

LTE Based High Performance Intelligent Transportation System using Multi-HOP Clustering

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Abstract: Vehicular ad-hoc network (VANET) was introduced with the principles of the mobile ad-hoc network (MANET). VANET is used for the wireless communication between the vehicles and it is the important part of the intelligent transportation system. In early days the VANET uses one to one communication and later it was familiarized with the inter vehicle communication. Here we are going to use this VANET and Long Term Evolution (LTE) traffic monitoring system is designed. LTE is a standard used for wireless communication between the mobile devices and data terminals. It is based on the GSM and HSPA network technology. The traffic monitoring system uses VANET for inter vehicle communication and the data are transferred to the monitoring system using LTE, it uses fourth generation telecommunication method for transferring the data to the end terminals so that the traffic can be monitored easily. Handover management is used to resolve the bandwidth; coverage decision algorithm for seamless handover of net-drones is based on received signals. Net-drone is used to find optimal coverage; this concept is derived from handover management. Multihop clustering is used to find the neighbouring vehicles. And the main aim is to analyse the vertical handover mechanism to provide efficient data transfer using handoff and send warning messages at emergency conditions.

Key words: Vertical handoff • LTE • VANET • Multi-HOP Clustering

INTRODUCTION

The passenger safety and comfort have been evolved by the Vehicular ad hoc network (VANET) [1]. It is used for inter vehicular communication. Long term evolution (LTE) is a standard 4G wireless system used for wireless communication between the mobile devices and data terminals. It is based on the GSM and HSPA network technology and wide variety of application which requires higher data transfers are supported by the LTE [2]. The wireless performance network is optimized for achieving the demands and better reliability and longer battery life. LTE was ratified by the international telecommunication union (ITU) as an advanced 4G network and adopted relaying cost effective throughput. VANET is the important booming element of the ITS. VANET is used specifically for the set of communicating vehicles with the interconnected wireless network devices [3]. It helps in development of the new driver assistance systems. It

gathers real information about the road traffic and environmental conditions. Based on the two kinds of communication (vehicle to vehicle and vehicle to RSU) VANET supports many applications.

VANET consist of mobile nodes, on board units (OBU) and stationary nodes called Road Side Units (RSU) attached to infrastructure is installed along the roads [4]. Both OBU and RSU have wired or wireless communication method. OBU will communicate with the RSU in an ad-hoc manner. Variety of advanced wireless technologies like dedicated short range communication (DSRC) where employed by the vehicular network. DSRC is the enhanced version of the WIFI technology used for VANET and to support the data transfer in rapidly changing technologies like VANET the DSRC was developed. The data propagation technique was designed to efficiently deliver the safety data to the receiver on time. The safety messages are broadcasted to the vehicle in a particular area [5]. So the safety message propagation

mechanism deals with the different types of network densities to eliminate the redundant rebroadcasted data, specifically in very high density situations. As there is a frequent topology change makes routing method complex in the VANET.

VANET significantly improves the safety in transportation system by the use of time and efficient data dissemination. Data dissemination follows the criteria like accident; road condition and traffic jam beyond driver's knowledge. Constraints like mobility and high speed creates unique characteristics, some topology are predictable. Changes in network density and frequent fragmentation for VANET's. The strict delay and packet delivery requirement of safety application in a dynamic network. The maximum dissemination distance is defined as the distance within the safety message needs to be disseminated. Maximum delay is the maximum tolerable delay. The packet application is defined as the ratio of the nodes that successfully receive packets within maximum dissemination distance.

Related Work

VANET Routing Protocols: The major routing protocol of the VANET are Topology based, position based, broadcast routing, geo cast routing and cluster based routing. In VANET node move randomly without any restrictions, because of this random movement the VANET has very complex and flexible topology in which drivers move [1].

Topology based routing protocol are divided into:

- Proactive routing protocol
- Reactive routing protocol
- Hybrid routing protocol

Proactive Routing Protocol: Proactive routing protocol is a table driven protocol, in these protocol nodes in MANET access routes of all possible nodes that try to uphold reliable routing information in their routing tables. DSDV is the one of the routing protocol used specially for the VANET. It is based on the algorithm called Bellman Ford algorithm. The vehicles uses incremental packets for the sharing the path information of the each vehicle and uses full dump packets for keeping the route table up to date. Full dump packets consist of the information about the each vehicle in the VANET. The incremental packets consist of

latest updation in the vehicle position. Paths are named with up to date entry in the table. Where the location of nodes is less changeable in this case DSDV is good option.

Reactive Routing Protocols: It is also known as demand routing protocol, in reactive routing protocol no destination node is accessible in this a route detection process is initiated. In this protocol the communication was initiated by a route request packet RREQ and route reply comes with RREP if the link fails then route error RERR packet is received. There are two types of reactive routing protocol are available:

- Ad hoc on demand distance vector routing algorithm
- Dynamic source routing protocol

Ad-hoc on Demand Distance Vector Routing Algorithm: In this AODV protocol all the vehicle contains the information of the other vehicle. In this protocol if the information in the table is value is not used in the specific time that will be deleted and RERR packet is forwarded if route is disconnected between the vehicles, so that route of the vehicle could might be updated in routing table efficiently

Dynamic Source Routing DSR: It is used as a source initiated on demand routing protocol which is based on the link state routing protocol. Route discovery request is sent to the other vehicle for the data transfer between the vehicles. For the route discovery the vehicle recruits a route request packet is send through the network and other vehicles will forward route request by updating their names as sender. If the route reply packet is not received by the sender, the sender node resumes discovery of route up to the destination node

Vehicular Networking with LTE: Vehicular networking uses combination of wireless communication, vehicle sensing module and global positioning system (GPS). The latest technologies are mainly based on the DSRC (dedicated short range communication) [6]. To spread these technologies standardization at each layer of networking protocol stacks should be done. So that a suite of protocol with the architecture is developed for the wireless environment called Wireless Access in Vehicular Environment (WAVE) [7].

The wave protocol stack consist of various components, which is an IEEE 802.11 based standard adapted for the vehicular networking environment [7]. The IEEE 802.11p mac is enhanced distributed channel access (EDCA) with quality of service support. The ad hoc communication among the OBU and RSU are enabled by PHY layer and MAC layer [2].

The LTE offers best performance in terms of throughput and lower latencies. LTE has good performance and less expensive due to their simplification in network and advanced algorithms were used for the resource utilization. All radio control, management functionality and their interaction between the user equipment and LTE core network are maintained by the radio access network (RAN) of the LTE network. Mobility management was supported by evolved packet core(EPC) which is directly connected with eNB, QOS handling and interoperability with the with legacy 3GPP and non 3GPP access technologies [8].

The RSU signals are received and combined in the RSU gateway. The processing is performed in RSU gateway and it is sent to the internet. The LTE eNB signals are sent from the other side by passing to the LTE core and those are combined and sent to the internet [9].

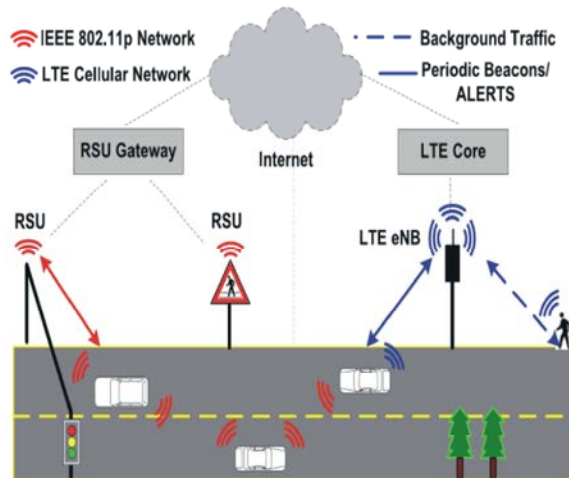


Fig. 1: Vehicular networking with LTE

Intelligent Transportation System: ITS is the advanced technology which provides innovative services relating to different modes of transport and traffic management and enables various users to be better informed and make safer, coordinated and smarter use of transport networks [10]. ITS will be implemented using various forms of wireless communications, the short range communications is accomplished using IEEE 802.11 protocols which was

promoted by the ITSA and US department of transportation. Longer range communication has been proposed using the infrastructure networks such as wiMAX, GSM etc. the long range communication uses expensive infrastructure deployment [11, 12]. There is lack of consensus as to what business model should support this infrastructure. Auto Insurance companies have utilised ad hoc solutions to support eCall and behavioural tracking functionalities in the form of Telematics 2.0 Emergency vehicle travels in the road for example ambulance. The signal is sent from the ambulance to nearest tower. The tower predicts the approaching vehicle and alerts it as a vehicle is going to intersect in the intersecting point (or) joining point [13].

Road Side Units: Computing device located on the roadside that provides connectivity support to passing vehicles. The road side units consist of sensors and one connectivity which support the VANET in the passing vehicle. The RSU captures and transfers the data of the one vehicle to the other vehicles for reducing the traffic level and reduces the accident conditions.

Proposed Work: The proposed method introduce a LTE based handover management and vehicular multi hop clustering algorithm for stable clustering best performance in terms of throughput and lower latencies. Advance network algorithms are used for resource utilization, vehicular multihop clustering is used to provide stable clustering concepts. In our proposed system the vehicle has to be identified and the signal alerts are to be given through the near by towers. RSU sends the signals to the tower, RSU are present in road side. Multihop is used to find the neighbouring vehicles that are approaching. LTE works efficiently and it is less expensive.

Handover Management: This mechanism is mainly used to resolve the bandwidth criteria (or) issues in aerial network. Handover clustering is used in the three-dimensional space for aerial network, which differs from the conventional. Seamless handover and false handover success probability and false handover irritation probability is used in order to evaluate the optimal coverage decision algorithm. Coverage decision algorithm for seamless handover of net-drones, based on the information of received signals (RSS), net-drones find their optimal coverage by adjusting the heights. First we use a handover algorithm that takes into account the

heterogeneous coverage of net-drones due to dimensional distributions. Secondly, optimal coverage decision algorithm makes the coverage of net-drones the same. It mainly controls the coverage of each net-drone, as the net-drone lowers the coverage will expand. The main idea is to adjust the height of each net-drone so as to make the coverage same. Initially the coverage is calculated as every drone with the lowest possible height. The inter coverage distance is considered. If it is short, the interface between net-drones will be significant and the number of drones to cover will get increased. Similarly, if the inter coverage distance is large, the communication between drones does not work. Drone is an aerial vehicle, hence it is deeply affected by climate environment. The performance of original structure infrastructure is degraded due to the unexpected events such as increase in population. We can use net-drones set up as an emergency network infrastructure. This deployment improves the network infrastructure without installing new ground infrastructure nodes. When the service provider wants to deploy net-drones, it will be deployed with group of multiple drones.

Vehicular Multi Hop Clustering Algorithm for Stable Clustering:

A hybrid technology is proposed, VMaSC-LTE with the use of IEEE 802.11p-based multi hop clustering and fourth generation (4G) cellular. The main advantage is the high data packet delivery (DPDR) and low delays while the use of cellular architecture. Vehicles are cluster based on normal approaches by vehicular multi hop algorithm for stable clustering. Cluster head selection is used with respect to the neighbouring vehicles. Cluster connection must be done with the minimum overhead by the use of direct connection to the neighbour that is already a head. Cluster merging mechanism is used based on the exchange of cluster information among CH's.

The features of proposed multi hop clustering algorithm VMaSC are follows:

- VMaSC provides stable CH selection by the use of the relative mobility metric calculated as the average relative speed with respect to the neighbouring vehicles in a multi hop clustered vehicular network.
- It provides cluster connection with minimum overhead by introducing a direct connection to the neighbour that is already a head or a member of a cluster, instead of connecting other CH in multiple hops and disseminating CM information within periodic hello packets.

- It provides reactive clustering to maintain the cluster structure without excessive packet transmission overhead.
- It provides minimum inter cluster interference by minimizing the overlap of clusters in space through prioritizing the connections to existing clusters and introducing efficient size and hop aware cluster merging mechanisms based on the exchange of cluster information among the CHs.

Heterogeneous approach for a cluster based routing protocol for stable topology is vehicular network. Cluster based routing protocol (CBRP) is used which analysis the movement of vehicles. Routing is an important concept for any network. Based on the required criteria the each routing protocol concepts are used. Clustering techniques divides the vehicles into overlapping clusters. Cluster head is present in each cluster which is used to communicate with other nodes within the cluster head. Cluster formation is done with the "lowest ID" clustering algorithm. Each node maintains the details of neighbouring cluster that are used. At each broadcast of the message the neighbour table is updated, these are sent at a specific time interval. It contains about the node state, neighbour table cluster adjacency table.

The initial version of the VMaSC and its integration with data aggregation appeared previously Fig. 3 shows a sample multi hop clustered network topology. Next, we describe the states of the vehicles, VIB generation and update, cluster state transitions, cluster formation, cluster merging and inter cluster interference. Multihop cluster topology is given with multiple vehicles that are moving. For each cluster head (CH) multiple cluster networks are connected. Each cluster member (CM) act as a moving object. Hop counts are considered, from each origin of the cluster head to the cluster member. If the cluster member is present after two members it is considered as 3HOP. The path is routed between two cluster members. Cluster member, cluster header and routing forms NODE A. Similarly with all these characteristics NODE B. NODE A and NODE B are connected in a network.

Implementation: Ad-hoc as needed in basic they do not require any existence of an infrastructure. Adhoc network is connected to a large network like internet. Single-hop adhoc network are networks where nodes do not act as a router, hence communication is possible only between nodes that are within each others radio frequency (RF) range. Whereas in multihop adhoc networks where nodes

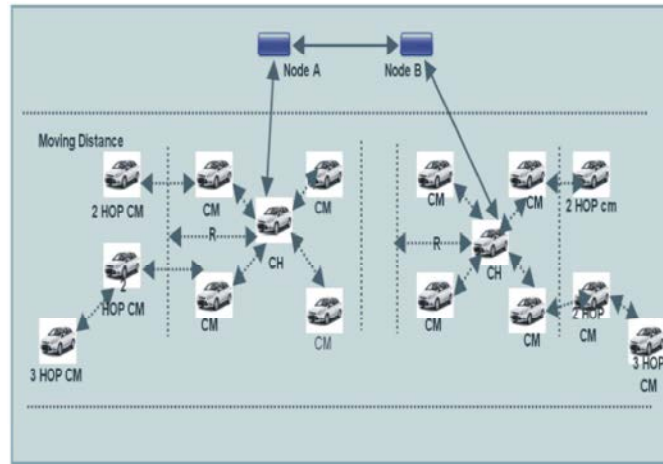


Fig. 3: Multi hopping cluster

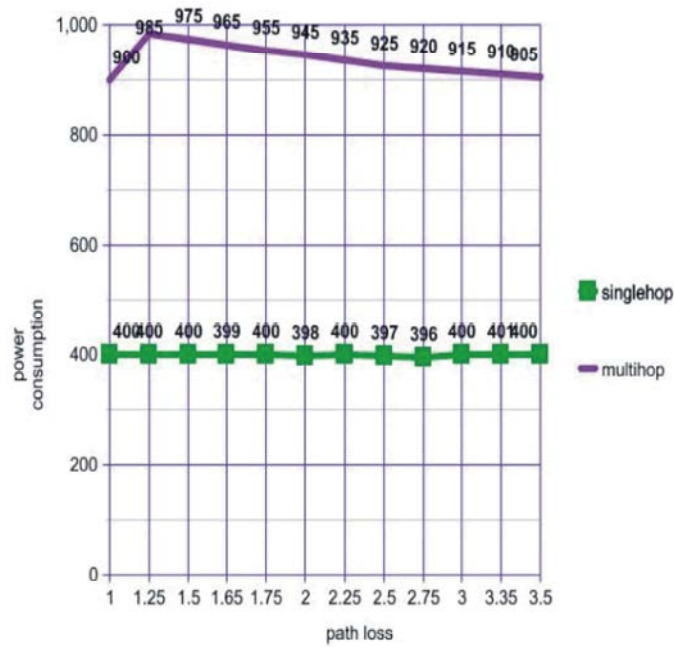


Fig. 4: Comparison of single-hop and multi-hop

Table 1: Comparison between Single and Multi-Hop

Singlehop		Multihop	
Path Loss	Power Consumption	Path Loss	Power Consumption
1	400	1	900
1.25	400	1.25	985
1.5	400	1.5	975
1.65	399	1.65	965
1.75	400	1.75	955
2	398	2	945
2.25	400	2.25	935
2.5	397	2.5	925
2.75	396	2.75	920
3	400	3	915
3.35	401	3.35	910
3.5	400	3.5	905

act as a router and routes (or) forward the traffic of other nodes. Routing in multihop adhoc networks are done with techniques like proactive routing, reactive routing. Proactive routing modifies the routing in static infrastructure. Each router uses the network topology information to compute and maintain routes to various destinations. Reactive routing aims to maintain a route to all other nodes; it works by computing when a route is needed. When a node has packet to transmit, it first identifies the route to the destination and transfers the packet.

Fig. 4 shows the graph about single hop and multi hop power consumption units with respect to path loss. In X axis path loss is considered, Y axis power consumption. In single hop for each path loss that is taken power consumption is the same and there is no change in graph. In case of multi hop since the neighbouring node is found the power consumption drastically decreases for each path loss and varies for each vehicle that is moving.

CONCLUSION

In this paper we have discussed about the different network used for the vehicle intercommunication and shares the data of the one vehicle to another vehicle which reduces the traffic level and the reduces the accident conditions. The passenger safety and comfort have been evolved by the Vehicular ad-hoc network (VANET). It is used for inter vehicular communication. Long term evolution (LTE) is a standard 4G wireless system used for wireless communication between the mobile devices and data terminals. The method is achieved using vehicular multi hop clustering algorithm for stable clustering and handover management. Proposed method is most efficient comparatively existing single hop clustering algorithm.

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