Coordinated Multipoint Joint Transmission Algorithm with Cognitive Radio Network for Improvement in Advance Cellular Communication

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***Abstract*—Cognitive radio (CR) has been proposed as an innovation to improve the range use effectiveness by giving a sharp access of the unused/underutilized range to unlicensed clients. Then, coordinated multipoint joint transmission (JT) is another promising method to improve the presentation of cognitive radio system. In this paper, we propose a CR framework with coordinated mul-tipoint JT strategy. A logical model is created for the got signal-to-commotion proportion at a CR to decide the vitality recognition limit and the base number of required examples for vitality location based range detecting in a CR organize (CRN) with CoMP JT procedure. The exhibition of vitality identification based range detecting under the created expository model is assessed by recreation and saw as dependable. It is figured an enhancement issue for a CRN with coordinated multipoint JT strategy to design the channel assignment and client planning for expanding the base throughput of the clients.**

***Index Terms*—Cognitive, Joint Transmission, CRN, Energy, Throughput.**

1. INRODUCTION

Cognitive radio (CR) has been proposed as an innovation to improve the range usage proficiency by giving an astute access of the unused/underutilized range to unlicensed clients it is the key empowering innovation that empowers cutting edge correspondence systems, otherwise called dynamic range get to (DSA) systems, to use the range all the more effectively in a pioneering design without meddling with the essential clients. It is characterized as a radio that can change its transmitter boundaries as per the connections with the earth where it works [3]. It contrasts from regular radio gadgets in that a cognitive radio can outfit clients with cognitive capacity and reconfigurability [4], [5].

Cognitive capacity alludes to the capacity to detect and accumulate data from the general condition, for example, data about transmission recurrence, transfer speed, power, tweak, and so forth. With this ability, optional clients can distinguish the best accessible range. Reconfigurability alludes to the capacity to quickly adjust the operational boundaries as indicated by the detected data so as to accomplish the ideal execution. In light of its capacities to distinguish and adjust to various radio conditions, cognitive radio has been characterized in different manners. Cognitive radio frameworks can chiefly be separated into 2 classes: underlay and intertwine. In underlay plot, the SUs, ie, cognitive clients get to the range while keeping the impedance at the PU, ie, authorized client under a specific cutoff. Then again, in interlace plot, the SUs get to the range while PU is inert and the SUs use range detecting method to decide the inertia of the Discharge. The join plot is the most appropriate for the current range the board approaches and inheritance remote frameworks. Range detecting is one of the key capacities in interlace CR organize (CRN). For exact identification of action on a range, precise range detecting procedures are required. While the idea of CR puts accentuation on better utilization of remote range and expanding all out throughput, there is as yet developing requirement for development in the inclusion of high information rates and an expansion in client/framework throughput.16 Participation among the base stations (BSs) in a system of little cells is one suitable answer for this issue. Expanding the information pace of cell-edge clients is additionally a worry in cell systems. Coordinated multipoint (CoMP) transmission is right now being considered as a viable answer for both these worries. In CoMP activity, various BSs arrange with one another so that the transmission signals from/to different focuses don't cause genuine impedance and adventure the advantages of dispersed numerous radio wire frameworks.

Both CR and CoMP transmission are exceptionally encouraging ideal models for future cell systems. A few investigates have been led on CoMP transmission–based CRNs. These investigates can be separated into 2 classes: underlay and intertwine. Underlay CRN with CoMP transmission has been concentrated in this examination under different angles by limiting the impedance to the Discharge under an edge.

2. System Description

We expect that a PU transmitter exists, which is continually transmitting with transmit power Ppu tx. The transmission intensity of the SU transmitters is equivalent and meant by Psu tx. There are 2 auxiliary transmitters that can perform non cognizant CoMP JT craftily on the authorized PU band. We accept that the SU transmitters arrange among themselves and perform JT just when them two recognize the channel as inactive. A run of the mill framework is appeared in Figure 1, where PU TX and PU RX are the essential transmitter and recipient, individually, and SU TX1 and SU TX2 are auxiliary transmitter 1 and optional transmitter 2, separately. The essential transmitter is put at cause (0,0), and the places of different transmitters and recipient are appeared in polar directions. We accept that the essential collector moves about cause around whose span is the ensured sweep Rp. Ensured range (Rp) of the essential transmitter is the span inside, which an essential beneficiary (PU RX) must be ensured gathering, in any event, when the SU transmitters (SU TXs) transmit utilizing a similar PU channel. In this locale, essential beneficiary (PU RX) gets a base expected sign to-obstruction in addition to clamor proportion (SINR) (γdec) to effectively decipher its sign at its target rate.

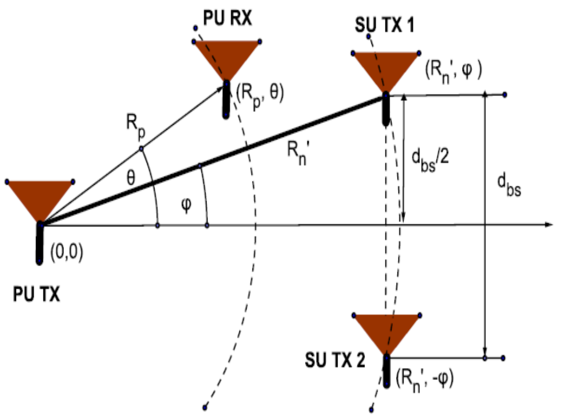

Figure 1: cognitive radio system with coordinated multipoint JT

At any occurrence, the situation of the PU RX at the edge of the secured sweep is given by the directions (Rp, θ). The optional transmitters are set at span Rn concerning the PU TX, and their directions are given by (Rn, ϕ) and (Rn, $-\phi$). We characterize Rn as the no discussion span for JT. The no discussion sweep is the separation inside which the auxiliary trans-mitters must not perform JT utilizing the channels being utilized by PU to encourage an effective PU transmission. In this manner, any SU arranged inside no discussion range must distinguish a continuous PU transmission precisely. The separation between the optional transmitters is signified as dbs.

3. Proposed methodology and System model

Let consider a CRN comprising of 2 BSs I and j with CoMP JT procedure. The arrangement of BSs is given as B = {i, j}. The SUs are haphazardly disseminated in the CRN. Each SU is related with a BS that is closest to it. The arrangement of SUs related with the BS b ∈ B is given by N′b, the arrangement of all the SUs N is given as Ni ∪Nj , and the all out number of clients is |N| =N. Give the arrangement of SUs access the crossing point territory of the 2 BSs is indicated by Nij. The arrangement of SUs in the BSs I and j that don't have a place with the converging territory are Ni and Nj, separately. Presently con-sider just downlink interchanges in the CRN, ie, the BSs transmit information to the SUs. The transmission power levels at the BSs are equivalent to Psu tx . The time is isolated into little monotonous time spans with length Tframe. Each casing is separated into 3 sections called Ts, Ta, and Ttx as appeared in Figure 6, where Ts is the time taken by the BSs to perform range detecting, Ta is the time taken for choice combination, channel allotment, and booking, and Ttx is the time spent for information transmission. The time Ttx is additionally isolated in Nslot spaces each with term Tslot. The free channels are assigned among the various clients for the various openings of a time frame.

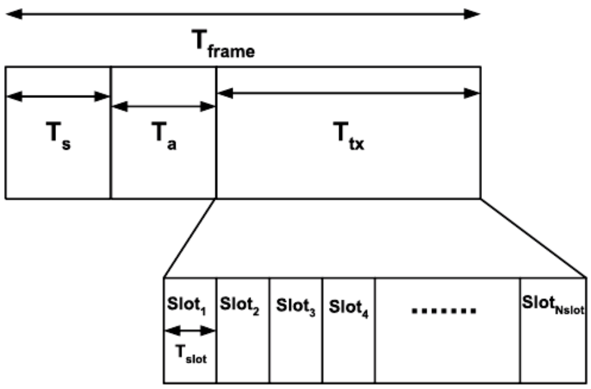

Figure 2: Distribution of time in each time frame T_{frame}

Network parameters

Consider cognitive radio network which consisting of 10 PUs, 100 SUs, and 2 network. The PUs is randomly distributed over an area 1500×2500m2. The SUs are also randomly distributed in the coverage area of the 2 BSs. The number of SUs associated to a BS depends on the positions of the SUs. The distance between the BSs (*dbs*) is considered to be 600 m. The cell radius is taken to be 400 m, and the maximum overlapping distance across the center of the cells is 200 m.

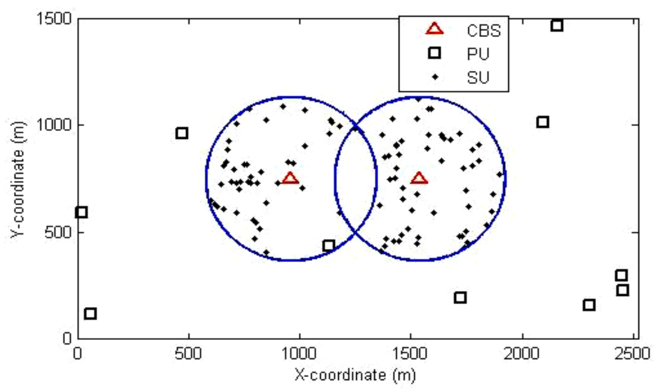

Figure 3: cognitive radio network model

The total number slot in a frame (N_{slot}) is taken to be 1000. Based on the activity of the PUs in each time frame, the channel allocation and scheduling algorithm is performed using the channel information and eventually, the channel allocations Ru,s's of each user u ∈ N are determined. Based on the type of the user u and the type of the allocated channels, the rate for each allocated channel is calculated and then for a time frame t, the throughput of the user u is calculated.
Let $\lambda u,t$ be the throughput of a user u in time frame t. At the end of simulation, the throughput of a user u ∈ N is calculated as

$$\gamma_u^T = \frac{1}{Nframe} \sum_{t=1}^{Nframe} \lambda u, t$$

where $N_{frame} = \frac{T}{Tframe}$ is the total number of time frames during the simulation

4. Simulation Result

Comparison of fairness index (FI): For the 20 CRN instances, the throughput of each user is determined via simulation for the "proposed" heuristic and "baseline" algorithms. The throughputs of the users of the CRN-1 without CoMP JT technique under the baseline algorithm, i.e. under the traditional channel allocation and scheduling algorithm, are shown in Figure 8. The results show that throughputs of the users differ significantly. From the throughput of the users, the Jain FI is calculated as

$$FI = \frac{(\sum_{u \in N} \lambda_u^T)^2}{N \sum_{u \in N} (\lambda_u^T)^2},$$

and it is found to be 0.7275. Thus, there is significant throughput unfairness among the users of a CRN without CoMP JT technique under the traditional channel allocation and scheduling algorithm. The throughputs of the users of the CRN-1 with CoMP JT technique under the proposed channel allocation and scheduling algorithm are shown in Figure 9. The results show that throughputs of the users are very close. We also calculate the FI in this case,

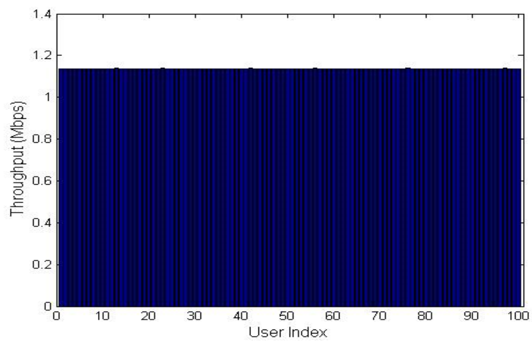

Figure 4: Throughput of the secondary users (SUs) in cogntive radio network with coordinated multipoint JT tecnique

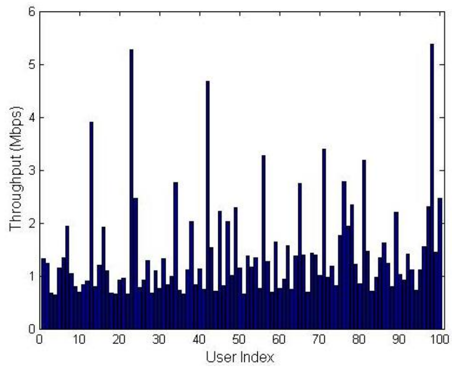

Figure 5: Throughputs of the secondary users (SUs) in conitive radio network-1

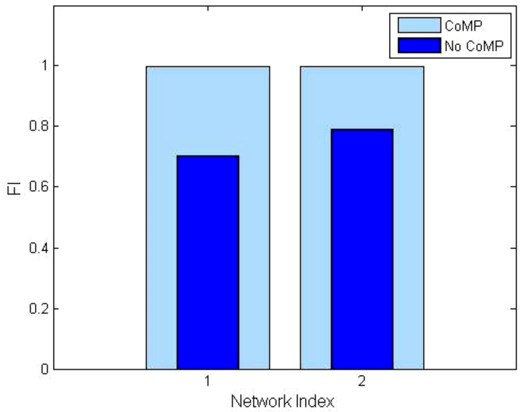

Figure 6: Fairness index in the different network instances

We also perform simulation for the other network instances and then calculate the FI for each of the network instances. The FIs of the 2 instances with the proposed and baseline algorithms are depicted. The average FIs for the 2 CRN instances with baseline and proposed algorithms are found to be 0.7377 and 1, respectively. Thus, CoMP JT technique under the proposed algorithm solves the throughput unfairness problem in CRNs.
Comparison of throughput performance: We determine the minimum throughput of the users for each CRN instance under the proposed and baseline algorithms. The minimum throughput of the users for each of the CRN instances is shown in Figure 6. It is observed that the minimum throughput of the users significantly improves in

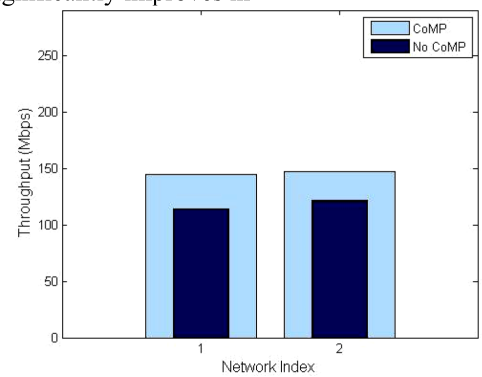

Figure 7: The total throughput of the users in the different network

CoMP JT–based CRN with respect to the traditional transmission based CRN. The average increment in the minimum throughput of the users is found to be 102.6876%. We know that there is a trade-off between throughput and fairness in wireless networks. The total throughput of the 2 CRN instances with and without CoMP JT technique is shown in Figure 7. We find that the total throughput in a CoMP JT based CRN is lower compared to that of a CRN without CoMP JT.

Table 1: Comparison of previous method with proposed aproach

Sr. No	Parameters	Previous Work	Proposed Work
1	Model	Cognitive Radio	Cognitive Radio with CoMP-JT
2	Methodology	Energy-harvesting and DNN	Energy Detection
3	Fairness index	0.6	1
4	Network Throughput	110 Mbps	150 Mbps
5	Secondary user Throughput	90 Mbps	120 Mbps

5. Conclusion

In this paper, we have proposed a CR system with CoMP JT technique. We have provided analytical formulations to determine the design parameters of ED-based spectrum sensing in CoMP JT–based CRN. The performance of the spectrum detection is evaluated in probability of detection and probability of false alarm and found to be very effective. We have formulated an optimization problem to maximize the minimum throughput of the users in CoMP JT–based CRNs by optimal channel allocation and user scheduling. Because of complexity of solving the optimization problem using an optimization tool, We have found that the CoMP JT–based CRN under the proposed algorithm significantly improves the FI as well as maxmin throughput compared to a CRN with traditional transmission. However, the total throughput in CoMP JT–based CRN is lower compared to a traditional CRN.

References

1. Akyildiz IF, Altunbasak Y, Fekri F, Sivakumar R. Adaptnet: Adaptive protocol suite for next generation wireless internet. *IEEE Commun Mag*. 2004;42(3):128–138.
2. Haykin S. Cognitive radio: brain-empowered wireless communications. *IEEE J Sel Areas Commun*. 2005;23(2):201–220.
3. Wang CX, Haider F, Gao C, et al. Cellular architecture and key technologies for 5G wireless communication networks. *IEEE Commun Mag*. 2014;52(2):122–130.
4. Zhao Q. A survey of dynamic spectrum access: signal processing, networking, and regulatory policy. *IEEE Signal Process Mag*. 2007;7:79–89.
5. Ghozzi M, Dohler M, Marx F, Palico J. Cognitive radio: methods for detection of free bands. *Comptes Rendus Physique*. 2006;7(7):794–804.
6. Urkowitz H. Energy detection of unknown deterministic signals. *Proc IEEE*. 1967;55(4):523–531.
7. Hoven N, Sahai A. Power scaling for cognitive radio. *Int Conf Wireless Networks Commun Mobile Comput*. 2005;1:250–255.
8. Dhillon RS, Brown TX. Models for analyzing cognitive radio interference to wireless microphones in TV bands. *3rd IEEE Symposium on New Frontiers in Dynamic Spectrum Access Networks*, Chicago, Illinois; 2008:1–10.
9. Bourdena A, Pallis E, Kormentzas G, Mastorakis G. Efficient radio resource management algorithms in opportunistic cognitive radio networks. *Trans Emerg Tel Tech*. 2014;25(8):785–797.
10. Vembadanthara JT. Scheduling algorithms for dynamic spectrum sharing. *Conf Adv Commun Control Syst*. 2013:89–97.
11. Wang P, Matyjas J, Medley M. Throughput optimization of cognitive radio networks. *Proc. IEEE Global Telecommunications Conference (GLOBECOM)*. Houston, Texas; 2011:1–6.
12. Gozupek D, Alagoz F. Throughput and delay optimal scheduling in cognitive radio networks under interference temperature constraints. *J Commun Networks*. 2009;11(2):148–156.