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A Review and Implementation of Modified DREAM Protocol in VANET

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Abstract

VANET is a kind of MANET is the emerging network environments for developing future automotive applications. Numerous research issues have recently been identified and tackled before the real implementations of widespread vehicular applications and services. The design and the implementation of efficient and scalable routing protocols is one of the main issues. In this chapter, we evaluate and present the performance of a geographical protocol, DREAM (Distance Routing Effect Algorithm for Mobility), SE_DREAM, ISE_DREAM in VANETS using vehicle mobility based on real road map. Performance metrics such as the control load and the average latency are evaluated using NS2.

Keywords: VANET, Geographical routing, DREAM, Location based protocols, SE_DREAM, ISE_DREAM

INTRODUCTION

A mobile ad hoc network is a collection of mobile nodes equipped with wireless communications capabilities without central network administration. They are often referred as an infrastructure-less mobile network [16, 20]. Vehicular Ad-hoc Networks (VANETs) represent fast emerging popular class of Mobile Ad Hoc Networks (MANETs). VANETs are distributed, self organizing networks built for moving vehicles, and they are characterized by their high mobility and with the limited degree of freedom in mobility.

Considerable research efforts have occurred in the area of inter-vehicle communications in order to carry out safety applications with the growth and expansion of wireless communication technologies. VANET which is a special case of MANET, that plays an important role in traffic control [18]. Two communication modes can be distinguished: the Vehicle-to-Infrastructure (V2I) and Vehicle-to-Vehicle (V2V) communications. In the first mode, the use of roadside sensors for vehicles gathers information such as traffic signal violation warning. In the second mode, vehicles communicate directly with each other without the assistance of the road infrastructure. The primary objective is to increase the vehicle safety by relying on information from a vehicle to vehicle. For example, a vehicle that detects an icy road would inform another vehicle like those traveling in the opposite direction and those traveling in the same lane [19].

To allow V2V communication, vehicles must form some network, called Vehicle Ad-hoc NETwork (VANET). VANET is a Mobile Ad-hoc NETwork (MANET) with vehicles as network nodes. A VANET is a decentralized and self-organizing network composed of high-speed moving vehicles [1]. It can be used to establish communication between vehicles and therefore develop pervasive applications [17] for road safety. For example, information about potentially congested areas can be relayed from a vehicle to another, to inform the drivers of eventual accidents or possible traffic jams. Thus, drivers could be notified that they are proceeding toward a location where an accident has occurred. Moreover, the system would be able to compute alternate routes if such information is used as an input into a vehicle navigation system in order to avoid congested area.

The dynamic nature and directional mobility of the vehicles and the unreliable wireless channel, delivering messages to one or all vehicles represent a challenge. Moreover, because of the absence of the infrastructure and the higher mobility of the vehicles, relying upon messages between vehicles require finding and maintaining information about routes which constitutes an issue that should be addressed. As stated in [1], geographic routing protocols are more convenient for dynamic networks due to their good performance. The MANET protocols in general use IP addresses but the position-based routing protocols are based on geographical positions of the vehicles for selection the best path to forward. This makes DREAM protocol more robust to frequent topology changes and high mobility of vehicles.

DREAM discovers the route by using location information of each node in the network. Each node knows its position by any positioning system [2]. The node should know the position of its immediate neighbor and the destination node to relay the data packet, to the destination. In DREAM, each node maintains the location table to discover the location of other nodes in the network. The location table gets updated by exchanging the location packet among the nodes. The location packet consists of coordinates of the source node, source node's speed and the time in which location packet has transmitted. After receiving the location packet, each node updates its location table. In DREAM, the route discovery area is restricted to reduce the overhead for discovering the route. The restricted area is called as request zone. In this paper, we apply the security scheme for only those nodes present in the request zone. Already we have embedded Traffic analyses method with DREAM protocol to provide the solution against flooding attack in MANET which is called as Secure and Efficient Distance Effect Routing algorithm (SE_DREAM) [3]. In addition to this, we propose OEDA approach to vanquish the Black hole /Gray hole and Sybil attacker inside the request zone. Hence we have named our proposed scheme as Improved SE_DREAM (ISE_DREAM)[4]. This paper is organized as follows: Section II deals with existing works in the literature and background work of the paper. In Section III, we provide the evaluation methodology with simulator. Section IV we present the simulation results and analyze to draw the conclusion.

RELATED WORKS

Inside or outside attackers perform the DoS by jamming the communication channel or overriding the resources in VANETs. The attackers may be distributed, which is called distributed denial of service (DDoS) [11, 12]. The main goal is to prevent authorized nodes from accessing the services [17].

The Delay Tolerant Vehicular Ad hoc NETworks (DTVANETs) aims to support a class of vehicular network applications characterized by the delay tolerance and the asynchronous data traffic. Such applications can tolerate some data losses. It uses opportunistic strategies to overcome frequent disconnections of the network.[5]

Secure Location Aided Routing algorithm (SLAR) is proposed for secure message transmission in existing Location Aided Routing protocol (LAR). The LAR is a geographical routing protocol where the region for route discovery between the source and distance is founded before forwarding the route request packets for route discovery. SLAR is an extension of LAR where the security of LAR is enhanced by incorporating cryptographic features in it and its performance is compared in the presence and absence of malicious nodes. [6]

SC_LARDAR (Security Certificate Location Aided Routing Protocol with Dynamic Adaptation of Request Zone) protocol is proposed as a new location based ad hoc routing protocol. SC-LARDAR locates black hole attack in MANETs. It is a reactive routing protocol. It detects the route between the nodes only on demand. This protocol is used to detect the secure route in the request zone constructed based on minimum angle [9].

Gao et al, [8] proposes a novel location privacy protection scheme for VANETs. When vehicles require changing the pseudonyms, they will oblige with their nearby nodes to create the encrypted area using group key encryption, so that the external adversary cannot crack the message in this area. During this period, some vehicles change the pseudonyms jointly so that the external adversary cannot associate the pseudonyms before and after. Thus the location privacy protection of the vehicle nodes is achieved.

EVALUATION METHODOLOGY

In this section, DREAM, SE_DREAM, ISE_DREAM evaluation study is performed using the code developed in using the network simulator, ns2.

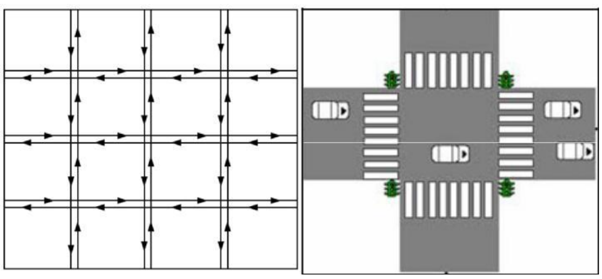
The parameters related to the DREAM protocol, to mobility scenarios, and to traffic that imitates the applications are presented. Performance metrics together with simulation results are also reported.

A. Mobility scenarios and traffic parameters

Performance studies of ad hoc network protocols depend mainly on the chosen mobility model [19] to obtain accurate simulation results. In order to evaluate the performance of the protocol DREAM, realistic vehicular mobility models or scenarios are necessary. A mobility model is the pattern that defines vehicles motions within the simulated area during a simulation time, which reflects, as close as possible, the real behavior of vehicular traffic. For this purpose, we have used MOVE (MObility model generator for Vehicular networks) [5] and TRaNS (Traffic and Network Simulation Environment) [10] to create a movement pattern for a small part of a city. These tools are built on top of SUMO, an open source micro-traffic simulator. The generated mobility trace file contains information of realistic vehicles movements. Network Simulation Environment (TraNS) is specially developed for VANETs that actually consists of two open-source simulators: SUMO [13] and NS-2 [14]. In TraNS, NS-2 can use realistic mobility models and influence the behavior of SUMO based on the V2V communication. The major negative of TraNS is that it can neither support large-scale simulations nor model the cost of securing protocols of VANETs.

In this evaluation study, the scenario generated is a grid topology with a block size of 200m x 200m as depicted in Figure 2. The number of vehicles was fixed at 50. This scenario generated randomly and contains six roads, nine intersections, and twelve crossover points at the border. Fifteen vehicles move along the grid of horizontal and vertical streets on the map. Each line representing a single-lane road and vehicular movement occurs on the directions shown by arrows. At a crossover, vehicles choose to turn left or right with equal probability, 0.5. At an intersection of a horizontal and a vertical street, each vehicle chooses to keep moving in the same direction with probability 1/2 and to turn left or right with probability 1/4.

It is worth to noticing that several realistic mobility models have been proposed for MANETs and VANETs as well [1]. The most known one is Random Waypoint mobility proposed mainly for the evaluation of MANETs. Other models are artificial mobility and real-world mobility models which can be considered as a major step towards generating realistic vehicle traces.



(a) (b)

Figure 1 (a) Mobility scenario, **(b)** The structure of each intersection

Several simulation scenarios by varying the number of traffic sources are generated from light to heavy traffic (1, 5, 10, 15, 20, 25 nodes). The CBR (Constant Bit Rate) traffic generator was attached to each node source to generate packets 64 bytes each and at a deterministic rate (4 packets /s) to all other nodes. All nodes use 802.11MAC operating at 2Mbps. The transmission range is 250m. Similar to [23], a peer-to-peer traffic pattern was used instead of random traffic in which traffic is randomly spreads among all nodes.

SIMULATION RESULTS AND CONCLUSIONS

The following performance metrics described in [19] are evaluated to study the scalability of the DREAM protocol:

- Data packet delivery ratio: defines the ratio of the number of data packets delivered to the destination nodes divided by the number of data packets transmitted by all source nodes.

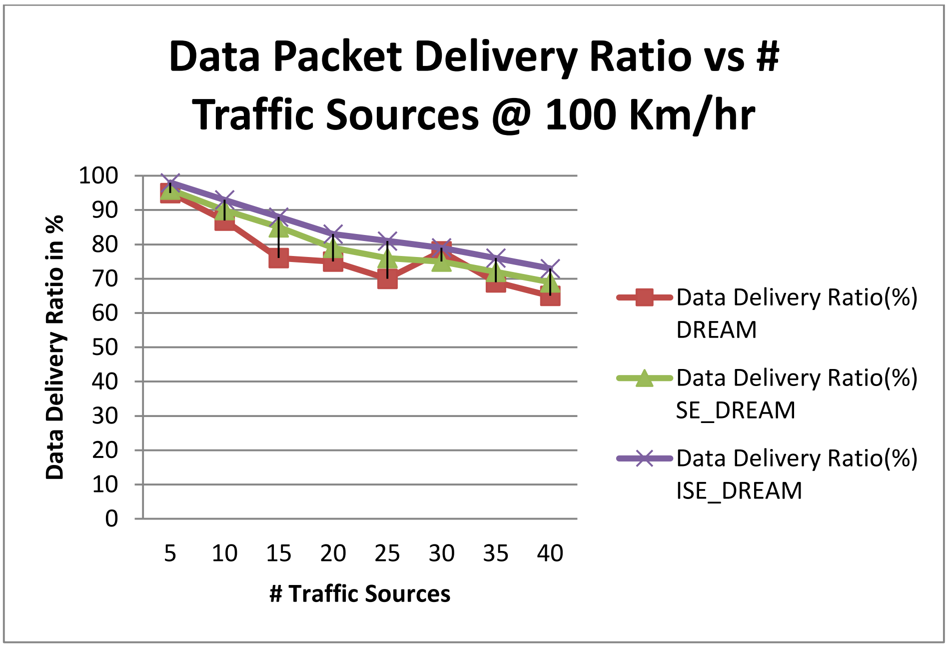


Figure 2. Data packet delivery ratio vs. number of traffic sources

- Average end-to-end delay or average latency: is calculated from the first data packet to arrive at the destination node. It includes buffering, queuing, retransmission and propagation delays.

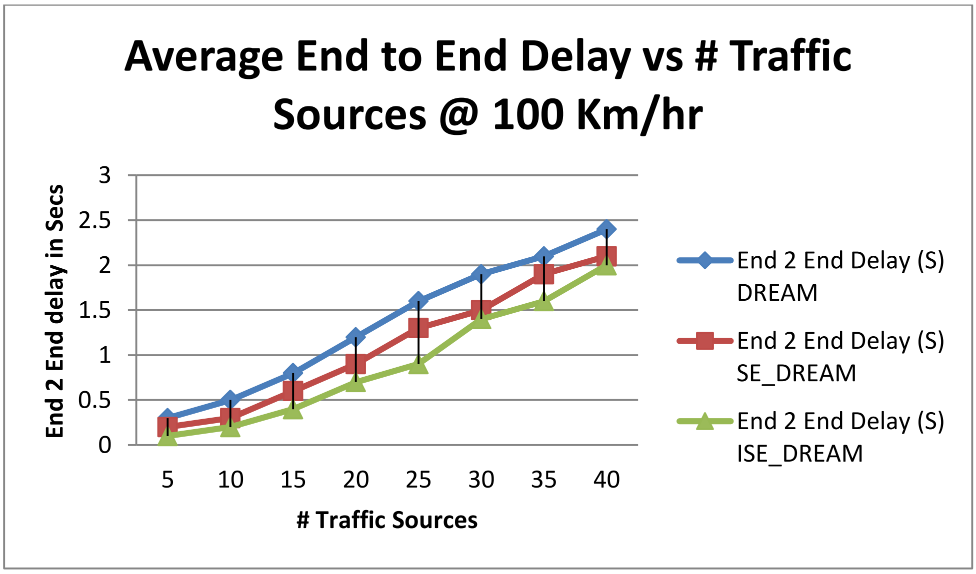


Figure 3. Average latency VS number of traffic sources

Results depicted in Figure 2 show the fraction of data packets that are successfully delivered during the simulations time versus the number of traffic sources. As the number of traffic sources increases, the data packet delivery ratio decreases because the network becomes more congested with heavy traffic causing more packets to drop. In another words, when the number of CBR sources increases, there is an increase in the number of packets contending for a common wireless channel, which leads to more collisions and packet drops. As shown in this figure, the drop is more sensitive to traffic load than vehicles' speed. However ISE_DREAM outperforms the performance as compared to DREAM and SE_DREAM protocol.

Figure 3 illustrates the variation of the average latency by varying CBR sources. When increasing the number of traffic sources beyond 5, the average latency increases constantly because increasing the number of source nodes the network becomes more congested with heavy traffic and so buffers become full causing more flits to wait in the buffers. We can also see in figure 4 that the average e2e delay is less sensitive when nodes speed increases. However ISE_DREAM outperforms the performance as compared to DREAM and SE_DREAM protocol.

As the number of traffic sources increases, more data packets will be sent. However, the protocol is less sensitive to vehicles' speed, i.e., data packet overhead remains constant as vehicles speed increases due to flooding behavior of the protocol.

The feasibility of VANET was studied with the city section mobility model was appended in NS2, the network model of VANET was established, the simulation scene was compiled, the performances of DREAM, classical routing protocols of MANET, and a the improved versions SE_DREAM and ISE_DREAM routing protocol were simulated in VANET and analyzed, and conclude that ISE_DREM and SE_DREM outperforms DREAM with respect to secure stable routes.

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