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M-DART based Asynchronous File Sharing scheme in VANET

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Abstract

Increasing need for people to remain connected while they are mobile poses several interesting challenges for today's Wireless Networks. Information sharing among vehicles can be considered as one of the most popular medium for exchanging safety and entertainment messages between mobile users. Recently data sharing has also started receiving increased attention from researchers. This paper proposes a Distributed Hash Table based File Sharing Scheme for Vehicular Ad hoc Networks using multipath routing protocol. The scheme guarantees multi-path forwarding due to its underlying property of reactiveness and its application of proactive routing protocol. The packets are transferred to distant nodes with assistance of created Distributed Hash Tables which store information about identities of sender's as well as receiver nodes. By using Multi-path Dynamic Address Routing the algorithm utilizes the best available path until it fails to switch to the next best available route in the network. Simulation results show that the proposed scheme achieves realistic performance of file delivery and also has comparative performance with the existing protocols.

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*Keywords:*VANET's; File Sharing; Distributed Hash Table; Multi-path Dynamic Address Routing.

1. Introduction

The increasing requirements from wireless communication technology, has created the need for new self organizing types networks which work without the interference of centralized infrastructure. The networks without

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the absence of any centralized infrastructure are called Ad hoc networks. Mobile Ad hoc Network (MANET) and Vehicular Ad hoc Network (VANET) are some prominent examples of such network[1]. The nodes connected in such networks are free to join and leave the network depending on the transmission range of the nodes. VANET is the subclass of MANET where vehicles are equipped with wireless transmission capabilities that can be formed with or without the help of any fixed infrastructure. The similarity between these two networks is characterized by the movement and self organization of nodes, infrastructure less and short range connectivity[2].

VANET offers direct communication between vehicles termed as Vehicle-to-Vehicle (V2V), to and from Road Side Units (RSU's) termed as Vehicle-to-Roadside (V2R) communication. VANET provides variety of safety related applications such as traffic monitoring, traffic flows control, prevention of collisions etc and non safety applications such as providing internet connectivity to vehicular nodes, watching and downloading music, movies or books, sending and receiving emails or playing online games.

Characteristics such as relatively high and dynamic topology as well as frequent network disconnection make it different when compared to other categories of ad hoc networks. These distinguishing characteristics of VANET offer opportunities to increase network performance but at the same time present various challenges like maintaining routing tables, scalability etc[3].

U.S. Federal Communication Commission (FCC) has allocated 75MHz of spectrum in the 5.850 to 5.925 GHz band for Dedicated Short Range Communication (DSRC) spectrum which allows various vehicles to communicate with each other and with road side units providing transmission range between 300m to 1000m[4].

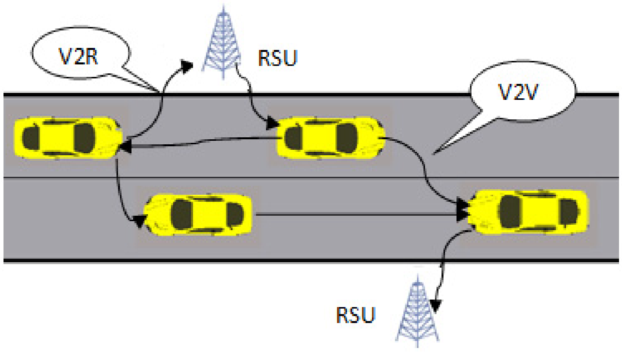

Fig. 1. VANET Architecture.

Figure 1 shows the Vehicular communication system through VANETs with RSU’s providing the infrastructure service. Each vehicle has an On Board Unit (OBU) for connecting the vehicles with RSU for communicating safety-related information[5]. RSU is a physical network device used for distributing information to other OBUs, providing internet connectivity to OBUs and extending communication range of an ad hoc network.

The paper is divided into the various sections: Section 2 describes the related work in the area of file sharing in VANET's, while Section 3 presents the proposed approach. Simulation results are shown in Section 4. Finally, Section 5 concludes the paper and gives directions for future work.

2. Literature Survey

Zeadally et al.[6] described that Vehicle-to-Roadside communication uses periodic broadcasting of messages between vehicles and RSU's whereas the Vehicle-to-Vehicle communication uses multi-hop broadcast or multicast communication to transmit traffic related information. Nadeem et al.[7] discussed dissemination mechanism. Each time a vehicle receives information which is broadcasted by another vehicles; it updates its stored information and forwards it. This broadcasting of information can either occur in all the directions or in a particular direction. There are three cases considered for dissemination mechanism in which mobility of vehicles in the opposite direction, same direction or in both the directions. Through analysis it was found that dissemination using the case when vehicles travel in the opposite direction has better performance.

Nandan et al.[8] introduced Swarming Protocol (SPAWN) for VANET in which information of available files are propagated using gossip mechanism. Lee et al.[9] designed CarTorrent protocol similar to SPAWN. Use of expensive gateways, broadcasting of gossip messages over network increases the message overhead. Distant vehicles does not take advantage of file sharing which remains some disadvantages of both these protocols. Reaidi et al.[10] modified BitTorrent protocol but the packet overhead increases due to which file sharing is not done between distant vehicles by this scheme. Kanhere et al.[11] proposed VANETCODE which uses gateways to store the files. The original file is divided into blocks which is encoded and then broadcasts these blocks to various requesting vehicles. This eliminates the need of content selection and neighbor discovery which in return reduces the time. In this technique gateways are the data source so modifying data in each and every gateway is a difficult task.

Dutta[12] proposed a file sharing framework in which the available network scenario was divided into different regions based on their geographical locations. A unique identifier was associated with these regions. The required file sharing was done using above two parameters. However this technique is not suitable when large files need to be shared.

Nasrin et al.[13] proposed ID based Scalable and Efficient Distributed File sharing (ISEFF) approach which uses both Consistent Hashing and BitTorrent protocol. Consistent Hashing provides look up functionality by implementing the Distributed Hash Tables (DHT’s) and BitTorrent protocol helps in reliable file transfer. Reducing the message and memory overhead as compared to other methods increases the scalability.

3. Proposed Work

The review of existing schemes for file sharing reveals that although there are number of available protocols for sharing data but most of these protocols are based on traditional routing mechanisms. Also, it is difficult for these protocols to function in urban scenario due to the higher infrastructure cost of installing gateways. So, to avoid above issues M-DART Protocol[14] is used for implementing DHT's. M-DART is characterized by some key features such as proactive, multi-path, hierarchical and DHT-based routing protocol[15]. All the available paths between the source and destination are discovered due to the inherent properties of M-DART. Moreover, no additional coordination and communication overheads are required for discovery and announcement of optimized path throughout the network.

The proposed work focuses on file sharing in a distributed way using the vehicular network. File sharing is provided among all the vehicular nodes of the network, even the distant vehicles could have the advantage of file sharing with this approach. To acquire efficient and scalable file sharing scheme for VANET’s the combination of two traditional techniques that is BitTorrent and Consistent Hashing is used. First of all, the available network scenario is divided into different regions based on their geographical locations then each file is divided into small parts. Vehicular nodes having a chunk of the file, records the file information in the DHT's and then share it with others. M-DART protocol is used for the construction and maintenance of the DHT's. M-DART being multi-path and proactive provides the functionality to the nodes to have information regarding all the available routes to face the challenge of changing topology. The following algorithm explains the proposed work in steps.

Algorithm 1 Algorithm for Proposed Scheme

Assumption: Each vehicle has Distributed Hash Tables(DHT's) which store the information of shared files along with their regions

```
Begin
for each vehicle do
    Select the file to be transmitted
    for Each Filedo
        Divide file in smaller parts
        Associate a File-Value (File-Owner, File-Name) with each file;
        Store File-Value in File-List
        Update DHT with File-list and Region
    end for
    Requester-Node searches for file in File-List based upon File-Value using lookup functionality
    Requester-Node download piece needed from File-List
    Broadcast the updated information to all the neighbouring nodes
end for
End
```

Each vehicular node in the network maintains the DHT. The node having the file is the File-Owner. File is divided into smaller parts. File-Value consists of the information regarding the file like File-Owner, File-Name. DHT consist of the shared File-List and region so that whenever these files are requested these can be searched easily. DHT is updated at intervals so that current region of vehicular nodes is stored in DHT. The Requester-Node when needs the file or piece finds it in the File-List with lookup functionality of M-DART and download the required piece. In comparison to previous schemes, the message and memory overhead decreases which results in better scalability.

4. Experimental Results

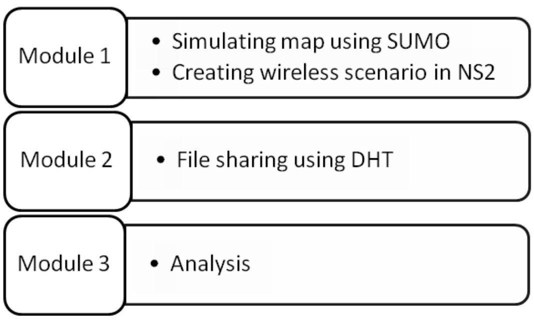

Fig. 2. Experimental Modules for Proposed Scheme.

The scheme is divided into three modules. Figure 2 shows that in first module, the urban scenario is simulated using Simulation of Urban Mobility (SUMO) simulator. This scenario is used to create a corresponding wireless scenario using NS-2. SUMO is used for generating traffic patterns and NS-2 is used for network related data generation. In the second module, the files to be sent are divided into packets and store their information in DHT's. The file sharing is done using M-DART protocol. This DHT-based routing protocol makes searching for information easier. To analyze the proposed protocol, various parameters are considered for performance evaluation which is done in the third module. These parameters are:

- **Simulation Time:** Simulation time is the total time for which simulation occurs. It is measured in seconds.
- **Cumulative Sum:** Cumulative sum is the total number of packets sent, received and dropped. It is measured in bytes.
- **Throughput:** Throughput is the total number of received packets in terms of total transmitted packets in the network. It is measured in bits per unit Time Interval Length (TIL) or packets per TIL.
- **End-to-End Delay:** End-to-End Delay is defined as the total time from the source end to the destination end taken by the packet. The unit for end to end delay is millisecond (ms).
- **Jitter:** The difference between the expected time of arrival and the actual time of arrival of the packet is termed to as Jitter. It is measured in millisecond (ms).

Table 1. Parameters Required.

Parameters	Values
Simulation Area	5km x 5km
Transmission range	250 m
Simulation Time	200 sec
Number of Vehicular Nodes	200
Routing Protocol	M-DART
Packet Size	512 bits
Average length of vehicle	5 m
Average gap between vehicles	2.5 m

The performance of the proposed scheme is measured through extensive simulations and various simulation parameters considered in the proposed scheme are described in table 1. The simulation area of 5km x 5km and 200 nodes are considered for evaluating the performance of the proposed scheme. The results of the simulation are shown in Figures 3 to 6.

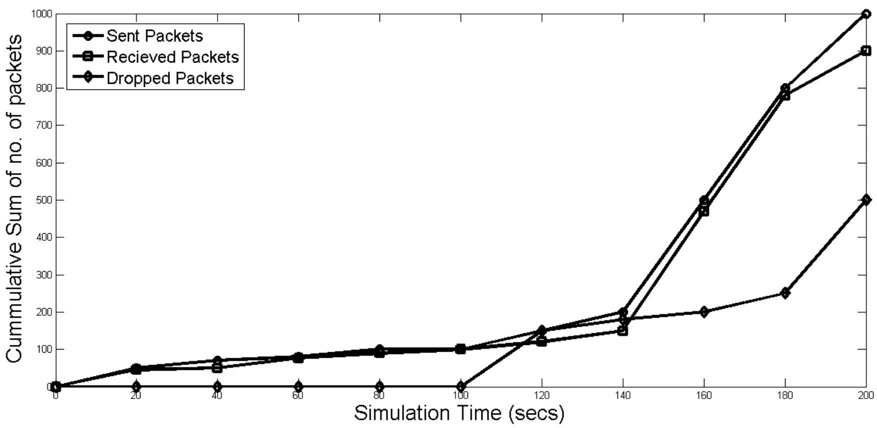

Fig. 3. Cumulative sum of Sent, Received and Dropped Packets for 200 nodes.

Figure 3 describes the variation in the cumulative packets being sent, dropped and received by the vehicular nodes in the network with respect to the simulation time. The graph shows that the cumulative packet value increases with simulation time. This is due to the fact that the use of DHT in the proposed scheme results in more number of packets being consumed as the simulation time increases.

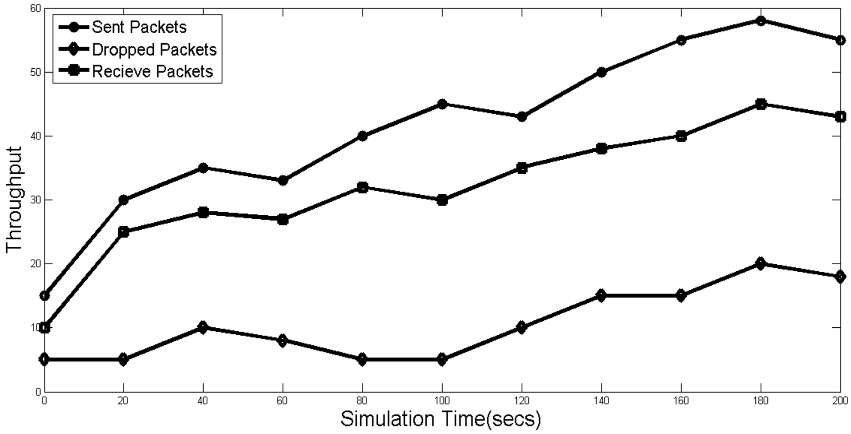

Fig. 4. Throughput of Sent, Received and Dropped Packets for 200 nodes.

Figure 4 describes the variation in the throughput of sent, dropped and received packets by all the nodes with respect to simulation time. The graph shows that the throughput of the dropped packets remains constant with increase in the simulation time. The proposed scheme has better performance due to the throughput being relatively higher for both transmitted and received packets. However, the throughput for dropped packets is low that again indicates superior performance.

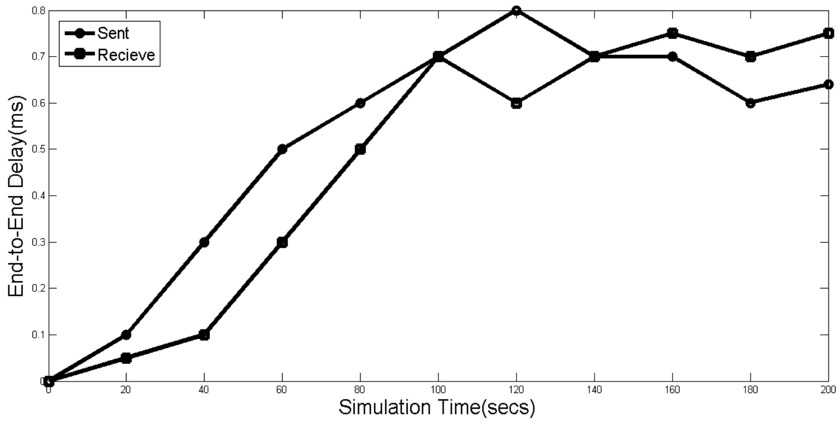

Fig. 5. End-to-End delay of Sent and Received Packets for 200 nodes.

Figure 5 describes end to end delay versus simulation time variation. The graph shows that end to end delay remains constant after certain point with increase in the simulation time because of the multi-path approach of M-DART protocol. This availability of multi-paths helps in better scheduling of packets.

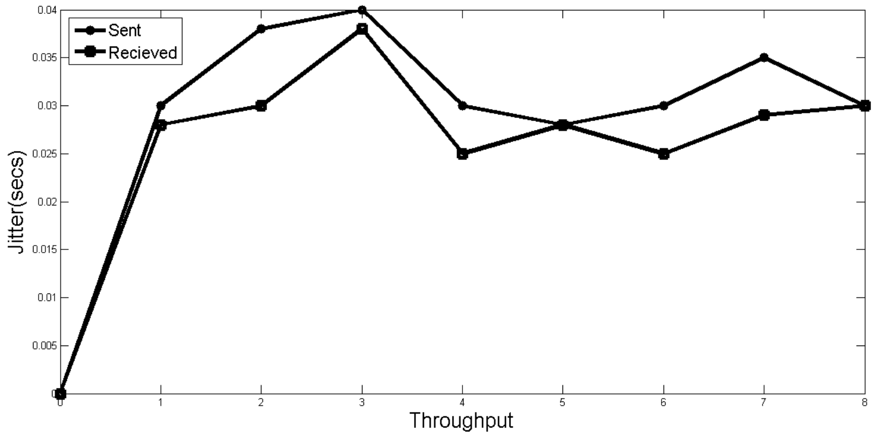

Fig. 6. Jitter of Sending and Receiving Packets for 200 nodes.

Figure 6 describes jitter versus throughput variation. The graph shows that jitter delay remains constant after certain point with increase in the simulation time due to the inherent properties of M-DART.

5. Conclusion

In this paper, distributed hash based scheme for data sharing in VANET's has been proposed. The main goal of proposed scheme is file sharing among all the vehicles in the network. This scheme helps us in overcoming the delay due to the use of request response based broadcast method which increases the performance. For this purpose M-DART protocol which is hierarchical, multi-path, proactive and DHT based routing protocol has been used. By decreasing message and memory overhead with the help of this scheme better scalability is achieved. The graphical analysis evaluates the performance of the proposed work.

In future work, one can enhance the capabilities of the proposed scheme by handling different types of packets such as multimedia. Also one can add security feature in this scheme where files can be shared in a secure way. Work can be carried out to decrease the download time by introducing cloud based infrastructure.

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