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Clustering in Vehicular Ad Hoc Network for Efficient Communication

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ABSTRACT
Clustering can be used in VANETs to partition the network into smaller groups of moving vehicles embedded with computing and network devices. Each cluster having a cluster head (CH), Gateway (GW) node and junction those are responsible for all management and coordination tasks of its cluster. We have designed algorithm for CH, GW Selection, Packet forwarding & Junction services. This paper presents the developed algorithm to provide Efficient and secure communication to the vehicles that allow drivers to warn other vehicles of potential dangers, and also provide valuable information to specified vehicle.

Keywords
Clustering, City map, Junction, Cluster head, Gateway etc.

1. INTRODUCTION
Clustering can be used in VANETs to partition the network into smaller groups of moving vehicles embedded with computing and network devices.

Cluster-based routing technique is a solution to fast & efficient communication. Inside the cluster one node that coordinates the cluster activities is cluster head (CH). Inside the cluster, there are ordinary nodes also that have direct access only to this one cluster head, and cluster head forward information through gateway node. Gateways are nodes that can hear two or more cluster heads those will be different clusters.

Ordinary nodes send the packets to their cluster head that either distributes the packets inside the cluster, or (if the destination is outside the cluster) forwards them to a gateway node to be delivered to the other clusters head. We have made more efficient this concept using junction those are fixed on circle or roadside. Junction gives the exact location of destination node and also provides optimal path for forward the data packet[1].

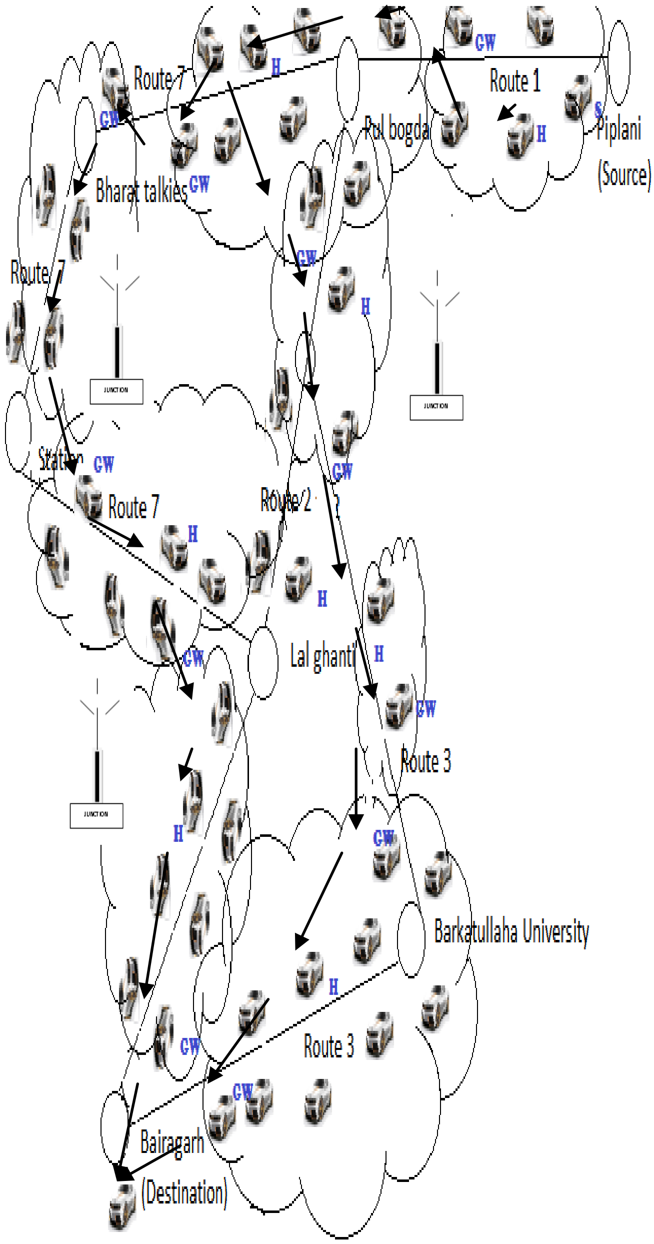

Figure: 1 Designed model of Clustering communication

2. CLUSTERING FEATURES

The clustering in VANETs is formed based on the following features:

- Vehicle movement
- Junction point on the roads: such as signs and traffic lights leading vehicles to follow some traffic patterns
- Availability of Global Positioning Systems (GPS) devices providing knowledge regarding geographical location
- Perform distributed operation
- Topology variations due to mobility and mobility pattern.
- Cluster formation plays a key role in VANETs for information assembly, aggregation and propagation.

3. JUSTIFICATION OF NEEDS OF CLUSTERING

We need the clustering for following reasons:

- Efficient Communication V2V & V2I
- Decrease Routing load
- Increase Packet delivery
- Bandwidth fully utilization[3]

4. DESIGNED CLUSTERING APPROACH

The clustering model relies on algorithms based, on the following; we present the notations and the details of these algorithms:

4.1 Algorithm Designed for Cluster Formation

The basic point of VANET is building efficient and secure communication. The clustering is one of the main and most important task of VANET that is concerned with organizing & optimizing of communication. It starts with the Cluster formation; perform operation by junction to locate destination node, predict next position of the node and shortest path, forward information with secure communication.

In the cluster formation phase, all vehicle nodes can keep in three categories

- **NM (Non member Node)** : those are not a members of the cluster in VANET
- **Cluster Head (CH)** : Head of all members of the cluster. Maintain cluster member table for all information about the member of cluster. Only single CH in a cluster.

  Cluster selection process is given below:

Algorithm 1: Cluster Head selection

```
Cluster Head selection (weight)
{
    On reception of  Hello msg from different candidates
        sort candidate[].weight list
          Top Candidate will be CH
          Node i <-CH
  }
```

CH selection is the beginning & important task of cluster formation. The node which will have the highest value of weight will be CH.

- **Node weight:** Each node maintains the node mobility with comparison to all neighbor nodes and also finds the number of nodes those are in coverage area.

  Both values find with call function mob() & Reqnode(), X & Y respectively[12].

  X = Call node mob()

  Y = Call reqnode()

  Weight = $\alpha.X + \beta.Y$ …………………. (i)

  Where node mobility X depends on the value of $-1>\alpha<0$

  Number of requesting node depends on the value of $0>\beta<1$

- **Gateway Node (GW):** it is a forwarding node which takes packet from CH or another GW or may be from nearest junction. More than one GW may be in a cluster. Gateway selection is the important task of Cluster head. Where CH send request to all members of cluster those are linked to other cluster's CH or GW node and their mobility should be lowest.
- **Cluster maintenance (enter/exit from cluster):** Due to the high dynamic nature of the VANET, vehicles keep joining and leaving clusters frequently, thus, causing extra maintenance overhead. The events that trigger the maintenance procedure can be summarized as follows:
- **Joining a cluster**: Periodically perform the selection process for all members of cluster including CH & GW and cluster's new member node.

Algorithm 2: Joining node in the Cluster

```
Join_new_node()
while(true)
{
Periodically calculate the weight of CH & GW and remaining member of cluster
Shortlisted of all member of cluster on the base of weight
Highest weighted member of cluster
Declared Cluster head
  }
```

- **Leaving a cluster**: when a cluster member moves out of the cluster radius, it loses the contact with the cluster head. As a result, this vehicle is removed from the cluster members list maintained by the cluster-head.
- **Resign Cluster Head:** When cluster weight is less than other member of cluster then current cluster head resign from CH & current highest weight node will be announced as a new CH and copy data from former CH.

As per our new concept if CH weight is less than other member of cluster than CH handover the role of cluster head to another eligible node.

5. SIMULATION AND RESULT ANALYSIS

5.1 Justification of needs of AODV

As in VANET, nodes (vehicles) have high mobility and moves with high speed. Proactive based routing is not suitable for it. Proactive based routing protocols may fail in VANET due to consumption of more bandwidth and large table information. AODV is a reactive routing protocol, which operates on hop-by-hop pattern. The Ad hoc On-Demand Distance Vector (AODV) [4] algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication.

After implementation of above clustering algorithm called Advance AODV Protocol (AAP) simulate through NS2 simulator using following input:

Table 5.1: Input data

Parameters	**Simulation value**
Simulator	NS-2.34
Simulation Time	300 second
Antenna Model	Omni directional antenna
Radio Propagation Model	Two Ray Ground
Transmission Range	250 m
MAC Type	IEEE 802.11
Interface Queue Type	Priority Queue (50 Packets)
Routing Protocols	Clustering
Simulation Area	1000 m X 1000 m
No. of vehicles	20

5.2 Analysis and Performance Comparison AODV with Advance AODV Protocol (AAP) find following Results:

5.2.1 Normal AODV and Advance AODV Protocol (AAP) Analysis

Table: 5.2 Results analysis AAP vs AODV

PARTICULAR	AODV	AAP
SENT PACKET	9564	9564
RECVD PACKET	9124	9357
ROUTINGPKTS	2109	1324
PDF	95.4	97.84
NRL	0.23	0.14
No. of dropped data	440	207
Actual Performance	20797	20245
Efficiency	96.40%	98.24%

Table 6.1 showing Implemented protocol's result is better than AODV. Here the efficiency is improved by 1.84% than AODV VANET routing protocol. Dropping packet makes the difference between sending and receiving packets. There are numerous conditions which occur when communication faces the problems those give the losses to communication and dropping packets.

Table 6.2 showing that dropping packets of AODV & Implemented protocol.

	AODV		**AAP**	
Drop from ARP	30	0.14%	22	0.11%
Drop from IFQ	37	0.17%	26	0.13%
Drop from CBK	63	0.29%	30	0.15%
Drop from TOT	0	0.00%	0	0.00%
Drop from NRT	199	0.92%	73	0.35%
Drop from END	7	0.03%	4	0.02%
Drop from DUP	0	0.00%	0	0.00%
Drop from RET	0	0.00%	0	0.00%
Drop from BSY	0	0.00%	0	0.00%
Drop from SAL	0	0.00%	0	0.00%
Drop from ERR	0	0.00%	0	0.00%
Total Drop Via Congestion	440	2.04%	207	1.00%
Total Drop	776	3.60%	362	1.76%

It is clear that total dropping packet of AODV rate 3.60% than Advance AODV Protocol (AAP) dropping rate 1.6%

6. CONCLUSION

In this paper we have designed for CH, GW selection and joining new node in the cluster etc. implemented these clustering algorithms (AAP) & compare with VANET routing protocol AODV, AAP is better than AODV. Our newly implemented protocol helpful in efficient communication due to their improved efficiency and lesser dropping rate.

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