A Random waypoint mobility model for Controlling Traffic Congestion

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Abstract- *The aim of the paper is to overcome traffic congestion of the real world. This paper provides a system which sends the information to drivers about traffic density near the junctions. The system develops an Intelligent Traffic Lights (ITLs) which monitors traffic density [1] and information thus collected is sent to other junction. Hence congestion is avoided in that particular junction and traffic is diverted towards alternate paths. In this approach the use of VANETs which have recently became one of the most attractive area of research, both in academics and industry has been implemented. High mobility, high speed of vehicles, fast topology changes and predicate vehicle movements are the characteristics that make VANET different from other types of Ad-hoc networks. Development of a warning system about the traffic in a particular area or a junction within a short distance motivated this prototype project plays an important role. This system provides an infrastructure in which vehicles communicate with each ITLs via Ad-hoc routing protocols and they can exchange data using roadside units about traffic density using two popular routing algorithms AODV and OLSR.*

Key Words: VANET, Congestion, AODV, OLSR, Mobility Model, ITL

1.INTRODUCTION

Traffic congestion on the roads today is a large problem in big cities [7]. The congestion and related vehicle accommodation problem is accompanied by a constant threat of accidents as well. Absence of road traffic safety takes a toll of precious human lives and poses a dire threat to our environment as well. Other negative consequences are related to energy waste and environmental pollution, time and cost of fuel.

To overcome the problem of traffic congestion in the real world, the proposed system uses an advanced technology Vehicular ad-hoc networks (VANETs) are networks in which each node is a vehicle. Such systems aim to provide communications between individual vehicles and between vehicles and nearby fixed roadside units called ITLs. Vehicle accident prevention, safer roads, pollution and congestion reduction are some of the main goals of VANETs. The efficient traffic alerts will improve road safety by providing timely information to drivers and concerned authorities. This will also reduces the trip time and fuel consumption thus decreases the amount of CO_2 emission.Therefore VANETs has recently become one of the most attractive area of research because of its high mobility , high speed vehicle and fast topology which changes and predicate vehicle movements with very high speed.

In this work, a highway has been considered where ITLs are set in two junctions which are responsible for gathering the traffic information from the vehicle which crosses the signal lights and also warning messages to avoid collision. These ITLs will inform the drivers about the signal statistics within a short distance with less communication delay which avoids collisions to prevent accidents.

In the proposed system, the VANET scenario has been developed using QualNet simulator and the exchange of data about the traffic density has been carried out by using two popular routing algorithms AODV and OLSR which compares the results by considering the parameters like throughput, average end-to-end delay and average jitter.

2.RELATED WORK

Barba el.al in [1] provides us with a system that uses ITLs that collect traffic statistics from nearby vehicles and issue warning messages that contain information about traffic density and weather condition. This information is used by the on-board driver assistance device to advise the driver to make timely decisions regarding optimal routes to avoid accidents and heavy traffic congestions. The minimum distance between the ITLs to the vehicle is calculated to be 130m in this work.

Charles E Perkin et.al in [2] mainly concentrated on two popular on-demand routing protocols like ADOV (Ad-Hoc On Demand Vector Protocol) protocol against DSR (Dynamic Source Routing Protocol) protocols which is used for routing the information from source node to destination node.

N.Maslekar, M.Boussedjra, J.Mouzna et.al in [4] provides an information about the urban scenarios traffic signal controls are the main mechanism to control vehicular flow at the intersections. However, traditional systems fail to adjust the timing pattern in accordance to the time variability. An alternative to such systems is to develop dynamic systems which will alter the timing patterns according to the traffic demand.

G. Ferrari and S. Busanelli et.al in [5] provides an overview of an innovative approach for effective cross-network information dissemination, with applications to Vehicular Ad-hoc Networks (VANETs). In particular, this work describes the main approach followed by an on-going bilateral Italy-Israel project ("Cross-Network Effective Traffic Alert Dissemination," X-NETAD). The X-NETAD project leverages on the spontaneous formation of WiFi local VANETs, with direct connections between neighboring vehicles, in order to disseminate, very quickly and inexpensively, traffic alerts received from the UMTS (Urban Multi hop Traffic Signal) network. In this system, the driver must have smart phone which is very expensive and also the phone should within the coverage area to maintain data integrity for better communication which is not always possible.

On analyzing available literature survey our contribution to this work involves reducing this distance between the vehicle and the ITLs , the protocols which used both are of proactive type, we have used the latest protocol OLSR (Optimized Link State routing Protocol) with AODV by comparing the parameters like throughput, average end-to-end delay and average jitter. Since the information has to be sent on timely basis, our system uses 802.11p , a wireless technology for sending the information between the nodes in regular timing intervals. Also our system uses GPS integrated with wireless device which is cost effective and location independent.

3. ROUTING IN VANETs

Routing in VANETs is challenging due to the constant changes in the network topology and the constrained transmission bandwidth. Therefore, routing protocols for ad-hoc networks differ from traditional routing protocols used in wired infrastructure networks like the Internet.
Routing protocols can be categorized by the time when routes are calculated.

- Pro-active routing protocols try to maintain an up-to-date view of the network at each node. Routes are calculated in advance, before they are actually used.
- Re-active protocols, in contrast, calculate routes only on demand. This is useful when bandwidth is limited or energy consumption should be minimized.

From another point of view, routing protocols can be categorized into two classes based on the type of routing information exchanged between nodes.

- Distance Vector (DV) protocols: exchange of whole routing table with neighbors.

- Link State (LS) protocols: state of the link to neighbors is flooded to other nodes.

3.1 Ad-Hoc On Demand Distance Vector (AODV)

AODV is a re-active routing protocol. Routes are calculated on demand when a node wants to send a data packet. The route discovery process is started when a source node S wants to send a data packet to a destination node D for which no route is available in the routing table of S. Node S floods a route request packet (RREQ) [2] into the network. A route request packet contains: source identifier, source sequence number, destination identifier, destination sequence number, broadcast identifier and a time to live (TTL). An intermediate node replies with a route reply packet (RREP) if it knows a valid route to the destination node, otherwise, the route request is forwarded to its neighbors. When forwarding a route request packet, a node sets up a reverse path to node S which uses the neighbor of S from which the request packet has first been received. A route request flooded into the network will cause a large amount of routing packets generated throughout the network even if the destination node is only a few hops away. The source node successively increases the search area into which RREQ packets are flooded. This is done by adapting the initial time to to live (TTL) value in the RREQ packets. Nodes periodically send HELLO messages to detect link failures. If a link failure is detected, a node sends a route error packet (RERR) towards the source node. Routing table entries that are not actively used expire after a pre-defined interval and are removed from the routing tables.

3.2 Optimized Link State Routing (OLSR)

The Optimized Link State Routing protocol [11] is a pro-active routing protocol based on link state. Network topology information is continuously distributed over the network and stored locally at each node. Continuous flooding generates a lot of redundancy, increases the possibility of collisions and wastes a lot of bandwidth. OLSR optimizes the distribution of topology control (TC) messages over the network by an optimized forwarding mechanism called multipoint relaying. Link state updates are only sent over a subset of all links. Every node selects a set of multipoint relays (MPR) from its one-hop neighbors which forward the link state packets generated by the node. Neighbors which are not a MPR for that node do not forward the link state packets. The set of MPRs of a node n have the following property: Every node in the two-hop neighborhood of n has a link to a MPR of node n. Nodes send periodic HELLO messages to discover its neighbors and to announce its neighbors to other nodes. The Multipoint Relay Selector Set of a node n contains the neighbors that have selected node n as an MPR. Each node periodically sends topology control messages to announce that it has reach ability to the nodes of its MPR selector set.

3.3. MAC and Physical Layer Protocol

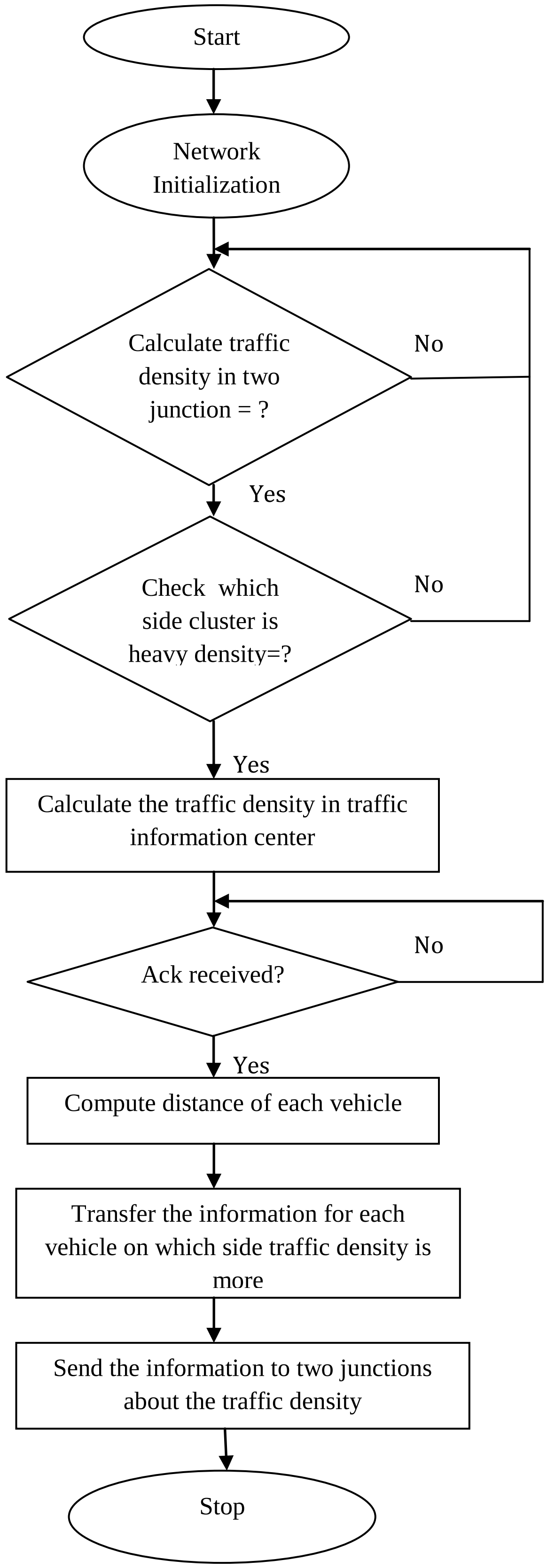
IEEE 802.11p is an approved amendment to the IEEE 802.11 standard to add wireless access in vehicular environments (WAVE), a vehicular communication system. It defines enhancements to 802.11 (the basis of products marketed as Wi-Fi) [8] required to support Intelligent Transportation Systems (ITS) applications. This includes data exchange between high-speed vehicles and between the vehicles and the roadside infrastructure in the licensed ITS band of 5.9 GHz (5.85-5.925 GHz). IEEE 1609 is a higher layer standard based on the IEEE 802.11p.

As the communication link between the vehicles and the roadside infrastructure might exist for only a short amount of time, the IEEE 802.11p [11] amendment defines a way to exchange data through that link without the need to establish a basic service set (BSS), and thus, without the need to wait for the association and authentication procedures to complete before exchanging data. For that purpose, IEEE 802.11p enabled stations uses the wildcard BSSID (a value of all 1s) in the header of the frames they exchange, and may start sending and receiving data frames as soon as they arrive on the communication channel. Because such stations are neither associated nor authenticated, the authentication and data confidentiality mechanisms provided by the IEEE 802.11 standard cannot be used. These kinds of functionality must then be provided by higher network layers. IEEE 802.11p standard uses channels of 10MHz bandwidth in the 5.9GHz band (5.850-5.925 GHz). This is half the bandwidth, or double the transmission time for a specific data symbol, as used in 802.11a. This allows the receiver to better cope with the characteristics of the radio channel in vehicular communications environments, e.g. the signal echoes reflected from other cars or houses.

4. PROPOSED WORK

The following wireless scenario has been developed and implemented as follows.

- A network with 10 mobile nodes and 2 fixed nodes has been created.
- IEEE 802.11p wireless standard for PHY and MAC layer. AODV (Ad hoc On-Demand Distance Vector) routing and OLSR (Optimized Link State Routing Protocol).
- Random Waypoint Mobility Model for the mobile nodes.
- Flow Chart for the implemented scenario



It listens for messages and broadcasts a reply for each received request which uses two types of protocol and compares the performance of each by considering its parameters like Total Packets Sent, Total Packet Received, Throughput, Average END-To-END Delay ,Average Jitter.

In AODV ,which is a reactive routing protocol follows a REQUEST – REPLAY method for broadcasting of information where as OLSR, which is a reactive protocol uses Multi – Point Relay Nodes will broadcast the information in a timely basis only on demand.

5. CONCLUSIONS

In this paper , an efficient random waypoint mobility model is proposed. Further, we can compare the efficiency of the routing algorithm using their parameters like throughput, average end-to-end delay, average jitter. Vehicles equipped with GPS will gives the exact location and speed of the vehicle will give the alert message to the drivers and also integrated information will be transmitted between source and destination by using 802.11p and is considered for dedicated short-range communications (DSRC), in both MAC Layer and PHY layer.

Future work will focus on implementing the above algorithm in real – time terrain and also using network simulators which will definitely avoid the traffic congestion. Radio obstacles like the effect of rain, fog, magnetic field and fire could be added to see more different results.

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