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Vehicular Handover Approach Based On LTE In Urban Road Scenario

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Abstract— The development of wireless technology has great impacted on various phases of communication system. In vehicular system the use of wireless technology is taking place at rapid pace. Intelligent Transport systems are evolving various new features are being added onto vehicular environment that are utilizing the wireless technology. The numbers of vehicles are increasing on the road and people spend a lot of time in transportation. So there is need of efficient communication system in which user can communicate with each other in an effective manner to enable lower delays and less data losses. To provide QoS enabled communication between vehicles, integration of Long Term Evolution can be done with Vehicular network so that data transmission takes place at relatively longer range with minimum delay. A handover scheme is also proposed for the efficient data transmission that takes place high mobility of vehicles and continuous topology change.
Keywords— Vehicular Ad-hoc Network, Long Term Evolution, Handover, Evolve NodeB.

I. INTRODUCTION

Now a days Wireless technology [1] is one of the most active area of research. The development of this technology is being done in various fields but in cellular communication the use of this technology is most widespread. Recently vehicular system is also incorporating this technology for the providing communication between the vehicles in the transportation system. These system support services, such as the transmission of data, images, text, and messages. Today Wireless communications covers a very large array of applications focused on vehicular system in the form of safety and entertainment applications. The largest and most noticeable and important part of the vehicular system is considered for the safety related applications to avoid collision and congestion etc on the roads.

The worldwide growth rate of wireless technology in Vehicular system is very aggressive. This technology is also known as Vehicular ad-hoc network (VANET) [2]. The Vehicular Ad-Hoc Network [3], or VANET, is an innovation that uses moving vehicles as nodes in a wireless network. VANET transforms each taking part vehicle into a remote switch or node. These permit vehicles to communicate nearly 100 to 300 meters and, thus, make a system with a wide range. In VANET's vehicles goes out of the range and drop out of the system at random periodic intervals other vehicles join in. This association vehicles to each other so that a continuous connection is maintained between vehicles. It is assessed that the first types of applications that will incorporate this technologies are emergency vehicles, police and fire vehicles to that may even connect with one another for security purposes. In VANETs such as there are On Board Units (OBU) which are situated in the vehicles and Road Side Units (RSU) placed along the road for the communication [4]. VANETs provide two types of communication i.e. Vehicle to vehicle communication (V2V) [5] and Vehicle to Infrastructure communication (V2I) [6]. This V2I based communication take place through RSU. Trusted Authority and RSU both are static and provide a fixed infrastructure as shown in Figure 1. These act as the backbone for the mobile networks and also provide security to our networks as they are assumed to be secure and free from attacks. The whole communication between vehicles take place through the 802.11p [7] standard. But the range of this 802.11p is very low and distance up to 300m is limited. The communication through 802.11p is not suitable In non sight conditions which is an issue. So to provide QoS to this network and for increasing communication range these networks are integrated with Long Term Evolution.

Long Term Evaluation (LTE) [8] is a 4G technology which comes into play in December 2008 after UMTS 3G technology [9] In the telecommunication system. This technology is based on 3rd Generation Partnership Project(3GPP) specification release 8. The motivation to use LTE with VANET's is to enhance the 3G technology in terms of Delay, Data transfer and reduce complexity. This also fulfills QoS and high data transfer requirements of the user.LTE provide high uplink/downlink speed to large class users. LTE integrated with VANET's to provide QoS communication in term of delay and supports V2I communication as shown in Figure 2. In this figure all vehicles are communicating through eNB [10] and all eNB communicating to each other throughan X2 interface. The whole information transmitted to Evolved Packet System through the S1 interface.

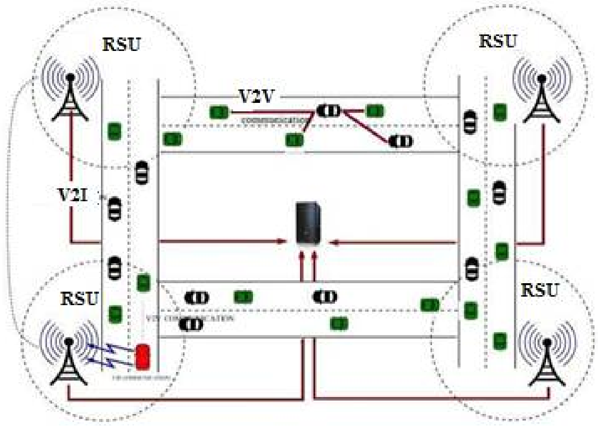

Fig. 1. Intelligent Transport System

This system consist of Mobility Management Entity (MME), Serving Gateway (SGw). Here MME is responsible for all routing information , hand off management, signal security, roaming etc where as the SGw is for the routing and forwarding of packet. Due to long range of LTE communication take place from long distance so to transmit data is quite difficult and chances of data lost becomes more due to high mobility of vehicle [11] and dynamic topology change.So there is efficient handover scheme required for transmission of data when vehicle goes out the range of serving eNB.

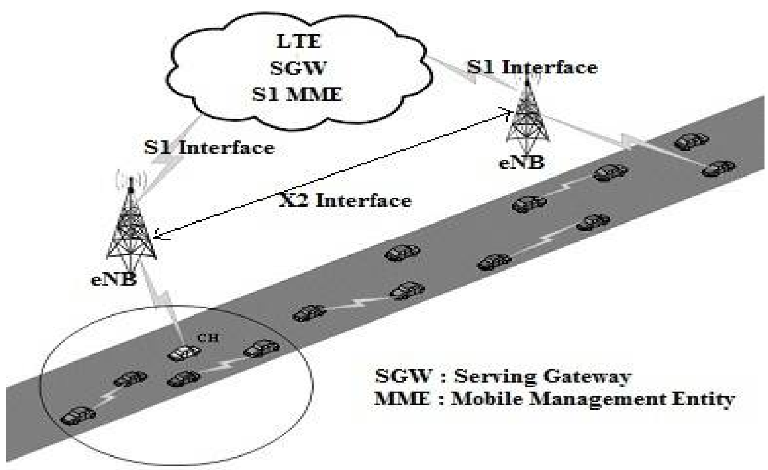

Fig. 2. LTE with VANET's

A. Motivation

As we know vehicular network supports IEEE 802.11p but its range is less and it is not suitable in non sight conditions. Also demand for efficient data transmission in vehicular system with QoS and low latency is a key challenge. Because of high mobility in vehicles the topology also changes very frequently and there is need of handover so that vehicle can move to another network without interruption.

B. Organization

The rest of the paper is organized as follows: section II involves the whole review about VANETs, handover in VANETs, Integration of LTE-VANET based network . In section III proposed Handover Scheme for V2I Communication in VANET is presented. Section IV evaluate the performance of our proposed Scheme on the basis of various parameters . Conclusion and future scope of our research is discussed in this section V.

II. LITERATURE REVIEW

Firstly Sultan et al.[12] describe a deep study about Vehicular ad-hoc networks. various issues of the vehicular network like its architecture, application, mobility models, simulation tools are explored here. This provides a basic structure of vehicular network to support various researchers. Zhu et al. [13] states the various mobility models of vehicular networks. Here mobility models are identified on the basis types of communication occur in VANET's i.e. V2V and V2I. various schemes are stated for both these communication and comparison of these schemes is also done. To manage mobility in vehicular networks the requirement of vehicles on the basis of communication types are also identified . Host and network based mobility is also described in this paper.

YH. et al [14] proposed a reactive handover scheme for VANETs and compared it with the proactive schemes. These proactive schemes predict and detect the movement of vehicle before breaking the current link. In result implementation of reactive schemes are more simple and robust than proactive schemes are proved. This proposed reactive scheme eliminated high signal overhead of the network.Leo et al.[15] proposed a scheme for mobility based handover in VANETs for Global management in V2V and V2I environment. This proposed

scheme manages the local ID of VANETS, permanent address and Mac address of vehicles. This is used for preparing fast handover process using L2 trigging and route optimization. These schemes better than other existing schemes in terms of delay and latency.

Araniti et al. [16] evaluate the performance of LTE-Network for Vehicular Ad-hoc network. As LTE is developing 4G technology for vehicular network the strengths, weakness or future challenges of LTE in VANETs are explored here. As 802.11p is one of the protocol for VANET's for data transmission at short range because the signal strength becomes low when connection is handled in some non sight condition . To overcome this problem high bandwidth, range etc. is required. In this how strengths of LTE are helpful to face all the drawbacks of 802.11p are also discussed. Various application based on safety are also stated in this VANET LTE network. Mir et al. [17] evaluate the performance of two communication standards, Long Term Evolution and IEEE 802.11p. Both of these standards are evaluated on the basis of parameters like vehicle density, speed transmission frequency etc. These standard are compared by calculating delay, scalability, mobility and reliability for various vehicular applications. After calculating the performance , result indicates that IEEE 802.11p is suitable for sparse network where there is low mobility. But LTE means most of application requirements in terms of scalability, reliability and mobility. But its challenging in term of delay due to high traffic load.

Sivaraj et al. [18] proposed the 3rd Generation project partnership LTE integration with the IEEE 802.11p VANETs for seamless data delivery among the vehicular clusters. Two issues are explored in this paper first is cluster head multi casting and another is about QoS requirement for communication. In addition of this LTE-VANETs

communication is stated with the issue of cluster head and gateway selection . In this an issue of resource allocation to eNB nodes is also discussed.In this section various Handover schemes are discussed for LTE - VANETs. Here Chae et al. [19] proposed a handover scheme in vehicular network which utilizes coordinated multi point transmission scheme. This scheme focus on efficient and seamless handover procedure for moving vehicular environment specifically between eNBs. The proposed architecture of this handover schemes utilizes femto cells for the improvement in quality of data transfer.

Pan et al. [20] proposed an enhanced handover scheme, which contains two procedures. The first one is an enhanced measurement procedure, which can accelerate the measurement procedure when the mobile relay knows that the train is moving toward some neighbor Donor- eNBs. The second one is a group in network handover procedure, which can aggregate similar network handover procedures in the core network. The group in handover scheme is used to reduce message overhead by predicting the handover timings. Vetrivelan et al. [21] proposed a rank based approach for soft handover decision which also utilizes nash-Equilibrium. This proposed framework is basically adopted for important criterion like collision avoidance between vehicles. Hence the QoS enabled approach basically differentiate the services according to vehicular priorities and provides group communication . Results are calculated in terms of bandwidth, delay, jitter bit error rate and velocity. Zhou et al [22] proposed a fast handover scheme which utilizes mobile relay for high mobility. In this handover scheme to guarantee a handover occur in time two reference points are introduced. Both of these are involved to reduce communication interruption and seamless handover. These are pre-preparation for handover and packet bi-casting. Their performance are analyzed in terms of interruption time , handover delay etc.

III.PROPOSED WORK

Basically we are implementing the horizontal handover which means that the handover is taken place in same type of network.For the implementation of a network of 100 vehicles is created. The vehicles on the road are mobile and communicating with each other in the V2I environment through eNB's. There communication performance is evaluated by using the network simulator along with LTE patch. Initially we have created a roadside scenario that includes bidirectional roads and vehicles move randomly in the lanes. The eNB are located at the center of intersection of lanes. All vehicles exchange their information through this eNB. The range of eNB is fixed and static where as the vehicles are mobile. When any of vehicle goes out of range of eNB while transmitting its data then handover is required as shown in figure 3.

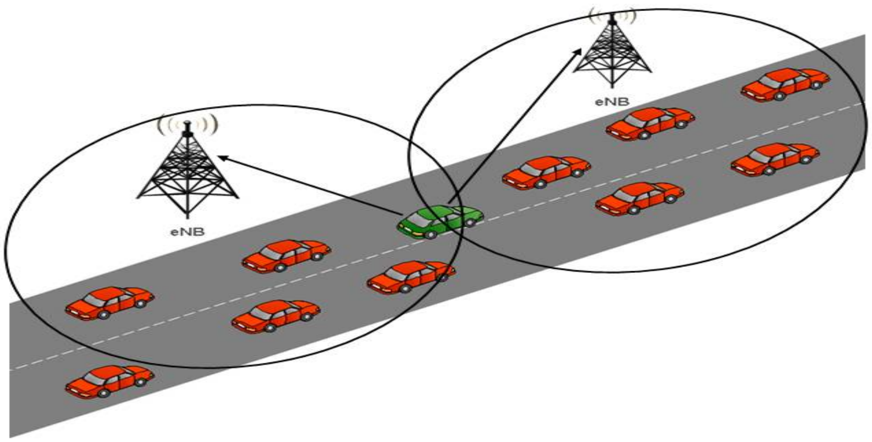

Fig. 3. Handover Scenario from eNB to eNB

In this figure there are number of vehicles are communicating in the range of eNB. let suppose we have a vehicle transmitting its data to eNB at the boundaries so for the seamless connection there is requirement of handover so that data will transmit to destination without any interruption. The whole handover scheme is based on the algorithm 1. In this algorithm state information of vehicle, serving eNB is taken as input which help us to know about target information. Handover decision is based on two assumption first when the Received Signal Strength (RSS) becomes less that then the threshold value RSSthr. or there is some another eNB whose signal strength is better than the serving eNB . For the handover the following steps need to be taken :-

Algorithm 1 Handover Scheme

Inputs: Id of requesting entity, Id of serving eNB,State Information of serving eNB
Target eNB Information
Outputs: (vehicle **-** eNB **-** Vehicle),
Handover from servingeNB to targeteNB
1: Begin
2: **for** each vehicle do
3: Calculate RSS
4: **if** (RSS=Low && neibhour RSS > RSSthr) then
5: vehicle report to serving eNB .
6: send HO request for new eNB.
7: **if** (message = valid) && (vehicle member = valid)
then
8: note the node id
9: eNB forwards the message to Target eNB
10: **else**
11: discard the message.
12: **end if**
13: **end if**
14: **end for**
15: **for** Target eNB do
16: **if** message received for handover then
17: set timeout interval

```
                broadcast id of serving vehicle
        while (response not recived)
                establish connection
                accept HO request and aggregate data from serving eNB
                send ACK
                 Perform HO
        for serving eNB do
                if (ACK recieved) then
                after getting ACK
                reset and flush buffer
                end if
                end for
        end if
end for
End
```

In the first step each vehicle calculate its signal strength and communicate to each other through eNB.
If any vehicle get that its signal strength becomes low and another eNB is having the better RSS that serving eNB. Then it can send request to the serving eNB for the new connection.
Now serving eNB send request to the target eNB and wait for the response.
On another side target eNB check the validity of message and eNB or vehicle and send acknowledgment.
After receiving the acknowledgment the serving eNB send the data to target eNB and vehicle will also connect to target eNB.
After handover given to target eNB and serving eNB flush its buffer and reset.

IV. SIMULATION AND RESULTS

The proposed architecture has been implemented in the Network Simulator (NS-2) along with the LTE patch. NS-2 is used for creating the mobility based scenario where as LTE patch is used for the implementation of LTE-Advance . The following describe the default parameter for the simulation.

TABLE I
PARAMETERS REQUIRED FOR SCENARIO

Parameters	Value
Simulation Area	2000 * 2000
Number of Vehicle	100
Packet Size	1024 bytes
RSS Threshold	40 dpm
Maximum Packet in interface queue	2000
Transmission Time	20 sec
Simulation Time	350 sec
Protocol used	AODV / PMIPV6
Mobility support for eNB	Fixed
Number of eNB	6

results are evaluated based on different parameters such as throughput, delay, Received Signal Strength , number of handovers. Each of result is evaluated for different number of nodes as discussed below.

A. Throughput

Throughput may be defined amount of data that is delivered from one node to another via a communication link per time unit. Figure 4 shows the throughput for different number of nodes network. This show that with increase in number of nodes it increases with respect to time. Here the average throughput calculated for eNB is 294 K bps. Here Throughput initially increase at a uniform

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rate after that this attain a constant value. Because as simulation starts, vehicles have comparatively less data to transfer to eNB, However as they reach closer to eNB, they transfer larger amount of data.

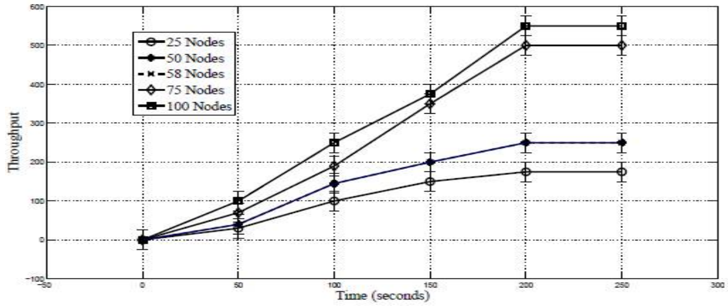

Fig. 4. Throughput

B. Delay

Delay is defined as the difference between the expected time of arrival of a packet and the actual time. Figure 5 provide an analysis of the occurrence of the delay during the handover procedure. There is an occurrence of minimum delay in 100 nodes as compared to the other modes . It is due to the fact that eNB can handle large amount of data from large distance easily. The delay occur on average by the eNB is 1.62 sec. However as the amount of data in the network increases it affects the delay in data transmission too.

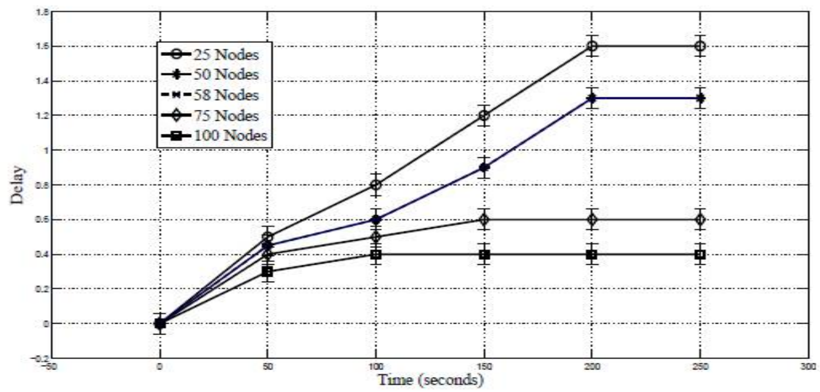

Fig.5. Delay

C. Received Signal Strength

Signal Strength may be defined as the magnitude of signals available with vehicles in their network at particular instant of time. Figure 5 shows the Received Signal Strength for whole the network. Variation in RSS is calculated in terms of number of nodes with respect to time in seconds. As figure6 shows RSS increases when number of nodes are increased. It will increase linearly and then reaches to highest value when it comes in maximum range of eNB.

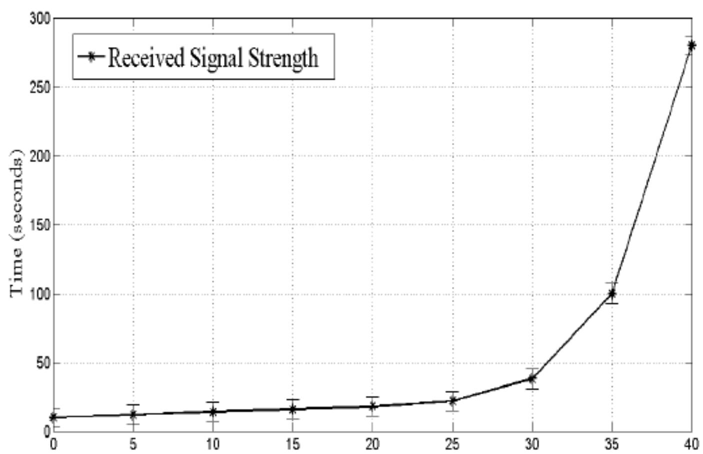

Fig. 6. Received Signal Strength

D. Number of Handover

Number of handover are the total number of handover taken by the vehicle in a single network when they move enter into new network. Here the total number of handovers are counted with respect to speed of vehicle. Figure 6 shows the Number of Handover for the network. The result evaluated shows that the number of handover increase with increase in speed of CH. This also proof the life validity of CH as if its speed is low it gets more life to stay in the cluster.

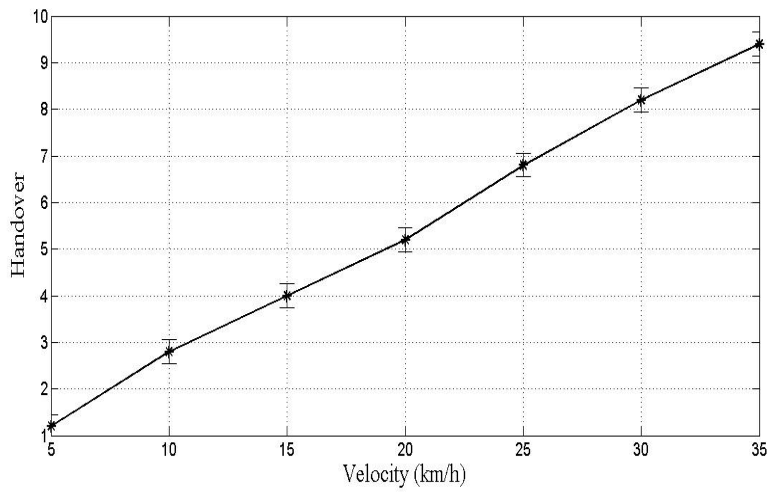

Fig. 7. Number of Handover

V. CONCLUSION

In this work a framework for data aggregation using VANET with LTE is proposed. The proposed framework used cluster based data aggregation and also provides handovers scheme for efficient data dissemination. The proposed model considered eNB's as central data control authority for providing information about signal strength to vehicles .The obtained simulations results show that the proposed scheme is efficient to aggregate information and provide a centralized control for check requirement of handover based on signal strength as the key parameter . In future the results can be evaluated for large amount of traffic and complex networks.

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