

# Reliable and Faster Data Communication in MANET and VANET Based on Localization and Clustering Techniques

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## Abstract

The concept of VANET (Vehicular Ad hoc Network) is derived from the idea of MANET (Mobile Ad hoc Network), where each vehicle is considered as a mobile node. Localization technique based on the clustering methods is an important issue for both MANET and VANET. To find out the position of a node and also provide the link stability in the ad hoc network is a present research area from the researcher view. Now-a-days a large spectrum of work has already been done in clustering techniques in ad hoc network, especially in VANET. The clustering technique is very much useful for reliable and faster data communication in both the forms of networks. The objective of this paper is to provide an idea about the localization concept related to clustering method based on both GPS and GPS free situations in real world scenario.

**Keywords:** MANET, VANET, Localization, Clustering technique and GPS.

## 1. Introduction

Contrasts between the two. A portable remote device is used in MANET to communicate among the nodes but in case of VANET, running vehicles speak to others vehicles. VANETs are made out of vehicles and highway guides. It is a critical method of competent moving framework. The development of the nodes in VANET is traditional as the vehicles proceed onward the settled pathways at high momentum confined just bottom of situations, for example, small or bended street, traffic crowdedness/jams and so forth.

To design this environment we assume that an On-Board Unit (OBU) and a Road-Side Unit (RSU) installed along the roads must be associated with each vehicle. The RSUs and OBUs are required to communicate and to exchange information between them through a protocol called Dedicated Short Range Communications (DSRC) [1]. In VANET, there are three types of communications possible like Vehicle to Vehicle (V2V), vehicle to Infrastructure (V2I) and Infrastructure to Infrastructure (I2I). But V2V method uses DSRC protocol. It is maintained purely as an ad hoc network. The main objective of DSRC is to provide low communication delay and high data transfers in the network [2]. The Federal Communications Commission (FCC) organization updated the DSRC protocol to WAVE (Wireless Access for Vehicular Environment) afterwards.

The example of VANET Architecture is given in fig-1

In spite of the fact that VANET is retrieved from the concept of MANET yet there are certain unnoticeable co

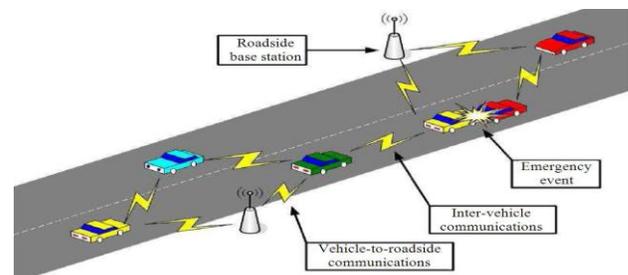


Fig-1: Structure of VANET

In this paper we have focused on the localization and clustering techniques in MANET and VANET. To provide the stability in the ad hoc network with the location the above mentioned techniques are suitable for both the network. Also we are trying to extend the some protocols of MANET to implement in VANET.

The remainder of this paper is organized as follows. In Section 2, distinguish between MANET and VANET is mentioned. Section 3 represents the Localization technique in MANET, section 4 describe the clustering technique in MANET. Section 5 includes localization technique in VANET; Section 6 provides the idea regarding

clustering technique in VANET. Section 7 represents analysis of clustering techniques in MANET and VANET. Section 8 concludes with possible future extensions.

## 2. Distinguish Between MANET and VANET:

The characteristics of MANET and VANET are not same. The design issues of VANET are complex as compared to MANET (fig-2).

### 2.1 Battery Power and Storage Capacity

The battery power and the storage capacity is not a challenging issues in VANET but in MANET it creates major problem during communication.

### 2.2 Communication Environment

The routing scheme is based on the different medium like dense and sparse. The more number of obstacles are possible in dense network, because trees, buildings and other objects are act as the obstacles in dense medium. But in sparse network these obstacles are absent such as high-way [5, 28].

### 2.3 Mobility Modeling

In VANET the mobility pattern is very much essential for communication. But the pattern of mobility depends on some parameters like: roads structure, the speed of vehicles, traffic environment and driver's driving behavior.

### 2.4 Highly Dynamic Topology

VANET supports dynamic topology where vehicles are changing their position frequently with high speed. Let a vehicle 'X' and another vehicle 'Y' are moving at the speed of 20m/sec and the transmission range between them is 200 m. So the connection between X and Y (vehicles) will continue  $200/20=10$  sec [4].

### 2.5 Frequent Disconnected Network

In sparse network environment the connection between the vehicles will proceed to disconnection most of the time due to its dynamic topology property. It creates interruption between the vehicles during information exchange.

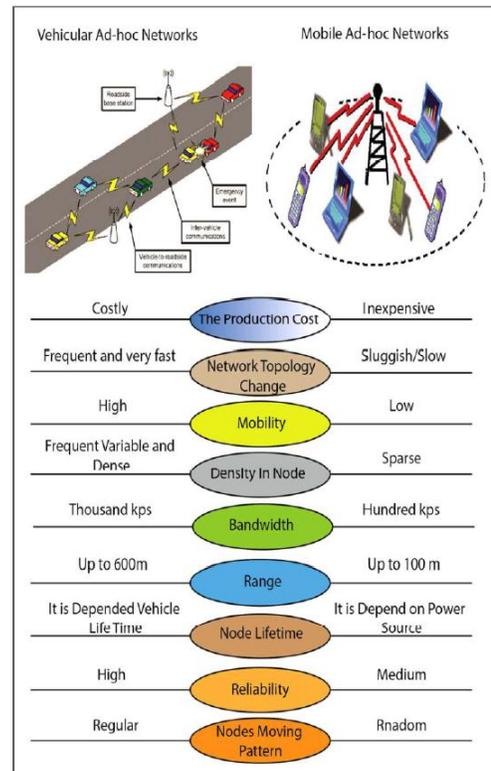


Fig-2: Discriminate between VANET and MANET

## 3. Localization Technique in MANET

Localization is characterized as the wonder of acquiring area data of nodes whose positions are not known. In this manner, with regards to MANETs, localization implies discovering area of mobile nodes (MNs). The surrounding of area is a fundamental component to increase full advantages of universal figuring. In this way, a few localization calculations are acquainted with appraise area of MNs. The area information got from confinement calculations can be valuable for getting to different area based organizations, for example, stock following, area observing, safeguard operations, historical center visit manage, and so forth. The position of mobile station (MS) can be resolved utilizing various radio signs transmitted or got by the MS. Some area estimation techniques like helped worldwide situating framework (A-GPS) depend on signals transmitted from satellites. Up until now ,a wide assortment of system based situating procedures have been proposed which utilize estimations acquired inside the phone systems, for example, got flag quality (RSS),time of arrival (TOA),time contrast of landing (TDOA),and edge of landing (AOA) strategies [6,7].

In self-organized wireless networks, for example, specially appointed or ad hoc networks, most nodes have a similar transmission go. In the meantime, most nodes can set up the trust association with just their immediate neighbors through cooperation. In this way, we can't find a gathering of uncommon nodes that can fill in as senders to cover the entire system. Luckily, the self-association property enables the remote less nodes to help each other. The nodes as of now taking in their position can fill in as grapple node for different networks. Under this condition we have to explore the required thickness and movement of the hidden grapple nodes and remote network with the goal that the confinement method can generate all through the system [8,29].

The localization of MANET is shown in Fig-3

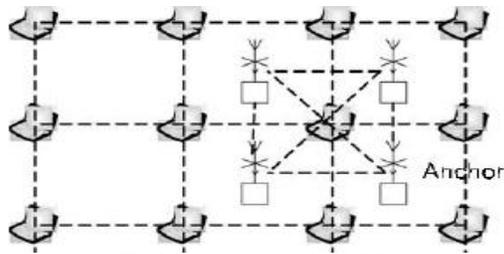


Fig-3: Localization in MANET

### 3.1 Existing Methods

There are a few existing strategies for finding the area of nodes in specially appointed systems. They are Received flag quality marker (RSSI), time based techniques (ToA, TDoA), Angle of Arrival (AoA), triangulation, Maximum probability estimation (ML). This strategy utilizes just RF signals which is generally a shoddy answer for limitation. RSSI does not utilize any additional gadgets since all portable are probably going to have radios. The execution isn't great as other, due to multipath way blurring.

### 3.2 Time Based Methods(Toa,Tdoa)

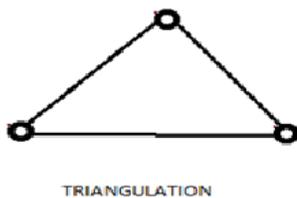
These strategies record the sending time of a packet and getting time of a packet. Utilizing the recorded time, time contrast between the nodes is computed. The propagation time can be specifically identified with the separation with the assistance of the engendering speed. These techniques can be connected to different signs like RF, acoustic, IR and Ultra sound. TDoA techniques are exact under viewable pathway conditions. In any case, LoS conditions is hard to accomplish. Acoustic flags likewise indicate multipath spread impacts that may diminish the precision of confinement [8].

### 3.3 Angle-of-Arrival

AoA decides the point at which signals are gotten and utilize geometric relationship to discover the node positions estimation is a strategy for deciding the course of proliferation of a sound recurrence wave episode on a receiving cluster. AoA decides the heading by measuring the Time Difference of Arrival (TDoA) at singular components of the cluster from these delay. The AoA can be establish the pickup of the reception apparatus exhibit. In AoA, the delay of landing in every component is measured straightforwardly and changed over to an AoA estimation [8].

### 3.4 Triangulation

Triangulation is the way toward deciding the location of a point by estimating edges to it from known focuses at either end of a settled pattern, instead of estimating separations to the point directly (trilateration). The point would then be able to be settled as the third point of a triangle with one known side and two known edges [6]. Fig.4.shown below:



TRIANGULATION

Fig-4: Triangulation

## 4. Clustering Technique in MANET

Clustering system permits quick connection, preferred directing Also topology management clinched alongside element structures and means at creating clustering techniques to process and overlook set about related clusters. Those nodes close should one another (structure those clusters). Furthermore every cluster may be obliged on choose a leader amongst its nodes likewise a principal cluster. These principal (head) clusters of every cluster not just deals with all the subsequent and bury cluster interchanges as well as determines the determination of the new cluster head at whatever point needed. The various kinds of cluster developments depend on the following factors like: mobility, neighbor, location, function and common clustering. The two important problems identified with clustering from claiming nodes in each specially infrastructure less networks are the arrangement of clusters and choice of cluster heads for every set of cluster [9, 10].

In this paper we have considered only the cluster based protocols for MANET. Again we have categorized only the location and mobility based cluster protocols in MANET.

The list of the protocols are given below:

### 4.1 Location Enhanced Cluster Based Routing Protocol (Location Based)

To avoid frequent cluster formation algorithm (cluster head failure) and improve the cluster performance LECBRP is developed. Enhance CBRP (ECBRP) algorithm intended to give a superior answer for cluster fail issue. Principle inspiration for this examination is to accomplish noteworthy effect in the execution of CBRP by enhancing the group security. To provide the cluster stability in the network location based clusters are required, which can reduce failure of cluster head [11].

Advantages:

- Packet transmission ratio increases
- Reduction in delay
- Restriction of information overhead is less

Disadvantages: It includes overhead.

### 4.2 Core Location-Aided Cluster Based Routing Protocol for MANET (Location Based)

In MANET cluster routing protocols are performed blindly based on the route information provided by GPS or other device. So routing overhead is generated. To overcome this situation CLABRP is formed. CLACR allotments the whole system into square groups. In each cluster, a group head is chosen for directing. Rather than flooding course ask for packets in the whole system at randomly, CLACR registers the coveted course by utilizing Dijkstra calculation in a cluster by-group premise. The cluster heads, source, and destination nodes are expected to take an interest in directing system that lessen steering overhead closely [12].

Advantages:

- Gain in path life span
- Cut down collision possibility
- Advertisement of storm issue reduces

Disadvantages: It introduces overhead

### 4.3A Robust Cross Layer Design Cluster Based Routing Protocol for MANET (Mobility Based)

Various hierarchical-based directing calculations have been proposed, for the most part in light of a layered outline approach, which implies that they are centered around planning ideal systems for "single" layer as it were an option approach i.e., a cross-layer outline, and present another cluster based steering convention named cross-CBRP. In this new approach, the communications between physical, MAC and steering layers are completely abused to better adjust the clustering calculation to differing connection and system condition because of versatility. All the more exactly, in the proposed cross-CBRP calculation, flag control data at the physical layer is used for the directing layer with the end goal that it can augment the strength of the framed clusters [13].

Advantages:

- Enhanced performance
- Adapts to the varying network conditions

Disadvantages: It include overhead.

## 5. Localization Techniques in VANET

In VANET various limitation systems have been recommended to figure the area of vehicle. Some of them are appeared in Fig. 2. Different limitation methods which are utilized for the identification of vehicle's position are the Global Positioning System (GPS)/Differentiated Global Positioning System (DGPS), Map Matching, Dead Reckoning, RFID Assisted Localization, Cellular Localization, Image/Video Processing, Relative Distributed Ad-hoc Localization and Localization administrations.

Limitation is a significant issue in VANET the same number of its applications incorporate position information. The common place confinement procedures in it utilize Global Positioning System (GPS) recipients and movement sensors. GPS is broadly utilized for steering and route restriction in spite of having some accuracy issues. However, GPS collectors positively are not the best alternative for circumstances where there is poor possibility of satellites like indoor or thick urban ranges. In any case confinement methods, for example, dead retribution, cell restriction and picture/video preparing can be utilized as a part of these sorts of circumstances [14,32].

Different sorts of procedures used to decide position of nodes in VANET is as per the following:

In this method, there are 24 satellites which together form worldwide situating framework also, works in circle around earth. Each satellite makes two finish circles each day and frames a hover around the earth at a stature of 20.200 km. The circles for satellite have been characterized in such a way, to the point that no less than four satellites can be found in the sky by every locale in the sky. The method utilized to assess the area of vehicle is known as Time of Arrival (TOA) where GPS beneficiary is continually getting the data that must be transmitted by the 4 number of satellites lastly; one more system is recognized as trilateration which is utilized to figure the location of vehicle.

Utilizing Time of Arrival strategy, recipient is likewise ready to know its scope, longitude and elevation. This technique is more affordable, as for the most part of vehicles are furnished with GPS recipient. In any case, this framework prompts some annoying issues, for instance not by ordinarily available, or not being vigorous for basic applications with a specific end goal to compute the area of vehicle, GPS operator needs to get to no under three satellite signs for 2D situating and no under four satellite signs for 3D situating.

The signs made by satellite can without quite a bit of an extend be or hold up that consequently root location incorrectness or on the other hand unavailability in urban thick circumstances. Moreover not all GPS recipients will give exact outcome after all GPS beneficiary may have confinement mistake of  $\pm 15$  to 30m. So this location regard isn't useful in the application which is lacking of proper limitation of data. This kind of fault can be limited among the cooperation of Differential GPS (DGPS) strategy. In this technique, GPS beneficiary can register its location by indicating the known environmental region. By then, the telecom of this separation is done in the framework and each close-by GPS recipient remedy their figured location data in light of the digital information conveyed by any one GPS receiver [15,33].

The weakness of DGPS technique is, it needs a few settled ground-based reference location for information transmitting. For basic operation, location data got from GPS should be joined among various wellsprings of location based data, and/or geological information. It will prompt too many precise situating of vehicle in the system. In some cases long postponement can happen while finding a cell phone utilizing GPS. The mention deferral may be limited by Assisted Global Positioning System (A-GPS) [16] that works on GSM, GPRS and UMTS systems. A-GPS is additionally utilizing satellite reference focuses to decide area and may be exact up to 10 meters.

### 5.1 Dead Reckoning

In this system the vehicle's position can be notified by the premise of location which is lastly referred and data, for example, heading, speed, remove, time and so on. The last referred location can be processed utilizing GPS collectors or by finding referred to the resource, for example street crossing, parking garages and so on advanced guide. This method can be utilized for brief terms when GPS isn't accessible or joined with delineate as it accumulates the location mistake effectively. Because of the issue of location mistakes, it is viewed as just as a reinforcement for GPS blackout, e.g. at the entry point of tunnel where vehicle enters and free GPS association [17].

### 5.2 Cellular Localization

In cell confinement [18] method, existing portable cell framework is utilized for the confinement of vehicles as appeared in Fig-5. To work appropriately, establishment of correspondence framework is required which is made out of number of cell base stations disseminated in the secured range. Cell phone is persistently speaking with the base terminal and when they got flag quality of one base station is more prominent than another, around then, cell phone begin correspondence along recent base terminal. It is a hand-off issue. In the meantime, this is conceivable that in excess of one base terminal can tune in to and talk with cell devices. Thus total number of various localization methods may be utilized to guide the precise position of vehicle. This type of strategy is known as RSSI (Received Signal Strength Indicator) that utilizes the quality of movement for finding the separation to the base terminal.

TOA (Time of Arrival) is an another method in which separation will be evaluated in light of the network it proceeds as long as individual flag to permit the source and reach to the base terminal. Also another approach is conceivable that utilizes reception apparatus exhibits by the base terminal which evaluates the location in view of the edge whichever the flag appear at the base terminal.

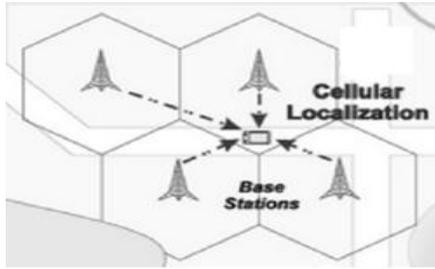


Fig-5: Cellular Localization

Finger Printing is a different approach for cellular localization where signal qualities for base stations are noted at every station. The mobile device may be acquired its location from the directory through test the perfect signal recorded properties, which must be referred from recent signal properties. So GPS based localization technique is more accurate than cellular localization method [16].

### 5.3 Map Matching

In this procedure some locations are obtained by customary provisional of time to generated evaluated direction. By then surveyed point is appeared differently in relation to the known digital map to locate the ultimate reasonable process geometry on the map which matches direction. This method can be used to recognize the accurate location data [17].

### 5.4 Image/Video Processing

For the limitation reason, at times, cameras that are as of now introduced in parking area are utilized. These picture/video handling systems together with a few information combination procedures are used to evaluate the position of vehicle. For example, location of sides of paths in video picture is recognized in light of some vision calculation which definitely assesses the vehicle's geometrical parameters in a neighborhood reference framework which incorporates separation of the vehicle from the left half of the path, street parallel arch, path width, vehicle's bearing edge and the camera slant edge [18].

### 5.5 GPS Free Localization Techniques

A framework is proposed (Lagraa et al ) to choose the location of the host when GPS is unavailable. It relies upon the clustering framework and use trilateration technique to enlist the location of the nodes. A total GPS free confinement tradition (Piran et al ) is proposed for VASNET with upgraded execution which can identify location in more than 90% situation. So it may produce GPS data in roadway and also where GPS-supported structures couldn't work, like tunnels [19].

## 6. Clustering Techniques in VANET

The design issue of VANET is different from the MANET design. So the concept of clustering related to routing protocols in MANET may not be suitable for VANET from all directions. In VANET the mobility factor is high between the nodes and variations also. These are the properties that create the environment for formation of clusters in VANET.

To improve the stability of the network, clustering computations should be reclassified to deal with location, course and speed too. Presently we talk about a portion of the progression did on the

current MANET clustering methods so as to fulfill the VANET condition prerequisites. These methods fundamentally circulate around twin targets of cluster creation and main node determination. An effective clustering calculation concentrates on least number of clusters and keeps up the present group formation with least overhead. In VANET the estimation of clusters are possible with a significant number which is recovered from MANET. The nodes in VANET are highly mobile in nature which is considered as its dynamic properties and their world in equivalent geographic region does not provide a similar probability outlines. Thus each clustering arrangement necessarily think about the measurement of momentum contrasts with neighboring nodes to create moderately strong clustering formation [25,30].

The vehicles in the roadway that have the equal moving course are isolated to a few clusters, each vehicle is considered as a node. Every node can be connected among neighbor clusters with wireless correspondence. The partitioning example is as fig-6

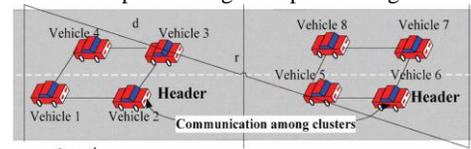


Fig-6: Partition of Cluster sample

It consists of two clusters in fig-6, the middle portion of one cluster is settled afterwards separated. For comfort, we generate a lot of suspicions as takes after, the semi diameter (radius) of radio is  $r$ , the diameter (length) of each cluster is  $d$ , the thickness (width) of divided roadway is  $w$ . As  $d \gg w$ , so the  $d$  is relatively equivalent to  $r^2$ . In 802.11 p standard, the range of wireless transmission is 1000 meters, so the hypothetical diameter (length) of one cluster can accomplish 500 meters. On the off chance that the header ways to deal with the inside position, the  $d$  can be significantly greater [20].

In this paper we have considered only the cluster based protocols for VANET. Again we have categorized only the location and mobility based cluster protocols in VANET which differs from MANET due to their high mobility nature. But the clustering technique provides better stability in VANET.

The list of the cluster based protocols for VANET are mentioned below:

### 6.1 Cluster Based Directional Routing Protocol for VANET (Mobility Based)

Subsequent to presenting and investigating a few sorts of normal guiding conventions, in this area we propose another convention called as Cluster-Based Directional Routing protocol (CBDRP) for the route direction. In this convention, we partition the vehicles in a similar motion bearing to a few clusters; at that point choose one header in every cluster. An intermediate information communication, the sender forwards the information to the header of its individual cluster, at that point the header advances the information to the header which is in a similar cluster for the goal, and finally the goal header holds the information to the goal. In this component, the connection will keep up just if there is one header in a middle cluster. In the meantime, just the header wish to discover the goal way [21, 24].

Advantages:

- Useful in highway environment
- Gives link support by path regenerated
- Rise in PDR (packet delivery ratio)
- Latency is small for secure application

Disadvantages:

- Restricted to highway pattern
- Not applicable for longer area

### 6.2 A Novel Cluster-Based Location Routing Algorithm for Inter-Vehicular communication: (Mobility Based)

The Cluster-Based Location Routing (CBLR) calculation can be named receptive and in light of area data Each cluster head keeps up a "cluster table." A "cluster Table" is characterized as a table that contains the addresses and geographic areas of the part and gateways nodes. We have assumed that all nodes can assemble their positions by means of GPS or some neighborhood arrange framework. The cluster head likewise keeps up a Cluster Neighbor Table that contains data about the neighboring groups (addresses and geographic location). The table incorporates a passage that contains the gateway or portals through which the cluster head would be able to go after each neighboring cluster. [22,26]

Advantages:

- Appropriate for large movable networks.
- Route detection duration is fine than LORA.
- Enhance the ability when number of nodes hike.

Disadvantages:

- Latency rise
- Packet drop may obtain

### 6.3 A Cluster Based Vehicular Ad hoc Network Model for Simple Highway Communication (Mobility Based)

In this Model a Simple Highway is taken for describing the VANET. On interstate vehicles can move spontaneously on either course. Every vehicle can have a restricted radio range. Vehicle inside a radio scope range can convey specifically as against the correspondence through a settled roadside unit in the current model. In this model many fixed roadside units are not expected. [23,27] So the framework deals with two situations.

- Vehicle to Vehicle communication within the city
- Vehicle to Vehicle communication outside the city.

The V2V communications for outside the city is mentioned in fig-7.

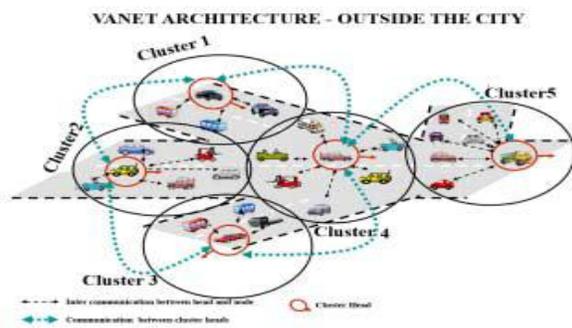


Fig-7: Architecture of VANET

Advantages:

- Latency reduces as cluster creation
- Cluster head poll is simple
- Utilize in highway environment

Disadvantage:

The output of simulation for each cluster and node may vary (every time).

## 7. Analysis of Clustering Techniques in MANET and VANET

In this paper we have analyzed from the different resources that clustering technique is essentially required for both the networks like MANET and VANET for various region which is explained in the given Table-1. In MANET we have taken location based cluster protocols for determining the exact location of mobile nodes and one mobility protocol for movement. The location based protocol reduces the cluster head failure in MANET. The CLBRP in MANET reduces the collision in cluster. In cross-CBRP of MANET, the performance of the cluster is optimized and stable. But it generates delay in network which may affect the cluster. The mobility based protocol in MANET provides an idea on mobility of nodes in vehicular technology.

But VANET is highly dynamic in nature as compared to MANET due to mobility quality of its nodes (vehicle). In VANET it is very difficult to establish the network connection between two or more than two vehicles for a long time. So clustering technique is required in VANET to increase the network stability in vehicles. In this paper we have chosen only the mobility based cluster protocols for VANET to reduce link failure between the vehicles. In CBDRP mobility protocol an intermediate node (head) is responsible for more than one cluster. So link stability is maintained which makes high packet delivery ratio in the network.

Again In CBLR a cluster table is formed to provide various information regarding the neighbor cluster and suitable for higher mobility vehicles. But it also increases the latency and packet loss in the cluster. The other mobility based protocol in VANET is responsible for intra vehicular communications with in the specified area also outside area. The latency between the nodes decreases with variation in result is the main task of this protocol.

As the mobility factor is important in the current scenario of VANET, we may modify the content of mobility based protocol (cross-CBRP) of MANET and trying to implement in VANET environment.

In this Table-1 we have explained regarding the advantages and challenges of cluster based protocols for both the networks MANET and VANET respectably.

## 8. Conclusion

In contempt of the fact that, MANETs and VANETs can be considered as same classification systems, yet in addition they are distinct on different factors as has been proposed by various authors and composed in the paper. Localization method is a fundamental factor among all these properties for a VANET and its frameworks that may be either GPS based or GPS free (Tunnel region).

The cluster based protocols is a vital category of protocol for both network MANET and VANET. So we are trying to analyze the clustering technique with their advantages and challenges in the above said network. Also we have planned to modify the clustering protocols based on mobility of MANET to implement effectively in VANET for achieving a better result in future.

Table-1- CLUSTER Based Routing Protocols For MANET and VANET In future we will develop a clustering method which may be flexible for both the network MANET and VANET effectively.

Network	Sl.No	Cluster based Protocols	Type	Advantages	Challenges
MANET	1	LECBRP	Location Based	Network Stability	Overhead
	2	CLACR	Location	Reduces	Overhead

			Based	Collision	
	3	Cross-CBRP	Mobility Based	Optimized Performance	Overhead
VANET	1	CBD RP	Mobility Based	Link Stability in network	Not work in Large Distance
	2	CBLR	Mobility Based	Cluster Table formed	Latency increases
	3	CB-VANET	Mobility Based	Latency decreases	Result varies

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