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SURVEY: PERFORMANCE ENHANCEMENT OF ROUTING PROTOCOL USING DIVERSE MOBILITY MODELS IN VANET

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ABSTRACT

Vehicular Ad-hoc network (VANET) is a collection of mobile nodes that are randomly located so that the connections between nodes are dynamically changing. Without the use of the existing network infrastructure, VANET mobile nodes form a temporary network. At present VANET is becoming an interesting research area characteristic that led to the need for competent routing and resource saving protocols and also to fit with different mobility environments. The aim of this paper is to give a survey of the VANETs routing Scenario. It also gives an overview of Vehicular ad hoc networks, existing VANET routing protocols and the exiting two mobility Models. The paper also describes the outlines of VANETs, investigates different routing schemes that have been developed for VANETs, and providing classifications of VANET routing protocols with different classification forms and gives summarization.

KEYWORDS: Mobility Models, Routing Protocols.

I. INTRODUCTION

VANET consists of a collection of wireless mobile nodes that are dynamically connected and can communicate with each other without the requirement for any pre-existing or centralized infrastructure. There is no static infrastructure. Vehicular Ad hoc networks (VANETs) are a special type of mobile ad hoc networks in which vehicles are simulated as mobile nodes. VANET contains two accesses: access points and vehicles, the access points are fixed and generally connected to the internet [1].VANET addresses the wireless communication between vehicles (V2V), and between vehicles and infrastructure access point (V2I). Vehicle to vehicle communication (V2V) has two types of communication: one hop communication (direct vehicle to vehicle communication), and multi hop communication. VANET also has special characteristics that distinguish it from other mobile ad hoc networks; the most important characteristics are: good mobility, self-organization, distributed communication, road pattern restrictions, all these characteristics made VANETs environment a challenging for developing efficient routing protocols. Routing protocols have been built for VANETs environment, which can be classified in further ways, according to different aspects; such as: protocols characteristics, techniques used, routing information, and so on. Some research papers classified VANETs routing protocols into five classes: topology-based, position-based, geo-cast based, broadcast, and cluster based routing protocols, and this classification is based on the routing protocols characteristics and techniques used [2], [3], [4]. As well, other papers classified VANETs routing protocols according to the network structures, into three classes: hierarchical routing, flat routing, and position-base routing. Moreover, they can be categorized into two classes according to routing strategies: proactive and reactive [8].

- Due to the high mobility of the nodes the connectivity is a real challenge. Routing protocols for VANETs must cope with the partitioning and merging of networks. Also, during the initial deployment of a VANET, there is sparse network connectivity, and this must be handled properly.
- In VANETs, mobility can be used to improve the Performance of the network that increases mobility, the throughput in MANETs, as is shown in [3].
- For safety applications, VANETs require to broadcast protocols to flood information efficiently and reliably within a given area.

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II. ROUTING FOR USER APPLICATIONS

Routing Applications can use either unicast routing or multicast routing. Our interest in this section is to see how a route can be provided between a source and a destination vehicle in such a way as to ensure the communication. We review the classical VANET unicast routing protocols. Due to intensive research in the field, a number of unicast routing protocols were developed especially for VANETs; for example, optimized link state routing (OLSR), ad hoc on demand distance vector (AODV), dynamic source routing (DSR), and so on. These protocols can be divided into two basic types: reactive and proactive.

Reactive protocols discover the route when there is a data packet to be sent. Generally, a control packet is flooded from the source, and the path of this packet toward the destination node. Hence, there is a delay before data can be transmitted while in Proactive protocols, maintain a correct routing table at all times by sending periodic control messages that contain topology information.

III. ROUTING PROTOCOLS

Routing Protocol is used in Network to send data from Host to destination. They are classified into three classes Proactive, Reactive and Hybrid protocol. Proactive protocol continuously tries to maintain up-to-date routing information on every node in the network. Reactive protocols or on-demand routing protocols rather than relying on periodical broadcasts of available routes, discover routes when needed, build and maintain routes. Hybrid Routing Protocol (HRP) is a network routing protocol that combines Reactive Routing Protocol and Proactive Protocol features.

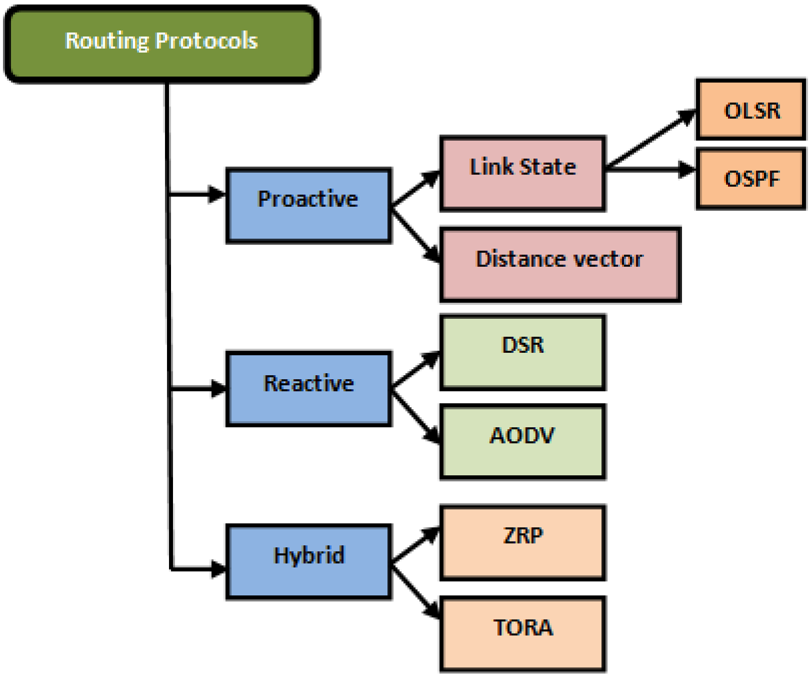

Figure1: Classification of Routing Protocols

IV. PROACTIVE ROUTING PROTOCOLS

Proactive protocols allow a network node to use the routing table to store routes information for all nodes, Though each entry in the table contains the next hop node used in the path to the destination, whether the route is actually needed or not. The table must be updated simultaneously to reflect the network topology changes and should be broadcast periodically to the neighbors. This scenario may cause more overhead especially in the high mobility network. However, routes to destinations will always be available when needed [4]. Proactive protocols usually depend on shortest path algorithms to determine which route will be chosen as they generally use two routing strategies: Link state strategy and distance vector strategy.

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Destination Sequence Distance Vector Routing (DSDV)
DSDV protocol it is an earliest ad hoc routing protocol in which it implements the distance vector strategy and uses a shortest path algorithm to implement only one route to destination which stored in the routing table, each routing table contains information about all accessible nodes as well as the total number of hops needed to reach these nodes and each entry in the routing table is labeled with a sequence number initiated by the destination node. To maintain routes properly, each node must periodically broadcast its routing table to its neighbors. DSDV protocol guarantees the loop free routs, excludes extra traffic caused by frequent updates, as well as reduces control message overhead[10]. However, by maintaining nodes randomized decision which allows each node to make a decision whether to forward or discard a packet.

Optimized Link State Routing Protocol (OLSR)
OLSR protocol utilizes the link state strategy; it provides a routing table contains information about all possible routes to network nodes. Once the network topology is changed each node must send its updated information to some selective nodes, which retransmit this information to its other selective nodes. The nodes which are not in the selected list can just read and process the packet [10]. Some researchers thought that OLSR has easy procedure which allows it to built-in different operating systems, besides it works well in the dynamic topology, However, OLSR may cause network congestion; because of frequent control packets which sent to handle topology changes, moreover OLSR ignore the high resources capabilities of nodes (like transmission range, bandwidth, directional antenna).

Fisheye State Routing (FSR)
In FSR, the node periodically updates its table based on the latest information received from neighboring nodes. The updating of the routing table entries that concern a certain destination must be broadcast by different frequencies for neighbors. Table entries that are further in the distance are broadcast with lower frequency than entries that are nearer, this scheme doesn't guarantee decreasing broadcast overhead in large distances routing process. However, it could be accurate, if the packets come closer to the destination [4], [14]. The problem with the FSR is that, the growing network sizes will also increase the routing tables, also if the topology changes increased, the route to a remote destination becomes inaccurate. The advantage of proactive routing protocols can be resulted that there is no need to route discovery process; because the route to the destination is kept in the background, moreover proactive protocols periodically update the routing information which lets these protocols to perform well in low mobility networks.

V. REACTIVE ROUTING PROTOCOLS
Reactive routing protocols is also called on-demand which reduces the network overhead; by maintaining routes only when needed, that the source node starts a route discovery process, if it needs a non existing route to a destination, it does this process by flooding the network by a route request message. After the message reaches the destination node (or to the node which has a route to the destination), this node will send a route reply(RRP) message back to the source node using unicast communication. Reactive routing protocols are applicable to the large size of the mobile ad hoc networks which are highly mobility and frequent topology changes.

Ad Hoc On-Demand Distance Vector (AODV)
AODV offers low network overhead by reducing messages flooding in the network; that when compared to proactive routing protocols, by reducing the requirement of memory size; by minimizing the routing tables which keep only entries for recent routes, also keeps next hop for a route rather than the route. It also provides dynamically updates for providing the route conditions and eliminates looping in routes; by using destination sequence numbers as a result it causes delays in a route discovery and also route failure may require a new route discovery which produces additional delays that decrease the data transmission rate and increase the network overhead. Moreover, the varying broadcasts without control will consume extra bandwidth (broadcast storm problem), this problem grows as the number of network nodes increases that besides collisions which excess lead to packet lost problem.

Dynamic Source Routing Protocol (DSR)
DSR protocol aims to provide a highly reactive routing process; by implementing a routing mechanism with an extremely low overhead and fast reaction to the frequent network changes, to guarantee successful data packet delivery regardless of network changes. DSR is a multi hop protocol; it decreases the network overhead by reducing periodic messages. This protocol has two main processes that are route discovery and route Maintenance. In the route discovery, when a source node needs an unavailable

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route, it initially broadcasts a route request message. All intermediate nodes which received this message will rebroadcast it, except if it was the destination node or it has a route to the destination; in this case the node will send a route replay message back to the source, later the received route is cashed in the source routing table for future use. If a route is failing, the source node will be informed by a route error message.

In DSR protocol, every data packet contains a complete list of the intermediate nodes; so the source node should delete the failed route from its cache, and if it stores other successful route to that destination in its cache, it will exchange the failed one by the other successful route. But if there is no alternative route, it will initiate a new route discovery process [9]. The benefit of DSR protocol is clearly shown in a network with low mobility; because it can use the alternative route before starts a new process for route discovery. However, the multi routes may lead to additional routing overheads by adding all route information to every data packet, besides, as the network span larger distance and including more nodes, the overhead will frequently increase and as result network performance will be degraded [9].

Temporally Ordered Routing Algorithm (TORA)
TORA is a distributed routing protocol using multi hop routing; it is designed to reduce the communication overhead related to frequent network changes. This protocol does not implement a shortest path algorithm, thus the routing structure does not represent a distance. TORA develop a directed graph which contains the source node as the tree root. Packets should be running from higher nodes to lower nodes in the tree. Once a node broadcasts a packet to a particular destination, its neighbor will broadcast a route replay if it has a downward link to the destination, if not, it drops the packet. TORA ensures the multi path loop free routing; since the packet always flows downward to the destination and don't flow upward back to the sending node. The advantage of TORA offers a route to every node in the network, and reduces the control messages broadcast. However, it causes routing overhead in maintaining routes to all network nodes.

VI. HYBRID ROUTING PROTOCOLS

Hybrid protocol is a mixture of both proactive and reactive protocols. The main aim is to minimize the proactive routing protocol control overhead and reduce the delay of the route discovery process within on-demand routing protocols. The hybrid protocol divides the network to many zones to provide more reliability for route discovery and maintenance processes.

Zone Routing Protocol (ZRP)
ZRP is the first protocol developed as a hybrid routing protocol, it allows a network node to divide the network into zones according to many factors; like: power of transmission, signal strength, speed and many other factors. The area inside the zone is the routing range area for the node and vice versa for outside zone. ZRP uses the reactive routing schemes for outside the zone and the proactive routing schemes for inside the zone; with a view to keep the latest route information within the inside zone. In the local inside the zone, the source node uses a proactive cached routing table to initiate a route to a destination, which can be helped in transmitting packets directly without delay. ZRP uses independent protocols inside and outside the zone; it may use any existing proactive and reactive routing protocols. For outside zone, the ZRP reactively discover a route; that the source node transmits a route request packet to the border nodes of its routing zone; the packet includes a unique sequence number, the source address and the destination address. When the border node receives a route request packet, it looks for the destination within its inside zone. If the destination is found, it sends a route reply on reverse path to the source node; else if it doesn't find the destination in its local zone, the border node adds its address to the route request packet and forwards it to its own border nodes.

After the source received a reply, it stores the path included in the route reply packet to use it for data transmission to the destination [15]. The weakness of ZRP protocol is that it performs like a pure proactive protocol particularly for large size zones; however for small zones it performs similar to a reactive protocol. Thus ZRP protocol is not applicable for large size VANET with highly dynamic topology and frequently change.

VII. MOBILITY MODELS

Random Waypoint Model (RWP)
The Random Waypoint Mobility Model includes pause times between changes in direction and/or speed [1]. A Mobile Nodes begins by staying in one location for a certain period of time (i.e., a pause time). Once this time

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expires, the Mobile Nodes chooses a random destination in the simulation area and a speed that is uniformly distributed between [minspeed, maxspeed]. The Mobile Nodes travels toward the newly chosen destination at the selected speed. Upon arrival, the MN pauses for a specified time period before starting the process again. In most of the performance investigations that use the Random Waypoint Mobility Model, the MNs are initially distributed randomly around the simulation area. This initial random distribution of MNs is not representative of the manner in which nodes distribute themselves when moving [2].

Reference Point Group Mobility Model

The Reference Point Group Mobility (RPGM) model represents the random motion of a group of MNs as well as the random motion of each individual MN within the group [6]Group movements are based upon the path traveled by a logical center for the group. The logical center for the group is used to calculate group motion via a group motion vector. The motion of the group center completely characterizes the movement of its corresponding group of MNs, including their direction and speed. Individual MNs randomly move about their own pre-defined reference points, whose movements depend on the group movement. As the individual reference points move from time t to t+1, their locations are updated according to the group's logical center. Once the updated reference points, RP(t+1), are calculated, they are combined with a random motion vector, R~M, to represent the random motion of each MN about its individual reference point. If appropriate group paths are chosen, along with proper initial locations for various groups, many different mobility applications may be represented with the RPGM model. In [8], two applications for the RPGM model are defined.

- The Mobility Model partitions in a given geographical area such that each subset of the original area is assigned to a specific group; the specified group then operates only within that geographic subset.
- The Overlap Mobility Model simulates several different groups, each of which has a different purpose and working in the same geographic region; each group within this model may have different characteristics than other groups within the same geographical boundary. For example, in disaster recovery of a geographical area, one might encounter a rescue personnel team, a medical team, and a psychologist team, each of which have unique traveling patterns, speeds, and behaviors.

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