A Cluster-based Highway Vehicle Communication in VANET

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ABSTRACT
The last few years VANETs have received several ideas related to safety as well as non safety applications for security enhancement and communication methods. In this paper a new technique is proposed for highway vehicle communication, taking the simple highway model for efficient communication among the vehicles. A cluster based vehicle model has been proposed for vehicle communication; the proposed model has applicability in the highway road. This paper focuses on the development of clustering technique, based on the vehicle density, speed and position of the vehicles. The proposed cluster technique is based on the vehicle density on the highway road; RSU is placed on the highway every 3km to 5 km. The cluster head is elected by comparison of each vehicle speed and position of the vehicles. The cluster head is to transfer the traffic related information's like warning messages and alert messages that are frequently sent to the other vehicles. The cluster head switching technique is proposed technique that is if the new vehicle speed is greater than the cluster head than the new vehicle is elected as the cluster head. The new cluster head is transferred messages, warning alerts to the RSU for efficient communication and to avoid the delay overhead.

General Terms
Cluster Based Highway Vehicle Communication Vanet.

Keywords
Cluster, Delay overhead, OBU, RSU, VANET.

1. INTRODUCTION
In a VANET Network the moving vehicles are considered as dynamic [1] [2] [3] nodes. The moving vehicles are move with higher speed or lower speed. VANET is a subset of MANET network. In an intelligent transportation system, VANET is maintaining an important role. The main advantage of the VANET is to provide the warning alert, as well as forwarding safety related messages and each vehicle should be registered in the VANET network for communicating with other vehicles as well as sharing information by passing warning alerts.

In VANET communication there are 3 types of communications, [9] the main communication is vehicle to vehicle (V2V) [2] [3] is used for exchanging the warning messages to other vehicles. The second communication is used to communicate with the infrastructures, road-side unit (RSU) and on-board unit (OBU).

Each vehicle has an OBU; it is broadcasting messages about the speed, position, location and the neighboring vehicles. The protocol DSRC is the main role of VANET that communicates between OBU, RSU [5] and vehicles. It is applied with IEEE 802.11p [10] standard for wireless communications.

2. VANET COMMUNICATION PATTERNS
Many applications are enabled by VANET's, mainly focusing on road safety. In this application, messages are interchanged over VANET have different concepts and purpose. There are four different communication patterns are involved,

2.1 V2V Warning Propagation:
In this situation vehicles are to send a message to a specific vehicle or a group of vehicles. For example, when [5] an accident occurs or detected, a warning alert message should be sent to other vehicles to enhance the road safety [9] and reduce the traffic. On the other hand when an emergency vehicle is coming, a message should be sent to the following vehicles. In this way it is used to provide the best solution for the emergency vehicle.

2.2 V2V Group Communication:
In this communication model some vehicles can participate [5] in the communication, vehicles in the same area and time interval.

2.3 V2V Beaconing:
Beacon messages are sent periodically to nearby vehicles. It contains current speed, location, and vehicles information's. These messages [5] are useful to increase neighbour awareness. Only one hop can communicate in this V2V beaconing.

2.4 I2V/ V2I:
Warning messages are sent from the infrastructure (through RSU) or by the vehicle, when an accident [5] or traffic occurs. It is used to enhance the road safety.

2.5 VANET Applications:
In VANETs system is classified into two types of applications. First one is safety applications and the second one is non-safety applications .These applications [5] are used to enhance the road safety. Safety applications are used to improve the drivers driving experience, for example traffic

events, curve places and dangerous areas that are periodically broadcasted by the use of OBU (On Board Unit), which is equipped with each vehicle. Non-safety applications [1] [2] are used to provide various entertaining services to drivers and passengers, this application is also called as value added services. These services are provided by the [5] use of the SP (Service Provider). For example internet access, instant messenger, toll payment services and E-advertisements. See fig1. for basic Vanet Structure.

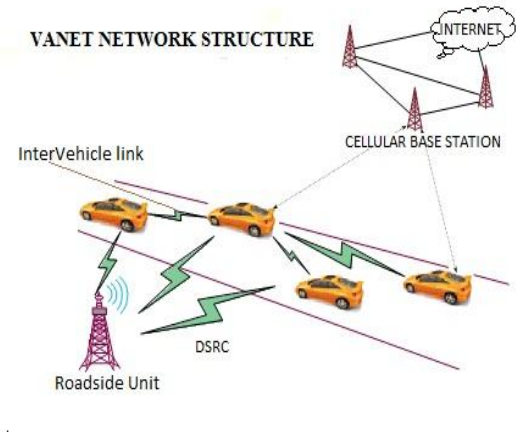

Fig1. Basic VANET Structure

2.6 VANET Clustering:

A group of VANET vehicles within a signal range can form a cluster group. Already clustering concepts has been applied successfully in MANET. Normally clustering or grouping is to group the vehicles to communicate easily and reduce the delay overhead. Clustering can simplify the routing techniques and reduce the delay.

3. EXISTING SYSTEMS

The authors [1] proposed a cluster based simple highway mobility model (CBSHWM) is to create a cluster model for efficient communication. The proposed mobility model is simple highway mobility [1] model. In this paper cluster head is elected by the cluster head election algorithm and delay is occurring by using an election algorithm. The authors [4] proposed a new clustering technique for ad hoc networks; cluster structure is determined by the geographic position of the nodes. The cluster nodes are selecting the cluster head and the cluster size is determined by the cluster head. In this paper the authors followed by 2 conditions; the first one is [4] the node has highest priority in its one hop neighborhood and the second one is node has highest priority in the hop neighborhood of one of its one hop neighbors.

4. PROPOSED SYSTEMS

The proposed model is forming a cluster for avoiding the delay overhead when the message is transferred to other vehicles. VANET Cluster depends upon the geographical area and its working on the highway. On a highway, vehicles are moving in the same direction within a certain area. Mostly all the vehicles are moving at the same speed. The proposed technique is to create a cluster; it depends upon the vehicle density. Each cluster head should transform the current traffic flow and warning alerts to RSU and other cluster heads.

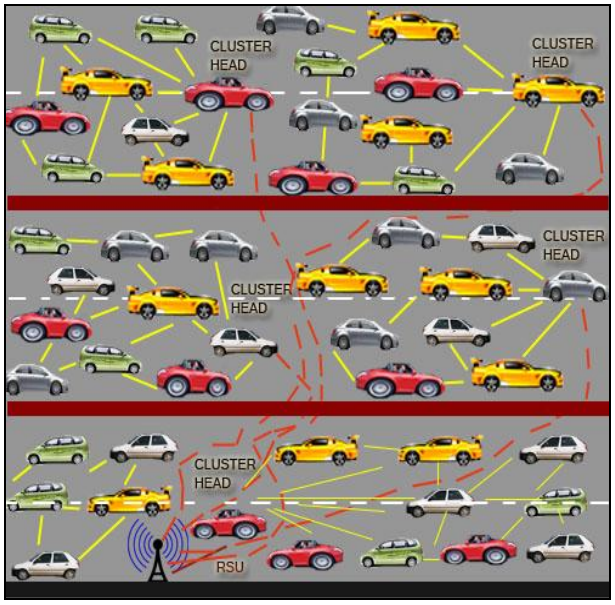

Fig2. The Proposed Model

The Above diagram Fig 2 shows the proposed model. All the cluster heads transfers the original messages to the RSU and the vehicles enter into the other vehicles.

4.1 Cluster Creation:

The cluster creation in the proposed system is different from the existing system. The size of the cluster size is changeable and depends upon the highway. The cluster size depends upon the vehicle density. Vehicles density [8] is calculated by the following equation,

Density (vehicles per mile) = Flow (vehicles per hour) / Speed (miles per hour)

Initially, find the vehicle's average speed and the density of vehicles in the particular area. The vehicle speed is different by situation, if the vehicle speed is low means density is high, density is inversely proportional to the speed. The cluster size is big because density is high and the density size is low cluster size is small. Cluster size depends upon the vehicle density. The below diagram Fig 3 (a) shows the cluster creation technique.

The below diagram Fig 4 (b) shows the cluster head selection technique. The proposed technique is to find the vehicle's exact position, speed and time for each vehicle in the cluster and these information are getting from the tamper proof device.

```
CLUSTER CREATION
[Xi, Yij= Pos (n); ASP=0;
[Ui,Vi] = Subset (Xi, Yi);
For (i=0; i< count (Ui); i++)
Each {
 Find movement speed (SP [i]);
ASP = (SP [ i ] + ASP)
}
Avg SP = ASP / Count& Find VD= F/ Speed;
Set the Vehicle's Density VD
If (ASP > High && VD < TH)
{Create Cluster (n), with smaller size }
 Else If (ASP < High && VD > TH){
Create Cluster (n); With Larger size
} Else
{Can't create cluster directly transfer to other vehicles.}
END
```

(a) Cluster Creation

Fig3. The Proposed Cluster Creation Model

```
CLUSTER HEAD SELECTION
  Node Count = No of Nodes in Cluster
  For i = 0 to Node Count
  Find the Speed, Position, and Time for
  from the known TP Device
  If (speed > TH)
  {
  Select Cluster Head
  Else If (Speed == TH)
  {
  Select Cluster Head
  Else If (Speed < TH)
   Consider as normal node in a cluster
    }
    }
 END
```

(b) Cluster Head Selection

Fig4. The Proposed Cluster Head Selection Model

If The speed is greater than the threshold value than select the cluster head else the speed is lesser than the threshold value than consider the vehicles as a normal node. Each and every cluster head is to transfer a traffic message, warning alerts are frequently sent to the RSU. The main concept of the proposed model is to transfer a message quickly to new incoming cluster heads and also the clustered vehicles.

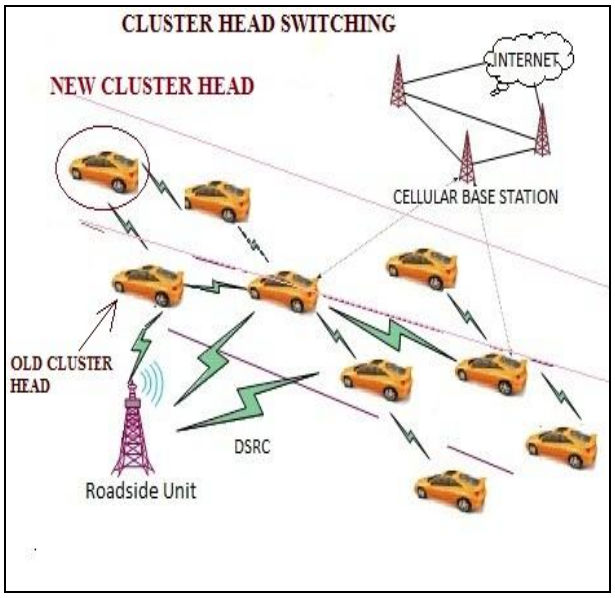

Fig5. The Proposed Cluster Head Switching Model

```
CLUSTER SWITCHING
Set Speed for Each Vehicle
Find Cluster Count (No of Clusters)
Find the no of Nodes in Each Cluster
For (i=0; i< No of Cluster; i++)
{
For (j=0; j< No of Nodes in Each Cluster; J++)
{
If (CH Speed <TH && New Vehicle Speed > TH)
{
Select New Vehicles as a Cluster
}
}
}
End
```

Fig6. The Proposed Cluster Head Switching Algorithm

4.2 Cluster Head Switching

The cluster head switching between the new vehicle and the old cluster head vehicle.

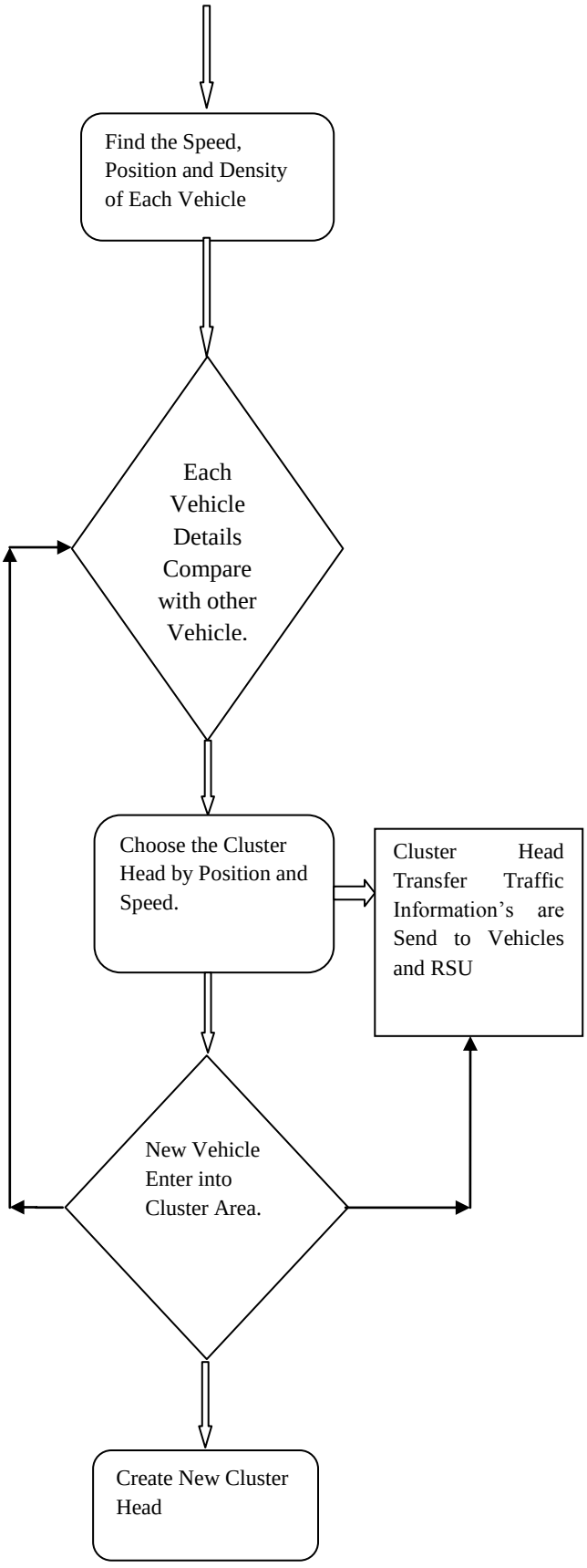

Fig5. Our Proposed Model Process

The new cluster head speed and position is greater than the old cluster head, above diagram figure 6 shows about the new cluster head switching technique based on the new vehicles information's. It depends upon the vehicle density area.

The cluster head should transform the warning alerts, traffic related information's to the cluster area vehicles and RSU. The RSU transforms cluster information's to the next cluster head and RSU. Each and every clustered vehicle transforms information's to the nearby vehicles.

The above figure shows about the proposed model of clustering technique, initially find the information's about the vehicles, and find the speed, density, positions of the vehicles.

These information's compared with the other vehicle and elect the cluster head based on position and speed, cluster head is to transfer the traffic related information's to the RSU and vehicle.

If the new vehicle enters into the cluster area than it wants to elect the new cluster head, elected by comparison to the information's with old cluster head. The proposed model advantage is to reduce the delay overhead and transmission speed will increase.

5. CONCLUSION

In this paper we have worked in cluster based highway road vehicle communication. Our proposed model is developed to reduce the delay overhead and enhance the efficient communication in VANETs safety applications. In future, this model will be enhanced by inner-city cluster based vehicle communication for road safety in VANETs and to reduce the communication delay during the drive.

6. REFERENCES

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