Cluster Based Routing Algorithms for Vehicular Adhoc Networks

Vehicular Adhoc Networks

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Abstract— **Vehicular adhoc network is very important in Intelligent Transport System. Vehicular Communication plays a major in Vehicular Network. Two types of communication is possible vehicle to vehicle and vehicle to infrastructure. We need to consider two scenarios in vehicular communication. Sending the packet to nearest vehicle and sending the packet to distant one. Routing plays a major role in Vehicular adhoc network. Two types of routing algorithms are present to route packets. One type of routing algorithms, static routing algorithms compute the path in advance. Another type of routing algorithms dynamic routing algorithms, dynamic routing algorithms compute the path based on current traffic and load. Dynamic routing algorithms are more suitable for vehicular adhoc networks rather than static routing algorithms.In vehicular adhoc networks topology changes dynamically. Coming to dynamic routing algorithms distance vector routing ,link state routing,broadcasting,multicasting are more popular. Routing algorithms for vehicular adhoc networks are more suitable than dynamic routing algorithms,Adhoc on-demand routing and Destination sequence distance vector routing. And Mobile Ip For Mobile adhoc network.In this paper want to discuss about suitable routing algorithms for vehicular adhoc networks and their map-reduce paradigms..**

Keywords—vehicular adhoc network, routing algorithms,IEEE802.11p,Intelligent Transport Systems;

I. Introduction

A latest advances in area of vehicular communication is V2V(Vehicle to Vehicle) and V2I(Vehicle to Infrastructure) .Within the vehicles the devices may provide wireless connection to various information and communication technology components and connect with sensors and other systems within the engine management system. There is growing consumer demand for wireless communication technologies in transportation applications from point to point to multiplexed communications. I have studied some of the communication technologies which support vehicular communications. Among them zigbee is the suitable communication for the vehicular communication. Dedicated short range communication(DSRC) which is a candidate for use in a VANET, is a short to medium range communication service that support both public safety and private communication. The communication environment of DSRC is both Vehicle-to-Vehicle and Vehicle to/From road side. The VANET aims to provide a high data rate and at the same time minimize latency within a relatively small communication Zone. Devices in a vehicular communication system connected to internet .Inter Vehicle Communication rely on direct communication between vehicles to satisfy the communication needs of large class of applications like Collision avoidance ,passing assistance and platooning.The gap between simulation and reality strongly shows the need for field trail. Main objective is to solve the problem of data transmission between two vehicles .IVC System are completely infrastructure free only onboard units some time also called in-vehicle equipment(IVE)are needed. A central processing unit (CPU) that implements the applications and communication protocols. A wireless transceiver that transits and receives data to/from the neighboring vehicles and synchronization infrastructure. Approximately sensors to measure the various parameters that allows human infrastructure with the system[6],[9],[10].

Onboard systems signals are transferred inside the car through different networks and domain. Read out sensor information from in-vehicle networks or displaying and reacting to warning messages from external sources. Wireless sensor networks deployed along hazardous roads can collect and process local environment information they share with vehicles passing by.Road side units that can be used to monitor vehicular activities along roads such as speed of cars accidents and more. Car and other vehicles can have communication capabilities with other fixed wireless access points and internet gateways along the road side which can alert them to provide useful and practical internet access.IVC is an important emerging field of research that takes advantage of the latest advances in micro processing and electronic circuitry that are installed inside moving vehicles as well as the increase in wireless communication capabilities of such devices with their environment .Vehicular networks have two distinct classes fo applications, which are driver assistance and vehicle safety, and onboard entertainment applications. These classes require different QOS characteristics, due to different communication patterns. Applications for vehicle safety and driver assistance are intended for vehicles that exchange messages among themselves., in order to identify dangerous situations or events that may occur in the vicinity. When a safety alert is received ,the vehicles warns the driver through sound or light indications, giving him/her enough time to react and avoid an accident. Examples of alerts are sudden breaking, skidding vehicles and vehicles in collision course. Other situations may arise as well ,for example the creation of convoys , where the leader vehicle defines the route taken by several cars, behind him. Vehicle to Vehicle communication is employed in this case ,to provide inputs for intelligent driving algorithms in order to maintain the distance ,speed and trajectory according to those defined by the leader. Those applications are characterized by small messages ,intended for vehicles which are close to the sender and must be received as soon as possible to avoid an accident. Thus ,those communications will occur among vehicles ,through a transport protocol based on datagrams.,such as UDP.such applications do not require large bandwidth instead depending on low latency and loss rates. such applications do not require large bandwidth instead depending on low latency ,jitter and loss rates. The second class of application involves on-board entertainment ,Providing weather forecast ,internet access ,television and radio engineering among other features. These applications require a connection with a metropolitan area network, through 3G/4G or by relaying messages using the access points installed at the edge Which are called Roadside Units(RSUs).Since such communication are more time consuming and typically involve larger amounts of data than driver safety and driver assistance applications, they tend to employ connection based protocols ,Such as TCP.In these applications ,the throughput and jitter are key QOS metrics. Entertainment applications can be implemented at low cost with widespread telecommunication technologies ,such as 3g and 4g networks ,or by using existing personal devices such as cell phones and tablets .Mean While,the innovative applications on VANETs are the applications related to driver assistance and safety. Those applications shouldn't rely on 3G/4G networks, since they should operate even in situations where there is little to no network coverage due to lack of pre-existent communication in infrastructure .Further in order to reduce end-to-end delay ,those messages should be exchanged from vehicle to vehicle ,without requiring to pass through fixed infrastructure. Thus,new communication standards intended for VANETs were developed[6],[7],[8].

II.IEEEE 802.11 P standard

Several initiative have been developed in order to standardize and optimize the communication between vehicles.In,1999 the FCC allocated 75 MHz in the 5.9 GHz band for DSRC in VANETs.In 2010 ,the 802.11 group finished the 802.11p standardizes the physical layer as well as medium access control protocols. Meanwhile the WAVE Standards define the message formats the allocation of channels for each kind of application ,as well as management and security aspects[1],[10].

The main identifications in 802.11p ,when compared with the traditional 802.11.In the MAC layer ,the overhead to establish a communication was reduced, due to the reduced time of contact between vehicles. In traditional 802.11 devices connected through an access point define a group called IBSS(independent basic service set),which must be identified when a connection is established .On the other hand 802.11p defines a new type of BSS called WBSS(WAVE BSS),which has a fixed identifier and transmits beacons on demand. A beacon contains the essential information to establish a communication ,as well as the list of services offered by the group, eliminating the authentication process. Finally , in order to eliminate the need of scanning the channels in order to find the desired network ,the functions of each channel are fixed. The spectrum band reserved for 802.11p is divided into seven 10 MHz channels, numbered between 172 and 184.Channel 178 is intended for control information ,and is restricted to security applications. The other channels are allocated for data transmission from different services. There are two channels dedicated to critical applications such as life safety and public safety. The physical layer is based on the 802.11 a standard and uses OFDM(Orthogonal frequency division multiplexing) modulation. The bandwidth was changed form 20 MHz to 10 MHz in order to reduce the spreading delay in VANETs .Optionally the bandwidth can be set at 5 MHz Also ,performance improvements reduce the amount of losses caused by the interference between adjacent channels. The standard provides communication at theoretical distances of up to 1000 m both in V2V and V2I modes, with absolute and relative speeds up to 30 m/s (108km/h) in several environment (rural,highway,urban)/.With 10 MHz Bandwidth channels ,the expected bitrate is between 3 and 27 Mbps ,Whereas with 5 MHz or 20 MHz bandwidth channels the maximum bitrate is 13.5 Mbps and 54 Mbps ,respectively[10]

Communications are more time consuming and typically involve IEEE 802.11p standard known as Wireless Access in Vehicular Environment(WAVE) is specially developed to adapt VANETs requirement and support intelligent transport systems(ITS) .The performance of WAVE physical layer is one of the important factors that play a great role in the communication process. This paper presented an overview of the physical layer (PHY) of the IEEE 802.11P standard. IEEE 802.11p is one of the recent approve amendments to the IEEE 802.11 standard to add wireless access in Vehicular environments (WAVE).It appended some enhancements to the latest version of 802.11 that required to support application of intelligent transportation systems(ITS).This includes data exchange between high speed vehicles and between the vehicles and the roadside infrastructure in the licensed ITS band. IEEE 802.11 pn radio frequency LAN system is initially aimed for the 5.15-5.25,5.25-5.35 GHz &5.725-5.825 GHz unlicensed national information infrastructure (U-NII) band. The support of sending data at „12 and 24 Mbit/s are mandatory while 9,18,36,48,54 Mbit/s are optional data rates. The system uses 52 subcarriers which are modulated using binary or quadrature phase shift keying (BPSK/QPSK),16 quadratic amplitude modulation (16-QAM) or 64-QAM.Forward error correction(FEC) coding is used with a coding rate of 1/2,2/3 or 3/4 .IEEE 1609 is a higher layer standard based on the IEEE 802.11P to support network security issues in the WAVE standard. Use of TDMA MAC layer for solving the real time communication constraints problem. Simulated the carrier sense multiple access(CSMA) as a MAC method of the upcoming vehicular communication standard IEEE 802.11p in a highway scenario with periodic broadcast of time-critical packets in a vehicle to vehicle situation. Their simulation results show that a vehicle is forced to drop over 80% of its message because no channel access was possible before the next message was generated. A self-organizing time division multiple access(STDMA) for real-time data traffic between vehicles is approached to overcome this problem. However ,the PHY analysis has not been thoroughly investigated. A PHY simulator based on NS-3 has been developed. We noted that majority of researchers have been concentrated in the MAC, routing, security of IEEE802.11P .Beside that IEEE 802.11P is quite new standard and still under research and its PHY layer has not been thoroughly investigated,ns2,ns3 are simulation tools for VANET[2],[7],[9].

Most of the Previous research on routing in VANETs is limited to vehicles within few hops away ,such as communicating with nearby vehicles to estimate upcoming traffic or to avoid collisions. However ,in some applications (emergency recovery after infrastructure failure) it is important for a vehicles to be able to send data to a far away destination ,thus necessitating a multi-hop routing protocol.

VANETs operate in a very different environment than most computing systems. Vehicles move in a patterned way. This makes the routing paths predictable .However, the high velocity at which vehicles move reduces the amount of time available for message exchange and causes fast and frequent topological changes and further instability in the wireless channel. Consequently ,some of the challenges fro VANETs are to deal with available for message exchange and causes fast and frequent topological changes and further instability in wireless channel. Consequently ,Some of the challenges that face researchers working on routing protocols for VANETs are to deal with available bandwidth estimation ,medium access control, hidden and exposed nodes problem, high mobility , obstacles ,support of heterogeneous vehicles, and fast handover .Traffic density often measured in the number of vehicles per unit distance, has a large influence on the capacity of roads and on the velocities of vehicles[14],[15].

A large number of unicast routing protocols have been developed for MANETs. However ,these protocols cannot be efficiently used in VANETs because of their unique characteristics .Several researchers have developed unicast routing protocols targeted for VANETs .A significant number of these protocols use a position-based .greedy approach to provide vehicle to vehicle communication..Position based approaches use information about the geographic co-ordinates or relative position of nodes to generate an efficient route through the network. Another set of protocols which aim to route packets in sparse VANETs are called delay-tolerant-networks or DTNs.In such cases ,establishing end-to-end routes may not be possible. Hence carry-forward approaches are used. Finally ,some quality-of-service (Qos) routing protocols focused on providing a robust route among vehicles. The main purpose of this set of protocols is to find routes that last for the longest possible time[6].

Each of the above mentioned routing protocols added some unique contributions to the advancement of this area of research. However ,,each set of protocols-based protocols assume dense conditions in which an intermediate vehicle in the routing path to forward the packet to. On the other hand ,delay tolerant algorithms might not perform well in dense conditions. Hence ,an approach is required which combines the advantages of both approaches and can work well in both dense and sparse circumstances.Vanets have distinctive characteristics and communication requirements. Short Contact time, connectivity disruption, packet losses, frequent topology changes ,high channel load in dense environments, are examples of the characteristics that make VANETs a very challenging communication environment, but also full of potential for interesting new applications. The ISO 21217:2014 Standard describes the ITS station reference architecture ,which consists of six parts(Applications,Management,Facilities,Networking & Transport ,Access and Security)[6].

Nowadays it is common for vehicles to be equipped with great communication capabilities, materialized in multiple and various wired and wireless interface. Wired communication technologies such as CAN,LIN and Flex Ray tend to coexist well in vehicle environments, although the tendency is manufacturers to start implementing Ethernet solutions, due to their benefits in terms of complexity ,cost or even cabling weight. Although IEEE 802.11P is the most popular solution for wireless vehicle communications, when applications require long range communications or have high bandwidth demands ,it may be necessary to resort to solutions like cellular networks or WiMax.Other technologies like ZigBee ,Bluetooth or LiFi are considered for every specific problems such as connecting the vehicles to the driver's smart-phone ,or taking advantage of the existing traffic lights infrastructures to disseminate traffic information.

III.Routing in Vanets

Adhoc network means spontaneously form a network to exchange information to accomplish a task. Vehicular adhoc network means form a vehicular adhoc network to exchange information. In vehicular adhoc network routing is very difficult issue. Because if we see the characteristics of vanet links change dynamically. Because need to communicate with moving vehicles. For that each vehicle contains one onboard unit, which is a combination of software and hardware. These onboard units need to communicate with Road Side Units ,Which are fixed and these are also combination of hardware and software. Each Road Side Unit need to maintain each and every vehicle no, time of crossing, location of vehicle, speed. So these vehicles/On board units need to communicate with each other or communicate to Road side Units. For that we need better routing algorithms. Coming to routing algorithms these are two types. static routing algorithms and dynamic routing algorithms. Static routing algorithms are shortest path routing and flooding. Route can be computed in advance. When compared to dynamic routing algorithms distance vector routing algorithms , link state routing algorithm, multicast routing, broad cast routing .these dynamic routing algorithms computes route based on current load. When coming to vehicular adhoc network adhoc on demand distance vector routing is the best routing algorithm. Because vehicular adhoc network is a huge network it is very difficult to maintain each and every node information within a router/Road Side Unit.Using Moble IP also we can easily send packet to the mobile node without changing IP[6],[11].

IV.Problem Statement

Assume in vehicular adhoc networks nodes/Rsus distributed among commodity hardware cluster nodes in the form of a Distributed graph. This graph can be divided into number of sub graphs. An edge represents a path from node to another. Convert this graph to Adjacency list. Finding shortest path is very difficult using classical routing algorithms.Classifcal routing algorithms shortest path routing, flooding, distance vector routing, link state routing, multicasting, broadcasting ,hierarchical routing and adhoc on demand distance vector routing. So routing algorithms based on map-reduce gives better solution for a huge real-time vehicular adhoc network. For that adjacency list of distributed graph(Vanet) loaded into HDFS.And application ,routing algorithm based on map-reduce can run on hadoop cluster which gives better paths for fast exchange of information. While implementing these routing algorithms need to consider some of the factors like vehicle speed, Range of transmission, Security etc.

A vehicle can transmit false warnings or messages in order to masquerade as an emergency vehicle to cause other vehicles to slow down and yield. In addition messages transmitted from vehicles using IVC systems can be used to track down a vehicles location and transactions which can lead to information about the driver and passengers.Inorder to protect IVC Systems from such possible attacks various security requirements should be implemented such as message authentication ,message integrity ,non repudiation ,entity authentication ,access control and privacy preserving.

1).Assume Each RSU as a cluster head.This cluster head has the information about vehicles/RSUs within the cluster.

2).Vehicles/RSUs within the range of any RSU(ie. 1 K.M/few meters) can form a cluster with number of vehicles/few RSUs.Using distance measuring algorithm compute RSU range .And then divide the regions

3)Using distance measuring algorithm compute RSU range and then divide the regions.

4)So now we have overlapping clusters.Entire vehicular adhoc network can be categorized into number of clusters/Overlapping clusters..

5)Now vehicles can enter into these cluster regions and also leave from these regions dynamically.

6)if we want to send a beacon within the cluster then use any map-reduce based algorithm like broadcasting.

Else if destination is out of the cluster then use map-reduce based Adhoc on demand routing algorithm.

Algorithm for sending packets to nearest Vehicle/RSU as well as distant vehicle/RSu using map reduce based broadcasting and AODV.

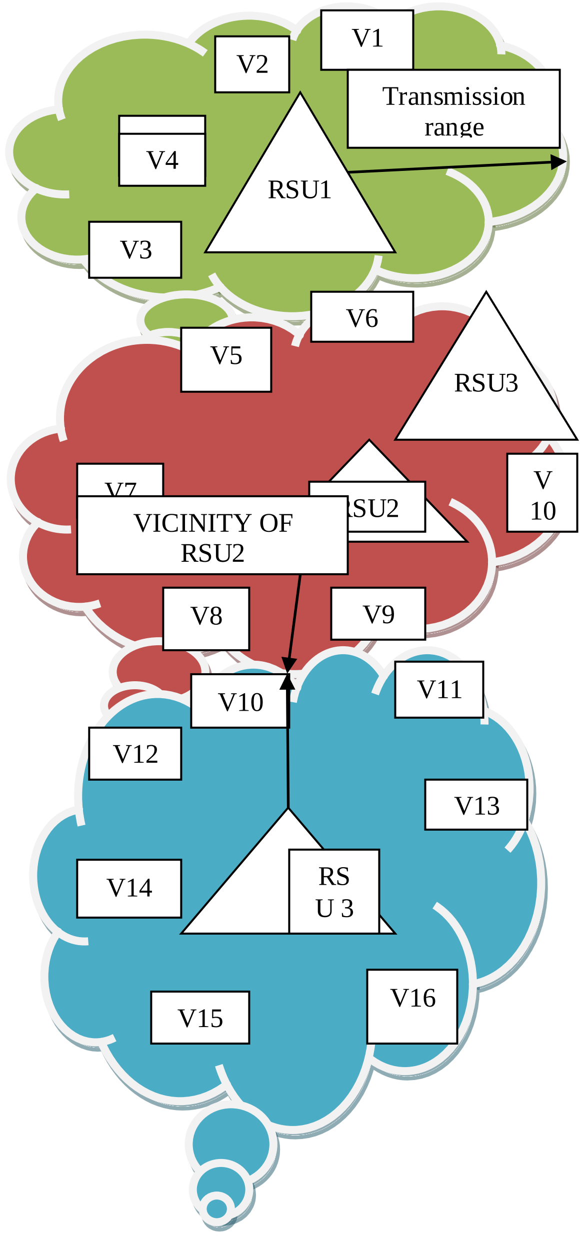

Fig.1 Vehicular adhoc networks with cluster heads

Mobile IP for routing in Vanets

Mobile IP used for sending packet to a distant node which is in out of transmission range of a particular RSU. Each and every vehicle which visits a particular cluster network must register with Home agent which is in RSU/Cluster Head. And corresponding addresses of their visiting networks(COA) maintained at each and every cluster head/RSU.This is done by sendig ICMP messages to the network/asking by RSU head to the internet.

Each cluster head maintains information about each and every vehicle addresses by sending ICMP messages to the internet. So that each and every vehicle transmits/broadcasts their addresses.

Based on these addresses Communication is possible in vanet very easily.

Algorithm 2 for routing in vanet using Mobile IP

Map-Reduce:

Map-reduce consists of two primitives one is map task and another one is reduce task.Hadoop provides HDFS to store data in distributed manner. Coming to performance hadoop works well for finished data set.Hadoop writes data for each and every finished round.For multiple rounds algorithms hadoop not suitable. Only single rounded algorithms hadoop works well.For multiple rounded algorithms Spark is better interms of performance. Spark is written in scala,for applications to write scala is useful when compared to map-reduce,scala requires less code.Multi-rounded algorithms run efficiently on spark.

VI. Future Scope

In Future want to Implement map-reduce based hierarchical routing , Adhoc On-demand Distance Vector Routing(AODV) and above proposed routing algorithms, Mobile IP etc.

VII.Authors Information

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