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Performance Evaluation of Data Delivery Mechanism For CognitiveRadio Vehicular And Vehicular Ad-Hoc Networks

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Abstract

Recently, the Vehicular Networks are gaining increased attention for generating extensive wireless communication. They are also integrated with Cognitive Radio to further enhance their performance. However the guaranteed delivery of data is an important parameter for evaluating these networks. This paper provides a simple, but nevertheless extremely accurate, simple model to evaluate the performance of both Vehicular Ad-hoc and Cognitive Radio Vehicular Networks. The proposed analysis applies to both the networks on the basis of various parameters like delay, packet loss, packet drop ratio, throughput using extensive simulation. The results validate the assumption that Cognitive Vehicular Radios outperform the` VANET's when various types of packets are transmitted using V2V communication.

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Keywords: Vehicular Ad-hoc Networks;Cognitive Radio;Cognitive Vehicular Radio;

1. **Introduction**

Wireless communication technologies have been gradually impacting almost all spheres of our lives. Both indoor wireless LANs as well as outdoor cellular mobile networks has provided benefits to the global population in one form or another. The evolution of Vehicular Ad-hoc Network (VANETs) is gradually gaining increased momentum and attention. VANETs are an emerging technology that can be provided a viable solution to most of the problems

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associated with the modern transportation system. The Inter-Vehicle Communication (IVC) systems have the potential to increase the safety, efficiency and comfort of everyday road travel in VANETs.

As we know the increasing traffic on roads is creating bottlenecks for traffic movement and this requires us to focus on safety applications such as Collision Avoidance, Road Congestion, Emergency Message Delivery of vehicles on the road as well as entertainment applications like multimedia- streaming, advertisements etc. VANETs provide an effective solution for both categories of problems. The network communication can be either Vehicle to Vehicle (V2V) or Vehicle to Infrastructure (V2I)[1,2] . Dedicated Short Range Communication (DSRC)[3] is used in VANETs for point to point communication for short distance communication. US Federal Communication Commission (FCC) provides 75MHz of DSRC band of 5.9GHz frequency for this communication. Wireless Access in Vehicular Environment (WAVE)[4] protocol is also utilize for regulating various network operations and 802.11p[5] standard helps to support communication in dynamic vehicular environment .

Thus efficient data delivery mechanisms are required so that VANETs can be employed in present as well as in future for providing sustainable user comfort and safety. The next generation Vehicular Networks will therefore integrate existing VANETs with Cognitive Radio (CR) to further enhance their capability. CR[6] deals with the efficient utilization of wireless spectrum band. The ever increasing demand due to growth of wireless communication is resulting in correspondingly higher requirement of more spectrums. Most of the bands are provided to licensed services like in TV broadcast[7] or cellular networks. Thus there is fixed band width provided for these networks, but their spectrum is generally underutilized. So FCC has proposed a scheme which utilizes the CR by using a hybrid technique in which wasted band in the spectrum which is not used by primary users are provided to unlicensed secondary users. These users always monitor the activity of primary users and try to find out the spectrum holes by various spectrums sensing techniques[8]. These networks are thus able to modify its physical behavior independently. The change in behavior of physical layer depends upon its past experience and current characteristics of environment. They can also perform complex adaptation strategies according to their cognition cycle. They can change their transmutation power, channel selection to meet QoS requirement of user.

Recently VANETs have the integrated with CR technology for enhancing their capability of communication[9]. These CR-enabled vehicles (CRV) have capability to use additional spectrum band outside the IEEE 802.11p specified standard. The CRVs utilize the existing vehicular communication system and enhance their capabilities by making them adaptive to wide variety of applications. This hybrid technology provides high bandwidth and is very helpful in applications such as multimedia. This is very useful for opportunistic spectrum usage. In such networks, each of the CRV's implements the spectrum management in coordination so that it does not interfere with the licensed owners.CR have many unique features that makes its more flexible to use with vehicles like its dynamic nature, high bandwidth, proper utilization of spectrum band.

CRV networks basically fall under three categories as shown in Figure 1.Figure (a) illustrates the process of cooperation within vehicles for achieving the higher network output. The propose system will utilize this model for V2V communication, in figure (b) interaction between vehicles take place through the Road side unit (RSUs).

Here information is initially sent to the nearest RSU and then this RSU forwards the information to next vehicle periodically. In figure (c) there is a centralized Base Station (BS) structure in which BS automatically decides which channel is to be used without interacting with vehicle and this provide completely centralized network with increased resource utilization.

In this paper, we successfully design a simple model that evaluate the performance of CRVs and VANETs, this also allows to compute the throughput, delay, packet delivery ratio and delay performance for both networks. This also enables our assumption such as CR performs better than VANETs due to its dynamical adaptive nature to be true. As simulation results proved our assumptions extremely true, especially in the case when the number of vehicles and simulation time in wireless scenario is more.