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Artificial decision making network for adaptive channel allocation in television white space

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***Abstract*— TV white space is the channel or spectrum that can be acquire from licensed operators when they turn their channel spectrum specifications. In this project the TV white space is shared with unlicensed secondary users. The TV channel sharing can be tackled as convex optimization problem. By using convex optimization the coexistence concerns like interference, fairness and throughput can be ameliorated. The accessibility of wireless channel reducing day by day. Hence this project proposes convex optimization based channel sharing that will share TVWS with unlicensed secondary heterogeneous network. Simulation result shows that the proposed algorithm has good performance when compared with existing Evco algorithm**

Key words*:* Evco algorithm, TV white space, Heterogeneous network, convex optimization,

I. INTRODUCTION

The amount of Wireless system has increasing day by day and it has given higher demand on radio spectrum in order to give new services. The TV transition is changed from analog-to-digital, it has freed up some amount of TV spectrum. These TV spectrums are known as TV white space (TVWS). In 2012, the U.S. Federal Communications Commission (FCC), in its report and order [1], given that the TVWS can be used for secondary (i.e., unlicensed) users, and regulators in other countries.

TV white space technology is revolutionizing traditional broadband .It is refers to the unused TV channels between the active ones in the VHF and UHF band. A traditional Wi-Fi router has a relatively limited range, around 100 meters under perfect condition, while TV white space can cover about 10kilometers in diameter.

For improving exertion of TV spectrum, regulatory bodies of different countries have been developing a technology that allows unlicensed users can share these bands given that interference to requisite broadcasters is eliminated. Therefore, a new service i.e., TV white space is implemented. This has motivated several standardization efforts such as IEEE 802.22-2011[2], 802.11af [3], 802.19.11, and ECMA 392[4] to further cognitive networking.

A set of procedures that ensures peaceful coexistence among a set of White Space Object (WSO) s operating in the same spectrum is referred to as CDM [5]. In this project, an 802.19.1compliant CDM system is implemented that performs TVWS sharing among a set of WSOs, operating in dissimilar MAC/PHY layer technology. While sharing TV white space among secondary unlicensed network some sharing problem can be obtained. The TVWS sharing problem can be modeled as an optimization problem this will improve system performance like throughput maximization and fairness.

The residue of the paper is structured as follows. Section II gives some related studies. The existing systems are defined in Section III. Section IV summaries technical background required to establish the project .Section V discusses the solution method and the proposed algorithm. Section VI presents the simulation results and compares the proposed algorithm with existing algorithms. Finally, Section VII concludes the paper

II. PREVIOUS WORK

In this section, abridge some standards and algorithms developed for TVWS sharing among WSOs. Some IEEE standards like IEEE 802.11af and 802.22.1[6] will give self -coexistence in TVWS operations. Some other standards like IEEE 802.15.2 and IEEE 802.15.4 had moderately

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addressed the coexistence issue in devices operating in, scientific, and medical bands. Then IEEE has introduced a new standard IEEE802.19.1 .The standard will have coexistence protocol and give effective usage of TVWS. Coexisting system architecture, defined in 802.19.1 [7], has been summarized in Section III.

On algorithm prospective M. A. Raza and Sangjun Park introduced a new algorithm known as Evolutionary Channel Sharing Algorithm for Heterogeneous Unlicensed Networks EvCo. [8].Here first the channels are a clustered into allocated and unallocated. After clustering EvCo compute the fitness function of each cluster .It will group the channels into two generations i.e., weak generation and strong generation. EvCo then forms an offspring cluster in order to get the proper channel. Then by using hill climbing, the weak channels are replaced.

The issue with the EvCo is its discrepancy in allocation. It will allocate the channel to WSO until channel occupancy demand is satisfied. But, in highly congested areas, the available spectrum may be insufficient to accommodate the channel demands of all the collocated WSOs .Another issue with EvCo is computational complexity. More steps are needed to find the proper channel and it will make the system costlier also.

III. TECHNICAL BACKGROUND

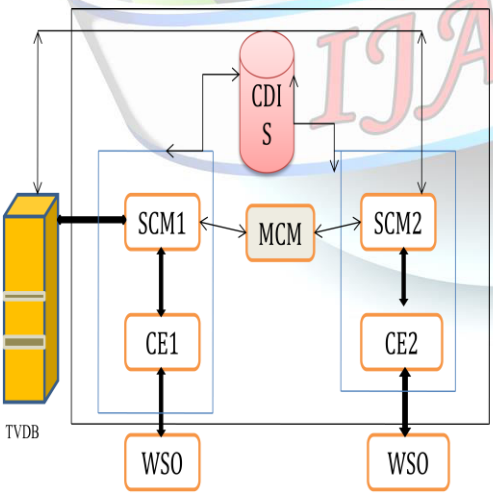

Fig. 1 IEEE 802.19.1-compliant coexistence system with centralized Topology

IEEE 802.19.1 [7] have three types of decision-making topologies i.e., autonomous, distributed and centralized. In autonomous decision making the coexistence decision making namely coexistence manager (CM) makes its decisions independently from another CM. In distributed decision making one CM makes its decisions in coordination with another CM. In centralized decision making, the neighboring CMs select one CM as master CM (MCM).

Most appropriate method is centralized topology as shown in Fig. 1.

The system components include coexistence managers (CM), coexistence enablers (CE), and a coexistence discovery and information server (CDIS). A TVWS database (TVDB), shown in Fig. 1, contains information about the TV channels available in the geographic region of the WSOs. In a centralized decision- making topology, the neighboring CMs select one of them as master CM (MCM), and rest of them become slave CMs (SCM), as shown in Fig. 1. The MCM in the proposed centralized CDM system implements the TVWS sharing process as a MOP. The CDIS stores the information regarding the channel allocation parameters of registered WSO. In the operation first wso register their specification to slave coexistence manager then it is given to master coexistence manager. At last the specification of different wso in a particular area is stored in CDIS.

IV.PROPOSED SYSTEM

In order to share the TV channel with WSO the following parameter must be satisfied:

WSO allocation is fair,
Maximization of system throughput,
Channel occupancy demands of WSO must be satisfied

Allocation fairness: The allocation in fairness can be Obtained as the equity that accesses the radio spectrum.

System Throughput Maximization: Throughput of the system is depends on multiple factors such as contagious channel allocation, homogeneity of wso...Etc

A. RESOURCE ALLOCATION BASED ON CONVEX OPTIMIZATION

In this section we discuss the TV channel allocation among WSO based on convex optimization [9].The work flow of the system is shown in fig2.

CDM topology creation: The CDM system, as shown in Fig. 1, is defined as follow,

$$O^* = TVWS\ (W, J, T, D) \quad (1)$$

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Where W = {1, 2. . . W}, J = {1,2,. . .,J}, and T = {T1, T2. TJ} represent a set of hetero-WSOs, a set of available TV channels and a channel window time set, respectively. A set of channel-demands of hetero-WSOs is defined as,

D=[nw]W×1,[Ow]W×1,[pw]W×1,[SINR]w,j (2)

WSO information creation: Each WSO have each channel occupancy demands. So before entering to resource allocation procedure the secondary user such as wso needs to store the wso information in the CDM topology.

Clustering of channels: Here first the channels are a clustered into allocated and unallocated. Allocated channel is referred as the channel that is already used by some user. The unallocated channel is used for resource allocation purpose.

An evolutionary algorithm, like the convex optimization proposed is requires a fitness function to rank the solution points. Therefore, we define an indicator based optimization function.

Channel assignment for each wso subset: After clustering the channels are assigned to a set of wso that *is* registered inside the 802.19.1 architecture. A WSO's desired bandwidth is defined as,

bw= nwb[MHz] (3)

Where b represents the bandwidth of a TV channel

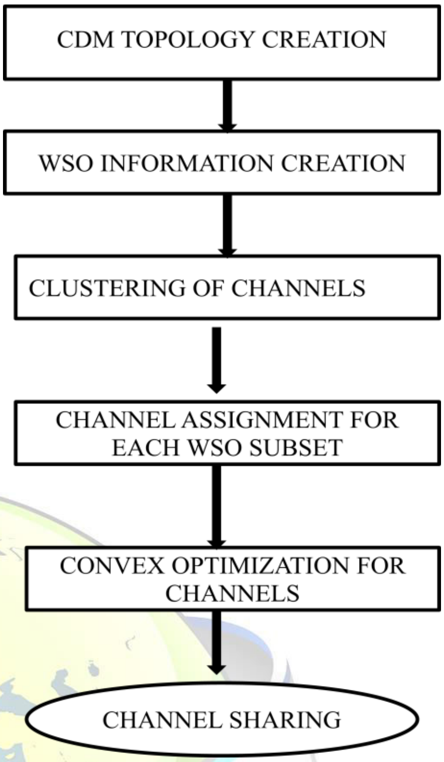

Fig. 2 Work flow of proposed system

Convex Optimization for resource allocation: After clustering the channel must be assigned to proper wso based on their channel occupancy demands. For assigning appropriate channel to wso convex optimization method is used. Convex optimization is a subfield of optimization that studies the problem of minimizing convex functions over convex sets.

Conventionally, the definition of the convex optimization problem requires that the objective function f to be minimized and the feasible set be convex. In the special case of linear programming (LP) the objective function is both concave and convex, and so LP can also consider the problem of maximizing an objective function without confusion.

The convex maximization problem is especially important for studying the existence of maxima. Consider the restriction of convex functions to a compact convex set: Then, on that set, the functions attain its constrained maximum only on the boundary.

Channel sharing: After clustering and convex optimization TV white space spectrum is shared with the proper wso for better working. In the congested area when number of users increased convex optimization technique will assign proper channel for each wso without having any computational complexity.

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V.SIMULATION RESULTS

In this section, we describe our simulation setup, and compare the primary user and secondary user allocation based on some criterion then give result of the simulation.

The algorithms are compared using the following performance metrics: System throughput performance capacity, signal to noise ratio and signal to interference plus noise

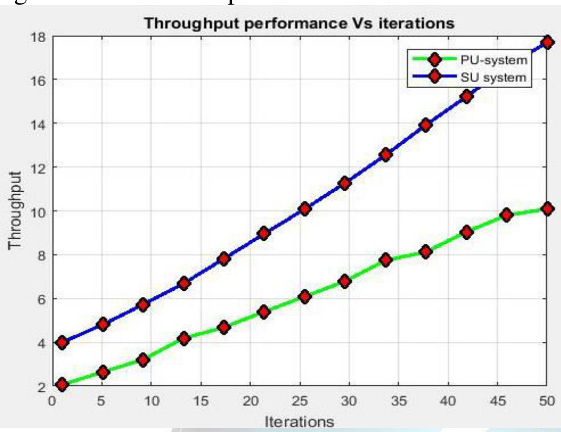

Fig 3. System throughput for PU system and SU system

By using convex optimization secondary user have gives a higher system throughput than the primary user as shown in Fig. 3, which is due to an orthogonal channel allocation in the first phase of allocation.

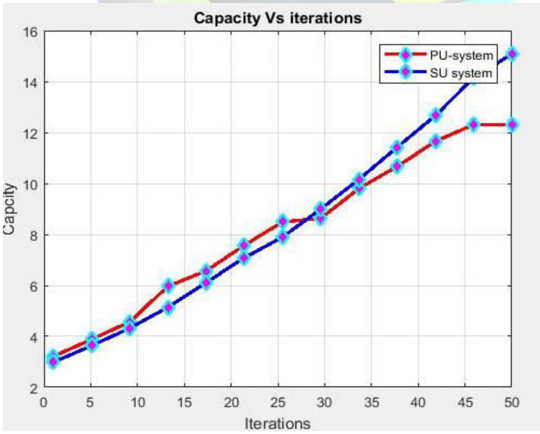

Fig 4: capacity of PU and SU based on iteration

In fig 4 the graph shows that capacity of assigning channels in TVWS domain is more for secondary user when compared with primary user.

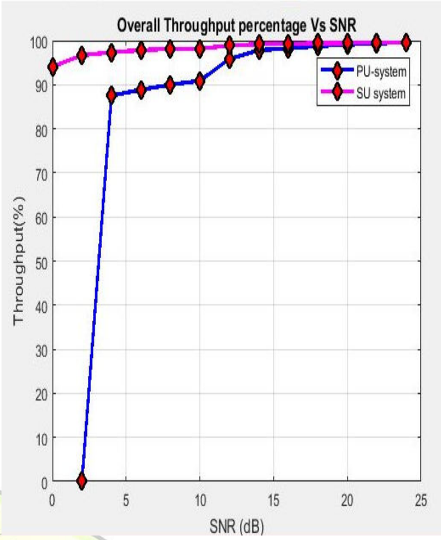

Fig 5. Over all system throughput percentage

From the fig 5 the overall throughput percentage of the system is obtained versus SNR. The secondary user get the peak throughput percentage in all SNR value but in primary user the throughput percentage is almost zero at initial stage.

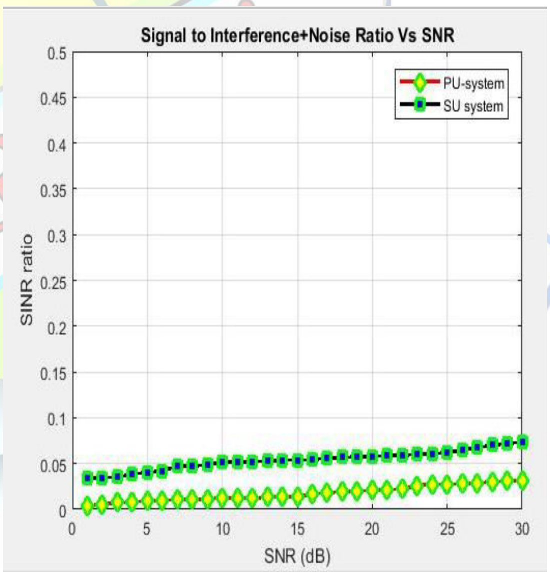

Fig 6. signal to noise ratio and signal to interference plus noise

Signal to interference and noise ratio of the system versus SNR is plotted in fig6. Both SU and PU SNR value increased constantly but the SINR value for secondary user is high compared with primary user. The SINR value of secondary user is almost 0.5 and it helps for better functioning.

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VI. CONCLUSION

In this project, an 802.19.1-compliant coexistence decision making (CDM) system is designed. We also design a convex optimization based channel sharing algorithm. We evaluate the performance of the convex optimization channel sharing on 802.19.1-compliant CDM system and compare its performance with primary user channel allocation.Our evaluation results show that the convex optimization resource allocation is superior to the comparative algorithms regarding throughput and WSO satisfaction from the allocation.

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