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Poster Abstract: Fundamental Topology-Based Routing Protocols for Autonomous Vehicles

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***Abstract*—It does not seem easy to generate reliable routes in Vehicular Ad-hoc Networks (VANETs) because of frequent link failures caused by vehicle's mobility. In this regard, we analyze the characteristics of topology-based routing protocols in order to assess the feasibility of each protocol for vehicular environments. We plan to design an efficient routing protocol for VANETs in order to generate reliable and stable routes.**

I. Introduction

These days, a number of vehicles are equipped with wireless devices and able to make wireless connections with each other to create a network, which is referred to as Vehicular Ad-hoc Networks (VANETs). Specially, vehicle to vehicle (V2V) communications as a pure ad-hoc mode (one type of VANETs) are highly affected by topology, density, and velocity of vehicles and the types of the roads (e.g., highway or local roads). The most critical issue considering a reliable and stable route for data forwarding service of vehicles is the frequent disconnections under time-varying topology caused by high mobility of vehicles on the road. To address this issue, we should identify the strength and weakness of the existing routing protocols by examining them for the design of a new routing protocol for VANET. We survey fundamental topology-based routing protocols which are classified into *Proactive* and *Reactive* protocols.

II. Proactive and Reactive Routing Protocols

Since the proactive routing protocol continuously tries to build a routing table for the shortest route, nodes can immediately transmit data. While the routing table of each node is periodically updated by using received control packets, it is bound to cause high overhead to maintain the topology of the whole network. In addition, the information of routing table could become obsolete quickly because of rapidly changing topology on the road. For example, Destination-Sequenced Distance-Vector (DSDV), which is one of proactive routing protocols, uses a sequence number to avoid route loops [1]. If proactive approach should be selected for VANETs, DSDV is more suitable for the highway rather than urban road, where the changes in interspace between vehicles are relatively small because most vehicles move at a constant speed on the highway.

The reactive routing protocol is referred to as on-demand routing protocol. When a node wants to send packets to destination, only then can the routing table be constructed to find the shortest path. In this regard, it does not frequently update the routing table, but it should flood the query to find adjacent nodes at that time. It could be more adaptive and have less control overhead under dynamic conditions than the proactive approach, because it makes a routing table only when nodes need routes. Under a high traffic density on the road, query flooding to create the routing table generates excessive control traffic in VANETs, and the time taken to identify the shortest route could be too long to transmit data (high queuing delay). Dynamic Source Routing (DSR), one of the reactive protocols, is a source routing method and has both route discovery and route maintenance phases [2]. In terms of route maintenance, it is an advantage in a static environment that an intermediate node sends Route Error Packet to the source in order to discover a new route when it cannot find the selected path. However, considering the dynamic and changeable conditions of VANETs, it could be more efficient than DSR if the intermediate node, instead of source node, can perform route recovery locally. In addition, one major drawback of DSR comes from the high overhead for the route maintenance because of the long path with many intermediate nodes. Nevertheless, DSR can immediately select an alternative route even though the existing route is disconnected. Thus, this approach would be reasonable in the case of traffic jam condition in urban, where the topology seldom changes. Ad hoc On-demand Distance Vector (AODV) [3] considers a hybrid method, utilizing the sequence number of DSDV and two phases of DSR. AODV also requires a lot of time to make a routing table. AODV could be more suitable in a big and dense city having many vehicles, since the maximum number of hops in a route is 35.

III. Conclusions and Future Work

We investigate the well-known routing protocols, since it is helpful to study the strengths and weaknesses of the existing protocols. Key characteristics of VANETs are that the traffic density and topology are highly dynamic over time. Therefore, it is worth setting up a reliable route. To focus on a reliable and rapid data forwarding service, we plan to develop a reactive approach for vehicular applications and consider various parameters (position and moving distance of nodes, control overhead, and road condition) as future work.

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