Survey of different Traffic Congestion Control Techniques in VANET

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Abstract- The vehicles are supposed to issue messages periodically to announce other vehicles about their situations such as speed, positioning and direction. Each vehicle equipped with communication devices will be a node in the Vehicular Ad Hoc Network (VANETs) and allow to receive and send other messages through the wireless communication channels. This network will provide wide variety of services such as Intelligent Transportation System (ITS). The safety application is one of the most crucial application in ITS. For example, if a vehicle detects traffic jamming, it will inform other neighbouring vehicles about this traffic situation. The traffic messages must to be delivered to each neighbouring node with almost no delays. Now traffic congestion is the major problem in VANET that has occurred because of not rapidly clearance of onwards traffic. In this survey we study the traffic congestion control schemes that control the traffic congestion on the basis of traffic density by that chances of avoidable delay are minimized.

Keywords- ITS System, VANET, Traffic congestion, jamming.

I. INTRODUCTION

Vehicular Ad Hoc Networks (VANETs) [1] are self-configuring networks where the nodes are vehicles (equipped with onboard computers), elements of roadside infrastructure, sensors, and pedestrian personal devices. Wi-Fi (IEEE 802.11-based) technologies are used for deploying such kind of networks. At present, the IEEE group is completing the IEEE 802.11p and IEEE 1609 final drafts, which are known as “Standard Wireless Access in Vehicular Environments” (WAVE), specifically designed for VANETs. This technology presents the opportunity to develop powerful car systems capable of gathering, processing, and distributing information.

Mobile Ad Hoc Networks or MANETs are the collection of dynamic self-configuring networks of mobile nodes. Each node will act as a host and a router that will offer connectivity to the sub-sequent node in the network. Because of the mobility feature of these networks, the communication should be able to adapt any changes in the location of the nodes or any changes that are due to the surrounding environment. It is important to find the multi-hop route between the source and the destination. Once the route is found, then each node will forward the traffic (or packets) till the target node is reached. The VANET example is shown in figure 1.

Fig: 1 Example of VANET

MANETs can be connecting a group of laptop computers, sensors or even vehicles. Additionally, its importance is growing in military applications such as in connecting autonomous robots and autonomous ground vehicles which are used to explore hostile battlegrounds and check for land mines [2]. VANETs (Vehicular Ad Hoc Networks) are a special and an important type of MANETs. These networks offer communication between number of vehicles (Vehicle to Vehicle Communication) travelling on streets and between vehicles and infrastructure (Vehicle to Infrastructure Communication).
A) Mobility Models:
There are mainly two types of mobility models based on the movement of nodes—Random Node Movement and Real World Mobility Models. The first type presents mainly the early approaches of modelling mobility. They were based on randomly moving nodes in any direction at any speed. These models clearly do not describe real car movement on roads. On the other hand, The Real World Mobility Models are based on the data recorded from simulation traces (Artificial Traces) or real world observations by using means such as Global Positioning System (GPS). These observations include information from long periods of time involving many vehicle nodes [3]. Additionally, Street maps databases can be used in modelling realistic mobility. Examples of that is the GIS (Geographic Information System) and the TIGER database (Topologically Integrated Geographic Encoding and Referencing) [4] where vehicular traffic can be modelled on these maps to create a mobility model that can be applied in for a specific geographical area, or modified to suit similar regions [5].

II. OVERVIEW OLSR PROTOCOL

OLSR is a proactive link-state routing protocol designed for MANETs (VANETs), which show low bandwidth and high mobility. OLSR is a type of classical link-state routing protocol that relies on employing an efficient periodic flooding of control information using special nodes that act as multipoint relays (MPRs). The use of MPRs reduces the number of required transmissions. OLSR daemons periodically exchange different messages to maintain the topology information of the entire network in the presence of mobility and failures. The core functionality is performed mainly by using three different types of messages: 1) HELLO; 2) topology control (TC); and 3) multiple interface declaration (MID) messages.

1) HELLO messages are exchanged between neighbour nodes (one-hop distance). They are employed to accommodate link sensing, neighbourhood detection, and MPR selection signalling. These messages are generated periodically, containing information about the neighbour nodes and about the links between their network interfaces.

2) TC messages are generated periodically by MPRs to indicate which other nodes have selected it as their MPR. This information is stored in the topology information base of each network node, which is used for routing table calculations. Such messages are forwarded to the other nodes through the entire network. Since TC messages are broadcast periodically, a sequence number is used to distinguish between recent and old ones.

3) MID messages are sent by the nodes to report information about their network interfaces employed to participate in the network. Such information is needed since the nodes may have multiple interfaces with distinct addresses participating in the communications.

III. RELATED WORK

Jamal Toutouh, José García-Nieto, and Enrique Alba has proposed [1] “Intelligent OLSR Routing Protocol Optimization for VANETs” In this title, we define and optimization problem to tune the OLSR protocol, obtaining automatically the configuration that best fits the specific characteristics of VANETs. An optimization problem is defined by a search space and a quality or fitness function in this title to find as fine-tuned as possible configuration parameters of the OLSR protocol, although it could directly be used also for a number of other routing protocols (AODV, PROAODV, GPSR, FSR, DSR, etc.) in this title can help the experts identify the main source of communication problems and assist them in the design of new routing protocols. The communication cost function represents the fitness function of the optimization problem addressed in this title. The VANET instance defined in this title contains 30 cars moving through the roads selected of an area of 1200 m × 1200 m2 from the city downtown of Malaga (Spain) during 3 min. In this title, we have addressed the optimal parameter tuning of the OLSR routing protocol to be used in VANETs by using an automatic optimization tool. In terms of the performance of the optimization techniques used in this title, SA outperforms the other studied metaheuristic algorithms when solving the defined OLSR optimization problem because it is the best ranked after the Friedman test. However, PSO presents the best trade-off between the performance and the execution time requirements. In turn, a parallel version of PSO running in multiple processors can also further reduce the computational time derived from large VANET simulations.

Hanan Saleet, Rami Langar, Kshirasagar Naik, Raouf Boutaba, Amiya Nayak, and Nishith Goel has proposed [6] “Intersection-Based Geographical Routing Protocol for VANETs: A Proposal and Analysis” In this title, we focus on message routing in both classes of applications. The main concern is whether the performance of VANET routing protocols can satisfy the delay requirements of such applications. We propose in this title an Intersection-based Geographical Routing Protocol (IGRP) consisting of successions of road intersections that have, with high probability, network connectivity among them. Geographical forwarding is still used to transfer packets between any two intersections within the path, reducing the path’s sensitivity to individual node movements. The selection of the road intersections is made in a way that maximizes the connectivity probability of the selected path while satisfying quality-of-service (QoS) constraints on the tolerable delay within the network, bandwidth usage, and error rate. To increase the connectivity probability, one may be able to take advantage of the vehicles moving in the opposite direction on a two-way road scenario. In this title, we have describe a new approach for routing messages in city-based environments that takes advantage of the roads layouts to improve the performance of routing in VANETs. Our proposal IGRP tends to satisfy QoS constraints on four performance metrics: 1) tolerable end-to-end delay; 2) connectivity probability; 3) bandwidth usage; and 4) BER. To achieve this, we have formulated the QoS routing problem as a constrained optimization problem. We have also derived analytical expressions for the four performance metrics in a two-way street scenario. Using both analytical and simulation approaches, we have compared our proposal with GPSR, GPCR, and
OLSR. We have found that IGRP achieves better performance. Indeed, it selects routes that are connected and, at the same time, satisfies thresholds on the end-to-end delay, hop count, and BER. As such, our solution stands out as a promising candidate for large-scale ad hoc networks, such as VANETs.

Khaleel Mershad and Hassan Artail [7] has proposed “A Framework for Secure and Efficient Data Acquisition in Vehicular Ad Hoc Networks”. In this title, we study the security of data messages exchanged between users and RSUs and the location privacy of VANET users who exchange these messages. However, they use asymmetric encryption systems, mainly the elliptic curve cryptography (ECC) standard. We on the other hand, use a symmetric scheme [Advanced Encryption Standard (AES)] and propose an approach to increase its security to a high extent by using a hierarchical-based encryption function.

The main contributions of this title can be summarized as follows.

1) We propose a novel approach for users to start their connections in the VANET in a secure way.
2) We illustrate a new handover scheme that is particularly suitable for VANETs.
3) We explain a new cryptographic approach that provides much higher security measures compared to existing ones and analyse the performance of our approach using mathematical and simulation means.
4) We suggest two novel mechanisms for data confidentiality and users’ location privacy in VANETs.

In this title, we argue that the security of users should be accounted for, starting from the initial contact between a user and an RSU. Hence, we describe a web-based secure registration process that allows a user to create an account with RSUs. During the registration, users provide all required information that enables them to have the benefit of secure connectivity starting from the first packet that they send to the RSUs. We propose a novel cryptographic function that enables users and RSUs to apply the required security level of exchanged messages by adjusting the number of iterations of the function. To defend against privacy hacking and impersonation, we make an RSU specify for each user the next encryption key and the next pseudonym to use. We derive a set of encryption keys that are used to encrypt the next packet from part of the data in the current packet.

In this title, we design a service-oriented vehicular security system that allows VANET users to exploit RSUs in obtaining various types of data. In REACT, users register once with the RSUs online (through the Internet) before they start connecting to the RSUs from their vehicle. After registration, the RSUs obtain from a trusted authority (TA) a master key (Km) for the user. The users get their Km the first time they connect to an RSU from their vehicle. We describe a novel algorithm that uses the user’s password from their account to securely transfer their Km to them. Km will be used to encrypt the initial packet key, which is assigned to the user at the beginning of each session. Then, each packet will be encrypted by a set of derived keys. In this title, we design an algorithm for securing data messages based on using a symmetric scheme for cryptographic operations. The algorithm is used by the source to generate a sequence of keys from a secret input string (S) and uses these keys to encrypt the next packet. The input string (S) is specified as part of the data in the current packet. We also use this algorithm to transfer the master key of the user to him/her, where the input string (S) to the algorithm will be the user’s password.

The evaluation of this proposed scheme confirmed its effectiveness compared to a recent security mechanism for VANETs. The ongoing work on REACT focuses on making the proposed system more scalable in terms of the number of users that can connect to an RSU. We are designing an RSU scheduling mechanism in which an RSU builds a schedule that is divided into time slots (TSs). In each TS, all users that are expected to connect to the RSU are specified. Hence, an RSU prepares users’ data and caches them during a free TS before the users connect.

Stefan Dietzel, Jonathan Petit, Geert Heijenk, and Frank Kargl [8] has proposed “Graph-Based Metrics for Insider Attack Detection in VANET Multihop Data Dissemination Protocols” In this title, we propose three graph-based metrics to gauge the redundancy of dissemination protocols. We apply our metrics to a baseline protocol, a Geocast protocol, and an aggregation protocol using extensive simulations. In addition, we point out open issues and applications of the metrics, such as colluding attackers and evasion of attacker nodes based on detected attacks. Results show that Advanced Adaptive Geocast behaves almost optimally from a routing efficiency point of view but fails to offer sufficient redundancy for data consistency mechanisms in many scenarios. The simulated aggregation protocol shows sufficient redundancy to facilitate data consistency checking. In this title, we assess different data consistency approaches for VANETs. Among these, we identify redundancy as a promising approach particularly for multi-hop protocols. Representing a message transfer of a multi-hop protocol as a directed graph, we derive metrics to assess communication redundancy. In this title, we present extensions of the metrics and perform extensive simulations to show that sufficient data redundancy for consistency checking can be achieved at the cost of higher bandwidth usage and smaller information dissemination areas or reduced information utility.

Kan Zheng, Fei Liu, Qiang Zheng, Wei Xiang, and Wenbo Wang,[9] has proposed “A Graph-Based Cooperative Scheduling Scheme for Vehicular Networks” In this title, we propose the use of graph theory to formulate the problem of cooperative communications scheduling in vehicular networks. We investigate these cooperative relaying problems in cellular-based vehicular networks with V2V communications by proposing a new graph-based approach. Most existing graph-based resource scheduling methods fall under two categories: 1) graph coloring and 2) maximum weighted matching (MWM) in a weighted bipartite graph (BG). This title focuses on the latter one, which is relatively less well investigated. In this title, we employ graph theory to formulate the problem of scheduling the V2I and V2V links in vehicular networks. Due to the tree structure of a relay network, a feasible approach is to solve the spanning tree of a complete graph, which contains all the possible links in the network. However, this brute force approach results in intractable computational complexity owing to exhaustive search. Therefore, we propose a BG based scheduling scheme, consisting of the following of three stages: 1) construct the weighted BG, 2) solve the MWM, and 3) optimize
the number of relayed VE. More specifically, we first construct a BG by grouping the VE with one subset containing the single-hop VE, and the other subset comprising the dual-hop VE. The edges are weighted according to the capacity of the links between VE. Then, we use the Kuhn–Munkres (KM) algorithm to solve the MWM problem of the constructed BG. Through stages 1 and 2, one can obtain an optimized solution of the link arrangement in the vehicular network according to certain separation of the VE set. The proposed BG-based scheme leads to much lower complexity than the exhaustive search for the optimal solution and can be demonstrated to perform extremely close to the optimal one.

Wen-Hsing Kuo and Shih-Hau Fang has proposed[10] “The Impact of GPS Positioning Errors on the Hop Distance in Vehicular Ad-hoc Networks (VANETs)” in this title, we study the impact of GPS positioning errors on the operation of Vehicular Ad-hoc Networks. To the best of our knowledge, this important issue has not been investigated before. First, we formulate a straight-road model. Then, to reduce the computational complexity of finding the expected degradation, we propose an approximate formula. The results of the simulations show that GPS errors do indeed degrade the hop-distance in VANETs. Moreover, the proposed approximation method yields good accuracy under sparse density conditions. There are no studies on the impact of GPS errors on the performance of VANETs. Therefore, to address this research gap, we focus on the issue in this title and propose an estimation approach. We conduct simulations and try to identify trends in the results, and also evaluate the accuracy of the proposed approximation method. We find that positioning errors result in significant degradation of the hop distance, while our approximation method can accurately estimate trends when the traffic density is sparse. Although we only consider the straight road model in this title, we hope that our results will motivate the study of more complicated road topologies, such as cross or grid networks. For those who are also interested in this important issue, this research provides a good starting point. In this title, we study the “distance degradation of each hop”. This is because hop distance degradation is the most direct effect of positioning errors. Typical performance metrics (e.g., throughput, end-to-end delay, and hop count) can be calculated basing on the hop distance. However, they need the information of the physical network deployment and the utilized routing protocol, both of which are beyond the scope of this title. In this title, we study how GPS positioning errors affect the operation of VANETs. To the best of our knowledge, this important issue has not been investigated before. Based on our proposed model, we show that analyzing the performance degradation caused by GPS positioning errors is complicated, even under a straight-road model. To solve this problem, we propose an approximation approach that can efficiently estimate the degradation of the hop distance, basing on the given vehicle density, the transmission range of the radio device, and the factors of a GPS positioning error.

We conducted simulations to verify our analysis and to observe the trend of the hop distance degradation. The results show that positioning errors do produce observable hop distance degradation, and thus affect the performance of a VANET. The degradation increases and then saturates gradually as the vehicle density and the transmission range increase. Our approximation approach provides a very close estimate under most conditions. Because of space limitations, we cannot provide a more sophisticated analysis here. In the future, based on the observations and results reported in this title, we will consider different road topologies, and also study the impact of positioning errors on other performance metrics, such as the transmission rate and packet delay.

Jagruti Sahoo, Eric Hsiao-Kuang Wu, Pratap Kumar Sahu, and Mario Gerla [11] has proposed “Congestion-Controlled-Coordinator-Based MAC for Safety-Critical Message Transmission in VANETS” In this title we propose a scalable MAC protocol that is built on a TDMA configuration. Basically, the highway is divided into a number of virtual segments. Each segment contains a local coordinator that assigns time slots to vehicles for beacon transmissions. Although the MAC method of IEEE 802.11p is inefficient for safety message transmission, the PHY can be of great use as it provides data rates of up to 27 Mb/s. In our protocol, we mitigate channel congestion by reducing beacon transmission duration, which is achieved by using higher 802.11p data rates. The TDMA configuration is designed to counteract the interference effects induced by higher data rates. As far as emergency messages are concerned, the sender/forwarder is rendered immediate channel access by means of a reservation mechanism.

Elias Yaacoub and Nizar Zorba [12] has proposed “Enhanced Connectivity in Vehicular Ad-Hoc Networks via V2V Communications” In this title, we present a collaborative V2V communications approach to enhance the effective communication data rate in vehicular ad hoc networks. The main contributions of this title can be summarized as follows:

- Deriving the effective rate expressions for several uplink (UL) and downlink (DL) V2V communication scenarios.
- Proposing resource allocation algorithms for the joint operation of short range (SR) V2V communications and long range (LR) LTE communications in vehicular networks.
- Simulating the presented methods using LTE and 802.11p taking into account transmit power levels, correlation in log-normal shadowing, and modulation and coding schemes (MCS) adopted by LTE and IEEE 802.11p standards.

IV. PROBLEM STATEMENT

The main challenge for communication in VANETs is the high mobility, the resulting high rate of topology changes, and the high variability in node to node density. VANETs the topology changes within seconds and a congested node used for forwarding a few seconds ago might not be used at all at the point in time when the source reacts to the congestion. The congestion is down the whole performance in network because of that the long delay is occurred and the other sections of network are also infected because of not deliver the traffic to particular time instance and location. Thus, in this title a scheme is proposed where each node efficiently utilizes the available bandwidth.
V. PROPOSED WORK
The system model assumed in this research for removing congestion is as follows. The VANET is formed of $N$ vehicles equipped with an air interface with a road and supervision system. In order to achieve a large information range, a combination of broadcast data transmissions and a store-and-forward approach is used:
- The roads on the map are divided into segments of a standardized length (e.g., 250 m).
- Vehicles act as sensors and measure the conditions at their current road segment.
- A VANET supervision system propagates one data value and a time-stamp per section.
- Supervision system transmits the currently available information in form of broadcast packets containing the information for multiple road segments.

Per node, one or multiple applications can be active. Applications are assumed to be independent of each other. Therefore, data values sensed by different applications are uncorrelated. Data packets are stored in a packet queue at the network layer before transmission.

VI. CONCLUSIONS AND RECOMMENDATIONS
This study focused congestion based safety message. The message is caused by the traffic of the same priority, typically the warning messages of safety applications from different transmitters. Furthermore, in real life various responses from drivers will happen to related to traffic conditions. The purpose of this survey is to study the different proposals that strongly removing the possibility of congestion in network. The road map divided into a number of segments and assigning a fixed transmission period to each segment for particular interval by that the possibility of bandwidth consumption are reduced. Then, vehicles are provided time slots in the transmission period of their respective segments so that the collision of information are avoids. The Supervision system scheduling ensures that all vehicles in a segment must receive and transmit their information in network in different time slots. The possibility of congestion free network are reduces the overhead and delay in network.

VII. REFERENCES