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An Improved Vanet Clustering and Channel Quality using Movc and Weighted Probability

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***Abstract:** VANET offers a vast range of application which will make travel experience safe. The concept behind VANET is quite simple which incorporates wireless communication and capable of sharing data; the vehicles are turned for offering network to provide services which can be used in the home or office networks. VANET network nodes are move in-network with higher velocity in the network. This higher mobility of vehicles causes increased resource and energy utilization which causes failure of nodes. Resource and energy consumption is higher for inefficient constructed clustering for VANET. Also, vehicle mobility causes several obstacles in data transmission this causes degraded channel quality. data transmission this causes degraded channel quality. In this paper concentrated on improving channel quality and energy efficiency in the network. Initially, performed efficient clustering through middle-order based cluster head (CH) election (MOVC) mechanism. Through effective CH election resource and energy utilization is limited. In the next stage, channel quality is improved by the proposed weighted probability approach for effective data transmission between vehicles in the VANET network. The weighted probability approach estimates the path for data transmission to destination vehicle. Through the selection of CHs using the middle-order approach, the network exhibits an effective maintenance phase here, the weighted probability is applied for the estimation of the path for effective data transmission in the VANET. The comparative analysis of the proposed approach exhibits significant performance rather than conventional technique. The estimated residual energy of the proposed approach is almost 20% higher than ACO, PSO, and KH. The packet delivery rate is observed around 80% and delay is minimal as of 2.5sec.*

***Keywords:** MOVC Algorithm, VANET, Enhance channel Quality of VANET, Development weighted probability for Data loss.*

I. INTRODUCTION

Wireless networking technology is an enduring field by offering a promise for the users to access the information services in immediate and electronic form irrespective of location and position. It is classified as centralized and distributed networks. In an infrastructure-based networks (centralized), there is a central access unit (base station) which connects all mobile hosts together.

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In this centralized network, the nodes are movable with a fixed base station. In distributed networks, all the nodes are communicated with each other in a distributed manner. There is no central access control in the distributed network. All nodes in distributed network are treated like routers to forward the packets for the intended nodes. The routing decision can be taken by the nodes based on the type of the routing scheme implemented in the nodes.If nodes are allowed to move from one place to another place in distributed network,then the network is called Mobile Adhoc Network (MANET). The ever increasing utilization of wireless networks through mobile devices has resulted in the evolution of Mobile Ad hoc Networks (MANETs) and Vehicular Ad hoc Networks (VANETs). In VANETs the mobile vehicles on road are inter-connected and are also integrated to a roadside base-unit, forming an ad hoc network.The high priority information regarding the condition of the roads, or occurrence of an accident or normal traffic messages can be transmitted to the mobile nodes through either the mobile nodes themselves or the roadside base station. Thus the other vehicles are notified about the situations in a particular region and accordingly alert the other vehicles. There are two possible modes of communication, namely vehicle-to-vehicle or roadside base unit-to-vehicle. The mobile nodes [4]. can send alert messages to the other mobile nodes as well as to the base station and vice versa. There could be diverse avenues of application of the VANETs both for the safety and non-safety applications. Some of the services which can be provided by VANETs include traffic management, navigation, several location-based services and some Internet based applications. Vehicular Adhoc Network (VANET) is a subset or specific type of the mobileAdhoc network where the mobility of the nodes is comparatively high. In the recent scenario, the Intelligent Transportation System (ITS) is implemented with help of VANET for improving road safety, travel comfort of drivers/passengers and infotainment connection among the vehicles. Hence, the world wide governments and societies (e.g. ITS America, ITS Taiwan) are agreed to deploy and implement such an ITS. The VANET plays an important role in supporting of all services required by the ITS. Since information like web media content, traffic and emergency are needed to be shared among vehicles, an ITS supports three types of communications such as vehicle to vehicle (V2V), vehicle to road side unit (R2V or V2R) and routing based communication. The inter-vehicle ie., vehicle to vehicle communication configuration is shown in Figure 1.1 (a) that uses multi-hop multicast/broadcast to transmit traffic related information to a group of receivers over multiple hops.

The roadside unit sends a broadcast message to all equipped vehicles in its area of vicinity. Lastly, the routing based communication. In modern times, Internet has become a default standard for most of the users of vehicles. An Internet connection has become mandatory almost in several parts of the globe for easy navigation and easy maintenance of the vehicles. Wireless LAN (WLAN) is an ideally suited technology for such an environment. But, due to the short communication paths, several access points need to be established for trouble- free functioning of the wireless network, requiring huge infrastructural support. This becomes economically non-viable and operationally impracticable. In order to permit greater ease and mobility and diminish the possibilities of collision with several users using the same points of access,in the mode of multi-hop access is envisaged. This joint network integrating the infrastructure on one side and ad hoc networks on the other, are known as 'hybrid networks', where mobile nodes are 2 provided access to the infrastructure of the wired networks also. The access point which manages almost everything is the primary component in the infrastructure of WLAN. Direct inter- communication between the individual node and the access point is always required in the form of a 'single hop'. This ad hoc mode is further intended to be integrated with a cluster of mobile nodes without infrastructure, which by default make use of the method of 'multi-hop'. Ideal network ambience requires continuous connection between these nodes with wireless networks using multi-hop methods, thus providing access to established wired networks. Since the difference between these two categories of nodes in MAC layer is marginal, their integration becomes possible.These nodes in real time must bridge the two diverse network environments of the wired and wireless. This concept is the basis for the evolution of a Hybrid Internet Extension to the AODV Extended Internet Service (EIS).

II. RELATED WORKS

Yacine Harkat et al., 2019 [9] proposed a analytical model with utilization of two-dimensional Markov chain approach. Also, the developed model uses EDCA mechanism for evaluating condition of traffic and error rate of channel. The major functionality of EDCA mechanism is development of effective standard with inclusion of AIFS waiting procedure, back-off freezing, virtual collision within same station and external collision with other stations in the VANET network, period for post-collision and retransmission range. The proposed approach considers channel error probability with consideration of explicit factors. Through this VANET network performance were analyzed. This research considers average access delay, normalized throughput and quality of service for evaluating the performance. Analysis of results illustrated that proposed approach perform effectively in VANET network with consideration of those parameters. Through analysis of results it can be concluded that minimal efficient network leads to increased collision with utilization of small frames.

Mohamed AymenLabiod et al., 2019 [11] developed a cross-layer mechanism for reducing network performance for VANET network with consideration of minimal delay constraints. The main idea behind this approach is assigning packet to every video with Access Category (AC) queue on the Medium Access Control (MAC) layer with utilization of structure known as temporal prediction. Simulation results illustrated that different scenario has been targeted for low-delay video communication with improved quality if tge network by means of end-to-end rather than Enhanced Distributed Channel Access (EDCA).

Chaudhary Muhammad Asim Rasheed et al., 2017[12]reviewed about application, challenges, routing, medium access scheme and privacy concern in VANET network.

IshtiaqWahid et al., 2018 [15] examined about routing protocol with consideration of pros and cons in VANET environment.

For analysis this research considers network parameters, distance, speed, no. of nodes, no. of hops, communication overhead, relative mobility, simulation parameters, simulation tool used, mobility model, performance metrics and compared protocols are taken under consideration. HazemAhmed et al., 2017 [18] evaluated the testbed requirement for flexible VANET environment with consideration of its needs and requirement.

The evaluation is made based on the consideration of application feasibility.

Results demonstrated that testbed is suitable for requirement of VANET.

III. PROPOSED METHODOLOGY

The methodology of a paper is a vital and key feature because this stage discusses the whole process of functional activity .This research followed the six steps of methodology for analyzing the data outcome and taking decision and aimed to improve VANET network functionality. To improve functionality of VANET this research focused on developing appropriate technique for clustering and channel quality. This research conducted in two phases such as phase 1 for VANET clustering and Phase 2 for channel quality improvement in VANET.

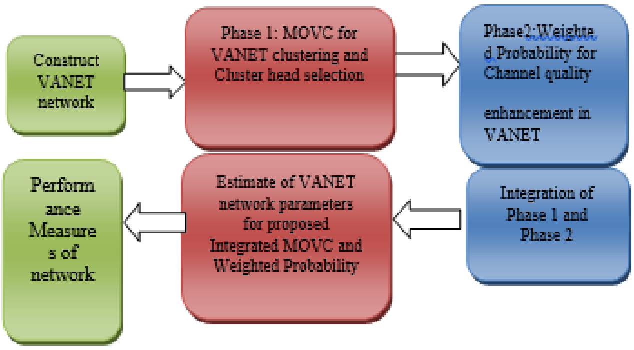

Figure 1: Proposed Flow Diagram

3.1 Phase 1: Efficient Cluster Formation using MOVC for clustering in VANET

In the proposed method, VANET communication performance is improved using the MOVC (Middle Order Vehicle Clustering) technique.

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The proposed technique involved in the construction of constant cluster with reduction of packet loss and reduced communication overhead. For the reduction of cluster recreation, Constant Cluster Model is constructed in which MOVC is applied for identification of middle-order in the cluster. With consideration of vehicle velocity, position, and mobility cluster are defined within the communication range. In figure 2 clustering performed through the Middle-Order Vehicle approach is measured for consideration of different traffic scenarios. Cluster is formed with consideration of a certain range of vehicles moving at a certain distance. As shown in figure 2.0 information transmitted between the cluster head of vehicle to other members of VANET. From VANET member to Unit Admin (UA) in the VANET cluster. Based on the defined cluster range UA effectively handles the vehicle performance characteristics. In this scenario, the cluster head act as an intermediate factor for sharing data between cluster member and UA. It is assumed that the proposed MOVC considered Long Term Evolution based communication strategy with consideration of DSRC. Using DSRC cluster size vehicles in are maintained at an equal distance with an unbreakable data sharing scenario. The proposed MOVC model covers a range of 300 meters with the utilization of the LTE scenario in UA and the range of cluster head is with a range of 1 km. Through UA, it effectively involved in the management of cluster numbers along the roadside in framed each cluster, cluster head involved in collection of data from other vehicles, and transmit data to other clusters in the VANET network. In the proposed MOVC, it is observed that the VANET model is embedded with the GPS technology for the provision of cluster location accuracy and vehicle nodes are incorporated for identification of vehicle velocity and destination in the network. According to the mentioned factors, MOVC is developed with consideration of clusters in the network through consideration of the density of vehicles. Based on vehicle acceleration and velocity cluster head are selected in the network. This involved in minimization of cluster reformation and construct constant clusters for a long time.

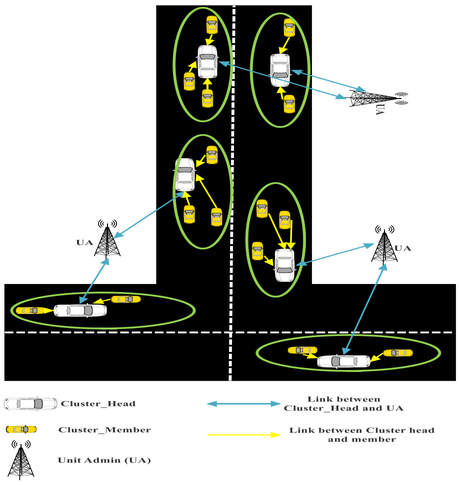

Figure 2: Typical MOVC Model in VANET

3.2 Phase 1: MOVC for VANET Cluster Construction for Data Transmission In the proposed MOVC approach, the first step is cluster construction in the constant state, which minimizes the cluster reformation frequency. In such manner for cluster construction every vehicle transmit BECON [22]n signal o the UA and those signal consists of particular vehicle identity ID_{V1}, vehicle position is stated as (X_{V1}, Y_{V1}), velocity of vehicle is defined as S_{V1}, direction of movement of vehicle as D_{V1} and A_{V1} defines the acceleration of vehicle. Based on the vehicle direction basic angle is obtained with consideration of vehicle position with identification of target location for vehicle place. Here, for vehicle V1 final position is identified as (X'_{V1}, Y'_{V1}) and directional angle is stated as θ_{V1}, which can be computed using following equation (1),

$$\theta_{V1} = \tan^{-1}\frac{Y_{V1} - Y_{V1}}{X_{V1} - X_{V1}} \tag{1}$$

Based on the consideration of above equation, the direction of VANET D_{V1} is identified as follows,

1. In case $\theta_{V1} \in [0°, 90°), D_{V1} = 1$
2. When, $\theta_{V1} \in [90°, 180°), D_{V1} = 2$
3. When, $\theta_{V1} \in [180°, 270°), D_{V1} = 3$
4. When, $\theta_{V1} \in [270°, 360°), D_{V1} = 4$

Based on the consideration of all factors beACO [22]n signals are transmitted to UA. With consideration of various factors beACO [22]n signal is transmitted to UA. Upon reception of beACO [22]n signal, system evaluates vehicle positional data and middle-order vehicle communication range are evaluate, in which vehicle density are measured. With consideration of Highest Degree Algorithm, vehicles those are closer communication range are identified. However, location of identified nodes are in middle order with MOVC algorithm, which is presented in below table 3.0. The below table 3.0 for MOVC for cluster head election is based on the consideration of vehicle location and energy level. Initially, vehicles are deployed in the network after deployment distance of vehicle and communication range which is hoping is measured. Based on the estimation of energy level and location cluster head is elected. After election of cluster head vehicle located within specified region are elected as cluster member else those vehicle are eliminated.

Developed MOVC Algorithm

Input: Vehicle Count in the VANET**VL**

Output: Formation of cluster

Initialize

Construct vehicle set based on Middle - order

Identification of middle-order and include in cluster

Initialize

Location set (LS) = CR

While** LS≠∅**do

∀ls** in LS **do

List of vehicle in the network as CR_{ls}≠∅

*∀vehicle V **do***

If

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```
Distance of vehicle ≤ communication range of vehicle
then
        Add vehicle (V) in to CR
              delete vehicle from the vehicle list
End
 End
If CRls≠∅ then
  Execute cluster head election
Calculate cluster head strength CRls
If
 Cluster strength is higher then
Check all vehicles in vehicle list CRls
End
 Else
Evaluate vehicle signal strength ∀cluster_member
If
  Vehicle strength is higher
Then
  Update to UA
End
End
Update nearby junction of the location (ls)
End
Delete ls location junction from the LS
End
End
```

```
End
End
While VS≠∅
do
∀ls in CR do
Select VS vehicle those are near by CR
Initialize
  Cluster set = {CS}
  Delete vehicle V from VS
  Set Cluster head as V ∀ vehicle as V performed as VS
Do
If
Distance of vehicle (Vs)≤communication range
then
      Add VS within the CS
      Delete V from the VS
End
End
      Return Vehicle Cluster v
Calculate cluster head strength in CRV
End
End
End
```

Based on the consideration of above parameters within the single cluster nodes radius and middle order in the range of 300 meters within single cluster. Based on the consideration of several factors closest junction is identified for every middle order with consideration of following states of the network,

i. The middle order vehicle distance and position need to satisfy DSRC communication range of vehicle.
ii. The junction estimation need not be in the range of cluster.

Based on the consideration of above factors, UA involved in mechanism of selection of junction those are near to junction identified and cluster. After, with consideration of various operation loops, vehicles those are not in cluster also cluster criteria that need not be exceeds DSRC communication range of network.

3.2.1 Cluster Head Selection using MOVC for VANET

Due to increased vehicle mobility in the network, VANET have minimal stability for vehicle mobility. Based on the distance vector cluster stability is provided with assurance for construction of cluster. In this section, presented about effective cluster head selection for cluster management for longer time period and reduces reformation of cluster in the network. For cluster head selection mobility parameters (MP) is utilized for ECHE. With consideration of assumptions, vehicles are denoted as V, cluster are stated as CRi, vehicle position difference are denoted as V1 and vehicle cluster $CR_i$is referred as in equation (2),

$$PositionalDifference(PD_V) = \sum_{m=1}^{M} \sqrt{(X_V - X_m)^2 + (Y_v - Y_m)^2} \quad (2)$$

The vehicle velocity is referred as V and other vehicles are presented as follows, acceleration of vehicles are presented as follows in equation (3) & equation (4):

$$S_V = \sum_{m=1}^{M} |S_v - S_m| \quad (3)$$

$$A_V = \sum_{m=1}^{M} |a_v - a_m| \quad (4)$$

The vehicle mobility parameters are defined as follows in equation (5),

$$MP_v = r\frac{PD_v}{\max\{PD_m | \forall m \in CR_i\}} + S\frac{S_v}{\max\{S_m | \forall m \in CR_i\}} + t\frac{A_v}{\max\{A_m | \forall m \in CR_i\}} \quad (5)$$

From the above equation (5) it is observed that weight factors ‘r’, ‘s’ and ‘t’ are measured with consideration of unit value. Those weight factors are incorporated for balancing variable flow of traffic scenario. It can be stated in three cases,

i. The network with stable flow of traffic without any collision, difference in vehicle positional difference which offers greater impact with factor value ‘r’ those are greater than two.
ii. In next scenario, vehicles are moving at higher speed, the factor ‘s’ is higher that other two factors.
iii. The speed of the vehicle changes frequently with respect to circumstance of road, the weighted factor ‘t’ with value of fixed and higher than other factors.

In figure 3.1 overview of cluster head election is presented also it is observed that $Positional\ Difference\ (PD_V)$ are explained based on the consideration of mobility parameters, under CR_ivehicle factors are represented as S_V and A_V. The vehicle minimal parameter for probability is selected for consideration of cluster head. For maintenance of constant cluster, the cluster head mobility need to be minimal rather than other cluster member in the network.

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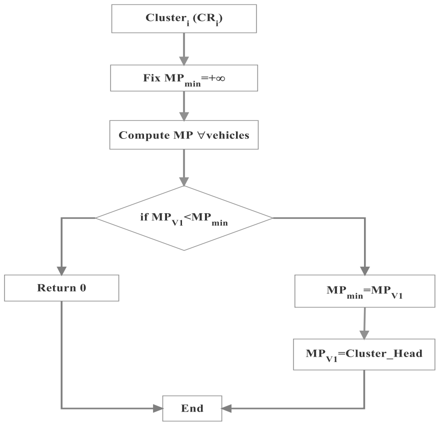

Figure 3: Flow chart of proposed MOVC

3.2.2 VANET Cluster Function for proposed MOVC

The speed of vehicles leads to increased vehicle mobility and unstable which leads to dynamic reformation of clusters. The reformation of the cluster is not effective for the VANET application in a real-time scenario. For minimization of cluster reframing constant cluster maintenance is developed. Based on the consideration of the following four cases:

Case 1: In the first case, cluster member is not able to establish communication with a cluster head, with effective maintenance of cluster. In this scenario, particular vehicle members are eliminated from the control related to the cluster head and send a notification to UA. The cluster member transmits the strongest signal to nearby clusters for including in cluster.

Case 2: When communication between UA and the cluster head is disconnected, the cluster head election process will be executed again for the selection of cluster head. For the selection of a new cluster head the process is executed again for effective communication between UA and VANET.

Case 3: If the vehicle needs to establish communication in the network, then it will transmit requests to the cluster head. In case if the request is not accepted by then the message will be transmitted to UA, the UA constructs a new vehicle for the formulation of cluster or cluster head.

Case 4: When two clusters are located each other, then both clusters are integrated. After the combination of both clusters, a new cluster head will be elected then other vehicle members transmit BEACON [22]n message for the formulation of the cluster which has the strongest signal.

Through the consideration of the above case model involved in the formulation of the cluster constantly. However, this involved in enhancement of clustering with improved communication efficiency in the VANET with reduced pack loss.

3.3 Phase 2: Weighted Probability Model for VANET Channel Quality Improvement

As stated earlier, this research developed a probability approach while MANET and VANET involved in the formulation of certain similar characteristics of dynamic network topology. Limited capability of the network, multi-hop networking, and scalability in a complex environment. The changes in network speed and vehicle position involved in the constitute of the driving environment which impacts connection probability.

For estimation of the probability of connection between vehicles with high -speed mobility is considered.

The traffic model of VANET needs to consider vehicle speed, density, and communication range in OBU. In the highway scenario, the vehicle high-speed movement needs to be considered several characteristics. The connectivity model of vehicle speed involved in the formulation of a mathematical model. To enhance VANET communication performance weighted probabilistic VANET communication involved in the reduction of packet loss and enhance channel quality. For dynamic network scenario MOVC involved in the management of dynamic networks. With consideration of MOVC, the performed network involved in the selection of cluster head using middle-order. Also, network vehicle subjected to congestion this causes data loss hence weighted probability minimizes data loss in the network.

3.4 Proposed integrated MOVC and Weighted Probability for VANET Mechanism

To improve the performance of VANET communication this research focused on weighted probabilistic based VANET communication for reducing packet loss and improves the quality of transmitting channel. In the existing work, the MOVC approach is utilized for managing dynamic network scenarios. Based on the existing work, the proposed approach performs the selection of cluster head to middle-order into consideration. In the first step, based on the location and vehicle mobility VANET is constructed, In the second step apply the middle-order MOVC approach for selecting cluster head in the network. In the third step, the probability is weighted probability is applied which means based on the middle-order distance between the vehicles are known concerning those distance probability of vehicle signal power received and transmitted are evaluated. Based on those values, weighting functions are estimated and applied to every vehicle in the network. Once the weights are estimated for vehicles located in the network hopping of the vehicle is estimated for evaluating data loss in the network. The weighted function estimates the distance probability and hopping lies between the transmitter and receiver on the other hand middle-order cluster head looks on to data communication in the network hence the information is updated to the cluster head. Based on the weighting function data from the transmitter are sends to the receiver which is expected to be efficient since already based on probabilistic function functionality of vehicles are estimated. Hence it is expected that data loss will be minimal and channel strength of the network also improved. Apart from this, it is expected that the lifetime of the cluster also improved.

3.4.1 Operation of Proposed integrated MOVC and Weighted Probability for efficient cluster and channel quality improvement

To improve the performance of VANET communication this research focused on weighted probabilistic based VANET communication for reducing packet loss and improves the quality of transmitting channel.

In the existing work, the MOVC approach is utilized for managing dynamic network scenarios. Based on the existing work, the proposed approach performs the selection of cluster heads concerning the middle-order into consideration. In the first step, based on the location and vehicle mobility VANET is constructed, In the second step apply the middle-order MOVC approach for selecting cluster head in the network. In the third step, the probability is weighted probability is applied which means based on the middle-order distance between the vehicles are known with respect to those distance probability of vehicle signal power received and transmitted are evaluated. Based on those values, weighting functions are estimated and applied to every vehicle in the network. Once the weights are estimated for vehicles located in the network hopping of the vehicle is estimated for evaluating data loss in the network. The weighted function estimates the distance probability and hopping lies between the transmitter and receiver on the other hand middle-order cluster head looks on to data communication in the network hence the information is updated to the cluster head. Based on the weighting function data from the transmitter are sends to the receiver which is expected to be efficient since already based on probabilistic function functionality of vehicles are estimated. Hence it is expected that data loss will be minimal and channel strength of the network also improved. Apart from this, it is expected that the lifetime of the cluster head also improved.

In the proposed MOVC probability approach, first step involved is construction of cluster with maintenance of constant state for avoiding reformation of cluster. In similar manner, cluster is constructed where each and every signal transmit BECON[22]n signal to the UA. Those signal consists of identity of vehicle ID_{V1}, present state of the vehicle position (X_{V1}, Y_{V1}), velocity of vehicle S_{V1}, acceleration of vehicle A_{V1} and vehicle direction D_{V1}.

The traffic flow in the network is considered for two-lane environment with inclusion of vehicle mobility and location. Also, this factors impacts on VANET connectivity and fast moving traffic scenario. Further, this research considers various densities of traffic, movement of vehicle and obstruction in equation (6).

$$G(P) = \begin{cases} 1 \; p \le p_0 \\ 0 \; p > p_0 \end{cases} \tag{6}$$

Where, $G(p)$ denotes the VANET network connection probability of cars, for the VANET path loss is referred as p and network threshold is represented as $p0$. The similar performance of signal transmitter and receiver is assumed with consideration various factor, two cars path loss is measured p with respect to distance between cars. In case p minimal than threshold it is denoted as $p0$, this illustrate vehicles are communicating successfully. In case, signal loss is larger which implies vehicles are communicated effectively. Otherwise, length of the two-lane road is represented as 5km. The vehicle density involved in traffic density with consideration of variable position by means of uniform distribution. The relation between vehicle density and speed are measured using following equation (7) & (8),

$$V_{avg} = V_f \left(1 - \frac{\rho}{\rho_{\max}}\right) \tag{7}$$

$$f(v_i) = \frac{1}{\sigma\sqrt{2\Pi}} e^{-(p_i - p_{avg})^2/2\sigma^2} \tag{8}$$

The vehicle speed Viinvolved in Gaussian distribution of vehicle in VANET with consideration of $Vavg$mean and σvariance. The vehicle speed involved in estimation of probability distribution for identification of effective path VANET communication is estimated using equation (9),

$$E(N) = \rho d\lambda \tag{9}$$

In above equation N denotes number of nodes, d is number of transmitted packets and denoted as other factor in the network as shown in figure 4.

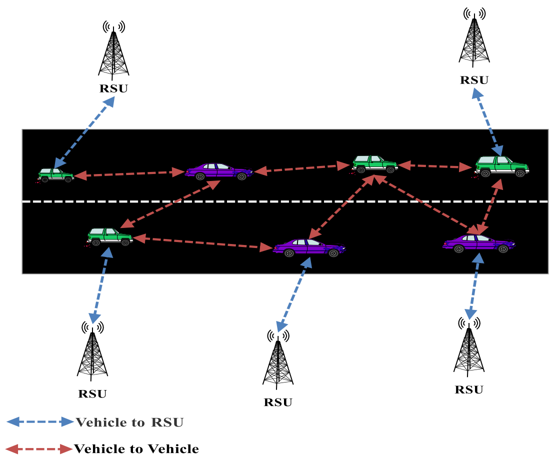

Figure 4: Communication in VANET

3.5 Cluster Head Selection

Cluster in the VANET is formulated based on the consideration of unknown vehicle for certain range of distance. As member in the VANET network clustered and cluster head are elected for transmission of information and gathered other members in the UA. Based on the constructed cluster environment UA handles the effective management of vehicles. The communication between UA and cluster member are managed effectively through defined cluster head which act as intermediate for sharing data among UA and cluster members. This approach utilizes DSRC with inclusion of Long Term Evolution based communications. The cluster size maintained with data sharing in unbreakable manner for data sharing by DSRC. In MOVC, the designed model involved in establishment of communication with 300 meters and communication range of UA with incorporation of LTE with cluster head coverage range of 1km. Here, UA involved in management of cluster in road where cluster head collects data from other vehicles for cluster formation. In the proposed model, VANEt network model are embedded with utilization of location accuracy in the cluster and vehicle node based on the destination and velocity of vehicle. Based on the consideration of above stated factors, middle-order clustering is constructed.

Based on the consideration of vehicle density the performance is estimated for vehicle density. By means of Effective Cluster Head Election, clustered network cluster network is measured with consideration of acceleration and velocity of vehicle. This involved in reduction of cluster reformation rate and formulate cluster for longer period of time.

4.2 Simulation Model

To evaluate the performance of proposed weighted based probability approach simulation is performed in MATLAB 2019b. Simulation parameters are changes for different scenario.

IV. PARAMETERS MEASURED

To estimate the performance of VANET network is measured by means of consideration of following parameters:

Packet Delivery Ratio (PDR):PDR provides number of packets received by the destination with consideration of number of packet transmitted from the source node.

PDR = No of packets received/ No of packets sent

.**Average end-to-end delay:**It provides average time taken by the data for transmission between source to destination across the network.

Average end to end delay = ∑ (arrived time – sent time)

Normalized Energy : Normalized energy is considered based on number of rounds per round with consideration of iteration in the system.

Residual Energy Estimation

In clustering process, residual energy is major factor for node location and distance obtained form base station. Residual energy of node is time varying process which can be subjected to several factors where network expression involved in network energy level and life time of node. Residual energy of VANET at time t is measured based on consumed energy Δt from the t-Δt which is initial energy level of network. Based on this, energy consumption Δt is measured as given in equation (9):

$$\begin{cases} E_{residual,i}(t_2) = E_{residual,i}(t_1) - E_{consumed,i}(\Delta t) \\ E_{consumed,i}(\Delta t) = \dfrac{\partial E_{residual,i}(t)}{\partial t}\Delta t \\ \Delta t = t_2 - t_1 \end{cases} \quad (9)$$

In real manner, the overall energy consumption of VANET involved in nonlinear relationship with dependence of constitutes and overall design relies on application.

However, formulation of nonlinear factor requires extensive exploration with consideration of metrics related to energy constituent in the network even non linear relationship is not derived for mathematical models.

The energy remaining in nodes and distance of base station involved in formulation of cluster head.

Based on distance in every node following equation is utilized for identification: in equation (10)

$$d = \sqrt{(S(i)).xd - S(n+1).xd)^2 + (S(i).yd - S(n+1).yd)^2} \quad (10)$$

In above equation d is denoted as node distance to base station and node is represented as S(i) and node base station is denoted as S(n+1). Once the cluster is formulated residual energy of CH is stored in memory.

Here the residual energy of the CH is presented as predefined values with consideration of specific bit of packet data where BS ends TDMA frame to the network. In this, BS transmit information to all nodes in the network about clustering process of each round. As stated earlier, cluster head in the VANET network is selected based on probability of VANET with consideration of residual energy of each node and network average energy.

The cluster head lifetime is estimated based on network initial energy and residual energy. This implies that nodes with higher initial and residual energy is selected as CH.

V. RESULTS

This research aimed to enhance the channel quality of the VANET network with reduced data loss. To achieve those performance this research formulated a MOVC based probability approach for VANET application. The performance of proposed approach is measured in MATLAB 2019 b version with RAM memory of 4GB. Initially, the iteration count is set to 1000 and results are obtained for varying the iteration count. The constructed network consists of 50 nodes where data are transmitted for selection of cluster head with appropriate energy level in the network. Based on the consideration of energy level of the nodes VANET network performance are measured with consideration of various variables in the network. Also the performance of VANET is improved with construction of data transmission between the nodes. As stated earlier, this research involved in improving channel quality of network and reduces data loss. The proposed model is based on selection of cluster head with application of cluster head selection. The proposed MOVC approach involved in effective maintenance of node in the VANET. For proposed approach parameters are measured for effective functionality of network those parameters are stated as follows:

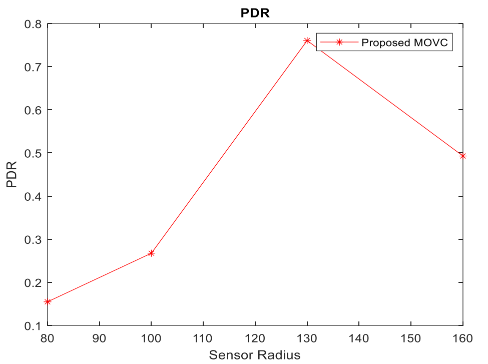

Figure 5: Estimation of PDR

The above figure 5 provides the packet delivery rate of the proposed MOVC probability-based approach.

From the figure it is observed that the packet is transmitted almost complete radius of the network. Even after 100 meters, the packet delivery rate is higher for the proposed VANET network.

Typically, around a radius of 130 meters PDR is higher rather than another radius. From this it can be stated that the proposed model effectively transmits data for the entire network radius.

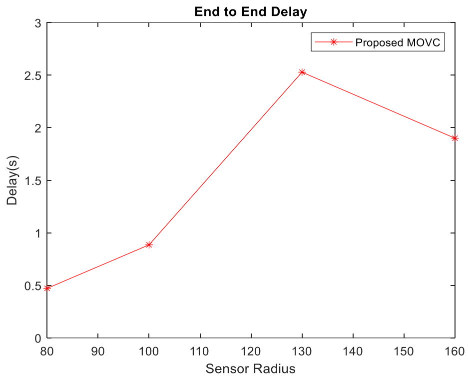

Figure 6 End to End delay

In figure 6 delay in data, the transmission is measured in the proposed VANET network.

As stated in figure 4.1, at a radius of 130 meters delay is higher rather than another network radius of the network. The maximal delay is observed at 130meters as 2.5secs but a higher rate of packets also delivered at 130 meters which leads to network delay.

Based on the analysis it is observed that end to end delay is higher at sensor radius of 130 meters as shown in figure 6. Also, in this figure 6 it is observed delay as 0.5 seconds for radius 80 meters and reaches maximal delay at 130 meters later based on the data transmission range sensor radius value degrades for 2 seconds. From this, it is concluded that the proposed approach significantly reduces end to end delay in data transmission.

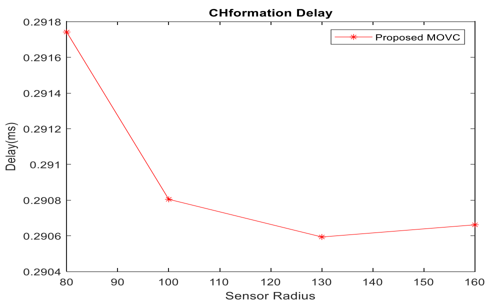

Figure 7 Cluster Head Formation Delay

The proposed MOVC incorporates cluster head selection while VANET network are dynamic in nature this impose immediate selection of cluster members and cluster head. Hence it is necessary to measure time taken by the proposed network for selection of cluster head with measurement of delay in the network.

4.5 Performance Metrics

The simulation measurement of proposed approach involved in evaluation of certain parameters for performance measurement of VANET network. The VANET network involved in evaluation of residual energy, normalized energy, number of active vehicles and number of inactive vehicles in the VANET network.

5.1 Performance Metrics

The simulation measurement of proposed approach involved in evaluation of certain parameters for performance measurement of VANET network. The VANET network involved in evaluation of residual energy, normalized energy, number of active vehicles and number of inactive vehicles in the VANET network.

5.2 Residual Energy

As stated earlier, VANET network involved in measurement of residual energy estimation. Based on the consideration of various VANET nodes residual energy of VANET network is measured. Residual energy of the VANET nodes are measured for various node level in to consideration. VANET network nodes are measured with respect to variation of 100 nodes, 200 nodes and 300 nodes. In figure 8 residua energy measured for 100 nodes are provided.

Table 1: Residual Energy for 100 Nodes

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed MOVC Probability
0	50	50	50	50
10	49.65	49.88	49.76	49.98
20	49.59	49.84	49.72	49.96
30	49.56	49.8	49.68	49.94
40	49.53	49.76	49.65	49.92
50	49.51	49.73	49.61	49.9
60	49.49	49.71	49.58	49.88
70	49.43	49.67	49.51	49.84
80	49.39	49.64	49.48	49.81
90	49.33	49.61	49.43	49.79
100	48.6	49.59	49.41	49.75

The iteration count is performed for 100 rounds with consideration of 100 VANET vehicles. Initially, all techniques have energy level of 50 after certain number of iteration it get reduced.

The maximum residual energy consumed by proposed MOVC probability approach for 100 iteration is observed as 48.6. The existing optimization technique ACO [22], PSO [23] and KH [24] technique offers residual energy range of 49.75, 49.59 and 49.41 respectively

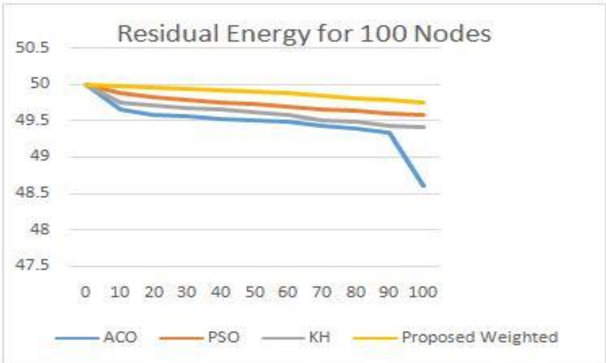

Figure 8: Residual Energy (N = 100)

Figure 8 provides a graphical representation of residual energy utilized for 100 nodes. The residual energy retained in the network is comparatively presented with an existing technique such as ACO, PSO, and KH. The measurement is performed for consideration of 100 nodes/vehicles in a network. The graphical representation illustrates that residual energy level of nodes is significantly higher than the existing technique. The graph implies that the proposed approach utilizes minimal residual energy utilization rather than other existing technique.

In table 2 residual energy consumed for 200 deployed nodes is presented. Initially, for all techniques residual energy is observed as 100 after residual energy gets reduced the maximum residual energy observed by proposed approach is 99.75, while ACO [22] retains ACO [22] residual energy for 100 rounds are 95.123, PSO [23] provides residual energy of 97.86 and KH [24] offers residual energy range of 97.45 which is significantly higher than proposed MOVC probability approach.

Table 2: Residual Energy for 200 Nodes

Rounds	ACO [22]	PSO[3]	KH [24]	Proposed MOVC Probability
0	100	100	100	100
10	98.46	99.21	99.56	99.6
20	98.126	99.16	99.25	99.3
30	97.456	98.78	99.28	99.9
40	97.249	99.63	99.26	99.88
50	96.45	99.42	99.1	99.87
60	96.267	99.16	98.45	99.82
70	96.17	98.88	98.12	99.8
80	95.86	98.64	97.75	99.77
90	95.621	98.16	97.65	99.7
100	95.123	97.86	97.45	99.75

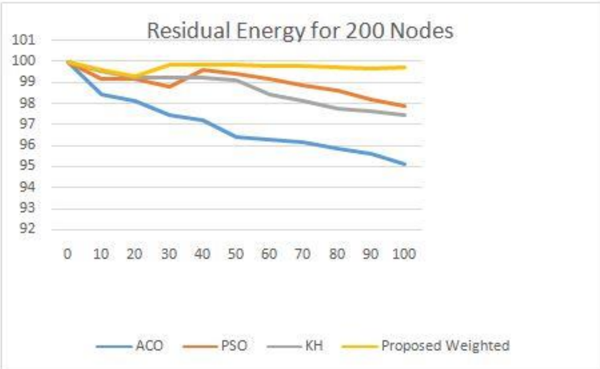

Figure 9: Residual Energy (N =200)

In figure 9 comparative analysis of residual energy level retained in network of 200 nodes. The comparative analysis of existing technique illustrated that ACO residual energy level is minimal rather than other technique. In case of PSO, residual energy level is fluctuating it reduces to minimal and reaches maximum and again it decreases. Similarly, KH residual energy level also less than that of proposed MOVC approach. Through analysis it is concluded that as 100 nodes performance of proposed technique is superior for 200 nodes also. As defined for 100 nodes, figure 10 provides offers illustration of residual energy utilized for 200 nodes. Similar to 100 nodes residual energy is minimal for 200 nodes rather than ACO [22], PSO [23] and KH [24].

Table 3: Residual Energy for 300 Nodes

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed MOVC Probability
0	150	150	150	150
10	149.91	149.93	149.95	149.97
20	149.88	149.9	149.91	149.94
30	149.86	149.88	149.9	149.91
40	149.81	149.83	149.85	149.89
50	149.79	149.82	149.84	149.86
60	149.76	149.79	149.81	149.84
70	149.74	149.77	149.78	149.82
80	149.71	149.72	149.75	149.8
90	149.67	149.68	149.71	149.78
100	149.63	149.64	149.6	149.75

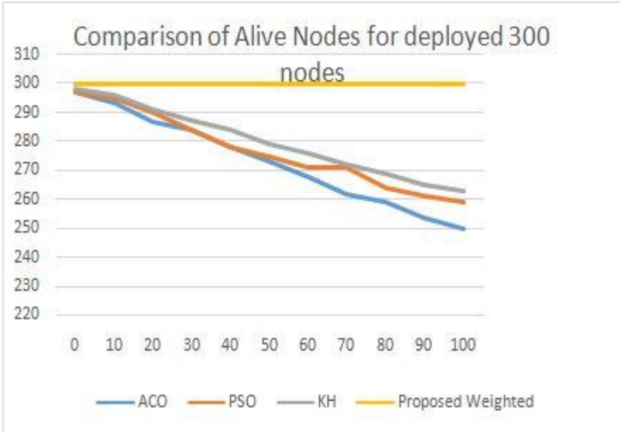

Figure 10: Residual Energy (N = 300)

The above table 9 and figure 10 provides comparative analysis of residual energy for 300 nodes. From those values it is observed that residual energy for proposed approach is 149.75 which is significantly less than other existing technique ACO [22], PSO [23] and KH [24].

5.5.2 Normalized Energy Level

Normalized energy level provides average energy consumed by the network. Based on the defined node data are transmitted between nodes with evaluation of network parameters. In table 4 normalized energy utilized for network nodes are presented. The performance of proposed MOVC probability approach is comparatively examined with other conventional technique such as ACO [22], PSO [23] and KH [24].

Table 4: Normalized Energy Level for Proposed MOVC Probability Approach

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed Weighted
0	0	0	0	0
10	0.763	0.76	0.8	1
20	0.758	0.76	0.77	1
30	0.74	0.74	0.76	1
40	0.72	0.72	0.72	1
50	0.7	0.68	0.71	1
60	0.69	0.66	0.7	1
70	0.67	0.66	0.7	1
80	0.65	0.63	0.68	1
90	0.6	0.62	0.68	1
100	0.58	0.61	0.68	1

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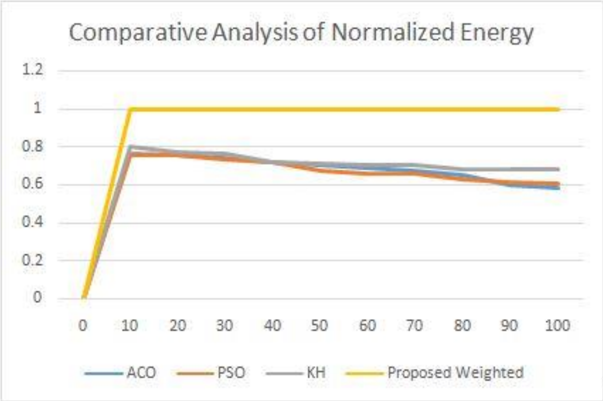

Figure 11: Comparison of Normalized Energy

In above figure 11 normalized energy level of proposed MOVC probability approach is presented. In ACO [22] approach 0.58 is observed as normalized energy, PSO [23] provides 0.61 as normalized energy and KH [24] provides normalized energy value of 0.68 which significantly minimal than proposed MOVC probability approach.

4.5.3 Number of Alive Nodes

VANET network subjected to mobility network environment hence it is necessary to estimate the energy level of the network. In previous section, measured about the energy consumption rate of VANET network. In this scenario, it is necessary to evaluate the number of alive nodes in the network.

Table 5: Number of Alive Nodes for 100 nodes

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed MOVC Probability
0	97	97	98	100
10	93	95	96	100
20	87	90	91	100
30	84	84	87	100
40	78	78	84	100
50	73	75	79	100
60	68	71	76	100
70	62	68	72	100
80	59	64	69	100
90	54	61	65	100
100	50	59	63	100

In table 5 presented about number of nodes those are alive after completion of iteration. The above table 4.5 number of alive nodes are observed as 100 this implies that no nodes losses its energy.

For 100 nodes ACO [22] reaches 50, PSO [23] alive nods are 59 and KH [24] alive nodes are observed as 63.

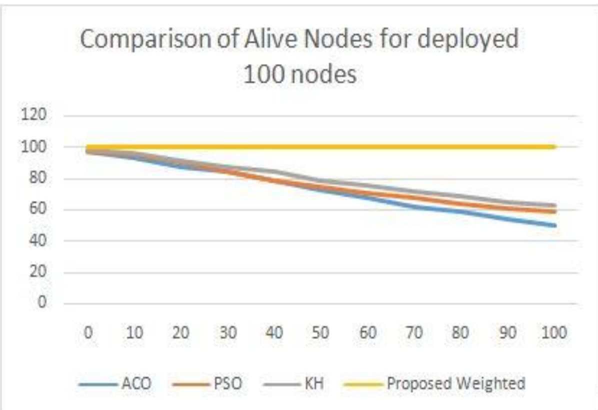

Figure 12: Alive Nodes (N = 100)

In figure 12 provides the illustration of number of nodes that are alive after transmission and reception of packets in the network for 100 nodes. As observed, residual energy level of vehicles are higher for proposed MOVC approach rather than existing this retain energy of nodes and make alive. From figure 12 it is observed that ACO alive node values are less than 60 nodes, PSO exhibits less than 65 nodes and KH have less than 80 nodes. It is concluded that proposed MOVC exhibits superior performance rather than existing techniques.

Table 6: Comparative Analysis of Alive Nodes for 200 Nodes

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed MOVC Probability
0	197	197	198	200
10	193	195	196	200
20	187	190	191	200
30	184	184	187	200
40	178	178	184	200
50	173	175	179	200
60	168	171	176	200
70	162	171	172	200
80	159	164	169	200
90	154	161	165	200
100	150	159	163	200

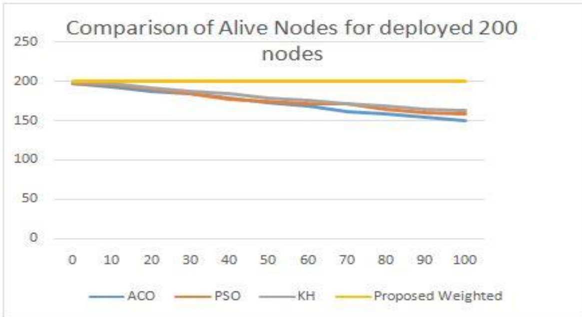

Figure 13: Alive Nodes (N = 200)

The figure 13 provides the number of vehicles alive which has energy level are presented for deployed 200 nodes. Similar to 100 nodes proposed MOVC approach exhibits large range of alive nodes.

Table 7: Comparative Analysis of Alive Nodes for 300 Nodes

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed MOVC Probability
0	297	297	298	300
10	293	295	296	300
20	287	290	291	300
30	284	284	287	300
40	278	278	284	300
50	273	275	279	300
60	268	271	276	300
70	262	271	272	300
80	259	264	269	300
90	254	261	265	300
100	250	259	263	300

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In table 7 for deployed 300 nodes number of alive nodes are provides in comparison with existing ACO, PSO and KH. As observed in deployed 100 and 200 nodes proposed MOVC offers higher range of alive nodes.

From this is is concluded that proposed approach exhibits superior performance rather than existing technique.

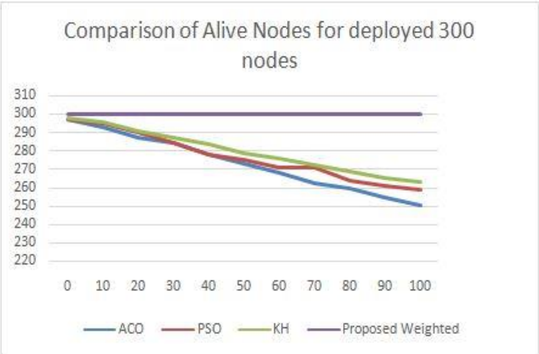

Figure 14: Alive Nodes (N = 300)

In table 6 and 7 presented about number of alive nodes after completion of iteration for 200 and 300 deployed nodes. For 200 nodes deployed scenario proposed MOVC approach offers all nodes are alive. In case of 300 deployed nodes proposed approach involved in deployed all nodes are alive.

4.5.4 Number of Dead Nodes

Dead Node implies that number of nodes losses its energy after completion of iteration of VANET network. In table 8 for deployed 100 nodes dead node count are estimated.

Table 8: Comparative Analysis of Dead Node Count for 100 Nodes

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed MOVC Probability
0	3	3	2	0
10	7	5	4	0
20	13	10	8	0
30	16	16	13	0
40	22	22	16	0
50	27	25	21	0
60	32	29	23	0
70	38	32	28	0
80	41	36	31	0
90	44	39	32	0
100	50	41	35	0

The above table stated that proposed MOVC probability exhibits minimal dead node count. ACO [22] dead node count is observed as 50, PSO [23] dead node count is observed as 41 and KH [24] exhibits dead node count of 35. From analysis of results it is observed that proposed approach offers dead count is minimal for proposed MOVC probability approach.

Table 9: Comparative Analysis of Dead Node Count for 200 Nodes

Rounds	ACO [22]	PSO [23]	KH [24]	Proposed Weighted
0	3	3	2	0
10	7	5	4	0
20	13	10	8	0
30	16	16	13	0
40	22	22	16	0
50	27	25	21	0
60	32	29	23	0
70	38	32	28	0
80	41	36	31	0
90	44	39	32	0
100	50	41	35	0

Similarly, for 200 deployed nodes proposed MOVC probability approach exhibits 0 dead node count while other existing technique provides dead node count at higher than proposed approach. For ACO [22] dead node count is observed as 50, PSO [23] provides dead node range of 41 and KH [24] provided dead node count of 35 which is almost 50% higher than the proposed approach.

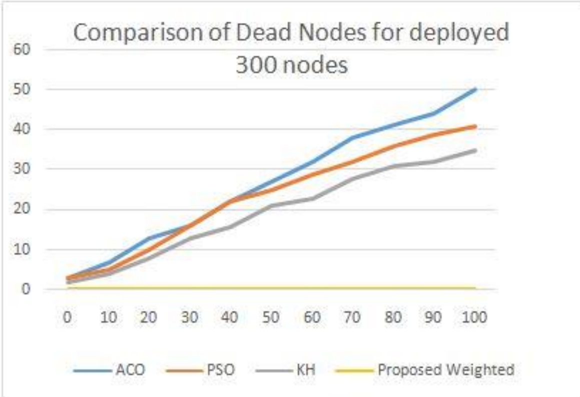

Figure 15: Dead Node (N =300)

In this section, performance of proposed approach is comparatively examined with other existing conventional technique for evaluating efficiency of the proposed technique. The performance is measured based on the consideration of residual energy of nodes, normalized energy, number of active vehicle and dead nodes in the VANET network.

Table 10: Comparison of Performance Characteristics for 100 Nodes

Iteration	Residua l Energy	Norma lized Energy	No.of alive nodes	No.of dead nodes
0	50	0.98	100	0
10	49.3	0.96	100	0
20	47.8	0.93	100	0
30	46.3	0.9	100	0
40	47.8	0.87	100	0
50	44	0.86	100	0
60	42.4	0.83	100	0
70	41.6	0.81	100	0
80	40.3	0.78	100	0
90	38.9	0.73	100	0
100	38	0.75	100	0

In table 10 for deployed 100 nodes performance of proposed approach is presented. From the table it is observed that residual energy utilized for 100 iteration observed for constructed network is observed as 38 and normalized energy is observed as 0.75.

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In case of active node all nodes are active which means every nodes has its own energy and dead node count also observed as 0.

Table 11: Comparison of Performance Characteristics for 200 Nodes

Iteration	Residual Energy	Normalized Energy	No.of alive nodes	No.of dead nodes
0	100	0.98	100	0
10	99.6	0.96	100	0
20	99.3	0.93	100	0
30	99.9	0.9	100	0
40	99.88	0.87	100	0
50	99.87	0.86	100	0
60	99.82	0.83	100	0
70	99.8	0.81	100	0
80	99.77	0.78	100	0
90	99.7	0.73	100	0
100	99.75	0.75	100	0

Table 12: Comparison of Performance Characteristics for 300 Nodes

Iteration	Residual Energy	Normalized Energy	No.of alive nodes	No.of dead nodes
0	150	0.98	100	0
10	149.97	0.96	100	0
20	149.94	0.93	100	0
30	149.91	0.9	100	0
40	149.89	0.87	100	0
50	149.86	0.86	100	0
60	149.84	0.83	100	0
70	149.82	0.81	100	0
80	149.8	0.78	100	0
90	149.78	0.73	100	0
100	149.75	0.75	100	0

The above table 11 and 12 parameters measured for proposed VANET network parameters are deployed node 200 and deployed 300 nodes. For deployed 200 nodes residual energy after 100 iterations are observed as 99.75 and normalized energy is observed as 0.75. In the case of 300 nodes, residual energy is observed as 149.75 and normalized energy is observed as 0.75. For both deployed 200 and 300 nodes almost all deployed nodes are active and there is no dead node count is observed.

VI. CONCLUSION

The performance of the proposed approach is comparatively examined with optimization techniques such as ACO, PSO, and KH since those are all emerging techniques. The comparative analysis of the proposed approach illustrated that rather than the conventional technique residual energy of the proposed approach is almost 20% higher than ACO, PSO, and KH. In the case of normalized energy level also proposed MOVC significantly improves the normalized energy utilization at the range of 40%. With consideration of alive and dead node count the proposed MOVC weighted probability offers significant performance rather than an existing technique. The proposed approach exhibits 75% significant performance in terms of active node count. The packet delivery rate is observed around 80% and delay is minimal as of 2.5sec. Through analysis it is observed that rather than existing technique proposed MOVC weighted probability offers effective performance.

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