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Optimum Location of DG Units Considering Operation Conditions

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Abstract: The optimal sizing and placement of Distributed Generation units (DG) are becoming very attractive to researchers these days. In this paper a two stage approach has been used for allocation and sizing of DGs in distribution system with time varying load model. The strategic placement of DGs can help in reducing energy losses and improving voltage profile. The proposed work discusses time varying loads that can be useful for selecting the location and optimizing DG operation. The method has the potential to be used for integrating the available DGs by identifying the best locations in a power system. The proposed method has been demonstrated on 9-bus test system.

Keywords: Distribution Generation (DG), Optimal placement, Time-varying load, Load profile, Energy losses

1. INTRODUCTION

In the restructured power systems, in order to considering losses, distributed generation units have been spread out in the power distribution systems. In the literature review, DG is a small scale power generation that is usually connected to a distribution system. DGs mainly consist of renewable energy resources such as photovoltaics (PV), wind turbines, and fuel cells. Among them PVs and fuel cells are DC resources and they are connecting to the power grid by DC/DC and DC/AC converters. DC/DC converters are mainly used to provide a controlled output voltage under different load variation [1]. The term DG also implies the use of generation units to lower the cost of services. A potential advantage of DG over conventional generations is that the energy production takes place near the consumer, which can minimize the power losses in the distribution lines.

Naresh Acharya et al suggested a heuristic method in [2] to select appropriate location and to calculate DG size for minimum real power losses. Though the method is effective in selecting location, it requires more computational efforts. The optimal value of DG for minimum system losses is calculated at each bus. Placing the calculated DG size for the buses one by one, corresponding system losses are calculated and compared to decide the appropriate location. Moreover, the heuristic search requires exhaustive search for all possible locations which may not be applicable to more than one DG. This method is used to calculate DG size based on approximate loss formula may lead to an inappropriate solution [3].

Go swami et al, [4] have analyzed load voltage sensitivity considering load models of voltage dependent load, whereas this method has been done by genetic algorithm. Singh et al [5] unlike other studies which dealt with the constant load models have studied on the effect of different load and sensitive to voltage and frequency and then they found the best location for DG units.

Authors of [6] have used and analytical method for optimal DG allocation, this method is based on power flow for the radial network and calculate loss sensitivity factor and priority list, which causes reduction on the search space. In [7] are proposed a heuristic method for optimal sizing and placement of DG in order to reduce economic costs, like energy cost, investment, operational cost, loss cost and technical aspect such as energy loss and voltage level.

In [8] optimal DG location is obtained considering economic and operational limits of DG and distribution system. Optimal DG placement is accomplished in [9] to maximize DG application benefit and minimize the costs for both utility and customers. A loss minimization approach is used in [10] too find optimal DG location.

There are so many DG placement methods in hand though each of these methods only focuses on some parameters. The optimal DG placement defined in [11] takes reliability, loss reduction, and load prediction into account while it fails to account for other parameters such as productivity, cost effectiveness, and type of DG. The optimal DG placement defined in [12] takes productivity, cost, effectiveness, loss reduction, and reliability and DG type into account and fails to consider other parameters.

In [13], a Newton-Raphson algorithm based load flow program is used to solve the load flow problem. The methodology for optimal placement of only one DG type 1 is proposed. Moreover, the heuristic search requires exhaustive search for all possible locations which may not be applicable to more than one DG. Therefore, in this paper, PSO method is proposed to determine the optimal location and sizes of multi-DGs to minimize total real power loss of distribution systems.

Whether DG is properly planned and operated it may provide benefits to distribution networks (e.g., reduction of power losses and/or deferment of investments for network enforcing, etc.), otherwise it can cause degradation of power quality, reliability, and control of the power system [14]. Also, placement of different DG units in the power system should be done considering interactions of the different units under primary and secondary frequency regulation carefully to prevent power system instability [15]. Thus, DG offers an alternative that planners should explore in their search for the best solution to electric supply problems and requires new planning paradigms and procedures able to face a more complex and uncertain scenario [16], [17], [18], [19].

Ault et al. in [20] have pointed out the dichotomy between the advanced status of academic researches on planning and the unwillingness of companies to resort to such algorithms. Indeed, the planners need tools to deal with uncertainties, risks, and multiple criteria. The final choice will be subjectively operated in the set of good solutions. To consider uncertainties of parameters and system inputs, [21] uses reachability analysis which is a mathematical analysis based on uncertain matrices. Reachability analysis can also be used to study DG integration and planning uncertainties.

An optimization technique should be employed for the design of engineering systems, allowing for the best allocation of limited financial resources. In electric power systems, most of the electrical energy losses occur in the distribution systems. It is a tool that can be used both for the design of a new distribution system and for the resizing of an existing system [22]. In [23] application of robust MPC provides an optimal solution to handle the system uncertainties. In [24] Monte-Carlo method is used to take uncertainties into account for renewable generation.

Distributed generation is not limited to conventional generation of electricity. A controlled reduction in demand can play the same role as distributed generation. For instance, [25] studies the possibility of using aggregation of small {ON/OFF} loads as a compensation for renewables variations. It was shown that only in Texas, 1.5 GW of flexible demand can act as distributed generation when controlled over the WiFi network.

Distributed Generation sometimes provides the most economical solution to load variations. Under voltages or overloads that are created by load growth may only exist on the circuit for a small number of hours per day or/ month or/ year. There may be many locations where DGs can be located and provide the necessary control [26]. Also, the authors address this issue for small size distributed generators in [27]. In [28] UPFC acts like a DG, and leads to power swing reduction and enhancing the system stability by reactive power injection.

However, the current research lacks the complete solution to the determination of DG allocation and operation, together with considering load voltage profile and time varying loads. For example too much emphasis on power loss cost and construction expenses but ignorance of the time varying loads and energy loss factors.

Moreover, the absence of the consideration about operation of DGs in the network structure may lead to the confusion of the benefit of placing DGs and dispatching policy.

The optimal placement and dispatching investigated in this paper are divided into two major parts, namely optimal allocation and optimal sizing of DGs. In firs part of section 2, placement of DGs is done based on the summation of energy losses during 24 hour and for time varying loads. In second part of section 2 sizing of DGs is determined in each time interval. In section 3 simulation network is explained. Simulation results on the test system are illustrated in section 4. Then the conclusion is given in section 5.

2. PROPOSED METHOD

2.1 Optimal Allocation of DGs

Optimal DG placement achieved to gain the optimal DG location to minimize or maximize a particular objective function. The optimal allocation model of DG is used to solve the problem of sizing and siting of various DGs [29,30].

Here, an energy based approach is explained for placement of a conventional DG in a distribution system. In this work conventional DGs are supposed to be diesel generators and fossil fuels producers. Wind turbines and solar panels have some limitations that cannot be used everywhere in distribution network and should be place in some particular locations. By considering these facts, only conventional DGs will be placed.

Loads that are studied here, are time varying that have different values at each time of day and night. Thus, the goal is minimizing the energy loss of distribution network. Load model are usually considered to be constant in a time period, while in reality, loads are function of the ambient temperature and human behavior [31,32]

So, considering energy losses instead of power losses seems better and therefore, minimizing the energy losses is the final goal. Using medium-voltage and high-voltage dc collection system would further improve the efficiency [33]. In [34] and [35], a new method for application in communication circuit system is proposed that it causes increasing the efficiency, PAE, output power and gain.

In order to minimizing the energy losses, load modeling is inevitable. As the load varies along time in 24 hour of a day, the time period should be divided into some appropriate intervals in order to approximate the load to be constant in each interval based on load profile. For instance, load profile in 24 hours is considered as follows:

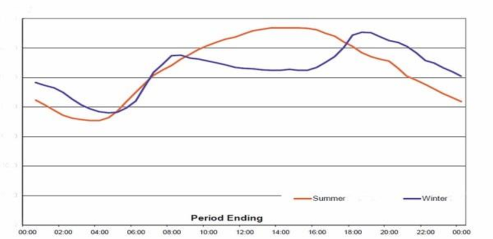

Figure 1: Load profile in 24 hours

Considering magnitude and variation of load during 24 hours of a day, sometime-intervals seem appropriate for the proposed method. Depending on the accuracy needed in a power network, the number of time intervals are computed. In each interval, load is being estimated by the average of load during at that interval with trapezoid method.

It should be noted that the duration of time intervals should not be the same. For example in the first times of a day that the demands are low and the variation is low enough to be neglected, the duration of that interval could be large enough to estimate the load at that interval. Although, in peak hours the variation of demands are high and the time interval should be considered small.

Here, in each interval in order to reduce energy losses of total network, the generation energy of each bus is computed. The proposed energy loss factor due to line currents can be defined as:

$$Energy\ loss = \sum_{j=1}^{T}\sum_{k=1}^{N} R_k\, I_{kj}^2\, t_j$$

Where:

R_k are the k[th] line total resistance.

N is the number of lines in the network.

T is the number of intervals for load modeling.

I_{kj} is the current for k[th] line in j[th] interval.

t_j is the duration of k[th] interval.

With this in mind, the optimization objective and the constraints are as follows:

$$\min\left\{energy\ loss_j = \sum_{k=1}^{N} R_k\, I_{kj}^2\, t_j\right\}$$

$$s.t: V_{bus}^{min} \leq V_{bus} \leq V_{bus}^{max}$$

Where, $V_{bus}^{min} = 0.95\ p.u.$ and $V_{bus}^{max} = 1.05\ p.u.$

In this section, the goal is siting the DGs in special buses in order to minimizing the energy loss. For this purpose, it is assumed that in each bus of the network, there is possibility to generate electrical energy and so, DGs could be place anywhere in the power network.

Power generated in each interval by each DG could be varying from 0 MW to the total load at that interval. The step of variation is considered 2 MW. In other words, DGs are available at sizes of 2 MW and in each bus, there is possibility to place any number of DGs.

The result of optimizing this problem is the power generated by each DG at each interval. The output power of each DG is given by:

$$P_{ij} = K_{ij} * 2$$

Where, K_{ij} is the number of 2 MW steps in i[th] bus and j[th] time interval. The total energy produced by each bus during the 24 hours is as follows:

$$E_i = \sum_{j=1}^{T} E_{ij} = \sum_{j=1}^{T} P_{ij} * t_j$$

As there is limitation in producing energy at all buses, selecting the buses that generate more energy is important. Therefore, by selecting the buses with bigger E_i and based on the number of buses needed for generating energy, placement of DGs is finished. For example if just 4 buses have this ability to be placed by DGs, 4 buses with higher total energy producing will be selected.

2.2 Optimal Sizing of DGs

In this section, after optimal DG placement and selecting the generator buses, the power generated by each DG in the selected buses for each time interval should be determined. In other words, Operation of DGs contributes in minimizing the total energy losses of the network. Thus, scheduling the energy produced by each DG should be done.

For this purpose, the minimizing objective is as mentioned before. The difference is just the number of buses producing energy. In the previous section, the placement of DGs is done in all the buses of the network and based on the total energy produced in each bus, buses with higher E_i was selected. In this section, placement of DGs is just done in the selected buses of the previous section.

In optimizing the size of the DGs in order to improve computational accuracy, steps of variation in the power generated is considered 0.5 MW. In other words, DGs are available at sizes of 0.5 MW and in each bus, there is possibility to place any number of DGs. It should be considered that increasing the steps of variation is possible, due to reduction in the number of buses generating energy and so the computational time will not increase so much.

With this consideration, the objective function and optimization problem is as mentioned before. The difference is just the output. The output of this optimization is generated power matrix in each bus.

The matrix is as follows:

$$P = \left[P_{ij}\right]$$

Where P_{ij} is the generated power of i[th] bus producer energy and j^{th} time interval and is computed as follows:

$$P_{ij} = K_{ij} \times 0.5\ MW$$

In this formula, K_{ij} is the number of 0.5 MW steps.

According to this goal optimization, the loss reduces when DGs are placed. Also, the voltage limits that mentioned before, shows that the appropriate voltage of a certain bus depends on the minimum and maximum voltages of the bus which considered 0.95 and 1.05 p.u, respectively.

3. SIMULATION NETWORK

In the proposed work, in order to implement the suggested method and compare the results with the network without DGs, a 9-bus distribution ring network has been selected as a sample. It should be noted that the specified algorithm can be used for all distribution networks with any number of buses and there is no limitation in implementing this algorithm. The single line diagram of the sample network is illustrated in figure 2.

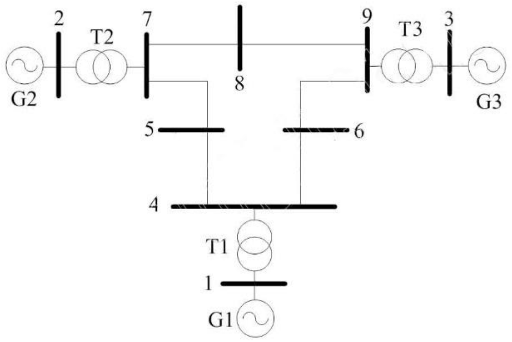

Figure 2: Single line diagram of the sample network

According to figure 2, the nine-bus system contains two sections. Section 1 is buses 1, 2, and 3 with voltage of 63 kV. These buses get connected to the other section by transformers with the ratio of 63/20. The other section is buses 4 to 9 with voltage of 20 kV. Placement of DGs is done in section 2, in the ring network with buses of 20 kV.

Table 1 shows the data of the lines of the network.

Table 1: Data of the lines of the network

Line	R (pu)	X (pu)
1	0.01	0.085
2	0.032	0.161
3	0.017	0.092
4	0.039	0.17
5	0.085	0.072
6	0.0119	0.1008

For load modeling, it is considered that the load variation curve is as plotted in figure 1. So, 7 time interval could be appropriate for this purpose. These time intervals are as follows:

$$t_1 : t = 0 - 5$$

$$t_2 : t = 5 - 7$$

$$t_3 : t = 7 - 12$$

$$t_4 : t = 12 - 16$$

$$t_5 : t = 16 - 20$$

$$t_6 : t = 20 - 22$$

$$t_7 : t = 22 - 24$$

Figure 3 shows the load profile estimation for load number 1 in 24 hours of a day.

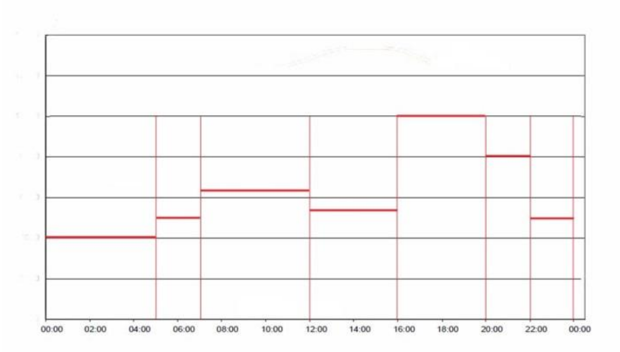

Figure 3: Load profile

In table 2, data of the loads of the system is shown.

Table 2: Data of loads of the network

Time interval	Load 1	Load 2	Load 3	Load 4	Load 5	Load 6
0-5	2	2	1	0.5	1.2	1
5-7	2.5	2	1.2	1	1.5	1.1
7-12	3.2	2.7	1.8	1.5	2	1.4
12-16	2.6	2.1	1.2	0.9	1.4	1.2
16-20	5	4	3	3	3	2
20-22	4	3.5	2.7	2.8	3	1.8
22-24	2.5	2.1	1.3	1.1	1.4	1.5

4. SIMULATION RESULTS

This study aims to optimize the placement and operation of DGs by taking energy losses into account. It should be noted that siting the DGs is done in 20 kV buses.

The peak demand in this network is 20 MW. Thus, the maximum total power generated by these 3-DG, are considered to be nearly 20 MW in peak hours. In other time intervals, also the total energy produced by DGs is near the total load at that interval.

In the first step, the goal is the placement of DGs in the network. By implementing the proposed method on the sample network, these results are achieved.

$$E = [52\ 40\ 36\ 38\ 60\ 88]$$

In this case, it is assumed that only 3 buses can produce energy. By this consideration, buses 1, 5 and 6 which have the biggest E_i are selected.

In the second step, the goal is optimal operation of DGs in the selected buses. Here, the algorithm of sizing the DGs is implemented on the buses 1, 5 and 6.

The following matrix is achieved for power generated at each time interval.

Time interval	E1	E2	E3
0-5	1.5	2	2
5-7	1.5	2	2
7-12	2	2.5	3
12-16	1.5	2	2.5
16-20	2.5	4	4
20-22	2.5	3.5	3
22-24	1.5	2	2

The above matrix shows that some DGs produce more energy than the other one in some intervals and in the other intervals it is vice versa. For example, DG 3 in times 7 to 16 produce more energy than DG 2, but in times 20 to 22 produce less energy than DG 2.

By considering the results of the above matrix, it is shown that placement of the DGs should not be based on the peak demand which is done in many of the research.

This method schedules the DGs based on the minimization of energy loss and gives a generating profile to each DG.

Table 3 compares the energy losses of the proposed method with the case that sizes of DGs are equal. Table 4 compares the results with other placement of DGs. The results of the tables show that the proposed method has the optimal solution.

Table 3: Comparison of the proposed method with equally dispatch

methods	Energy loss(MWh)
Proposed method	14.636
Equally dispatched	20.742

Table 4: Comparison of the proposed method with other placement of DGs

DG placement at buses	Energy loss(MWh)
1,5,6	14.636
1,4,3	17.892
2,4,6	15.465
1,2,5	20.886
2,3,4	22.846
2,5,6	17.632

By considering the results that shown in table 3 and 4, it is obvious that placement of DGs should not be based on the peak load, which is done in many of the research.

5. CONCLUSION

This paper has discussed a two stage methodology of finding the optimal location and sizes of DGs for maximum energy loss reduction of distribution systems. First stage is DG placement method which is proposed to find optimal DG location. Second stage is optimal DG operation based on load varying. Voltage constraints are included in the algorithm.

This methodology is tested on 9 bus system. By installing DGs at all the potential locations and optimizing the size at each time interval, the total energy loss of the system has been reduced and the voltage profile of the system is also considered.

Inclusion of the non-linear loads and power quality constraints is the future scope of this work.

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Performance Evaluation of VANETs for Evaluating Node Stability in Dynamic Scenarios

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Abstract: Vehicular ad hoc networks (VANETs) are a favorable area of exploration which empowers the interconnection amid the movable vehicles and between transportable units (vehicles) and road side units (RSU). In Vehicular Ad Hoc Networks (VANETs), mobile vehicles can be organized into assemblage to promote interconnection links. The assemblage arrangement according to dimensions and geographical extend has serious influence on attribute of interaction .Vehicular ad hoc networks (VANETs) are subclass of mobile Ad-hoc network involving more complex mobility patterns. Because of mobility the topology changes very frequently. This raises a number of technical challenges including the stability of the network .There is a need for assemblage configuration leading to more stable realistic network. The paper provides investigation of various simulation scenarios in which cluster using k-means algorithm are generated and their numbers are varied to find the more stable configuration in real scenario of road.

Keywords: VANET; RSU; Clustering; K-means; CBR; Cluster Head;

1. INTRODUCTION

VANET is the preeminent element in the intelligent transport system (ITS) constitutes with the basic requirements such as the number of nodes that acts as vehicles, embedded OBU i.e. a communication device and RSUs that are considered as the a group of fixed constituents along the road, literally called road side units (RSUs) [1][3]. A vehicle unit that contains OBU has a group of interconnection unit's linkage that grants the straight connection between the node (vehicles) and RSUs within its vicinity range. In order to connect with other networks for communications such as Internet, RSUs behave as gateway. This system allows the vehicles to warn from collisions, sudden breakage by allowing them to communicate with the movable units and the roadside infrastructures[6].ITS used for traffic management, for retrieving the vehicle owner's information, check on the mobility of the vehicles, in management of railway services. In ITS speed, position, velocity types of information are communicated [10].

VANETs platforms a broad category of usage in paved surface safety, user preference entertainment, and optimization of mobile trade in conformity to vehicle-to-0vehicle (V2V) and vehicle-to-RSU (V2R) interconnections. Communication is a means through which different components communicate with each other[2].In VANET communication is between different vehicles ,between vehicles and RSU or the vehicle & the RSU .Communication in Vanet can be categorized into various communication patterns such as Vehicle –to-Vehicle (V2V), Vehicle –to –Infrastructure(V2I) and Cluster-to-Cluster[12]. The V2V as a type of vehicle to vehicle communication is for cooperative driving .V2I is a type of vehicle to infrastructure communication in which no. of Access points are positioned with the static infrastructures [4][7]. Similarly C2C is the type of cluster to cluster communication in which different vehicles group together forming a self clusters that communicate with other clusters of vehicles as shown in figure 1[3]. The cluster consists of cluster members and the cluster heads for communication. The route of packets within a given range or area using different routing algorithms are used .The establishment of route is significant as links are important for communication between the nodes [27]. Due to the wide range of the mobility, the stability of network is very challenging task.

As per, United States of Federal Communication Commission (USFCC), DSRC has allotted 75-MHz radio spectrum in the 5.9-GHz band for V2V and V2R communication, inspired from the vehicular communication[10][13].The spectrum of the DSRC consists of the control channel and the service channel. The service channel i.e. 6 in no. are considered to be for both types of applications i.e. safety and non-safety. For controlling of information, control channel is used to deliver the priority based safety short messages [5] [11].

According to the Analysis, there is great demand for high throughput that includes in it a great challenge to the safety applications in VANETs as communication are more complex as shown in Figure 1[2][5]. Therefore a clustering approach, deals with the increase in the stability of the network. In this result oriented outcome research, principle efforts are as follows, first selecting a assemblage algorithm that is applicable to all the nodes in remarkable mode. The algorithm partitions the nodes of vehicular network environment into clusters so that high probabilities are achieved along the boundaries of the cluster and second Cluster head selection based on certain parameters. The election of the Cluster Head (CH) and the re- clustering is more challenging task to maintain the stability [16].Thus, there is a need for stability in terms of cluster configuration that lead to increase in throughput.

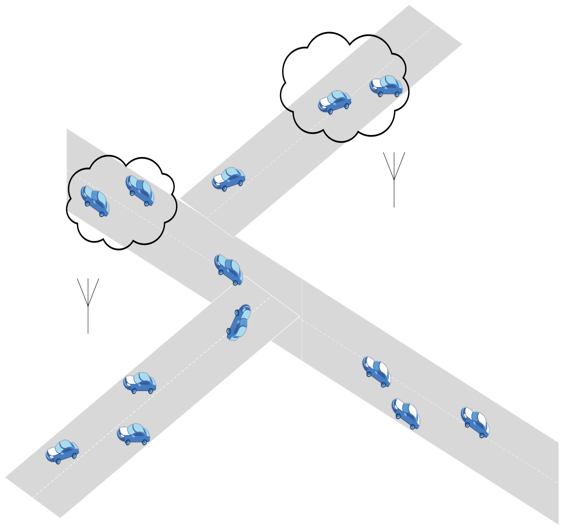

Figure. 1 Architecture of VANET with Clusters

The rest of the paper is organized as follows: Section 2 focused on the related work on stability of clustering in vehicular environment. Section 3 discussed about clustering, requisites of clustering, different types of clustering and schemes under clustering. Section 4 explains the system overview containing the underlying proposed idea. Section 5 discusses about the algorithm used i.e. K-means clustering algorithm for stability in network. Section 6 and 7 shows the experimental setup and Result Analysis respectively.

2. RELATED WORK

In VANET, some of the related work in clustering are done in terms of challenges, drawback and approaches, thus a tremendous development in the growth of vehicular communication technologies has been done that deals with the routing and other clustering approaches. The flow of vehicles in accordance to the road topology indicates the predictability of the vehicles before the mishappenings or any change occurs. Velocity vectors are used for grouping of vehicles and hence the stability of vehicles is more likely to exist when the nodes move together forming single and multihop paths. With stable routing approach, the duration of link and point -to-point throughput are enhanced and also in reduction of link-breakage .The drawback of this approach is the occurrence of hidden terminal problem [22].

Increase in vehicles on the roads is growing year by year. Due to the movements of vehicles and congestion of the roads, the roads accidents are more .To increase the safety, we use the new technologies that reduce the accidents on roads. The intelligent transportation system increases the safety of roads that avoid in applications such as overtaking, avoidance of collision, detection of oil etc [4]. Dissemination of information uses the broadcasting but this causes flooding. To avoid flooding, clustering algorithms are used for proper transmission of information. Clustering involves the formation of clusters of nodes according to similarities .For further improvements in algorithms, the drawbacks of the technique are discussed [14] [15].

Modern advances in technologies of wireless communication and industry that are auto -mobile have bring out an important research in the area of VANETs in the past few years. With the wireless technologies i.e. IEEE802.11p, the communication such as V2V and V2I is possible .This shift in the wireless communication has been featured to enhance safety of the roads and efficiency in terms of traffic in near forthcoming by the advancement in the area of Intelligent Transport Systems [8].With the approaches, governments with other industries are collaborating through the extra ordinary projects and researches in order to enhance the improvement in VANETs. Different applications of VANETs has introduced a lot many interest in the field of communication where disseminate of packets goes on. The new challenges, state of research and well off inherent potentials in VANETs are discussed [23]

The survey on clustering algorithms for vehicular ad-hoc networks featured a tremendous mark up growth in research related to inter-vehicle communications [21]. With increase in mobility of vehicles algorithms and new solutions need to be developed. The specific technique used is clustering in which nodes are grouped according to the nodes nearby in the neighborhood in order to make clustering more flexible. This highlights different clustering techniques with their limitations and overview of new clustering technique for vehicular Adhoc network. Different techniques are focused on different performance metrics. This involves detail understanding of the clustering and the performance metrics to feature different research trends in the field of VANET [18].

Vehicular ad-hoc network (VANET) has acquired a considerable importance. In VANET, applications are supported by safety application and user Internet related applications [26].The challenges and hardships that are faced by different features of

VANET such as mobility, quality of service, channel fading property, and channel competition mechanism etc on data transmission in VANET. Thus it involves the clustering and the idea of election of cluster head with different clustering techniques for transmission of data. The proposed idea of clustering considers the difference in the velocities of the nodes in their vicinity, cluster members and the node degrees in a cluster. The requirements of QoS of delay and throughput sensitive service considered by the clustering [17]. Some of the related work are also discussed.

In DDMAC i.e. distributed multichannel and mobility aware cluster based MAC protocol aims to overcome high collision rate and the latency and increases the high stability. The creation of more stable cluster is based on the channel scheduling and mechanism known as adaptive learning in which they both combine within fuzzy-logic interference system. The hidden terminal problem eliminated, when each cluster use different sub channel from its neighbors in distributed manner [28].

To accomplish stable cluster, node having high mobility contrasted with its neighboring nodes can't be chosen as a cluster head. In the event that such a node is chosen as cluster head, the likelihood of cluster breakage and even re-grouping is immense. Subsequently, MOBIC suggests that a node with slightest versatile nature contrasted with neighboring nodes ought to be chosen as the cluster head. MOBIC is fundamentally intended for versatile especially mobile ad-hoc network works for VANET. It utilizes versatility metric for determination of cluster heads. It relies on upon lowest ID algorithms. The clusters framed by utilizing this technique are more stable when contrasted with the Lowest-ID algorithm with slightest cluster head .The rate of cluster head modifications is decreased by 33 percent when contrasted with the Lowest-ID clustering algorithm [24]

Zhenxia Zhang et al. review about a novel clustering plan where clusters are chosen in view of the relative versatility between vehicles at multi-hop level. This method utilizes transmission of packet delay in order to produce distance between two vehicle nodes in the system. It is acquired from beacon delay on every node transmitted and reached to different nodes. Vehicle nodes having low total mobility can be chosen as the cluster head nodes. In the wake of getting two beacon messages, the vehicles can ascertain the vehicles relative mobility. In situations, where two cluster heads are in same range, the re-clustering of nodes is deferred for a little measure of time which helps in enhancing stability of cluster. One of the upsides of this method is that it stays away from irrelevant re- clustering [25].

3. CLUSTERING IN VANET

Clustering or assemblage is the formation of small groups of nodes known as clusters in order to split the network. A cluster in VANET elaborates the concept of the set of nodes in one group and the communication that takes place between the nodes. The nodes in a particular cluster elect one Cluster Head (CH) from all the nodes in a cluster [16] [18].

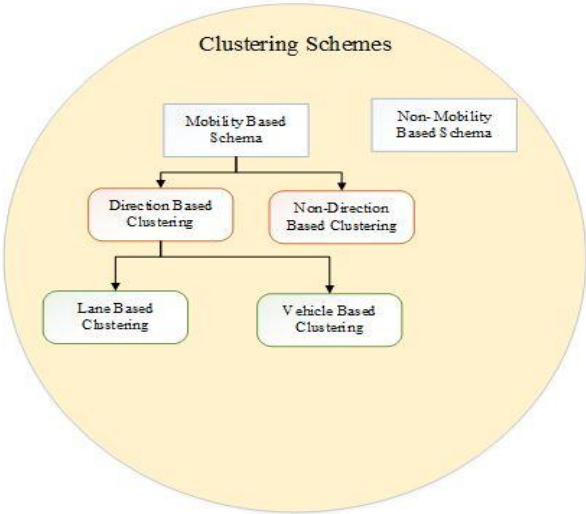

Figure 2. Different Categories of Clustering Schemes

The Cluster Head (CH) made to communicate with the nodes of cluster and Cluster Head (CH) of different cluster. Thus communication is defined as to be Inter and Intra cluster organizations. Generally, the nodes in the neighborhood are notified by position data equipped in periodic messages. Different clustering types are discussed as mentioned in figure 2 includes two types of clustering- static clustering and dynamic clustering in order of cluster formation [22]. In static, the clusters formed are very stable in nature. These clusters consist of RSUs and the working of clustering is within the range of RSUs. The direction and speed of the clusters movement is in same direction. Thus, the process of reconfiguration of the nodes is not required in static clustering. Maintenance and formation of clusters is simple in static clustering. Design of routing is not so complex, only the scalability and other issues lead to reduction in the network performance. Dynamically formations of clusters termed as dynamic type of clustering. Thus, the reconfiguration is much important. Due to the mobility of nodes, the cluster heads goes on changing. The different clustering protocols are separated on the bases of different parameters such as speed, direction and so on [19].

4. SYSTEM OVERVIEW

In mobile based interconnection, assemblage is crucial of all confined diagrammatic design employed for a purpose to produce geometric forms of Vehicular Based Network which is least consistent [12]. Most of the assemblage implementation of vehicular based interconnection is featured from mobile Adhoc based networks (MANET). Nevertheless, VANET peripherals are represented by their considerable distinguished feature, and the presence of mobile interconnections in the identical platform area didn't imply that they show the identical area stage. Therefore, in Vehicular based interconnection, grouping design should be taken into process with defining parameters as mobility and non-mobility schemes to create stable cluster structure with other metrics in comparison.

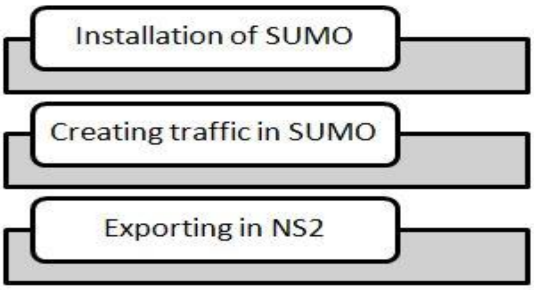

Figure 3: Steps for creating the mobility file for location

Stability of a network can be dimensioned with different categories in vehicular Adhoc network. The first criteria are to be considered in terms of packet delivery that involves the estimation of the flow of packets by taking different performance metrics. The second criteria are the need of topology of network to be maintained for any stability or instability of the network. The other one are route of packets by using various protocols for enhancing the stability in the network [26].

In dynamic vehicular environment, cluster re-configuration and selection of the cluster head cannot be neglected. For dynamic environment, to increase the stability of network in clustering can be traced in view of certain metrics such as position, speed, and initial source, destination of mobile nodes, distance and direction. Thus, operating on the number of clusters used and the cluster heads for coordination in order to reduce the drop to increase throughput with the suitable metrics for performance.

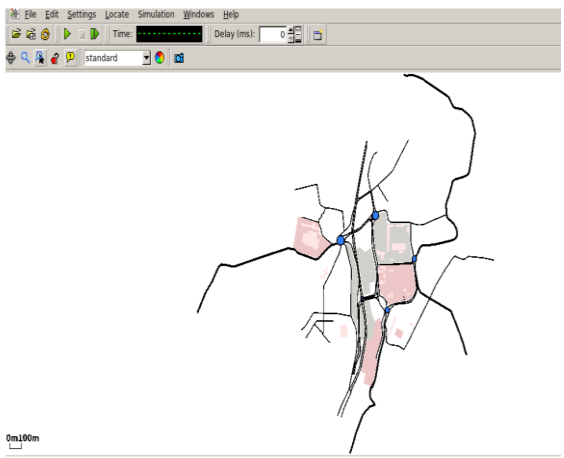

Figure 4. Selected area of Jammu region using open street map and SUMO

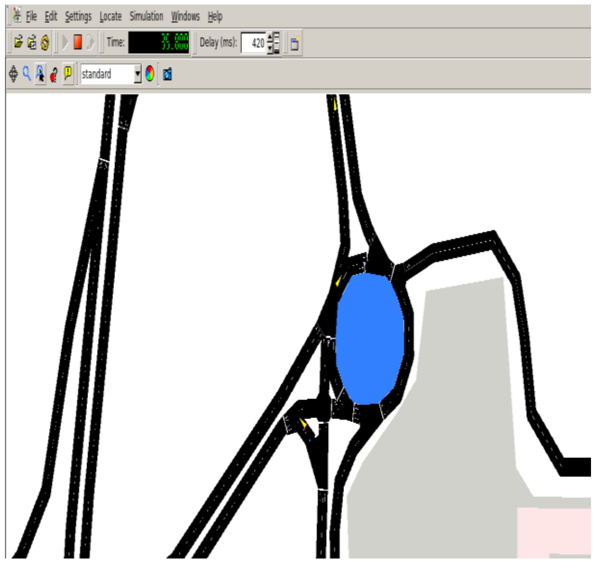

Figure 5. Movement of vehicles in real scenario of road

In the considered scenario, the numbers of nodes are 100 with random movement of the vehicles. For localization in VANET, to estimate the location, direction of the mobile nodes using Global Positioning System (GPS) is utilized where each vehicle is known by its different parameters as discussed .This is measured by mobility trace file that is created to trace the real scenario of the road exporting the selected small area of Jammu region as in figure 3[22]. The mobility based file consists of the longitudes and latitudes for exact location of the mobile nodes by using open street map and SUMO to create traffic and exporting in NS2, steps as shown in figure 3. The open street map provides the xml based .osm file for any selected area chosen. The SUMO is simulation of urban mobility software that empowers to simulate the street movement .The SUMO then used .osm file to its local xml document and then traffic is created and then ported in NS2.So as the simulation can be done in NS2 using the locations as traced by mobility file.

Table1. Showing various Notations and Description

Notation	Description
N	Number of nodes
CH_i	Cluster Head
CM_i	Cluster Member
K	Total clusters to be formed
C_i	Centroid
S_i	Total Packets send
r_i	Total Packets receive
S	Source
T	Transmission time

The clusters are formed by nodes using the K-means algorithm travelling in different directions according to real scenario of road as shown in figure 4 and figure 5.The node is chosen as cluster head within one cluster when the distance of that node is minimum with the cluster head of other node in different cluster[23][30]. Thus, nearest cluster heads forward the packets following different routes. The tabular format with the notations and description for the particular architecture along with other notations as used in research paper is shown in table 1.

5. K-MEANS CLUSTERING ALGORITHM

In order to ensure a smooth understanding of formation of Clusters and Cluster Head (CH), the proposed Centroid approach i.e. K-means is considered. The Centroid based technique classify the mobile nodes establishing a basis for inputs or features in the assemblage named as K groups where K is any +ve integer. In vehicular network, K-means grouping is a technique of collection of nodes which intends to divide n conditions into K-groups in which individual node is monitored by checking condition which is a part of the group with the nearest mean as shown in figure 3 [31].

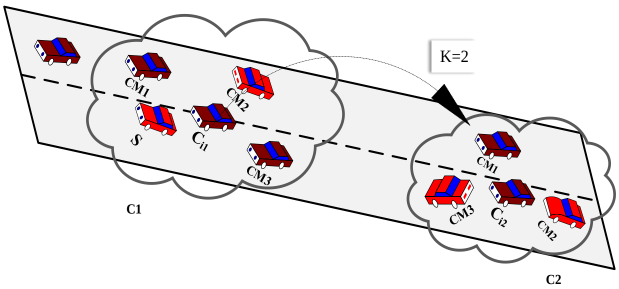

Figure 6.Architecture of VANET with K-means clustering for K=2

The architecture of VANET with K-means clustering highlights the scenario, considering number of clusters K =2 as example to discuss about the clustering. The C1 and C2 are the two clusters and CM_i i.e. CM1 ,CM2 and so on are represented cluster members of the cluster C1 and C2 .The C_i is the Centroid such that C_{i1} and C_{i2} are the Centroid of clusters C1 and C2. The messages are disseminated from cluster head to cluster head following the origin of information i.e. S, source to particular destination. Cluster head are selected considering the metrics. Assuming , $|| x_i - c_j ||^2$ be the Euclidean distance , wi be the number of nodes in i th cluster and w be the number of Centroid.

$$\sum_{i=1}^{w} \sum_{j=1}^{w_i} \| x_i - c_j \|^2$$

1. Set the desired number of clusters as (CLUST_NUM). Let n={x 1, x2, x3...xn} and c be {c1 ,c2, c3...cw}.
2. Calculate the total number of nodes as 'n'
3. Calculate the nearest mean distance between each node and cluster centers as 'w'.
4. .Group the nodes belonging to a specific range with respect to nearest mean distance under one cluster.
5. Calculate the center node of the group or Centroid again by means of nearest mean distance values and name the node as center head or group head.

Figure 7. Algorithm of K-means Clustering

K-means as one of the Centroid based algorithm or procedure is as differentiating the given nodes by taking into consideration the number of clusters. Then defining the Centroid i.e. K for each cluster. As per dynamic environment, the locations of nodes are in scattered fashion and hence the results will be different. The next step is to take each node and relate it with the nearest Centroid .When no node is undetermined, the initial step is done. Then again recalculating the new centre's of clusters and loop has been initiated again. The assemblage of node data is used by reducing the aggregate of squares of range between nodes i.e. location values and the corresponding cluster Centroid [29] [30]. The Centroid are considered as cluster head for communication in order to attain the stability in terms of data dissemination or flow of packets successfully from one node location to another node within the stipulated period of time. Therefore, we scheme K-means algorithm with the procedure where all CH and clusters can be evenly presented by taking their distances and considering other metrics i.e. speed, direction and position to enable the stability as discussed above in consideration.

6. EXPERIMENTAL SETUP

The result oriented system is simulated in network based software (NS2). The simulation was setup with the specifications as shown in table 1. The performance parameters including packet delivery ratio, throughput, receive percentage, drop percentage and number of clusters. A cluster that consists of group of nodes that can communicate with each other and enabling transfer of data to the desired destination [17]. A cluster head for each cluster is selected for the coordination of communication among nodes in the network. The cluster head are selected using mean distance value (μ) calculated by K-means algorithm. The Cluster_Num are varied with 4, 6, 8 and 10 for various results with performance parameters in table 2.

Table 1.Showing the Setup with Specifications

Attributes	Type
Channel	**Channel/WirelessChannel**
Network interface	**Phy/WirelessPhy**
Radio propogation	**Propogation/TwoRayGround**
Interface queue	**Queue/DropTail/PriQueue**
MAC	**Mac/802_11**
Antenna	**Antenna/OmniAntenna**
Link layer	**LL**
Max packet in ifq	**100**
Routing protocol	**AODV**
X dimension of topography	**3500m**
Y dimension of topography	**3500m**
Simulation time	**60s**

7. RESULT ANALYSIS

A comprehensive simulations study was regulated to evaluate the performance of the clusters. In our simulation, we consider the road traffic and the network parameters. We simulated a real scenario of road with particular area coverage includes intersection of roads, turns, curves and vehicles as shown in figure 4. In simulation, we investigate 100 vehicles on real world.
The more stable configuration is calculated using the various parameters quality parameters with their expected formulas for evaluation of results. The different parameters includes the packet delivery ratio, throughput, receive percentage and the drop percentage.

The Cluster_Num are simulated with cluster_ Num 4, 6, 8 and 10. The different colors depicts the clusters in NS2 with the mobility based file along with the cluster heads numbered as CH (1), CH (2), CH (3) ….so on are shown in figure 8, 9, 10 and 11 according to Cluster _Num 4, 6, 8 and10. The channel to channel communication and channel to destination communication in order to deliver the packets following the different routes. The routing protocol used is AODV and the topology dimension used is a 3500-3500 meter with simulation time for each of cluster configuration is 50 s. The mobility file generated with the open street map and SUMO and exported in NS2 for simulation is used in the simulation containing the positions of the nodes.

Table 2.Showing the formulas for packet delivery ratio, throughput, receive percentage and drop percentage

Parameters	Formulae	
packet delivery ratio (pdr)	$\left(\frac{\sum_{i=1}^{t} s_i}{\sum_{j=1}^{t} r_j}\right) * 100$	
throughput (tp)	$\left(\frac{\sum_{j=1}^{t} r_j}{t}\right) * 8$	**where t is transmission time**
receive percentage (rp)	$\left(\frac{\sum_{j=1}^{t} r_j}{\sum_{i=1}^{t} s_i}\right) * 100$	
drop percentage (D)	$\left(\frac{\sum_{i=1}^{t} s_i - \sum_{j=1}^{t} r_j}{\sum_{i=1}^{t} s_i}\right) * 100$	

When the density was zero, the flow was zero, the flow as observed to be zero against s, r, D. When the flow of packets gradually increases the density against each parameter also start increasing. When more and more packets get added to flow, it reaches saturation point and gradual drop in density is observe d in each case. The numbers of clusters are varied & performance is evaluated based on the parameters as shown in table 3.

The density plots are formed in R studio that includes s, r, f and D for each of the cluster configuration. The figure 12, figure 13, figure 14 and figure 15 show the plots for cluster configuration 4, 6, 8 and 10 respectively.

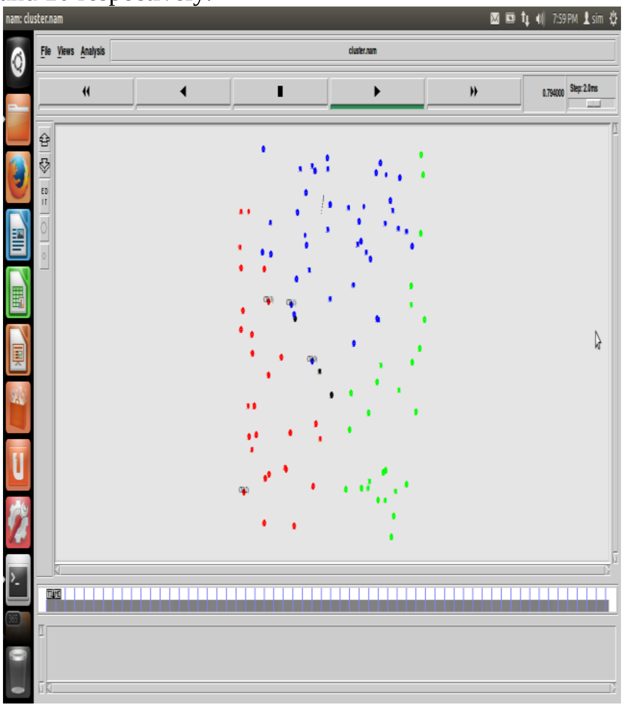

Figure 8. Showing simulation for Cluster_Num 4

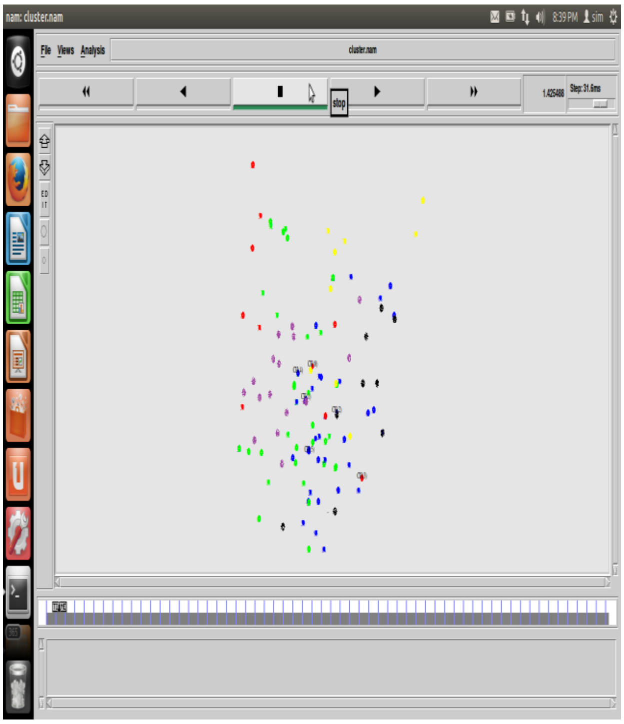

Figure 9. Showing simulation for Cluster_Num 6

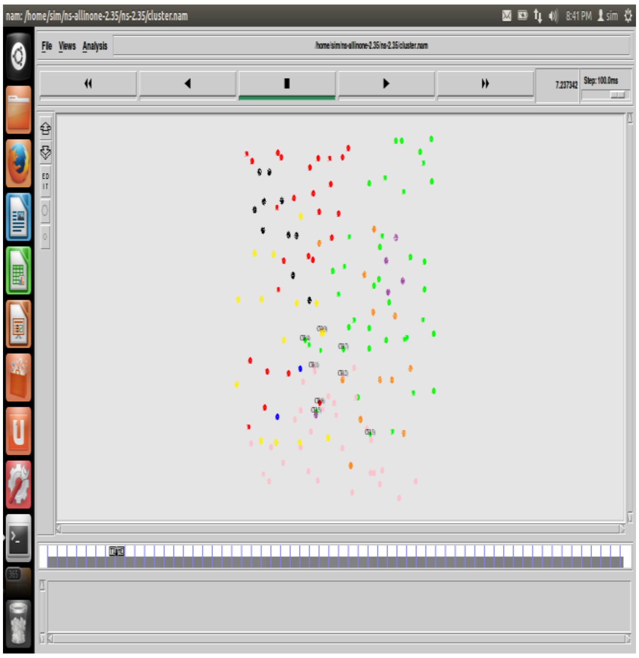

Figure 10. Showing simulation for Cluster_Num 8

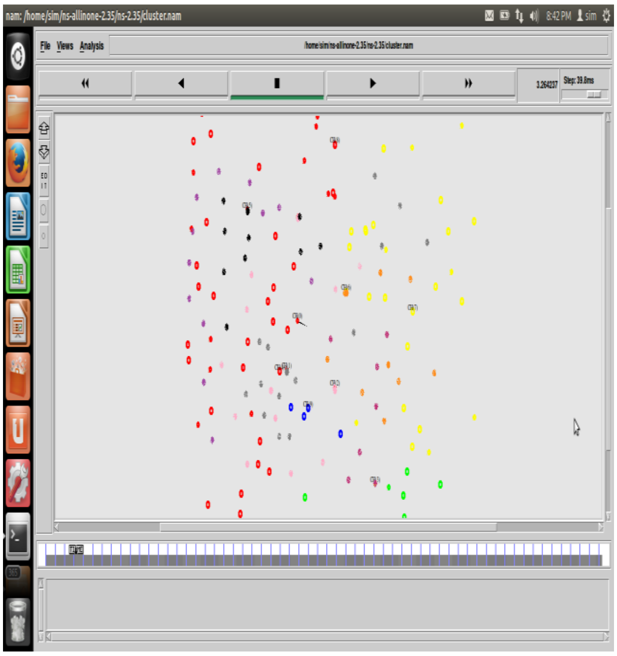

Figure 11: Showing simulation for Cluster_Num 10

When the number of mobile nodes were set to 4. The total number of packets send were 1827 and the total in density is observed in each case packets received were found to be 1728. The packet delivery ratio was 105.729 and while the throughput was observed to 276.48 as shown in table 3 and can clearly be observed in the density plot as shown in Figure12.

Table 3: Showing parameters used in comparison as total packets sent, receive, forward, packet delivery ratio, throughput, receive percentage and drop percentage

Cluster_Num	sent (s)	receive (r)	forward (f)	packet delivery ratio (pdr)	throughput (tp)	receive% (rp)	drop % (D)
4	1827	1728	4383	105.729	276.48	94.581	5.419
6	1982	1789	6129	110.788	286.24	90.262	9.737
8	3168	2978	2295	106.380	476.48	94.002	5.997
10	3531	3203	3919	110.240	512.48	90.71	9.289

When the number of mobile nodes were set to 6. The total number of packets send were 1982 and the total in density is observed in each case packets received were found to be 1789. The packet delivery ratio was 10.788 and while the throughput was observed to 286.24 as shown in table (3) and can clearly be observed in the density plot as shown in Figure13

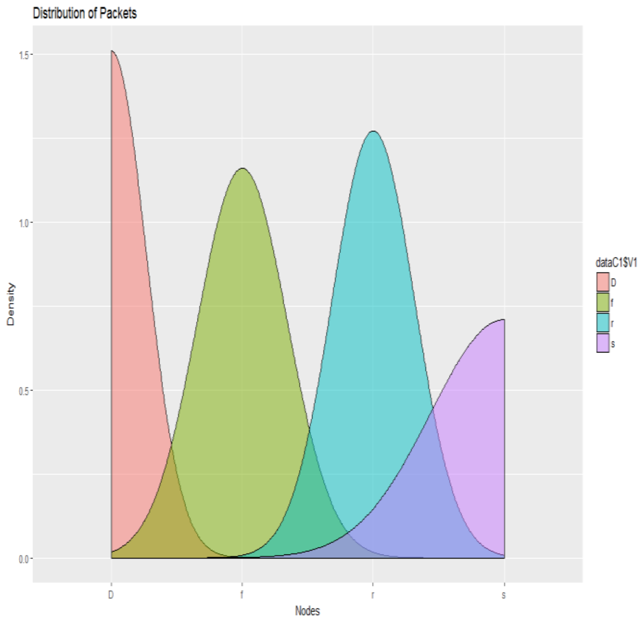

Figure 12. Showing density plot for total packets sent (s), total packets receive(r), total packets forward (f) and total packets dropped (D) for cluster 4

When the number of mobile nodes were set to 8. The total number of packets send were 3168 and the total in density is observed in each case packets received were found to be 2978. The packet delivery ratio was 2295 and while the throughput was observed to 476.48 as shown in table (3) and can clearly be observed in the density plot as shown in figure14.

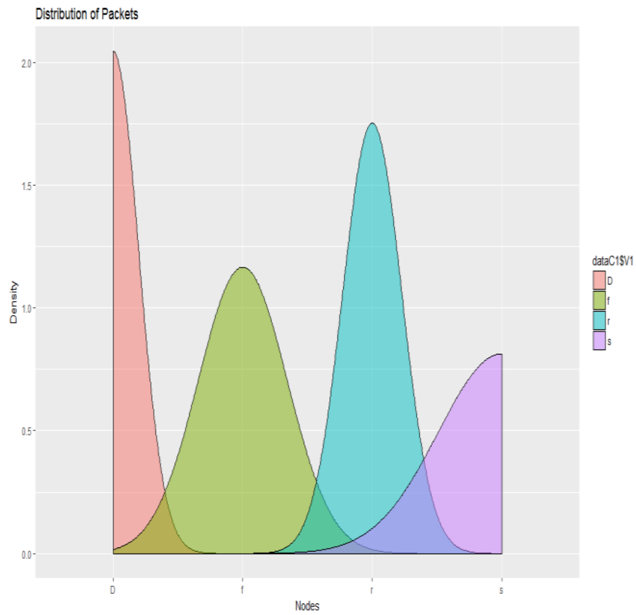

Figure 13. Showing density plot for total packets sent (s), total packets receive(r), total packets forward (f) and total packets dropped (D) for cluster 6

When the number of mobile nodes were set to 10. The total number of packets send were 3531 and the total in density is observed in each case packets received were found to be 3203. The packet delivery ratio was 110.240 and while the throughput was observed to 512.48 as shown in table (3) and can clearly be observed in the density plot as shown in Figure15

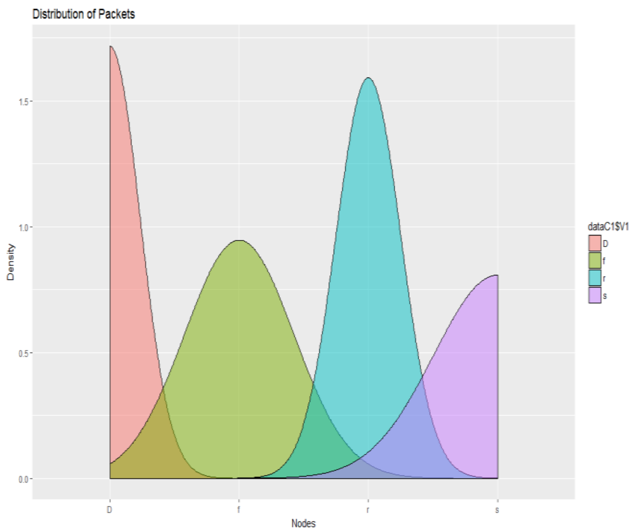

Figure 14. Showing density plot for total packets sent (s), total packets receive(r), total packets forward (f) and total packets dropped (D) for cluster 8

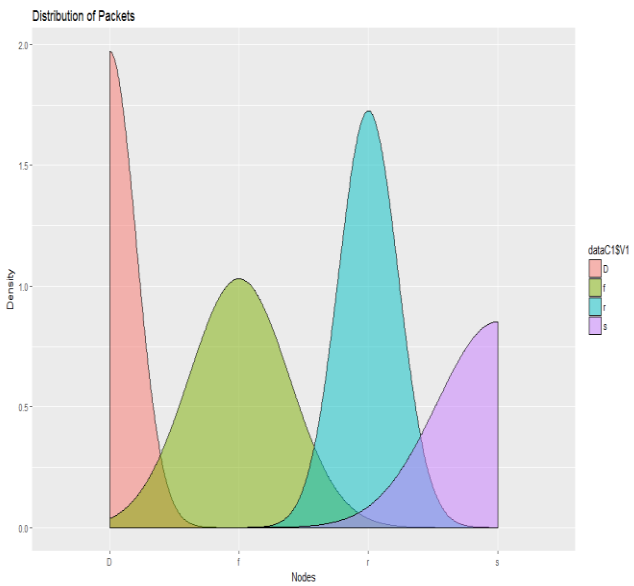

Figure 15. Showing density plot for total packets sent (s), total packets receive(r), total packets forward (f) and total packets dropped (D) for cluster 10

8. CONCLUSION

Vehicular Ad-hoc network is an encouraging technology for facilitating the communication among the nodes in real environment with Roadside Units (RSU) that leads to complexity in mobility patterns. With the movement of nodes, the topology of the network goes on changing. The dynamic nature of the nodes in network promotes a lot of technical issues including the stability of the network in terms of stable configuration in clusters using real scenario of road SUMO, open street map and NS2 with K-means clustering. The simulation shows that the maximum packet density was observed to <=1.5 in case the number was set to 4. The density was observed to <=2.0 in case the number of clusters were set to 6,8 and 10 as illustrated in Figure 12, Figure 13, Figure 14 and Figure 15 respectively. Different performance parameters which include throughput receive percentage, packet delivery ratio and drop percentage for evaluating the performance. This clearly depicts that the flow of packets optimized with increase in the number of clusters.

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