Empirical Analysis of Vehicular Network Design Strategies and Routing Efficiency with AODV Protocol

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Abstract:

In digital world, wireless technologies and its associated communications are attaining drastical improvements over past decades. Vehicular AdHoc Network (VANET), a most important wireless communication medium to get raising everyday due to its necessity. Generally, Vehicular Networks are designed to apply the logics of Mobile Networks such as MANET and disconnected architectural support as well. But the sudden improvement of mobile device and its associated growths place a standard platform for vehicular communications. VANETs are used for inter vehicle communications, which is generally termed as I-VC, in which it uses any type of wireless communication technologies but specifically using Short Range-Radio Communication Technologies. The usual problem occurred in Vehicular Network scenario is the lacking of spontaneous connectivity and sustainability due to its moving scenario and failed to analyze the range limitations during navigation. In order to resolve the issues in past and provides a good enough communication abilities to Vehicular Networks, in this paper a new vehicular network strategy is introduced, called Energetic Vehicular Route Optimizer (EVRO), which provides ability to Vehicular Networks to achieve better transmission accuracy, reducing the failure rates over transmission and improving the throughput rate over communication between vehicles. The proposed simulation results guarantee the improvement of throughput, lifetime and energy efficiency with reduced delay.

Keywords: *Vehicular Network, VANET, Wireless Technologies, Energetic Vehicular Route Optimizer, EVRO, AODV Routing-Protocol.*

I. INTRODUCTION

In a communication environment, each and every transactions are purely based on location, distance between source and destinations, time taken to deliver the data to destination, interal between packets and Strength of available nodes are the main concern to take care on communication and its efficiency. The security over transmission is also an important concern to take care as well as the traffic-ratio estimations is drastically high in this era, because of the unpredictable number of users and communication devices growth. In this proposed system, the main concentration is vehicular network communication, which is also similar to mobile communications, but the main problem here is the transmission is established between moving vehicles. Already, we discussed what are all the problems cause network down and which is more important to take care on communication scenario. In that one point is highlighted called node position or location, in case of vehicular networking scenario, node position and location is not easily predictable, which is continuously moving from one place to another instantly without any specific path strategies. So, that it is really a tough mode to analyze the path ratio between source vehicle and destination vehicle. Another main problem in the vehicular network scenario is based on traffic-ratio estimations, which is also a serious issue to deal with and many analysts try a lot to provide the resolution to such issue over vehicular network model [1][2]. Some analysts try to move ahead with device to device communication (D2DC) techniques, in which it is purely focused on 5G-enable network technology over vehicular network environment.

However, the support of 5G-standards to vehicular network environment are in initial processing stage alone now-a-days and the associated gadgets are not properly established with such 5G enabled protocols. So, that the analysts realize a great pressure and complexity behind such establishments of device to device communication over vehicular network model, because of such 5G-oriented involvements [3][4][5]. A Wireless Communication and Standardization Committee (WCSC) provide some advanced protocols to solve the traffic issues over vehicular networks such as AdHocOnDemand Distance-Vector Protocol (AODV), in which it contains MAC802.11 standard supportivity. This protocol can ensure the secure adhoc network environment by means of establishing data security in association with advanced-cryptographic principles such as Advanced-Encryption-Standard-256(AES256) with 256-bit encryption technique, as well as this particular protocol does not encouraging third-party communication medium to deal with the transactions such as basestations and so on [4][5][6]. Many analysts proceed on working with Physical_Layer and MAC_Layercommunications along with AODV routing protocol [5][6], however, the real-time work complexity and practical establishments of such things over Vehicular Networks create an issue and the analysts cannot succeed with their development [5][6][7] because of their disconnected-architectural mistakes. Different analysts have contributed a lot of exertion in the investigation of traffic-ratio by many types of simulation-environments such as 'Qual-Net' [6][7]. In any case, aftereffects of the test will be more sensible and dependable in the event that we get the information from the ready AODV model. Likewise, on the grounds that the protocols in convention underpins multichannel supportivity as well as the application_layer is able to operate physical_layer attributes (for example channel_ratio, transmitter_energy_level, information_rate and so on.) legitimately by the AODV Short-Message-Convention (SMC) [7][8][9], a sensible channel-portion conspire in the application_layer will significantly improve the transmission effectiveness of the vehicular networks.

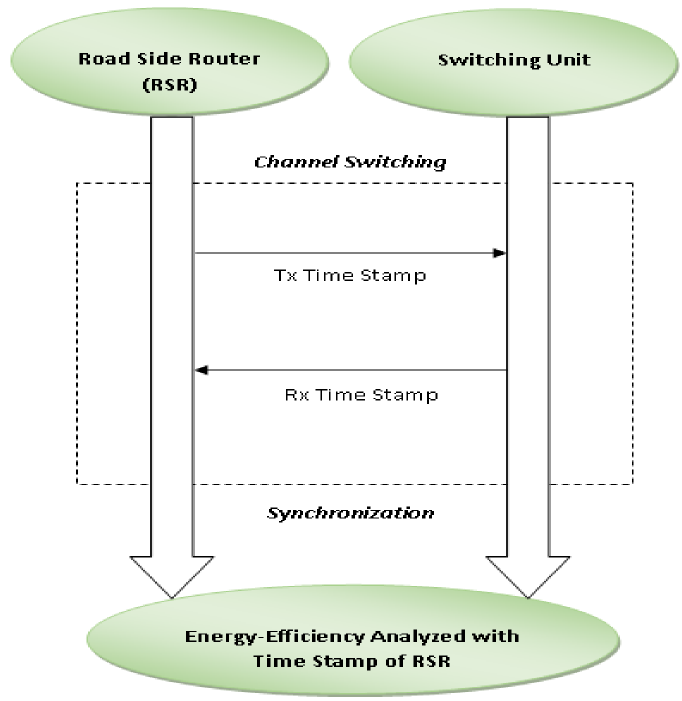

Fig.1 Road Side Router Time-Stamp Estimations with respect to Energy Efficiency

Also, the AODV enabled gadgets should be synchronized before correspondence and it very well may be executed in the application_layer. Albeit, a few organizations like JRADA have created the system model for IEEE_802_11 and accomplished many IEEE conventions, there is no proper framework level AODV gadget. Also, the security, which is a message set standard in the AODV convention, characterizes seven sorts of security enabled application situations. However, every situation needs extra sensors and frameworks like the guide datasets [7][8][9]. Be that as it may, it

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is hard for a AODV protocol routing establishments to get to the bus_type routing protocol or other different frameworks. So planning the suitable methodology and improving the judgment strategy with existing sensor like 'GPS are important to accomplish these Quality of Service applications. By alternate definition, explore on the vehicular network application agreeing to AODV routing-protocol merits its consideration. Hence, we have structured a AODV application dependent on the protocol, which is not just meets the prerequisite for information transmit in the fast condition, yet in addition performance oriented features such as security applications with existing equipment assets. It can mitigate the traffic pressure, the auto collision and furthermore, follow the pattern of portable web. Right now, take a perspective of the AODV routing-protocol at the first. At that point, in view of understanding the protocol we accomplished the time synchronization dependent on the calculation for the Network-Time-Protocol and planned two sorts of channel-separation and assigning techniques, these two are the planning for information transmission. The transmission of the data over wireless vehicular network and the plan of sub-application are indicated in the following. We structured a Task-Manager for applications planning and asset the executives. At that point, we improved the strategy for assurance in the security and set forward the methodologies for the quality of service applications with standard secure way of transmissions in further areas. The reenactment with a Network-Simulator program that we created is toward the further section of this paper.

II. System Model

A. Safety Enabled Applications

This Vehicular Network safety enabled applications are expect to spare human lives on-road. The point of these applications is to convey the safety-measures related data to the necessary recipient so as to maintain a strategic distance from any accidents. The safety-measures related applications are appeared in Table-1 as well as additional details are depicted as follows.

(a) Data-Messages: Data Messages comprise of work area messages while driving on the road/high-way, cost assortment point as well as speed-limit estimation messages and so forth.

(b) Route-Assistance Messages (RAM): This is the sort of data which will help the driver during the excursion. Route-Assistance Messages incorporates the data identified with the path exchanging, helpful impact evasion and route. Collision free message viewed as the most basic as far as making a difference the driver by notice the person in question to lessen the speed for keeping away from any questionable condition.

(c) Alert Messages: Alert Messages incorporate data like traffic signal a head, cost point or any awful street condition alerts and so on.

Table.1 Spectrum-Channel Assignments (SCA) over Vehicular Networks

6.85 Gigahertz	**6.87 Gigahertz**	**6.89 Gigahertz**	**6.92 Gigahertz**
184 SCA (over 6 Ms Interval)	190 SCA (over 6 Ms Interval)	196 SCA (over 6 Ms Interval)	199 SCA (over 6 Ms Interval)
192 SCA (over 8 Ms Interval)	198 SCA (over 8 Ms Interval)	199 SCA (over 8 Ms Interval)	201 SCA (over 8 Ms Interval)
196 SCA (over 9 Ms Interval)	197 SCA (over 9 Ms Interval)	198 SCA (over 9 Ms Interval)	202 SCA (over 9 Ms Interval)
199 SCA (over 10 Ms Interval)	201 SCA (over 10 Ms Interval)	205 SCA (over 10 Ms Interval)	207 SCA (over 10 Ms Interval)

B. Solace Applications

The fundamental goal of these applications is to give traveler/driver solace and traffic proficiency. In addition, aforementioned applications can be called as Value-Added Support providers. These applications incorporate a programmed cost

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assortment, site based administrations like the area of shopping centers, restaurants and so on.

Table.2Initial Channel Assignments (Threshold Level)

Continues Access Channel 1 MS	Continues Access Channel 5 MS	Continues Access Channel 10 MS	Continues Access Channel 15 MS
194ICA (for 6 msdata transfer)	215 ICA (for 6 ms data transfer)	247ICA (over 6 Ms Interval)	266ICA (over 6 Ms Interval)
196 ICA (for 8 ms data transfer)	219 ICA (for 8 ms data transfer)	256 ICA (over 8 Ms Interval)	276 ICA (over 8 Ms Interval)
204 ICA (for 9 ms data transfer)	245 ICA (for 9 ms data transfer)	258 ICA (over 9 Ms Interval)	284 ICA (over 9 Ms Interval)

Table.3Initial Channel Assignments for Media Transmissions (Threshold Level)

Channel Occupancy (2 MHz)	Channel Occupancy (5 MHz)	Channel Occupancy (7 MHz)	Channel Occupancy (9 MHz)
146 frames for 5 ms	166 frames for 5 ms	168frames for 5 ms	172frames for 5 ms
175frames for 10 ms	286frames for 10 ms	298frames for 10 ms	312frames for 10 ms
256frames for 15 ms	306frames for 15 ms	322frames for 15 ms	372frames for 15 ms

C. Road Side Router Unit (RSRU)

The proposed vehicular networks highly believe in transmission accuracy by means of Road Side Router Unit (RSRU), which is formed based on the principles of mobile communications for data/information sharing between one and another. Road Side Router Unit are the constantly applied blocks over the road or high-way, which provides sufficient ability to transmission of data between vehicles via powerful internet oriented establishments. This road side router unit can support two different modes of communications such as: Vehicle to Vehicle Communications and Vehicle to Environment Communications.

C. Energetic Vehicular Route Optimizer

The proposed algorithm of Energetic Vehicular Route Optimizer (EVRO) is implemented over this paper to attain improved transmission accuracy, failure free data transmission over vehicles, throughput rate improvisation and reduction of delay levels over communication between source and destination vehicles based on Road Side Units. The following summary clearly explains the algorithm oriented details and the respective Pseudocode for the practical implementation details over network simulator tool.

Algorithm: Energetic Vehicular Route Optimizer

Input: Simulation Area X & Y, Distance and Number of Vehicles/Nodes.
Output: Traced Distance Estimation for better and fault free QoS enabled communications.

Step-1: Set the Wireless Communication Channel for X and Y Proportions. (Ex. Channel 1 & 2).
Step-2: Initialize the Node Configurations by means of AdHoc Routing Protocol, AODV.
Step-3: Assign and Define the Link Layer Principles over routing protocol definition.
Step-4: Specify the Media-Access-Control (MAC) with the standards of 802.11.
Step-5: Create a Storage unit model by declaring the queue portions, (Ex. Queue/DropTail/PriQueue).
Step-6: Define the declared Queue Length as per your communication needs, (Ex. ifqlen = 1000).
Step-7: Specify the Antenna Type for communications, (Ex.Antenna/OmniAntenna).
Step-8: Specify the Propagation Model to on ground communications, (Ex.Propagation/TwoRayGround).
Step-9: Define the communication channel; in this we define physical_layer communications, (Ex.Phy/WirelessPhy).
Step-10: Manipulate the Tx and Rx idle power ratios based on the traffic estimations.
Step-11: Plot the nodes/vehicles on the defined simulation area and assign channels to precede communications over vehicular medium.

The following summary illustrates the Pseudocode samples of the above defined algorithm EVRO.

Pseudocode: Energetic Vehicular Route Optimizer

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```
set chan_1_ [new $val(chan)]
set chan_2_ [new $val(chan)]
$ns_ node-config -adhocRouting $val(rp) \
       -llType $val(ll) \
       -macType $val(mac) \
       -ifqType $val(ifq) \
       -ifqLen $val(ifqlen) \
       -antType $val(ant) \
       -propType $val(prop) \
       -phyType $val(netif) \
       -topoInstance $topo \
       -agentTrace ON \
       -routerTrace ON \
       -macTrace ON \
       -movementTrace ON \
       -channel $chan_1, $chan_2_ \

# Traffic Establishments and Processing
setudp [new Agent/UDP]
$ns_ attach-agent $node $udp
#Create a CBR  agent and attach it to the node
setcbr [new Application/Traffic/CBR]
$cbr attach-agent $udp
$cbr set packetSize_ $pkt    ;#sub packet size
$cbr set interval_ $int
#Attach CBR source to sink;
$ns_ connect $udp $sink
return $cbr to RoutingTable.out # trace out

if {$distance<300} {
if {$Node_Dest!=$Node_Src}
       puts $nbr "$nd1\t\t$nd2\t\t$x1\t$y1\t\t$x2\t\t$y2\t\t$d"
   }
```

III. Related Study

Numerous anlaysts have advanced their exertion for giving confirmation in Vehicular Network. Wang'et-al in 2016, introduced a model comprising of Certificate-Respective-Decentralization for decrease of its outstanding workload and dual-secured authentication principles by utilizing bio-secret key for affirmation of safeness. Also, Shao'et-al over 2016, proposed a verification model for vehicular networks, in which it is dependent on the dynamic limit and signature validation of the endorsers. Another plan was proposed by Jiang'et-al over 2016, with the assistance of unknown signature validation. Over that paper, author declared the validness and security is accomplished in vehicular network without broadcasting the authentication disavowal list to each vehicle, which leads to diminish the overhead and to guarantee the protection level. Xie'et-al, 2016, proposed another model for protection with the assistance of bilinear integration for the development of attribute based node/vehicle idnetitiy to guarantee trustworthiness and confirmation.

Mr.Vijayakumar'et-al. over 2016, proposed a model of double-key handling for cluster correspondence. In that the author specifies, the transmissions in cluster with approved and unapproved clients' leads to reduce the overall network lifetime. Authenticated clients get the permissions from the service-handler while non-authenticated clients get the data from authenticated clients as they are unable to convey legitimately with the service-handler.

Lo'and-Tsai over 2016, introduced protection measure with the assistance of methodologies for setting up a association and confirmation of the clients without utilizing unidirectional hash capacity and blending activities. Along these lines, 'Malik'-and-'Panday' over 2016, proposed an improved form of Intermediate ReEncryption Confirmation (IRC) technique to conquer the intrusions like DDoS type attacks, congestion spreading and so on. Moreover, cloud helped security verification model was proposed by Rajput'et-al over 2016, comprised of an aggregate of five stages, for example: vehicle registration, location-of-vehicle, locale-accreditations issuance, message to communicate and renouncement.

IV. Results and Discussions

In this section, the outcome of proposed system called Energetic Vehicular Route Optimizer (EVRO) is clearly shown with experimental proofs, in which it assures the throughput level improvement, traffic-delay reductions, congestion avoidance, frame success ratio (FSR) between vehicles over communication period, vehicular network lifetime improvements and energy consumption reduction scenario with energy efficiency proof. The following figure, Fig-2 illustrates the proposed simulation result view with Node formation principles and the results are

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achieved by using Network Simulator version-2 (NS2) tool.

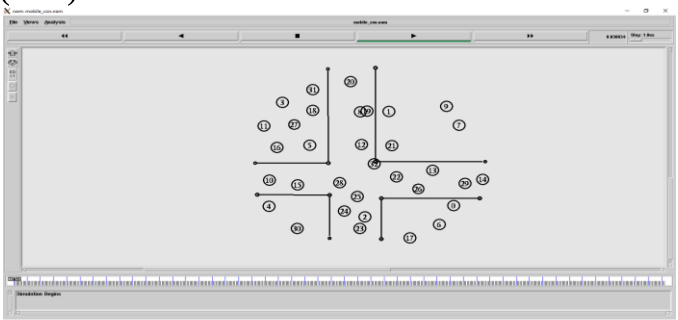

Fig.3Vehicle Formation over Simulation Area

The following figure, Fig.4, shows that the Vehicle Transmitter and Receiver formulation over simulation and start communication with one and another over simulation area of the proposed system.

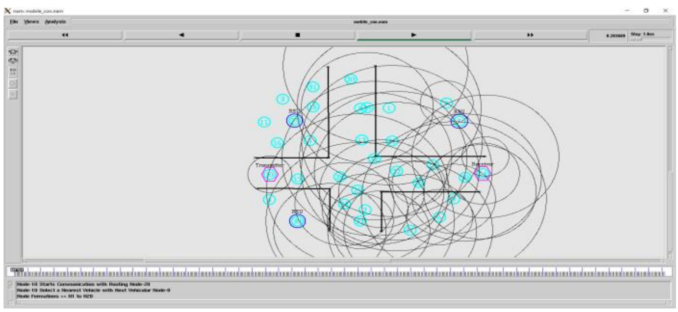

Fig.4Proposed System Communication View

The following figure, Fig.5, shows that the RSRU formation and Accident Vehicles are analyzed over the simulation view of the proposed system.

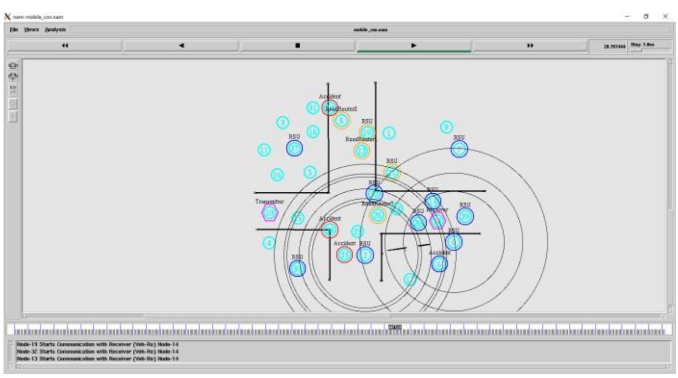

Fig.5RSRU Formation and Accident Vehicles Identification

The following figure, Fig.6, shows that the overall network delay analysis of the proposed system, which is estimated based on the number of nodes and delay over transmission, that is clearly estimate the interval of sending and receiving time of packets during transmission is analyzed over here and the states are clearly visualized over the following figure.

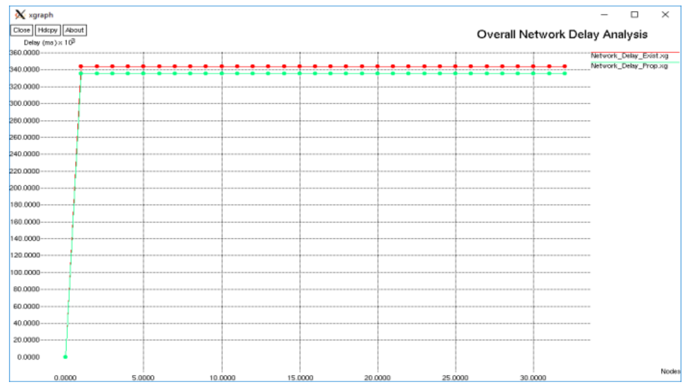

Fig.6 Overall Network Delay Analysis

The following figure, Fig.7, shows that Energy Consumption Analysis of the proposed system, in which the number of available nodes and the energy consumption level is considered as a parameter over here to process and the results are clearly visualize over the following figure.

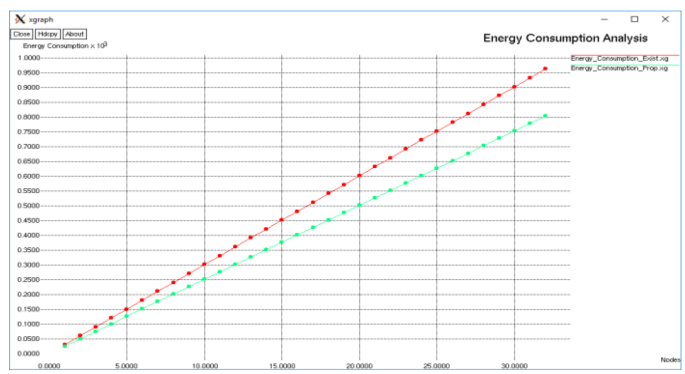

Fig.7Energy Consumption Analysis

The following figure, Fig.8, shows that the Throughput (Goodput) Ratio of the proposed system, in which the number of nodes and the delivery ratio is considered to be the parameters and

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the results are clearly visualized over the following figure.

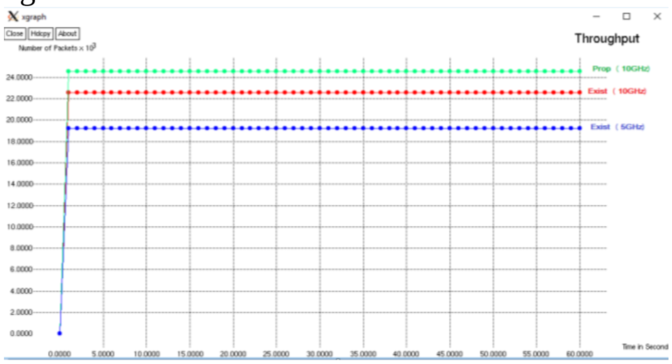

Fig.8 Throughput Analysis

V. Conclusion and Future Scope

In this proposed approach, a new methodology for route analysis called Energetic Vehicular Route Optimizer (EVRO) is applied, which gives drastically improved performance in association with AdHoc Disjoint Vector Routing protocol and well formed a stable network environment for vehicular communications. The crypto function called AES256 gives more improved security features to the data while transmission between vehicles. This proposed system assures the low-energy consumption scenario with improved through and lifetime of vehicular networks. This paper, illustrate the scenario of intelligent network routing protocol AODV in assistance with AES256 crypto scheme and Energetic Vehicular Route Optimizer methodology. This all process work integratedly and provides high transmission accuracy and avoid congestion between traffic-paths with reduced network delay. All these mentioned points are clearly illustrated and showed over results and discussion section of this paper. In future the implemented results can be further refined by means of streamline our vehicular network program based on data as well as media transmissions, actualize the remainder of the security application by using Secure Crypto Principles compare to present application, and attempt to port our program to an advanced network coding simulation tools.

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