TRAFFIC CONGESTION CONTROL USING VEHICULAR FOG COMPUTING

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Abstract : In recent years, vehicles have increased but our roads are still underdeveloped and sometimes fail to handle the number of vehicles. Therefore, traffic has become one of the major problems in recent times. In this paper, we propose an Internet of Things (IOT) based intelligent traffic system that merges the idea of fog computing to Vehicular Ad Hoc Networks (VANET). This enables us to help extensive vehicles accomplish a smoother communication and tackle the restrictions in vehicular systems in terms of network latency, traffic awareness, and real time response (normally required in rush hour traffic control.)[1]

***IndexTerms* - Fog, Fog computing, Internet of Thing, VANET.**

I. Introduction

In the world of emerging innovation, Cisco delivered the concept of fog computing. The devices which are connected to Internet of Things can run directly on the network edge consequently making it ideal for the IOT applications that require real time interactions. Fog Computing distributes the various core functions such as communication, computing, storage, control, security, and decision making, all the while ensuring that they are all closer to the data origin. Any devices with storage communication and network connectivity can be referred to as "Fog Nodes" and can be deployed anywhere within a network connection. Fog computing, also referred to as edge computing, serves as an intermediary between cloud data centers and IOT devices [2].

Integration of fog computing With Vehicular Ad Hoc Network (VANET) is just one of the many applications of Fog Computing. VANET is an upcoming part of the transportation system. It works by using a short range communication based on IEEE standards ranging from 802.11a -802.11p. The IEEE then regulates the family referred to as WAVE. These protocols are used for sharing information about traffic jams, accidents, route selection for traffic congestion, and safety information between vehicle to vehicle, and vehicle to infrastructure.[4] When mobile nodes (Vehicles) and roadside units (infrastructure) are combined with WAVE communication devices, they form a highly dynamic VANET.

VANET has two modes of operation: Vehicle to Vehicle, and Vehicle to Infrastructure.[5] Vehicle to vehicle communication is further divided into two types: single hop communication and multi hop communication. VANET uses Road Side Units (RSU), On Board Unit (OBU), and Application Units (AU) to provide congestion and safety information to vehicles. OBU uses the services provided by the RSU and is attached on nodes (vehicle). RSU provides the services and is also known as a service provider. AU, using the application provided by RSU with the help of OBU, is also mounted on the nodes (vehicle) that [4]. RSU uses the IEEE 802.11p protocol for short range of communication. It is generally located on the road side or at any dedicated path such as parking. OBU is responsible for message transfer, data security, ad hoc position and congestion information. AU is a dedicated device for safety application.

In Vehicular fog computing, by attaching sensors, the vehicles are made intelligent and have the capability to gather traffic information from external environment and from the intra vehicle sensors. The traffic data can be processed and stored in real time by deploying Fog nodes at the edge of vehicular networks. Vehicular fog computing helps us accomplish better communication and address the people about the traffic congestion.

This paper recounts our experiences addressing the problem of traffic congestion and user mobility right from the network edge up to the distributed cloud data center. We have proposed a method integrating the concepts of fog computing and VANET that is validated using the network simulator NS3.

II. RELATED WORK

A lot of research has been done in VANET in recent times due to its applications in the fields of traffic congestion and broadcasting route planning. Previously cloud computing for services like computing, communication, control, security, storage, and decision making were used by the VANET's. With the increase in the traffic, the demand for powerful communication with less delay and high security increased. As a result cloud was not able to satisfy low latency because of the distance between client and data centres. Thus to satisfy these demands and to provide an efficient method for the vehicles to communicate with each other we used the concept of vehicular fog computing. Fog computing provides low latency as fog is geographically close to users and provide instant responses. Fog Computing offers excellent Security since the data is processed by a large number of nodes. As cloud was not able to fulfil the demands of the increased traffic we have proposed a vehicular fog computing architecture in our paper.

III. SDN ARCHITECTURE

The SDN Architecture comprises of the control and data plane. The data plane contains the traffic forwarding information and the control plane controls the flow of communication. The control plane has 3 layers.

1) Data plane:- It contains the data processing devices such as RSU. Open flow is the defined standard protocol for communication between the SDN controller and devices such as RSU. Open flow protocol is divided into 4 fields.

- Priority field: it is used to define the order in which the data is coordinated.
- Matching field: this field matches the condition according to source and destination IP.
- Action field: this field defines the action that should be taken when data packet is received.
- Counter: it is used to count the number of data packets received.

2) Control Plane:- in SDN, the SDN controller manages all the resources of the system. A network controller is referred to as the brain of the network because it performs functions like installing updates and deletes the rules. When connected directly to the network controller, each vehicle in SDN based VANET have policies for to communicate with data. Thus in case of a congestion the RSU or another device that is directly connected to the SDN controller informs the vehicles.

Network Compiler:- network programs designed by the SDN based programming language are used to control the functionality of the controller. It also allows the code to be reused.

IV. SDN BASED VANET ARCHITECTURE:

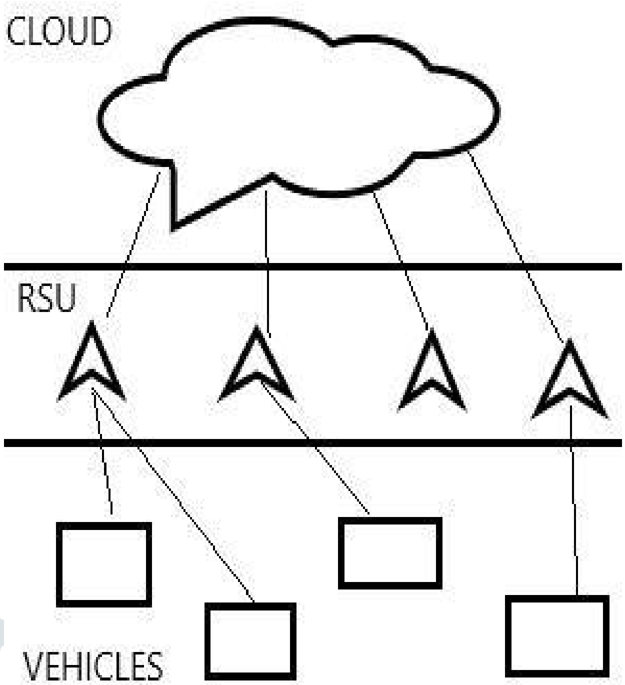
This section describes the software defined network architecture utilizing Fog Computing. Under the supervision of a Remote Controller, Software Defined VANET Architecture depends on handling the load between various elements of the network. Our contributions are as follows:

- We propose a method to know about the traffic congestions with the flexibility to choose to correct lane and route.
- Implementation and test of the proposed architecture on network simulator NS3.

The modules of SDN based VANET are SDN Controller, SDN wireless node, and SDN Road Side Unit.

- SDN Controller: It controls the network behaviour of the system as well as manages resources for the fog. It is usually connected to the RSU.
- SDN wireless node: Nodes in SDN based VANET architecture are referred as vehicles. They are mounted with OBU, AU and Operating over flow. Using the OBU device, the AU can be used as a digital assistant and communicates through the network. SDN nodes take care of all types of communication.
- SDN Road Side Unit: It is a fog device controlled by the SDN controller. The RSU device is connected through the network to provide communication between vehicles and the controller. OBU uses the services provided by the RSU to host an application. AU's in multiple vehicles can connect to the internet using RSU.
- SDN operations:- SDN system can operate in three different modes that is central control mode distributed control mode and hybrid control mod. Our architecture should be operated in the hybrid control mode due to Fog Computing. In this mode SDN based controller has full control; over the entire network the SDN controller sends out the instructions that contain the rules for the functionality of the network thus devices like RSU and SDN use their own intelligence to forward the packets. The base controller communicates with the RSU and flow rules are exchanged through the control plane.[6] The second communication happens between vehicles and RSU. Data messages are exchanged when the vehicles are connected to the Road Side Controller (RSU). The last communication occurs between the vehicles themselves. Vehicles near each other can communicate and exchange data packets all the data communicated is managed by base controller.

Figure:- Network Architecture



V. CONCLUSION AND RESULTS

This paper proposes a method to monitor the traffic congestions with the flexibility to choose to correct lane and route. We combined the concept of fog computing and vehicular ad hoc network to help vehicles achieve better communications and are aware about the traffic congestions. The proposed method is validated using the network simulator NS3.

VI. REFERENCES

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