

An Efficient and Stable Intersection-based Segment Aware Routing Algorithm for Urban Vehicular Networks

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ABSTRACT: High vehicular mobility causes frequent changes in the density of vehicles, discontinuity in inter vehicle communication, and constraints for routing protocols in vehicular ad hoc networks (VANETs). The routing must avoid forwarding packets through segments with low network density and high scale of network disconnections that may result in packet loss, delays, and increased communication overhead in route recovery. Therefore, both traffic and segment status must be considered. This paper presents real-time intersection-based segment aware routing (RTISAR), an intersection-based segment aware algorithm for geographic routing in VANETs. This paper presents RTISAR, an intersection based segment aware algorithm for geographic routing in VANETs. This routing algorithm provides an optimal route for forwarding the data packets toward their destination by considering the traffic segment status when choosing the next intersection. RTISAR presents a new formula for assessing segment status based on connectivity, density, load segment, and cumulative distance toward the destination. A verity period mechanism is proposed to denote the projected period when a network failure is likely to occur in a particular segment. This mechanism can be calculated for each collector packet to minimize the frequency of RTISAR execution and to control the generation of collector packets. This routing algorithm provides an optimal route for forwarding the data packets toward their destination by considering the traffic segment status when choosing the next intersection. RTISAR presents a new formula for assessing segment status based on connectivity, density, load segment, and cumulative distance toward the destination. A verity period mechanism is proposed to denote the projected period when a network failure is likely to occur in a particular segment.

KEYWORDS: Communication Overhead, VANETs, Segment Aware.

1. INTRODUCTION

Vehicular ad hoc networks (VANETs) are considered an emerging technology in the industrial and educational fields. This technology is essential in the deployment of the intelligent transportation system, which is targeted to improve safety and efficiency of traffic. The implementation of VANETs can be effectively executed by transmitting data among vehicles with the use of multiple hops. However, the intrinsic characteristics of VANETs, such as its dynamic network topology and intermittent connectivity, limit data delivery. One particular challenge of this network is the possibility that the contributing node may only remain in the network for a limited time. Hence, to prevent data loss from that node, the information must reach the destination node via multi-hop routing techniques. An appropriate, efficient, and stable routing algorithm must be developed for various VANET applications to address the issues of dynamic topology and intermittent connectivity. This paper presents RTISAR, an intersection-based segment aware algorithm for geographic routing in VANETs. This routing algorithm provides an optimal route for forwarding the data packets toward their destination by considering the traffic segment status when choosing the next intersection. RTISAR presents a new formula for assessing segment status based on connectivity, density, load segment, and cumulative distance toward the destination. A verity period mechanism is proposed to denote the projected period when a network



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failure is likely to occur in a particular segment. This mechanism can be calculated for each collector packet to minimize the frequency of RTISAR execution and to control the generation of collector packets. As a result, this mechanism minimizes the communication overhead generated during the segment status computation process.

Previous researchers consider vehicular ad hoc networks (VANETs) that facilitate ubiquitous connectivity between vehicles and do not rely on expensive network infrastructure. Communication between vehicles and preexisting infrastructure opens up a plethora of different types of promising applications for passengers and drivers. These applications provide safety and comfort and assist drivers to be alert in order to avoid any accident, traffic jam, unseen obstacles, speed violation, internet access, weather information, multimedia services, and so forth. Although being a subclass of mobile ad hoc networks a vehicular network has several unique properties that distinguish it from other ad hoc networks. The most significant differences are high mobility pattern, rapid changing, and dynamic topology which lead to high network partition and disconnectivity in network. However, dynamic topologies are not completely random and movement of nodes is restricted with roads and relatively predictable. The predictability is important factor for link selection but linear topology reduces the possible path redundancy. Another representative characteristic is the impact of obstacles on the communication quality in urban environment in the shapes of trees, buildings, and so forth. Efficient data routing is considered as essential for practicability of these aforementioned applications. One of the main issues in routing protocols is the absence of end-to-end path from source to the destination. To address this diversity many routing protocols employ extensive approaches to flood the network with data packets. The success of routing revolves around various key factors and without an appropriate routing strategy it will continue to be limited. RTISAR, a new optimal segment aware-based geographic routing algorithm in urban VANET that considers traffic segment status when selecting the next intersection. Apart from combining the advantages of the segment result metric, this is based on their connectivity, density, and load of segments. RTISAR also considers the cumulative distance to a specific destination. This algorithm can avoid selecting intersections with low connectivity, sparse density segment, high load segment, and low cumulative distance to the destination

II. LITERATURE SURVEY

R. Jalali, K. El-Khatib, and C. McGregor, "Smart city architecture for community level services through the Internet of Things,"

Today, more than half of the world's population spend their lives in cities, and this number will jump to 70 percent by 2050. Increasing population density in urban environments demands adequate provision of services and infrastructure. This explosion in city population will present major challenges including air pollution, traffic congestion, health concerns, energy and waste management. Solution to these challenges might require the integration of various Information and Communication Technologies into the artifact of the city. This paper presents architecture for smart cities, where city management, community service providers and citizens have access to real time data which has been gathered using various sensory mechanisms in order to analyze and make decisions for future planning.

A. Ghazal, C.-X. Wang, B. Ai, D. Yuan, and H. Haas, "A nonstationary wideband MIMO channel model for high-mobility intelligent transportation systems".

The recent development of high-speed trains (HSTs), as a high-mobility intelligent transportation system, and the growing demands of broad-band services for HST users, introduce new challenges to wireless communication systems for HSTs. The deployment of mobile relay stations on top of the train carriages is one of the promising solutions for HST wireless systems. For a proper design and evaluation of HST wireless communication systems, we need accurate channel models that can mimic the underlying channel characteristics for different HST scenarios. In this paper, a novel nonstationary geometry-based stochastic model (GBSM) is proposed for wideband multiple-input multiple-output HST channels in rural macrocell scenarios. The corresponding simulation model is then developed with angle.



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S. A. A. Shah, M. Shiraz, M. K. Nasir, and R. B. M. Noor, "Unicast routing protocols for urban vehicular networks: Review, taxonomy, and open research issues"

This implies that in city scenarios unicast protocols show minimal persistence towards highly dynamic vehicular characteristics, including mobility, road structure, and physical environment. Unlike other studies, this review is motivated by the diversity of vehicular characteristics and difficulty of unicast protocol adaption in city scenarios. The review starts with the categorization of unicast protocols for city scenarios according to their requirement for a predefined unicast path. Then, properties of typical city roads are discussed, which helps to explore limitations in efficient unicast communication. Through an exhaustive literature review, we propose a thematic taxonomy based on different aspects of unicast protocol operation. It is followed by a review of selected unicast protocols for city scenarios that reveal their fundamental characteristics. Several significant parameters from the taxonomy are used to qualitatively compare the reviewed protocols. Qualitative comparison also includes critical investigation of distinct approaches taken by researchers in experimental protocol evaluation. As an outcome of this review, we point out open research issues in unicast routing

Y. Chen, M. Fang, S. Shi, W. Guo, and X. Zheng, "Distributed multihop clustering algorithm for VANETs based on neighbourhood follow"

Recent advances in development of Wireless Communication in Vehicular Adhoc Network (VANET) has provided emerging platform for industrialists and researchers. Vehicular Ad hoc networks are multi-hop networks with no fixed infrastructure. It comprises of moving vehicles communicating with each other. Inter vehicular communication lies at the core of a number of industry and academic research initiatives that aim at enhancing the safety and efficiency of transportation systems. Vehicular ad hoc networks (VANETs) enable vehicles to communicate with each other and with roadside units (RSU). In a previous study [1], the authors have proposed a Distributed multi-hop clustering algorithm for VANETs based on neighbourhood follow (DMCNF) in which the new vehicle initially broadcast hello packet (location, speed, position, direction) to all 1-hop distance neighbours and wait for the replies.

W. Chen, R. K. Guha, T. J. Kwon, J. Lee, and Y.-Y. Hsu, "A survey and challenges in routing and data dissemination in vehicular ad hoc networks"

We survey recent results in VANET data dissemination. We structure the survey into three broad categories: geocast/broadcast, multicast, and unicast approaches; and describe key ideas of representative technologies in each category. In addition, we consider location service and security issues that are crucial for data dissemination in VANET. We conclude by sharing our thoughts on further challenges

III. SYSTEM MODELS

Routing Protocol

Basically in these protocols the packets are forwarded to all the vehicle nodes within specified geographical area which leads to looping and network overhead issues in network. A node has a set of one-hop neighbour nodes within transmission range that checks the optimal forwarding node with different strategies. These vehicle nodes are moving randomly and frequently change their position. Each vehicle node periodically broadcasts the beacon messages to know the mobility characteristics and obtain the information of each other.

Proposed Routing Protocol Packet Forwarding

Vehicular ad hoc networks (VANETs) have earned a gigantic consideration in the recent era. Wide deployment of VANETs for enhancing traffic safety, traffic management, and assisting drivers through elegant transportation system is facing several research challenges that need to be addressed. One of the critical issues consists of the design of scalable routing algorithms that are robust to rapid topology changes and recurrent link disconnections caused by the high mobility of vehicles. In this article, first of all give a detailed technical analysis, comparison, and drawbacks of the existing state-of-the-art routing protocols. Then propose a novel routing scheme called a Reliable Path collection and

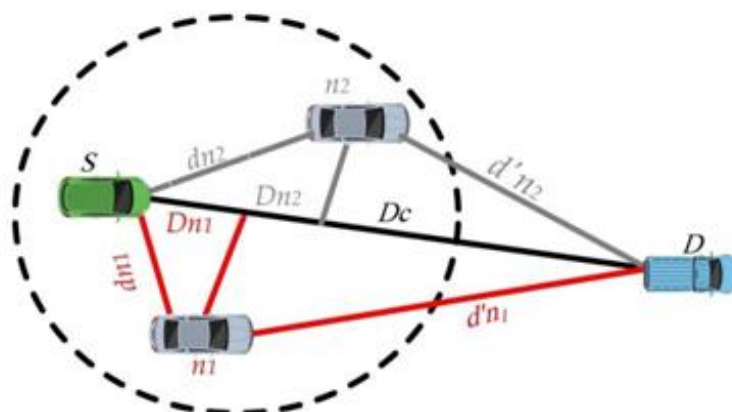
Packet Forwarding Routing Protocol (RSPPF). The originality of our protocol comes from the fact that firstly it establishes an optimal route for vehicles to send packets towards their respective destinations by considering connectivity and the shortest optimal distance based on multiple intersections. Secondly, it uses a novel reliable packet forwarding technique in-between intersections that avoids packet loss while forwarding packet due to the incidence of sudden link ruptures. The performance of the protocol is assessed through computer simulations.

Routing Metrics between Intersection

A) Distance and Direction.

The distance and direction are considered to be very important parameters because in transmission range of vehicle node there is a possibility that two nodes are very close to each other or they are alienated through a distance of maximum radio range. The shorter distance of vehicle nodes leads to high number of hops and nearest nodes can generate higher interface in network. If source node selects the closer node with maximum radio range the possibility of link failure increases because of high signal reduction of unreliable wireless channels. The selection of outmost and tremendous end of transmission range nodes may have advanced probability to exit on or after radio range and plunge the packets. It adopts vehicle density on every road to avoid sparse connectivity. The third protocol SDR uses direction and path duration prediction to select next hop in network. The proposed RPGR also uses midrange node, link quality and direction as routing metrics to select next hop or route in network. The performance of the proposed direction-finding protocol is evaluated by packet delivery ratio, end-to-end delay, average path length, and different data packet sizes. The elaborate description of these metrics is as follows:

- (i) Packet delivery ratio (PDR) is defined as portion of successfully received data packets at the destination over the total sending packets from source side. This metric shows the ability of routing protocol to successfully transmit data from source to destination in network.
- (ii) The end-to-end delay is defined as total time of transferring data from source node to destination. Basically the packet delay is a sum of sending buffer, retransmission, medium access delay due to interface queue, propagation delay, and relay election delay.
- (iii) The average path length is defined as an average number of nodes during transmission of data packets between source and destination. This metric also demonstrates the path quality



IV. PROBLEM STATEMENT

The most recent intersection-based routing protocols are discussed. It summarizes the comparison between them. A geographical greedy traffic-aware routing (GYTAR) protocol proposed that dynamically chooses intermediate intersections through which packets can travel to reach their destination. The number of vehicles and the curve metric distance toward the destination are considered during the selection process. The segment with the largest number of

vehicles and shortest route to the destination is given the highest score. Fixed location cells are formed within each segment, and each cell shares the same radius as the transmission range. The routing must avoid forwarding packets through segments with low network density and high scale of network disconnections that may result in packet loss, delays, and increased communication overhead in route recovery. Therefore, both traffic and segment status must be considered.

V. PROPOSED SYSTEM

A. Generate, Forward and Declared Collector Packet Phase:

The GFD-CP phase is initialized by the vehicle that moves on a segment by generating a CP upon reaching the intersection area. The CP collects information about the traffic segment status, which is then forwarded from the current to the next intersection.

B. Bounded Generation of Collector Packet Reply Phase:

At the end of GFD-CP, RTISAR generates a CPR that is directed to the starting intersection as shown in Figure 5 in order for the computed results of RTISAR to become readily available at the intersections and to suppress the redundant generation of CPs.

C. Decision Data Packet Routing Phase:

As mentioned in phases GFD-CP and BG-CPR, when the vehicle receives a CP or CPR at an intersection, the carried RTISAR results are processed to evaluate the segment event (Sevent) metric. Seventies based on three parameters, namely, segment density (Sden), segment connectivity (Scon), and segment load (Sload)

VI. METHODOLOGY

Wi-Fi model

To implement such applications in a vehicular environment, several protocols should be induced to take full advantage of the communication between V2V. 802.11 is a set of institute for electrical and electronic engineers (IEEE) standards for WLAN. IEEE 802.11 is better known as Wi-Fi, which is an acronym of wireless fidelity. IEEE 802.11p is the most relevant to this study. IEEE 802.11p includes the WAVE protocol required to support ITS applications [48], [49]. IEEE 802.11p primarily focuses improving vehicle safety and preventing traffic congestions

Mobility model

The heightened pace at which wireless networks are being transformed throughout the world is the outcome of many different factors. Given that mobile users constantly demand remote access, mobility is an important driving factor for mobile networks. Node speed defines the mobility of nodes in a mobile multi-hop wireless network.

Propagation channel model

The most accurate means of predicting the path loss in simulations is using a 3D ray-tracing technique combined with accurate models of the geometry and RF properties of the environment. The accuracy of the ray-tracer depends both on the number of rays simulated and the availability of accurate information about the environment.

Network model:

A graph $G(V, E)$ is used to model VANETs, where mobile devices are denoted by V and the arcs' set is denoted by E . The communication range intersection between two devices is modelled by the arcs. Direct communication can occur between every node $v \in V$ and in-range neighbouring devices, whereas the routing protocols are used for transmitting packets to devices that are not in the communication range

Traffic model:

In conducting a simulation study, the type of the traffic pattern significantly affects the routing protocols' performance. Furthermore, a network's congestion level is affected by certain modelling parameters, such as the number of flows and the effective transmission rate.

VII. CONCLUSION

The paper presented the assumption, description, phases, and simulation results of the performance evaluation of RTISAR, an intersection-based routing algorithm that provides the optimal route for forwarding data packets toward the destination by considering the traffic segment status when choosing the next intersection. Result was used to assess the segment status based on connectivity, density, load segment, and cumulative distance toward the destination. The RTISAR considers distance, direction and mid-section node to reactively select the next intersection. Whenever the forwarder node is at the intersection, curve metric direction and high traffic density are rechecked and forward the data toward destination in the network. The performance of the proposed routing protocol has been analysed in simulation with three existing CMGR, Geo SVR, and SDR routing protocols. The results demonstrate worse performance of RTISAR in terms of packet delivery ratio average packet delay and average path length with different vehicle density and packet size. The deployment of such framework can provide end users with connectivity information prior to use VANETs. Users can enjoy the target applications at significantly low cost comparing to pure LTE data services. For our future work, we will focus on sensitivity analysis to adjust the different system parameters. The results also prove that the proposed protocol is a realistic solution for urban area.

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