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Model for Real-Time Communication between Vehicles in VANET

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ABSTRACT

For VANETs to achieve its overarching purpose (providing a secure and stable environment for its users), It is essential that urgent communications be sent without delay or interruption. Congestion management systems, however, do not prioritise urgent communications over less urgent ones. In real-time safety applications, this is a much bigger problem. In VANETs, safety messages are often transmitted across a wide area and to many recipients by virtue of their great transmission range (power). When there are several nodes vying for the same transmission channel, however, the likelihood of collision rises when the transmission range is great. In addition to the information being sent each second, the pace at which it is sent has a major bearing on how quickly the channel becomes saturated. The efficiency of VANET applications improves as the speed at which data can be sent increases. On the other hand, raising the transmission rate might often cause the channel to become saturated. Signaling their location, speed, and heading at regular intervals, vehicles send out beacon signals for the sake of safety. The control channel serves as the communication medium for these types of communications. A high beaconing rate in a densely populated area might cause the control channel to become overloaded and congested. When the beaconing rate is reduced, however, problems arise when the beacon message and updated information are not received in time to keep safety applications running well.

Keywords : VANET, Transmission Range, Signaling

I. INTRODUCTION

If VANETs are to achieve their overarching goals (such as providing a safe and reliable environment for its users), then emergency signals must be sent quickly and without delay [2]. However, under normal situations, the blockage control processes do not differentiate between emergency and other types of communications. For always-on security applications, this is a particularly pressing concern [24]. To swiftly disseminate security messages over a wider area and to a greater number of users, health signals in VANETs are often transmitted with high transmission range (power). However, when more and more hubs compete to acquire the channel, the potential of effect grows when the transmission range is great. The channel's realism is also universally influenced by the data transfer rate. VANET applications benefit from transmission rate increases since data is often updated. However, increasing the data rate is a reliable way to drown out the channel [10, 14]. Signal messages are a kind of security communication that periodically relays information on the vehicles' whereabouts, speeds, and directions. The control channel is used to transmit these types of communications. The control channel may experience over-burdening and obstruction due to the high beaconing rate in densely packed vehicle environments. However, by reducing the beaconing rate, the activity of health apps faces various challenges due to failure in receiving the reference point message and updated data [28], [25]. The state of the channels is significantly impacted by modifying the transmission range and transmission rate, and this may help with channel blockage management. But with VANETs, where the number of vehicles, the rate at which the landscape is ever-changing, and the adaptability of the hubs all make fine-tuning transmission reach and rate difficult. Acquiring the proper characteristics for transmission reach and rate may be affected by several factors (such as vehicle speed, vehicle thickness, message size, distance among shippers and receivers, and number of pathways). It is also important to fine-tune the transmission rate and range in order to meet the unyielding quality requirements of health-related applications. [12], [20], [26]

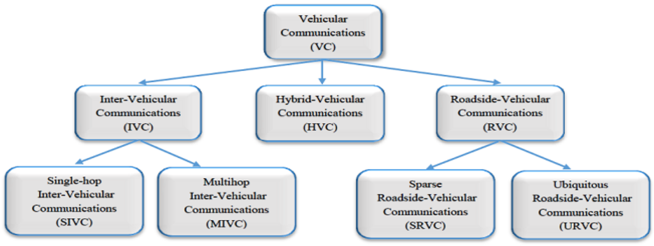

Figure 1.1: Communication patterns in VANETs.

II. RELATED WORK

Intelligent transport systems use vehicular ad-hoc networks (VANETs) to provide wireless communication between moving vehicles. By decreasing the number of traffic accidents, traffic delays, and fuel consumptions, etc., VANETs aim to provide users with a stable and secure setting. Users of VANETs are often alerted to potentially dangerous circumstances via vehicle communications and the sharing of local information [1, 2]. VANETs are an example of a kind of mobile ad hoc networks (MANETs). While VANETs share many traits with MANETs, they also exhibit their own distinct qualities, such as more mobility, more frequent topology changes, greater network density, and so on. So, VANETs are distinct from MANETs in many ways [1, 3–7].

Most accidents occur daily because drivers do not promptly and accurately assess road conditions. Typically, drivers are forced to make judgements like braking and lane shifting without the advantage of complete data, including information about the road condition, the speed of cars surrounding them, and so on. Mobile ad hoc networks (MANETs) [15] arose out of the necessity for communication in situations where the building of any permanent infrastructure was unfeasible, thanks to developments in computer and wireless communication technology. A car participating in a Vehicular Ad-hoc Network has a wireless local area network (WLAN) and a cellular communication device, as Vehicular Ad-hoc Networks are a subset of Mobile Ad-hoc Networks that provide data exchange via Vehicle-to-Vehicle (V2V), Vehicle-to-Roadsides (V2R), and Vehicle-to-Infrastructure (V2I) communications [8]. For example, "it should upon implementation, collect and distribute safety information to massively reduce the number of accidents by warning drivers about the danger before they really face it" [9], which is why VANETs are defined as a wireless communication technology that can improve driving safety and speed through the exchange of real-time transportation information. By informing cars, drivers, and passengers of the state of the roads, VANETs help reduce accidents and make travel easier for everyone. When compared to other forms of MANETs, VANET stands out because to its unique properties, which include, among others, predictable mobility, the absence of power limitations, flexible network density, rapid changes in network structure, high computing ability, and large-scale networking [10].

Information related to safety services that is time-sensitive and requires dependable and real-time communication, such as traffic accidents and road congestion, should be broadcast quickly. In such a setting, data transmission is crucial and must be spread over numerous pathways to improve the end-to-end latency. Unnecessary routing cost is incurred as a result of the creation of stale routes in the routing table, which results in frequent connection failures and route discoveries. To meet QoS criteria [11], the stability of the identified path between a pair of vehicles is crucial. The short-lived and intermittent nature of these techniques allows the resulting clusters to scale with little additional connectivity requirements [11]. High routing overheads and poor throughput [12] result from the difficulty of maintaining a route in the face of rapidly changing topology caused by time-varying vehicle density and other external and internal variables. In [13], a technique called "cluster on demand least spanning tree with prims" is presented for VANET. This method employs vehicle clustering with intra-cluster QoS considerations. In [14], an improved version of the Kruskal algorithm is given for use with QoS.

III. Architecture of VANETs

In-vehicle domain, Ad hoc domain, and infrastructure domain are the three shown domains of VANETs in Figure 1.2. The OBUs create the realm of the vehicle itself. Assume that every car, truck, or other vehicle has an OBU installed.

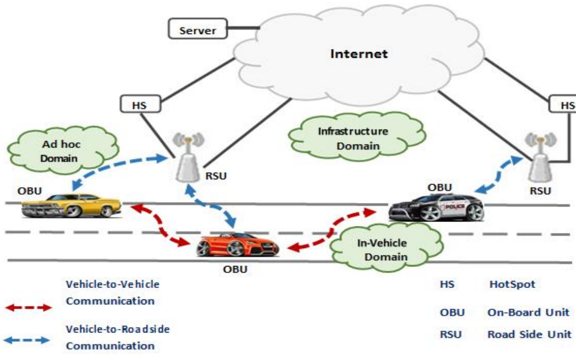

Figure 1.2: VANET system architecture.

Standards for vehicular communications are defined by major standardisation organisations including the IEEE, IETF, and ISO, as well as consortia like the car-to-car communication consortium (C2C-CC). The Dedicated Short Range Communication (DSRC) standard was developed by the Federal Communication Commission (FCC) in the United States [3, 4]. To facilitate vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications, this standard reserves 75 MHz of spectrum in the 5.9GHz range. Transmission range and rate in DSRC are specified to be 10-1000 metres and 3-27 Mbps, respectively. With the help of Wireless Access in a Vehicular Environment (WAVE), the DSRC standard establishes a baseline for the quality of communications between vehicles via the PHY and MAC levels. To handle network services, resources, security services, multi-channel operations, and so on, WAVE is made up of two protocols from five separate IEEE standards [1]-[4], [6]. These include the IEEE 802.11p and IEEE 1609 protocols.

To facilitate data transmission in mobile environments, IEEE created the 802.11p standard, which specifies the use of the 802.11 protocol's physical (PHY) and media access control (MAC) layers. This standard employs a MAC layer standard based on Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA) to disperse data over VANETs. The technical nuances and functional capabilities of DSRC's presentation are managed by IEEE 1609 standards. The application layers of IEEE 1609.1 are designed to handle user activities like connecting OBUs to other company resources. Without a doubt, IEEE 1609.1 standardises the operation of VANETs' applications in light of the WAVE standard. Protection in WAVE is provided by IEEE 1609.2, which defines secure message settings and wraps up encrypted message processing. Message exchange security is also provided by IEEE 1609.2. The management layer of IEEE1609.3 is defined by its function of directing and monitoring communications. Finally, IEEE1609.4 resides in the top portion of the MAC layer, which provides multi-direct activities in VANETs and manages the duties of higher levels ignoring the real divert borders in lower layers.

IV. CONCLUSION

Vehicles capable at very high speeds (120-140 km/h on highways, for example) are the mobile nodes in VANETs. As a result, great mobility is one of VANETs' most distinguishing features. In addition, the topology of VANETs may change rapidly due to the constant motion of the vehicles, the drivers' freedom to choose routes at will, etc. Because of the ever-changing nature of road traffic, isolated node clusters are often formed when spaces open up between cars. In addition, the link lifetime is quite short in VANETs due of the frequent topology changes. Nodes must regularly choose the other path. Likewise, the frequency of disconnection tends to rise as network density diminishes. The poor efficiency of VANETs is exacerbated by the frequent link failures that plague them. Using relay nodes and roadside devices, this problem may be fixed. As a result of these challenges, new studies are being conducted to preserve continuous connection and lessen the consequences of fading in VANETs.

The mobility concept of VANETs is constrained to the layout of roads and streets. However, in order to better forecast the longer term driver choice and halt the link disconnection, it is required to determine the location of nodes and the direction of their movement. Moreover, the design of the control algorithms in VANETs is affected by a shift in the mobility paradigm (e.g., highways vs. urban settings). Unlike the urban mobility model, which must account for street patterns, high node density, two-dimensional vehicle movements, obstructions and interferences through tall buildings and trees, the highway mobility model is relatively simple since cars only move in one dimension. Because of these differences and additional challenges, VANET design in urban settings requires special considerations.

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