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Cognitive Architecture Based Spectrum Sharing between 4G LTE-Advanced Network and TV Band

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***Abstract*— There is now a barrier in place because to the exponential increase in demand for faster wireless communications to meet the needs of more applications. There are almost no remaining frequency bands to allot for new systems since the spectral resources are running low. Based on a geographic TV database, this article presents the prospective approach sharing concerns between LTE-Advanced and TV band. The enabling technology will work with LTE-Advanced devices to address the TV band's under used.** ***Key Words*— cognitive-based, optimal decision, 4G, LTE- Advanced, TV White space**

I. INTRODUCTION

A Notice of Proposed Rule Making (NPRM) allowing unlicensed radio transmission to operate in television spectrum at various areas when it is not being used has been released by the Federal Communications Commission (FCC) [1]. The law mandates that the FCC keep up its rule-making processes regarding the availability of TV channels 2-51 (54 MHz–698 MHz) for usage by wireless broadband services and other devices that support Dynamic Spectrum Access (DSA). In order to avoid interfering with main rights holders, particularly television broadcasters, the NPRM stipulates that any devices approved to use TV white spaces must use agile or cognitive radio technology in a dynamic spectrum access (DSA) configuration [2].

The IEEE 802.22 standard (TV Band) working group on Wireless Regional Area Networks was established in October 2004 in reaction to the NPRM. Its primary goal is to create a WRAN system that shares the television spectrum to provide broadband connection, especially to remote locations. There existed the IEEE 802.22 standard, but there was still a lot of work to be done [3]. Talks with the broadcasters whose spectrums are being shared are necessary because they are worried about interference and decreased advertising income.

Under a DSA method, the "secondary" users are not allowed to interfere with the primary users or any other unauthorized users that share the same spectrum in a damaging way. Primary users are the only parties with exclusive rights to the spectrum. Primary users are not obligated to reduce any extra interference resulting from secondary or unlicensed device operation since they have exclusive rights to the spectrum. In order to minimize mutual interference, these devices must be able to adjust to the changing spectrum circumstances and regularly sense the spectrum in order to identify primary or secondary user broadcasts [4].

RELATED WORK

Much research and development on 4G LTE-Advanced has just begun at 3GPP. The most recent standard in the family of mobile network technologies that gave rise to UMTS/HSxPA and GSM/EDGE is called Long Term Evolution (LTE). The term "third generation" (3G) refers to the current generation of upgrade convert 3.5G mobile communications networks. In autumn 2009, LTE Advanced, a proposed 4G system, was formally submitted to ITU-T as a preliminary mobile communication standard [5].Despite being advertised as 4G, first-release LTE is actually a 3.9G technology since it doesn't meet all of the standards for IMT Advanced 4G. The fourth generation (4G) of radio technology, known as LTE Advanced, is a step up from the pre-4G standard and is intended to boost the speed and capacity of mobile phone networks. While LTE is incompatible with 3G networks, LTE Advanced is compatible with LTE and uses the same radio channels [6].

By now, LTE standardization has reached a point of maturity where only minor modifications and bug fixes are made to the specification. In December 2009, the first commercial services in Scandinavia were introduced. As a logical development of several 2G and 3G systems, such as the Universal Mobile Telecommunications System (UMTS) and the Global System for Mobile Communications (GSM) (3GPP as well as 3GPP2). More first edition LTE networks are anticipated to be implemented internationally during 2010.

Currently, The International Telecommunication Union defines IMT-advanced specifications for 4G, also known as IMT Advanced, as having peak data rates up to 1 Gbit/s, which LTE does not fulfill. Candidate Radio Interface Technologies (RITs) are asked to submit to the ITU in accordance with the guidelines outlined in a circular letter [ref]. It is important that LTE Advanced share frequency bands with first release LTE equipment in order for it to work with first release LTE equipment.

Moreover, most of the radio frequency spectrum in TV band, specifically the Malaysian TV band is not fully utilized and benefited the unused spectrum is also known as spectrum white space. These white spaces vary from time to time and place to place [7],[10], [11]. In USA, the FCC issued a second order [8] that makes white spaces in TV bands available for use by unlicensed broadband wireless devices. On the other hand, in LTE-Advanced systems, spectrum scarcity is an inevitable issue due to wider bandwidth requirement for a downlink peak throughput of 1Gbps. This is because the spectrum assigned to LTE-Advanced system is insufficient [9],[12].

In [9] authors have introduced spectrum sharing scheme based on cognitive for LTE-advanced system and Digital Video Broadcasting DVB .the authors came up with spectrum sensing mechanism named Auto Correlation based Advanced Energy to increase the efficiency of the general spectrum sharing technique they have separated LTE-Advanced system into these groups A,B and C. The ACAE algorithm starts from calculating DVB OFDM symbols. After obtaining the comparison has been performed in between threshold. After running bribability for attaining false alarm, Newton itedtion is used for comparison. Resource Block RB is selected according to the sequences of three groups. Conflicts will be judged by fairness into account while RB allocation procedure [13], [14]. The authors have analyzed the ACAE only through simulation and numerical results. The technique was not tested for different environments and according more parameters can be taken under consideration for better efficiency.

In this paper extensive review on spectrum sharing

II. PROPOSED WORK

The proposed Database is given in Table 3.1, the proposed table is comprising of 7 different parameters (Channel, working time, not working time, noise level, coordinate, Max and MIN Power (dbm)), that will help in decision making, that data is collected from UTM-MIMOS lab, table show proposed Database for 10 channels in UTM-MIMOS lab, during our experiment, the Bandwidth and attenuation will be 8 and 31 respectively.

Table 3.1 Proposed Geolocation Database

Ch	station	Working time	Not working	Coordinate	Max Power dbm	Min Power dbm
40	Not located	0	24 hour	01° 33' 31"N, 103° 38' 33.322 "E	-150.8520	-158.9480
41	TPI Indonesia	0	24 hour	01° 33' 31"N, 103° 38' 33.322 "E	-150.4560	-158.8160
42	nTV7 Malaysia	6am-1am	6 hour	01° 33' 31"N, 103° 38' 33.322 "E	-131.3800	-159.3440
43	RCTI Indonesia	24hour	0 hour	01° 33' 31"N, 103° 38' 33.322 "E	-142.3000	-159.3080
44	TV9 Malaysia	6am-1am	6 hour	01° 33' 31"N, 103° 38' 33.322 "E	-135.6120	-160.3080
45	Tranc TV Indonesia	24hour	0 hour	01° 33' 31"N, 103° 38' 33.322 "E	-145.6800	-160.5680
46	8TV Malaysia	6am-1am	6 hour	01° 33' 31"N, 103° 38' 33.322 "E	-129.8640	-159.3040
47	SCTV	24hour	0 hour	01° 33' 31"N, 103° 38' 33.322 "E	-143.5760	-158.9120

48	Not located	0	24 hour	01° 33' 31"N, 103° 38' 33.322 "E	-150.6720	-159.7360
49	Indosiar Indonesia	0	24 hour	01° 33' 31"N, 103° 38' 33.322 "E	-149.3280	-159.2840

There proposed Database have more parameters thus more actual information for achieving the accurate and more precise decisions as compared to the Mark Waddell that have only two parameters and to get the precise and concise results and efficiency, we need more and more assumptions, which leads holes towards some actual and sharp calculations and results. Mark waddell table is shown in Table 3.2

Table 3.2 Mark Waddell Geolocation Database

Ch	Power dbm	Time
21	-10	1hr
23	5	2hr
31	15	1hr

3.5 Cognitive Pilot Channel

The main function of CPC is to establish collaboration between network and terminals. In order to provide such collaboration, CPC has been developed for the centralized CR system solutions

3.5.1 Scenario LTE Access TV throws Database using CPC

First the two base stations sent their information to Database and set configuration after setup the network. For example, LTE-UE Setup of initial connection, CPC sends request information from Database for available ch. Database will determine if there is available ch or not. According to information in Database, Database sends answer. If there is available ch and in which region, CPC send information answer to LTE-UE to utilize the ch. If not, CPC send information answer to LTE-UE there in no available ch. then CPC switch LTE UE to set up and repeat new connection. Figure3.3 show scenario LTE access TV throws Database using CPC

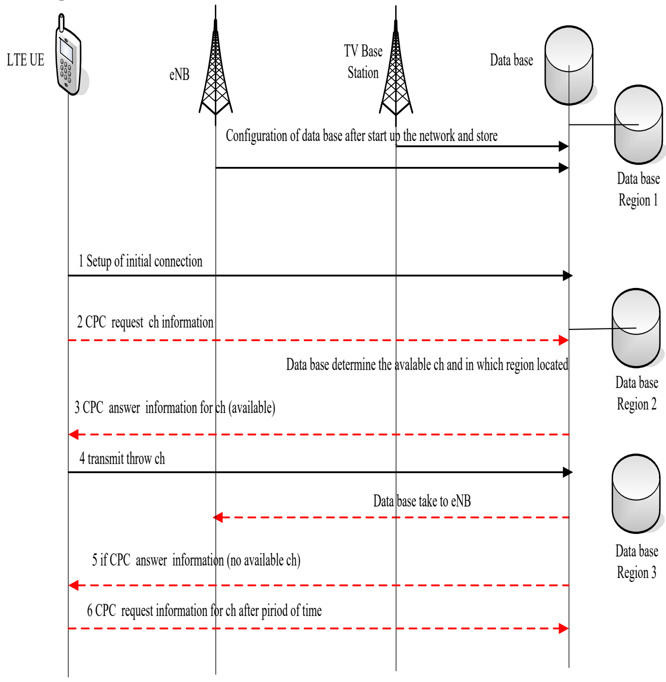

Figure 3.3 Scenario LTE UE Access TV throw Database using CPC

3.5.2 CPC Request ch from Distributed Database

First CPC request the ch, and then Database determines the position (distance) from base station. According to distance Database make decision to which region should get the information, region 1, 2 or 3. Figure 3.4 shows CPC request ch from distributed Database

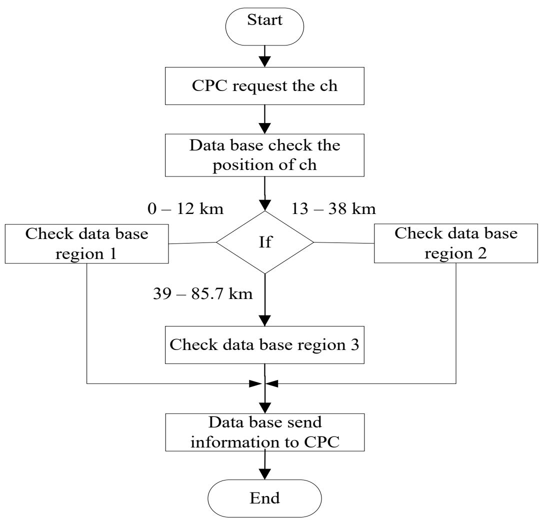

Figure 3.4 CPC Request ch from Distributed Database

3.5.3 CPC during Start up with the Reference

Figure 3.5 displays CPC with a reference to an already-deployed network during startup. The network that carries CPC is linked to the CPC Manager. The CPC Manager can get the data to be shared via the CPC via JRRM or other network-side services. The information that has to be delivered over the network can, in theory, be obtained by the CPC Manager through the others (JRRM). Additional CPC relevant information also be used to update the CPC Manager.

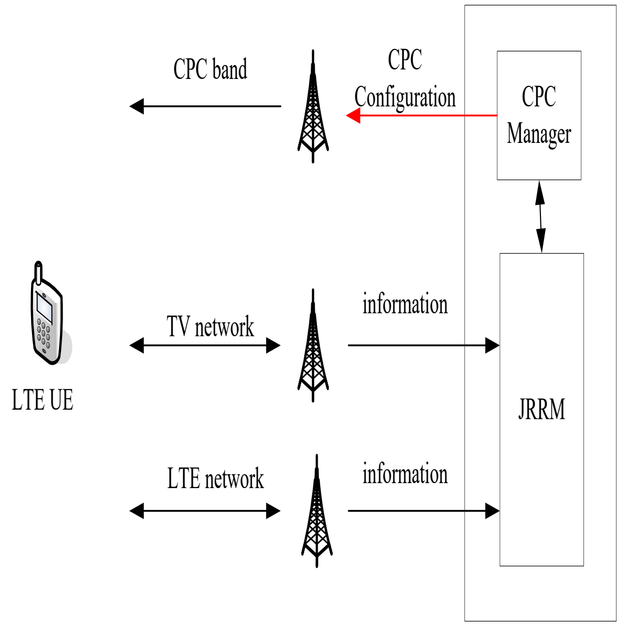

Figure 3.5 CPC during Start Up with the Reference

3.5.4 CPC Operation Procedure and decision

The steps of the CPC operation procedure and decision on LTE UE are described in Figure 3.6. After switching on LTE UE, it will have first to detect and synchronize with the CPC. Then the information carried by the CPC can be extracted, evaluated and used to select and connect to a network. The steps of detect, extracts and check performed periodically to detect changes in the environment due to other variation(s) of network reconfigurations. If LTE UE find free ch in period of time, then transmit data, if not switch no next channel. During transmitting CPC switch LTE UE to next ch when available time is finish.

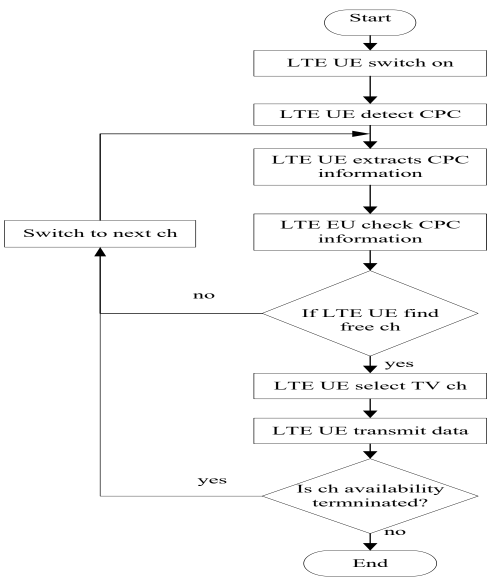

Figure 3.6 CPC Operation Procedures and Decision

3.6 **Decision**

The decision is primarily based on threshold which determines the available frequency and region. The values for the threshold will be computed using the experimental data collected and then the scenario is modeled. Three threshold values will be set based on the minimum and maximum power received for each of the region. Consequently, this will ensure better identification of the available spectrum and possible region where it exists.

3.7 Compare the proposed strategy with proposed from Google

The proposed strategy uses CPC, because CPC has some advantages mainly it provides information on which radio accesses can be expected in a certain geographical area, help the terminal to select the proper network depending on the specific conditions and helping the secondary system to establish communication by indicating frequency bands available for secondary usage and assisting in secondary system start-up. But proposed from Google not use CPC, resulting from that I expect my strategy will be bitter

III. ANALYSIS AND DISCUSSION CONCLUSION

Anticipated findings from this study will eventually result in promising concerns related to route sharing between TV band and LTE-Advanced. The enabling technology will work with LTE-Advanced devices to address the TV band's underutilization. By using these techniques, the findings will demonstrate that LTE-Advanced will achieve high throughput and low latency after occupying TV, and that TV channel use may be raised without harming TV transmission. This is a good way to get dynamic spectrum access data when combined with Geo Location Database approaches. The precise incumbent service kinds that are produced based on optimum decision algorithms will be used to carry out the choice. The LTE-Advanced network will make use of the entire infrastructure.

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