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LTE-U Coexistence With Wi-Fi in Unlicensed Spectrum of 5ghz : A Literature Survey

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Abstract:The co-existence of Long Term Evolution Unlicensed (LTE-U) and wifi on same band is a challenging issue. If these two techniques co-existed then the performance of wifi could be degraded.In this paper we reviewed several solutions for co-existence of wifi and LTE-U techniques. From the literature we also observed that some of the soft computing techniques such as genetic algorithms (GA), deep learning also have been applied for this coexistence problem.

Keywords: LTE-U, Soft computing, genetic algorithms, deep learning

INTRODUCTION

The exponential growth of data traffic is a challenging issue for mobile industry. It is very complex task for mobile and communication industry to provide 1000 times network speed, as it was in year 2010, by year 2020 [1]. To achieve this challenge here is a need of some effective techniques that can enhance the network capacity.

The LTE technology integrates different small bands into a bigger virtual bandwidth for licensed bands. [2]. But LTE licensed bands are having limited bandwidth very expensive. The alternative to LTE is LTE-U. The LTE-U offers high speed data rate and lowers the network cost. Thus instead of LTE licensed bands the LTE operator are interested in LTE 5Ghz unlicensed bands. Then again, the IEEE 802.11 Working Group (WG) essentially centered around improving the framework execution of Wi-Fi in thick organization situations [5][6]. With the deployment of LTE in unlicensed network, there are some unavoidable practical issues related which impose limitations on the deployment. The major challenge is the co-existence of wifi and LTE technology is on the same frequency bands. Due to this co-existence the performance of the wifi technology degrades. Hence here is a need to develop some approaches which could deal with the technological challenge.

LTE, Wifi and LTE unlicensed spectrum

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The unlicensed spectrum[7] is the frequency bands at 5 GHz. More specifically, band from 5150 to 5250 MHz. The band at this frequency remains unlicensed, and is free to use by operators or individuals.

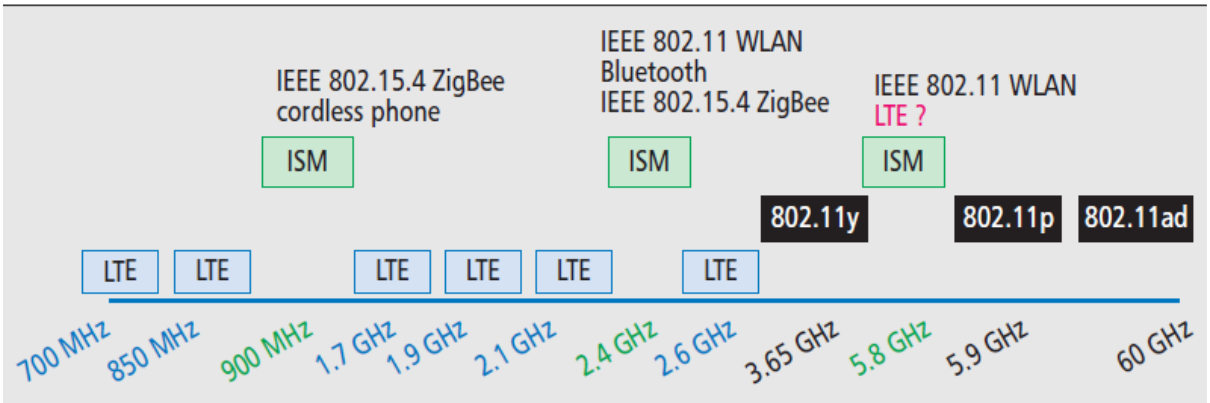

Figure 1: Spectrum Allocation in United States, considering future LTE deployment at 5.8 GHz. [4]

Wifi is a very popular network technology that used radio waves for networks connectivity. It uses wireless adapters or access points to connect the different client nodes it works on the frequencies between 2.4 GHz – 5GHz. LTE is a cellular technology that uses OFDMA (Orthogonal Frequency Division Technology) to provide the high-speed network connectivity. For licensed frequency bands the network operators use the LTE technology. Whereas the LTE-U (LTE in unlicensed spectrum) provides high speed data communication and requires no licensing at 5GHz band. The LTE-U lower the networks cost. In the paper different approaches for LTE-U and wifi coexistence problem available in the literature were presented .Section 2 of this paper presents the different approaches for wifi and LTE-U coexistence problem available in the literature and section 3 concludes the paper.

2. Literature Survey

Ljiljanaet. alpresented aco-existence study of Wi-Fi and LTEin 5GHz unlicensed bands[8]. The research work shows that the co-channel problem could be easily avoided by using large number of 5 GHz channels. The authors discussed that if the network density is low then LTE is better neighor to wifi than wificontestant. If the network density is very high than LTE is worst technology with the combination of wifi.

Erika Almeida et. al. introduced the problems that would be occurred due to the coexistence of LTE and wifi in the same band [9]. The authors in [9] observed that the performance of WiFi is degraded much more significantly than LTE in coexistence scenarios. The authors proposed a new approach to improve the throughput of wifi in LTE and wifi coexistence scenarios. The proposed approach can improve the throughput of wifi network upto 50 times.

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Song et. al evaluated the performance of wifi and cellular networks using variety of listen before talk (LBT) approaches [10]. In the research work presented in [10], A new framework was proposed that finds the optimal contention window size of cellular base stations. The proposed approach increased the throughput of both co-existed wifi and cellular networks.

Yubing et. al represented the study about the interference impact of LAA-LTE on wifi networks technology [11]. In this work the authors considered office indoor environments for experimental purposes. From experimental results it have been observed : 1) less bandwidth of LTE-LAA has the large impact on performance of wifi. 2) LAA/LTE signals with LAA/LTE can give the channel busy indication of CS/CCA (Career Sense/Clear Channel Assessment) inwifi.Cristina Cano et. al. proposed a fair allocation technique for co-existence in LTE-U and wifi technologies. The proposed approach is very simple and easy to implement as it don't requires huge knowledge of network parameters [12].

As the data traffic is increasing with time, it would be a nice option that cellular networks and local network could work on same unlicensed bands [13]. Wifi and LTE are most popular and efficient network technologies. These technologies works on different bands. In [13] authors presented the issues due to the coexistence of wifi and LTE. The research work shown that the performance of wifi is hardly affected due the transmission of LTE on same unlicensed bands.
Wang et.al. presented the different challenges faced by LTE-U in respect to Wi-Fi. A comprehensive study of proposed coexistence solutions and schemes is also presented in [14].
A new approach for LTE unlicensed application was proposed in [15]. The proposed approach is based upon full-dulex radio technology. This approach allows concurrent transmission and sensing in opportunistic access.

Yubing et. al presented his research work and shown that how LTE will affect the performance of wifi if both technologies are working on same unlicensed band. The author also developed an algorithm to indicate the coexistence between both technologies in unlicensed band [16]. The presentation of the proposed calculation was assessed by considering the various situations and it has been seen that the proposed calculation gives great channel use.

Le et al. talked about a few agreeable procedures for range partaking in remote systems including techniques to helpfully decrease the transmitting force, and ways to deal with helpfully diminish transmission obstruction. The creators detailed the range sharing issue as a helpful game. The broad investigations to show methods and marvels for agreeable range partaking in remote systems was displayed in the paper [17]. An efficient algorithm based upon energy ration was used to detect guassian noise and wifi leakage in coexistence with LTE signal [18]. Minho et al. presented dynamic spectrumsharing algorithm (DSSA). As the bands are limited and expensive, The proposed algorithm saves spectrum resources. To provide the QOS (quality of service) for each user it reallocates the occupied channels [19].

To portray the impedance of LTE and wifi another structure was proposed for thick sending situations with spatially covering inclusion [20]. The performance results shown in [20] indicates that the performance of wifi is reduced by a nearby LTE system. Also performance of LTE did not that much reduced as long as the wifi system is within career sense range.

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A new approach was proposed to share the spectrum for LTE eNB virtualization with multi-eNBs and multi-VOs system [21]. From the reproduction results it was seen that the proposed methodology can use the assets in proficient manner by different Vos. Hence it improves the system performance. A new approach i.e. BMSN-OSS was proposed by wang et. al [22]. The performance of the proposed approach was compared with FSA, PSS and DSS schemes. It is indicated that BMSN-OSS can make it conceivable to cut down the blocking likelihood of MVNOs having a similar radio assets when different MVNOs have empty range, meanwhile it doesn't impede MVNOs' advantage.

A novel system was presented for co-existence between LTE and wifi [23]. The proposed system has the capability to decode all interfering signals under heterogenous technology interference.Here is no need to refine the signals from any transmission. The another advantage of the proposed system is that it could be able to decode wifi MIMO signals under the stronger LTE signal existence. The proposed approach is having a effective carrier sense

The proposed system influences LTE and WiFi radio wires effectively accessible on cell phones to let LTE and WiFi transmit together and effectively translate the meddled sign.

A Wi-Fi and LTE-U combination figuring is proposed in multi-channel circumstances reliant on Q-learning [25]. The amusement eventual outcomes of the proposed procedure demonstrated that the proposed count can enough improve the throughput of the structure in the explanation of ensuring sensibility.

Some soft computing based approaches are also been applied for the problem of wifi and LTE coexistence. A multi target advancement system was proposed to adjust the exhibitions of LTE and WiFi in the unlicensed range [24]. In the proposed work three goals were improved for instance the throughput of WiFi, the throughput of LTE, and the typical package deferral of WiFi. The creators used the non-overwhelmed arranging hereditary calculation II (NSGA-II) to acquire the total Pareto ideal arrangement set of the advancement issue. The algorithm is simple, robust, complete and having fast convergence rate [24]. A deep learning approach was proposed for demonstrating the asset portion issue of LTE-U small base stations (SBSs) in [25].

Sadly, there exists restricted open information concerning fine-grained client execution, especially with respects to the progress among 3G and LTE and the transaction between 3G, WiFi, and LTE. The focal point of this paper is to offer understanding into these specific progress focuses as gathered from almost 200 well-instrumented cell phone clients. In particular, we note the impressive effect that the nature of cell phone WiFi plays notwithstanding taking note of that utilization crosswise over WiFi and cell will in general remain strikingly predictable once adequate cell speeds are accomplished was proposed by Striegel et. al [26]

Alkhansa et. al presented (multi–RATs) transporter conglomeration (CA), otherwise called multi flow CA, is an imagined future system that enables channels from various RATs to be totalled and allotted to the end client. This strategy takes into account an productive usage of

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the divided and swarmed range, just as for coordination and burden adjusting between the extraordinary Rodents[27].

Termizi et. al looks at Wifi and its different gauges, LTE and its groups, the contrast between Wi-Fi (802.11ac) and LTE-U, and the need why unlicensed range is utilized[28].

Maglogiannis, Vasilis, et al. explained portable administrators are utilizing WiFi to diminish the weight presented on their systems by the flooding data transfer capacity request of uses. Be that as it may, administrators frequently need insightful systems to control the manner in which clients get to their WiFi systems. This absence of advanced control makes poor system usage, which thoroughly corrupts the nature of experience (QoE)[29].

Bajracharya, Rojeena et al. visualized that because Wi-Fi and LTE are assorted with different physical and connect layer setups, a few answers for accomplish an efficient and reasonable concurrence have been proposed. A large portion of the proposed arrangements encourage a reasonable concurrence through a spasmodic transmission utilizing an obligation cycling or dispute system and an efficient conjunction through a perfect channel choice. Be that as it may, they are obliged distinctly by decency or efficient concurrence however not both. In this, we propose joint versatile obligation cycling (ADC) and dynamic channel switch (DCS) components.

CONCLUSION

This paper presented the overview of different available approaches for the co-existence problem of wifi and LTE-U networks on same band. It was observed from the literature that some of the soft computing approaches also could be used to solve the problem of LTE-U and wifi.

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