Demo: Cross-Technology Interference Nulling for Improved LTE-U/WiFi Coexistence

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ABSTRACT

Smart antennas can unlock the potential of unlicensed spectrum by letting the coexisting networks transmit concurrently without harmful interference. This is possible by strategically allocating the antenna degrees-of-freedom for both beamforming toward the intended receiver and interference nulling toward the victim receiver(s). Our solution, named Xzero, achieves this goal for the particular case of LTE-unlicensed (LTE-U) and WiFi by overcoming the challenges of cross-technology interference nulling by a null search at the LTE-U BS with assistance from the WiFi network. Our demo shows a running prototype of Xzero implemented using USRP SDR platform running srsLTE and commodity WiFi hardware. We illustrate the change in the airtime of colocated WiFi and LTE-U networks upon activation of Xzero and fast reconfiguration of the null beam upon a change in WiFi node's location.

CCS CONCEPTS

• **Networks** → **Network architectures**; **Network experimentation**;

1 INTRODUCTION

To increase the capacity of cellular networks cost-effectively, LTE-unlicensed (LTE-U) aggregates component carriers from both licensed and unlicensed spectrum, particularly 5 GHz band which is already used by 802.11 (WiFi). While WiFi is coexistence-friendly owing to its listen-before-talk scheme, LTE-U has to implement coexistence techniques for fair and efficient spectrum sharing with WiFi. Current coexistence proposals aim at tuning LTE-U's access to resources (e.g., time, frequency) such that only one network is active in the band of interest at a certain time. For example, LTE-U has off-periods, whose duration is adapted based on the WiFi activity, to let WiFi network access the medium during such off-periods.

Our proposal in [1] enables instead both LTE-U and WiFi to access the medium by exploiting LTE-U BS's smart antennas for both beamforming toward LTE-U UE and interference nulling toward the carefully selected WiFi nodes. However, for cross-technology interference nulling (CTIN), LTE-U BS needs the knowledge of instantaneous channel state information to the WiFi nodes. Xzero [3], tackles this challenge by running null search with the help of feedback from the WiFi network. Although legacy LTE-U and WiFi networks lack such a feedback control channel, our recent solution LtFi [2] provides an easy-to-setup and standards-compliant cross-technology communication channel. In this demo, we present a running prototype of Xzero.

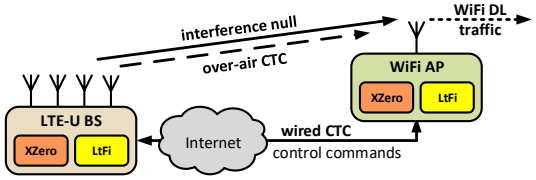

Figure 1: LTE-U BS with Xzero performs CTIN towards co-located WiFi nodes.

2 XZERO: A TREE-BASED SEARCH

For CTIN from LTE-U towards WiFi nodes (Fig. 1), Xzero searches the null direction by forming null beams one after another and covering the angular space in several steps. First, it starts with a large null region, e.g., 60°, and later decreases the region width by focusing on the best configuration at each step: the WiFi node(s) to be nulled report the nulling configuration providing the lowest interference-to-noise-ratio (INR) and LTE-U BS continues its search by further decreasing the null region, e.g., 20°, only in the reported angular space. Hence, Xzero with its tree-search, is significantly faster compared to the sequential search of all angles, e.g., 10× [3].

3 DEMONSTRATOR DESCRIPTION

Fig. 1 shows our demo setup. We control the operation of LTE-U BS via an interactive web-based GUI, which lets us vary the RF gain of the LTE-U BS to emulate different eNB to AP distances. Moreover, we can control the LTE-U duty cycle length. Finally, using the GUI, we can enable Xzero for CTIN by LTE-U BS towards WiFi AP. In this demo, we will demonstrate on-the-fly CTIN from LTE-U BS towards WiFi AP. The audience will observe the change in the airtime of both networks: without Xzero as both networks are in the same collision domain, the available airtime needs to be shared by LTE-U eNB and WiFi AP sums to 1. With Xzero, co-existence gaps are created also in space domain which lets both networks utilize the full airtime of 1. During the demo, we will change WiFi AP's location to show the low reconfiguration delay of Xzero.

REFERENCES

[1] Suzan Bayhan, Anatolij Zubow, and Adam Wolisz. 2018. Coexistence Gaps in Space via Int. Nulling for LTE-U/WiFi Coexistence. In *IEEE WoWMoM*.
[2] Piotr Gawłowicz, Anatolij Zubow, and Adam Wolisz. 2018. Enabling cross-technology comm. between LTE unlicensed and WiFi. In *IEEE INFOCOM*.
[3] Anatolij Zubow, Piotr Gawlowicz, and Suzan Bayhan. 2018. On Practical Coexistence Gaps in Space for LTE-U/WiFi Coexistence. In *European Wireless*.

This work has been supported by the European Union's Horizon 2020 research and innovation programme under grant agreement No. 645274 (WiSHFUL project).

MobiSys '18, June 10–15, 2018, Munich, Germany

ACM ISBN 978-1-4503-5720-3/18/06.
https://doi.org/10.1145/3210240.3211110