Metric Base Analysis and Modeling Experiments of Routing Protocols in MANETs and VANETs Wireless Network using Real Time Scenarios

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Abstract

Ad hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. In such an environment, it may be necessary for one mobile host to enlist the aid of other hosts in forwarding a packet to its destination, due to the limited range of each mobile host's wireless transmissions. Mobile ad hoc networks (MANET) do not rely on any fixed infrastructure but communicate in a self-organized way. Vehicular Ad hoc Network (VANET) is a subordinate of Mobile Ad hoc Network (MANET). In this paper, we have discussed experimental metrics base framework in which Data Drop (DD) and throughput are measured and analyzed for Mobile Ad-hoc Network (MANETs) and Vehicular Ad-hoc Network (VANETs). Moreover, the authors have contributed the performance comparison of routing protocols. Novel contribution in this paper is to compare different routing protocols in both MANETs and VANETs. The proposed system classifies the changing in MANET nodes and VANET vehicles data drop, and throughput. It was observed from the results that in form of high through put and low packet drop DSR shows better performance compared to DSDV and AODV in both VANET and MANET. Protocols which are being analyzed in this paper are: AODV, DSR and DSDV. The performance parameter includes Data Dropped and throughput.

Keywords: *VANET, MANET, AODV, DSR, OLSR, DSDV*

1. INTRODUCTION

Wireless technology in the field of has been growing fast previous more than two decades. Developments have played a vital role to explore new horizons doors for researchers to dig out unique cost-effective solutions for different applications. Cellular networks, Ad hoc networks, ,wireless sensor networks, Visible Light Communication, Wi-Fi, Wi-Max are some of the illustrations of new wireless network technologies that have been used in security ,telecommunication, engineering, location tracking , network monitoring , remote sensing, , medical, education, and tracking systems.

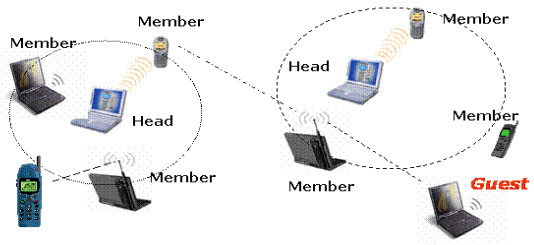


Fig. 1. Communication architecture of MANET

The proliferation of wireless communication and mobile devices in recent years has opened the door to research on self-organizing networks that do not require a pre-established infrastructure as shown in Fig. 1. Those spontaneous networks, normally called ad hoc networks, provide mobile users with

ubiquitous communication capacity and information access regardless of the location.

The most important characteristic of such network is the independence of any fixed infrastructure or centralized administration. An ad hoc network is capable of operating autonomously and is completely self-organizing and self-configuring. Therefore, it can be rapid and easily deployed.

Another important property of an ad hoc network is the multihop capability. Unlike the cellular networks, which are single-hop wireless networks, an ad hoc network does not guarantee that a mobile node can directly communicate with its destinations all the time. A mobile node, which lies outside the transmission range of its specific destination, would need to relay its information flow through other mobile nodes. This implies that mobile nodes in ad hoc networks bear routing functionality so that they can act both as routers and hosts.

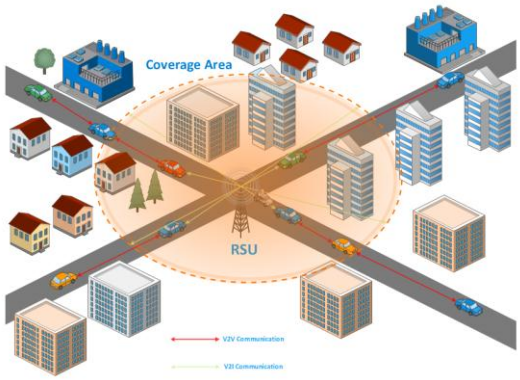


Fig. 2. Communication architecture of VANET

Fig. 2 shows the architecture of VANET in which different components are shown. This is generic architecture in which data is transferred among different on-board units (OBU). Intelligent Transportation Systems (ITS) is a wide-ranging technology system applicable to transportation to make system safer, more effective, and more reliable and more environment friendly, without altering the existing infrastructure. Technologies ranges include sensor network, control technologies, communications system, computer informatics, transportation, engineering, telecommunications, computer science, finance, electronic commerce and automobile manufacturing. A vehicular ad hoc network (VANET) is an emerging research area for the communications industry and academician. Researchers proposed an entirely new wireless networking concept i.e. vehicular ad hoc network which can increase passenger safety and reduces vehicle collisions on the road. VANET can provide an efficient road, comfort facility to the passengers and traffic regulations monitoring in future. Wireless communication among moving vehicles is unique and innovative research era in the academics and in the corporate sector, driven by the vision to communicate information among vehicles to ensure the safety and comfort of the users [1–2]. Now a days automobile industry have equipped their new vehicles with global positioning systems (GPS), digital maps and even wireless interfaces, e.g. Honda-ASV3.The network architecture of VANET can be classified into three categories: Cellular network/WLAN, ad hoc network, and hybrid network [3].

This paper summarizes the impact of topology based routing protocols in MANET and VANET wireless scenarios. The remainder of the paper is organized as follows: Section II describes the problem statement. Section III discusses the different routing protocols used in VANET and MANET. Section IV presents the experimental and model scenarios & V analyze the results of urban and rural area scenarios. We conclude in Section VI and section VII for reference.

2. PROBLEM STATEMENT

With the emergence of vigorous wireless network technologies and wireless applications intensive research have been conducted in VANET and MANET. Vehicles are needed to equip with Global Positioning System (GPS) and IEEE 802.11 wireless adaptors to create ad-hoc network for data sharing. Ad-hoc routing protocols are susceptible to move during data transmission in the network. Path is pre-established for data transfer and network configuration changes frequently.

Challenges faced by ad-hoc network includes security, bandwidth limitation, energy utilization, scalability, network performance etc. while measuring different parameters mentioned above we use different protocols to show the network performance and quality of service. The proposed system classifies the changing vehicular density, data drop, and throughput and end-to-end delay of nodes and vehicles in the network.

To guarantee the performance of network multiple protocols have been analyzed in the simulation scenario like AODV, DSR and DSDV. Performance has been measured in rural and urban areas using parameters like: data drop, throughput and end-to-end delay of nodes in both VANET and MANET network.

3. TOPOLOGY BASED ROUTING PROTOCOLS

In this paper, we have only considered only proactive and reactive protocols. Based routing protocols usage is link's information, which exists in the network and use as packet forwarding. These protocols can be categorized into:

- Proactive (table-driven) routing protocols
- Reactive (on-demand) routing protocols
- Hybrid routing protocols

3.1 Proactive-Routing Protocols

Proactive protocols based mostly on algorithm's shortest path. Information is kept of all nodes connected in table form and are also shared with their neighbors [4]. Even if the paths are not being used currently, they do maintain and give updates on routing amongst all the vehicles for given network at any times, therefore even in cases where paths are never used, updates regarding them are continuously broadcasted among nodes [5]. When periodical route updates are performed, network load, constraints of bandwidth and size of the network are never regarded. This is a major limitation of using this approach in VANETs. Types of Pro-active Routing Protocols: FSR, DSDV, PLSR, CGSR, WRP and TBRPF.

1) Destination Sequenced Distance Vector (DSDV)

It is Table Driven routing protocol which is used in VANET and is grounded on classical Bellman-Ford algorithm. Primarily every vehicle broadcasts its own route information tables to its neighbor vehicles. The neighbor vehicles keep up-to-date routing table by two type of packets- Full Dump Packet and Incremental Packet. Full Dump Packet comprises information about every contributing vehicle in the VANET. These packets are communicated intermittently after a long time intermission. Incremental Packet covers latest change in vehicle position since last Full Dump Packet. These packets are communicated periodically in short interval of time and their information is stored in additional table. Routes are nominated with the up-to-date entry in the table. DSDV is better option for networks where location of nodes is less changeable. If position of a vehicle changes frequently, its performance will decreases due to more Full Dump Packets are required to send in the network, which results the bandwidth wastage.

3.2 Reactive Routing Protocols

Reactive routing protocols for mobile ad hoc networks are similarly known as "on-demand" routing protocols. In a reactive destination node but no route is accessible, it initiates a route detection process. It is initiated with RREQ packet, response is with RREP and while link is not available it is received RERR packet. Reactive routing protocols has less overhead, a unique feature, while reactive routing protocols scalable than proactive routing protocols. But while using reactive routing protocols, source nodes may undergo routing protocol, routing paths are look for only while it is desirable. Fig. 3 shows the classification of AODV showing the procedure of RREQ and RREP. Fig. 4 shows the classification of DSR showing the procedure of RREQ and RREP. Henceforth these protocols are not appropriate for real–time applications. The Dynamic Source Routing (DSR) [6] and Ad hoc On-demand Distance Vector routing (AODV) [6] are examples for reactive routing protocols.

2) Ad Hoc on-Demand Distance Vector Routing (AODV)

AODV protocol is an enhancement on DSDV protocol. When two nodes require a connection, AODV maintains overall routing tables in the nodes and establishes routes only. AODV classification is as a pure on demand route acquisition system [7]. This is because a small number of routing information is kept in the nodes which are not on the route selected.

A distinguishing feature of AODV is that it tries to avoid the "counting to infinity" problem by using sequence number in routing discovery process [8]. Three types of messages used in AODV routing process are Route Error (RERR), Route Request (RREQ) and Route Reply (RREP).The network maintains silence until when the source nodes requires communicating with the node of communication. In case of lack of valid route that existed, an initiation of route discovery process will begin. The source of the node then broadcasts RREQs to its neighbors, then RREQ is forwarded to their neighbors and it continues on and on until a point is reached which is the RREQs destination or an intermediate node that is the destination's valid route. A sequence number and broadcast ID will be assigned by each node. An increase in the sequence number is done along the path with every generation of RREQ. Consequently, identification of RREQ can be done based on the IP address and broadcast ID based on the source node.

RREQ replies back to the source when it reaches the destination or an intermediate node that has a route that is active. All the other RREQ that arrives later from other nodes are done away with. Link failure detection by upstream node

within the network makes RERR to be fed back to the source node and an initiation of new route discovery process begins after receiving RERR. Fig. 3 shows the classification of AODV showing the procedure of RREQ and RREP.

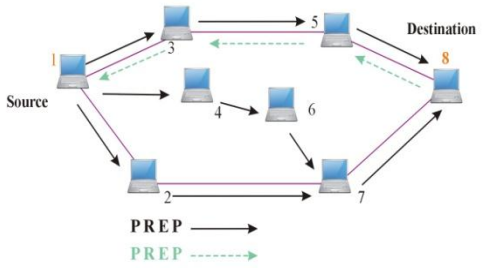


Fig. 3. AODV Protocol Behavior

3) Dynamic Source Routing (DSR)

DSR is based on the source concept routing [9] it is uncomplicated ad hoc routing protocol. It is Source Initiated on Demand routing protocol used in VANET and is grounded on link state routing algorithm. When a vehicle needs to transfer data to another vehicle, first it initiates route discoveries request up to that vehicle. For route finding, source vehicle recruits a route request (RREQ) packet in the network and other nodes forward the RREQ by changing their name as sender. Lastly when RREQ packet spreads to the destination vehicle or to a vehicle having path to the destination vehicle, a route reply (RREP) packet is unicasted to the sender node. If the reply packet is not received, the source vehicle resumes violent discovery of route up to the destination vehicle. Fig. 4 shows the classification of DSR showing the procedure of RREQ and RREP.

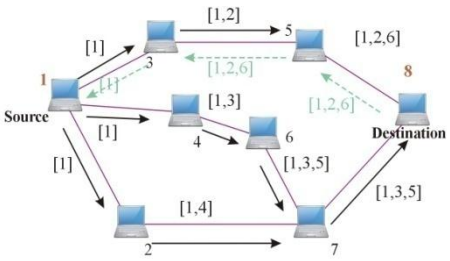


Fig. 4. DSR Protocol Behavior

Table I Comparisons of routing protocols

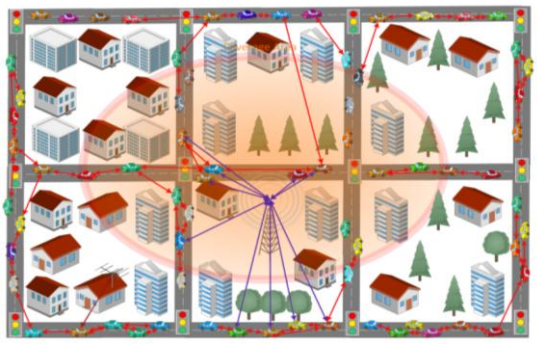
Protocol Property	DSDV	DSR	AODV
Loop Free	Yes	Yes	Yes
Multicast Routes	No	Yes	No
Distributed	Yes	Yes	Yes
Unidirectional Link Support	No	Yes	No
Multicast	No	No	Yes
Periodic Broadcast	Yes	No	Yes
Routes Preserved in	Route Table	Route Cache	Route Table
Route Cache	Yes	No	Yes
Reactive	No	Yes	Yes

4. EXPERIMENTAL MODEL AND SCENARIO

In the MANET and VANET networks basically NCTUns 6.0 is used which is the free version of NCTUns network simulator and emulator, which is a world-renowned tool and has been used by more than 20,000 listed users from 144 countries all over the world. EstiNet 7.0 is latest version and whose central technology is based on the novel kernel re-entering methodology invented by Prof. S.Y. Wang [10]. The various features of VANET supported by NCTUns 6.0 make it a clear choice for proposed research work.

4.1 VANET Urban Area Scenario

Fig. 5 shows the urban area grid scenario where 80 vehicles devices identified as On-Board Units (OBUs) communicate with each other as well as with RSU (Road Side Unit) .Vehicles show the network behavior as the OBUs move within the network to analyze the performance of each protocol. While assessing the performance of a given scenario in the vehicle-to vehicle communication (V2V) and vehicle-to-roadside communication (V2R) vehicles move within network and establish VANET. In this mobility model we used Random waypoint. Using this mobility model vehicles



are free to move to reach at random destination. Movement of the vehicles is calculated by the algorithm.

Fig. 5. VANETs Urban Area Grid Scenario

4.2 MANET Scenario

Fig. 6 shows MANET scenario where 80 MANET nodes communicate with each other.

Fig. 6. MANET Scenario

5. PERFORMANCE RESULTS OF AODV, DSR, DSDV

Following graphs show the performance of the routing protocol using different metric considered above. The X- Axis demonstrations the time in minutes and the y axis displays the Metric considered.

5.1 Throughput

From fig. 7 it can be realized that in VANET area scenario throughput with DSR protocol is better than with AODV and DSDV with throughput peak reaching up to 300 kB/s. It is also observed that speed is increased and more vehicles connected to the RSU than AODV performance suddenly degrades from about 270 KB/s to 40 KB/s while DSDV performance slightly decrease remains moderately same.

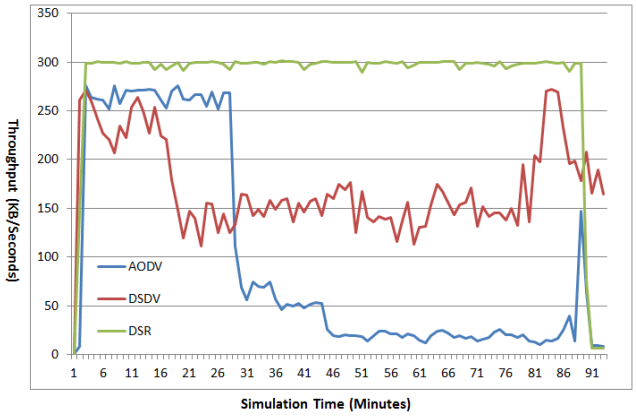


Fig. 7. Throughput of VANET Scenario

Fig. 8 shows the Throughput in MANET scenario is exposed. Clear implication from graph DSR Throughput is uppermost. AODV Throughput remains in between other two and DSDV Throughput is lowest among all three.

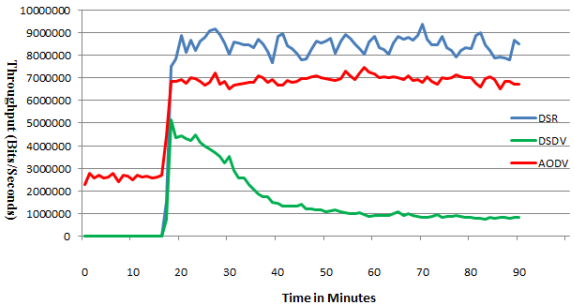


Fig. 8. Throughput of MANET Scenario

5.2 Packet Dropped

The packet drop performance of DSR protocol is much better than AODV and DSVDV in VANET scenario as is seen from fig. 9. About 10 to 20 packets dropped in urban area while less than 50 packets drop in rural scenario while this drop of packets better as time passes for the DSR protocol. As the speed is increased the packet drop rate for AODV protocol increases from 200 to 1100 drop packets in urban area whereas in rural area packet drop for AODV remain between 100 to 140 packets. In terms of dropped packets for DSDV's performance is the worst in both scenarios. The performance degrades with the increase in the number of nodes and speed.

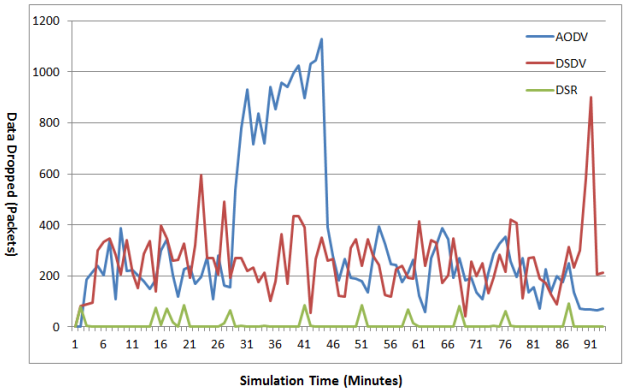


Fig. 9. Packets Dropped in VANET Scenario

Figure 10 shows the drop packet performance of DSR protocol is better than for both AODV and DSDV in MANET scenario.

As the number of vehicles increased data dropped ratio of DSDV suddenly increased.

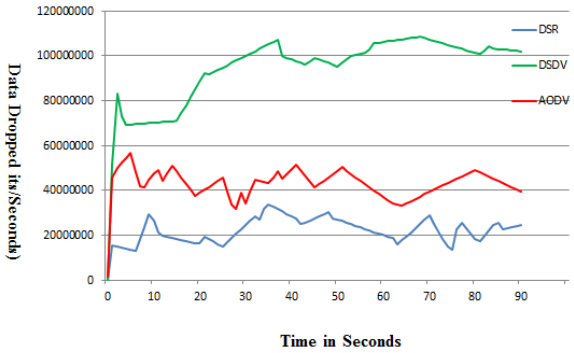


Fig. 10. Packets Dropped in VANET Scenario

6. CONCLUSION

In this paper, presented simulation studies and compared the Routing protocol DSDV uses proactive "table driven" routing, while AODV and DSR use reactive "on-demand" routing. Protocol DSDV periodically updates its routing tables, even in cases when network topology doesn't change. AODV protocol has inefficient route maintenance, because it has to initiate a route discovery process every time network topology changes. Both protocols, AODV and DSR, use route discovery process, but with different routing mechanisms. In particular, AODV uses routing tables, one route per destination, and destination sequence numbers as a mechanism for determining freshness of routes and route loops prevention. On the other hand, DSR uses source routing and route caching, and doesn't depend on any periodic or time-based operations. From the parameter values characterizing the two traffic scenarios, DSR is found suitable for both rural and urban traffics scenarios. Thus it can be concluded that DSR outperforms from other routing protocols AODV and DSDV in both urban and rural area scenarios. Poor performances of DSR routing protocol, when mobility or load are increased, are the consequence of aggressive use of caching and lack of any mechanism to expire stale routes or determine the freshness of routes when multiple choices are available.

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