Pros

- It creates DAG (Direct acyclic graph) when necessary.
- Reduce network overhead because all intermediate nodes don't need to rebroadcast the message.
- Perform well in dense network.

Cons

- It is not used because DSR & AODV perform well than TORA.
- It is not scalable.

C. Propose Hybrid Protocol

Till date AODV is best according to previous research taken place in the area of VANET. AODV broadcast messages to all its neighbored in 360 degree, so its leads to wastage of resources such as time, memory, node utilization, node energy hence it cause flooding in the network On the other hand TORA used to send the messages in the particular direction toward the destination by means of directed Acyclic Graph (DAG).

According to previous research, it is found that TORA is not suitable for VANET because of high mobility of nodes. If we use the concept of Directed acyclic graph from TORA and add in AODV it will lead hybrid protocol and produces the better result.

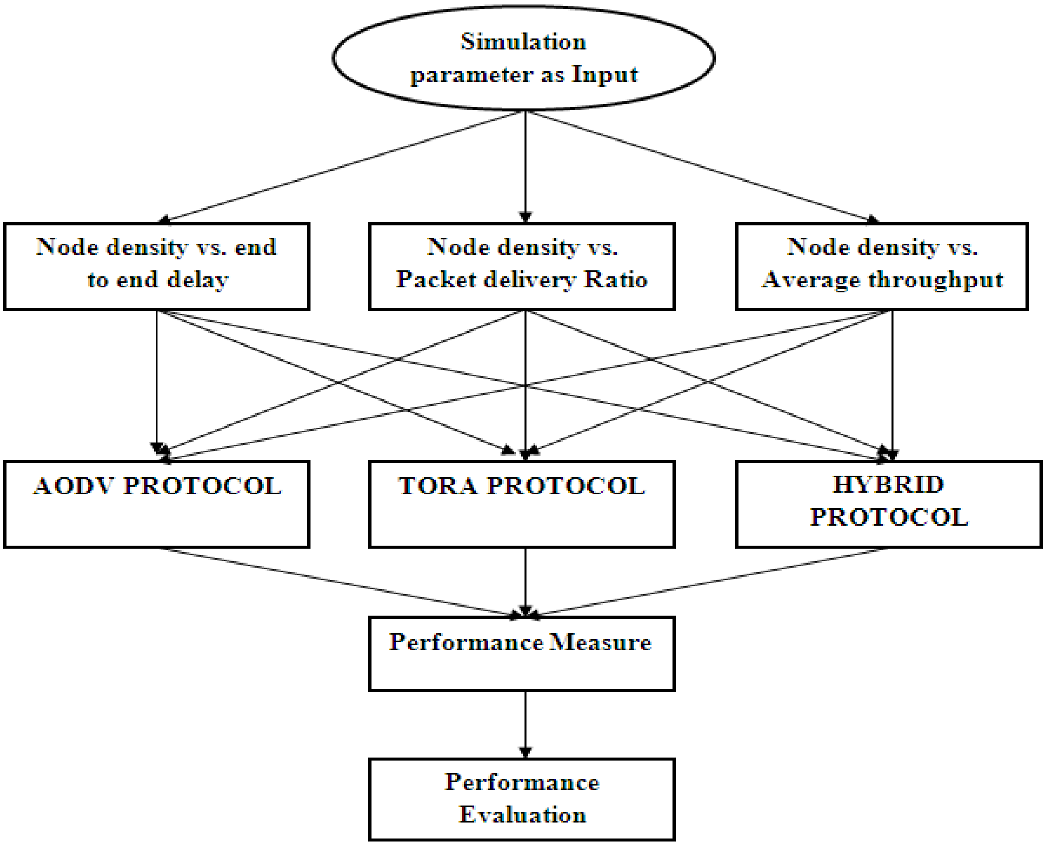

Figure 02: System Architecture

IV. PERFORMANCE EVALUATION

We are considering the following parameter for simulation and will compare the results for performance evaluation.

A. End to End delay

End to End delay refers to the time taken by a packet to reach the destination from the source. This includes the delay such as transmission delay, propagation delay, processing delay and queing delay that occurs during transmission. Since, these delays occur at each router, so mathematically it can be written as:

E= N (T+P+PR+Q), where E= End to End Delay. N= Number of links. T= Transmission delay. P= Propagation delay. PR= Processing delay. Q= Queing delay. Lower the value of end to end delay, better the protocol.

B. Packet Delivery Ratio

Packet Delivery Ratio is the ratio of packets delivered to the number of packets sent by a source. Mathematically, Packet Delivery Ratio = (DATAR/DATAS)×100 Where DATAR is the number of packets received DATAS is the number of packets sent. A higher Packet Delivery Ratio means a better protocol.

C. Throughput

Throughput is the ratio of packets received to the time over which the transmission takes place. Mathematically, Throughput = Number of bits (or data Packets) successfully received/Time for transmission. Throughput is generally measured in bits per second (bps) or kilo bits per second (kbps). Higher the throughput better is the performance of the protocol.

CONCLUSION

A Hybrid routing protocol for vehicular ad-hoc Network will be design which will minimize end to end delay also it will maximize packet delivery ration and control the network partition. It is found that TORA is not suitable for VANET because of high mobility of nodes. If we use the concept of Directed acyclic graph from TORA and add in AODV it will lead hybrid protocol and produces the better result. This protocol will efficiently work in heterogeneous traffic environment.

REFERENCES

[1] Peppino Fazio, Floriano De Rango, Andrea Lupia : A New Application for Enhancing VANET Services in Emergency Situations Using the WAVE/802.11p Standard :Wireless Days (WD), 2013 IFIP

[2] Yun Li ; Fei Fang ; Qianbin Chen: A New TORA-based Energy Aware Routing Protocol In Mobile Ad Hoc Networks: 3rd IEEE/IFIP International Conference in Central Asia on Internet, 2007. ICI 2007.

[3] Song Fang, Tao Luo: A Novel Two-timer-based Broadcast Routing Algorithm for Vehicular Ad-hoc Networks IEEE International Conference on Green Computing and Communications and IEEE Internet of Things and IEEE Cyber, Physical and Social Computing, 2013.

[4] N.Arulkumar, Dr. E. George Dharma Prakash Raj: A Simulation Based Study to implement Intelligent Transport Systems concepts in VANETs using AODV Routing Protocol in NS2: IEEE- Fourth International Conference on Advanced Computing, ICoAC 2012

[5] Ganesh S. Khekare Apeksha V. Sakhare: A Smart City Framework for Intelligent Traffic System Using VANET : International Multi-Conference on Automation, Computing, Communication, Control and Compressed Sensing (iMac4s), 2013

[6] P.Kuppusamy, Dr.K.Thirunavukkarasu, Dr.B.Kalaavathi: A Study and Comparison of OLSR, AODV and TORA Routing Protocols in Ad Hoc Networks : 3rd International Conference on Electronics Computer Technology (ICECT), (Volume:5) 2011

[7] Jae Won Lee, Sang-Sun Lee: A Study on Local Repair Routing Algorithm based on Link-Duration for Urban VANET : International Conference on Information Science and Applications (ICISA), 2013

[8] Sang-woo Chang, Sang-sun Lee: A Study on Stable Route Decision Scheme in Urban Inter-Vehicle Communication: International Conference on Information Science and Applications (ICISA), IEEE 2013

[9] Wai Chen, Ratul K. Guha, Taek Jin Kwon, John Lee and Irene Y. Hsu: A Survey and Challenges in Routing and Data Dissemination in Vehicular Ad-hoc Networks: Proceedings of the 2008 IEEE International Conference on Vehicular Electronics and Safety Columbus, OH, USA. September 22-24, 2008

[10] Raja Jurdak, Cristina Videira Lopes, And Pierre Baldi: A Survey, Classification And Comparative Analysis Of Medium Access Control Protocols For Ad Hoc Networks : IEEE Communications Surveys & Tutorials, First Quarter VOLUME 6, NO. 1 IEEE COMMUNICATIONS, 2004

[11] Sarah Madi , Hend Al-Qamzi: A Survey on Realistic Mobility Models for Vehicular Ad Hoc Networks (VANETs) : 10th IEEE International Conference on Networking, Sensing and Control (ICNSC), 2013

[12] Hyun Yu, Joon Yoo, Sanghyun Ahn : A VANET Routing based on the Real-time Road Vehicle Density in the City Environment : Fifth International Conference on Ubiquitous and Future Networks (ICUFN) ,2013

[13] Ying He, Changle Li, Hang Lin and Lina Zhu: Accident Driver Model for Vehicular Ad-Hoc Network Simulation: Vehicle Power and Propulsion Conference (VPPC), IEEE 2013

[14] Aslinda Hassan, Mohamed H. Ahmed ,M.A. Rahman: Adaptive Beaconing System based on Fuzzy Logic Approach for Vehicular Network: 24th International Symposium on Personal, Indoor and Mobile Radio Communications: Mobile and Wireless Networks, IEEE 2013

[15] Cong Yu, Lianxiang Guo, Yanxi Zhou, Huabiao Qin: Adaptive State Aware Routing Protocol for Vehicle Ad Hoc Network in Urban Scenarios: 10th IEEE International Conference on Control and Automation (ICCA), June 12-14, 2013