Vehicle Prioritization and Modified GPSR for Congestion-Adaptive Routing in VANETs

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Abstract

This study presents a new congestion-adaptive prioritization algorithm in order to address the performance deterioration of Vehicular Ad-hoc Networks (VANETs) due to the dense vehicle traffic and traffic congestion, targeting the urban settings with automation of traffic lights. The main contribution is a vehicle prioritization-based communication optimization algorithm that makes routing behaviour and overall routing network abilities much higher due to the extensive analysis of communication parameters. The proposed model using NS2 as its simulator assigns vehicle priorities according to network level information with high-importance nodes having higher priorities, followed by a modification of the GPSR protocols to produce optimized, load-balanced communication paths using shortest path, node priorities, and network load to avoid communication failures.

Keywords. Vehicular Ad-hoc Networks, Congestion Control, Prioritization, GPSR Protocol, Network Simulation, NS2, Communication Optimization.

1. Introduction

Vehicular Adhoc network is the infrastructure-less network distributed in larger geographical space. It is a self-organized network with a specification of some infrastructure units and the scenario. The nodes in the network are vehicles with variant mobility within the scenario restriction [1]. The mobility, communication and architectural control are defined using specialized infrastructure specifications localized within the geographical region. The technological requirement and sensing technologies are also defined under the vehicle, infrastructure, and geographical diversities. The traffic level, accidental situations, and environmental changes affect the network performances, priorities and challenges. The application, road, environment, safety, and traffic specific challenges exist in this network in a real scenario [2]. The network actually combines the features, restrictions, and challenges of mobile and sensor networks in diverse environments. The message, communication, and architectural specific constraints are defined in the network [1,3].

2. Research Methodology

The main issue that has been discussed in this study is the deterioration of vehicular network performance as a result of high density and traffic jams which results in a direct way to a rise in communication delay and loss of packets. As a response to this, the study proposes an adaptive prioritisation approach to congestion-sensitive optimisation of the vehicular network performance, particularly during urban operation where traffic lights automation is a feasible control system.

3. Proposed Model

The complete functional flow, as shown in Figure 1, is specific to the network scenario where architectural specifications, including the placement and role of Roadside Units (RSUs), are defined for a city environment. The traffic information sharing and load distribution are managed by these controller devices, which also handle the characterization of vehicle nodes and information transition via V2I communication.

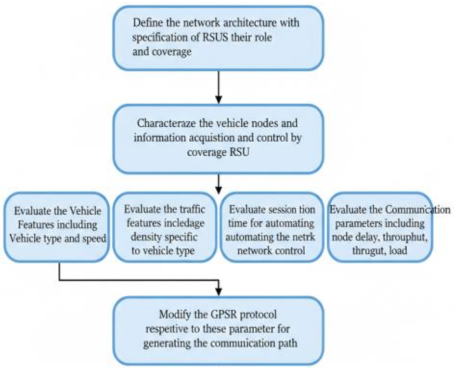

Figure 1. Flowchart of the Step Process from Network Setup to Performance Analysis.

4. Results and Discussion

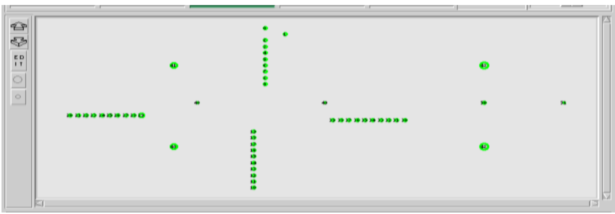

Figure 2. Generation of Vehicular Network.

In this section, the simulation outcome of the defined network and the algorithmic model proposed in this research are provided. Figure 2 and Figure 3 show the static network composed in this research for evaluating the operation of the suggested approach. The diagram shows the simulation environment of the network animator. The main window and the sidebars are shown.

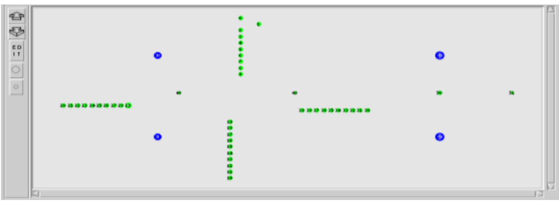

Figure 3. Activation of Network Components.

4.1. Analysis of Results

To validate the significance, operation, and reliability of the suggested prioritization model, the comparative analysis is done for the city network. The first parameter considered for analytical evaluating is the number of packets communicated over the network. The packet communication-based evaluation is indicated in Figure 4 and Table 5.

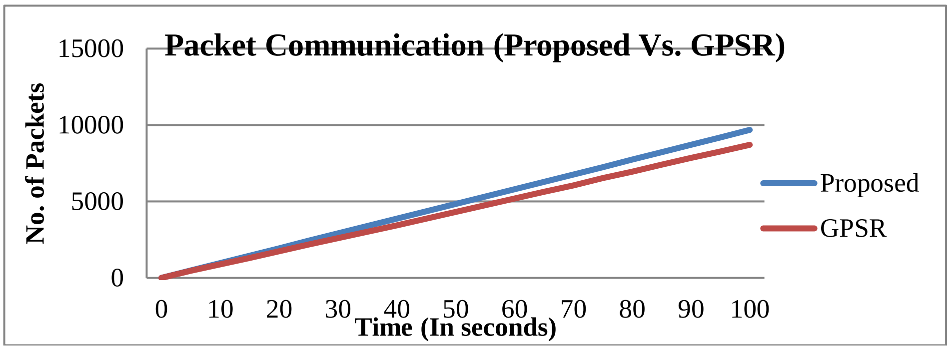

Figure 4. Packet Communication Analysis (Scenario I).

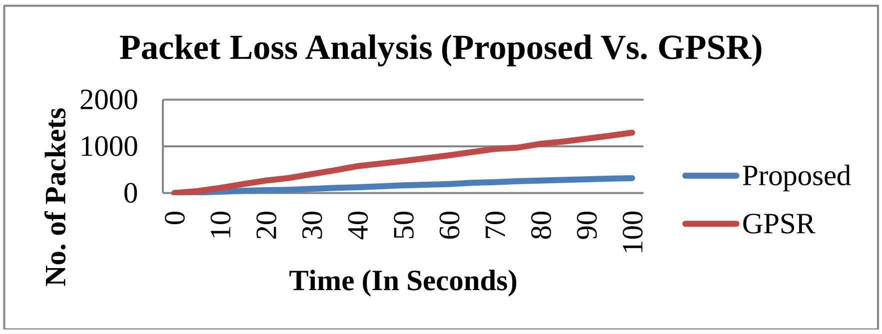

Figure 5. Packet Loss Analysis.

5. CONCLUSION

This research successfully developed and validated a novel congestion-adaptive prioritization method for Vehicular Ad-hoc Networks (VANETs), specifically targeting performance degradation in high-density urban environments. The proposed model can greatly increase the reliability and effectiveness of communication, as it introduces the two-stage model in which the vehicle priorities are assigned on the basis of network information and integrated into an adjusted GPSR protocol to generate optimal routes.

6. REFERENCES

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