CAMP: Congestion Adaptive Multipath Routing Protocol for VANETs

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Abstract. Long congestion periods, frequent link failures and hand-offs in VANETs lead to more number of packets being dropped and incur high end to end delay, there by degrading the overall performance of the network. Congestion control mechanism, though mainly incorporated in transport protocols, if coupled with the routing protocols, can significantly improve overall performance of the network. In this paper we propose Congestion Adaptive Multipath Routing Protocol (CAMP) that aims to avoid congestion by proactively sending congestion notification to the sender. The proposed CAMP routing protocol is implemented in Network Simulator-2 (NS-2) and its performance is compared with Ad-hoc On Demand Multipath Distance Vector (AOMDV) in terms of Packet Drop due to Congestion, Packet Delivery Fraction, Throughput and Average End-to-End Delay. Simulation results show that CAMP routing protocol achieves significant performance gain as compared to that of AOMDV.

Keywords: VANETs, MANETs, Congestion, Multipath routing protocols.

1 Introduction

Vehicular Ad Hoc Networks (VANETs) are special type of Mobile Ad Hoc Networks (MANETs). Like MANETs, VANETs also do not require any fixed infrastructure. Wireless devices within the vehicles form a vehicular ad hoc network and the road side infrastructure like traffic signals, gas stations, etc can be used for establishing communication. Using VANETs we can share the information about road situations such as accidents, traffic jam, etc and try to avoid those roads, thus avoiding congestion.

Vehicle mobility may cause problems such as inefficient hand-offs and performance issues. Since specific addresses of the potential communication partners are unknown and irrelevant, most approaches use a form of broadcast. Hence a lot of work has been carried out on routing protocols for VANETs to make it more cost efficient and robust. Vehicles make routing decisions based on locally available information within a close range. Therefore exchanging information between the vehicles is a major part of VANETs routing protocols. Protocols for VANETs can be classified into Topology-based routing protocols and Geographic routing protocols.

P.S. Thilagam et al. (Eds.): ADCONS 2011, LNCS 7135, pp. 318–327, 2012.

Topology-based routing protocols can be further classified into proactive (table-driven) routing protocols and reactive (on-demand) routing protocols. Several performance studies of ad hoc networks have shown that on-demand protocols incur lower routing overheads compared to their proactive counterparts. However, they are not without performance problems [1][3].

High route discovery latency together with frequent route discovery attempts in dynamic networks can affect the performance adversely. Multipath on-demand protocols try to alleviate these problems by computing multiple paths in a single route discovery attempt. Congestion is one of the parameters that affect network performance apart from link failures and handoffs. In this paper we have designed Congestion Adaptive Multipath Routing Protocol (CAMP) that aims to avoid congestion by proactively sending congestion notification to the sender. The proposed CAMP routing protocol is implemented in Network Simulator-2 (NS-2) [4] and its performance is compared with Ad-hoc On Demand Multipath Distance Vector (AOMDV) [2] in terms of Packet Drop due to Congestion, Packet Delivery Fraction, Throughput and Average End-to-End Delay.

The rest of the paper is organized as follows. Section 2 describes the routing protocols for VANETs. Section 3 describes the CAMP. Section 4 describes the simulation setup. Section 5 presents the results and the analysis and Section 6 presents conclusion and future work.

2 Routing Protocols for VANETs

A routing protocol is the set of rules that defines how two communication entities can exchange information; it specifies the procedure of establishing a route decision making while forwarding and maintaining the route or recovering from routing failure. Routing protocols for VANETs can be classified into topology-based routing protocol and geographic routing protocol. Topology-based can be further classified into table driven and on-demand routing protocols.

2.1 Table Driven Routing Protocols

These protocols maintain consistent, up-to-date routing information from each node to every other node in the network. These nodes maintain routing tables and respond to the changes in the network topology by propagating updates throughout the network to maintain a consistent view of the network. Different table-driven routing protocols differ in the number of routing tables and the methods by which changes in the network topology are broadcasted. Examples of table driven routing protocols are: Destination Sequenced Distance Vector (DSDV), Optimized Link State Routing (OLSR), etc.

The disadvantages of table driven routing protocols are: such protocols require high storage capacity to maintain the routing information and they react very slowly on restructuring or route failure in the network.