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# Performance Analysis of Diverse Routing Protocols Incorporated in the Rescue Vehicular Nodes of Multi-hop VANETs

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**Abstract**

Vehicular Ad hoc NETwork is an Ad hoc network used for communication between vehicles within a range of 250 m. In order to make a communication between vehicular nodes we have to finding a valid path between the source and the destination nodes. The most commonly used routing protocols for VANETs are namely Destination sequenced Distance Vector (DSDV), Ad-hoc On demand Distance Vector (AODV) and Dynamic Source Routing (DSR).In this paper these protocols are incorporated at each of the rescue vehicular nodes and equal to the realistic scenario the group of rescue vehicular nodes at the rescue stations are set to move towards the disaster zone of grid based city. To improve the coordination among the vehicular nodes within an each group, communication between head vehicle and other vehicles is established at both movement and rescue operation. The above scenario is created using MOVE(MObility model generator for VEhicular networks), SUMO(Simulation of Urban Mobility) and simulated using NS-2.The performance of these routing protocols is analyzed and compared in terms of packet delivery ratio, normalized routing overhead, throughput, end to end delay, goodput and jitter.

**Keywords**: VANET, AODV, DSDV, DSR, MOVE, SUMO

# 1 Introduction

New vehicular networking scenarios are created as a result of advancements in wireless communication technologies [1]. VANETs typically classified into two types namely single-hop VANET and multi-hop VANET. In a single-hop VANETs communication is possible only between vehicular nodes are in the radio vicinity of each other, but in multi-hop VANETs, communication between two end vehicular nodes is carried out through a number of intermediate vehicular nodes whose function is to relay information from one point to another. VANETs routing protocols typically have two routing strategies namely proactive approach (DSDV) and Reactive approach (DSR and AODV)

## 1.1 Destination Sequenced Distance Vector

In DSDV Looping is avoided by incorporating the table updates with increased sequence numbered tags. Routes to all destinations are available at all the nodes always. An up to date view of topology is obtained by exchanging tables between neighbors at regular intervals. Table updates are divided into two types, namely Incremental Updates and Full Dumps. The end node of the broken link initiates a table update message with the broken link weight assigned to infinity. Each node upon receiving an update with weight infinity quickly disseminates it to its neighbors in order to propagate the broken link information to the whole network. When a neighbor node perceives the link break, it sets all the paths passing through the broken link with distance as infinity. Those neighbors detecting significant changes in the routing tables rebroadcast it to their neighbors. In this way, the broken link information propagates throughout the network. An advantage is less time involved in route setup process due to ready availability of routes to all nodes. Disadvantage of DSDV is Overhead grows quadratically to the number of nodes in the network [2].

## 1.2 Dynamic Source Routing

DSR is an On demand routing protocol that is based on the concept of source routing. It restricts consumption of bandwidth by control packets by eliminating periodic table update messages. The basic approach of this protocol is when it has data packets to be sent to that destination, it first consults the route cache of the source node to determine whether it has route to destination if it has route to the destination it will use this route to send the data packet .If source node does not have such a route. A route is constructed using a route request RREQ and route reply RREP. Route request packets are flooded in the network. Sequence numbers are used to avoid multiple transmissions of same RREQ packets. In this way all nodes except the destination forward the RREQ packet. A destination after receiving its first RREQ packet sends a RREP to the source node through the reverse path in which RREQ had traversed. When a link is broken route error packet is generated from the adjacent node and the source restarts route initiation procedure. Advantages are routes are established only when required and hence the need to find routes to all nodes is eliminated, gives good performance in static and low mobility environments. Disadvantages are Route maintenance mechanism does not repair a broken link. It has a higher connection setup delay than the table driven protocols. Increase in mobility degrades its performance [3].

### 1.3 Ad hoc On Demand Distance vector

AODV routing protocol uses an On demand approach for finding routes, the route is established only when it is required by a source node for transmitting data packets. AODV is an improvement on DSDV because it typically minimizes the number of control packet required. The major difference between AODV and DSR is which a packet carries the complete path to be traversed in DSR. However in AODV the source node and the intermediate nodes record in their route tables the address of neighbor from which the first broadcast packet is received, there by establishing the reverse path. The source node broadcast a Route request packet to all nodes in a network to find the destination node. After the destination node receives the Route request packet it replies the source node with a Route reply packet in a traversed way that a Route request packet has travelled. Associated with each route entry is a route timer which will cause the deletion of the entry if it is not used within the specified life time. Only if the destination sequence number of the current packet is greater than the last one, the node updates its path information. Link failure is informed to the upstream neighbors with help of link failure notification message (RREP with infinite metric) for erasure of the part of the route. Advantages here connection setup delay is less. The Disadvantage is Multiple RREPs for a single RREQ results in heavy control overhead [3].

## 2 Simulation Model

Equal to the realistic scenario we have designed a grid based city with all amenities. Let us consider a disaster zone at one part of the city and rescue stations at different corners of the city. Once the rescue stations receive the message from the disaster zone, the rescue vehicles start moving towards the disaster zone in their respective paths as defined in the diagram. In order to make coordination between the head vehicle and all other vehicles in the group. Head vehicles node need to maintain a communication to its own group. The above scenario is designed using MOVE, SUMO. MOVE is an open source tool placed on top of another open source micro traffic simulator SUMO .MOVE is used for generating realistic mobility models that reflect the real world environments. SUMO is a graphical user interface that is used to show the movement of vehicles, routes etc.

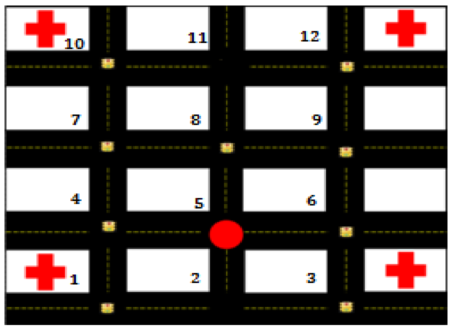



**Fig.1** Grid based city Road map

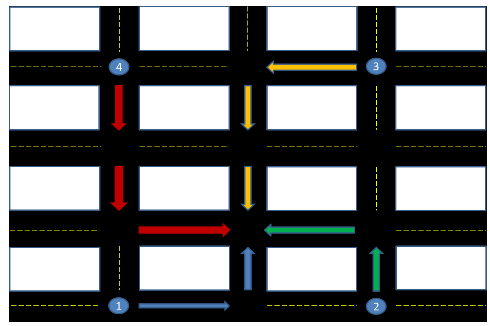



**Fig.2** Vehicles flow: source to destination

MOVE having two main menus for designing the required mobility and traffic models.

**1. Mobility Model:** The MOVE mobility model consists of 3 main menu such as map generation, vehicle movement's generation and simulation [4].

**Map Generation**

**i. Node:** A node is defined as a junction where 2 or more roads join. In our scenario, there are 12 nodes. The coordinates for their positions are as follows:

**ii.**

| **Node** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Position** | 100, 100 | 400, 100 | 700, 100 | 100, 300 | 400, 300 | 700, 300 | 100, 600 | 400, 600 | 700, 600 | 100, 800 | 400, 800 | 700, 800 |

**Table 1:** Junction's position

Introducing of Traffic light at junctions is optional. In this design traffic light is introduced at all the nodes except at node2 and node11.after entering these coordinates; the file is saved as ".nod.xml" format.

**iii. Edge:** The road between two successive nodes is called an edge. The road defined here having two lanes. After entering the values the file is saved as ".edg.xml" format.

| From node | To node | Road with 2 lanes | From node | To node | Road with 2 lanes |
|---|---|---|---|---|---|
| 1 | 2 | Edge-R-0-0 | 7 | 4 | Edge-D-1-0 |
| 1 | 4 | Edge-U-0-0 | 7 | 8 | Edge-R-2-0 |
| 2 | 1 | Edge-L-0-0 | 7 | 10 | Edge-U-2-0 |
| 2 | 3 | Edge-R-0-1 | 8 | 5 | Edge-D-1-1 |
| 2 | 5 | Edge-U-0-1 | 8 | 7 | Edge-L-2-0 |
| 3 | 2 | Edge-L-0-1 | 8 | 9 | Edge-R-2-1 |
| 3 | 6 | Edge-U-0-2 | 8 | 11 | Edge-U-2-1 |
| 4 | 1 | Edge-D-0-0 | 9 | 6 | Edge-D-1-2 |
| 4 | 5 | Edge-R-1-0 | 9 | 8 | Edge-L-2-1 |
| 4 | 7 | Edge-U-1-0 | 9 | 12 | Edge-U-2-2 |
| 5 | 2 | Edge-D-0-1 | 10 | 7 | Edge-D-2-0 |
| 5 | 4 | Edge-L-1-0 | 10 | 11 | Edge-R-3-0 |
| 5 | 6 | Edge-R-1-1 | 11 | 8 | Edge-D-2-1 |
| 5 | 8 | Edge-U-1-1 | 11 | 10 | Edge-L-3-0 |
| 6 | 3 | Edge-D-0-2 | 11 | 12 | Edge-R-3-1 |
| 6 | 5 | Edge-L-1-1 | 12 | 9 | Edge-D-2-2 |
| 6 | 9 | Edge-U-1-2 | 12 | 11 | Edge-L-3-1 |

**Table 2:** Junctions and connecting lanes of the road

**iv. Configuration:** Here the files with ".nod.xml" and ".edg.xml" are given as input and the output is obtained in ".net.xml" format. The file is saved as ".netc.cfg" format. This file is loaded in the create map menu of MOVE and run to see if the nodes and edges were created properly. If executed successfully, a map is created.

**Vehicle Movement's Generation**

**i. Flow:** Flow is used to define the route in which the vehicles should move. It is fixed in terms of from edge and to edge. Apart from routes, numbers of vehicles, begin time and end time of the vehicles also defined. This file is saved in ".flow.xml" format.

| ID | From Edge | To Edge |
|---|---|---|
| Path0 | Edge-U-0-2 | Edge-L-1-1 |
| Path1 | Edge-R-0-0 | Edge-U-0-1 |
| Path2 | Edge-L-3-1 | Edge-D-1-1 |
| Path3 | Edge-D-2-0 | Edge-R-1-0 |

**Table 3:** Sources to Destination route

**ii. Create Vehicle:** This menu is used to create vehicle movement by giving the "flow.xml" file as input to the dynamic router along with map file ".net.xml file". Then the output file is saved as ".rou.xml" format.

**Simulation:** Here the Simulation includes the configuration and visualization sub menus. In the configuration menu, we give the ".net.xml" and ".rou.xml" files as inputs and the output file is named as ".sumo.tr" file(trace file).Then this file is saved as ".sumo.cfg" format which is loaded into the visualization menu to see the vehicular movement at SUMO [5].

**2. Traffic Model:** The MOVE traffic model consists of following three menus such as Static mobility, Run NS2 and Run NAM.

**Static mobility:** In static mobility, the ".sumo.tr" and ".net.xml" files are imported as inputs. The routing protocol is defined here are AODV, DSDV and DSR. For sending voice command between head vehicle and all other vehicles in the group User Datagram Protocol is chosen as transport layer protocol. In addition to that name of output NAM and trace file also defined here. After this the file is saved in ".tcl" format.

**Run NS2:** Load the ".tcl "file into the Run NS2 menu and run the simulation. At the end of the simulation NS-2 will generate output files in ".tr" and ".nam" format.

**Run NAM:** Here the ".nam" file is loaded and executed with help of the Run Nam menu. where the NAM window shows the movement of vehicles along with the movement of data between vehicles equivalent to the realistic scenario.

## 3 Results and Discussion

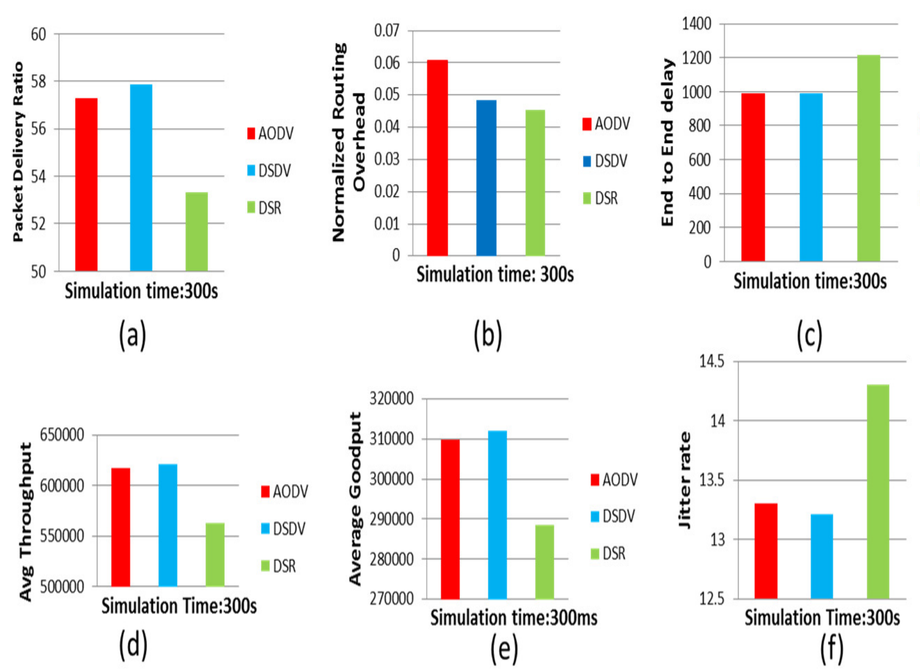
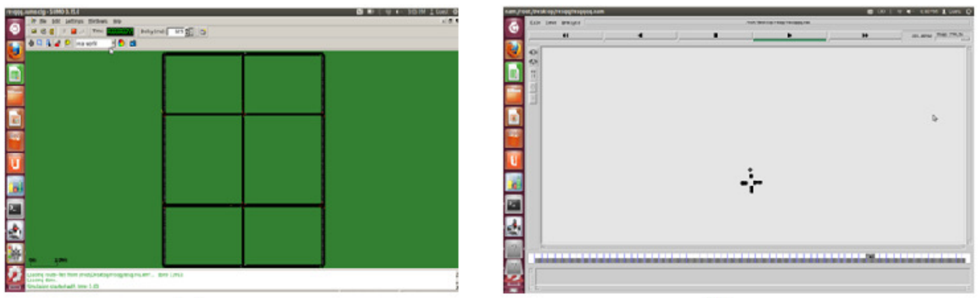



**Fig.3** Simulation result for VANETs at rescue scenario

From the simulation results of the given rescue scenario we found that the DSDV possess a highest Packet delivery ratio, average throughput, average goodput, lowest dropping ratio, end to end delay and jitter than AODV and DSR. In the same scenario when we compare in terms of normalized routing overheads we find that DSR has the lowest normalized routing overhead among the three protocols.



(a) (b)

**Fig.4** Visualization of rescue vehicular movements at both SUMO and NAM

## 4 Conclusions

In this paper, during vehicles movement and rescue operation DSDV provides excellent performance in terms of packet delivery ratio, throughput, goodput, end to end delay, jitter and dropping ratio than other two routing protocols. The limitation of DSDV routing protocol in this simulation scenario is its normalized routing overhead is higher than that of DSR and lower than that of AODV. In future it can be minimized by modifying the existing DSDV protocol.

## 5 References

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