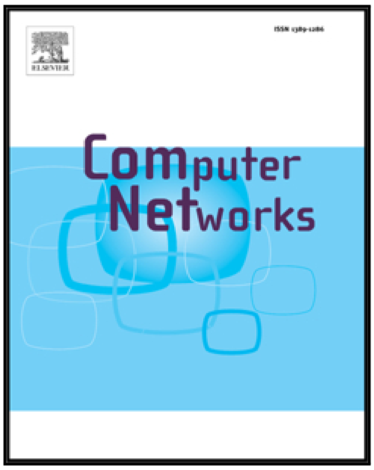

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Virtualization-based Evaluation of Backhaul Performance in Vehicular Applications

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Abstract

Next-generation networks, based on SDN and NFV, are expected to support a wide array of services, including vehicular safety applications. These services come with strict delay constraints, and our goal in this paper is to ascertain to which extent SDN/NFV-based networks are able to meet them. To this end, we build and emulate a vehicular collision detection system, using the popular Mininet and Docker tools, on a real-world topology with mobility information. Using different core network topologies and open-source SDN controllers, we measure (i) the delay with which vehicle beacons are processed and (ii) the associated overhead and energy consumption. We find that we can indeed meet the latency constraints associated with vehicular safety applications, and that SDN controllers represent a moderate contribution to the overall energy consumption but a significant source of additional delay.

1. Introduction

Vehicular networks are mobile wireless networks whose nodes are represented by connected vehicles and the infrastructure supporting them, e.g., road-side units (RSUs) providing Internet connectivity, as exemplified in Fig. 1. Current and expected applications abound, and include navigation, e.g., downloading maps or traffic updates, and entertainment, e.g., streaming movies to on-board entertainment systems similar to those found on airplanes.

A third, and arguably more critical, application of vehicular networks is represented by *safety*: indeed, in 2015 road accidents accounted for over 35,000 deaths in the United States alone [1], and over one million worldwide [2]. The most significant of these safety applications is *collision detection*. The idea of collision detection is fairly simple, and is summarized in Fig. 1. Vehicles periodically [3] (and anonymously [4]) report their position, direction and speed to a *detector*. The communication between vehicles and detectors happens through *road-side units* (RSUs), that make communication possible even in non-line-of-sight (NLoS) conditions, e.g., due to buildings or other obstacles. The detector combines these reports, determines whether any two vehicles are set on a collision course, and, if so, it alerts their drivers. Collision detection is especially important in presence of obstacles, e.g., buildings, that prevent drivers from