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Empirical Data Analysis in Urban VANET Using Exponential Decay of Inter Contact Time

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Abstract : VANET is a technology that uses moving vehicles as nodes in a network to create a mobile network .It is used to improve safety, security and efficiency of transportation systems. Inter-contact Time between moving vehicle is a key metrics in VANET , and for forwarding data and end to end delay. Inter-contact Time denotes the time elapsed between two successive contacts of the same two vehicles. In order to trace data on the frequencies and duration of transfers between vehicles three models were upgraded. No method or mobility models are proposed to decrease the end to end delay while transferring process, due to interference and signal loss of wireless links. The proposed system uses a Time Variant Random Way Point Mobility Model which minimizes the inter-contact time distribution, data transfer rate and reduces the delay. It improves the texture of Common traffic influxes and Common traffic converges.

I. INTRODUCTION

The VANET (Vehicular Ad-hoc Networks) technology which is used to move vehicles as joint in network to make a transportable network. VANETs are recognized as an important component in the next generation of intelligent transportation systems to improve safety, security and efficiency of transportation systems and enable new mobile services to the public. Participating vehicles become a wireless connection or router through VANET and it allow the vehicles almost to connect 100 to 300 meters to each other and in order to create a wide range network, other vehicles and vehicles are connected to each other so the mobile internet is made. VANETs have emerged as a new application scenario that is envisioned to revolutionize the human driving experiences, optimize traffic flow control systems, etc. Addressing security and privacy issues as the prerequisite of VANETs' development must be emphasized.

To avoid any possible malicious attack and resource a vehicle, employing a digital signature scheme is widely recognized as the most effective approach for VANETs to achieve authentication, integrity, and validity. However, when the number of signatures received by a vehicle becomes large, a scalability problem emerges immediately, where a vehicle could be difficult to sequentially verify each received signature with the current Dedicated Short Range Communications (DSRC) protocol and GPS. In this paper, we focus on studying the metric called inter-contact time [1,2,3,4]] which observe that the distribution of the inter-contact time, that is the time gap separating two contacts of the same pair of devices, exhibits a heavy tail such as one of a power law, over a large range of value. Since data transfer arises in a store-and-forward fashion, the inter-contact time of the two vehicles is a major component of the end-to-end delay, as it presents how long it takes to encounter the other mobile vehicle to have any chance to forward/relay the data for communication. Larger inter-contact time results in larger end-to-end delay.

In the literature, there have been many studies on the characteristics of the inter-contact time in delay tolerant networks (DTNs) and mobile ad hoc networks (MANETs). Most of these results focused on theoretical models, such as random walk mobility models (RWMs) [5,6,7], random waypoint mobility models (RWPs) [8,9], and random direction mobility models (RDMs) [10,11].GPS is used to establish the communication between two vehicles. Global Positioning System (GPS) is a space-based global navigation satellite system (GNSS) that provides location and time information in all weather, anywhere on or near the Earth, where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver with some technical limitation which is only removed for military users.

The GPS program provides critical capabilities to military, civil and commercial users around the world. It is an engine of economic growth and jobs, and has generated billions of dollars of economic activity. It maintains advantage over opponents and is one of the four core military capabilities. In addition, GPS is the backbone for modernizing the global air traffic system. The GPS project was developed in 1973 to overcome the limitations of previous navigation systems, integrating ideas from several predecessors, including a number of classified engineering design studies from the 1960s. GPS was created and realized by the U.S. Department of Defence (DoD) and was originally run with 24 satellites. It became fully operational in 1994.Well the uses of GPS Receivers just get more and more innovative. What started out as an invention of the US Military has become almost ubiquitous technology for the western world. I thought I would review where GPS Receivers had proliferated too and there are some great and not so great developments. Unfortunately many people now equate "a GPS" with a model that includes a large screen showing your location on an urban street map. That's a popular use sure, but it's far from being the best use for GPS Receivers.

DSRC would be particularly useful in the implementation of such a system because of the need for an absolutely secure and high-bandwidth communication link between a vehicle that is in trouble and a remote-control centre where professional drivers are prepared to take control of vehicle at a moment's notice. This concept can be developed and demonstrated using one Google-equipped self-driving vehicle, one roadside DSRC access point with high-speed

Internet connectivity, one DSRC transceiver in the vehicle, and a remote driver. It can be implemented on a large scale without the full set of Google's technology for self-driving vehicles of course, but the existence of such vehicles is useful for rapid demonstration of the concept. This concept can be developed and demonstrated using one Google-equipped self-driving vehicle, one roadside DSRC access point with high-speed Internet connectivity, one DSRC transceiver in the vehicle, and a remote driver. It can be implemented on a large scale without the full set of Google's technology for self-driving vehicles of course, but the existence of such vehicles is useful for rapid demonstration of the concept.

Empirical results [1,3,12] based on human mobility showed that the tail distribution of the inter-contact time is far from being exponential, but can be approximated or lower bounded by a power law. This implies that two have to wait a long period of time before they can meet ad communicate with each other. There is no existing work, to the best of our knowledge, studying vehicular inter-contact time distribution I urban settings based on real experiments. The Time Variant Random Way Point Mobility Model is proposed that characterizes the effect of traffic gathering at certain locations. The time variant random way point mobility model fully involved in the process of reducing inter-contact time. Mobility model is established corresponding to the inter-contact time between the each pair in the network. The time variant random way point mobility model to reduce the end to end delay.

The rest of this paper is structured as follows. Section 2 is dedicated to related work. In Section 3, we describe some of the methods related to our project. In section 4 we discuss the Simulation results, Finally, we present concluding remarks and outline the directions for future work in Section 5.

II. RELATED WORK

In the literature, a majority of research results have uncovered a common property of many theoretical mobility models that the tail of the inter-contact distribution decays exponentially. For example, authors in [7] draw this conclusion through numerical simulations based on RWP mobility models. In particular, authors in [1] proved that a finite boundary is a major factor that causes the exponential tail behaviour under any RWP mobility model and any RWM mobility model. While using Theoretical mobility models simplifies problem analysis, they are inconsistent with the reality and thus impractical in designing networking protocols for real systems. In recent years, there has emerged more research work taking experimental study on the characteristics of the inter-contact time. For example, authors in [1], [3] found that the tail behaviour of the inter-contact time based on human mobility is far from being exponential but is close to a power law instead. These results were based on real traces such as human contacts while at conferences, campus WiFi login records [3] and a Bluetooth network containing hundreds of people in an office. It is apparent that the mobility of vehicles is significantly different from that of human beings in terms of speed, constraints of road transportation systems and travel distances. Although these empirical results based on human mobility depict different inter contact time distribution, the situation in vehicular environments is still left unknown.

DieselNet at UMass consisting of 40 vehicles studies the aggregated inter-contact time distribution at a granularity of vehicle route and find a clear periodic structure in the inter-contact times between two vehicle routes. For the lack of enough contact samples between two individual vehicles, the vehicle trace data are not sufficient for studying the distribution of the inter-contact time between two individual vehicles. In the RAPID routing protocol , two nodes transfer data packets to each other when within communication range. During a transfer, the sender replicates packets while retaining a copy. A node can deliver packets to a destination node directly or via intermediate nodes, but packets may not be fragmented. There is limited storage and transfer bandwidth available to nodes.

Destination nodes are assumed to have sufficient capacity to store delivered packets, so only storage for in-transit data is limited. Node meetings are assumed to be short-lived then it is assumed that the distribution of vehicle inter-contact times is exponential to make their problem tractable.

To the best of our knowledge, there is no existing work studying the empirical characteristics of the inter-contact time of urban vehicles. The inter contact time between the participants of the network will be calculated from the successful information transfer.

The inter contact time lies between the process of sending message from sender and the reaching time to the receiver vehicle. Inter contact time will be calculated to the each pair of the network. A vehicle with a commercial GPS device installed, the highlight area in the inset shows such a devices.

III. SYSTEM DESIGN

A. Connection Establishment:

There are three main components are used to establish the communication between vehicles such as DSRC, GPS and In vehicle Sensor. The network is established in ad hoc manner which means each participant in the network is the reason for the data transformation. A wireless ad-hoc network is a decentralized type of wireless network. The network is ad-hoc. Because it does not rely on a pre-existing infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks.

Instead, each node participates in routing by forwarding data for other nodes, and so the determination of which nodes forward data is made dynamically based on the network connectivity. In addition to the classic routing, adhoc networks can use flooding for forwarding the data. Each system is consider as a node in the ad hoc network and the connection is established using GPS receiver.GPS unit can calculate the information, such as vehicle’s current location, speed.

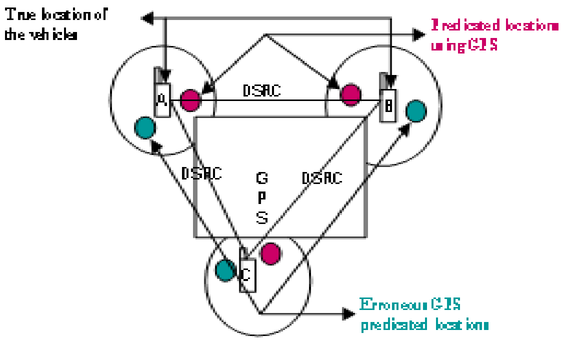

Figure. 1: Connectivity Analysis

DSRC would be particularly useful in the implementation of such a system because of the need for an absolutely secure and high-bandwidth communication link between a vehicle that is in trouble and a remote-control centre where professional drivers are prepared to take control of any wayward vehicle at a moment's notice. In vehicle Sensor, based on secured wireless technology, are installed in the ground in roadways, parking areas or any place that requires vehicle parking monitoring. The sensors detect vehicle arrival and departure information and determine when a vehicle is in violation. This information is transmitted wirelessly to the patented integrated Pin Force Mobile device when the officer is in range and vehicle status is communicated. This includes alarms for overstayed parked vehicles.

B. Data Transfer:

The initialization of transformation process begins from sender ends with the receiver node .In VANETs environment each vehicle take a responsibility of the forwarding information.

a. Wait-and-Forward

Source transmits a frame. Destination receives frame and, if wants to continue, replies back with an acknowledgement for that frame. The source waits until its next direct contact with the destination to communicate. Transformation of data is represented in fig2.

b. Flooding:

Device forwards all its received data to any device which it encounters, keeping copies for itself. These two algorithms are used to transfer data [1]. The message will be sent at least once to every host it is almost guaranteed to reach its destination. The traffic aware message or the geographical location based details are the information between the participants. Forwarding algorithm uses a routing table to select next hop router as the next destination for a datagram. A variant of flooding called selective flooding partially addresses these issues by only sending packets to routers in the same direction. In selective flooding the routers don't send every incoming packet on every line but only on those lines which are going approximately in the right direction.

Routing protocols handle routing activity on a system and, by exchanging routing information with other hosts, maintain known routes to remote networks. Both routers and hosts can run routing protocols. The routing protocols on the host communicate with routing daemons on other routers and hosts. These protocols assist the host in determining where to forward packets.

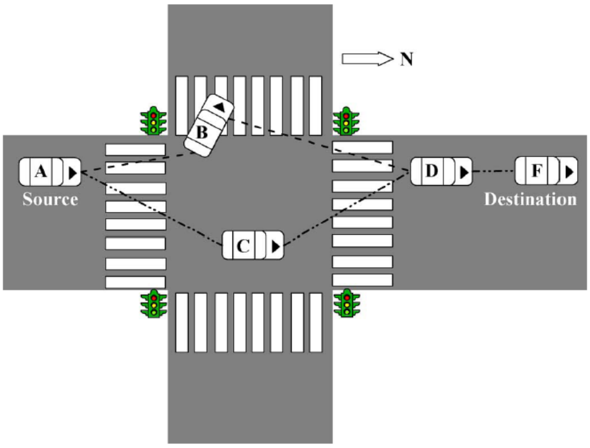

Figure 2. Data Transformation

A routing protocol is a protocol that specifies how routers communicate with each other, disseminating information that enables them to select routes between any two nodes on a computer network, the choice of the route being done by routing algorithms. Each router has a priori knowledge only of networks attached to it directly. A routing protocol shares this information first among immediate neighbours, and then throughout the network. The client uses the same algorithm the server implemented in providing an acknowledgement number. The client's acknowledgment of the server's request for synchronization completes the process of establishing a reliable connection and data is transferred.

C. Empirical Traces of Inter Contact Time:

The inter contact time between the participants of the network will be calculated from the successful information transfer. The inter contact time lies between the process of sending message from sender and the reaching time to the receiver vehicle. Inter contact time will be calculated to the each pair of the network. To characterize heterogeneities in inter-contact times, and find that the empirical distributions tend to be well fit by log-normal curves, with exponential curves also fitting a significant portion of the distributions. The exponential distribution is the only continuous memory less random distribution. A log normal distribution results if the variable is the product of a large number of independent, identically-distributed variables in the same way that a normal distribution results if the variable is the sum of a large number of independent, identically-distributed variables.

a. Steps For Empirical Analysis:

Step1: Find a process for improvement.
Step2: Organize the process to improve.
Step3: Clarify the current knowledge of the Process.
Step4: Understand the causes of process Variation.
Step5: Select the process improvement.
Step6: Plan the improvement.
Step7: Do the improvement to the process.
Step8: Check and study the results for Enhancement.

Power law distribution function implements both the discrete and continuous maximum likelihood estimators for fitting the power-law distribution to data, along with the goodness-of-fit based approach to estimating the lower cutoff for the scaling region. we have inferred the inter-contact time for each of the traces and estimated the aggregate CCDF(complementary Cumulative distribution function) of inter-contact time between all devices. Power law finding was previously used to support the hypothesis that inter-contact time has a power law tail, and that common mobility models are not adequate. simple models such as random walk and random waypoint can exhibit the same dichotomy in the distribution of inter-contact time in empirical traces.

D. Time Variant Random Way Point mobility Model:

The time variant random way point mobility model fully involved in the process of reducing inter-contact time. Mobility model is established corresponding to the inter-contact time between the each pair in the network. The time variant random way point mobility model to reduce the end to end delay. In Random Walk mobility model, a mobile node moves from its current location to a new location by randomly choosing a direction and speed in which to travel. The new speed and direction are both chosen from pre-defined ranges, respectively *[min-speed, max-speed]* and *[0, 2*pi]* respectively. Each movement in the Random Walk Mobility Model occurs in either a constant time interval *t* or a constant traveled d distance, at the end of which a new direction and speed are calculated. In Random Way Point Mobility Model includes pauses between changes in direction and/or speed. A Mobile node begins by staying in one location for a certain period of time (i.e. pause). Once this time expires, the mobile node chooses a random destination in the simulation area and a speed that is uniformly distributed between *[min-speed, max-speed]*. The mobile node then travels toward the newly chosen destination at the selected speed. Upon arrival, the mobile node pauses for a specified period of time starting the process again.

IV. RESULTS AND DISCUSSION

The results of simulation in Network Simulator (NS2) shows that use of a Time Variant Random Way Point Mobility (TVRWPM) model reasonably reduces both Inter-contact time as well as delay.

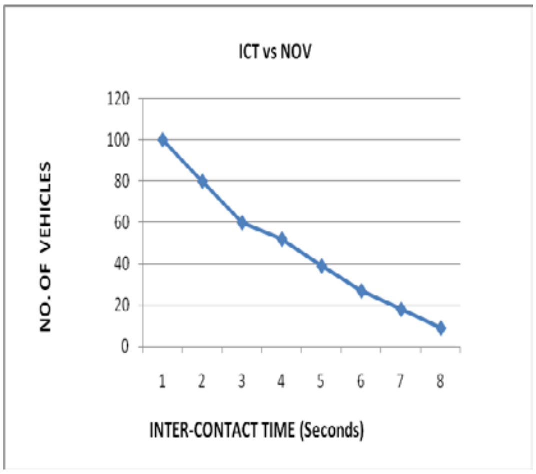

Figure 3. Inter-contact Time vs Number of Vehicles

As per Figure 3 It is clear that when the number of vehicles decreases then Inter-contact Time also gets decreased. But Inter-contact time should remains decreased even when the number of vehicles are increased.

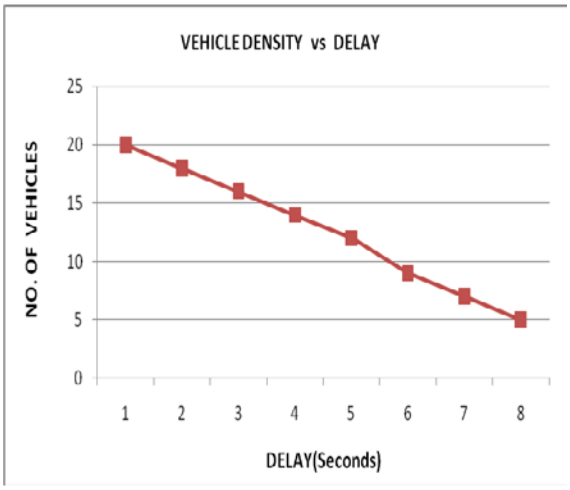

Figure 3. Vehicle Density vs Delay

Delay in communication between moving vehicles is also reducing if we use Time Variant Random Way Point Mobility (TVRWPM) model when the number of vehicles are less.

V. CONCLUSION AND FUTURE WORK

In this paper we have demonstrated that the proposed system uses a Time Variant Random Way Point Mobility Model which minimizes the inter-contact time distribution, data transfer rate and reduces the delay. We strictly proved that the tail distribution of the inter contact time of any two vehicles follows an exponential decay as long as these vehicles have at least one constant traffic influx involved in their normal activities.

Our results provide fundamental guidelines on design of new mobility models in urban scenarios, new data forwarding protocols and their performance analysis in VANETs. Its necessary to reduce inter-contact time between the vehicles while transferring data to establish a Time Variant Random Way Point Mobility Model. Retransmissions occur if the data transfer fails in a contact. First, although we point out that urban vehicles have exponential tail distributions of inter-contact time. Second, in reality, there can be multiple traffic arrival existing in the motion of a vehicle. The relationship between the geographical distribution of these traffic influxes and the tail distribution of inter-contact time is uncertain and worth studying. Third, it is often assumed in the literature that data transfers can be done immediately as soon as two vehicles have a chance to meet. Thus, we will examine the end-to-end delay and inter-contact time. At par with Simulation results both Inter-contact time and Delay are low when the vehicle density is low. But when the vehicle density is Increased both Inter-contact time and Delay goes up. Hence need to improve the performance further better.

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