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EFFICIENT RESOURCE ALLOCATIONS FOR SPECTRUM LEASING IN COGNITIVE RADIO NETWORKS

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Abstract:

Cooperative Cognitive Radio Networks (CCRNs) merged cooperative communication into cognitive radio networks, in which, primary users take their data to secondary users, and in exchange, the primary users leverage secondary users as cooperative relays to raise their own throughput. Mobile manipulators offload their Internet traffic to privately owned Wi-Fi Access Points (APs), much to the inaccessibility of non-cellular users served by the APs. However, by employing the CCRN scheme, the mobile operator can raise an accredited channel to the AP, effectively raise its capacity. In this paper, we propose an implementation of the CCRN model applied to IEEE 802.11 WLANs. The cooperation is projec as a two-player holdout game where the two players are the primary users and the secondary users who deal for either throughput share or channel access time share. The best imagination allotment that ensures efficiency as well as equity among users is provided by the final solution.

Introduction:

Mobile data offload to small cell technology such as Wi-Fi or fem to cell provides a compelling solution for mobile operators who want to relieve the strain on their core networks. Compared to cellular macro cells, small cells provide increased spectrum reuse in the coverage area, higher signal to noise ratio in the cell (hence superior link bit rate for its users), and are highly cost effective even for large scale deployments. Furthermore, the reduced transmission times enabled by the superior link bit rates in the small cells directly translate into battery power saving for the user devices.

Wi-Fi hotspots operate in the unlicensed bands and suffer from severe interference due to scarce spectrum availability. On the other hand, macro cells and fem to cells require the use of the same costly and scarce licensed spectrum and suffer from co-site interference problems. To unlock new spectrum for small cell technology, a new regulatory spectrum sharing framework is being proposed by the Federal Communications Commission (FCC), where non-mobile incumbent owners, such as military who do not use their spectrum at all times and locations are allowed to grant exclusive access of their spectrum to mobile operators in regions where there is no incumbent activity. Recently, FCC and the US Federal government have identified the 3,550-3,650 MHz band (3.5 GHz Band), currently utilized for military and satellite operations localized to the U.S. coastline, as an ideal spectrum band for shared use with mobile operators for small cell operations.

The European Commission is working on a similar proposal in the 2.3-2.4 GHz band that has very localized incumbent military telemetry use. Such a spectrum sharing approach regime can potentially unlock more than 100 MHz of high-quality spectrum, especially in higher spectrum bands (>2 GHz) that are ideal for small cells. To expedite spectrum sharing in small cells, FCC in its recent ruling has eliminated spectrum sensing as a requisite for cognitive radio devices. Instead, FCC mandates that devices learn of spectrum availability at their respective locations from an external source such as a location based query to the database of the incumbent, Devices with such “cognitive” or “frequency-agile” transceivers are regarded as the main enabler of spectrum sharing in small cell technology. Although, spectrum leasing simplifies commercial deployment and promotes better spectrum utilization, developing a workable pricing model between the primary network (owner of the spectrum) and the secondary network (beneficiary of the leased spectrum) is not trivial.

To expedite spectrum leasing in real-world deployments, researchers have recently advocated for schemes that employ spectrum leasing, not necessarily on the basis of fees or charge, but in return for improved quality-of-service of the primary network via cooperation with secondary network.

Existing System:

Resource allocation and spectrum trading are treated as two separate problems in the spectrum sharing model of cognitive radios Much of the existing CCRN schemes in the literature assume that the users access the spectrum using TDMA Frequency Division Multiple Access (FDMA) Space Division Multiple Access (SDMA) Orthogonal Frequency Division Multiple Access (OFDMA) Or Using Other Special Orthogonal Schemes A random access scheme is presented in where secondary users access the spectrum using slotted Aloha. In contrast, WLANs have adopted a contention-based medium access control such as the IEEE 802.11 distributed coordination function (DCF). To leverage cooperative transmission and spectrum leasing in WLANs, such as the scenario in Fig. 1b, existing CCRN schemes are no longer applicable. In our work, we propose an implementation of the CCRN framework for primary network that supports any IEEE 802.11 multi-rate WLAN based secondary network. When served by the secondary AP, all users (both primary and secondary) employ an IEEE 802.11 DCF based channel contention mechanism. As shown in Fig. 1, both the AP and the BS are connected to the Internet over wireline channel (backhaul), as is common in the present-day deployments. No back haul capacity limitation is assumed for the wire line channel. The primary network owns bandwidth in the form of "channels" of certain size (e.g., 20 MHz channels in the 3.5 GHz band), which it is willing to lease to the secondary network; in exchange, the AP of the secondary network offloads data traffic for the primary (cellular) users in its range. To enable spectrum leasing, the AP of the secondary network is equipped with an auxiliary radio that can be tuned to the frequency of the leased channel (licensed spectrum). All the user equipments (primary and secondary) are also equipped with radios that can be tuned to the unlicensed frequency as well as the leased channel and support dual-mode (Wi-Fi þ Cellular, common in today's smartphones). The setup in scheme in a mixed wireline/wireless network where the source-to-relay (Internet/BS-to-AP) is a wireline channel, and the relay-to-destination (AP-to-users) is a wireless channel. The problem formulation for the proposed CCRN scheme.

Drawbacks:

- Low complexity
- Delay Spectrum Availability.
- Reduce Path reliability

Proposed System:

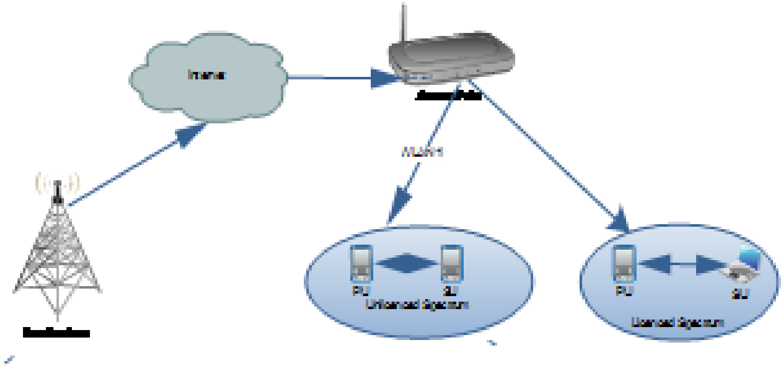
- To lease to the secondary network in exchange, the AP of the secondary network offloads data traffic for the primary (cellular) users in its range.
- To enable spectrum leasing, the AP of the secondary network is equipped with an auxiliary radio that can be tuned to the frequency of the leased channel (licensed spectrum).

- The entire user (primary and secondary) is also equipped with radios that can be tuned to the unlicensed frequency as well as the leased channel and support dual-mode (Ex. Wi-Fi þ Cellular).

Advantages:

- Reduce transmission time.
- Maximization network throughput.
- Time fairness and Equal channel occupancy time.

System Architecture:



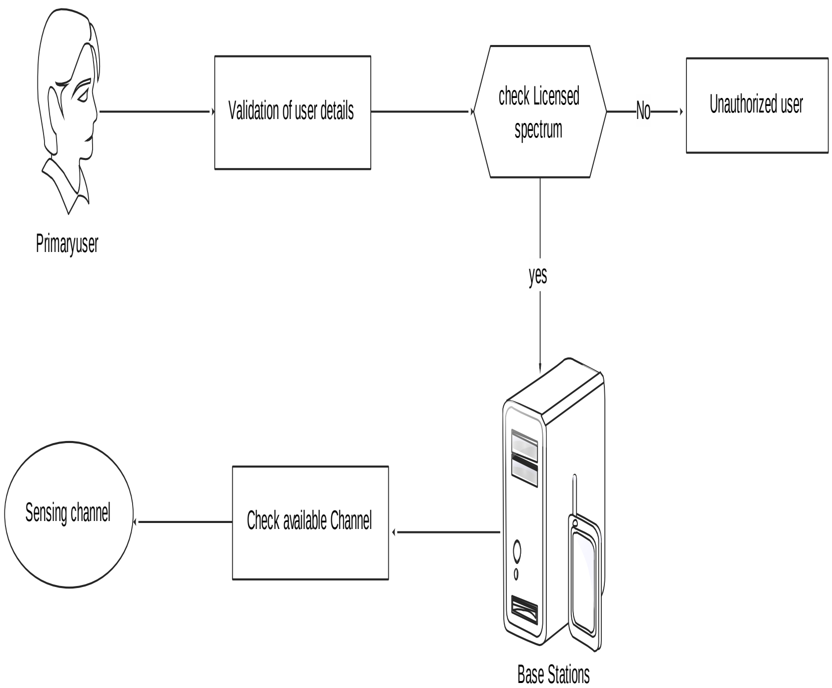
Modules Description:

Modules:

1. Licensed User Channel Allocations
2. Unlicensed User Channel Allocations
3. Source to Relay Wire Line Channel
4. Relay to Destination Wireless Channel

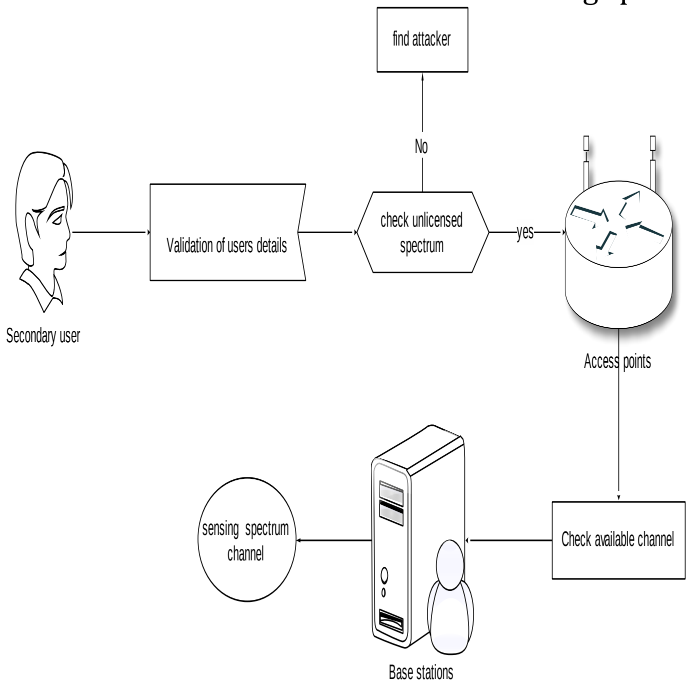
Licensed User Channel Allocations:

In this module each primary users needs to provide valid details. The primary users initially connect to their cellular base station (BS) using cellular technology such as licensed spectrum to check the available channel for sensing and to select channel and transferring data.



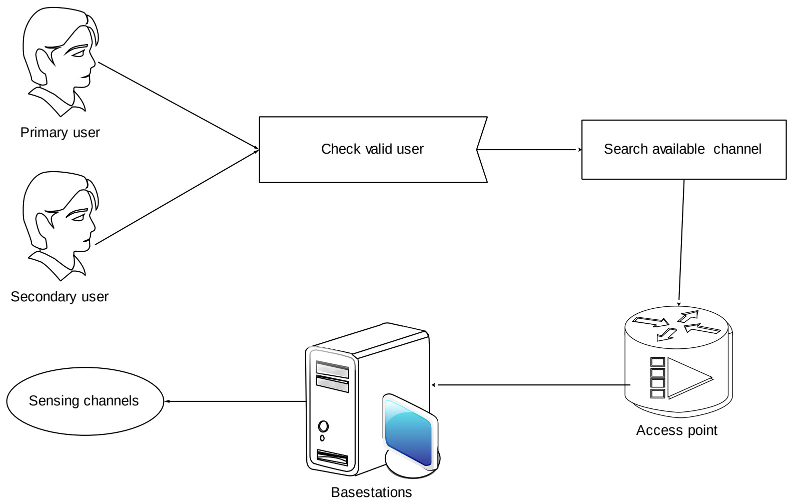
Unlicensed User Channel Allocations:

Each Secondary user to provide their valid details and verified those details. These secondary users to accessing channel with the Access Points (AP) and checking availability of users from base stations networks their sensing spectrum channel.



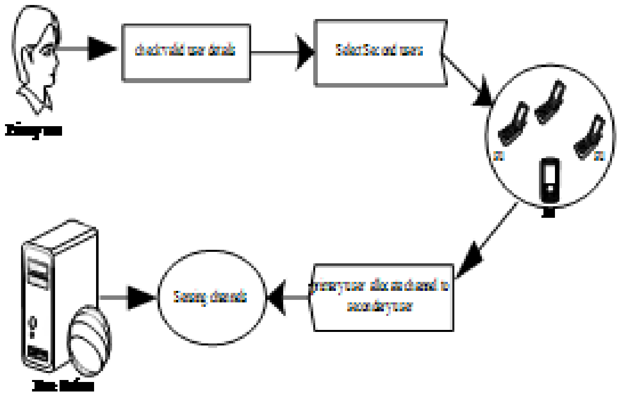
Source - To Relay Wire Line Channel:

In Both primary secondary users need to provide valid details and searching their available channels to access point and sensing channel from base stations. Devices with such cognitive spectrum leasing simplify commercial deployment and promote better spectrum utilization, developing workable pricing model between the primar and the secondary network.



Relay-To-Destination Wireless Channel:

The primary and secondary, assume that spectrum leasing is enabled via the CCRN scheme for the network. The primary network leases an additional channel from the licensed spectrum to the secondary AP.



Conclusion:

In this paper, we have investigated and proposed an implementation of the CCRN framework for IEEE 802.11 WLANs. In the proposed CCRN scheme, the mobile operator leases a channel from the licensed spectrum band to a privately owned Wi-Fi AP, and in return, the mobile operator leverages the AP as cooperative relays to offload its Internet traffic. The cooperation between the primary (cellular) and secondary (WLAN) networks is analyzed using a two player bargaining game where the utility function for the players are their respective aggregate network throughputs. We show that under fairness and optimal throughput constraints, the bargaining set for the bargaining game is a straight line whose slope only depends on the bit rates of the users.

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