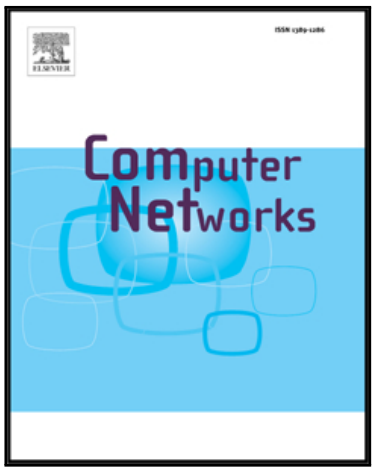


# Determining vehicles' radio transmission range for increasing cognitive radio VANET (CR-VANET) reliability using a trust management system

Salman Goli-Bidgoli , Naser MovahHedinia

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# *Determining vehicles' radio transmission range for increasing cognitive radio VANET (CR-VANET) reliability using a trust management system*

SALMAN GOLI-BIDGOLI, University of Isfahan, IRAN, salmangoli@gmail.com
NASER MOVAHHEDINIA, University of Isfahan, IRAN, naserm@eng.ui.ac.ir

**Abstract**: As a part of an intelligent transportation system, a Vehicular Ad-Hoc Network (VANET) requires reliability by way of an essential need. Timely and accurately delivering safety messages in VANET is one of the reliability issues affected by different factors such as the lack of frequency spectrum as well as nodes' inabilities or misbehaviors. To overcome spectrum shortage, Cognitive Radio (CR) has been proposed while employing a trust mechanism can lessen any damage caused to reliability by incapable or misbehaver nodes. An effective trust management system can analyze 'agree' and 'disagree' messages and decide about an event to increase reliability. However, message transmission based on trust assessment imposes an extra decision delay causing a reliability cutback, especially in delay-sensitive safety messages. In this research, an effective trust management system for CR-VANET is proposed and analyzed based on a Birth and Death Process (BDP) model to evaluate the average delay imposed by the decision-making process. The probability of event occurrence is also derived in terms of arrival message rate. Moreover, the minimum and maximum permissible range of radio transmission to reach an acceptable degree of reliability, based on the above analysis, are determined. Simulation results show that, using the proposed radio transmission range, reliability can be improved by increasing the accuracy of event detection while reducing decision-making and safety message delivery delays.

Keywords: Vehicular Ad-Hoc Networks, Reliability, Trust Management System, Birth and Death Process, Radio Transmission Range.

## 1. INTRODUCTION

VANETs, as a subset of mobile ad-hoc networks, have attracted the attention of numerous researchers [1]. They involve different properties regarding certain aspects, which include specialized applications, unrestricted energy, convenient access to GPS, multi-hop communications, and communication with road side units (RSUs).

There are three applications of a VANET: safety, non-safety and entertainment. One of the most important goals of a VANET is to increase the reliability of safety applications, and using an efficient MAC protocol is necessary in achieving this goal [1]. All of these applications, however, jointly use the available bandwidth [2]. To this extent, safety packet forwarding, only after evaluation, is a good way to optimize channel usage and increase reliability.

On the other hand, improving the reliability of VANETs using CR has been previously demonstrated [3]–[5]. CR can reduce the contention period and safety packet delivery delay in addition to increasing reliability. However, the spectrum handoff delay has been neglected in the reliability evaluation of CR-VANETs [6]. In this way, considering this parameter in trust management system design and reliability evaluation is among the contributions of this research.

Many different definitions have been proposed for MAC layer reliability. Some reliability definitions are concerned with correct safety message delivery [7], [8], timely delivery of safety messages and end-to-end delay [3], [6], [8], [9], or average percentages of accessible vehicles to receive a safety message [10]. In order to avoid a multiplicity of reliability definitions, the definition adopted here is similar to [11], *the ability to carry out the assigned task within the constraints of required efficiency.*

So far, copious activity has been carried out to increase networks' reliability although nothing noteworthy has been conducted to examine the effect of trust management system on reliability [12]. The existence of malicious and selfish users, or those who cannot send