

Optimization of Cluster Based Routing Protocol Using Bee Colony Optimization for VANet

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Abstract— Optimization is a techniques tends to improve maximum result under given condition. For large scale network having large traffic there has been used cluster based routing protocol to improve the performance of network. In this paper we consider as a VANET play and vital role for road side safety and to solve the emergency situation. Communication between vehicles is done by using routing protocol in this paper we introduce a cluster based routing protocol i.e. CBLR and HCR and compare its results. Also we apply Bee Colony Optimization techniques on these protocol to achieve maximum results. On the distinctive situations like ruler and metro areas analysis were consider. Performance Metrics like mean delay, mean throughput, PDR, available energy, jitter and packet loss has been calculated by varying no of vehicles (nodes).In this paper application of VANET is and future scopes also introduce.

Index Terms—CBLR, HCR, routing.

I. Introduction

Now a day's vehicles safety is a big issue because vehicles traffic is increasing on road. WHO (World Health Organization) report says in every year around 180 countries on the basis of global report available in 2015 there has 1.25 million death has happened by the road accident. Form early 2000s VANET consider as a sub branch of MANET (i.e. Mobile Ad-hoc Network) nodes in this network is dynamic in nature means every nodes can stay connected when it is in network but keeps moving. VANET can be categories on the basis of following points.

- 1) Exceptionally alterable topology: Due to availability of choice of different path and dynamic nature of the Vehicles we cannot define any fixed topology
- 2) Continuously detached system: For the Highway road the vehicles speed is more as compare to Hillary road so it is not possible to monitor location of vehicle and to maintain

- the connectivity. Many more factors responsible for dis-connectivity of network like in the tunnel GPS system fails due to satellite system unable to work in tunnels. Also the availability of RSU unit in every area is not possible.
- 3) Prediction of On Board Unit (Nodes): Prediction of position of mobile nodes can be done on the basis of speed of vehicle and current position of the vehicle, but many times due to the traffic availability and not able to monitor on the Vehicles.
- 4) Communication scenarios: In VANET network structure is dissimilar every time it has to be monitor on the basis of geographical area as well as traffic availability on the road.
- 5) Tough Hold-up: At the time of emergency it is needed to communicate urgently so to handling such situation has to be taken care.
- 6) Communication between Sensors: VANET is a real time system so to gather data like velocity, position, speed from sensor and transmit by using protocol have to make fast and in less amount of delay.
- 7) Battery Requirement and Storage Capacity: Sensors are continuously gathering data and transmitted to the RSU so the Nodes do not have to limitation or less storage capacity also the optimized duty cycle has to be implemented.

Due to movement of nodes VANET doesn't have any fixed infrastructure so to apply fixed routing path is not possible in VANET. Data communication is done between Vehicles to Vehicle, Vehicles and RSU (Road side Unit) and Base station also. Due to limited amount of storage capacity data can be stored in Base Station and when data is needed then vehicle is able to make request to RSU and then to the Base station for data. Different choices additionally taken by Based Station and RSU like which routing path is efficient for communication and the location of vehicles also updating in Base Station Memory Table. In one network there is having more than one RSU which is directly link with Base Station. Sometimes same

Base Station can act as a RSU. Vehicles which is in network stays connected with RSU and RSU sent all the information to the Base Station. Path decision also make in RSU.

Other services like road traffic awareness, finding a best traveling route that has been decided by driver, web internet connection, multimedia services, collision warning these above all the application is done by VANET.

II. Routing in VANET:

Router play an important role for communication, in every Vehicle On Board Unit (OBU)with Global Positioning System (GPS) need to be installed for communication. RSU has a high coverage and it is act like a router. For VANET manly communication done by using wireless standards (IEEE 802.11g) modem. Data has been collected from the sensors and given to the Routers. VANET is a sub-branch of MANET, same routing protocol cannot applicable for communicating because of dynamic nature of VANET and no fixed architecture of VANET.

Routing protocol for VANET can be decided on basis of following conditions

- a) Distance of Route: for different scenarios like range is large as well as short network. Routing Protocol has to be aware of these scenario for short range then packet size is having more and delay is also more but for long distance communication continues beacon signal has to be broadcasted.
- b) Geographical Area : for Hillary area normal routing protocol fails due to fixed object comes in between Vehicles so need to use appropriate protocol
- c) Emergency Situation: In trafficking and medical situation routing need to be done with-out any congestion in network and have to esurience of delivery of message in less amount of time
- d) Replicate Rejection:VANET used typical order addresses which is unique one for each vehicle. During the broadcasting of location routing protocol need to ensure that the duplication of address need to be filtered or rejected.
- e) Topology Selection: Due to sudden change topology of network, protocol need to select appropriate vehicles within the network and in less amount of time^[1].
- f) Coverage Area: Normally road area is lesser than the coverage area so monitoring on vehicle speed, movement pattern is to be well organized.

VANET routing protocol has been categorized on the basis of position acquiring and route update method^[1]. They are as follows:

- Position based
- Topology based
- Broadcast based
- Geo Cast based
- Cluster based

2.1) *Position Based RP*: In this type of category of protocol uses mainly three things i.e GPS module for finding the exact location of vehicle, also made available of neighbor node for creating communication link between source and destination by using beacon signal and forwarding. Route discovery is totally depending upon the location of source and destination of vehicle^[1]. In a tunnel where satellite service stop working this protocol fails to discovery of position.

2.2) *Topology based RP*: In this protocol uses available link information of network for forwarding data. Mainly there are two sub-categories they are as, Proactive and Reactive

Proactive: Uses shortest path algorithm, route finding is not required. ex. DSDV, OLSR. Main disadvantage of this protocol is, it maintain unused route path which is not required and so that large unused bandwidth.^[1]

Reactive: It is on demand routing protocol in this periodic flooding is not required. It is beaconless so that it save large bandwidth. Main disadvantage is required high latency for route finding and unreasonable flooding among the vehicles^[1].

2.3) *Broadcast based RP*: Packets has been flood over the entire network so that the destination node is outside the network can able to receive the message. Mainly this protocol is used for emergency related application like trafficking and climate information sharing purpose. Same message has been flooded over entire the network so the bandwidth uses is more and replication packets arrive at destination.^[1]

2.4) *Geo Cast based RP*: In this protocol zone forwarding concept has been used for communication. When the destination node goes outside the address of that zone has been forwarded to the source zoned then the communication takes place. This type of protocol reduce congestion and it has high PDR.^[3]

2.5) *Cluster Based RP*: Protocol create a network on the basis of same characteristics of node like velocity of mobile

node, routing direction. The group of same characteristics form a cluster. In this type of protocol communication within the same cluster is done by direct path creating but for other cluster communication done by cluster head. Formation of head on the basis of high energy available on that node as well as shortest distance within all the network, only cluster head communication outside the cluster. Due to long distance of route path delay is highly dynamic and overhead is increase advantage of this type protocol has a high scalability.^[4]

III. Protocol Used

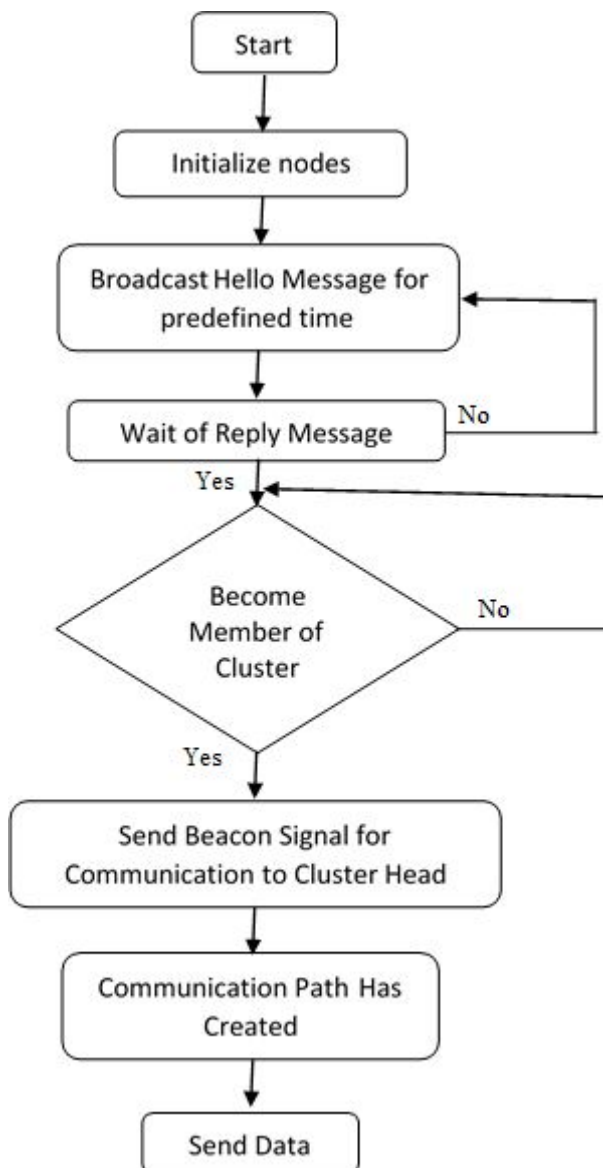


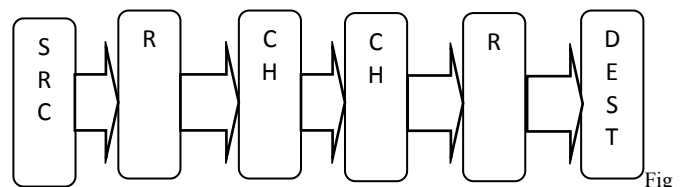
Fig 1. Cluster Formation Flow chart of CBLR protocol

Cluster Based Location Routing Protocol:CBLR protocol is energy efficient protocol from the family of proactive routing algorithm. Formation of Cluster Head in this protocol is by

selecting a higher energy nodes and closed to all the nodes cluster head is form other nodes become a cluster member.

Cluster Formation:

- Find all the available nodes in network
- Sent hello message including available energy and location of the nodes
- Form a lookup table on the basis of higher energy and neighbor node location
- Wait for reply message from neighbor nodes
- Node received reply message then this node act as a member of same cluster.
- Due to dynamic nature of nodes lookup table keeps updated in specific time
- Within same cluster nodes can form a direct link for communication but outside the network nodes need to send data through the cluster head.



2. CBLR protocol Route path

SRC- Source Node
R- Router Node
CH- Cluster Head
DEST- Destination Node

Hierarchy Cluster Based Routing Protocol:HCR protocol is developed version of LEACH protocol. Basic difference between CBLR and HCR is that it uses round-robin technique for cluster head formation.

Cluster Head Formation:

- On the basis of high energy available it form a cluster head
- Communication done within cluster directly form a link
- For outside cluster communication it follow the path

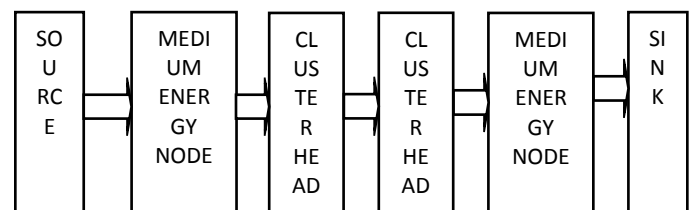


Fig 3. HCR protocol Route Path

- Due to use of round robin technique every member within the cluster get a chance to Become a cluster head

- On the basis of energy available in the node new node within the cluster became and cluster head after completion of specified no of iteration.
- Cluster created for the short duration it is called as round [4].
- Again round consist of two phases i.e. election phase and data transfer phase.

Election phase: cluster heads are created using threshold function [4].

Data Transfer Phase: Aggregation of data from network node to the network Cluster Head and send it to the Destination Cluster Head or to the RSU unit.

- Protocol uses TDMA sequence to give a priorities on the basis of round robin techniques.

IV. Honey Bee Optimization:

Karl von Frisch introduce a theory about bee colony that how bees find a food source and how they communicate between other bees. This food location sharing technique is very useful for finding the proper food source.

In every bee colony there is having a mainly three types of bees they are as follows:

Scout bees: These bees responsible for finding the new food source and new nectar. After finding the food source scout bees came back to the colony and perform the dance.

The Employed Bee: It get information from the scout bees and stays on a food source. It calculate the probability of quality of food source and make decision if more than one food source is available then to which food source have to give a priority and how many bees has to be recruited to which food source. This all decision has to be taken in the nectar after collecting the food information from the scout bees

On hooker Bees: These bees has been recruited by the employees bees for collecting the actual food which has been discover by the scout bees.

In bee colony scout bees play an important role for finding the new food sources after finding the food source scout bees came back to the colony and perform the dance to give the information about the food source. There are mainly two types of dance has been performed by the scout bees which is,

Round Dance: When the food source is less than 100 meter then round dance has been performed by scout bee. On the basis of distance, direction and quality of food source this dance has been performed.

Waggle Dance: When the food source distance is more than 100 meter then this dance has been performed by the scout

bees. This dance is also performed in the nest of colony but main difference in this type dance is bees move her wing on the basis of sun direction and food source, it form an angle which is decoded by employed bees for finding the food source. Bee continues move her wings on the basis of distance of food source if distance is close to the nest the movement of wings is faster on the basis movement of wing employed bees get the information and move toward food source.

Honey Bee for VANET: Honey Bees is an intelligent insect as we see how they find the food source and how they share food information with other bees this same method has been apply in VANET communication. Some consideration has to be made for applying Honey Bee Optimization techniques in VANET they are as follows:

Bee Techniques	VANET Alternative
Bee Hive	RSU
Scout Bees	RSU transmit HELLO message within the network
Food Source	Event Detected
Scout Bees Dance Performance in the HIVE	Get acknowledge message from the Nodes which came inside the network area to the RSU along with ID of each node
Recruited Employed Bees	On the basis of direction and distance of Node, RSU share the information and decide the no of path for communication.
Only Good Food Source has been selected by Employed bees other are abandoned	On the basis of availability of closest node which has been detected by acknowledge message from nodes, best path has been selected.

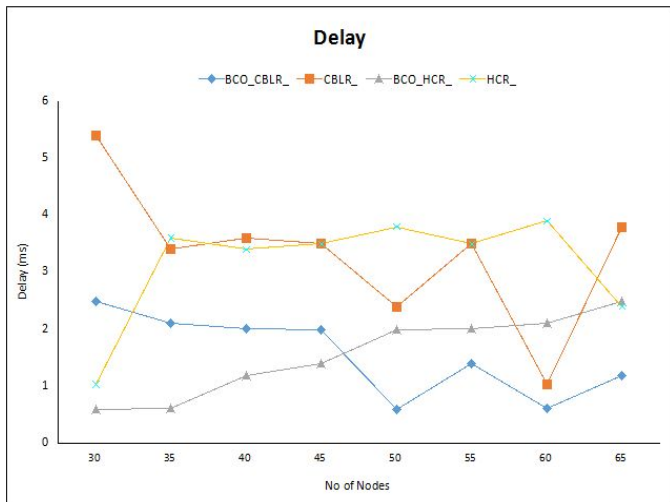
Table 1. Rules for finding best probable path after applying Bee optimization Technique in VANET

V. Simulation:

Simulation tool: Network Simulator 2.34 package has been used for simulation. For different scenarios like Urban and Rural areas by varying no of nodes. Both the protocols i.e. CBLR and HCR has been simulated for same scenarios with varying no of nodes. Simulation intend to compare both protocols with performance metrics for 30, 35, 40, 45, 50, 55, 60, 65 nodes. Parameter to be set is, Coverage area (300m*300m), Packet size (1000 bytes), Channel Bandwidth (2Mbps), Transmission Range (250m), Data Rate (100 packets/s), Max Delay (0.1s), MAC Specification (IEEE 802.11p), Simulation Time (400 seconds) after setting all these parameter simulation has been takes place.

Simulation Result: Performance Metrics like Delay, Throughput, Energy Mean Delay, PDR and Jitter has been

same for the both protocol only for 60 nodes CBLR throughput gets low up to the 220 packets. Without applying optimization technique throughput is much low as compare to optimized output.



compare.

Fig 4. Delay of HCR and CBLR Protocol

Fig 4 shows the comparison of delay between the HCR, CBLR, BCO_HCR and BCO_CBLR protocol. Initially for 30 nodes HCR delay is less but after increasing the no of nodes delay getting more. In CBLR protocol initially delay is more but by increasing no of nodes it show a good result that delay getting less. After applying optimization technique on HCR protocol delay is much less as compare to the CBLR delay.

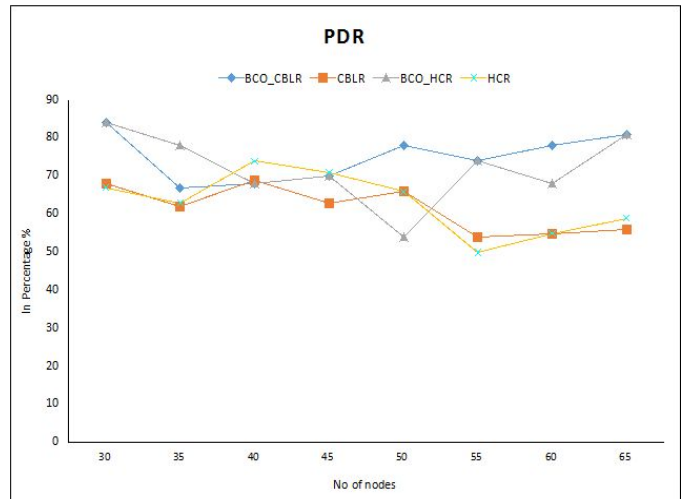


Fig 5. PDR of HCR and CBLR Protocol

Fig 5 shows Packet Delivery Ratio of both protocol which has been calculated in percentage. In HCR protocol PDR goes low for 50 nodes but for other cases it kept same. We can say that PDR for CBLR protocol is optimized and show a constant and good result.

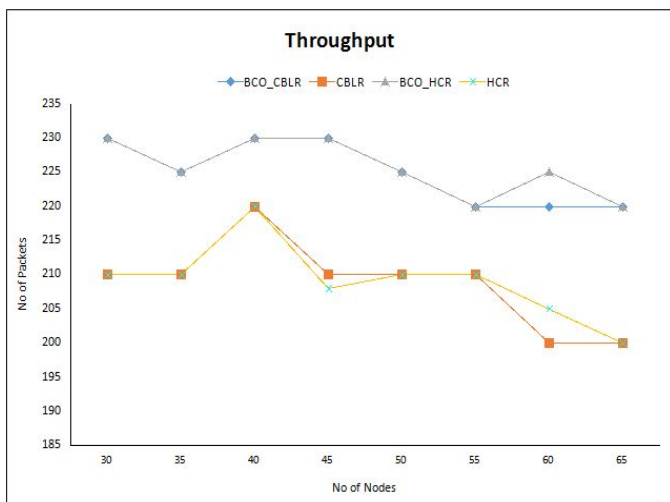


Fig 4. Throughput of HCR and CBLR Protocol

Fig 4 shows the throughput of HCR and CBLR protocol which has been calculated for how much amount of packets has been deliver to the destination in one iteration, throughput can also define in kbps. After applying Bee Colony Optimization Technique, Throughput has been optimized and it is almost

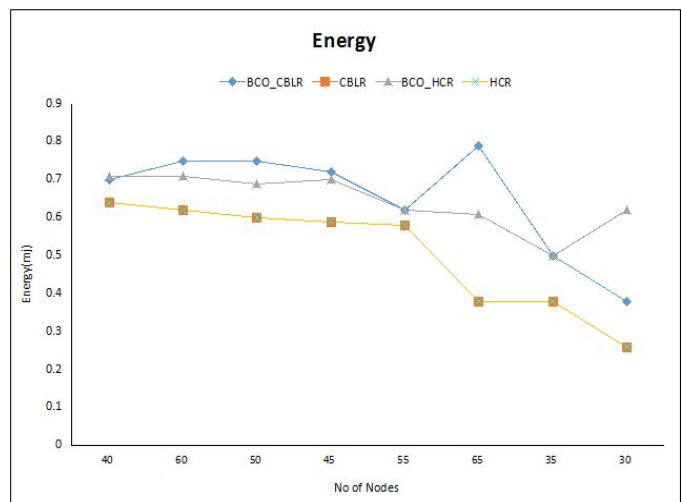


Fig 6. Energy Used by HCR and CBLR Protocol

Fig 6 shows the energy graph of both protocol. Without optimization technique energy used by both protocol is same but by applying optimization technique it uses more energy. We can say that the optimization technique require more energy because of it performed more operation for finding the best path for communication.

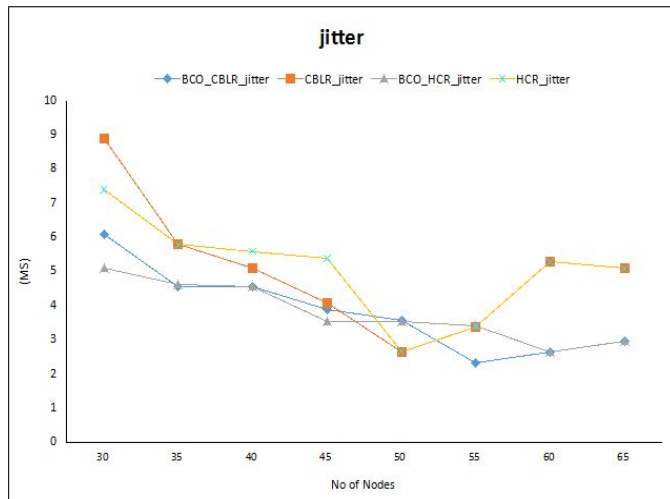


Fig 7. Jitter of HCR and CBLR Protocol

Fig 7 shows the jitter in mile second for both protocol. Jitter is nothing but a packet inter arrival time which can be calculated using difference starting time of packet and actual received time at the destination. After applying optimization technique for both protocol jitter is less.

VI. Conclusion

In this paper, purposed application of Bee Colony Optimization in VANET. The main goal is to provide each vehicle good reliable communication link for emergency situation. Performance metrics has been optimized after applying BCO. It shows that RSU play an important role for deciding the route path. On the basis of geographical location available and direction of vehicle RSU decide close path between source and destination. Future work is to compare with other protocols and choose proper protocol for different scenarios like for Hillary area, Metros and for the rural areas which protocol is to be suited.

VII. References

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