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Performance Evaluation of DDSR via NS-3 Simulation using RSU's in Vehicular Network

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Abstract: - Mobile Ad hoc Networks (MANET) are wireless networks without an infrastructure, which are usually set up on a temporary basis to serve a particular purpose within a specific period of time. The nodes in MANET have some mobility due to which the topology changes and move freely, where the nodes move with very less speed like 20 km/hr. But, in vehicular ad hoc networks (VANETs) the nodes are free to move but according to road topology. And their average speeds are about 75-80 km/hr. In VANET the link breakage can be avoided with the help of the mobility pattern knowledge for neighbor nodes. In this paper, the performance evaluation of Dynamic Source Routing (DSR) and modified DSR called Distance based DSR (DDSR) with RSU's for metric Delay via NS-3.15 simulator.

Keywords: - Delay, Distance DSR, DSR, MANET, NS-3.15 Simulator, RSU, VANET.

1 INTRODUCTION

Vehicular Ad Hoc Network (VANET) is a new challenging network environment that pursues the concept of ubiquitous computing for future. Vehicles equipped with wireless communication technologies and acting like computer nodes will be on the road and this will revolutionize the concept of travelling. VANETs bring lots of possibilities for new range of applications which will not only make the travel safer but fun as well. Reaching to a destination or getting help would be much easier. The concept of VANETs is quite simple by incorporating the wireless communication and data sharing capabilities, the vehicles can be turned into a network providing similar services like accidental information, advertisements etc. In order to provide service for data sharing or message exchange one of the solution is Vehicle to Vehicle (V2V) communication. Vehicle to Vehicle (V2V) communication is based on wireless technology which is designed for vehicles to communicate with each other. There are many approaches to provide communication between vehicles but the low cost approaches to use in wireless networks are 3G, Wi-Fi, Wi-MAX, etc [1].

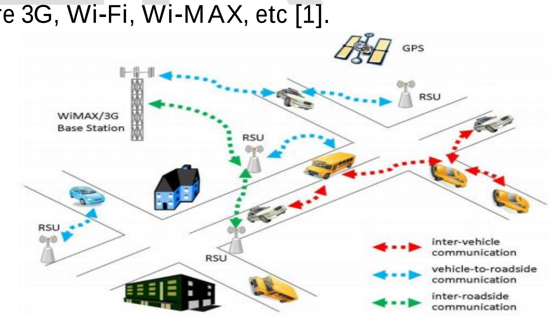

Fig 1: Vehicular Ad-hoc Networks

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In this paper, we concentrate on the performance analysis of a vehicular Ad Hoc Network. Using DSR and DDSR protocol the simulations are carried out to evaluate the performance of wireless message exchange at highway scenario in VANET.

The ns-3 [2] is a discrete-time event driven network simulator, which means that it simulates time-stamped events, so that the internal clock of the simulator advances in a discrete manner. It supports network researchers working on Internet systems, and attempts to ease the reuse of existing code for networking protocols, networking stacks or applications.

The ns-3 is an open source software, licensed under GNU GPLv2, written in C++ and offering Python bindings. Development of ns-3 was started in 2006, and releases are made about every 3 months or so. The ns-3 will became a replacement for ns-2, a popular network simulator written in C++ and OTcl, which suffers from some design issues.

In this work, we evaluate the performance of vehicle to vehicle (V2V) communication considering the DSR and DDSR protocol. We compare the delay for highway scenario with using RSUs via ns-3 simulation.

The structure of the paper is as follows. In Section II, we discuss the related work. In Section III, we make an overview of DSR and DDSR protocol. In Section IV, we describe the simulation system. In Section V, we discuss the performance evaluation. Finally, conclusions are given in Section VI.

2 RELATED WORK

According to [3], the protocol comprises of two main mechanisms of “Route Discovery” and “Route Maintenance”, which work together to allow nodes to discover and maintain routes to arbitrary destinations in ad hoc networks. The authors further stated that the protocol operates entirely on demand, allowing the routing packet overhead of DSR to scale automatically only what is needed to react to changes in the routes currently in use. The protocol allows multiple routes to any destination and at the same time allowing each packet sender to select and control the routes used in routing its packets.

Jerome Haerri et.al [4] evaluated the performance of AODV and OLSR for VANET in city environment, in their study all the characteristics are handled through the Vehicle Mobility Model. Their study showed that OLSR has better performance than AODV in the VANET, as the performance parameters that they used have less overhead on the network as compared to OLSR.

Performance analyses of traditional ad-hoc routing protocols like AODV, DSDV and DSR for the highway scenarios have been presented in [5], and the authors proposed that these routing protocols are not suitable for VANET. Their simulation results showed that these conventional routing protocols of MANET increase the routing load on network, and decrease the packet delivery ratio and end to end delay.

O. Abedi et.al enhanced traditional MANET routing protocol AODV to improve route stability and less overhead of network and makes it suitable for VANET, they named it as PAODV and DAODV [6, 7]. Their study showed that more appropriate routes can be found with and without mobility prediction. In their study, they selected fewer routes to overcome routing overhead on network and this effect overcomes the link breakage as compared to AODV.

In Roadside aided routing Inter-Vehicle Communications (IVC) and Roadside-to-Vehicle Communications (RVC) in vehicular networks

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH VOLUME 5, ISSUE 3, MARCH-2014
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based on IEEE 802.11 are emerging technologies for future Intelligent Transportation Systems (ITS). The representation of a new efficient routing approach, called RAR (Roadside-Aided Routing) that is the first one to exploit the unique characteristics of vehicular networks. A novel affiliation method is proposed to affiliate a vehicle to several Roadside Units based on road constraints. This scheme allows (a) agent advertisement to be broadcast in one hop (instead of multi-hop), (b) routing to be done in single phase, comparing to two phases, (c) to eliminate the use of hierarchical addressing which is commonly used in single-phase schemes. Simulation results of ns-2 show that RAR approach can provide a high packet delivery rate in vehicular networks with a low and constant overhead. The efficient routing approaches in the emerging vehicular networks. The unique road constraints and deployment of vehicular networks are different from the default assumptions of general networks. Exploiting those unique characteristics, we affiliate each vehicle to a sector, which is a closed area bounded and managed by several RSUs.

3 OVERVIEW OF DSR AND DDSR PROTOCOL

The Dynamic Source Routing (DSR) protocol is an on-demand routing protocol based on source routing. In the source routing technique, a sender determines the exact sequence of nodes through which to propagate a packet. The list of intermediate nodes for routing is explicitly contained in the packet's header. In DSR, every mobile node in the network needs to maintain a route cache where it caches source routes that it has learned. When a host wants to send a packet to some other host, it first checks its route cache for a source route to the destination. In the case a route is found, the sender uses this route to propagate the packet. Otherwise the source node initiates the route discovery process. Route discovery and route maintenance are the two major parts of the DSR protocol.

3.1 Route Discovery

For route discovery, the source node starts by broadcasting a route request packet that can be received by all neighbor nodes within its wireless transmission range. The route request contains the address of the destination host, referred to as the target of the route discovery [8], the source's address, a route record field and a unique identification number. At the end, the source host should receive a route reply packet containing a list of network nodes through which it should propagate the packets, supposed the route discovery process was successful.

During the route discovery process, the route record field is used to accumulate the sequence of hops already taken. First of all the sender initiates the route record as a list with a single element containing itself. The next neighbor node appends itself to the list and so on. Each route request packet also contains a unique identification number called request-id. request-id is a simple counter which is increased whenever a new route request packet is being sent by the source node. So every route request packet can be uniquely identified through its initiator's address and request-id. When a host receives a route request packet, it is important to process the request in the order described below. This way we can make sure that no loops will occur during the broadcasting of the packets.

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH VOLUME 5, ISSUE 3, MARCH-2014
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1. If the pair (source node address, request-id) is found in the list of recent route requests, the packet is discarded.
2. If the host's address is already listed in the request's route record, the packet is also discarded. This ensures removal of later copies of the same request that arrive by using a loop.
3. If the destination address in the route request matches the host's address, the route record field contains the route by which the request reached this host from the source node. A route reply packet is sent back to the source node containing a copy of this route.
4. Otherwise, add this host's address to the route record field of the route request packet and re-broadcast the packet.

A route reply is sent back either if the request packet reaches the destination node itself, or if the request reaches an intermediate node which has an active route to the destination in its route cache. The route record field in the request packet indicates which sequence of hops was taken. If the node generating the route reply is the destination node, it just takes the route record field of the route request and puts it into the route reply. If the responding node is an intermediate node, it appends the cached route to the route record and then generates the route reply. Sending back route replies can be accomplished in two different manners: DSR may use sym-metric links, but it is not required to. In the case of symmetric links, the node generating the route reply just uses the reverse route of the route record. When using unidirectional (asymmetric) links, the node needs to initiate its own route discovery process and piggyback the route reply on the new route request.

3.2 Route Maintenance

Route maintenance can be accomplished by two different processes:

• Hop-by-hop acknowledgement at the data link layer

• End-to-end acknowledgements

Hop-by-hop acknowledgement at the data link layer allows an early detection and retransmission of lost or corrupt packets. If the data link layer determines a fatal transmission error (for example, because the maximum number of retransmissions is exceeded), a route error packet is being sent back to the sender of the packet. The route error packet contains two parts of information: The address of the node detecting the error and the host's address which it was trying to transmit the packet to. Whenever a node receives a route error packet, the hop in error is removed from the route cache and all routes containing this hop are truncated at that point.

End-to-end acknowledgement may be used, if wireless transmission between two hosts does not work equally well in both directions. As long as a route exists by which the two end hosts are able to communicate, route maintenance is possible. There may be different routes in both directions. In this case, replies or acknowledgements on the application or transport layer may be used to indicate the status of the route from one host to the other. However, with end-to-end acknowledgement it is not possible to find out the hop which has been in error.

3.3 Distance DSR (DDSR) PROTOCOL

This protocol works as same as DSR routing protocol but the change that have been modified is that whenever the source has a packet to send it will first calculate the time that the packet will take to reach to the destination and then distance that the

INTERNATIONAL JOURNAL OF SCIENTIFIC & ENGINEERING RESEARCH VOLUME 5, ISSUE 3, MARCH-2014
ISSN 2229-5518

vehicle will travel during that duration assuming that the vehicles are moving with constant speed. And after calculating the distance that the destined vehicle will travel then the source vehicle will calculate whether the destined vehicle will remain during that duration within that RSU only or to the next RSU. If the destined vehicle remains within the range of the same RSU then it will deliver packet to that RSU only otherwise it will be delivered to the next RSU in the direction of the destined using DSR protocol.

4 SIMULATION DESCRIPTION AND DESIGN

The ns-3 simulator is developed and distributed completely in the C++ programming language, because it better facilitated the inclusion of C-based implementation code. The ns-3 also is architected similar to Linux computers, with internal interface and application interfaces such as network to device driver and sockets. Users of ns-3 are free to write their simulation scripts as either C++ main() programs or Python programs. The ns-3 low-level API is oriented towards the power-user but more accessible helper APIs are overlaid on top of the low-level API.

The ns-3 simulator has models for all network elements that comprise a computer network. Network devices which represent the physical device that connects a node to the communication channel. This might be a simple Ethernet network interface card, or a more complex wireless IEEE 802.11 device.

The ns-3 simulator is equipped with Pyviz visualizer, which has been integrated into mainline ns-3, starting with version 3.10. It is mostly written in Python, it works both with Python and pure C++ simulations. The function of ns-3 visualizer is more powerfully than nam.

The graphs are generated with the Trace-Metrics tool [9]. In trace-metrics tool, the generated trace file is read out and according to that trace file the delay variance is calculated and with that calculation the graphs are generated in gnuplot.

Trace-Metrics is a trace file analyzer for Network Simulator 3 (ns-3). The main goal is to perform a quick analysis of the trace file produced by ns-3's simulations and calculate useful metrics for research and performance measurement.

Such tool is needed because a research simulation may generate a trace file with thousands of lines, becoming difficult to analyze manually. Due to this, this tool can be handy in case someone needs a metric that the tool already supports.

Trace-Metrics is an open-source tool, developed in Java.

4.1 SIMULATION PARAMETERS

PARAMETER	VALUE
Bandwidth	2Mbps
Vehicle Range	1 km
RSU Range	1 km
Routing Protocol	DSR
Packet Size	64 bytes
Speed	60-80 km/hr
Simulation Time	130 c

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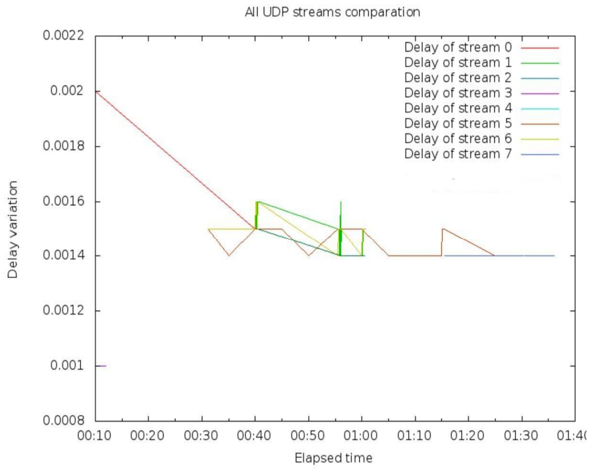
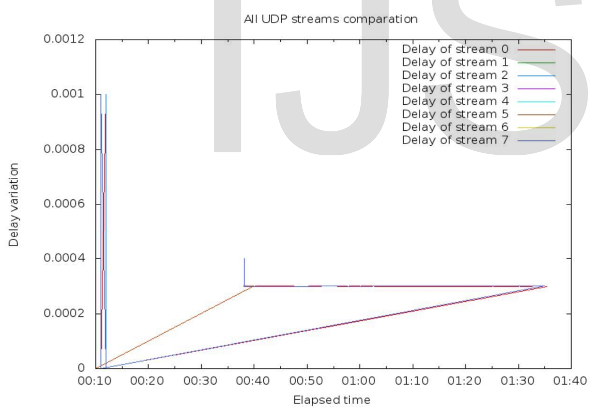
5 PERFORMANCE EVALUATION

The following are the graphs shown below. These graphs are the Delay variation-elapsed time graph.

Graph-1 for the DELAY Variation for DSR



Graph-2 for the DELAY Variation for DDSR



6 CONCLUSIONS

This simulation is carried out using NS-3.15 simulator and graphs are generated using Trace-Metrics tool. In Graph-1the delay time is more. And in Graph-2 the delay time is less. So, the result of DDSR protocol is better than DSR protocol.

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