ISSN: 2277-9655
Impact Factor: 4.116
CODEN: IJESS7

IJESRT
INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

DESIGNING INTELLIGENT TRANSPORTATION SYSTEM FOR COGNITIVE RADIO MOBILE AD- HOC NETWORKS

Prasenjit Mahato*, Krishna Satya Varma Mantena
* Department of Information Technology (IT) S.R.K.R Engineering College, Bhimavaram. Andhra University, Visakhapatnam
Assistant Professor Dept of Information Technology (IT) S.R.K.R Engineering College, Bhimavaram. Andhra Pradesh

DOI: 10.5281/zenodo.168437

ABSTRACT

Time and the Constraint are both typically interrelated and lead us to the next level high technological revolution journey where we analyses the Human Automation instead of System Automation. Technological in the View Point cognitive science Information technology will have to make high level of demanding journey; in that aspect we consider the best of the technical revolution in the Social media where we share the thoughts , informational to many more . In cognitive radio networks (CRNs), secondary users (SUs) can flexibly access primary users' (PUs') idle spectrum bands, but such spectrum opportunities are dynamic due to PUs' uncertain activity patterns. In a multi hop CRN consisting of SUs as relays; such spectrum dynamics will further cause the invalidity of predetermined routes. In this paper, we investigate spectrum-mobility-incurred route-switching problems in both spatial and frequency domains for CRNs, where spatial switching determines which relays and links should be reselected and frequency switching decides which channels ought to be reassigned to the spatial routes. The proposed route-switching scheme not only avoids conflicts with PUs but also mitigates spectrum congestion.

KEYWORDS: Routing, spectrum dynamics, Transport protocol, cognitive radio, mobile ad hoc network, multi-hop communication.

I. INTRODUCTION

Cognitive Radio Network (CRN) is a primary network infrastructure operated within a spectrum band with a license such as TV broadcast network which provides services to the primary users. CRN is able to work in both licensed band and unlicensed band. A cognitive radio network (CRN) is defined as intelligent wireless communication networks of CRs, where the network can improve the end-to-end performance of the system by adaptively reconfigure its communication parameters. CRN has two types of user, primary user and secondary user. Primary User (PU), also known as the primary service licensed user, has the exclusive right on the radio spectrum. On the other hand, Secondary User (SU) is the secondary service and/or unlicensed user, also known as the cognitive user, who utilizes the free spectrum and has to vacate the spectrum band as soon as the PU appears [4]. With the current spectrum allocation policy, all of the spectrum bands are exclusively allocated for licensed users (i.e., primary users PUs), and violation from unlicensed users (i.e., secondary users SUs) is not allowed. A primary network makes use of licensed band for primary user and Secondary network make use of unlicensed band for secondary user (Fig. 1). In CR system, the secondary user seeks the opportunity to use free radio spectrum when the primary user is not active. In other words, Cognitive User is allowed to use the licensed spectrum in a given time and location when and where the PU is idles. Thus in CRN, the SU can use the spectrum temporarily, which makes the SU an important component in CRN architecture [7]. The sensing operation of the channel in CRN is based on the sensing measurement. The measurement is done by the cognitive radio members in two ways such as Centralized and Cooperative [4].

In Cognitive Radio Mobile Ad hoc Network (CogMANET) is developed where the channel switching is done the primary user appears on the channel with the license and allow secondary users to choose available channel from among a wide spectrum range thus enables reliable communication in this context, CogMANET, the channel switching is inherently necessary when primary users appear on the channel. During the channel switching, the communication, characteristics such as bottleneck bandwidth and RTT will change.

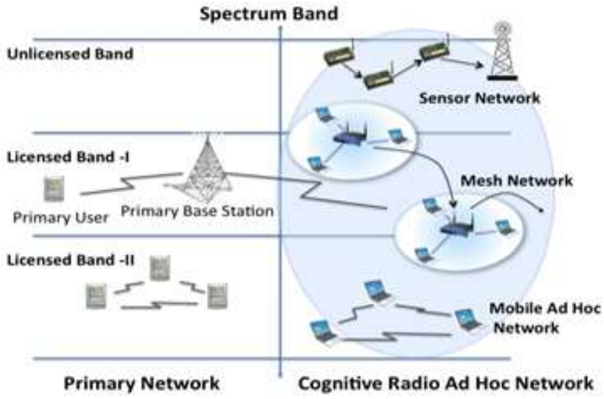


Fig. 1 **Cognitive Radio Mobile Networks**

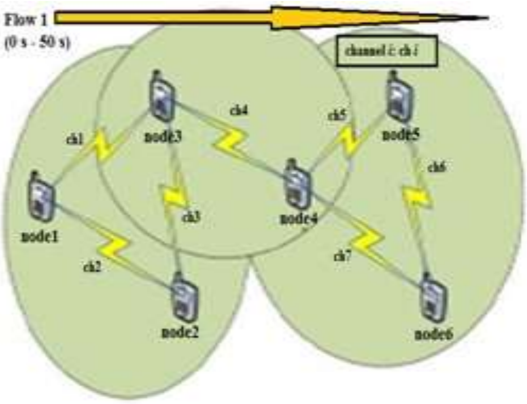


Fig. 2 Cognitive Radio MANET Architecture

change, TCP has to adaptively update its congestion window (*cwnd*) to make an efficient use of the available resources. For this purpose, TCP CRAHN was proposed for CogMANET. Furthermore, it is assumed that SUs are allowed to use some wide range of the spectrum, such as 400 MHz to 6MHz, in a future CogMANET, for spectrum efficiency.

During the channel switching the communication parameters such as bottleneck bandwidth [6], RTT, cwnd and Bandwidth Delay Product (BDP) will change accordingly. TCP CoBA is developed and compared with TCP CRAHN. It's show that the TCP CoBA improves the throughput than TCP CRAHN.

TARGET NETWORK

Our focus in this paper that, packet losses on wireless links do not occur since the goal is to focus on the impact of cognitive radio only. Interference in CR networks depends on the sensing accuracy, which is determined by the observation time. However, in periodic sensing, SUs users cannot sense the spectrum bands during the transmission time, which leads to the increase in interference, which has potential to interfere with PU communication [8]. Thus, for the interference avoidance, both the observation time and the transmission time need to be considered in the periodic spectrum sensing method. SUs users are not able to perform the transmission and sensing tasks at the same time. Thus, due to this hardware limitation.

RELATED WORK

TCP CRAHN

TCP CRAHN is a window-based, spectrum-aware protocol for CR ad-hoc networks that distinguishes between the different spectrums specific conditions in order to undertake state-dependent recovery actions. TCP CRAHN comprises of 6 states addressing a particular CR network condition namely, Connection establishment, Normal, Spectrum sensing, Spectrum change, Mobility predicted, and Route. To obtain the sensing schedules of the nodes in the routing path, TCP CRAHN modifies the three-way handshake in TCP NewReno. First, the source sends SYN packet to the destination. An intermediate node in the routing path appends its ID, a timestamp and other sensing related information to the SYN packet. The receiver in response to the SYN packet sends a SYN-ACK message back to the source. The sensing information collected for each intermediate node is saved over the SYN-ACK. This process helps the source to know when a node undertakes spectrum sensing and its duration. Finally an ACK is sent by the source to the destination to complete the 3-way handshake process, constituting the connection establishment process. In TCP CRAHN, these collected sensing times from the nodes are dynamically updated. In CRAHN, nodes switching their channels measure communication characteristics (link bandwidth W, link delay L^T) and send back related information to the TCP sender. Whenever the TCP sender receives the information, the bottleneck bandwidth (W_b') is calculated using this information. When (W_b') is changed by over 20% relative to the value before channel switching, the sender updates *cwnd* and RTT is the link delay before channel switching. In TCP-CRAHN updated *cwnd* is intentionally limited to less than the *cwnd* limit.

EXISTING SYSTEM

A promising way to improve not only the survivability but also the reliability of communication in CogMANET is to allow SUs to select a communication channel satisfying their application requesting from a wide range of spectrum. However, since SUs always need to guarantee no impact on PU performance, they have to engage in

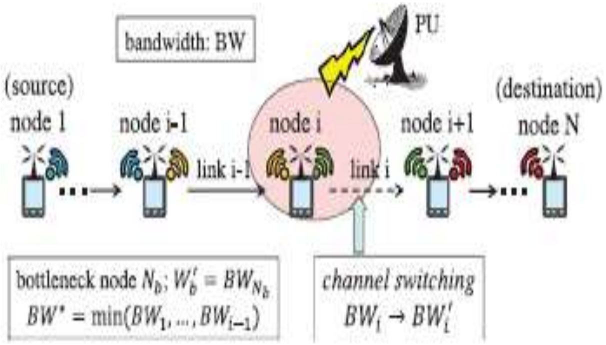
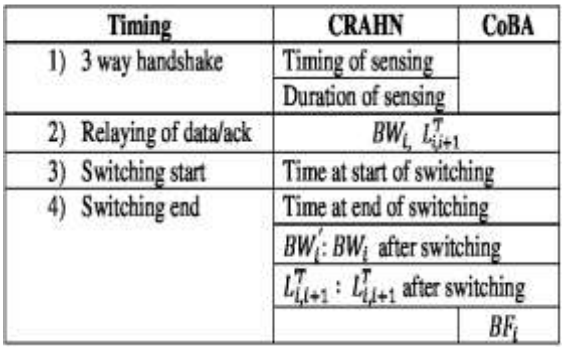


Fig 3: Channel Switching



Timing	CRAHN	CoBA
1) 3 way handshake	Timing of sensing	
	Duration of sensing	
2) Relaying of data/ack	BW_i, $L^T_{i,i+1}$	
3) Switching start	Time at start of switching	
4) Switching end	Time at end of switching	
	BW'_i: BW_i after switching	
	$L^T_{i,i+1}$: $L^T_{i,i+1}$ after switching	
		BF_i

Table 1: Feedback Information from Relay Nodes

periodical sensing to detect PUs and then switch channels whenever a new PU appears. Hence, communication in CogMANET is likely to experience changes in characteristics in terms of bottleneck bandwidth and round-trip time (RTT) due to channel switching. Therefore, we will propose a new TCP which solves this issue in the following section.

TCP CoBA

TCP CoBA (Concurrent Bandwidth Aggregation) is totally same therewith of TCP New-Reno apart from the amount of channel switch, as within the TCP CRAHN. SU will synchronously execute periodical sensing by exploiting GPS operate. CoBA is projected to attain high performance by change the *cwnd* fittingly in response to the modification within the bottleneck information measure and RTT. CoBA conjointly updates the *cwnd* (Fig.4) once the RTT is modified by over twenty percent attributable to channel switch that is completely different from CRAHN. CoBA freezes knowledge transmission and RTO timer throughout the channel switch as in CRAHN.

Feedback-Based Method:

A sender of TCP CoBA will get numerous data from every relay node. Relay nodes send the knowledge within the following four cases: (1) tripartite acknowledgment (2) forwarding of information packet (3) begin of channel switch and (4) finish of channel switch as shown in Table 1. In the Table, where $\mathrm{BW_i}$ is the bandwidth on link i, L.

Bi-directional flows exist every of the 2 neighboring nodes experiencing channel switch sends back the feedback data to the TCP sender, in order that every of the TCP senders adjusts the transmission rate to the acceptable price supported the updated *cwnd*. Sender node of TCP CoBA receives feedback data transmitted from relay nodes once channel switch the end-to-end principle can't be applied to CoBA as within the CRAHN. Cooperative management between sender node associated relay nodes needs an exchange of management message, thereby increasing not solely procedure load however conjointly message overhead within the network.

Procedures for cwnd Updates

When a relay node changes its channel if PU communication is detected its bandwidth and link delay can also be changed. This change is drastic when the bottleneck bandwidth or RTT changes. We can categorize cases of where the bottleneck node is located into two cases, depending on whether the remaining buffer space at the switching node should be considered or not. The first case is that the bottleneck node is located on a path from the TCP sender to node in which even in the bottleneck node the buffer will be empty by the end of channel switching because the TCP sender stops sending packets during channel switching.

a) When the TCP sender receives the feedback message after channel switching, it calculates the $\mathrm{RTT_{new}}$ by Eq. (1).

$$RTT_{new} = L^T_{1,2} + \cdots + L^T_{i-1,i} + L'^T_{i,i+1} + \ldots \qquad (1)$$

It's also includes queuing delay in $L^T_{i,i+1}$, because the new cwnd result assumes that some packets are in buffered at relay nodes. This can congest the buffer, while achieving high throughput, if remaining buffer space is large enough.

b) The $\mathrm{W_b}$ is the bottleneck bandwidth and $\mathrm{RTT_{old}}$, The RTT before channel switching. The W'_b or $\mathrm{RTT_{new}}$changed by over 20 percent from the previous value before channel switching (i.e., $\mathrm{W_b}$and $\mathrm{RTT_{old}}$), the sender updates cwnd.

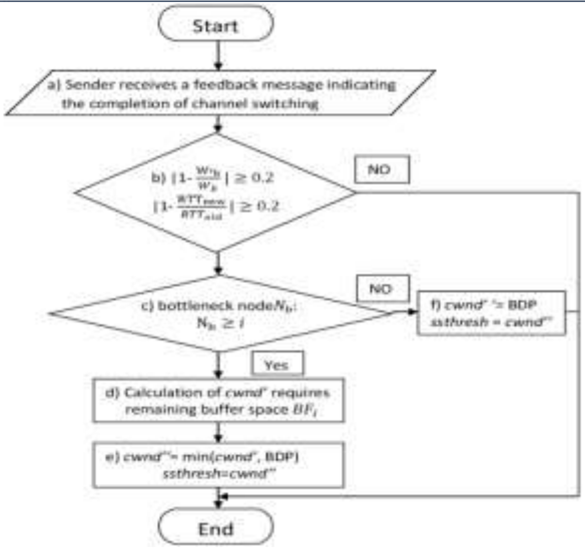


Fig 4: Procedure for *cwnd* updates

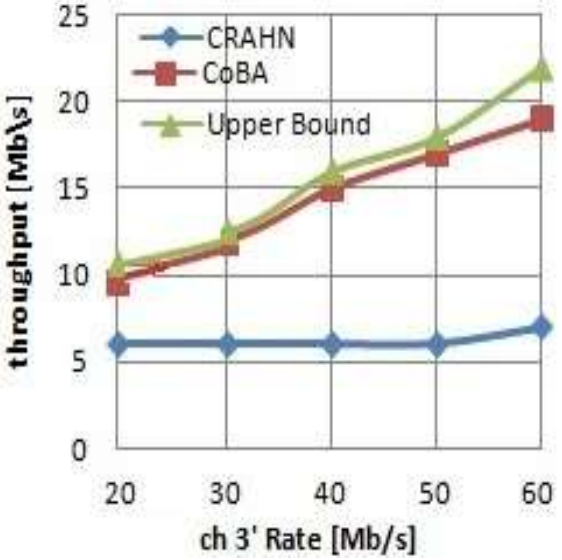


Fig.5 Bottleneck node is switching node-BW$_i$ of 3′ set 20 to 60Mb/s

c) In the section b the cwnd updates diagram in (Fig. 4) if success then this step depends on the bottleneck node $N_b$is located. It is very carefully to deal with the case where the bottleneck node is just node *i* or some other node located between node *i* and node N after channel switching, i.e., N_b>1 (i.e. in the figure (d) section). Or else, the *cwnd* and *ssthresh* are determined by just BDP (in the figure (f) section).

d) Here in this section, the *cwnd'* that restricts buffer overflow in the bottleneck node $N_b$based upon the remaining buffer space given by node $N_b$is derived. For example, we suppose that cwnd in incremented to *cwnd'*. In this scenario, some packets of *cwnd'* – *cwnd*, which is known by R[packets], are permitted to be sent. In Eq. 3 the R consecutive packet arrivals cause the queue of packets to increase by BL_{N_b}. Now, in order to prevent buffer overflow in node N_b, $BF_{N_b} \geq BL_{N_b}$. Furthermore, the bandwidth of node N_b is smaller than that of node *i*. The value of $BL_{N_b}$is not to be smaller than BF_i. We can assume that, $BF_{N_b} = BF_i$ and BL_{N_b} satisfies inequality (4). Therefore, *cwnd'* considering BF_i is calculated by Eq. 5.

$$\mathrm{R[pkts]} = (\mathrm{cwnd}'[\mathrm{pkts}] - \mathrm{cwnd}[\mathrm{pkts}]), \qquad (2)$$

$$BL_{N_b}[pkts] = R\left(1 - \frac{\mathrm{W}'_{\mathrm{b}}}{BW^*}\right),$$

$$= (cwnd' - cwnd)\frac{BW^* - \mathrm{W}'_{\mathrm{b}}}{BW^*} \qquad (3)$$

$$\mathrm{BF_i}[pkts] \geq BL_{N_b} = (cwnd' - cwnd)\frac{BW^* - \mathrm{W}'_{\mathrm{b}}}{BW^*} \qquad (4)$$

$$\mathrm{cwnd}''[\mathrm{pkts}] = BF_i \frac{BW^*}{BW^* - W'_b} + \mathrm{cwnd}. \qquad (5)$$

e) In the switching node, the *cwnd'* can avoid the buffer overflow. But it does not update the BDP account which is known to be desirable for *cwnd*. So, it occur congestion when *cwnd* is updated to *cwnd'*. To overcome this problem, the TCP sender of CoBA also calculates BDP by using Eq. (6), and it also updates *cwnd* by using Eq. (7). In addition, after channel switching the TCP sender of CRAHN can change its mode to slow start instantly after channel switching, because of the non-updated ssthresh. So finally, buffer overflow may occur. Hence, the TCP sender of CoBA updates ssthresh using Eq. (10).

$$\mathrm{BDP[pkts]} = \frac{W'_b\,[\mathrm{b/s}].\mathrm{RTT_{new}[s]}}{PS[b/pkt]}, \qquad (6)$$

$$\mathrm{cwnd}''[\mathrm{pkts}] = \min(BDP, cwnd''), \qquad (7)$$

$$ssthresh[pkts] = \mathrm{cwnd}''. \qquad (8)$$

f) The cwnd and ssthresh are determined by BDP only by Eq. (9), which is equivalent to Eq. (10), when the bottleneck node N_b is Situated on a route between TCP sender and node *i*.

$$\mathrm{cwnd}''[\mathrm{pkts}] = \frac{W'_b\,[\mathrm{b/s}].\,\mathrm{RTT_{new}[s]}}{PS[b/pkt]}, \qquad (9)$$

$$ssthresh[pkt] = \mathrm{cwnd}''. \qquad (10)$$

PERFORMANCE EVALUATION

In this performance evaluation section, we can see how improves the performance of communication by comparing between two different techniques CRAHN and CoBA. As shown in Fig. 4, the procedure for *cwnd* updates in different ways it's depend upon the location of bottleneck node. Here, we examine the impact of the change in bottleneck bandwidth and RTT due to channel switching affects on single flow of CRAHN and CoBA. In the Fig. 3, when the *cwnd* and the queue length of node 3 is not only switching node it is also a bottleneck node. The bandwidth of channel 3′ is 60 Mb/s. The sender of CoBA can increase the *cwnd* to a best value when node 3 switches from low rate channel 3 to higher rate channel 3′, while preventing buffer overflow in the switching node, In the same scenario the *cwnd* of CRAHN is drastically increased and then immediately reduced. It's happen because the buffer in the relay nodes overflowed due to an excessive large *cwnd*. Finally, throughput of CRAHN is degraded. When node 3 switches from high rate channel 3′ to low rate channel 3, CoBA can decrease the *cwnd* to a best value. In Fig. 5 it shows the average throughput between the TCP-CRAHN and CoBA, when the channel 3′ bandwidth is changed from 20 to 60 Mb/s. Now, we can examine that the throughput of CoBA is higher than the CRAHN; this is the advantage of CoBA. When we compare with other TCP variants the huge changes in the communication characteristics for each channel switching. For example, when channel 3′ is 60 Mb/s, TCP-CoBA can achieve up to a 200 percent improvement in performance compared to CRAHN.

CONCLUSION

Primary users wish to achieve as much profit as possible. Such problems can be discussed within the range of a double auction design. We would like to design mechanism to achieve several properties. First of all, truthfulness is one of the most important properties to implement an auction in order to achieve efficiency. When a mechanism is truthful, each secondary will maximize his profit by telling the truth. This property is extremely important because if a certain user can increase his utility by misreporting his value, the auction will be vulnerable to market manipulation. It will harm both the primary users and the other secondary users' profits. Efficiency is also one of the desirable properties. We can usually achieve that by maximizing social welfare, which can be defined as the sum of each user's utility. If we maximize social welfare each round, we are guaranteed to have an efficient mechanism, and yet it may lead to unfairness.

REFERENCES

[1] Y. R. Kondareddy and P. Agrawal, "Effect of dynamic spectrum access on transport control protocol performance," in Proc. IEEE Global Telecommun. Conf., 2009, pp. 1–6.
[2] A. M. R. Slingerland, P. Pawelczak, R. V. Prasad, A. Lo, and R. Hekmat, "Performance of transport control protocol over dynamic spectrum access links," in Proc. 2nd IEEE Int. Symp. ew Frontiers Dyn. Spectr. Access Netw., 2007, pp. 486–495.
[3] W. Kim, A. Kassler, and M. Gerla, "TCP performance in cognitive multi-radio mesh networks," in Proc. 4th Int. Conf. Cognitive Radio Adv. Spectr. Manage., 2011, p. 44.
[4] M. D. Felice, K. R. Chowdhury, W. Kim, A. Kassler, and L. Bononi, "End-to-end protocols for cognitive radio ad hoc networks: An evaluation study," Elsevier Perform. Eval., vol. 68, no. 9, pp. 859–875, 2011.
[5] A. Al-Ali and K. R. Chowdhury, "TFRC-CR: An equation-based transport protocol for cognitive radio networks," Elsevier Ad Hoc Netw. J., vol. 11, no. 6, pp. 1836–1847, 2013.
[6] K. Tsukamoto, S. Matsuoka, O. Altintas, M. Tsuru, and Y. Oie, "Distributed channel coordination in cognitive wireless vehicleto-vehicle communications," in Proc. Int. Conf. Wireless Access Veh. Environ., 2008, CD-ROM.
[7] K. Chen, Y. Xue, and K. Nahrstedt, "On setting TCP's congestion window limit in mobile ad hoc networks," in Proc. IEEE Int. Conf. Commun., pp. 1080–1084, 2003.
[8] F. Li, M. Li, R. Lu, H. Wu, M. Claypool, and R. Kinicki, "Measuring queue capacities of IEEE 802.11 wireless access points," in Proc. 4th IEEE Int. Conf. Broadband Commun., Netw. Syst, pp. 846–853, 2007.
[9] W. Y. Lee and I. F. Akyildiz, "Optimal spectrum sensing framework for cognitive radio networks," IEEE Trans. Wireless Commun., vol. 7, no. 10, pp. 3845–3857, Oct. 2008.
[10] C. Luo, F. R. Yu, H. Ji, and V. C. Leung, "Optimal channel access for TCP performance improvement in cognitive radio networks," Springer Wireless Netw., vol. 17, no. 2, pp. 479–492, 2011.