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A Relativity Cram between MANET and VANET Background along Routing Protocols

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ABSTRACT

The fault tolerance and unconstrained connectivity are the advantages that why mobile computing continues its rapid growth. The great development is made in research area of wireless ad-hoc network in last three decades. At present the most eye-catching research topic is inter vehicle communication i.e. understanding of mobile ad-hoc network. In recent times VANET catch the attention of both industry as well as research communities. A well heeled writing in MANET exist, but the accessibility of traffic data and vehicle equipment encourage the researchers to explore the special characters of VANET. In this paper, we review and contrast the environment for MANET and VANET. At last we conclude it with collection of useful references.

Keywords - CBR, GPSR, MANET, Proactive &, Reactive protocol, VANET

1. INTRODUCTION

MANETs consist of mobile or semi mobile nodes. There is no existing pre-established infrastructure. The nodes connect themselves in a decentralized, self-organized manner and also establish multi hop routes. Consider that the nodes are vehicles then this type of network is called VANET (vehicular ad-hoc network). A VANET is a type of MANET. It is used to provide communication among the nearby vehicles and between vehicles with fixed infrastructure on the roadside. The most important property that differentiates MANET from VANET is that nodes move with higher average speed and number of nodes is assumed to be very large.

Vehicular networks consist of vehicles and Road Side Units (RSU) outfitted with radios. Dropping cost of electronic components and the willingness of manufacturers to increase road safety and to discriminate themselves from their competitors are considered. Vehicles are becoming "Computer on Wheels" rather than "Computer N/W on Wheels". Congregate from both the public and private sector implies that in not-too-distant future we are likely to see the total birth of vehicular n/w.

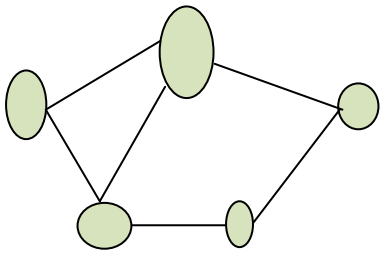
In this paper we start our discussion with the introduction of vehicular ad-hoc networks. Next we specify the various distinctive characteristics that differentiate VANET from MANET. We also state the routing techniques for both MANET and VANET and make a comparison study. Finally we end our discussion with few useful references.

2. MANET CHARACTERISTICS AND ARCHITECTURE

In ad-hoc networks all nodes are connected dynamically in an arbitrary manner. All the nodes of the network behave as routers and take part in route discovery and maintenance of routes to other nodes in the network. The ad-hoc routing protocols can be divided into two categories:

a. Table-Driven Routing Protocol → This protocol will maintain all the nodes consistent and up-to-date routing information.

b. On-Demand Routing Protocol → It creates routes when required. The source node invokes route discovery mechanisms to find the path for its destination.



[Fig: Simple MANET architecture]

2.1 MANET Characteristics

- Dynamic topologies: Nodes are free to move arbitrarily (multi-hop) may change randomly and rapidly at unpredictable times and may consist of both bidirectional and unidirectional links.

- Bandwidth constrained variable capacity links: Wireless links have significantly lower capacity than their hardwired counterparts. MANET users will demand services that will continue to increase as multimedia computing and collaborative networking application rise.

- Energy constrained operation: Some or all the nodes may work on batteries or other exhaustible means for the energy.

- Limited physical security: Mobile wireless networks are more tedious to physical security threats. To reduce threats use the existing link security techniques.

3. VANET CHARACTERISTICS AND ARCHITECTURE

Wireless ad-hoc networks have the characteristics to be infrastructure-less and do not depend on fixed infrastructure for communication and dissemination of information.

3.1 VANET Architecture:

The architecture of VANET consists of three categories: Pure cellular/WLAN, Pure Ad-hoc and hybrid.

- Pure cellular or WLAN → VANET uses a fixed cellular gateways and WLAN entry points at the traffic juncture to connect to the internet to gather traffic information or for routing purposes.
- Pure mobile ad-hoc networks → VANET can include both cellular network and WLAN to form a network. Stationery or predetermined gateways just about the road sides also provides connectivity to vehicles.
- Hybrid architecture → it consists of the infrastructure networks and ad-hoc networks together. No centralized authority is required as nodes can self organize and self manage the information in a distributed fashion. Since the nodes are mobile so data transmission is less reliable and sub optimal.

3.2 Unique VANET characteristics:

Vehicular network share the common characteristics with predictable ad-hoc sensor network such as self structured and lack of central control. VANET have exclusive challenges that force the design of communication system and its protocol security. The challenges of VANET include:

3.2.1 Potentially high number of nodes

By considering VANETs as the technical basis for visualize Intelligent Transportation System (ITS) we anticipate that a large portion of vehicles will be prepared with communication capabilities for vehicular communication. In addition, potential road-side units are taken into account, VANET needs to be measured with a very high number of nodes.

3.2.2 High mobility and frequent topology changes

Nodes potentially travel with high speed. Hence, in certain situations when vehicles pass each other, the duration of time that leftover for exchange of data packets is somewhat small. Also, intermediary nodes in a wireless multi-hop chain of frontward nodes can move quickly.

3.2.3 High application requirement on data delivery

To avoid road accidents, use VANET applications for traffic safety, possibly include safety-of-life. This application has high requirements with respect to real time and consistency. Safety information is meaningless if there is a delay of seconds in end-to-end.

3.2.4 No confidentiality of safety information

The information contained in the message should be the interest of road users and it should not be confidential.

3.2.5 Privacy

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

4. COMPARISON OF MANET AND VANET

Nodes in MANET and VANET are self-organized and self-managed in a distributed fashion without a centralized authority or a server dictating the communication. Nodes themselves engage as servers and/or clients by exchanging and sharing information like peers. Mobile Ad-hoc networks and Vehicular Ad-hoc differ with the following parameters on the basis of which we can compare both environments.

S. No.	Parameters	MANET	VANET
1.	Cost of production	Cheap	Expensive
2.	Change in network topology	Slow	Frequent and very fast
3.	Mobility	Low	High
4.	Node density	Sparse	Dense and frequently variable
5.	Bandwith	Hundred Kps	Thousand Kps
6.	Range	Upto 100 m	Upto 500 m
7.	Node lifetime	Depends on power resource	Depends on lifetime of vehicle
8.	Multihop	Available	Weakly available
9.	Reliability	Medium	High
10.	Moving pattern of nodes	Random	Regular
11.	Addressing scheme	Attribute based	Location based
12.	Position acquistion	Using ultrasonic	Using GPS, RADAR

Table: Comparison of MANET and VANET

5. ROUTING TECHNIQUES FOR MANET AND HITTING THE REALITY FOR VANET

5.1 Routing Protocols for MANET

MANETs have several applications and each of such application engross different settings with movement pattern, traffic rate and density dependent on nature of interaction among the participants and environment. Active research is been done in the area of

exploiting the routing for mobile networks but based on different application areas the classification is very vast.

Routing techniques can be on the basis of unicast or multicast OR topology based OR QoS based OR power awareness based OR broadcast based etc. The operational principles of both VANET and MANET are same to some approach. Thus most of the routing approaches are taken from MANET but due to very high mobility and node's unpredictability behavior routing protocols for MANET are not suited for vehicular communication environment.

The routing protocols in a MANET can be classified as follows:

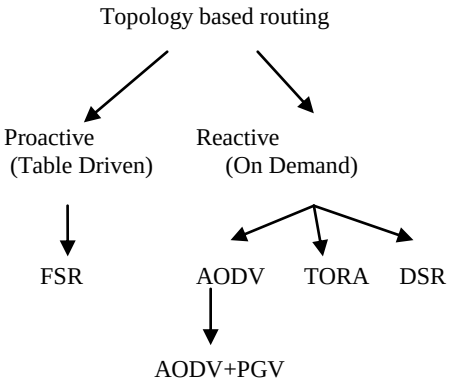
- Proactive Protocols: Each node maintains one or more routing tables which are updated regularly. Each node sends a broadcast message to the entire network if there is a change in the network topology. Ex: Distance Vector (DV) protocol, Destination Sequenced Distance Vector (DSDV) protocol, Wireless Routing Protocol Fisheye State Routing (FSR) protocol.

- Reactive protocols: Each node in a network discovers or maintains a route based on demand. This protocols needs less routing information. Ex: Dynamic Source Routing (DSR), Ad-hoc On Demand Routing(AODV) and Associativity Based Routing (ABR) protocols.

- Hybrid Protocols: It is a combination of proactive and reactive protocols. Ex: Zone Routing Protocol (ZRP).

5.2 Routing Protocols for VANET

The routing protocols of VANETs fall into two major categories: Topology-based and position-based routing. Many routing techniques have been proposed for traditional ad-hoc networks but due to different characteristics of VN, they fail to fit in the scenario. In this paper we classify the routing into five categories



5.3 Ad-hoc routing and modification for VANET

The MANET and VANET share the same principles, thus most ad-hoc routing protocols are applicable such as AODV and DSR. On the other hand most of the study have shown that both these protocols undergo from highly dynamic nature of nodes i.e. they give low communication throughput. Thus little modification need to be deployed to deal with dynamic mobility. For this two algorithms were proposed by Namboodiri etal. to reduce the ill effects of route breakage as faced in AODV. Two prediction based protocols are PRAODV and PRAODV-M. PRAODV constructs alternate routes before the end of estimated lifetime while PRAODV-M selects maximum predicted life time among multiple route options. These two protocols showed great efficacy in vehicular scenario concerning improvement in packet delivery ratio.

5.3.1 Geographical Routing

Geographical routing or position based routing has been identified more promising paradigm in VN. Two best known protocols in literature are Greedy Perimeter Stateless Routing (GPSR) and Greedy Perimeter Coordinator Routing (GPCR[). It works best in open space scenarios with uniformly distributed nodes. It gave good results when compared to DSR in highway scenario. GPCR works on the principle that packet should always be forwarded on a junction called co-coordinator. The authors showed that GPCR has higher delivery rate than GPSR and slight increase in latency.

5.3.2 Cluster Based Routing

Cluster based routing protocol was first developed by Jiang in 1999. Nodes of the wireless network are divided into several disjoint clusters. Each cluster selects one node as cluster head. These heads are responsible for routing process.

Protocols were proposed based on cluster mechanism for MANET but due to driver's intentions and high speed etc were not suited for VN. For vehicular specific environment two known routing protocols in literature are Clustering for Open IVC Networks (COIN) and Cluster Based Flooding (CBR). COIN selects cluster head based on vehicle dynamic and driver's intention rather than communication range or ID as in ad-hoc networks and produced much more stable structure. CBR works principally on location based theory sending location request LREQ and location reply LREP msg. In total cluster based routing can achieve good scalability for large networks but extra overhead of formation of cluster and heads.

5.3.3 Broadcast Routing

Broadcasting technique is used for sharing traffic emergency conditions, advertisements etc. the way to achieve broadcasting is flooding and it is easy to be implemented. But its performance drops quickly as networks grows larger. Two well known routing

protocols are BROADCOMM and Urban Multi-hop Broadcast Protocol (UMB). BROADCOMM works on hierarchical structure and it out performs flooding algorithm. UMB overcome the problem of hidden nodes and packet collision. This protocol gives high success rate for heavy traffic density and packet load.

6. CONCLUSION

In this paper we discussed the typical architectural features of vehicular network and compare it with traditional mobile ad-hoc network. Table 1 shows an outline of MANET and VANET routing principles. Even though VANET is a type of MANET but the routing protocols of MANET are not feasible with VANET and if they are even feasible then they are not able to provide the optimum throughput required for the fast changing vehicular ad-hoc network. The difference between these two are that in VANET, the nodes are moving on predefined roads, and their trails are not too complicated and this is where the routing protocols have to be modified or changed. By analyzing the protocols, we find that there are very few routing protocols that can be applied to both the MANET and VANET and hence we conclude that AODV protocol is the efficient and best protocol.

In general although this paper does not discuss about the practical results but presents an overall picture of different routing challenges that are faced in vehicular environment and various routing procedures followed in both the networks. We believe this paper will be helpful for future designer in vehicular communication networks.

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