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SDR-based Distributed Spectrum Analysis in a Smart City

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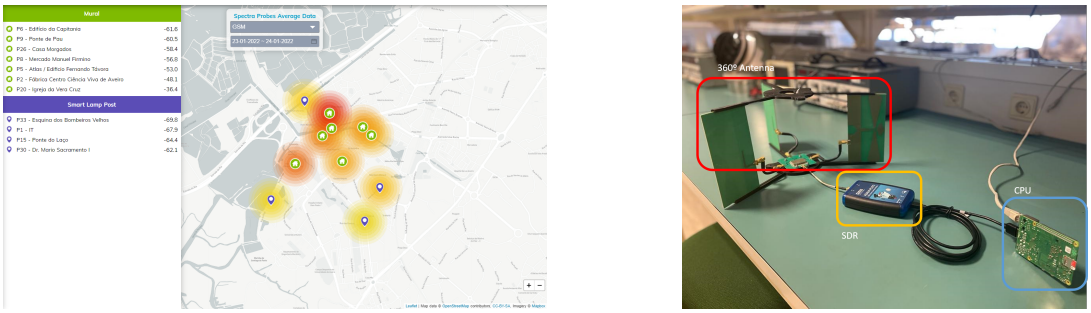
The concept of Smart Cities is increasingly ingrained in the world culture, and therefore cities focus many of their efforts by becoming smarter using big data management network technologies such as the Internet of Things(IoT) or cloud computing technologies [1]. In [2], the authors demonstrate a system for detecting pedestrians at a zebra crossing, warning all vehicles in the vicinity of that zebra crossing, which proved to be a significant development awareness system in a city environment. In this paper we present a distributed deployment of spectral probes in the Aveiro Tech City Living Lab (ATCLL), regarding the development of backscattering wireless-powered communications in smart cities. ATCLL is a city-scale testbed, located in Aveiro, Portugal, which includes nodes in the form of Smart Lamp Posts and building facades connected to a core data center through a dedicated fiber network. In these nodes, there are sensing devices, communication access points (5G, V2X, Wi-Fi and LoRa) and Multi-access Edge Computing (MEC). Examples of sensing devices are traffic radars, LiDARs and video cameras. The MEC comprises in a PC Engines APU, a NVIDIA Jetson and a Raspberry Pi in each node. Embedded to these nodes, there are the spectral probes, which are able to capture the spectrum of common communication frequencies present in a city environment and expose that data in the form of a heat map as shown in Fig. 1a.



(a) Spectral probes heatmap for GSM band (https://aveiro-open-lab.pt)

(b) Spectral probe hardware

Figure 1. Spectral probe system and data

The spectral probe is a passive radar system consisting of three main blocks. As shown in Fig. 1b, it consists of three dipoles (marked with red) which form a 360º antenna connected to the second main block, a low-cost commercial SDR - ADALM-PLUTO (marked with yellow). The data collected by the SDR is then processed by the Raspberry Pi (marked with blue) and the output is sent to the cloud, where the collected data from all the distributed radars has the final processing stage to be plotted in the web app.

References

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[2] F. Pereira et al., "When Backscatter Communication Meets Vehicular Networks: Boosting Crosswalk Awareness," in IEEE Access, vol. 8, pp. 34507-34521, 2020, doi: 10.1109/ACCESS.2020.2974214.

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