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Data Dissemination in Software Defined Vehicular Ad hoc Network: A Review

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Abstract - *To integrate new technologies into the vehicles many automotive manufacturers are taking interest in VANET, which is a form of MANET, in order to provide safety applications, traffic monitoring and entertainment applications. But due to inflexibility in the deployment of protocol the real world application of vehicular communications are obstructed. To overcome the limitations in vehicular networks, Software Defined Networking (SDN) is giving assurance to bridge the cleft through programmability. It mainly concentrates on the centralized control of vehicle to vehicle communication. The foundation for building SDN is the Open-Flow protocol. In this paper, we have described SDN architecture and have given flow management in case of vehicular communication network. As the applications uses variety of data received from server, road side units and other vehicles, the latency problem arises. Data must be transmitted with minimum delay for efficient vehicular network communication. We survey on data dissemination techniques and scheduling concept which will help to improve the system.*

Key Words: VANET, SDN, V2V, Data Dissemination, Open-Flow.

1. INTRODUCTION

In the recent years VANET have achieved a lot of interest in vehicle communication. It offers communication between vehicle to vehicle (V2V) and vehicle to infrastructure (I2V). VANET with the decentralized network is providing variety of services like accidental prevention and entertainment services for the drivers and passengers.

U.S. Department of Transportation (DOT) elaborated with eight large automotive manufacturers listed as TOYOTO, Mercedes-Benz, Ford, Hyundai-Kia motors, General motors, Honda, Volkswagen-Audi, Nissan. Wireless protocol like Wi-Fi called Dedicated Short Range Communication (DSRC) enables V2V communication work. When DSRC is attached with GPS technology, the result is low cost V2V communication system. Common messages that are transmitted to all vehicles contain each vehicle's existing position, speed, acceleration, Heading. Along with this vehicle control information like transmission state, brake status, angle of steering wheel, also vehicles path history and path prediction is added.

In general there are 3types of applications provided by VANET include safety, traffic management and infotainment. Some important safety applications are listed here.

Emergency Electronic Brake Lights (EEBL) will notify a driver that hard braking vehicle is on the road ahead. Blind Spot Warning Safety (BSW) application provides warning of vehicles at blind position of driver. Lane Change Warning (LCW) is one of the important application that help driver with the intention to change lane will get warning that lane change should not be attempted if there is a faster moving vehicle coming on the same lane. Forward Collision Warning (FCW) application provide warning of standing or slow speed vehicle ahead if you are coming quickly on the way. Similarly Do Not Pass Warning (DNPW), Intersection Movement Assist and Turn Assist Applications are helpful.

Infotainment application present entertainment and useful data indicating closest shops, mall, fuel station, theaters with best prize in that area and available parking slots. Moving ahead with this progress there are many challenges in VANET like frequent link disconnections, heterogeneity of applications, data dissemination, mobility etc.

Challenges in the installation of VANET applications like flow traffic in multi-path topology and feeble use of network. To meet these challenges, Software Defined Networking (SDN) is the option.

SDN is the ability to program network performance in open way using languages, systems, computers that are ordinary. Networking is being change into software discipline. Even in the major implication networking is becoming the part of computing. SDN is being circulated to different networking system. To enhance the performance and for better traffic management SDN can be applied on the fog devices. SDN is the rising prototype that makes deportment of vehicular switches programmable and allowed to be controlled by central element known as controller. Resulting in advance customizability of network

control and forwarding manners. This concept is similar to mobile phone operating systems, such as Apple's i OS and Google's android in which 'apps' can be installed to the system.

2. SDN ARCHITECTURE

SDN is the leading technology to manage the vast networks. The basic idea behind SDN is the separation of the network control plane from the data plane. The standard used for the implementation of SDN is the Open-flow (Open Networking Foundation).

There are three layers in the architecture namely Data plane, Control plane and application layer. In data plane RSU and vehicles are considered as vehicular switches. In control plane there is a controller which is nothing but server connecting switches and network applications. Controller can control the packet forwarding manner of switches by inserting and deleting flow entries. Vehicular switches ceaselessly update state (location and velocity) to the controller thus it is said that controller has a global view of whole network.

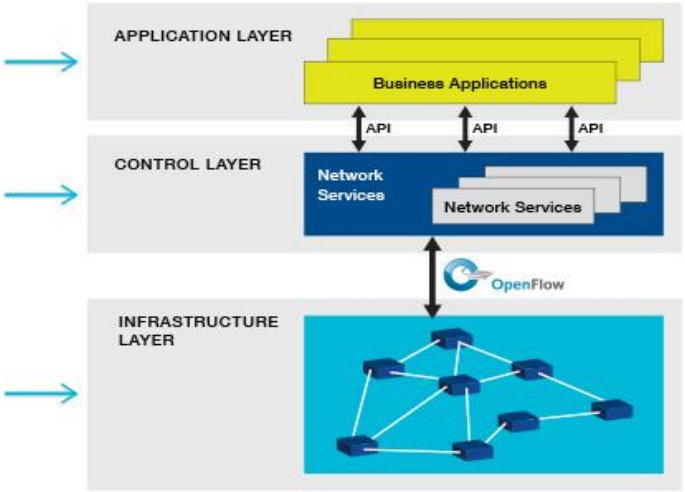

Fig -1: SDN architecture

Flow tables are located in every Open-flow enabled switch, which contain list of flow entries related to instruction, match field, count and related actions.

When packets arrive at the switch, it will look into the flow table entries. If there is no rule entered in table, the path request will be sent to the controller. In the acknowledgment

There will be installation of rule into the switch and accordingly packets will be forwarded to the destination. If flow entry match then packets will be forwarded according to action associated.

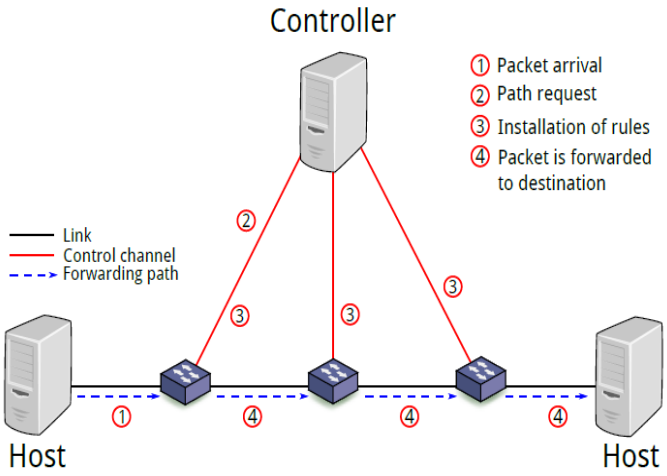

Fig-2: Flow management

Integrating SDN with VANET gives programmable and flexible network architecture and network management is simplified.

3. DATA DESSIMINATION

Characteristics of VANET such as very high mobility, infinite extension, intermittent connectivity through the sparse infrastructure challenges the information exchange and data scheduling. Routing is the keystone of any data dissemination scheme in vehicular network. Effective data dissemination process is used to solve many problems. Parameters to be considered during data dissemination are size of network, intermittent connectivity, speed of vehicle. Another problem which can affect the entire the process is latency requirement. So, the content information must be discovered immediately and share between nodes.

For data dissemination, data broadcast is an attractive solution. Two major data broadcast tendencies are push based and pull based.

In push based broadcasting to retrieve data items of interest without sending any request, all vehicles listen inactively to the broadcast channel. Push communication has objective of information exchange which may include data like speed, position and direction of vehicles to access traffic conditions. Pull based broadcast is called as on-demand broadcast. As a reply RSU disseminate data items to express clearly the requests submitted by vehicles. It is more scalable as compared to push based.

Methods for data dissemination are as follow.

3.1 Opportunistic Data Dissemination

Opportunistic communication is proposed to overcome the limitation inflicted by lack of connectivity.

When target vehicle come in contact with other vehicles or RSU, information is pulled or retrieved from them.

3.2 Vehicle Assisted Data Dissemination

Vehicles carry information and delivers either to the RSU or to other vehicles when it comes across them. In order to spread data, this process involves mobility in supplementary to wireless transmission.

3.3 Cooperative Data Dissemination

Some part of data can be downloaded by the vehicles and subsequently shared to obtain whole data. This method is relevant for content dissemination.

As vehicles moves at high speed they resides in the region of RSU only for a while. Therefore scheduling of data is essential to service as much request as possible and to reduce downloading delay. Using some performance metrics like gain of scalability, service ratio, service delay, success transfer rate etc. any scheduling algorithm can be verified. Some scheduling algorithms noticed are Most Requested First (MRF), First Come First Serve (FCFS), Cooperative Data Dissemination (CDD), Earliest Deadline First (EDF), Multi-item Motion Prediction Scheduling (MMPS), etc. In MRF most pending request data items are scheduled first. FCFS avoids data popularity and CDD marks the popularity of data item even though it is ranked behind.

4. RELATED WORK

Author in[1] have presented data dissemination system via hybrid I2V and V2V communication and an online scheduling algorithm Cooperative Data Dissemination is proposed. In heavy traffic scenario CDD outperforms as it uses benefit of V2V communication. Simulation result shows that more requests are served by CDD than MRF and FCFS algorithm in every scenario.

Rakesh and Mayank [9] give descriptive study of various challenges, characteristics and applications of VANET. Comparison of different protocols based on many parameters has been given in the paper which helps in research.

Kai Liu and Victor C.S. Lee [13] concluded that Data Dissemination must be adaptable to the changing traffic pattern. To catch the dynamic traffic characteristics it examines vehicle dwell time and data access pattern as two representative factors. It showed that push based and on-demand services gives better performance for longer dwell time (vehicle time spend in coverage area).

Yiqing Gui [11] proposed Multi-item Motion Prediction Scheduling scheme (MMPS). This is a cooperative scheduling scheme which transfers the requests to the nearby RSU using prediction of vehicle motion. Performance metrics like service ratio and success transfer rate are used to compare the results of MMPS with classical algorithms like MRF and EDF which outperforms in a various situations.

Author in [4] proposed a token based admission control policy to reserve a lane. It focused on identification of most rewarding requests and granting most suitable tokens to them.

5. CONCLUSION

This paper presents survey on VANET, software defined networking and data scheduling. We have put SDN architecture along with flow management in case of vehicular network. In addition data dissemination techniques and scheduling concept is sorted. Section IV describes related work by several researchers and academicians. We conclude that though there are many works there are still thought provoking issues. This review will contribute to the further work.

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