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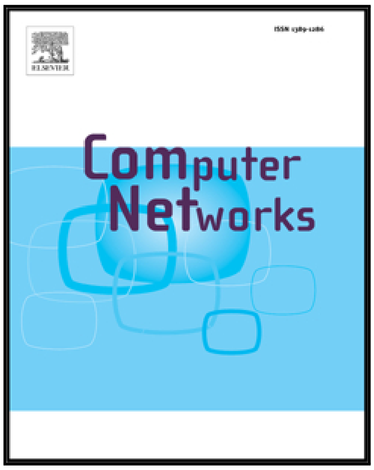

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Prabhat Thakur , Alok Kumar , S Pandit , G Singh , SN Satashia

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Analysis of High-Traffic Cognitive Radio Network with Imperfect Spectrum Monitoring Technique

Prabhat Thakur[1], Alok Kumar[1], S Pandit[1], G Singh[1] and S N Satashia[2]

[1]Department of Electronics and Communication Engineering,
Jaypee University of Information Technology, Waknaghat-173215, India
[2]Space Application Centre, Indian Space Research Organization, Ahmedabad -380015, India
prabhat.thakur@mail.juit.ac.in, (alok.kumar, shweta.pandit, ghanshyam.singh)@juit.ac.in,
satashia@sac.isro.gov.in)

Abstract— **This paper introduces the concept of imperfect spectrum monitoring for realistic wireless communication environments with high-traffic cognitive radio networks (HTCRN). The effect of imperfect spectrum monitoring in the HTCRN is analyzed in terms of the probability of data-loss (in the form of packets) and interference at primary user (PU). Further, two algorithms are proposed to compute the data-loss and interference-at-PU considering different scenarios of the traffic-intensity and spectrum monitoring error. Moreover, the closed-form expressions for the ratio of achieved-throughput to the data-loss, power-wastage, interference-efficiency as well as energy-efficiency are derived, and numerically simulated results are presented to support the proposed work. Furthermore, the randomness in emergence of PU is considered and the Monte-Carlo simulations are exploited to validate the numerically simulated results.**

Index Terms—**Cognitive Radio, Data-Loss, Energy-Efficiency, Interference-Efficiency, Throughput, Spectrum Monitoring.**

I. Introduction

Cognitive Radio (CR) is an promising technology in the field of wireless communication, which enables the unlicensed/cognitive user (CU) to access the spectrum/channel of the licensed/primary user (PU) without interfering with PU [1-3]. In the "high-traffic (traffic intensity of the PU is greater than 0.5)[1] cognitive radio networks (HTCRN)", the PU exploites the spectrum very frequent and random selection of the channel for sensing leads to the active detection of channel. The active detection of channel reduces the performance of spectrum sensing and results in the wastage of "sensing-energy" and "sensing-time" [4]. Therefore, it is worth to forecast the state of channel before sensing and if it is forecasted as idle only then perform the spectrum sensing [5]. The complete coomunication process using time frame which comprises the spectrum prediction/forecasting, spectrum sensing and data-transmission phases, proceeds as follows and shown in Fig. 1(a).

[1] An appropriate example of the high traffic environment is mobile network in the busy hours and internet rush hours. In the busy hours [6], most of the channels are occupied at most of times and in addition the mobile users come very frequently in the idle time slots.

The CU predicts the state of channels (active or idle) and senses only the idle predicted channels in order to improve the sensing errors and communicates via (with full-power i.e. interweave approach [7]) on the idle sensed channel [8]. Even though, the CU knew the channel state before to start the data transmission, however the possibility of "re-appearance of PU" is very significant phenomenon [9]. Therefore, two approaches, namely, the proactive and reactive are proposed in the literature to detect the "re-appearance of PU during data transmission". In the former approach, the CU exploits the prediction technique in order to detect the "emergence (re-appearance) of PU" and switches its communication before the "actual emergence of PU" as reported in detail in [10-12]. In the spectrum prediction approaches, the pre-available information about the channel states and training of the device/CU is required to forecast the future behaviour of the channel. This information is used to improve the "sensing reliability of CU" by selecting only the idle predicted channel for sensing and spectrum switching with the "emergence of PU" [10-12]. Due to the dynamic and random nature of channels, the spectrum prediction is a potential option to increase the sensing reliability however, the channel access decision is obtained on the basis of sensing results rather than the prediction results. However, the spectrum sensing appears as a unfruitful approach for spectrum switching because the "emergence of PU during the CU transmission" cannot be detected by employing the spectrum sensing process as the spectrum sensing and data transmission performs at different time slots.

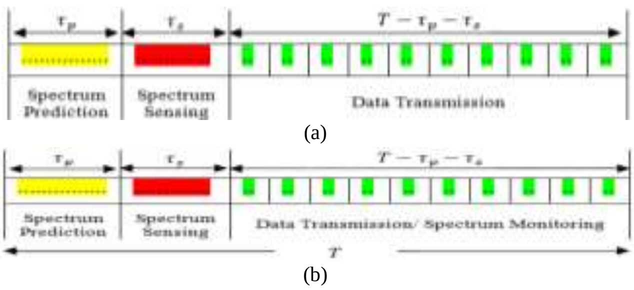

Fig. 1 The time-frame for HTCRN model (a) conventional [5] and (b) proposed.