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Efficient Message Passing in VANET Using Message Handling Algorithm and LTA, MNA Agents

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Abstract- The agent based architecture proposed in this paper, is a multi-hop broad cast scheme which is called as Link-Based Distributed Multi-hop Broadcast (LDMB). The existing scheme is a backtracking scheme while the proposed scheme is a forwarding approach which broadcasts emergency messages efficiently in vehicular ad hoc network. The forwarding scheme in LDMB is completely distributed, where each vehicle who receives the emergency message estimates its link status firstly and then computes the waiting time before forwarding this message. LDMB does not need any handshakes and there may be several candidates to forward the message which provides the reliability of the multi-hop broadcast. This paper uses the advantages of LDMB in an agent based environment thereby improving performance of message passing and overcoming the problem of fixed packet size as proposed in the earlier systems.

Index Terms- Link-based Distributed Multi-hop Broadcast (LDMB); Vehicular Ad Hoc Network (VANET); emergency messages; forwarding scheme

I. Introduction

VANET which is a promising solution to Intelligent Transportation System (ITS) are experiencing a rapid development under the urgent demand of road safety in recent years. With the continuous increasing number of vehicles on roads, the safety applications of VANET are extremely important to thousands of people's lives. The VANET which supports complete mobility and applications in dynamic, random, and multi-hop topology is one of the branches of MANET (Mobile Ad Hoc Network) in a special situation. In VANET, the change of the topology is rapid but predictable; fragmentation of the network occurs frequently; the mobility of the nodes is regular and they do not have the problem of energy limitation, there is rich information from outside equipments such as GPS (Global Positioning System) and GIS (Geographic Information System). To cope up with this rapid changing topology in VANET it is a high time need to go for an alternate approach for packet forwarding and this paper discusses on agent based approach using LDMB [12].

II. EXISTING PROTOCOL

The Existing VANET geocast routing protocols cannot fully support the requirements essential for efficient communication. Moreover the vehicles in the dangerous region are not properly intimated with warning notifications. As such, this results in link connectivity problem or frequent temporary network fragmentation problem. With frequent temporal network fragmentation problem in mobicast messages may not be successfully received.

III. CONCEPT OF LOCATION TRACKING AGENT (LTA)

The location tracking agent keeps track of the location of each agent and their current state. This agent may reside on one or more hosts on the network. The registry implementation may utilize a central registry, a fully replicated registry or a distributed registry. The LTA agent is equipped with a special registry to maintain location information. The registry keeps track of three tables: the transient table, the user agent location table, and the system agent location table. The transient table has two attributes: Agent name and target address. The location table for user agents has five attributes: Agent name, network address, MNA agent, MEA agent name, and agent mobility state. The MEA and the MNA attributes provide the ability to load-balance the message forwarding and events management services. In the simplest environments, a single MEA agent and a single MNA agent carry these services. The location table for system agents has four attributes: Agent name, network address, agent running state, and utilization load.

IV. THE MESSENGER AGENT (MNA)

The messenger agent is responsible for storing asynchronous messages. The MNA agent buffers messages for agents in transient and is equipped with a special registry to maintain message information. The registry keeps track of one table that has five attributes: Agent name, message ID, message envelope, message contents and timestamp buffering a message is triggered by an event that is posted by the middleware of the agent in transient. At arrival the middleware may instruct the MNA agent to deliver its messages or it may retrieve the messages itself. The MNA reassembles the message from the message envelope and the message content fields and routes the message to the recipient. The MNA agent also serves as a messaging board that stores asynchronous messages.

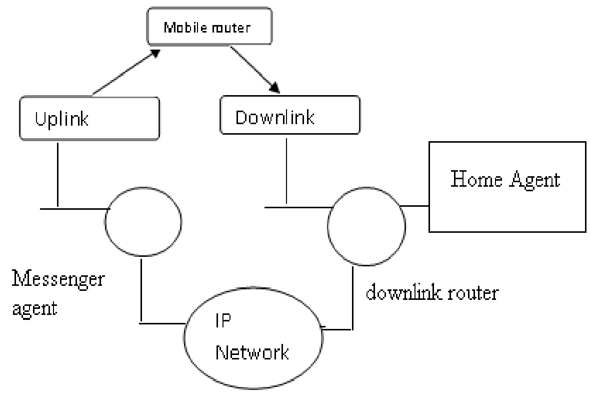

Fig 1: Messenger agent Architecture

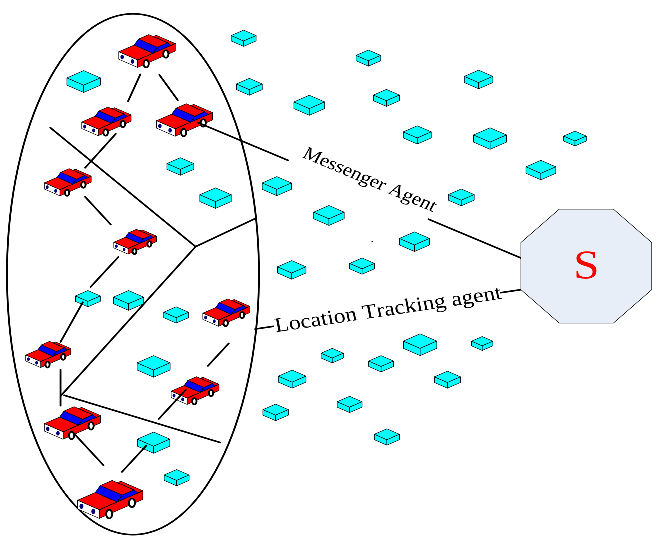

Fig 2: Proposed Architecture

In order to avoid the congestion the source node tracks the nearest location and send a message to the nearest neighbor node. Whenever the node want to transfer the information from the node to sink node. It broadcast the message to Agents. It gathers the neighboring nodes information and make sure the message reachs sink node with more surely.

V. LINK-BASED DISTRIBUTED MULTI-HOPBROADCAST PROTOCOL

The scenario we consider in the paper is a straight expressway without any intersections, where the behaviors of vehicles are relatively regular, and which will also have a profound influence on the performance of the network. The speed of the vehicles, density, vehicle flow, and headway are some basic measurements to describe the condition of some road section in traffic theory. The speed of vehicles running on expressway is limited from 80km/h to 120km/h in China, and density maybe different as the time or location changes. Headway is another important factor not only in traffic theory but in our simulation scenario. One of the most popular distribution models of time headway is Erlang distribution [1], and the density distribution is as follows,

$$f(t) = \lambda \exp(-\lambda t)\frac{(\lambda t)^{k-1}}{(k-1)!} \quad (1)$$

$$\hat{\lambda} = \frac{\mu}{\sigma^2}, \ \hat{k} = \frac{\mu^2}{\sigma^2} \quad (2)$$

Where μ is the mean of the observed headways and σ is the standard deviation of the observed headways.

VI. ALGORITHM DESCRIPTION

We propose that the forwarding scheme is based on the link status of each vehicle which is measured by the probability of packet reception. The analytical estimation of probability of packet reception is shown as [7],

$$P(x,\delta,r,f) = e^{-3(x/r)^2}\left(1+\sum_{i=1}^{4} h_i(\xi,r)\left(\frac{x}{r}\right)^i\right) \quad (3)$$

where $$h_i(\xi,r) = \sum_{i,k\geq 0} h_i^{(i,k)}\xi^i r^k \quad (4)$$

$$i=1,\ldots,4, \quad \text{with } \xi = \delta \cdot r \cdot f$$

and x is the distance between sender and receiver in meters (m); δ is the traffic density in vehicles per kilometer (veh/km); r is the transmission range in meters (m) with certain transmission power; f is the message rate; $h(i;k)$ i is the empirical coefficients that is given in [7]. We denote the reception probability of packet from vehicle m to vehicle n as Pmn, and distance between vehicle m and n is xmn. For simplicity, the transmission range r of all vehicles is assumed to be the same. This empirical probability may not accurate because it is well know that wireless link is influenced by shadowing and fading losses and the quality of wireless link changes quickly. So the probability of packet reception here is just an estimation value but this will not affect the reliability of the message transmission.

When the source vehicle s has broadcasted the emergency message, vehicles in its transmission range may receive this message. Without loss of generality, emergency messages in this paper is supposed to transmit in the opposite direction of the running vehicle, i.e. backward. Consequently, each vehicle in the forward direction that receives the emergency message will discard it whereas backward vehicles will calculate the possible reception probability of this message. A probability threshold Pth is set to screen out high quality links and vehicles with high quality link then calculate the waiting time before forwarding.
The waiting time of the location-based forwarding scheme can be obtained from [6]

$$T_w = \left(-\left\lfloor \frac{x}{r} * MaxSlot \right\rfloor + MaxSlot\right) * T_s \quad (5)$$

where *MaxSlot* is the maximum number of slots a vehicle waits before forwarding and *Ts* is the length of one slot.

The forwarding scheme in LDMB is link-based, so we modify the formula (5) to

$$T_w = \left|\left(\alpha^{P_{sj}} \quad \alpha^{P_{th}-\varepsilon}\right) * MaxSlot\right| * T_s \qquad (6)$$

where *MaxSlot* and *Ts* is the same as in (5), *Pth* is the threshold aforementioned, *Psj* is the packet reception probability of vehicle *j* which may receives the packet from the source vehicle *s*, *α* and *ε* are adjusting factors of waiting time and their empirical values are shown in table 1. After getting the waiting time vehicles begin their waiting process and the shorter the waiting time of the vehicle is the earlier the vehicle forwards the emergency message. If the vehicle which is supposed to forward the packet firstly forwards the packet successfully, other vehicles that are still in the process of waiting receive the forwarding packet and will stop the waiting process immediately. On the other hand, if the vehicle which is supposed to forward the packet firstly fails to forward because of collision, other vehicles will continue the waiting process until a vehicle forwards the message. The worst situation is that all neighbors in the source vehicle's one-hop range fail to forward the packet or there is no neighbor in the source vehicle's one-hop range, and in this circumstance the source vehicle will rebroadcast the packet after the maximum waiting time, i.e., *MaxSlot***Ts*. This forwarding scheme will be repeated several times which is decided by the transmission range of the vehicles and the demand of the kind of the emergency message. The summary of the forwarding scheme in LDMP is shown as follows.

Step1. On receiving the packet from source vehicle *s*, vehicle *j* in the specified direction estimates the packet reception probability *Psj*. For any *Psj* ≥ *Pth*, vehicle *j* is the candidate to forward the packet.

Step2. Vehicle *j* calculates its waiting time *Tw* based on *Psj* and begins the waiting process.

Step3. On hearing the packet for the second time from candidate vehicles, go to Step5.

Step4. Having waited for the time of *Tw*, vehicle *j* forwards the packet.

Step5. Vehicle *j* quit the process of waiting. The procedure exits.

VII. PROPOSED MODEL

First the location tracking agent tracks the location and then messenger agent receives the message and compare the message identifier with vehicle identifier. If the message identifier matches with vehicle identifier then the message is reported to the driver otherwise it gets rejected. The reported message is stored in the memory and it is transmitted periodically to other vehicles. When the message queue is filled with the messages, or the time stamp gets off the configured time period, the messages are automatically deleted. This scheme is depicted graphically in the figure below.

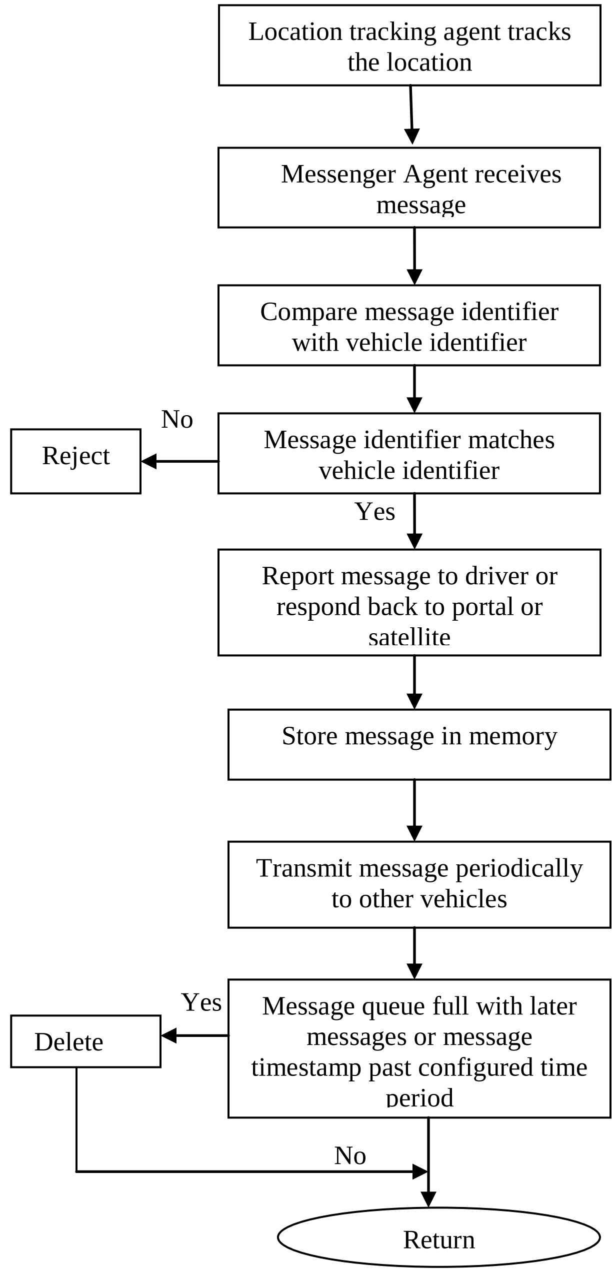

Fig 3.Message Handling model

VIII. MESSAGE HANDLING(MH) ALGORITHM

Step 1: The agent tracks the location.

Step 2: The Messenger Agent receives the message.

Step 3: The Messenger Agent compare the message identifier with vehicle identifier

Step 4: If the message identifier matches with the vehicle identifier. Then the report messages are send to driver or respond backto portal or satellite.

Step 5: Then it stores the message in memory and transmits the message periodically to other vehicle.

Step 6: If the message queue is full with later messages or message timestamp past configured time period then delete it, otherwise return.

IX. RELATED WORK

The LDMB we propose in the paper takes the distance between sender and receiver, transmission power, transmission rate, and vehicular traffic density as the influencing elements to link status. Then, vehicles which receive the emergency message will make the forwarding decision according to their own link status. Once one of the elements aforementioned changes, the link status would change accordingly and the forwarding decision of vehicles might be different. The forwarding scheme in LDMB is completely distributed which does not need any handshakes, and we will describe it in detail in the following section.

It is supposed all vehicles are equipped with GPS receivers and all kinds of sensors, which provide the current vehicle state to the routine messages exchanging between vehicles. However, the traditional GPS receivers on vehicles which are widely used all over the world can provide position information with an accuracy of approximately 10m, which is far from the demand of VANET. In [4], DGPS (Differential Global Positioning System) is used in automated vehicle location systems. Other vehicle state, such as speed, direction and acceleration can be obtained through sensors. We will not consider the topology changes during the message propagation because the transmission, propagation and back off time scales are much smaller compared with the vehicles' position changes. The headways between vehicles follow the Erlang distribution as mentioned above. Vehicles exchange routine messages with their neighbors through one-hop broadcast at certain rate and these messages are stored in every vehicle's neighbor information table. Once something emergent happens, emergency message would send out though multi-hop broadcast as soon as possible. The forwarding scheme during the multi-hop is discussed in the following subsection.

X. CONCLUSION

We proposed a time/location-critical framework using Location Tracking Agent LRA and Messenger Agent MNA for emergency message dissemination in vehicular ad-hoc networks. Although data dissemination in VANET and MANET has been studied extensively in the literature, to the best of our knowledge, it is the first time that multiple deadlines at different locations are taken into account at the same time. This is achieved through our previously proposed LTA and MNA scheme, which allows messages of different importance to be broadcast to different distances simultaneously. We propose a location-based secure and dependable disaster rescue network. By solving the challenging problem of exploiting the stored location information for post as well as pre disaster rescue, and at the same time preserving location privacy in normal network operations, the system offers a functional, secure, and sound networking solution for disaster rescue, which is likely to gain user acceptance and requires little deployment effort. We plan to carry out simulations for different connectivity scenarios and different parameter settings (e.g., time interval in the temporal redundancy mechanism), by incorporating various locating/positioning techniques, and different methods for dividing geographic areas in redundancy storage, to evaluate the performances of the proposed networking solution applied in Location Tracking Agent LTA and Messenger Agent MNA. This paper uses the advantages of LDMB in an agent based environment thereby improving performance of message passing and overcoming the problem of fixed packet size as proposed in the earlier systems.

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