

An Optimal Network Selection and Efficient Two Level Cluster-Based Routing Mechanisms for Seamless Vertical Handover in Vehicular Networks



S.Angelin Sophy, I. Laurence Aroquiaraj

Abstract: Mobile Ad Hoc Network includes the crucial type Vehicular Ad-hoc Networks, (VANET). In this developed work, nodes are considered from vehicles and transmission capabilities are outfitted with its interconnected vehicles forming a network. Roadside equipment is fixed as all vehicles nearby are equipped with fixed equipment thus enabled communications in real-life application of VANET. In existing methodologies, designs of mobility are required by VANET specifically from Vertical Hand Over decision approach. This fails as of failure in links in networks on focusing issues. Thus, in dissemination of networks, routing is mandatory. Hence, our designed work of Effective two-layer cluster based Routing Mechanism is implemented in VANET to diminish the problems of failures in link. So, hybrid model is incorporated with Biogeography-Based Optimization (BBO) for choosing best available network done and process of vertical handover are done by ant colony optimization. Specific node for vertical handover is chosen based on the weight value from the hybrid model and deploys the SVM classification. On unsteady shape of topology, Effective Two-Level Cluster-based Routing Mechanism is used for maintenance of route. Initially, two clusters are formed with both links as strong and weak from divided nodes to perform routing among cluster members and the best route is chosen by greedy algorithm. High packet delivery ratio and low end to end delay is attained in this proposed approach from the analyzed results against existing methods.

Keywords: Vehicular Ad Hoc Networks (VANETs), Vertical Handover Decision (VHO), hybrid optimization, Support Vector Machine (SVM), Effective Two-Level Cluster-based Routing Mechanism, greedy algorithm

I. INTRODUCTION

One of the ensuring and securing technology is Vehicular Ad hoc Networks (VANETs) and allocated with the pool of several mobile nodes with self-configured while unique nodes plays router role intended for relay nodes with multi-hop.

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To realize more secure and convenient transportation system, VANETs facilitate smart vehicles to exchange wireless messages between themselves [1]. Information regarding warnings and alarms, adaptive trip assistance, traffic flow conditions and parking or gas station accessibility are included in these messages [2]. Vehicles furnished with wireless interfaces are capable of offering ITS services like navigation of vehicle, cloud computing with mobile vehicular, monitor of traffic along with nearby information services which is made possible by the development of intelligent vehicle and new generation wireless communication systems. The applications h framework of have base fact of entire traffic system of traffic connected and facilitated by means of VANETs for communication of nodes in the vehicles. In order to deliver a trustworthy service, several existing challenges in VANET must be looked up [3]. Routing algorithms, security and network architecture are those challenges. In VANET, steady and consistent routing is one of the chief issues, because of the changeable infrastructure and high mobility.

Vehicular communications in VANET are categorized in to two major divisions as Vehicle-to-Vehicle (V2V) and Vehicle to Roadside (V2R) [4]. Comparing with V2R based VANETs, V2V-based VANETs are superior with quite a lot of benefits as mentioned below:

- 1) Primarily, V2V-based VANET is predominantly appealing for majority of the expanding and enhancing countries and distant areas while inaccessible infrastructures of roadside are present, since this kind of VANET is more adaptable and much more unrelated to the roadside conditions [5].
- 2) Next aspect is that, since more expensive equipment is not needed, unlike V2R-based VANET, the V2V-based VANET is inexpensive.
- 3) Subsequently, tiny time of connectivity, fast fading and elevated hand-offs affected frequently by elevated speed relative in distinction of fast-moving vehicles and road-side stations prevented by V2V-based VANET [6].
- 4) Conclusively, for vehicle-related functions where in adjacent vehicles exchange messages, the V2V-based VANET is much more suitable.

Two major problems in VANET are concerned deeply in this research work. Because of the extreme vehicle speed and continuously altered network topology,



uninterrupted connectivity is a major challenging task and since the mobile nodes in the network are dynamic in nature, there comes the play of link failure issue [7].

Every single vehicle has a limited communication span. Hence some intermediate nodes are needed to direct some messages from the source to the objective node on less stipulated communication range is lesser than source to the objective node and also routing is a significant mission for VANET because of the link failure problem [8]. Thus to moderate this setback, a constant and reliable routing is very much indispensable. Sustaining constant connectivity between the vehicles and infrastructures and to conquer the continuous connectivity problem, Vertical handover process (VHO) is more essential [9]. An effective two-layer cluster based Routing Mechanism is applied to solve the link failure problem. The primary reason behind the application of routing with base of Cluster, achievability of self-organized and maintenance of routing in sort of network topology of is altered [10]. This research technique emphasizes resting on forming an Effective double-layer cluster based Mechanism of Routing through a algorithm of greedy in VANETs to lessen the link failure problem.

Including the aim of choosing the best prevailing network, a hybrid model is applied in this research work. Biogeography-Based Optimization (BBO) and ant colony optimization for vertical handover process are merged together to accomplish this task. The SVM classification method is then utilised to select a particular node for vertical handover decision based on the weight value from the prior stage hybrid model. Under the circumstances where topology does not have a stable shape, route maintenance especially is made easier by Effective Two-Level Cluster-based Routing Mechanism. By means of dividing the nodes into two sets, as those with strong and weak links, routing is implemented between cluster members. Strong links are selected initially and then at the next stage, best route is selected applying greedy algorithm. Safety of the vehicles is thus increased leads to maximize the ratio of packet delivery.

Rest of proposed work is structured as below:

- Section 1 - general idea of the system at objectives in optimizing network selection and the performance of routing at topology of dynamic get varies.
- Section 2 - presents review of the existing Routing and handoff mechanisms.
- Section 3 - describes about the efficient two level cluster based routing mechanism and Vertical Handover process are detailed and combined to solve the challenges in VANETs.
- Section 4 - explains the component experiment, analysis, and results are being compared of proposed protocol.

Section 5 - the conclusion of the research work are presented..

II. LITERATURE REVIEW

Many of the prevailing routing techniques with base of clustering for communication among vehicle to vehicle are discussed detail in this section. Enhancing the packet transmission with the help of several routing mechanism by

manipulating the parameters is the primary attention given by majority of these methods existing in literature. A concise study and review of various methodologies in routing as well as network selection is depicted as following.

Mamatha et al [11] proposed the hybridization of two clustering techniques Fuzzy C Means (FCM) and Quadrature- Low Energy Adaptive Cluster Hierarchy (Q-LEACH). Network clustering is done first by the FCM based clustering followed by network optimization by Q-LEACH. The optimal Cluster Head (CH) for aggregating the data from the Sensor Nodes (SNs) is chosen in the course of the clustering process. In order to minimizing the transmission time from the source (SN) to the BS, IEEE 802.11p protocol was utilized to achieve the communication from the Road Side Unit (RSU) to the Base Station (BS). In terms of network latency, total packets transmitted, energy consumption and throughput, the performance of FCM-Q LEACH-VANET was studied. The results reveal that, in comparison to the existing protocol, the throughput of the FCM-Q LEACH-VANET is further improved

The structure of Vehicular Ad Hoc Network (VANET) surrender its plan grounded on Long Term Evolution – Advanced (LTE-A) by means of decision technique in hybrid communication mode for Vehicles to Vehicles (V2V) communication network and Vehicles to Infrastructure (V2I) communication network is portrayed in this paper. An interoperable wireless networks, VANETs encompass numerous vehicles and element infrastructure [1]. An On Board Unit (OBU) that permits vehicles communication with ad hoc manner denoted as Vehicle to Vehicle (V2V) communication is contained in every single vehicle with mobile node (MN). information are communicated among Vehicles concerning an instant or an rising problem like a road obstacle, an accident or another securing life alerts that are time critical. Communication with its inner elements such as a Road Side Units (RSU) or a base station is performed by the Vehicles. This communication is termed as Vehicle to Infrastructure (V2I) communication. Service providers giving out the obtaining work and updated information by the vehicles is granted by V2I [2]

Yang et al [12] proposed a residual route function time to compute the overlapping time between the vehicles quantitatively with information route by means of novel cluster head metric selection is offered. Mechanism of future-cluster head is devised in addition, though which the message exchanges at intersections could be prevented and the overhead of cluster maintenance could be reduced. In contrast to the previous works, our clustering algorithm can accomplish higher stability and concurrently lesser communication cost which is demonstrated through the simulation results. Verma et al [13] offered the base protocol LEACH that typically controls in the network of homogeneous criteria, where identical energy levels are maintained in all sensor nodes. Here exists a part that regions get partitioned and further divisions of regions are still more classified and the cluster heads are being counted in every region and parameters like alive nodes, dead nodes, residual energy, cluster heads, network lifetime are all evaluated up to some finite rounds on the basis of this. In order to contribute every parameter with similar feature and maximized outcome, and resulting in obtaining the top potential value is considered in this criteria.

Abbas et al [14] recommended a novel Clustering-based Reliable Low-Latency multipath Routing (CRLLR) scheme by utilizing Ant Colony Optimization (ACO) technique. For Cluster Head (CH) selection, the link reliability is applied as a criterion. If a reliability of link is high in vehicle of given cluster then chooses CH. With the intention of efficiency, calculating the routes with optimal amongst the communicating vehicles for VANETs via QoS metrics such as end-to-end latency, throughput, reliability, and energy consumption, the ACO technique is applied furthermore. This approach takes parameters as of latency; reliability with high energy consumption against the AQRV and T-AOMDV and this is validated through simulation results.

Sugumar et al [15] put forward a scheme of authentication trust-based intended for clustering based on VANETs. Thence this proposed clustering of the vehicles is achieved, and the trust degree of all the nodes is approximated. Direct degree of trust and indirect trust degree combined together provide the trust degree. Cluster heads are chosen depending on approximated degree of trust. Followed by this set of verifier monitors the every vehicle, which in turn trailed by the digital signing of the sender messages and a private/public key is applied for encryption which is distributed via authority in trust and destination are being decrypted finally. Authentication is thus taken care of in this system by substantiating the sender and receiver identity. By means of the simulation results, achieving less overhead and better security and delay by the proposed method is proved.

An approach by [16] Bali et al initiated a clustering scheme effectively in prediction of energy conscious in favor of vehicles. by further predictions in mobility and typical vehicles variations on the road, the algorithms are fabricated efficiently. The clustering period and cluster containing clump sum vehicles are evaluated by the algorithms. Compared with prevailing benchmarked structure, still more wide range of simulations which are accomplished by vehicles in variation and durations of cluster are made use of to study the performance of the designed algorithms. The results achieved illustrates research scheme is outstanding on distinguishing against existing category scheme.

An approach of cluster-based directional routing protocol (CBDRP) is proposed by Song et al [17] for a way of high scenarios. This scheme corresponds to the moving direction of vehicle, cluster header pick out next header in order to forward the packets. A simulation result indicates that, realizing reliable and rapid data transmission, the issues of VANET stability link are resolved by the CBDRP.

Luo et al [18] offered an innovative protocol on routing for VANET termed Cluster Based Routing CBR taking the former results as the foundation. With the escalation of number of vehicles, the novel strategy has noticeable enhancement in the typical routing overhead and small average end to end delay jitter, comparing with other existing routing protocols. Since the real-time traffic applications necessitate relatively transmission of data in stable with time delay and have lesser typical jitter in end to end delay with more vehicles number, the proposed system just satisfies the need of real-time applications.

Ahizoune et al [19] put forth a new stability-based clustering algorithm (SBCA), exclusively designed for VANETs, while acquiring in to consideration the neighbors in number, mobility, and leadership (i.e., cluster head) duration so as to afford a further stable architecture. Noteworthy up gradation in the network stability by increasing the cluster head lifetime

longer than other preceding standard clustering algorithms is achieved by the proposed technique and this is evidenced by the results obtained through massive range of simulations.

Lin et al [20] proposed new methodologies that object modeling are begin moving and from the theory of large moving object databases using indexing techniques into the design of VANET routing protocols. Wide-ranging simulation research were performed out on maps with road in real and the results make obvious that this approach achieves outstanding results in distinguishing the in routing protocols of both clustering and non-clustering.

Various clustering techniques for the effective network selection in VANETs are studied and analyzed in the previous sections. The blending of vertical handover and clustering techniques which is not been studied in earlier works might be still more precise than the other existing methods and hence may direct to better results. As a matter of fact, this crucial issue can be taken into account as a hole in the existing work and literature selection criteria.

III. PROPOSED METHODOLOGY

A Vehicular ad hoc network (VANET) offers communication among vehicles on the road and also the connection between vehicles and infrastructure units which are normally installed at the side of the highways. Two key issues in VANETs are given attention to in this research work as, 1) uninterrupted connectivity between network and the node 2) the issue of link breakage between the vehicles. Vertical handover decision strategy is applied in the proposed work with the aim of resolving one of the key issues of supplying continuous connectivity to the node. An effective two layer cluster based routing mechanism is provided to resolve the next key issue as link failure problem. Vertical handover is the procedure that is put into operation in situations where the mobile users switching among the networks with dissimilar technologies like Wi-Fi to WiMax. Thus VHO is primarily utilized in heterogeneous networks.

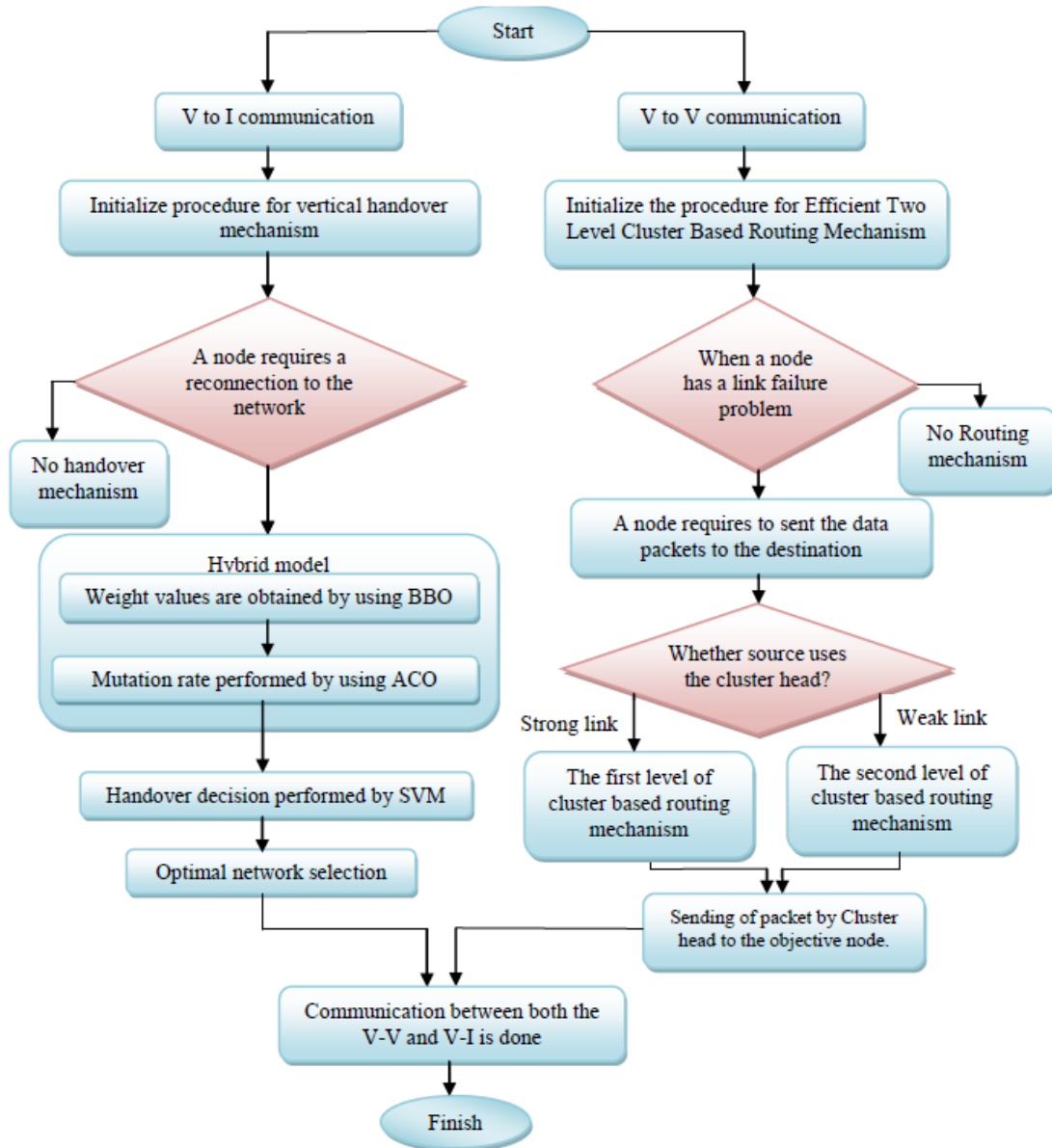
For selecting the network in best-optimized access for the purpose of handover process and at the same time for preserving the stability of connection throughout the complete session, the vertical handover decision-making (VHD) strategy is employed in this research work. There is a limited communication scale for every vehicle. Hence some intermediate nodes are needed to direct some messages from the source to the objective node, and conditioned communication range is lesser than the distance between source & destination or else if being affected by various other issues such as Road Side Unit (RSU) failure. Consequently, optimal route is determined among source to objective nodes ensuring routing is inevitable. Cluster based routing mechanism creates cluster between nodes or vehicles. A collection of nodes categorizes themselves as a part of a cluster and the only cluster-head of the group takes the responsibility of both intra and inter-cluster communication. Through the direct link, nodes within each cluster are connected in order to provide the intra-cluster communication and likewise communication of inter-cluster is provided through the header cluster. On aiming to select the best available network, a hybrid model is applied in this research work. Biogeography-Based Optimization (BBO) and ant colony optimization for vertical handover process are merged together to accomplish this task.



The SVM classification method is then utilised to select a particular node for vertical handover decision based on the weight value from the prior stage hybrid model. Under the circumstances where topology does not have a stable shape

the shape, route maintenance especially is made easier by Effective Two-Level Cluster-based Routing Mechanism. By means of dividing the nodes into two sets, as those with strong and weak links, routing is implemented between

cluster members. Strong links are selected initially and then at the next stage, best route is selected applying greedy algorithm. Safety of the vehicles is thus increased in sequence to delivery of packets ratio in maximization. The functional block diagram of the proposed vertical handover mechanism and efficient two level cluster based routing mechanism is depicted in Figure 1.



3.1. Vertical Handover Strategy

The Vertical Handover algorithm, a model of hybrid that brings together the Biogeography-Based Optimization (BBO) and ant colony optimization so as to decide on the best available network for Vehicle communication. Swarm intelligence is used to assign weight values of each service on the basis of each sensor's quality of the services parameters. Than a specific node for vertical handover decision is chosen based on the weight value using the SVM classification technique. Setting up of a beneficial network from the existing node in the frame of wireless network be necessary and this is made possible by an efficient adjusting feature of the QoS weights. Based on the user preferences and the network features, to examine the network quality, every parameter of QoS is allocated a set of weights. A weight that

exists in the range of 0 to 1 can be assigned to an overall QoS profile including parameter. For this measure termed as cost function, a specific function is accountable. Calculation of this function is carried out in the VH decision-making phase. And thus, achieving the valuable resolution with the low cost consumption on applying networks is the consequence of the optimization issue. For the VH phase as making decision, this solution would be preferred as the best one. The component of the BBO assigns an appropriate weight (w_1, w_2, \dots, w_i) to each initial decision based on the function objective recognized by the operator in terms of importance and sensitivity to the selection criteria of the access network to diverse features of the wireless heterogeneous setting.

If $S = \{s_1, s_2, s_3, \dots, s_N\}$ is regard as a set of candidate networks and $Q = \{q_1, q_2, q_3, \dots, q_N\}$ as a set of quality of service factors, then M is the number of quality of service factors and N is the number of candidate networks. Furthermore, each factor of QoS is deemed to have its own weight which demonstrates the impact of the factor on the user or the network.

3.1.1. Hybrid biogeography-based optimization (BBO) and Ant Colony Optimization

Selecting the best suitable solution from all possible solutions is referred as the Optimization model which in turn is a mathematical model. Because of the complementation of BBO and ACO, both are combined together in the proposed system as a hybrid technique with a remarkable performance. By extending mutation operation in BBO so as to yield a better solution generated by ACO, the proposed hybridization structure is slightly more efficient. The solution is attained through two stages – firstly, the solution that reached local optima is generated by means of ACO. The

solution creation in this step is repeated iteratively and independent to each other.

Amidst biology-based optimization methods, BBO has certain characteristics which are more unique. Over a population of individuals called habitats, the BBO algorithm performs its operation. Habitat suitability index (HSI), is a metric which determines the goodness of a candidate solution and the fitness of each habitat is decided by HIS and also each habitat feature is named as a suitability index variable (SIV) [21]. In order to probabilistically share the information between habitats, the immigration rate λ and the emigration rate μ of each habitat are used. The number of species S in a habitat is affected by these parameters. When the habitat is empty, maximum immigration rate I occurs; as more species are added, it decreases; when all possible species S_{max} are present on the habitat, maximum emigration rate E occurs. The immigration and emigration rates when there are S species in the habitat are given by,

$$\lambda_s = I \left(1 - \frac{S}{S_{max}}\right) \tag{1}$$

$$\mu_s = E \left(\frac{S}{S_{max}}\right) \tag{2}$$

Input: A network with Vehicle attributes
Output: A set of partitions of vehicle attributes

1. Initialize the population
2. Population size $\leftarrow N_p$
3. Sort the population according to the increasing order of fitness
4. Calculate λ and μ
5. Generation index \leftarrow GenIndex;
6. **for** GenIndex = 1 to Maxgen **do**
7. Apply migration
8. **for** $i = 1$ to N_p **do**
9. Select habitat H_i according to λ_i
10. **if** $rand(0,1) < \lambda_i$ **then**
11. **for** $e = 1$ to N_p **do**
12. Select habitat H_e according to μ_e
13. Replace the selected SIV of H_i by randomly selected SIV of H_e
14. **end for**
15. **end if**
16. **end for**
17. Apply mutation
18. **for** $i = 1$ to N_p **do**
19. Compute mutation probability $m(S)$
20. **if** $rand(0,1) < m(S)$ **then**
21. Replace H_i (SIV) with ACO weight calculation of each SIV
22. **end if**
23. **end for**
24. Sort the population according to the increasing order of fitness
25. Keep the elite solution
26. Stop, if termination criteria satisfied
27. **end for**

3.1.2. Vertical Handover decision performed by Support Vector Machine (SVM)

Two processes are implemented by the SVM method: history location information training with offline module; by inputting test location data vector to SVM module though online next subnet number prediction [22].

The objective of offline module training is to obtain an approximate prediction module $D(x_i)$ which reflects the relationship between the prediction values y_i and x_i , by using

the history information $(x_1, y_1), \dots, (x_m, y_m)$. When a new vector X is given as input to the module $D(x_i)$, it can output a prediction result y to predict the next subnet number the user will leave for. In two-class SVM, this process is equivalent to construct an optimal hyper plane H in the feature space. And the equation of can be written as,

$$w \cdot x + b = 0 \tag{3}$$

Where w is the weight vector and b is the bias. The separation margin between support vectors (SVs) is $2/\|w\|$. The goal is to find the optimal w^* and b^* .

The problem is actually to maximize the separation margin with the corresponding constraints:

$$\text{minimize } \Phi(w) = \frac{1}{2} \|w\|^2 + C \sum_{i=1}^m \xi_i \quad (4)$$

$$\text{s.t. } y_i(x_i \cdot w + b) \geq 1 - \xi_i, \quad i = 1, 2, \dots, m, \quad (5)$$

Where ξ_i is the relaxation variable. It is introduced to construct the optimal-type hyperplan in the case when the data are linearly inseparable. C is the adjustment factor that is used to determine the model complexity and punishment degree.

$$Q(w, b, \alpha, \beta, \xi) = \frac{1}{2} \|w\|^2 + C \sum_{i=1}^m \xi_i - \sum_{i=1}^m \alpha_i [y_i(x_i \cdot w + b) - 1 + \xi_i] - \sum_{i=1}^m \beta_i \xi_i \quad (6)$$

Where α_i and ξ_i are the Lagrange multipliers.

To estimate the α_i coefficients, it is sufficient to find the maximum of its dual functional with the corresponding constraints:

$$\begin{aligned} \text{maximize } W(\alpha) = & \sum_{i=1}^m \alpha_i - \frac{1}{2} \sum_{i=1, j=1}^m \alpha_i \alpha_j y_i y_j K(x_i, x_j) \quad (7) \\ \text{s.t. } & 0 \leq \alpha_i \leq C \\ & \sum_{i=1}^m \alpha_i y_i = 0 \quad i = 1, 2, \dots, m, \end{aligned} \quad (8)$$

Where $K(x_i, x)$ is kernel function. The task of kernel function is to extract features from the original space and map samples in original space to a vector in the high-dimensional feature space, so that the problem of linear inseparable in the original space is resolved [23]. Linear kernel, polynomial kernel, RBF kernel, and sigmoid kernel are chief kernel function types. The optimization can be written as,

$$w^* = \sum_{i=1}^m \alpha_i^* y_i x_i \quad (9)$$

Bias b can be obtained by the original constraint condition:

$$b^* = \frac{1}{2} \left[\max_{y_i = -1} (\langle w^*, x_i \rangle) + \min_{y_i = +1} (\langle w^*, x_i \rangle) \right] \quad (10)$$

And the prediction module can be written as

$$D(x) = \text{sign}(\sum_{i=1}^m \alpha_i y_i K(x_i, x) + b) \quad (11)$$

$D(x)$ is the two-group prediction results. To implement the online mobility prediction, test location data x is then given as input to (x) . It is worth mentioning that SVM algorithm in this section is just designed for two-group classification problems initially. Nevertheless, more than two kinds of results need to be output from SVM.

3.2. Effective Two-Level Cluster-based Routing Mechanism

3.2.1. The first level of proposed routing mechanism

In this section, routing inside the cluster which is the first level of the proposed method is explained in detail. By means of the nodes with a high quality link to the cluster head, at the first level of proposed routing, the cluster node transmits the data packets. Following are the steps for the first level of routing:

1) Essential information such as location from cluster head, velocity and direction are collected first by the source sending a REQ packet to the cluster head

2) The distance between the source node and cluster head is calculated after attaining the required information by the source node using (12).

$$D = \sqrt{(X_2 - X_1)^2 + (Y_2 - Y_1)^2} \quad (12)$$

So that (X_1, Y_1) and (X_2, Y_2) are the coordinates of the first and second nodes respectively, and D represents the distance between two nodes.

3) Making use of the information which is received from the cluster head, the source node computes its quality of link (QoL) to the cluster head. Taking the required information such as direction, velocity, and distance, in order to calculate QoL, the node uses (14).

$$DIR = |Direction_{source} - Direction_{clusterhead}| \quad (13)$$

$$QoL = \left(1 - \frac{Distance}{Max\ Range}\right) \times \left(1 - \frac{Velocity}{Max\ Velocity}\right) \times \left(1 - \frac{DIR}{180}\right) \quad (14)$$

where distance between node and the cluster head is represented by Distance, velocity of the node is represented by Velocity, highest velocity of the node is denoted by Max Velocity, highest radio range of node is denoted by Max Range, direction of the source node is indicated by Direction source, direction of the cluster head is represented by Direction cluster head, both of which are of the interval $[-90, 90]$, and QoL denotes the quality of link between node and cluster head. The greatest difference is supposed to be 180.

4) A node would be regarded as a strong node, if the quality of the link is greater than a defined threshold value of QoL (QoL_{th}). Through a strong link, the strong node transmits the packet directly to the cluster head.

5) Otherwise, this node is regarded as a weak node or else node with a weak link. Through a strong node, the node sends its data packet with a weak link to the cluster head. A REQ_L1 packet is sent to neighbors by the source node with its location with a request to send back their quality of the link to cluster head and distance to the source node. The node which receives the REQ_L1 packet first calculates its distance to the source node using (12) and also their QoL to the cluster head is calculated using (14), and then send them through the REP_L1 packet to the source node.

6) The information such as quality of the link to cluster head and distance between the source node and its neighbors are all buffered in to a table by the source node after receiving REP_L1 packets by it from its neighbors. In order to send information, the source node selects the best node using (16). Each of neighbors that are all having the best value of optimal path (OP) is designated as the best node to deliver data packet to it.

$$Scope = \frac{1}{ST} \quad (15)$$

$$OP = CV \times \left(\frac{QoL}{D \times scope} \right) \quad (16)$$

Where CV is a constant value that is between 0 and 1.

7) The source node hand over its data packet to the neighbor possessing attributes as a high quality link, less distance and high value of S_T .

8) Received data packet is then delivered to the cluster head by the neighbor selected in step 7. The flowchart of the first level of the proposed method is presented in figure 2.

3.2.2. The second level of the proposed routing mechanism

In case the destination is present in a different cluster, then in this case, the data packet must be forwarded between the cluster heads so as to reach the cluster head of the destination [24]. For routing between cluster heads, second level of the proposed method is applied. The best next step or the best next cluster head is found at this point of juncture by applying

a greedy algorithm by the cluster head. The steps of the second level of routing are described in detail as follows:

1) To get the information it requires, the cluster head transmits a REQ_L2 packet to its identical cluster head neighbors.

2) The velocity and location of its neighbor cluster head are requested by the containing packet.

3) To signify that it is the destination, the cluster head set the check field as one, in case the cluster head that received REQ_L2 packet is happened to be the destination and sends the REP_L2 packet to the source node. Without the intermediary, the cluster head of the source node then sends the data packet to the destination node

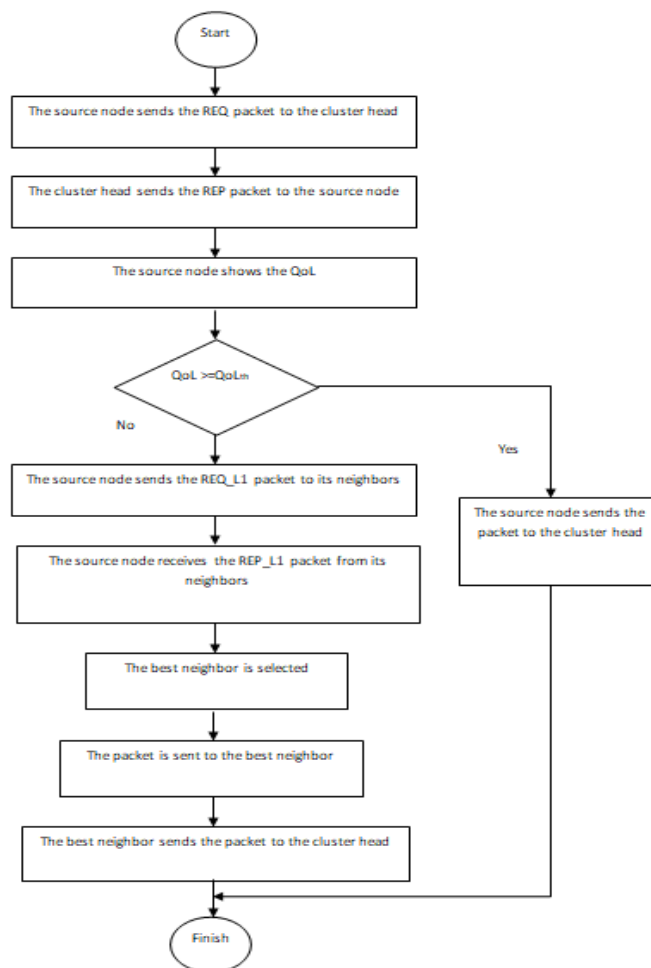


Figure 2. The first level of the proposed cluster based routing mechanism

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Without the intermediary, the cluster head of the source node then sends the data packet to the destination node.

4) Under the instances that the cluster head that receives REQ_L2 packet identifies that the destination exists within its cluster, then the cluster head set the check field of the REP_L2 packet as one which specifies that the destination is

within the cluster and it is return to the source node. On receiving REP_L2 packet, the data packet is sent to the cluster head of the destination by the cluster head of source node. The data packet is then sent to the destination node within its cluster by the cluster head of destination node.

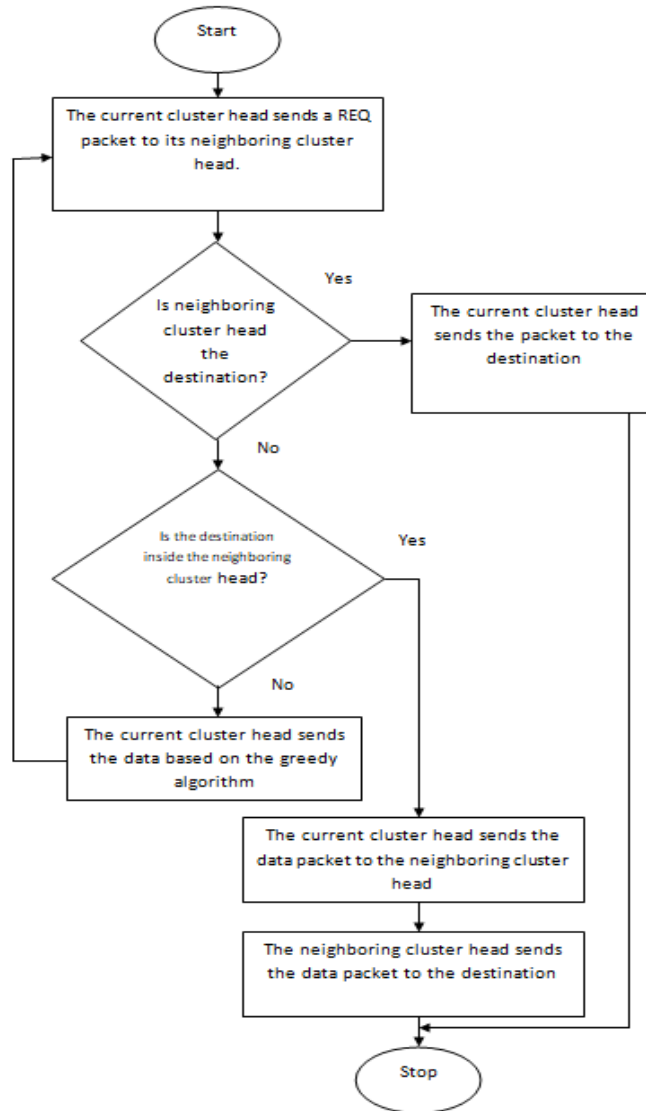


Figure 3. The second level of the proposed cluster based routing mechanism

5) If the cluster head that receives REQ_L2 packet is not the destination, the cluster head set the check field as zero to signify that it is not the destination or the destination is not within its cluster and returns the REP_L2 packet to the source node. Based on the information obtained from its neighbor cluster head, the cluster head of source node make decision in a greedy way, to deliver the data packet to the preferred cluster head. At that time, the data packet is sent to the selected cluster head.

6) The cluster head chosen by step 4 iteratively perform the steps in order to select the next step from step 1. Up until the delivery to the destination is done, this procedure continues. the most excellent neighbor is selected from the following steps are performed. The element selection in a greedy method is based on a certain criterion in each step, in

spite of the selections already made or will be considered in future. The algorithm of greedy function as in this method is explained in the following section. When the cluster head that is neither the destination nor the destination within the cluster, receives the packet, information including the location and velocity are delivered by this cluster head to the source node by sending back the REP_L2 packet.

According to the REP_L2 packets accepted from neighboring cluster heads, the source node uses the greedy algorithm for choosing best suitable next cluster head. Evaluation function utilized in the algorithm of greedy for examining cluster heads is given by equation (17)

$$F = (\alpha \times |V_{source} - V_{selected}|) + ((1 - \alpha) \times D) \tag{17}$$

- D, the distance between the source node and selected node
- (X_{source}, Y_{source}) and $(X_{selected}, Y_{selected})$, the coordinates of the source node and selected node
- V_{source} and $V_{selected}$, the speed of the source node and node selected
- α , the weighting factor ($1 = \alpha$). To reach the data packet to the cluster head of the destination node, this step is repeated for each cluster head.

figure 3 gives out the proposed method of second level.

3.2.3. Greedy approach

In the play field, keep the nodes randomly inside initial stage and location randomly at I^{th} node. To form a chain, nodes will be organized. algorithm of greedy is being used and commencing a few nodes, this process is carried out by sensor nodes themselves or this chain could be computed and every sensors nodes gets transmitted by the base station (BS)[25]. Presuming that every node has the global knowledge of the network to construct the chain and utilize the greedy algorithm for constructing the chain. To construct the chain, commence from the BS and ensure that the farther nodes from the BS have close neighbors. As in greedy algorithm the neighbor distances increase progressively, a node that exists already in a chain cannot be revisited.

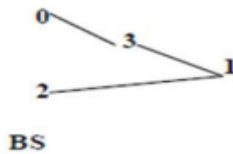


Fig 4.chain construction using greedy algorithm

From Figure 4. It is clear that node 0 is connected to node 3, node 3 is connected to node 1 and node 1 is connected to node 2. Chain is recreated in the same manner when a node dies, so as to bypass the dead node. Figure 5 illustrates the token passing approach meant for gathering data in each round. On receiving data from one neighbor, every node attaches its own data with the original one and the sends it to other neighbor residing on the chain. In each round of communication, the leader will random position on the chain, this is vital for the nodes to die at random locations. Initiated by the leader, the data transmission starts from the ends of the chain by the simple protocol token passing approach

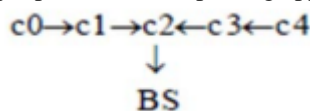


Fig 5.token passing approach

In the above figure, leader is C2 and transmits the token next to the chain to node c0. Node c0 will pass its data headed for node C2. Once data from node C1 is received by C2, the token will be passed by it to C4. In turn, data from node C4 will be passed back towards node C2. Thus in every round of communication, transmission to BS is finally by one single node only.

IV. SIMULATION RESULTS AND DISCUSSION

NS-2 simulator is used in this section on simulation focus and evaluates the proposed optimal network selection and cluster based routing mechanism. In sort of accuracy and the user adaptability beside several parameters such as throughput, handover latency, handover rate, Efficient Two Level cluster based Routing Mechanism (ETLCRM) and BBO-SVM results in efficient against other existing methods.

4.1. Throughput

Throughput is referred of rate of packets data getting transmitted over network or communication links successfully and measured in bits per second (bit/s or bps). The units of information transmitted over a particular time slot gives throughput.

Table 1. Throughput comparison between the proposed and existing techniques

Time	Throughput			
	MADM	M-BBO	BBO-SVM	ETLCRM
10	1.835	2.053	2.243	2.633
20	2.059	2.852	3.262	3.502
30	2.420	3.103	4.103	4.513
40	3.830	4.592	5.202	5.819
50	4.165	5.536	6.806	7.433

Table 1. tabulates the throughput comparison between the proposed and existing techniques

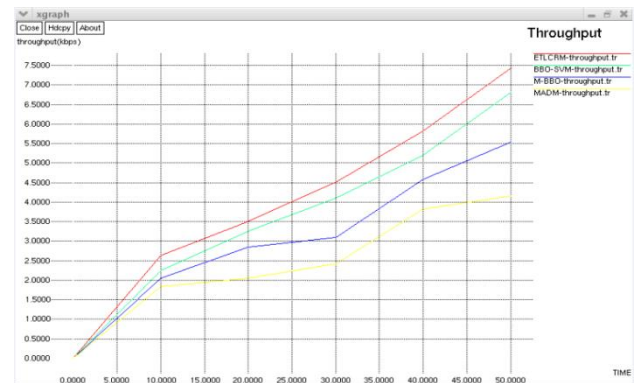


Fig.6. Throughput comparison of vertical handover mechanism between proposed and existing methods

The proposed and existing methods are compared with Throughput metric and selection of available network using vertical handover mechanism and cluster based routing mechanism are shown in Fig.6. Simulation result exhibits that the proposed ETLCRM achieves high throughput results against existing BBO-SVM and M-BBO methods.

Table 2. Comparison of handover rate between the proposed and existing techniques

Vehicle	Handover Rate			
	MADM	M-BBO	BBO-SVM	ETLCRM
10	3	2	1	1
20	4	2	1	1
30	4	3	1	1
40	6	4	2	1
50	6	4	3	1

Table 2. tabulates the handover rate comparison between the proposed and existing techniques

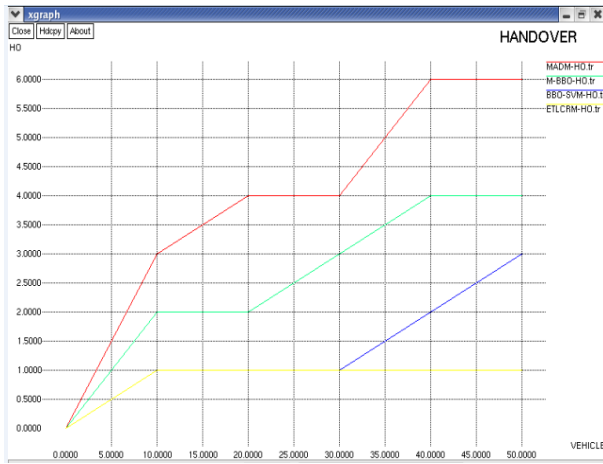


Fig.7. Handover rate comparison of vertical handover mechanism between proposed and existing methods

The proposed and existing methods are compared with Handover rate metric and selection of available network using vertical handover mechanism and cluster based routing mechanism are shown in Fig.7. Simulation result exhibits that the proposed ETLCRM achieves less Handover rate against existing BBO-SVM and M-BBO methods.

Table 3. Comparison of Latency rate between the proposed and existing techniques

Speed	Latency			
	MADM	M-BBO	BBO-SVM	ETLCRM
10	2.229	2.102	1.873	1.500
20	2.719	2.309	1.979	1.611
30	4.977	3.435	3.035	2.502
40	6.665	5.665	4.937	3.401
50	8.964	6.636	5.963	4.113

Table 3. tabulates the Latency rate comparison between the proposed and existing techniques

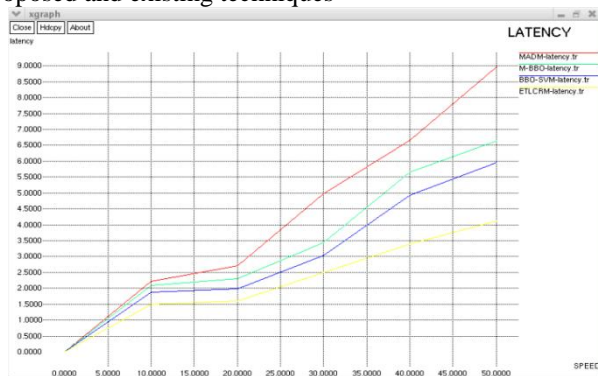


Fig.8. latency comparison of vertical handover mechanism between proposed and existing methods

The proposed and existing methods are compared with the latency metric and selection of available network using vertical handover mechanism and cluster based routing mechanism are shown in Fig.8. Simulation result exhibits that the proposed ETLCRM achieves less latency rate against existing BBO-SVM and M-BBO methods.

Table 4. Packet Loss Ratio Comparison of proposed against existing techniques

Speed	Packet Loss ratio			
	MADM	M-BBO	BBO-SVM	ETLCRM
10	0.200	0.00	0.00	0.000

20	0.622	0.322	0.212	0.119
30	0.740	0.540	0.359	0.222
40	1.000	0.722	0.562	0.344
50	1.236	0.844	0.634	0.419

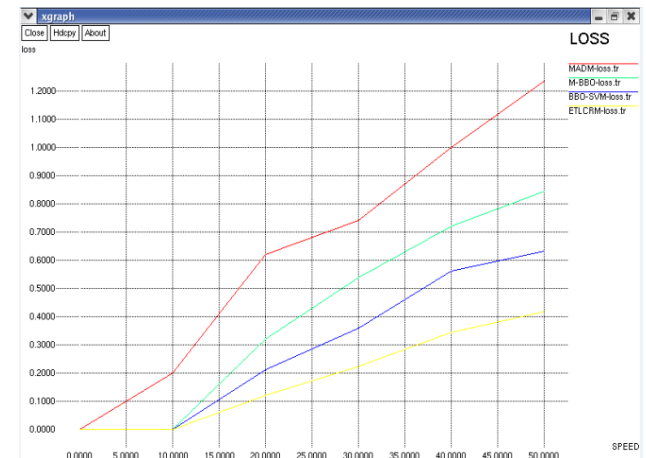


Fig.9. Packet loss ratio comparison of vertical handover mechanism between proposed and existing methods

The proposed and existing methods are compared with the Packet loss ratio metric and selection of available network using vertical handover mechanism and cluster based routing mechanism are shown in Fig.9.

Simulation result exhibits that the proposed ETLCRM achieves less Packet loss ratio against existing BBO-SVM and M-BBO methods.

V. CONCLUSION

Depending on Routing mechanism, Quality of Service are performed well in VANET. The main definitive objectives of proposed routing mechanism are maximum throughput, minimum packet loss and controlled overhead. Vertical handover strategy and an efficient two level cluster based routing mechanism with two levels are proposed in this work. Vertical handover mechanism is utilized in this optimal network selection. At initial level, routing was done amongst cluster members of the. Select the best neighbor and deliver the data packet to it, and sequentially the data packet is received by cluster head from best neighbor. At second level, the data packet reaches routing from cluster head. Head cluster does routing in this phase. the best path is chosen by algorithm of Greedy and best link among cluster heads. The best link is selected from the velocity parameters, direction parameters and distance parameters. The preminent neighbor is selected by distance and QoL and by choosing these parameters could achieve better performance. A greedy algorithm being utilized in selecting the top neighbor of the header cluster based on local information. This proposed work results in maximizing the packets delivery ratio of network and reduce the end to end delay while comparing with existing research techniques.

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