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# RSU Positioning for Improved VANET Connectivity

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**Abstract -** *Ad-hoc network systems which comprise a collection of mobile nodes or vehicles that use wireless transmission for direct communication. They are self-configured, self-organized, and self-controlled holding minimum infrastructure networks. Their important characteristics are the continuous change in mobility pattern and frequent connection failures during handoff. Frequent disconnection between source and destination nodes, which represent a challenge to provide accurate routing protocols with low communication delay and low overhead. In this paper, we propose an idea of improved the area of controlled operation of road side units (RSUs) in Vehicle Ad Hoc Networks (VANETs).*

***Key Words*:VANET, Antenna placement, Expansion and Coloration Algorithm, Average connectivity.**

## 1.INTRODUCTION

Ad-hoc network systems which consists of a collection of mobile nodes or vehicles that use wireless transmission for communication. They are self-configured, self-organized, and self-controlled infrastructure-less networks. This kind of network can be placed wherever it is required, can be set up anywhere.It is very essential to place very simple infrastructure setup and no or minor central administration [1]. This type of network is mainly used by community users such as researchers, students, military, business and emergency services. The Mobile Ad-hoc Network (MANET) group was created within the Internet Engineering Task Force (IETF). The primary goal of this working group was to develop and evolve MANET specifications and introduce them to the Internet Standard Track. Its target is to support MANET with hundreds of routers and solve challenges in this type of network. Wireless ad hoc network, developed by Vehicle Ad Hoc Networks (VANETs), for the growing population of the wireless network technology and providing a more comfortable driving life. Many researchers feel that vehicles can exchange their information through the vehicular ad-hoc network system to provide a more secure and satisfactory for safe driving environment. In the past year, car-field and communication technologies were inter-mobile communication and a hopeful field of research.

### 1.1 Smart Antenna

The smart antenna systems' goal is to cover all direction of vehicle movements without missing any information. Road side units (RSU's) placement based on the road traffic characteristics, aiming at improving connectivity in VANETs. To divide the coverage area of each RSU, we propose an Expansion and Coloration Algorithm (ECA). The average connectivity model for all vehicles in the network is established based on the results obtained from ECA. Smart directional antennas are placed in all directions with particular angle. Each antenna rotated at an angle of 60°to cover desired direction using highly beamed directional antennas and these antennas lead to the increase incoverage area. Smart antennas collect data fromvehicles and process it optimally by combining data received from all vehicles and retransmit back to the vehicle. Sensed data from vehicles is forwarded to smart antenna, which gathers iteffectively from a particular direction. By using smartantenna we can avoid accidents and also reducedelay. Hence it enhances network life time.

## 2. RELATED WORK

We present a distance-based broadcast protocol for VANET using Directive Antennas, an efficient direct broadcast (EDB). In EDB, the most of the receivers are responsible for the packet forwarding in the opposite direction of theincoming packet [2]. Here we focus on beam formation, which is clearly a signal transmitted message of a particular regional area by using one step-delay antenna, which reduces overall channel load on VANET as described in [3]. The major challenges here are how to overcome the problem of vehicle connectivity from the intermediate vehicle. Secondly, how to improve coverage in scarce atmosphere. We place the RSU as a buffer point as suggested in [4]. Vehicles exchange information between themselves and there are plenty of apps developed. Originally VANET is a Delay Patience Network (DPN), with long-term delays and messaging in low-density areas. Decided to deploy roadside components to improve connection coverage [5]. VANET have received major considerations for helping inter-vehicle communication to get out of the vehicle for a frequent disconnection problem. During traffic, the roadside component may be overloaded by multiple requests submitted by vehicles. Because of its limited real-time low coverage restrictions. There are usually two types of vehicle requests submitted: delays and delays tolerance [6] have received major considerations for helping inter-vehicle communication to get out of the vehicle for a frequent disconnect problem.

## 3. PROPOSED WORK

In this section we are discussing network environment, RSU positioning and directional antennas that are used in our work.

### 3.1 Network environment

Here, we model a VANET scenario as shown below in Fig - 1. We have considered some interacting nodes like directional antenna (RSU's), vehicles or nodes as located in the VANET scenario. As we know that, vehicles are randomly moving in ad-hoc network and it is restricted to be placed all the nodes to the network scenario which should behaving communicating capability also involved in the network. When vehicle can communicate each other with a coverage area or vehicle to roadside unit. Here, the nodes are supposed to request for their desired service by means of subscription and the base station need to generate an event and has to provide to the intended receiver.

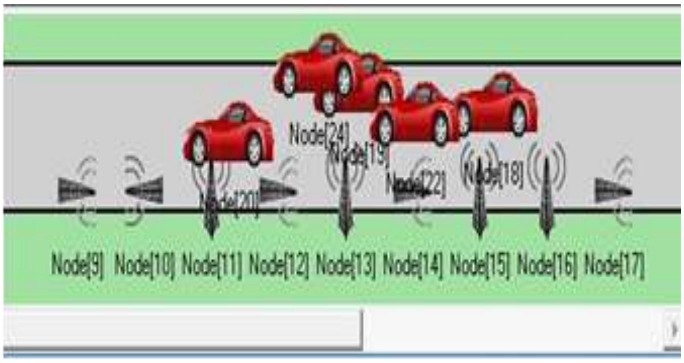



**Fig – 1** Network environment.

### 3.2 Proposed work

The smart antenna system's goal is to cover all the direction of vehicle movements without missing any information. Smart antennas are placed in all directions with particular angles. Each antenna is rotated at an angle of 60 degree to cover desired direction using highly beamed directional antennas as these antennas can eliminate data from unwanted directions. This leads to increase coverage area and decreases the signal to noise ratio (SNR). Smart antennas collect data from vehicles and process it optimally by combining data received from all vehicles and
retransmits back to vehicle. Sensed data from vehicles is forwarded to smart antenna, which gathers it effectively from particular direction. By using smart antenna, we can avoid accidents and also decreases delay. Hence it enhances network life time.

The main contributions of proposed work are:

1. Under the condition that every vehicle establishes a communication connection with their nearest RUS's, the coverage area division of the Extension and Colorization Algorithm (ECA) is proposed. Using the ECA, the nearest road segments can be identified at some RSU ranges in the network.

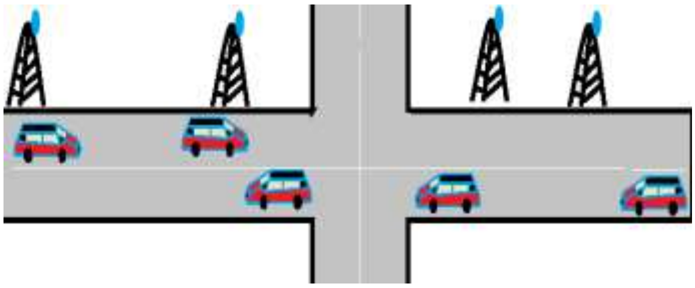
2. The average connection model is built on a variety of traffic characteristics, such as vehicle density and road distance. we make the placement of RSUs a problematic integration problem. Optimization is the goal of finding a placement plan that will achieve high average connection for all vehicles.

### 3.3 Coverage area division

Here, we divide the area of each and every RSU range in VANET. The distance between the original node and the destination is more uncertain situation expression and the low reliable communication link works. On that condition to connect Euclidean-nearby RSU with each vehicle, the RSU must include a cover Minimum Desirable Areas. We present a method called extension and color. Our objective is to identify at least individual coverage areas of RSUs. When a cell passes through the RSU border, it is present the matching color of the RSU is described. All RSUs extension and color processes begin. When all the cells in the network are painted, the same startup time is complete. Giving a specific area of urban road network, the S region is a set of road segments. Imagine the presence of RSU N versus on the network.

### 3.4 RSU Positioning

Here we design and develop VANET scenario using directional antennas. Fig -2 shows the communication between roadside unit and vehicles or vehicle to vehicle communication infrastructure.



**Fig–2** Low traffic flow network.

The traffic flows have imbalanced features in both time and space scales, which can be analyzed statistically. Considering the characteristics of the road, this paper provides a connection-based technique for the employment of RSUs in the regional distribution of imbalances. We study road placement as an integrated optimization problem, in which the purpose of optimization is the highest average connection between vehicles and their RSU. When the traffic is low, the positioned antennas are satisfactory to maintain the network.

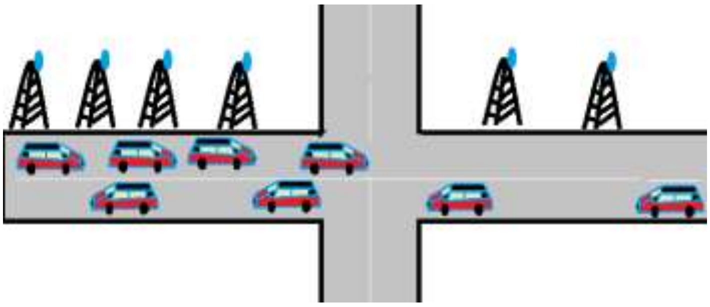


**Fig – 3** Heavy traffic flow network.

If the traffic flow is heavy (as depicted in Fig - 3) at that time some communication problem will occur and some information will be lost and hence, in order avoid that problem we have implemented this network by positioning directional antenna to maintain effective coverage area for better connectivity purpose.

### 3.5 Directional antenna and Omni-directional antenna

In our studies, when directional antenna uses the same transfer power as the Omni-directional antenna, the directional antenna relatively provides the most effective isotopic emission power in the directing of the Omni-directional antennas. Originally the Omni-directional antenna shave the power to receive less than the antenna. In the Ad-Hoc network, nodes connect to each other, maintaining dynamic and temporary connections from time to time and through peer-to-peer wireless communications. As we know, the Omni-directional antenna emits equally in all directions, and it has small radiation power and sent to the environment to reach the desired client. The directional ray emits and accepts the signal energy from one direction and increases the ion strength in that direction to the receiver and transfer. So the directional antenna provides better connectivity than the Omni-directional antenna.

## 4. SIMULATION

The proposed scheme has been simulated in vehicular ad-hoc network (VANET) scenario using OMNET++ simulator. OMNeT++ simulator is an object-oriented modular discrete event network simulation frame-work. It has a universal architecture, so it can be used in different problem domains:

- Modeling of wire and wireless communications networks
- Protocol Modeling
- The model of queuing networks
- Multiprocessors model and other distribution hardware systems
- Evaluation of hardware architectures
- Evaluation of complex software systems is the performance aspects
- Separately, any system type and simulation of a separate electrical system Suitable, and conveniently mapped into communications units Messages.

### 4.1 Simulation parameters

Some of the performance parameter evaluated are coverage area, packet delivery ratio, throughput, control overhead, and latency. The area covered by omni-directional antenna or directional antenna, which we have employed in vehicular domain.

- **Packet Delivery Ratio (PDR):** PDR is the ratio of actual packets delivered to total packets sent in the desired network.

$$PDR = \frac{actual\ packet\ delivered}{Total\ packet\ sent\ in\ the\ concern\ network} \quad (1)$$

- **Throughput:** It is the process of measuring the efficiency of the network in terms of data rate and transfer of non-repetitive information or the overall performance of the system.
- **Latency:** This is measured as the time required for a packet to be returned to the source or sender. And it is the amount of time taken by packets to traverse the entire network from source to destination node.
- **Control overhead:** The amount of overload on the system which is imposed by the excessive control messages in the network.

### 4.2 Simulation model

In our work, we have considered 'N' number of nodes in the area of $X \times Y\ kms$. Initially, we should set the each and every node mobility speed at which it has to perform. In this network multiple number of vehicles are included. In order to simulate, the mobility of the vehicles can be kept on continuously varying as like in moving randomly. We have considered here, each and every node is assigned with different ID and positioning the nodes with 'x' as vertical and 'y' horizontal position in order to give specified service.

### 4.3 Simulation procedure

The simulation procedure of our proposed work starts with designing VANET scenario on OMNET++ simulator and place the nodes or vehicles' RSU's.

- Define the number of nodes.
- Assign the node ID's, and make the connection between vehicle, speed of vehicles, position of each node.
- Create the VANET scenario for given number of nodes and antennas.
- Based on subscription the services will be given to desired users.
- The services are vehicle density, speed and nearby hospitals etc.
- In visual studio 2008 keep the programs file as aodv.cc, dsr.cc, physic.cc, and omnetpp.
- Generate the event and assign the service.
- Write the c program code for operation to be execute and debug the errors.
- Compute the performance of the system.

## 5. RESULTS AND DISCUSSIONS

To examine the effectiveness and performance of our proposed scheme, we have analyzed few of the performance parameters like coverage area, packet delivery ratio (PDR), distance, latency, throughput and control overhead.

Chart 1 shows PDRvs signal to noise ratio (SNR). Here, as the SNR increases the respective packet delivery ratio will keep on increasing linearly as shown in the chart – 1 below. In this graph PDR OPT indicates optimization packet delivery ratio and PDR indicates without optimization packet delivery ratio. Clearly, the PDR increases with optimization.

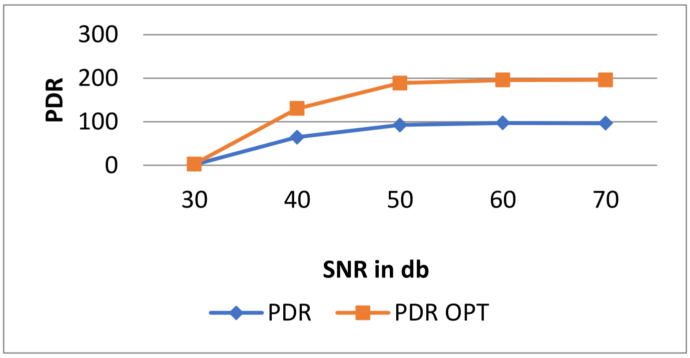



**Chart – 1**PDR Vs signal to noise ratio.

Chart – 2depicts, throughput vsSNR. Here, as the SNR increases the respective throughput will keep on increasing linearly as shown in the chart – 2 above. From this graph we can infer that throughput increases with increased optimization.

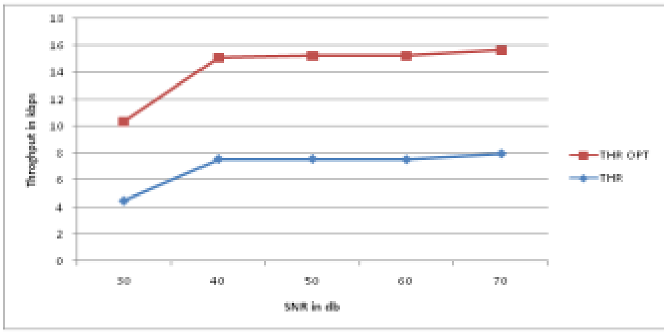



**Chart – 2**Throughput Vs signal to noise ratio.

Chart –3 shows control overhead vs SNR. Here, as the SNR increases the respective control overhead will keeps on increasing linearly as shown in the abovechart – 3. This is expected because as the SNR increases the packet control overhead also increases.

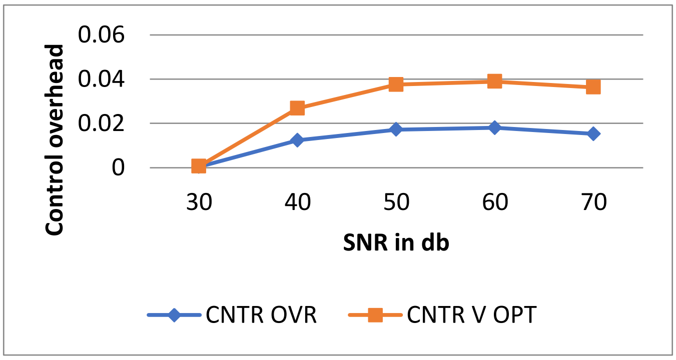



**Chart – 3**Control overhead Vs signal to noise ratio.

Chart – 4depicts latency vs SNR. Here, as the SNR increases the respective latency will keep on decreasing initially and then increases a little linearly as shown in the chart – 4above.

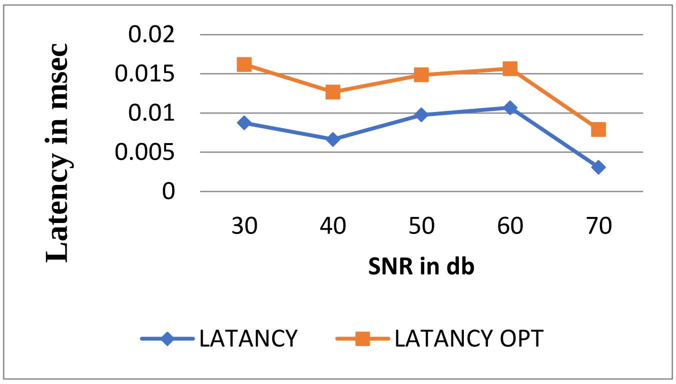



**Chart – 4**Latency Vs signal to noise ratio.

Chart - 5 shows packet delivery ratio Vs Number of RSU's. Here, as the number of RSU's increases the respective coverage area will keep on increasing linearly as shown in the abovechart – 5.

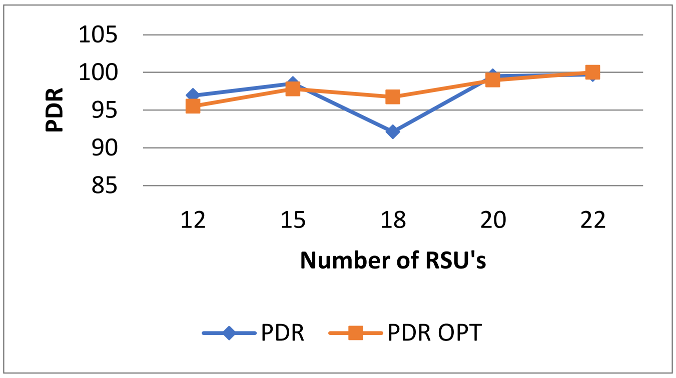



**Chart – 5**Packet delivery ratio Vs Number of RSU's.

Chart –6 displays average energy remaining in nodes vs number of RSU's. Here, as the number of RSU's increases the respective RSU will increasing coverage area linearly as shown in the chart below. From this graph we can infer that the optimized node have higher energy than the un optimized node.

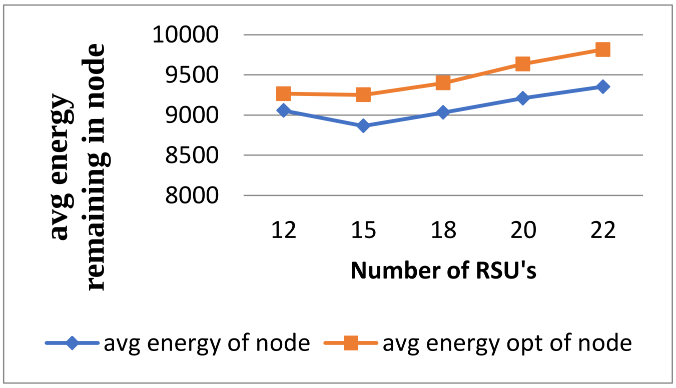



**Chart – 6**Average energy remaining in node Vs Number of RSU's.

## 6. CONCLUSION AND FUTURE WORK

New challenges/issues are arising due to advancement in the modern technology in VANETs. In our proposed work, we have discussed about positioning of smart antenna to cover more area in network. The network scenario of proposed work involves RSU positioning to have connectivity between the vehicles. The smart directional antennas are used in vehicle-to-road side communication. By using smart directional antenna, we have got 30% higher throughput as compare to other antennas. We can establish proper communication between V2I with help of positioning smart antennas in networks. The analysis of measurement of communication range of antennas is predefined and positioning of antenna is also determined in the network. The proposed work is compared with existing scheme in VANET with consideration of some of the performance parameters viz; latency, throughput, packet delivery ratio, signal to noise ratio etc. Finally, the communication is established between the vehicles and RSU is through proper positioning of smart directional antenna in the network. In future work, we are planning to establish over all smart antenna scenario in VANET systems.

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