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Efficient Packet Delivery Mechanism Using Vehicle Platoon for A VANET Network

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Abstract: **This paper presents an adaptive tracking controller for a two-vehicle convoy where the lead vehicle is driven in reverse. We assume that the lead vehicle linear and angular velocities are unknown constant parameters. We consider the problem of autonomous vehicle tracking without the use of road infrastructure or inter-vehicle communication. The only information the robot vehicle can use for feedback control is the relative position and orientation with respect to the lead vehicle obtained from onboard sensing. The control velocities of the ego-vehicle are computed using the leader velocity estimates obtained from the dynamic part of the proposed controller. The proposed adaptive control law achieves asymptotic stabilization of the closed-loop system in error coordinates. In highway systems, grouping vehicles into *platoons* can improve road capacity and energy efficiency. With the advance of technologies, the performance of platoons can be further enhanced by *vehicular ad hoc networks* (VANETs). In the past few years, many studies have been conducted on the dynamics of a VANET-enabled platoon under traffic disturbance, which is a common scenario on a highway. However, most of them do not consider the impact of platoon dynamics on the behaviors of VANETs. Moreover, most existing studies focus on how to maintain the stability of a platoon and do not address how to mitigate negative effects of traffic disturbance, such as uncomfortable passenger experience, increased fuel consumption, and increased exhaust emission. In this paper, we will investigate the dynamics of the VANET-enabled platoon from an integrated perspective. In particular, we first propose a novel *disturbance-adaptive platoon* (DA-Platoon) architecture, in which a platoon controller shall adapt to the disturbance scenario and shall consider both VANET and platoon dynamics requirements.**

Keywords: **Vehicular Ad Hoc Networks (VANETs), platoon, VANET connectivity, Inter platoon connectivity, MANET.**

1. INTRODUCTION

Vehicular ad hoc networks (VANETs) can provide scalable and cost-effective solutions for applications such as traffic safety, dynamic route planning, and context-aware advertisement using short-range wireless communication. To function properly, these applications require efficient routing protocols. However, existing mobile ad hoc network routing and forwarding approaches have limited performance in VANETs. This dissertation shows that routing protocols which account for VANET-specific characteristics in their designs, such as high density and constrained mobility, can provide good performance for a large spectrum of applications.

In recent years, most new vehicles come already equipped with GPS receivers and navigation systems. Car manufacturers such as Ford, GM, and BMW have already announced efforts to include significant computing power inside their cars [5, 6] and Chrysler became the first car manufacturer to include Internet access in a few of its 2009 line of vehicles [7]. This trend is expected to continue and in the near future, the number of vehicles equipped with computing technologies and wireless network interfaces will increase dramatically.

These vehicles will be able to run network protocols that will exchange messages for safer, entertainment and more fluid traffic on the roads. Standardization is already underway for communication to and from vehicles. The Federal

Communication Commission (FCC) in the United States has allocated a bandwidth of 75MHz around the 5.9GHz band for vehicle to vehicles and vehicles to road side infrastructure communications through the Dedicated Short Range Communications (DSRC) [8] services.

The emergence of vehicular networks would enable several useful applications, both safety and non-safety related, such as automatic road traffic alerts dissemination, dynamic route planning, service queries (e.g., parking availability), audio and video file sharing between moving vehicles, and context-aware advertisement (e.g., [9, 10, 11]).

To deploy these services, three types of communications involving moving vehicles are considered, including cellular network, vehicle to roadside infrastructure and ad hoc vehicle communications.

2. RELATED WORK

This work presents background and related work literature in the domain of routing in MANETs (section 2.1), routing in VANETs (section 2.2), distributed next hop selection (section 2.3), methods specifically aimed at reducing delay in ad hoc networks) and distribution of path durations in ad hoc networks.

2.1 Routing in MANET:

Routing has been a major research topic in MANETs. DSDV [30] and DSR [25] areprotocols that focus on the topology of the network to select the end-to-end communicationpath. DSDV is a proactive protocol that may work well in small static environments, but does not scale well in larger, dynamic environments in which link information are frequently updated. RBVT-P is a proactive algorithm as well, but unlike DSDV it is not tied to individual Vehicles. RBVT-P constructs a real-time view of the vehicular traffic on the roads. DSR is a source-based routing that creates routes on-demand. RBVT-R creates routes on-demand, but the two protocols differ in the representation of the routes. In DSR, routes are sequences of Vehicles, thus leading to frequent route break in VANETs, while in RBVT-R, the routes are sequences of road intersections defining connected road segments.

To improve on traditional Vehicle-centric protocols that do not consider the road topology, a few protocols for VANETs [31, 32] exploit the fact that movements of vehicles are constrained on roads to either predict the lifetime of routes in Vehicle-centric protocols (and repair routes before they break) or reduce the number of route breaks by selecting, during the route creation, neighbors moving in the same direction and with a small relative speed. RBVT-R routing differs from these protocols in that the routes are road-based and their main components are the road intersections traversed on the path from source to destination.

2.2 Routing in VANET:

The main concepts of anchor-based routing in sensor networks have been adapted to vehicular networks environments. GSR and SAR integrate the road topologies in routing using those concepts. In these protocols, a source computes the shortest road based path from its current position to the destination. Similar to RBVT, they include the list of intersections that defines the path from source to destination in the header of each data packet sent by the source.

To alleviate this issue, A-STA modifies GSR by giving preference to streets served by transit buses each time a new intersection is to be added to the source route. The recently introduced CAR [23] protocol finds connected paths between source and destination pairs considering real-time traffic. CAR uses "guards" added to "hello" messages to reflect the movements of the source and destination Vehicles on the paths. Gytar does not store the full intersection-based route in the packets. Instead, the selection of the next intersection is made dynamically, each time choosing the next road segment with the best balance of road density and road length.

MDDV and VADD use opportunistic forwarding to transport data from source to destination. VADD uses historic data traffic flow to determine the best route to the destination. MDDV considers the road traffic conditions as well as the number of lanes on each road segment to select the best road-based trajectory to forward data. In both protocols, when no vehicle Vehicle can be found by along the forwarding trajectory, a carry and- forward approach is used. The vehicle Vehicle which is unable to transmit the data packet will store it until it finds a more suitable relay. These protocols are well suited for delay tolerant applications i.e. applications for which the users can tolerate a certain level of delay (up to a minute or more), as long as the data eventually arrives. The RBVT protocols on the other hand provide support for applications that are not delay tolerant. RBVT protocols require that an end to end path exists for data to reach the destination. Under very sparse vehicular traffic, as well as at the early stages of the deployment of wireless technology in vehicles (while many vehicles do not have wireless interfaces), opportunistic forwarding solutions, such as these, will be needed for car-to-car ad hoc communications.

Note that real-life measurements with commercial GPS receivers showed errors in reporting of GPS positions in urban environment. Because RBVT protocols follow paths made of road segments, they are more resilient to vehicle Vehicle positions errors of a few meters. The integration of inertial navigation system to GPS receivers is expected to improve the detection and handling of GPS position errors.

2.3 Distributed next hop selection:

Multiple criteria receiver-based next hop selection has been described in a general form in [47]. The authors demonstrated that using carefully selected criteria can improve the election of the optimal next hop. However, actual criteria to be used in practice were not defined. In this dissertation, the idea is applied to vehicular networks and criteria to optimize the election of the next hop are defined.

3. METHODOLOGY

3.1 Vehicle Deployment Algorithm:

This module is responsible placing the vehicles in the given area.

3.2 Four Way Lane's or Area of Interest Formation:

Area of Interest (AOI) Formation is responsible for placing the vehicles in multiple Lane's (Roads) and the vehicles may or may not change lanes based on their destination lane

Advantages:

1. Route Discovered from Source Vehicle to Destination Vehicle is very efficient
2. The Number of Hops and End to End Delay is less.

Disadvantage:

1. Lot of maintenance is required for RSU and Control Server

3.3 Information Propagation Speed Analysis (IPSA):

IPSA algorithm does not require VRT. IPSA algorithm main strength is based on the density of the vehicles. The next forward vehicle will be picked based on which neigbour vehicle has the maximum density

Density of vehicles is defined as the count of number of vehicles falling in range. One of the special cases is that if the density of two vehicles is maximum and is the same then the vehicle with low vehicle id is considered to move forward and vehicle which is closer to destination vehicle is considered.

Note – For both CAGR algorithm and IPSA algorithm first the Vehicle Route Discovery is performed and then the data packets are delivered towards the destination.

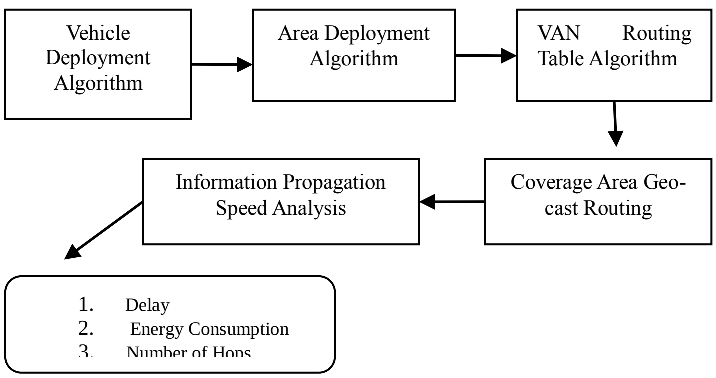

Figure: Modules of the work

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4. NUMERICAL RESULTS

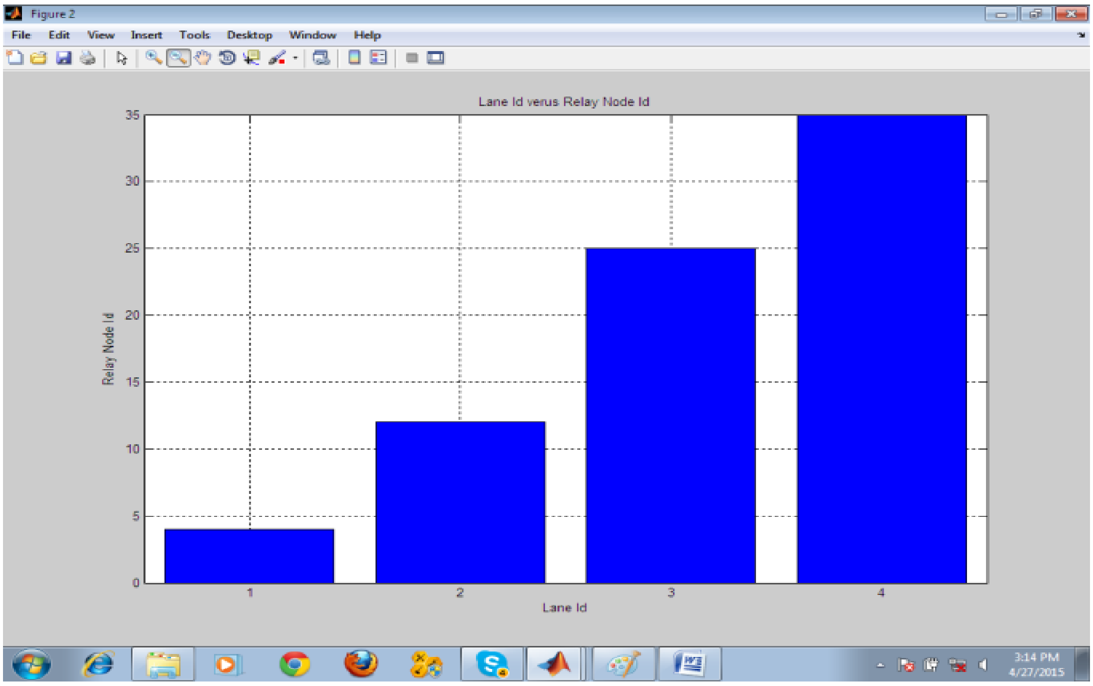

Figure shows Relay node selection process

5. CONCLUSION

In this work 3 mechanisms or algorithms have been simulated for VANET network for various density f vehicles and each algorithm has its own way of establishing the path and sending the packets. CAGR finds the GPS vehicles pick the vehicle whichs sends reply first and has the lowest channel noise like this it repeats until destination is reached. In IPSA algorithm the forward node is chosen based on the density of the neighbor vehicles the vehicle which has the highest density is chosen to move forward. In Mobicast routing a dedicated sensor is used which moves to and fro and delivers the packets to all the other vehicles.

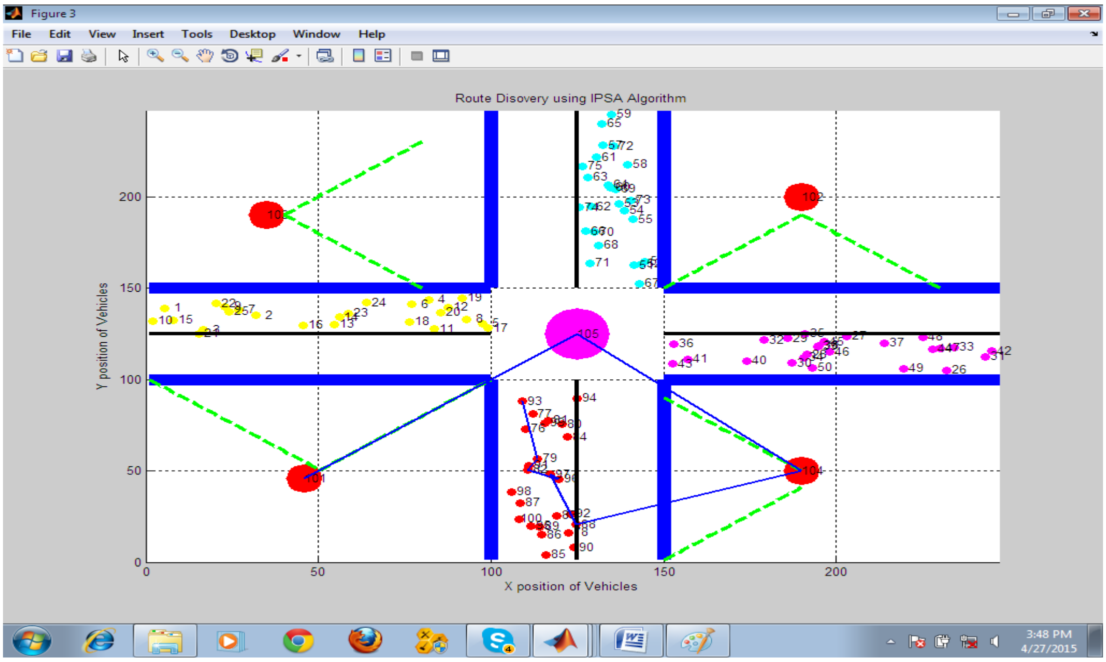

Fig Final routing process

6. FUTURE SCOPE

Algorithms can make use of Centralized Server and Security mechanisms to reduce the overhead and to avoid security attacks.

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