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Performance Evaluation of Network Aggregation Techniques in VANET

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Abstract: Network aggregation mechanism for vehicular ad hoc networks (VANETs) aims at improving communication efficiency by summarizing information that is exchanged between vehicles. Summaries are calculated, while data items are generated in and forwarded through the network. Due to this vehicular networks are special types of VANET that support diverse infrastructure-based commercial services including internet access, real-time traffic management, video streaming, and content distribution. The success of network acquisition and delivery system depends on their ability to defend against the different types of security and privacy attacks that exist in VANETs. In this research work different protocols like AODV, Q-Learning approach and cryptographic approach that being used in VANET have been studied and their performance has been then evaluated by providing a real time environment on NS2.

Keywords: VANET, Roadside Units, Security, Network Aggregation, ad hoc Network.

I. INTRODUCTION

A VEHICULAR AD HOC NETWORK (VANETS) IS TO establishes a network of cars for communication purpose, safety and comfort of the driver. Vehicular Ad Hoc Network (VANET) utilizes moving cars as nodal point to build mobile network [1]. It brings cars into a wireless router or node that allows cars to connect and communicate with each other within a distance of 100 to 300 meters approximately. VANET play an important role in safety as well as non safety applications [2]. Collision avoidance, Driver drowsiness prevention system, Emergency warning system, Automatic emergency braking systems are included in the safety applications. On the other side the traffic information systems like direction changer, cooperative entertainment, toll service, Internet access falls under the Non-safety applications[3]. Major applications of VANET includes applications for accident avoidance, road information dissemination which provides driver assistance and car safety based on sensor data , regional weather forecast, Information regarding next available parking space, fuel prices offered by the nearest station and many more [4]. To enable these applications different protocols have been developed but there is need to keep bandwidth consumption low while maintaining information quality [5]. The information from multiple sources needs to be combined and aggregated during routing instead of being forwarded unmodified and only being evaluated by receiving vehicles. This is the goal of in-network aggregation protocols for VANETs [6] .There are many interesting research issues and challenges in this field. Few of them are mentioned below:

Quality of Service: In VANET the connection is established between the nodes for a very short time because the nodes are continuously moving [7]. So it is a challenging task to make a network which establish new routes quickly and have high connectivity time [8]. The network must be intelligent enough to make use of full available bandwidth.

Scalability: It is one of the VANET challenges which deals with the operability, because VANET has to work in very low density areas like highways and roads as well as in very high density areas like in traffic jams and cities [9]. This variation in the values of nodes is a challenging issue both for researchers as well as developers.

Routing protocols: Routing is very important issue in VANET, because we have to establish the network between moving vehicles [10]. The network must have maximum system capacity, less computational complexity and also able to give high throughput. While selecting the protocols many challenges are faced by the researchers to choose the type of routing protocol for example some protocols [Position based routing protocol] require maintenance of unused paths which results in wastage of bandwidth, while other protocol [Reactive routing protocol]may cause disruption in the network because of excessive flooding during peak traffic hours. Due to this selecting a routing protocol in VANET becomes a major challenge for researchers.

Broadcasting: When the vehicle goes out of range, broadcasting approach is used. Packets are transmitted using different techniques by using extensive resources of bandwidth. It is thus one of the significant research areas [12]. To ensure the effective information transmission in the low density traffic areas and high density traffic areas, the selection of effective and co-operative broadcasting algorithms becomes a challenge for the researchers.

Network Security: Security is a major issue in VANET.As in VANET the information is shared between nodes through wireless communication network security becomes very crucial. Any successful attack can cause a great harm or threat for drivers as well as passengers [13]. It can decrease the speed of the whole network and may put a great impact on the performance of the network. So designing a highly secure network becomes an open research area for researchers and developers [14]. Few challenges that come on the way of researchers are like use of fast cryptographic algorithms, authentication of nodes from external and internal attacks, key distribution for encryption and decryption of a message and high mobility of nodes.

II. LITERATURE SURVEY

Celimuge Wu, Yusheng Ji, Fuqiang Liu, Satoshi Ohzahata & Toshihiko Kato [15] proposed routing protocol which is able to learn the best transmission parameters by interacting with the environment. The protocol takes into account multiple metrics specifically data transmission rate, vehicle movement and route length. They used both real-world experiments and computer simulations to evaluate the proposed protocol. The protocol employs a Q-Learning-based approach to estimate transmission rate from the hello packet reception ratio. For the route selection, the protocol uses a fuzzy logic-based algorithm to evaluate the direct link and uses a Q-Learning algorithm to learn the best end-to-end route. The proposed protocol has been implemented with Ubuntu 12.04 and then evaluated using a real vehicular ad hoc network. Q-Learning is a form of reinforcement learning algorithm that works by estimating the values of state-action pairs without requiring a model of its environment. Q-Learning adjusts behaviour through trial-and-error interactions with a dynamic environment.

Seon Yeong Han, Dongman Lee [16] conveys that in mobile ad-hoc networks, local link connectivity information is extremely important for route establishment and maintenance. However, unnecessary Hello messaging can drain batteries while mobile devices are not in use. This paper proposes an adaptive Hello messaging scheme to suppress unnecessary Hello messages without reducing detects ability of broken links. Simulation results show that the proposed scheme reduces energy consumption and network overhead without any explicit difference in throughput. In this paper, they proposed an adaptive Hello interval to reduce battery drain through practical suppression of unnecessary Hello messaging.

Ehsan Mostajeran, Rafidah Md Noor et al. [18] conveys that Ad-hoc On-Demand Distance Vector (AODV) is one of the ad-hoc routing protocols utilized in MANET and VANET. On-Demand routing protocols find their destinations based on the process of flooding a request to neighbours searching for their destinations. Neighbours of nodes are detected based on the neighbour discovery method, which periodically broadcasts HELLO messages to detect available neighbours at time. Generating routing packets and neighbour discovery messages produce high overhead in the On-Demand routing protocol, such as AODV. In order to overcome such issues, a novel scheme in Ad-hoc networks based on Intelligent-AODV (I-AODV) is proposed. This scheme functions to exploit neighbour discovery and reduce the overhead of neighbour discovery processes. It provides reasonable performance by updating the neighbour list based on routing packets such as RREQ, RREP and RERR. Moreover, the broadcast of HELLO messages is filtered by checking the destination node in the neighbour list to reduce overhead.

Christian Lochert, Hannes Hartenstein et al.[17] analyzed a position based routing protocol which can work under high mobility of nodes. They utilize the navigation system for their work. With the help of simulation they compare their approach with the no position based approach by using the highly realistic mobility of the vehicles. They concluded their approach as “geographic source routing” (GSR) which combines both position and topology approach. They found that GSR performs much better than the topology based approaches that are DSR and AODV on the basis of delivery rate and latency.

F. Dotzer, L. Fischer, and P. Magiera [19] They proposed that VARS (Vehicle Ad-Hoc Network Reputation System) is a reputation-based system which uses modules for direct and indirect reputation handling, opinion generation and confidence decision (message handling) and situation recognition. They concluded that VARS defines three areas: the event area within which an event can be recognized, the decision area where the trustworthiness of event messages have to be decided upon and the distribution area which specifies how far those messages are distributed.

Khaleel Mershad, Hassan Artail[11] introduced a cryptographic algorithm for key generation and powerful encryption. They evaluated the effectiveness of their proposed algorithm as compared to a recent security mechanism for VANETs. They focused on making the proposed system more scalable in terms of the number of users that can connect to an RSU. In ongoing work they pretend to design an RSU scheduling mechanism in which an RSU will build a schedule that is divided into time-slots (TSs). The users that are expected to connect to the RSU in each time slot are to be specified. Hence, an RSU will prepare users data and catch them during free TS before the users connect. Using this scheme, the RSU will distribute its load among the available TSs.

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III. PROBLEM FORMULATION

To ensure security and privacy in service-oriented VANETs is a challenging issue. In this research work the various techniques used in VANET are studied and then analyzed. A more secured algorithm named cryptographic technique is proposed and its performance based approach is being analyzed and its performance analysis is to be done with other existing protocols like AODV and Q Learning. Thereby results are to be compared in terms of different performance parameters like TCP throughput, UDP packet delivery ratio. The performance of this technique is to be adjudged in terms of these parameters for its effectiveness as compared to a recent security mechanisms used for VANETs.

IV. SIMULATION

The development of "Simulation of Urban Mobility" or SUMO started in the year 2000. The major reason for the development of an open source, microscopic road traffic simulation was to support the traffic research community with a tool into which own algorithms can be implemented and evaluated with or without the need to regard all the artefacts needed to obtain a complete traffic simulation such as implementing or setting up methods for dealing with road networks, demand, and traffic controls.

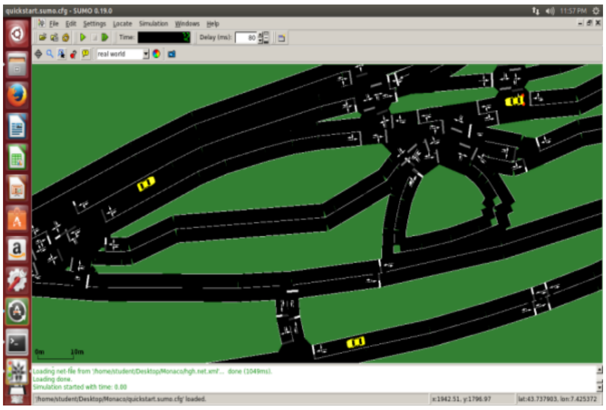

Fig 1: Simulation of Urban Mobility

Some features of SUMO are Collision free vehicle movement**,** different vehicle types**,** multilane streets with lane changing feature**,** hierarchy of junction types**,** a fast open GL graphical user interface, manage networks with several 10.000 edges (streets) [14], fast execution speed (up to 100.000 vehicle on a 1GHz machine).

V. RESULT

The vehicle mobility, the data rate and multi-hop data transmission efficiency have significant impact on the performance of a routing protocol for vehicular ad hoc networks (VANETs). Both the real-world experiments and computer simulations are performed to evaluate the cryptographic approach in terms of different parameters.

Fig.2 Animation of Vehicles

TCP throughput for different protocols at varying distance is shown in Fig 3 in street scenario. At an intersection, the source-destination distance changes due to the change of inter-vehicle distance. We observed that the cryptography based protocol attained much better performance as compared to other protocols. This is because when vehicles are stopping at an intersection, the cryptographic based protocols not only is more secure but also have an ability to change to a shorter route and therefore improve the throughput. For AODV-ETX and HLAR, an existing route does not change until it is broken. This proves that the dynamic route switching mechanism is particularly important for intersection scenarios.

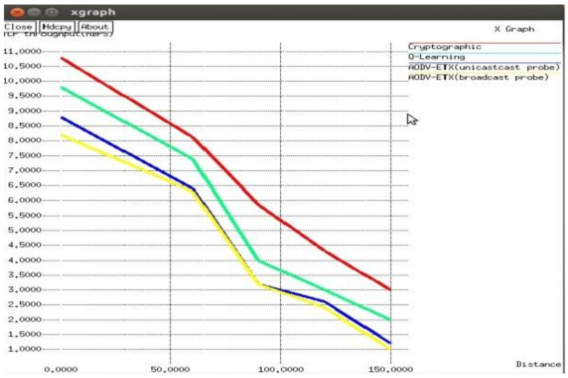

Fig.3 TCP throughput for various initial source-destination Distance (street scenario)

UDP packet delivery ratio for various initial source destination distances is shown in Fig.4.

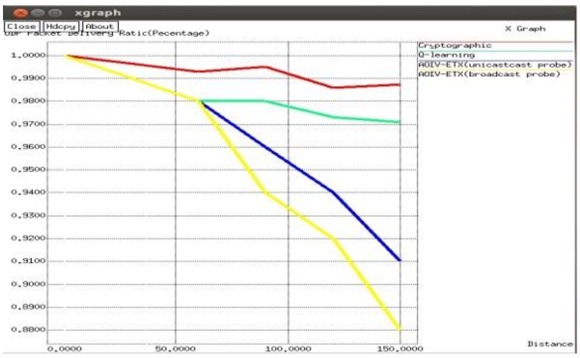

Fig.4 UDP packet delivery ratio for various initial source destination

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The cryptographic based protocol attained high UDP packet delivery ratio even when the source-destination distance is large. By selecting better end- to- end routes, the cryptographic based protocol reduces the number of retransmissions at the TCP layer, which can improve the performance of TCP performance significantly. distance (two-way road)

VI. CONCLUSION

Due to the increase in traffic day by day the vehicles are needed to be more intelligent in terms of various safety measures. The research literature, however, offers a number of proposals for suitable aggregation mechanisms with varying degrees of flexibility, scalability, and integrity protection VANET puts an emphasis on improving the network efficiency in terms of different parameters few of which are studied and evaluated in this research. As the network is wireless the security becomes one of the biggest challenge in this domain.

The different aggregation protocols like AODV, Q Learning and cryptographic based are studied and their performance is evaluated in terms of UDP and TCP throughput. Furthermore the research in this field may be extended by improving the cryptographic technique being used with enhanced security features and its performance can thus be compared with the existing protocols in terms of some more parameters. Further, integrity protection of aggregated information is still an open challenge the mechanisms could inspire researchers in other research domains too.

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