

## **Vanet Based Route Assigning Algorithms Using Network Simulator-2**

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**Abstract:** *Vehicular ad hoc network (VANET) is a peculiar subclass of mobile ad-hoc network (MANET) that has the potential in improving road safety and in providing travellers comfort. Currently it has gained an important part of interest of researchers and become very popular. This paper has three major contributions. First, a vehicular ad-hoc network (VANET)-based A\* (VBA\*) route planning algorithm is proposed to calculate the route with the shortest travelling time or the least oil consumption, depending on two real-time traffic information sources. The first one is the recorded traffic information of the water segment that the vehicle has passed through. This traffic information is further exchanged between vehicles when they enter the transmission range of IEEE 802.11p wireless link in the VANET. The second one is the traffic information provided by Google Maps. Similar process is performed with AODV. Finally, simulations are performed and the results are compared with each other. This application is implemented in marine.*

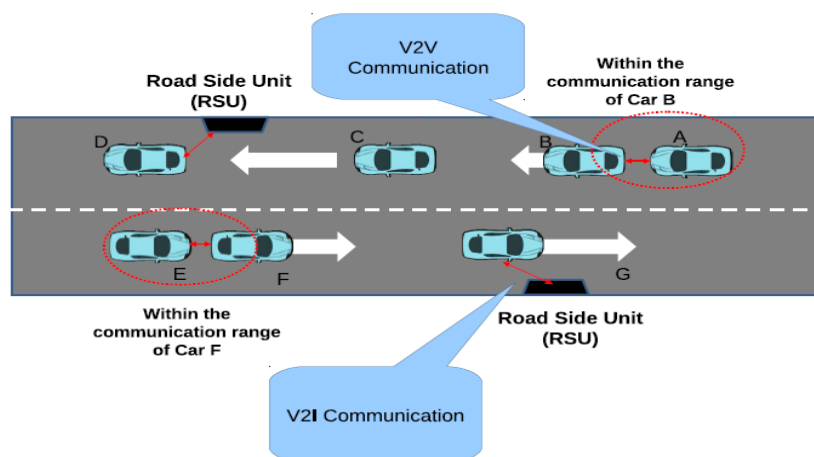
**Keywords:** *AODV, least oil consumption, route planning algorithm, shortest travelling time, VBA\*.*

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### **I. INTRODUCTION**

Every day, a most of people die, and many people are injured in traffic accidents around the world. As there is no sign of improvement in near future, government agencies and leading car company jointly works together for develop solutions. The desire to improve road safety information between vehicles to prevent accidents and also improve road safety was the main motivation behind the development of vehicular ad hoc networks (VANETs). VANETs are a promising technology to enable Communication among vehicles on roads. They are a special form of mobile ad hoc networks (MANETs) that provided developments to a novel type of wireless access called Wireless Access for Vehicular Environment (WAVE) dedicated to vehicle- to-vehicle (V2V) and vehicle-to-roadside communications (V2I). VANET uses a dedicated short range communication (DSRC) IEEE 802.11a later it amended for low overhead operation to IEEE 802.11p. Then IEEE standardizes whole as 1609 family referred as WAVE. These protocols are used for different type of information sharing between vehicle to vehicle and vehicle to road side unit (RSU), for example, safety information like accident prevention, navigation route selection for traffic jams, entertainment with internet service.

In this paper, we examine the possibility of deploying an intelligent and real-time adaptive traffic signal controller, which receives information from vehicles, such as the vehicle's position and speed, and then utilizes this information to optimize the traffic signal scheduling at the intersection. This approach is enabled by onboard sensors in vehicles and standard wireless communication protocols specifically for vehicular applications. For example, all vehicles are already equipped with a speed sensor. In addition, new vehicles are increasingly being equipped with Global Positioning System (GPS) units that can provide location information with accuracy of a few meters. If a vehicle has met a traffic incident, it can send safety messages to warn its neighboring vehicles of information about the time, location and status of the incident. Then these neighbors further forward these safety messages to their neighbors such that they can re-plan their routes in real-time. The Dijkstra shortest path, A-star (A\*) algorithms and AODV are usually used to plan the route in the GPS navigation system. This paper has the advantage of reducing the travelling time, fuel consumption and emitted carbon dioxide.



Figure(1): Vehicular ad-hoc networks communication

## II. II.ROUTING

The main goal for routing protocol is to provide optimal paths between network nodes via minimum overhead. Many routing protocols have been developed for VANETs environment, which can be classified in many ways, according to different aspects; such as: protocols characteristics, techniques used, routing information, quality of services, network topology, routing algorithms, and so on. Vehicular Ad hoc Network (VANET) is aimed to support safety, traffic monitoring and comfort related services. Though functioning of the network closely resembles with that of MANET, its high speed mobility and unpredictable movement characteristics are the key contrasting feature from that of MANET. This similarity nature suggests that the prevailing routing protocol of MANET is very much applicable to VANET.

The topology based routing is classified as follows:

### 2.1 Proactive Routing:

Proactive protocols allow a network node to use the routing table to store routes information for all other nodes, each entry in the table contains the next hop node used in the path to the destination, regardless of whether the route is actually needed or not. The table must be updated frequently to reflect the network topology changes, and should be broadcast periodically to the neighbors. This scheme may cause more overhead especially in the high mobility network. However, routes to destinations will always be available when needed. Proactive protocols usually depend on shortest path algorithms to determine which route will be chosen; they generally use two routing strategies: Link state strategy and distance vector strategy.

#### 2.1.1 Destination Sequence Distance Vector Routing (DSDV):

DSDV protocol it is an earliest ad hoc routing protocol, it implements the distance vector strategy and uses a shortest path algorithm to implement only one route to destination which stored in the routing table, each routing table contains information about all accessible network nodes, as well as the total number of hops needed to reach these nodes, and each entry in the routing table is labeled with a sequence number initiated by the destination node. To maintain routes reliability, each node must periodically broadcast its routing table to its neighbors. DSDV protocol guarantees the loop free routs, excludes extra traffic caused by frequent updates, as well as reduces control message overhead, it also keeps only the optimal path to every node, rather than keeping multi paths which will help to reduce the total size of routing table. However, DSDV increases the overhead in the large network; because of unnecessary updating broadcast even if there is no change in the network topology. Besides that, DSDV don't provide multi routes to destination node and has no control over the network congestion which decreases the routing efficiency.

#### 2.1.2 Optimized Link State Routing Protocol (OLSR):

OLSR protocol implement the link state strategy; it keeps a routing table contains information about all possible routes to network nodes. Once the network topology is changed each node must send its updated information to some selective nodes, which retransmit this information to its other selective nodes. The nodes which are not in the selected list can just read and process the packet. OLSR has easy procedure which allows it to built-in different operating systems, besides it works well in the dynamic topology; also it is generally suitable for applications that required low latency in the data transmission (like warning applications).

### 2.2 Reactive Routing:

Reactive routing protocols (also called on-demand) reduce the network overhead; by maintaining routes only when needed, that the source node starts a route discovery process, if it needs a non-existing route to a destination, it does this process by flooding the network by a route request message. After the message reaches

the destination node (or to the node which has a route to the destination), this node will send a route reply message back to the source node using unicast communication. Reactive routing protocols are applicable to the large size of the mobile ad hoc networks which are highly mobility and frequent topology changes. Reactive routing protocols have been developed such as AODV DSR etc.

**2.2.1 Ad-hoc On-demand Distance Vector (AODV):**

AODV routing protocol is proposed for mobile ad hoc network, it has been evaluated in several researches and shows good results compared to related routing protocols. AODV offers low network overhead by reducing messages flooding in the network; that when compared to proactive routing protocols, besides reducing the requirement of memory size; by minimizing the routing tables which keep only entries for recent active routes, also keeps next hop for a route rather than the whole route. It also provides dynamically updates for adapting the route conditions and eliminates looping in routes; by using destination sequence numbers. So AODV is flexible to highly dynamic network topology and large-scale network. It is a reactive routing protocol (i.e) it establishes a route to destination only when it is demanded. It is capable of unicasting and multicasting routing. Each route has a lifetime after which the route expires if it is not used. A route is maintained only when it is used and hence old and expired routes are never used. This protocols uses three types of messages, route request (RREQ) and route reply (RREP) and route error (RERR). Every time a node sends a new message, it uses a new sequence number which increases monotonically.

**RREQ Messages:**

While communication routes between nodes are valid, AODV does not play any role. A RREQ message is broadcasted when a node needs to discover a route to a destination. As a RREQ propagates through the network, intermediate nodes use it to update their routing tables (in the direction of the source node). The RREQ also contains the most recent sequence number for the destination.

**RREP Messages:**

When a RREQ reaches a destination node, the destination route is made available by unicasting a RREP back to the source route. A node generates a RREP if (i) It is itself the destination. (ii) It has an active route to the destination. (eg) an intermediate node may also respond with an RREP if it has a new route to the destination. As the RREP propagates back to the source node, intermediate nodes update their routing tables (in the direction of the destination node).

**RERR Messages:**

This message is broadcast for broken links. It is generated directly by a node or passed on when received from another node.

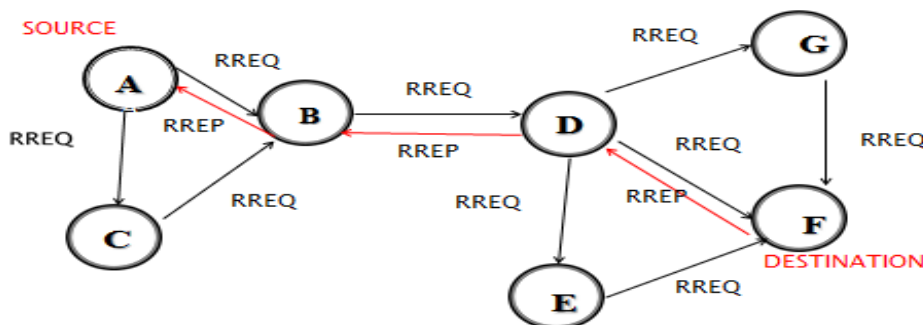


Figure (2): Message Routing

**2.2.2 Destination Source Routing (DSR):**

DSR protocol aims to provide a highly reactive routing process; by implementing a routing mechanism with an extremely low overhead and fast reaction to the frequent network changes, to guarantee successful data packet delivery regardless of network changes. DSR is a multi-hop protocol; it decreases the network overhead by reducing periodic messages. This protocol has two main processes: route discovery and route Maintenance. In the route discovery, when a source node needs an unavailable route, it initially broadcasts a route request message. All intermediate nodes which received this message will rebroadcast it, except if it was the destination node or it has a route to the destination; in this case the node will send a route replay message back to the source, later the received route is cashed in the source routing table for future use. If a route is failing, the source node will be informed by a route error message. In DSR protocol, every data packet contains a complete list of the intermediate nodes; so the source node should delete the failed route from its cache, and if it stores other successful route to that destination in its cache, it will exchange the failed one by the other successful route. But if there is no alternative route, it will initiate a new route discovery process. The benefit of DSR protocol is

clearly shown in a network with low mobility; because it can use the alternative route before starts a new process for route discovery. However, the multi routes may lead to additional routing overheads by adding all route information to every data packet, besides, as the network span larger distance and including more nodes, the overhead will frequently increase and as result network performance will be degraded.

### 2.3 Hybrid:

Hybrid protocol is a mixture of both proactive and reactive protocols; it aims to minimize the proactive routing protocol control overhead and reduce the delay of the route discovery process within on-demand routing protocols. Usually the hybrid protocol divides the network to many zones to provide more reliability for route discovery and maintenance processes. Each node divides the network into two regions: inside and outside regions; it uses a proactive routing mechanism to maintain routes to inside region nodes and using a route discovery mechanism to reach the outside region nodes.

### 2.4 Position Based Routing:

Position or geographic routing protocol is based on the positional information in routing process; where the source sends a packet to the destination using its geographic position rather than using the network address. This protocol required each node is able to decide its location and the location of its neighbors through the Geographic Position System (GPS) assistance. The node identifies its neighbor as a node that located inside the node's radio range. When the source need to send a packet, it usually stores the position of the destination in the packet header which will help in forwarding the packet to the destination without needs to route discovery, route maintenance, or even awareness of the network topology.

#### 2.4.1 Greedy Perimeter Stateless Routing (GPSR):

GPSR is a famous greedy routing protocol in VANETs. In this protocol, each node forwards packets to other intermediate nodes that are constantly nearer to the packet's destination (greedy forward), until the packet reaches its final destination. If there is no neighboring node close to the destination, it uses perimeter forwarding to decide to which node it will deliver the packet. GPSR is a stateless protocol that keeps information of its first hop neighbor's positions, which could increase protocol scalability more than shortest path ad hoc routing protocols. Another advantage is the dynamic forwarding packet decision. However, GPSR could face a link failure due to the high mobility network and frequent topology changes (it holds old position information). This problem can be handled by perimeter forwarding, but it may cause high packet loss and more latency time due to the large number of hops in perimeter forwarding mode. Moreover, if the destination node moves to a new location, its information which embedded in the packet header will never be updated.

#### 2.4.2 Geographic Source Routing (GSR):

Geographic Source Routing use Dijkstra's shortest path algorithm on a map obtains from GPS system. GSR carries out shortest path calculation on each junction and uses greedy forwarding strategy along the path to the next junction until destination is reach. As no real time traffic information is used for path selection of next node may stop at local maximum, then as a recovery it tries to select another vehicle outside that road using greedy forwarding rather than described recovery strategy.

#### 2.4.3 A-STAR (Anchor-based Street Traffic Aware Routing):

The Anchor-based Street Traffic Aware routing calculates full path for forwarding packet. Like GSR, it also use Dijkstra's shortest path algorithm, but uses number of bus line on the road as weight parameter of road for selecting path. Considering the number of bus line on the road, it provides some sort of traffic awareness for better decision making towards path selecting, as better vehicle density lower the chances of local maximum situation. If local maximum occurs then the road is marked as "out of service" and recalculation of path taken place.

## III. HARDWARE & SOFTWARE

### 3.1 Minimum Hardware Requirements:

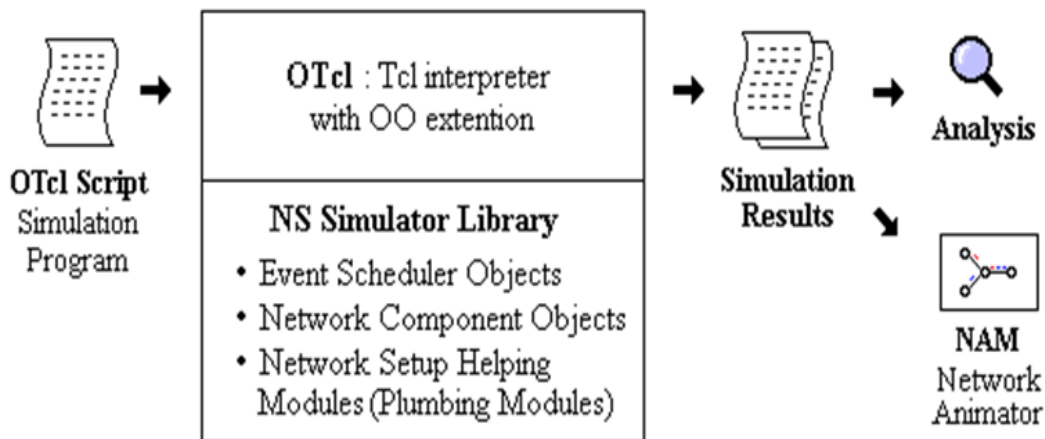
Operating system	: Windows XP/Ubuntu
Processor	: Intel Core 2 Duo processor (2.2 GHz)
Hard disk	: 160 GB
RAM	: 2 GB DDR

### 3.2 Software Requirements:

Since the project is based on Ad-hoc networks it makes use of NS2 simulator for this purpose. The simulator is an open source product. Since NS2 is a Unix/Linux based application, Fedora 8 Linux is used as the platform for the development process.

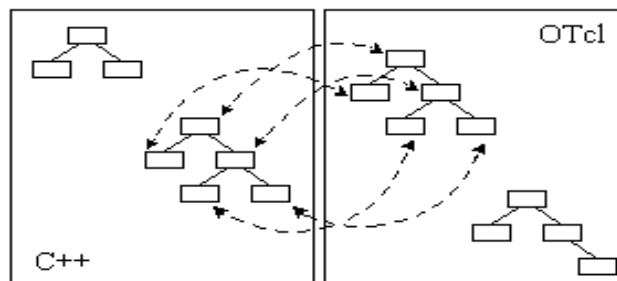
**3.2.1 Network Simulator:**

Network simulator is an object-oriented discrete event simulator. It is also a package of tools that simulates behavior of networks. It is primarily UNIX based. It creates network topologies. It is written in C++ and OTCL formats (TCL scripting with object-oriented extensions). NS is primarily useful for simulating local and wide area networks. It can be used to simulate a variety of IP networks. It implements network protocols such as TCP and UPD, traffic source behavior such as FTP, Telnet, Web, CBR and VBR, router queue management mechanism such as Drop Tail, RED and CBQ, routing algorithms such as Djikstra, and more. NS also implements multicasting and some of the MAC layer protocols for LAN simulations. A simplified view of NS2 is shown below in figure 4.2



**Figure (3): Simplified user view of NS2**

NS is Object-oriented TCL (OTCL) script interpreter that has a simulation event scheduler and network component object libraries, and network setup (plumbing) module libraries (actually, plumbing modules are implemented as member functions of the base simulator object). In other words, to use NS, you program in OTCL script language. To setup and run a simulation network, a user should write an OTCL script that initiates an event scheduler, sets up the network topology using the network objects and the plumbing functions in the library, and tells traffic sources when to start and stop transmitting packets through the event scheduler. The C++ and OTCL duality is shown below in figure 5.2 NS is written not only in OTCL but in C++ also. For efficiency reason, NS separates the data path implementation from control path implementations. In order to reduce packet and event processing time (not simulation time), the event scheduler and the basic network component objects in the data path are written and compiled using C++. Likewise, an object (not in the data path) can be entirely implemented in OTCL. figure 4.2 shows an object hierarchy example in C++ and OTCL.



**Figure (4): C++ and OTCL- The duality**

The event schedulers and most of the network components are implemented in C++ and available to OTCL through an OTCL linkage that is implemented using Tcl. The whole thing together makes NS, which is a OO extended TCL interpreter with network simulator libraries. When a simulation is finished, NS produces one or more text-based output files that contain detailed simulation data, if specified to do so in the input TCL (or more specifically, OTCL) script. figure 4.3 gives a broad idea about the architecture of NS. The data can be used for simulation analysis (two simulation result analysis examples are presented in later sections) or as an input to a graphical simulation display tool called Network Animator (NAM).

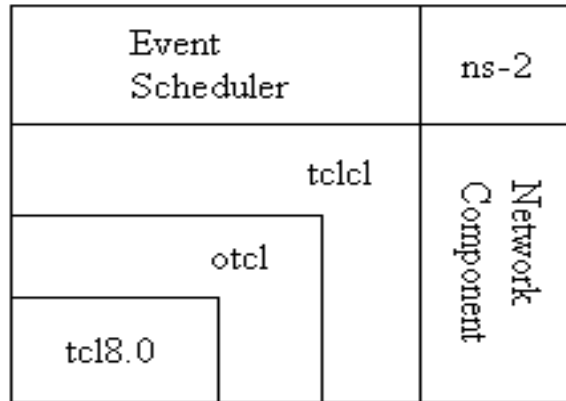


Figure (5): ArchitecturalView of NS

**3.2.2 Network Animator:**

NAM is a TCL based animation tool for viewing network simulation traces and real world packet trace data. The design theory behind NAM was to create an animator that is able to read large animation data sets and be extensible enough so that it could be used indifferent network visualization situations.

**3.2.3 Trace Graph:**

Trace graph is a free network trace file analyzer developed for network simulator NS2 trace processing which runs under UNIX systems. Trace graph can support any trace format if converted to its own or NS2 trace format. Trace graph supports wired as well wireless network tracing.

**IV. RELATED WORK**

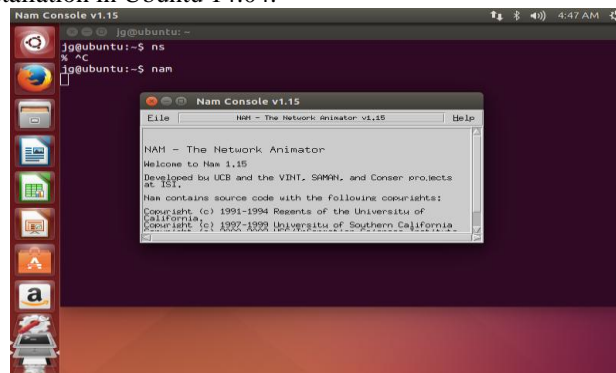
VBA\*and AODV route planning algorithm has been proposed to dynamically calculate the route that meets the shortest travelling time or the least oil consumption criteria. It adopts two real-time traffic information sources, i.e., the recorded and exchanged traffic information of the road segment that the vehicle has passed through and the traffic information from Google Maps, to find a better route than traditional algorithms that adopt static information only.Four performance metrics, i.e., the average travelling time, distance, speed and oil consumption is calculated.

Field name	Description
RoadSegmentID	The unique ID of the road segment between two adjacent intersections
RecordTime	The time when traffic information is recorded.
Average Speed	The average driving speed of this road segment.

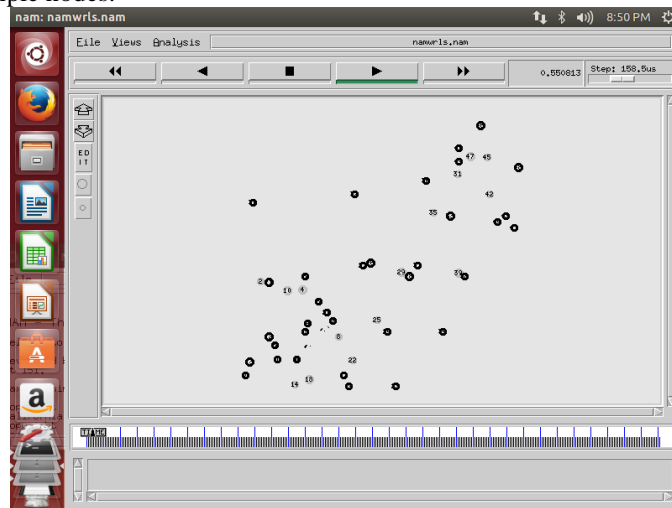
Table (1): The Three-Field Format For Traffic Information of a Road Segment

**V. MEDHOLOGY&SIMULATION RESULTS**

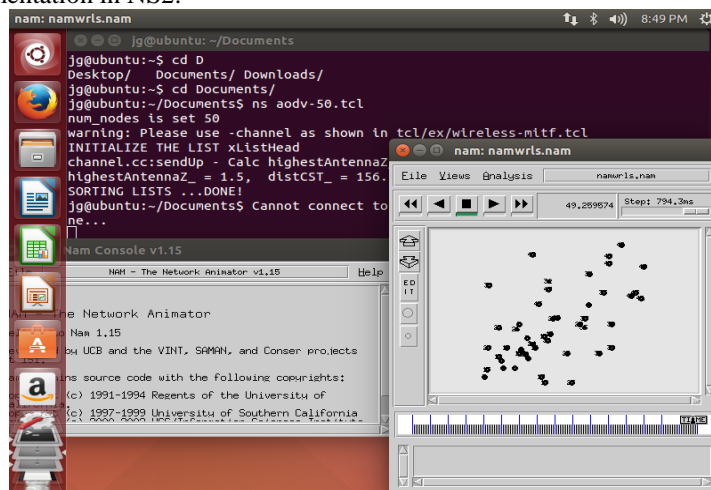
**Step 1:** NS2 and NAM installation in Ubuntu 14.04.



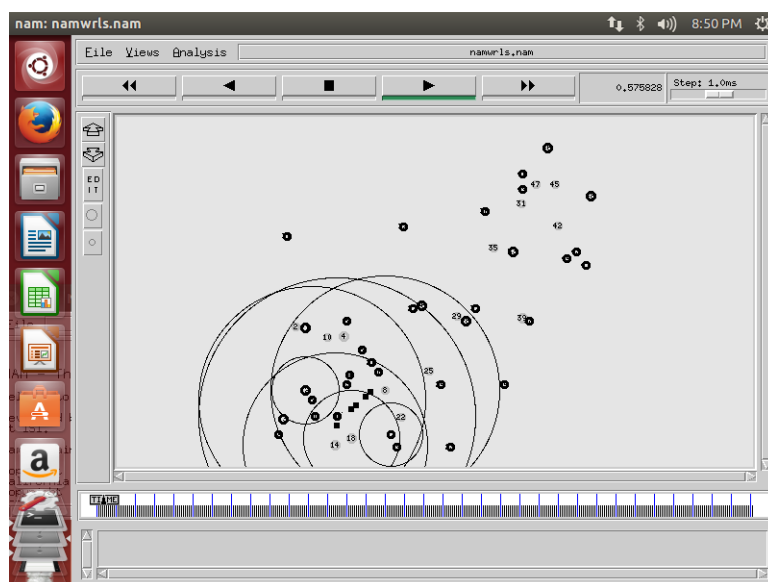
Step 2: Creation of multiple nodes.



Step 3: AODV implementation in NS2.



Step 4: A-STAR implementation in NS2.



**Step 5:** Comparison of both algorithms.

Parameters	AODV	A-STAR
Life time	8150s	7450s
Energy Consumption	Very low	High
Throughput	310 pkts	250 pkts
End to end delay	0.042s	0.045s

## VI. VI. APPLICATIONS

V2V and V2I communications allows the development of a large number of applications and can provide a wide range of information to drivers and travellers. A VANET communication platform allows an enormous variety of applications aimed at administration, companies, drivers and people in the vehicle.

### 6.1 Safety Related Applications:

Safety-related applications are the most important kind of applications for VANETs due to its main objective: decrease of injuries and deaths due to vehicle accidents. These applications use the wireless communication between vehicles or between vehicles and infrastructure, in order to improve road safety and avoid accidents [1]. Electronic sensors in each car can detect abrupt changes in path or speed and send an appropriate message to neighbors.

- Intersection Collision Avoidance
- Cooperative Collision Avoidance
- Cooperative Driver Assistance System
- Public Safety
- Sign Extension
- Vehicle Diagnostics and Maintenance
- Information from others vehicles
- Policing & Enforcement and so on.

### 6.2 Comfort Applications:

The general aim of these applications is to improve passenger comfort and traffic efficiency. That could include nearest POI (Points of Interest) localization, current traffic or weather information and interactive communication. Passenger can play online games, access the internet and send or receive instant messages while the vehicles connected to the infrastructure network.

- Optimum route calculation with real-time traffic data
- Data Transfer
- Software Update/Flashing
- Automatic Parking and so on.

### 6.3 Applications for Administration:

- Vehicle identification
- Electronic Toll Collection
- Parking Lot Payment
- Traffic Information and so on.

## VII. CONCLUSION

Vehicular Ad-Hoc Network is an emerging and promising technology. Routing is an important component in vehicle-to-vehicle (V2V) and infrastructure-to-vehicle (I2V) communication. This paper has an Analysis of VANET Topology Based Routing Approach on Various Parameters presented a comparative analysis of topology based routing protocols. Hence, an analysis of VANET protocols, comparing the various features is absolutely essential to come up with new proposals for VANET. The performance of VANET routing protocols depend on various parameters. It also presented an analysis of networking, traffic and VANET simulators. This paper also tells the application of the VANET. This can serve as a quick reference for researchers who want to do research in VANETs. We hope that the instrument presented in this paper to be useful and helpful to students and researchers in this field.

## REFERENCES

- [1]. Bachir and Benslimane, "A Multicast Protocol in Ad-Hoc Networks: Inter-vehicle Geocast," IEEE Semiannual Vehicular Technology Conference, Spring 2003.
- [2]. A. Eskandarian, and L. Hoffman, "Challenges of Intervehicle Ad Hoc Networks," Blum, J., IEEE Transactions on Intelligent Transportation Systems, vol. 5, no. 4, December 2004.



- [3]. Briesemeister and Hommel "Role-based Multicast in Highly Mobile But Sparsely Connected Ad Hoc Networks," ACM MobiHoc 2003.
- [4]. Goel, S.; Imielinski, T.; Ozbay, K.,"Ascertaining viability of WiFi based vehicle-to-vehicle network for traffic information dissemination"., IEEE Intelligent Transportation Systems, page(s): 1086 - 1091, Oct. 2004.
- [5]. Montgomery,J,"A real-time traffic and weather reporting system for motorists", IEEE Consumer Communications and Networking Conference, page 580 - 581, Jan. 2005.
- [6]. Sun et al. "GPS-based Message Broadcast for Adaptive Inter- Vehicle Communications," IEEE Seminannual Vehicular Technology Conference, Fall 2000.
- [7]. Sweeney, L.E,"Comparative benefits of various automotive navigation and routing technologies", IEEE Position Location and Navigation Symposium, page 415 - 421, April 1996.
- [8]. Sweeney, L.E., Jr. Zavoli , W.B. Loughmiller , "Comparative performance of various automotive navigation technologies", G., IEEE Vehicle Navigation and Information Systems Conference, page(s): 437 - 440, Oct. 1993.
- [9]. Terry Costlow,"Wi-Fi Could Augment GPS", IEEE Distributed systems online, Vol. 5, Issue no. 9, Pages 1-2, Sep 2004.
- [10]. Ye, Tao, H.-Arno Jacobsen Katz, and Randy,"Mobile Awareness in a Wide Area Wireless Network of Info- Stations," Proceedings of the 4th Annual ACM/IEEE International Conference on Mobile Computing and Networking, Dallas, Texas, 1998, pp. 109 120.
- [11]. Abdalla. G.M.T and Abu - Rgheff. M.A,"Current trends in vehicular ad hoc networks," Proc. IEEE Global Inf. Infrastruct.Symp. Marrakech, Morocco, 2007.
- [12]. Andrews. L. C., "Special Functions of Mathematics for Engineers," 2nd ed.New York, NY, USA: mcgraw-Hill, pp. 110-120, 1992.
- [13]. Blum. J.J, A. Eskandarian, and L. J. Hoffman, "Challenges of inter vehicle ad hoc networks," IEEE Trans. Intell. Transp. Syst., pp. 347-351, Dec. 2004.
- [14]. Cormen. T. H., Leiserson. C. E., and L. R. Ronald,"Introduction to Algorithms,"Cambridge, MA, USA: MIT Press, 1990.
- [15]. Clausen. T. H., Hansen. G., Christensen. L., and Behrmann. G, "The optimized link state routing protocol, evaluation through experiments and simulation,".inProc. IEEE Symp. Wireless Pers. Mobile Commun, Aalborg, Denmark, pp. 1-6, 2001.
- [16]. Davis. V. A "Evaluating mobility models within an ad hoc network,"M.S. thesis, Colorado Sch. Mines, Golden, CO, USA, 2000.
- [17]. Ferreira, "Building a reference combinatorial model for manets,"IEEE Netw. Mag., vol. 18, no. 5, pp. 24-29, Sep. Oct. 2004.
- [18]. Jiang. S., D. He, and J. Rao ,"Prediction-based link availability estimation for mobile ad hoc networks," in Proc. IEEE INFOCOM, pp. 1745-1752, 2001.
- [19]. J.Kerner. B. S, Berlin, "Introduction to Modern Traffic Flow Theory and Control,"Germany: Springer-Verlag, 2009.
- [20]. H. Menouar, M.Lenardi, and F. Filali,"A movement prediction- based routing protocol for vehicle-to-vehicle communications," in Proc. 1st Int. V2V Commun. Workshop, San Diego, CA, USA, pp. 1-7, 2005.
- [21]. J. Monteiro,"The use of evolving graph combinatorial model in routing protocols for dynamic networks," in Proc. XV Concur so Latin-Americans de Tests de Maestria, pp. 1-17,2007.