VOL. 3, NO. 2, February 2012 ISSN 2079-8407
Journal of Emerging Trends in Computing and Information Sciences

http://www.cisjournal.org

AODV Extension using Ant Colony Optimization for Scalable Routing in VANETs

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ABSTRACT

On demand set up, fault tolerance and unconstrained connectivity are the major advantages of mobile computing, that's why it continues to enjoy rapid growth. In last three decades, tremendous improvement is made in the area of wireless adhoc network. Now a days ,one of the most attractive research topic is inter vehicle communication i.e. realization of mobile adhoc network .VANETs have been attracting an increasing attention from both industry as well as research communities .It requires reliable packet transmission, but rapid topology changing and frequent disconnection makes it difficult to design an efficient routing protocol. To disseminate the warning messages among vehicles to avoid accidents are sometimes a mission critical problem at some level. Therefore, this paper proposes a scheme that avoids the delay of communication that occurs due to frequent disconnection in routing. For this, the meta heuristic search i.e. ant colony optimization is combined with AODV and route repair strategy is applied to ACO.

Keywords: *VANET, Ant Colony, AODV-PGB*

1. INTRODUCTION

Vehicular adhoc networks are one of the most important technologies to provide various ITS services. An ongoing European project eCall [1] and projects like Fleetnet and CarTalk 2000 NOW (network on wheels) aim at providing automatic call service by 2009 using existing cellular infrastructure and dedicated short range communication. VANET like MANET embody the objective of providing useful communication among an arbitrarily formed collection of vehicles that are geo-located. Fast changing network topology and heavily varying communication conditions are challenging conditions for routing protocol for VANET. Many routing schemes based on positions and geography are known to be good candidate for inter vehicle communication. But these protocols experience problems when the distribution of nodes is more complex and less random. Apart from this, there are numerous issues to consider when deploying VANET. To resolve such issues, this paper introduces the concept of swarm intelligence and considers AODV as the base protocol in which ACO technique is introduced. ACO algorithm is one of the most important algorithm in swarm intelligence. It has the potential to optimize the existing AODV protocol. The aim is to disseminate messages among vehicle using ants' behavior so that load is optimized and routes becomes scalable.

The organization of the paper is as follows: first literature survey of some related work is taken. Then a co-operative architecture is proposed. Finally the paper concludes with a summary and future research direction.

2.VANET CHARACTERISTICS

Though Vehicular network share common characteristics with conventional ad-hoc sensor network such as self organized and lack of central control. VANET have unique challenges that impact the design of communication system and its protocol security. These challenges include:

2.1 Potentially high number of nodes

Regarding VANETs as the technical basis for envisioned Intelligent Transportation System (ITS) we expect that a large portion of vehicles will be equipped with communication capabilities for vehicular communication. Taking additionally potential road-side units into account, VANET needs to be scalable with a very high number of nodes.

2.2 High mobility and frequent topology changes

Nodes potentially move with high speed. Hence in certain scenarios such as when vehicle pass each other, the duration of time that remains for exchange of data packets is rather small.Also, intermediate nodes in a wireless multi-hop chain of forwarding nodes can move quickly.

2.3 High application requirement on data delivery

Important VANET applications are for traffic safety to avoid road accidents; potentially including safety-of-life. These applications have high requirements with respect to real time and reliability. An end-to-end delay of seconds can render a safety information meaningless.

2.4 No confidentiality of safety information

For safety application the information contained in a message is of interest for all road users and hence not confidential.

2.5 Privacy

Communication capabilities in vehicles might reveal information about the driver/user, such as identifier, speed, position and mobility pattern. Despite the need of message authentication and non-repudiation of safety messages, privacy of users and drivers should be respected in particular location privacy and anonymity.

3. EXISTING INFORMATION PROPAGATION SCHEME FOR VEHICULAR NETWORKS

[2] defines greedy perimeter stateless routing(GPSR).This position based routing has been identified as a promising routing mechanism for vanet.Greedy routing always forwards the packets to the node that is geo-graphically closest to the destination .By keeping information only about the local topology ,GPSR scales well about the number of network nodes and frequent changing network. It works on two methods of forwarding –Greedy forwarding and Perimeter forwarding. It gives good results on highway scenarios when compared with dynamic source routing(DSR).But for city environment ,GPSR suffers from several problem-greedy forwarding is often restricted because direct communication may not exist due to obstacles such as buildings and trees.

Geo-graphical source routing (GSR) [3] assumes the street map in city. It uses Reactive Location Services (RLS) to get the destination position. The algorithm needs global knowledge of city topology. Given this information ,sender determines the junction that has to be traversed by the packet using Dijkstra algorithm combining geo-graphical routing with topology knowledge from street maps. GSR outperforms DSR and AODV with respect to delivery ratio and latency. But this protocol neglects the situation like sparse network where there are not enough nodes for forwarding the packets. It also shows higher routing overhead because of using hello messages as control messages.

[4] addresses the performance problem of AODV and GPSR in VANET and suggests two kinds of improvements. One is preferred group broadcasting (PGB) strategy with the ability to split and merge hops that improves the performance of table driven broadcast based routing protocol. Another technique is advanced greedy forwarding (AGF) which is more fault tolerant technique than traditional greedy forwarding. AGF improves the performance of GPSR for VANET.

[5] presents a pre-emptive route repair strategy for AODV called router handoff. Router handoff tries to detect a weakning link before it fails and tries to find suitable node in the vicinity which can participate in routing around the affected links. The decision to handoff is made by a node based on perceived signal strength of its neighbors with whom it forms part of an active route.

Table1: Characteristics of representative routing protocols that have either been used or specially designed for VANET routing.

Routing Protocol	Type	Sub Type	Overhead	Mobility Model	Propagation Model
AODV	Topology Based	Reactive	Path States	IDM on Manhattan grid	Probabilistic shadowing
AODV+PGB	Topology Based	Reactive	Path States	MTS	Probabilistic shadowing
GPSR	Position based	Non-DTN,Non-overlay	Beacons	MTS	Probabilistic shadowing
GSR	Position based	Non-DTN,overlay	Beacons	M-grid Mobility	Road Blocking
GPSR+AGF	Position Based	Non-DTN,Non-overlay	Beacons	MTS	Probabilistic shadowing

4. PROPOSED WORK

The proposed algorithm considers some important issues-unpredictable behavior, unreliable communication links, changing topology and frequent disconnection. In our scheme we are applying ant colony optimization (ACO) to AODV to establish the route and apply repair algorithm in case of route failure.

The algorithm considers two events-route establishment and route repair(in case of failure).For this following data structure is used:

1. Routing Table-this table is usual vector distance table but with pheromone entry added. This value P defines the most desirable value of choosing next node.
2. Pheromone Table-this table defines the probabilistic routing policy at any node. It stores a pheromone value that expresses the goodness of choosing next node.

Event 1(Route discovery)

When the packet arrives from a new neighbor , update the routing table and pheromone table with the initial pheromone value of 0.

- Route request-To find the route forward ant agents are sent to the destination. If the active neighbor with highest pheromone value exists then send the forward ant to that neighbor otherwise broadcast the ants to all available active neighbor.
- Route reply-Backward ant agents are sent to inform the source with a route to destination .pheromone value is calculated from the formula1 [6]:

$$P = \frac{N_n}{N_h} + \frac{L_C}{100} + \frac{1}{T}$$

P-pheromone value from src to dest.
Nn-no of nodes in the network. , Nh-no of hops from src to dest, Lc-link capacity, T-trip time of ants between src to dest.
If the route to destination exists then update the value of pheromone using formula2:

$$Pn = \alpha * Po + \beta * P,$$

Where P is from formula1, Po is old pheromone value and Pn is new, α **and** β are weights of old and current pheromone values.

Find the highest pheromone neighbor and update the routing table to make the node forward the packet to that neighbor.

Event 2(Route Repair)

In VANETs routing path breaks very frequently due to high mobility. According to ACO , if the connection loss occurs , the routing table entry is removed and pheromone value is reset to 0. But as vanets very important feature is its nodes' highly dynamic behavior , we can't waste maximum time in updating the table entries. So we add the scheme proposed by Jung et.al.that improves AODV-PGB based on threshold zone.In AODV based ACO packet is transmitted to some next highest pheromone valued neighbor. When that node moves out of the radio range,it handover the packet to next immediate node and previous node. In our scheme previous and next nodes are found based on pheromone values.Suppose the transmission is from A to B to C and if B moves out then it hands over the packet to next and previous nodes based on pheromone values and avoids connection break.

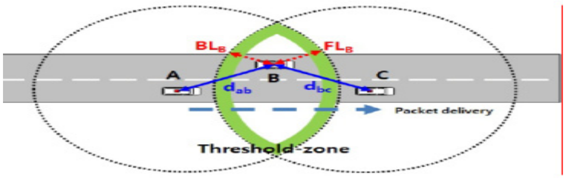

Fig.1: Threshold area [7]

Following equations from [7] are used to calculate the threshold area:

ThB = Trecover * Vnode B (1)

MLB = min (FLB, BLB) (2)

FLB = ra - dab (3)

BLB = rc - dbc (4)

Trecover: Maximum time for repairing routing path

ThB: Threshold-zone value

MLB: Minimum distance until relay zone

Vnode: Relay node speed

ra: node A radio range

rc: node C radio range

dab: Distnace between A and B

dbc: Distnace between B and C

B detects the possibility of path loss if
MLB< ***ThB***

5. DISCUSSION AND CONCLUSION

We have extended the candidate AODV protocol with ant colony optimization. ACO is a meta heuristic search that performs well in adhoc network. We have combined the goodness of ACO with AODV repair strategy. This combination reduces the routing overhead and increases the performance by avoiding the frequent path loss. Future work includes implementation of the scheme on NS-2 Simulator.

ACKNOWLEDGEMENT

Our sincere thanks to Dr.Ashwani Kush,Head of Department, Computer Science, University College, Kurukshetra University, who has contributed towards the development of this paper.

REFERENCES

[1] Brussels,"E-Call,European Project", Feb-05.

[2] Santos, R. A. Alwarez, A. Edwards, "Performance evaluation of two location based routing protocols in vehicular ad-hoc networks",IEEE 62nd conference on VT,sept-05,pp 2287-2291,ISSN 1090-3038.

[3] M.Zerbi, S. Senouci, Y. Doudane, "Towards efficient routing in vehicular networks",www.ubicc.org.

[4].Valery Naumov, R. Baumann, Thomas Gross ,"An Evaluation of Inter-Vehicle Adhoc Networks Based on Realistic Vehicular Traces", Proceedings 7th ACM international symposium on mobile adhoc networking and computing,NY-USA-06,ISBN 1-59593-368-9.

[5] S.Perur, Abhilash P., Sridhar Iyer, "Router-Handoff: A Preemptive route repair strategy for AODV," proceedings IEEE international conference on personal wireless communication,dec-2002,pp 168-171

[6] A. Elmoniem, H. Ibrahim, A. Hedar, " Ant colony and Load Balancing Optimization for AODV routing Protocol",research article international journal of sensor networks and data communication, Vol 1,ID X110203,14 pages.

[7] Sungdae Jung, S.Lee,H.Oh, "Improving the performance of AODV-PGB based on positionbased routing repair algorithm in vanet",KSII transaction on internet and information systems,vol 4,no.6,pp 1063-79.

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