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Data Gathering Optimization in Hybrid Software Defined Vehicular Networks

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Abstract

Vehicular Adhoc Networks (VANETs) are characterized by the absence of fixed infrastructure for communication and dynamic network topology. Software Defined Vehicular Network (SDVN) is a new paradigm that enhances programmability and flexibility in VANETs. However, we find that there is no proper mechanism to gather data for the hybrid architecture of SDVN even though data gathering in centralized and distributed architectures is well-defined. We scrutinize the characteristic of hybrid architecture, which is that it consists of a combination of distributed and centralized architecture features where the degree of data broadcasting and unicasting are selected using optimization. We formulate the data gathering problem for the hybrid SDVN architecture as an Integer Quadratic Programming (IQP) problem. The novel IQP model optimally selects broadcasting nodes and agent (unicasting) nodes from a given vehicular network instance with the objective of minimizing multiple factors such as the number of agents, communication delay, communication cost, total payload, and total overhead. We observe that due to dynamic network topology in vehicular networks, a new solution to the optimization should be found in order to avoid node isolation and redundant data transmission. Therefore, we propose a systematic way to collect data and metadata and take optimization decisions by inspecting the heterogeneous normalized network link entropy, which is formulated by considering links to Road Side Units (RSUs) and vehicular nodes as two different types of links. The proposed optimization technique for data collection for the hybrid architecture yields much lower communication cost and end-to-end latency in large vehicular networks compared to the data collection in the centralized architecture. According to the results, in order to achieve the ultra-reliability benchmark for vehicular communication, the proposed optimization should occur frequently with a low heterogeneous normalized network link entropy threshold.

Keywords*: Entropy, Hybrid Architecture, Optimization, Software, Vehicular Network.*

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