5GSPECTRUM: Advanced Spectrum Management in 5G and Beyond Systems

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Abstract—**Spectrum is, and with the 5G deployment will become more and more, a very important asset in wireless telecommunication networks. The way that spectrum is allocated to different technologies and services, most of the time even in non-contiguous bands, varies a lot according to the geographic area in focus and to the different operators' policies. The diverse usage of spectrum and the forthcoming availability of new bands in the mmWave domain will free a huge amount of new bandwidth that will allow for new services and application, not effectively deployable so far. A special session on advanced spectrum management in 5G and beyond systems, held in Venice, Italy. Two papers are presented, one discusses CoMP for 5G and another address the handover in 4G systems.**

Keywords—5G, Spectrum, CoMP, handover, LTE-U, WiFi

I. INTRODUCTION

3G and 4G technologies have mainly focused on the mobile broadband use case, providing enhanced system capacity and offering higher data rates. This focus will clearly continue in the future 5G era, with capacity and data rates being driven by services such as video. But the future will also be much more than just enhancements to the "conventional" mobile broadband use case. Future wireless networks should offer wireless access to anyone and anything. Thus, in the future, wireless access will go beyond Human Type Communication (HTC) and expand to serve any entity that may benefit from being connected. This vision often is referred to as "the Internet of Things (IoT)," "the Networked Society," "Machine-to-Machine communications (M2M)" or "machine-centric communications." North American operators' best customers are no longer humans; they are increasingly machines, such as smart utility meters, digital signage and vehicle infotainment systems [1-2].

To meet the above challenges of increasing traffic demand, the 3GPP has been continuously endeavoring to increase the network capacity by improving the spectral efficiency of the LTE-based cellular system by the introduction of higher order modulation, massive MIMO, mmWave and carrier aggregation, to name a few. However, the current amount of spectrum allocated by ITU to LTE-based cellular systems is deplorably insufficient, until new spectrum is available in WRC΄19. For example, it is estimated that there is at least a 663 MHz spectrum deficit in China [3]. Such a looming spectrum crunch has imposed a great challenge for the mobile operator. Recently, leading telecom carriers have started to explore new potentials for exploiting the unlicensed 5 GHz band for the LTE-based cellular system. Up to 500 MHz of spectrum is available in the 5 GHz band on a global basis with similar band plans [4]. The 5GHz band has so far been occupied by WiFi, recently 3GPP proposed an approach of LTE-Unlicensed (LTE-U) or Licensed-Assisted Access (LAA) [4], which enable LTE operators to offload their traffic in the 5GHz unlicensed band and leverage the usage of unlicensed band.

However, enabling the operation of LTE in unlicensed band raises the coexisting issue with WiFi. To solve coexistence issue, there are mainly two methods: 1) Listen before Talk (LBT) and 2) duty cycle. LBT is stated by Sony, Intel, Huawei, Qualcomm, ESTI, Nokia, and so on. LBT mechanism is not only used to coexist with other technologies in the unlicensed band but also required in some regional market, such as EU and Japan. The regional requirement is subject to the CCA (Clear Channel Assessment) requirement specified in [ESTI

301893]. On top, if the requirement, detail mechanism is left to be designed. The duty cycle approach is also proposed by same companies as LBT. Duty cycle divides the channel time equally to the small cells (LTE-U, WiFi APs) so that the WiFi transmission time is guaranteed and fairness is achieved. However, the disadvantages are the fact that channel access of non-LBT LTE becomes inflexible that is cannot access WiFi´ s share immediately when WiFi devices are in low channel utilization. Furthermore, the long duty cycle period can directly affect the latency of each technology.

II. Contribution from Authors

Two paper have been submitted to this track on 5GSPECTRUM: Advanced Spectrum Management in 5G and Beyond Systems. In this paper, authors focused on CoMP topology using different frequency spectrum design shared and dedicated for wireless communication systems, namely within the context of RRH antennas, and HetNet scenarios. Performance results are obtained not only in terms of UE average spectral efficiency but in terms of UE throughput too, that is now increasingly becoming an important design indicator for planning, deploying and optimizing next-generation mobile networks. One of the simplest ways of improving system performance is to enhance the signal power. This goal can be achieved using LTE SLS to joint transmission downlink CoMP scheme. As the same frequency bandwidth is used, the system is very sensitive to ICI. The utilized CoMP scheme with dedicated spectrum is introduced to improve the performance of cell edge users by customizing the repartition of bandwidth. The use of shared spectrum increases the cell average throughput. The simulation setup is based on 3GPP Technical Specification Group reports. CoMP plays an important role in improving the system performance and, therefore, this work can be extended such that the optimal parameters are determined for the CoMP and further parameters can be analyzed to optimize the system capacity and end-to-end delay.

Second paper discussed the densification of small cells has the potential to deliver increased network capacity based on increased cell density and high spatial and frequency reuse, enhanced spectral efficiency based on improved average SINR (with tighter interference control) and improved energy efficiency based on reduced transmission power and lower path loss resulting from smaller cell radii or distance between the small cells and the UEs.

On the other hand, however, UDN presents serious challenges in terms of mobility support, interference management and cost. In the context of mobility, it poses a severe problem due to the high frequency of handovers (due to shorter handover time), increased signaling and high measurement overheads that would be incurred if the control signals are from spatially-close small cells.

Results from this simulation campaign buttress these outcomes.

III. Conclusion and Open issues

The trend and direction for future work in realizing the gains of densification of small cells, therefore, is to decouple the control and user planes such that mobility management (handover and another control signaling) is handled by the macrocell layer where very high data rate is not required, while the data plane functionalities are handled by the closest small cell in order to support the high data rate demands of next-generation services and applications. This framework is an area of growing research interest for 5G and beyond-5G (B5G) systems. For coexistence with LTE-U and WiFi, following open challenges still needs to be addressed: Intra-operator deployment of LTE-U and WiFi: Coordinated scheduling in the shared unlicensed spectrum between LTE-U and WiFi; -planned network deployment. Inter-operator deployment of LTE-U and WiFi: Ensure the fair accessibility between WiFi APs and LTE-U eNBs; Efficient LBT-like mechanism to mitigate the access collision; FDM and/or TDM of unlicensed spectrum among RATs, or mutual agreements on placement or configuration of the nodes among operators; Feasible channel selection mechanism to avoid interference/DFS

References

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