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Evaluation on Spectrum Pooling:- Public Safety Radio System

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Abstract: *Dynamic spectrum access(DSA) technologies including (CR) technologies are in the development for next generation of public safety networks . These technologies holds the ' CONRUS' which helps for flexible and adaptive radio system .In this paper we represent review on (CONRUS) which helps to reach the goal for license spectrum band under (FCC) frequency by using (CR) technology .*

Keywords*: CONRUS, FCC, CR technology, DSA technology*

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I. Introduction

"CONRUS"

A CONRUS is the vision of cognitive radio (CR) which does not create no hurdle by unlicensed for license holders so that the license can take any privileges of it in this white paper the basic architecture & function of (CONRUS) has been explained . IT has been observed that the crises of spectrum availability at frequencies can be economically used for wireless communication. The basic utilization of frequency is (3-4) GHZ and this frequency band 0.5% and drops to 0.3%. These frequency absorbedness has been concern for the license spectrum. Moreover usage of frequency band more than 5GHZ there will be inconsistency with FCC frequency and this signed towards discrepancy between FCC allocations and real usage lead to new approach for the spectrum license needed. By developing CR technology there will no priority users reduce the concern of general allocations to unlicensed.[1]

II. Cr Technology

CR technology benefits the wireless environment and transmission .This paper have some consideration of requirements by CR:

1) Determine the portion of spectrum which is available known as **'SPECTRUM SENSING'**
2) Determine the available channel known as **'SPECTRUM DECISION'**
3) Coordinate the channel with users known as "**SPECTRUM SHARING"**
4) Detect the users license and than vacate the channel known as **"SPECTRUM MOBILITY"**

CR'S are very cognitive capability reconfigurable capability and mostly self organized. CR"S mostly works with [MITOLA-00]- It is an software works learning and reasoning and basically CR used for narrower sense.[2] wireless communications technologies play an irreplaceable role in emergency and disaster relief situations. It is generally determine that the existing public safety (PS) wireless communications facilities very fast response for fall short of meeting users' needs in many critical situations.[2]

III. Spectrum Pooling

In the most general sense, spectrum pooling is the situation wherein multiple users share access rights to a common "pool" of spectrum. This is the case with unlicensed spectrum in the ISM band wherein multiple users share access to spectrum subject to complying certain access protocols. While this provides one regulatory framework for how spectrum might be shared, it is not the one we have the perception here. Rather, we visualize a context in which holders of licenses for public safety spectrum would voluntarily agree to contribute their spectrum to a common pool. Access to the pool would be "closed" relative to an unlicensed jurisdiction of open-access to all/any observe devices. In essence, the license rights would transfer to the pool from the individual. Any use of the spectrum would be in acceptance with pool policies .Implementation of this concept requires inscribe the two critical elements: first, what are the terms under which those contributing spectrum to the pool contribute their spectrum rights; and second, what are the terms governing usage of the spectrum[5].

Emergencies and major incidents often require the participation of several emergency services (e.g., law enforcement, fire and rescue, medical assistance, and so on) and gradually include the involvement, either directly or indirectly, even large numbers of first responders. Major disasters (e.g., earthquakes, hurricanes, chemical factory explosions, and so on) may have extensive impact on geographical areas and cross borders ,they have physical and administrative and involving PPDR agencies from different jurisdictions. In addition to local PPDR agencies, major incidents often require the help of out-of area emergency support units. Communications facilities used in the incident are these are available to local agencies for their day-to-day communications. These facilities mainly consist of PMR networks that are either exclusively used by a single PPDR agency or shared by a number of them. In addition to permanent network infrastructures, fast deployable equipment can also be brought to the affected area to establish incident area networks (IANs) for real-time mission-critical voice, video, and data, and sensor communications.

The need for higher data rates is increasing as a result of the transition from voice-only communications to multimedia type applications. As the limitations of the natural frequency spectrum, it has become an obvious that the current static frequency allocation schemes can not accommodate the requirements for an increment number of higher data rate devices. As a result, innovative techniques that can offer newer ways of exploiting the available spectrum are needed. Cognitive radio arises to be a perfect solution to the spectral congestion which is problem faced by introducing opportunistic usage of the frequency bands that are not heavily occupied by licensed users [4]. While there is no agreement on the formal definition of cognitive radio as of now, the concept has been evolved recently so that it can include various meanings in several contexts [2].In this paper, we use the definition adopted by Federal Communications Commission (FCC): “Cognitive radio: A radio or system that senses its operational electromagnetic environment and can dynamically and self governing so it can adjust its radio operating parameters to modify system operation, such as maximize throughput, allay interference, facilitate interoperability, access secondary markets.” [4]. Hence, one main aspect of cognitive radio is related to allay exploiting locally unused spectrum to provide new paths to spectrum access . Being focus on this paper, spectrum sensing by far is the most important component for the establishment of cognitive radio. Spectrum sensing is the task of obtaining awareness about the spectrum usage and existence of its primary users in many geographical area. This awareness can be obtained by using geo location , database, beacons, or by local spectrum sensing at cognitive radios [4]–[5]. When beacons are used, the transmission of information can be tenant of a spectrum as well as it has advanced features such as channel quality. In this paper, we focus on spectrum sensing performed by cognitive radios because of its broader application areas and lower infrastructure requirement. Although spectrum sensing is traditonnellementlly understood the measuring the spectral content, or measuring the radio frequency energy over the spectrum; when cognitive radio is considered, it involve its important characteristics such as time, space, frequency, and code even it involves determining what types of signals are occupying the spectrum including the modulation, waveform, bandwidth, carrier frequency ,etc. and according requirement more powerful signal analysis techniques with additional computational complexity.

Analysis of Spectrum Availability in Emergency Scenarios

Emergencies and major incidents often require the participation of several emergency services (e.g., law enforcement, fire and rescue, medical assistance, and so on) and generally include the involvement, either directly or indirectly, of large numbers of first responders. Major disasters (e.g., earthquakes, hurricanes, chemical factory explosions, and so on) can impact extensive geographical areas and cross borders ,both physical and administrative and involving PPDR agencies from different jurisdictions. In addition to local PPDR agencies, major incidents often require the help of out-of area emergency support units. Communications facilities used in the incident are those available to local agencies for their day-to-day communications. These facilities mainly consist of PMR networks that are either exclusively used by a single PPDR agency or shared by a number of them. In addition to permanent network infrastructures, fast deployable equipment can also be brought to the affected area to establish incident area networks (IANs) for real-time mission-critical voice, video, and data, and sensor communications. Also, the PS personnel often rely on communications over the public mobile networks to complement their dedicated systems. In an illustrative emergency scenario intended to guide the discussion in this article, it is assumed that in an incident area two separate PSNs, denoted as PSN 1 and PSN 2,are deployed. These networks will provide PPDR services to local PPDR agencies (e.g., local police, fire and rescue units, and so on) as well as some of the arriving out-of-area emergency support units (e.g., fire brigades from nearby locations). It is considered that some out-of-area emergency teams arriving at the incident have their own dedicated PSN, termed as PSN 3, although it is assumed that there is no coverage of this network in the incident area (e.g., specialized units that do not operate in the incident area but displaced to help). In addition to PPDR communications facilities, a communication infrastructure devoted to support non-PS services (e.g., broadcast transmitters, commercial cellular network, military point-to-point links ,and so on), denoted with the generic name Network 4, is also considered to operate in the incident area.[3]

In this context, **Figure 1** distinguishes the different types of spectrum that might be potentially used for emergency communications. Two distinguishing factors for the categorization of spectrum availability shown in Figure 1 are whether

1. Individual spectrum rights of use exist or not.
2. Spectrum rights are entitled to provide PS services or non-PS services. The use of radio frequencies is subject to individual rights that are concede to users by means of individual authorizations (e.g., through administrative models and traditional licensing procedures managed by spectrum regulatory authorities) or, alternative, granted through a general authorization (e.g., license-exempt bands where devices are mainly updated to be compliant to some standards but no individual authorization is issued) . Without any loss of generality, individual rights of use, if any, are assumed here after to be directly held by the operators of the communications infrastructure (i.e., network operators). In addition, the categorization in Figure 1 also difference whether network infrastructures (i.e., base stations) damage the spectrum are deployed in the incident area or not.

On this basis, Figure 1 identifies the following spectrum options**:**

Spectrum S1: This is a dedicated band for the provisioning of PS services. Exclusive individual usage rights for this band are considered to be held by PS Operator 1 that fully or partly exploits S1 spectrum in the PSN 1 infrastructure deployed in the incident area.

Spectrum S2: Like spectrum S1, this is a dedicated band for the provisioning of PS services. Exclusive individual rights of use over S2 are held by PS Operator 2 that fully or partly allay it in the PSN 2 infrastructure.

Spectrum S3: This is a band also dedicated to the provisioning of PS services whose exclusive individual usage rights are held by PS Operator 3 that uses them to run PSN 3. However, unlike PSN 1 and PSN 2,it is considered that the PSN 3 infrastructure does not have coverage in the incident area.

Spectrum S4: This is a band used to provide services other than PS services (e.g., commercial cellular services, TV broadcasting, military communications, among others). A non-PS operator, denoted as Operator 4, is assumed to have exclusive individual rights of use over S4. The spectrum is used by Network 4communications facilities run by Operator 4.

Spectrum S5: Like S4, this is a band used to provide non PS services. Exclusive individual usage rights of this spectrum are considered to be held by another non-PS operator, denoted as Operator 5. In this case, it is assumed that this operator does not have any communication facilities using spectrum S5 in the incident area.

Spectrum S6: This band represents a portion of the spectrum that is set to be used by multiple authorized users that do not hold exclusive individual rights of use (e.g., license-exempt band).It is worth noting that under a classical regulation and communications technologies, spectrum usage for PS communications in the incident scenario depicted in Figure 1 would be limited to spectrum S1, S2, and S6. Furthermore, the usage of S1 and S2 would be strictly coupled to PSN 1and PSN 2 infrastructures, respectively, without any flexibility to reallocate it as needed across both networks. In contrast, the next section elaborates possible spectrum sharing models aimed at improving spectrum availability and flexibility of use for PPDR in the incident scenario, thus enhancing the capacity available for PS communications

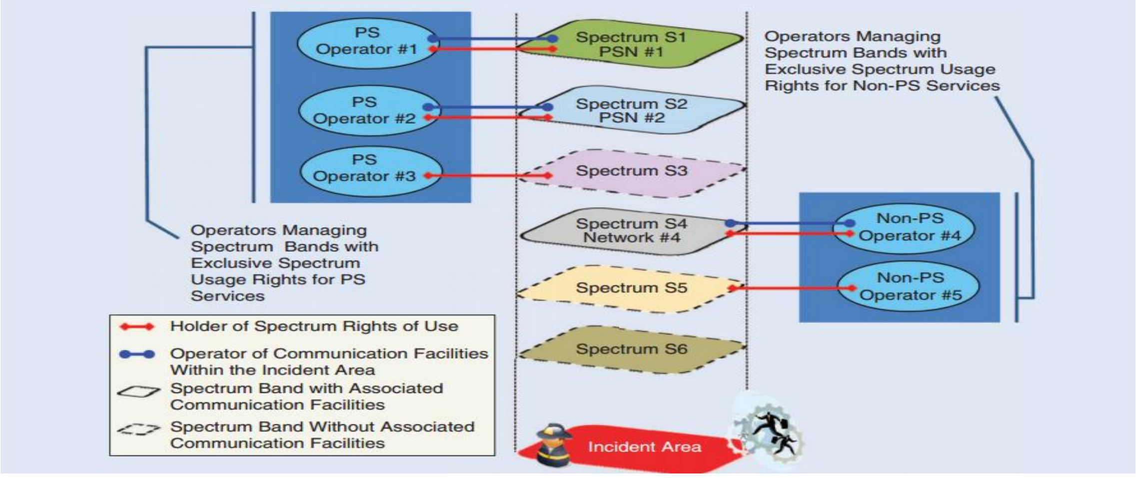

Figure 1: A Categorization of Spectrum Availability In An Incident Area[2]

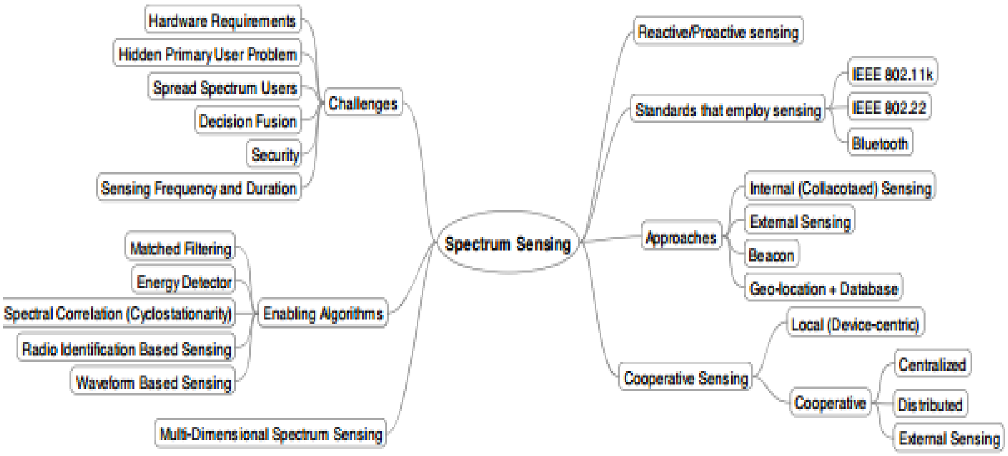

Figure 2: Various Aspects Of Spectrum Sensing For Cognitive Radio.[4]

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