Adaptive Congestion Controlled Multipath Routing in VANET: A Multiagent Based Approach

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ABSTRACT

This article describes how in the VANET environment, routes are broken owing to node mobility. Moreover, the usage of wireless links for data communication leads to inherent unreliability and are error prone. Single path routing uses a prediction mechanism to compute a reliable path considering vehicle velocity and vehicle direction. Nevertheless, this methodology does not deal with major real-world traffic conditions. Hence, to address the aforementioned problems and to enhance reliability and fault tolerance, multipath routing protocols are employed. However existing multipath routing protocols even though compute multipath, only one path will be engaged in actual communication at any given time. Hence this work proposes Adaptive Congestion Controlled Multipath Routing in a VANET. The proposed work computes multiple paths from source to destination using cubic Bezier curves and more importantly, employs all/more than one path during the communication. The paths thus computed are adaptive in nature dependent upon the direction of mobility of source and destination vehicles.

KEYWORDS
Adaptive Routing, Bezier Curve, Communication Overhead, Congestion, Degree of Bezier Curve, Multipath, Path Discovery, Path Weight Factor, Transmission Time, VANET

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INTRODUCTION

Vehicular Ad hoc Network (VANET) is a variety of MANET intended for V2V (vehicle-to-vehicle) and V2I (vehicle to infrastructure) communication. It is a core part of Intelligent Transportation System (ITS) projected to provide safety applications in vehicle transportation. Now a days VANET is being extensively researched. VANET makes the communication between the vehicle drivers possible, in order to avoid any critical situation e.g. road side accidents, traffic roadblocks, speed control, free way for emergency vehicles and unseen obstacles etc. Besides safety applications VANET also provide comfort applications to the road users viz. weather information, mobile e-commerce, internet access and other multimedia applications. The foremost challenge in VANET is the design of dynamic routing protocol. Unique features of VANET like highly dynamic and ever-changing topologies, portability designs and varying density of vehicles makes routing in VANET very challenging. For optimal performance the designed routing protocols should cope with the unpredicted and dynamic nature of VANET. Possibly, the crucial job in VANET routing is computing and sustaining the ideal paths.

Based on the number of paths employed for communication, VANET routing protocols can be classified into three categories: Single path, Carry-and-forward mechanism and Multipath routing. Single path routing uses a prediction mechanism based on vehicle velocity and vehicle direction for computing the most reliable path or link. However, in VANETs owing to the high mobility of nodes, there is no static configuration. Because of this, routes are frequently fragmented. Further, the transmission links used for data communication are untrustworthy and erroneous. Because of this the probability of computed reliable path getting disconnected is very high. Hence in single path routing, there is a substantial amount of data transmission delay due to route maintenance. In addition to this single path routing does not address major real-world traffic conditions. Carry-and-forward type routing protocols carry the data packet along with them and transfer to the next immediate neighbor node. These protocols are mostly suitable for sparse environments and are not suitable for high mobility environments. Multipath routing protocols compute multiple disjoint paths from a source to destination. They are thereby more resilient to route/network failures. Thus, it is highly imperative that instead of relying on not just a single route, thereby causing more congestion on it, it is meaningful to focus on multipath routing (Balamurugan, Punniakodi, & Arulalan, 2013).

Advantages of multipath routing: (1) minimize delays in data transmission because of link failure, (2) packet delivery ratio, throughput and delay are optimized by simultaneously transferring the packets employing multiple paths between the source–destination pair, (3) increased reliability (the same packet is sent on each path) and fault tolerance (by ensuring the readiness of backup routes at all times), (4) facilitate load balancing (TianLi et al., 2012) (Jayavel, Venkatesan, & Vinoth, 2013).

However, with most of the existing multipath routing protocols even though multipath are computed, only one path will be engaged in actual communication at any given time. Thus, all the paths are not utilized simultaneously leading to extra
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