International Journal For Technological Research In Engineering
Volume 2, Issue 4, December-2014 *ISSN (Online): 2347 - 4718*

ANALYSIS OF VARIOUS ROUTING PROTOCOLS FOR RURAL ENVIRONMENT IN VANET

Divyang S. Panchal[1], Mr. Ajay Singh Dhabariya[2], Prof. Ajaykumar T. Shah[3]
[2,3]Assistant Professor, [2,3]Department of Computer Engineering
[1,2]Shrinathji institute of Technology & Engineering, Nathdwara, Rajasthan, India
[3]Alpha College of Engineering & Technology

Abstract: VANETs have particularly important applications in sparse and rural areas because of the lack of fixed communication infrastructure. In rural areas, vehicle densities are low and roadway communication infrastructure is scarce, leading to long periods where vehicle-to-vehicle or vehicle-to-roadside communications is infrequent, interrupted, or simply not possible. Channel between vehicles is necessary for realistic modeling of VANETs and the development of related technologies and applications. The applications range from safety and crash avoidance to Internet access and multimedia. These include frequency allocation, standards for physical and link layers, routing algorithms. Routing algorithms appropriate for these circumstances have been less explored and the design of such a routing protocol is challenging. In this paper, we examine a range of VANET routing protocols and describe their associated issues and various approaches to resolve them. The comparative study is mainly done on the essential characteristics and behavior of the protocols.
Keywords: VANET, Routing Protocols, Unicast, Broadcast, Multicast, Security, RSUs

I. INTRODUCTION

Vehicular Ad hoc networks (VANETs) are a special type of mobile ad hoc networks; where vehicles are simulated as mobile nodes. VANET contains two entities: access points and vehicles, the access points are fixed and usually connected to the internet, and they could participate as a distribution point for vehicles. VANET addresses the wireless communication between vehicles (V2V), and between vehicles and infrastructure access point (V2I). Vehicle to vehicle communication (V2V) has two types of communication: one hop communication (direct vehicle to vehicle communication), and multi hop communication (vehicle relies on other vehicles to retransmit) [1]. VANET also has special characteristics that distinguish it from other mobile ad hoc networks; the most important characteristics are: high mobility, self-organization, distributed communication, road pattern restrictions, and no restrictions of network size, all these characteristics made VANETs environment a challenging for developing efficient routing protocols. Recent improvements in mobile ad-hoc network (MANET) technology and ever-increasing safety requirements as well as consumer interest in Internet access have made VANETs an important research topic. Vehicle to vehicle and vehicle to roadside communications have become important components of vehicle infrastructure integration.

Most of the VANET research has focused on urban and suburban roadway conditions, where the numbers of vehicles are large, the inter-vehicle spacing is small, terrain is not a significant factor and fixed communication infrastructure is available. In rural and sparse areas, the conditions and constraints are significantly different. Node densities are low, inter-vehicle spacing can be large, terrain effects may be significant and there is very little or no fixed communication infrastructure available. The coverage provided by wireless carriers is predominantly in urban areas and along major highways, not in rural areas and minor roadways. While data is moving in VANET it will suffers from recurrent interruptions due to frequent mobility and sporadically linked network system. A system warning for e.g. on-coming traffic has the potential of saving many lives on rural roads. Due to the relatively high speed and lack of physical counter measures (e.g. lack of guardrails), rural roads account for a majority of the fatal traffic accidents today. On sparsely trafficked roads in rural areas, it is rather the radio environment than the volume of vehicles that challenges the communication technology. Dense vegetation or steep road cuts on the road side limit a vehicle's transmission range and thereby its ability to detect other vehicles and make its own presence known to others. Vehicles on both sides of steep crests and narrow curves can experience similar difficulties which must be dealt with. The remainder of the paper is organized as follows: Section II describes the major challenges and requirement in VANET Section III discusses related research work on routing protocol design as applied to VANETS and highlights work associated to rural areas Section IV focuses on various issues related to the existed routing protocols and possible approaches to resolve it. Section V relates our discussion on comparison of defined routing protocol based on their essential characteristics and behavior. Section VI Concludes the paper Section VII Future works are drawn in the final section.

II. CHALLENGES AND REQUIREMENTS IN VANET FOR RURAL AREAS

Many issues arise when efforts are gathered towards running vehicular ad hoc networks in rural or sparse areas in an attempt to provide an improvement to driver behavior, with the aim of reducing the number of fatalities caused by automobile accidents. To realize the requirements that needed to deploy VANET concept, many factors that have a critical impact on achieving the VANET goal need to be

taken into consideration, represented by safety applications and non-safety applications. Thus it is vital to specify the main important challenges in VANET, and the key challenges from the technical perspectives are as follows:

Signal fading and distortions: Objects placed as obstacles between two communicating vehicles are one of the challenges that can affect the efficiency of VANET; these obstacles can be other vehicles or buildings distributed along single road in the villages. Their impact is placed on preventing the signal from reaching its destination and increasing the fading in the transmitted signal

Bandwidth limitations: Another key issue in the VANET is the absence of a central coordinator that controls the communications between nodes, and which has the responsibility of managing the bandwidth and contention operation. Therefore it is necessary to utilize the availability of bandwidth efficiently. There is a high probability that channel congestion can occur, Owing to the limited range of bandwidth frequency (10–20 MHz) for VANET applications, particularly in a rural environment. The fair use of bandwidth has its impact on reducing the time delay for disseminating messages; if a vehicle needs to send a message and finds there are no opportunities for transmission, it must wait for a time to have a chance for transmission, which will have an effect on increasing the latency.

Connectivity: Owing to the high mobility and rapid changes of topology, which lead to a frequent fragmentation in networks, the time duration required to elongate the life of the link communication should be as long as possible. This task can be accomplished by increasing the transmission power; however, that may lead to throughput degradation. Accordingly, connectivity is considered to be an important issue in VANET.

Small effective diameter: Owing to the small effective network diameter of a VANET, that leads to a weak connectivity in the communication between nodes. Therefore, maintaining the complete global topology of the network in rural areas is impracticable for a node. The restricted effective diameter results in problems when applying existing routing algorithms to a VANET

Security and confidentiality: Keeping a reasonable balance between the security and privacy is one of the main challenges in VANET; the receipt of trustworthy information from its source is important for the receiver. However, this trusted information can violate the privacy needs of the sender [6].

Routing protocol [1]: Because of the high mobility of nodes and rapid changes of topology, designing an efficient routing protocol that can deliver a packet in a minimum period of time with few dropped packets is considered to be a critical challenge in VANET. Further more, many researchers have concentrated on designing a routing protocol suitable for rural and dense environments that have a high density of vehicles with close distance between them. Designing an efficient routing protocol has an impact on improving many factors, the first of these is enhancing the reliability of the system by leveraging between them. Designing an efficient routing protocol has an impact on improving many factors; the first of these is enhancing the reliability of the system by leveraging the percentage of packets delivery, and second by reducing the extent of interference caused by high buildings. The third factor is that taking scalability into consideration is essential to avoid conflict, if a simultaneous operation of unicast routing request has been initiated. Another factor is to deliver a packet in the shortest possible time, especially in the emergency situation; this factor is considered to be a very critical factor.

III. ROUTING PROTOCOLS FOR VANET

The design of efficient routing protocols for VANETs is challenging due to the high node mobility and the movement constraints of mobile modes. Here we highlight the overview of various routing protocol designed to work in rural environment [7].

A. BORDER NODE BASED ROUTING PROTOCOL (BBR)

The BBR protocol is mainly based on broadcast and applies the store-and-forward approach used in epidemic routing. Instead of simply flooding the network, a flooding control scheme is explored by using one-hop neighbor information only [2]. The BBR protocol is specifically designed to accommodate for the effects of node mobility on data. Border nodes are selected per broadcast event, which stores the broadcast information and forwards the data packets. The border node selection is based on the assumption that the nodes located at the edge of transmission range has a least no. of common neighbors and they will meet more new neighbors than the nodes closer to the current source.

B. EPIDEMIC ROUTING PROTOCOL

Epidemic Routing distributes application messages to hosts, called carriers, within connected portions of ad hoc networks. In this way, messages are quickly distributed through connected portions of the network. Epidemic Routing then relies upon carriers coming into contact with another connected portion of the network through node mobility. At this point, the message spreads to an additional island of nodes. Through such transitive transmission of data, messages have a high probability of eventually reaching their destination.

C. POSITION BASED ROUTING PROTOCOL

In VANET each vehicle wishes to know its own position as well as its neighbor vehicle position, because position is one of the most important data for vehicles. A routing protocol which uses the position information is known as the position based routing protocol. Position based routing protocol need the information about the physical location of participating vehicles be available [3].

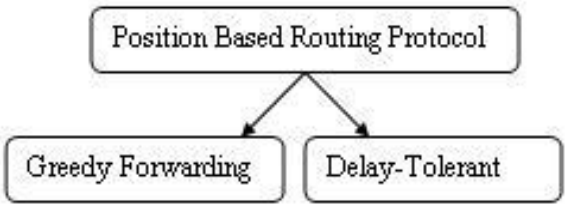

Figure: 1 Types of Position Based Routing Protocol

A sender requests the position of a neighbor node by means of a location service. Since the vehicular nodes are known to move along establish paths, position based routing protocols are more suitable for VANET. So there is no overhead when tracing a route because routing tables are not used in these protocols. It is further divided into Greedy forwarding Protocols and Delay Tolerant Protocols.

D. TOPOLOGY BASED ROUTING PROTOCOL

The topology based protocols use the information about the network topology and the state of communication links between nodes to perform the routing decisions. Because of the high mobility of vehicles, the topology based algorithms fail to handle frequent broken routes usually constructed as a succession of vehicles between the source and the destination.

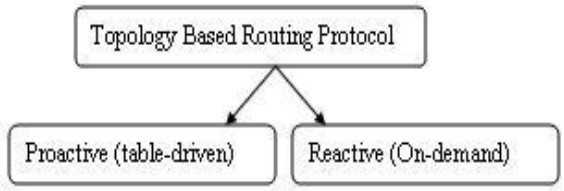

Figure: 2 Types of Topology Based Routing Protocol

Moreover, the route instability and frequent topology changes increase the overhead for path repairs or change notifications and thus, degrade the routing performances. It is further divided into Proactive routing protocol (table-driven) & Reactive routing protocol (On-demand).

E. CENTRALIZED TRAJECTORY BASED ROUTING PROTOCOL (TBR)

A Centralized routing protocol designated as Trajectory-Based Routing (TBR) designed specifically for vehicle-to-vehicle communications in rural networks. Each vehicle utilizes a future knowledge of the trajectories of the other vehicles route over which to deliver its packets to the destination. The vehicle trajectories are identified using location service implemented at the Road-Side Units (RSUs). The Performance of the TBR scheme is evaluated by conducting a series of simulations using the ns-2 network simulator

F. VEHICLE SECOND HEADING DIRECTION ROUTING PROTOCOL (VSHDRP)

Vehicle Second Heading Direction Routing Protocol (VSHDRP), which is designed to leverage the probability of delivering a data packet to its destination and to increase connectivity and route stability by utilizing the knowledge of the Second Heading Direction (SHD)in the process of selecting the next-hop node [8]. This new routing protocol contains two modes; the highway straight mode and the roundabout\intersection mode. They show the higher improvement in the safety and efficiency of communication. VSHDRP works under the following assumptions: the transmission range of each vehicle in the network is up to 250m, and each vehicle has sufficient knowledge about its surrounding neighbors through exchanging a HELLO beacon message periodically, i.e. vehicle id, its position, direction and speed. We assume in this proposed protocol that each vehicle is supplied with a GPS (Global Positioning System) device and navigation system (NS), and vehicles are equipped with preloaded digital road maps; therefore we assume that each vehicle can know its own location, direction through the fitted GPS device and NS, and can predetermine its route to its destination from the beginning. This approach minimizes the path length by minimizing the number of hops between source and destination vehicles.

IV. ISSUES AND APPROACHES

The broadcast messages in the BBR protocol bring undesirable large overhead. Border nodes are selected per broadcast event, which stores the broadcast information and forwards the data packets. The border node selection is based on the assumption that the nodes located at the edge of transmission range has a least number of common neighbors and they will meet more new neighbors than the nodes closer to the current source which employs high end to end delay this is not acceptable in safety application for VANET. The performance of the BBR protocol should be well evaluated such that its simulation results indicates that BBR performs well for networks with frequent partitioning and rapid topology changes [7]. High packet delivery ratios can be achieved with long packet delivery delays when the network is highly partitioned.

Epidemic Routing Protocol suffers from the disadvantages of flooding as the node density increases. In case of speed value equals to1m/s since in such a case the delivery ratios are very small since this protocol needs bidirectional unicast communications which become unavailable in case of sparse networks with high mobility. For hop count, after each encounter, a node forwards copies of all messages to an adjacent node, if it does not hold them already. A time-stamp is attached to each message when it is created and nodes remove copies when their timeout expires. With an unlimited buffers and bandwidth, the Epidemic routing gives us always the smallest delay. Adjusting diffusion Parameters like messages' timeout and number of copies can be distressed task for real applications in a rural environment. Hence routing loops for carried messages and confirmed combination of trajectory-based forwarding and movement predictions is able to solve those problems.

The position based routing protocol is not that much suitable in rural areas because of terrain effects [3][7]. It requires position determining services. GPS device doesn't work in tunnel because satellite signal is absent there. Stale

information of neighbors' position is often contained in the sending nodes' neighbor table. Though the destination node is moving its information in the packet header of intermediate node is never updated. Therefore a scalable route discovery and management is required which needs to remember the neighbors location.

Topology based routing protocol has unused paths which occupy a significant part of the available bandwidth. It has very poor performance in small ad hoc networks and has comparatively less knowledge about distant nodes. Due increase in network size, the storage complexity and the processing overhead of routing table also increases [5]. It is also responsible for carrying In-sufficient information for route establishing. Hence routing information should be exchanged only with the neighbors which reduces the consumed bandwidth significantly. Flooding should be required only when it is demanded.

TBR may not be easily implemented in real-world rural VANETs since Road-side Units (RSUs) are not always available [5]. Unused paths occupy a significant part of the available bandwidth. For route finding, latency is high. Excessive flooding of the network causes disruption of nodes communication. Therefore an up-to-date path to the destination should be maintained using destination sequence number which reduces excessive memory requirements and the route redundancy.

VSHDRP sometimes has low number of nodes in the network which can affect negatively on the network's performance in terms of delivering the packet to its desired destination, which will lead to the creation of gaps between nodes (disconnected area), and as a result will prevent the packets being forwarded to their destination. So it is necessary to increase the packet delivery ratio, by increasing the stability of the link route packet and decreasing the generated overhead, by reducing the transmission of the packet caused by drops occurring.

V. COMPARATIVE ANALYSIS

Table 1 (at the end of paper) described below compares various routing protocol for rural areas as already discussed. The comparison is based on essential behavior and characteristics of the routing protocols [4].

Table 1: COMPARATIVE ANALYSIS OF ROUTING PROTOCOLS IN VANET

Routing Protocols	Routing Types	Urban Scenario	Rural Scenario
Border Node based Routing Protocol	Broadcast	Applicable	Applicable
Epidemic Routing Protocol	Unicast	Applicable	Applicable
Position Based routing Protocol	Unicast	Applicable	Partially applicableas GPS information is unavailable due to terrain effects in some areas.
Topology Based Routing Protocol	Unicast	Applicable	Not much applicable due to less knowledge about distant node which fails to discover the complete path
Centralized Trajectory Based Routing Protocol	Unicast, Multicast & Broadcast	Applicable	Applicable
Vehicle Second Heading Direction Routing Protocol	Multicast	Applicable	Applicable

VI. CONCLUSION

As a result of the substantial advances in the wireless technology, vehicles are becoming a part of the global network in rural as well as in sparse environment. The high dynamic nature of VANET makes it different from other ad hoc network and present the challenge for routing. In this paper we present the various routing protocol that applied in the rural areas with the issues of VANET and the approach

to overcome the traditional routing protocol challenges. Although many problems are not yet solved, the general feeling is that vehicles could benefit from spontaneous wireless communications in a near future, making VANETs a reality which should also be implemented to sparsely related areas.

VII. FUTURE WORKS

In wireless network community VANET received attention of many researchers due to its unique nature. Although amount of research has been devoted to the various routing issues in VANET but still there are some areas that need more attention.

- Performance metrics such as end-to end delay, average routing overhead and packet delivery ratio etc should be major points of consideration.
- Secure routing is one of the challenging areas. Due to the un-secure and ad hoc nature of VANET, there is prone to several security attacks that may lead to devastating consequences. So security attacks should be investigated with respect to different attacks in VANET.
- Several other routing methods such as geo-cast and cluster based routing methods used for urban approaches should also be considered for the evaluation of routing protocols in rural as well.
- New algorithms should be proposed to provide reliable QoS for safety and comfort applications in VANET.

REFERENCES

[1] "Survey of Routing Protocols in Vehicular Ad Hoc Networks," Kevin C. Lee, Uichin Lee, Mario Gerla, Advances in Vehicular Ad-Hoc Networks: Developments and Challenges, IGI Global, Oct, 2009."Border Node-based Routing Protocols for VANETS in Sparse and Rural Areas", Zhang and Wolff: Auto net Workshop, IEEE Globe COM, Washington DC, November 2007.

[2] "Position-based unicast routing scenarios," Schnaufer, S., Effelsberg, W World of Wireless, Mobile and Multimedia Networks, 2008. WoWMoM 2008. 2008 International Symposium on a , vol., no.,pp.1-8, 23-26 June 2008.

[3] "Comparative and Behavioral Study on VANET Routing Protocols", S.Sujatha1, P.Soundeswari: IOSR Journal of Computer Engineering (IOSRJCE) ISSN: 2278-0661, ISBN: 2278-8727 Volume 5, Issue 2 (Sep-Oct. 2012)

[4] "VANET Routing Protocols: Pros and Cons", Paul, Md. Ibrahim, Md. Abu Naser Bikas: International Journal of Computer Applications (0975 – 8887) Volume 20– No.3, April 2011

[5] "Security on Vehicular Ad Hoc Networks (VANET): A Review Paper"- Agrawal, Garg, Chaudhiri, Gupta, Pandey, Roy International Journal of Emerging Technology and Advanced Engineering ISSN 2250-2459,ISO 9001:2008 Certified Journal, Volume 3, Issue 1,January 2013.

[6] "Routing Protocols for Vehicular Ad Hoc Networks in Rural Areas", Zhang and Wolff IEEE Communications Magazine, November, 2008, pp. 126-131.

[7] "Reliable routing for roadside to vehicle communications in rural areas", Wan, Tang and Wolff :IEEE International Conference on Communications (ICC'2008), Beijing, May 2008.

