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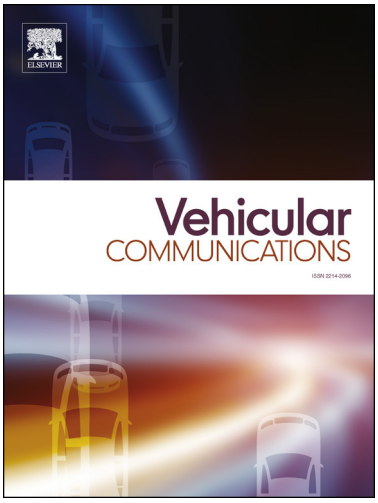

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Energy Efficient Nano Servers Provisioning for Information Piece Delivery in a Vehicular Environment

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ABSTRACT

In this paper, we propose energy efficient Information Piece Delivery (IPD) through Nano Servers (NSs) in a vehicular network. Information pieces may contain any data that needs to be communicated to a vehicle. The available power (renewable or non-renewable) for a NS is variable. As a result, the service rate of a NS varies linearly with the available energy within a given range. Our proposed system therefore exhibits energy aware rate adaptation (RA), which uses variable transmission energy. We have also developed another transmission energy saving method for comparison, where sleep cycles (SC) are employed. Both methods are compared against an acceptable download time. To reduce the operational energy, we first optimise the locations of the NSs by developing a mixed integer linear programming (MILP) model, which takes into account the hourly variation of the traffic. The model is validated through a Genetic Algorithm (GA1). Furthermore, to reduce the gross delay over the entire vehicular network, the available renewable energy (wind farm) is optimally allocated to each NS according to piece demand. This, in turn, also reduces the network carbon footprint. A Genetic Algorithm (GA2) is also developed to validate the MILP results associated with this system. Through transmission energy savings, RA and SC further reduce the NSs energy consumption by 19% and 18% respectively, however at the expense of higher download time. MILP model 4 (with RA) and model 5 (with SC) reduced the delay by 81% and 83% respectively, while minimising the carbon footprint by 96% and 98% respectively, compared to the initial MILP model.

Index Term: **Information Piece Delivery; Mixed Integer Linear Programming; Sleep Cycles; Rate Adaptation; Nano Servers (NS).**