GREEN TETHERED UAVS FOR EMF-AWARE CELLULAR NETWORKS

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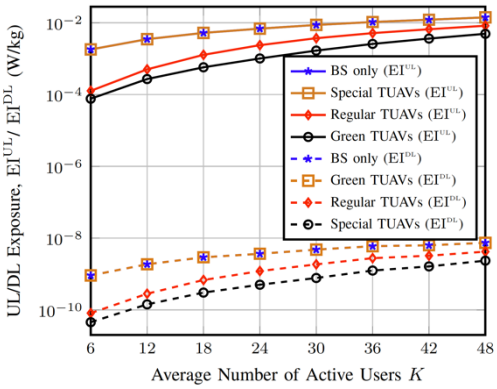
ABSTRACT
The exposure to electromagnetic fields (EMF) from base stations (BSs) concerns some of the population. To alleviate this concern, in this work, we use aerial antennas carried by tethered unmanned aerial vehicles (TUAVs) to receive the signal from the user equipment (UE), reducing the radiation and users' uplink (UL) exposure. In this system, we put several ground stations on the top of some buildings. These accessible stations can provide power and data backhaul for TUAVs. These TUAVs are considered to relay users' data to the BS. We tune the location of the TUAVs to reduce the required user equipment (UE) transmit power and consequently the exposure. The proposed TUAV-assisted architecure has better flexibility, and it further reduces the EMF exposure compared to fixed antennas-based schemes.

1. INTRODUCTION

In EMF-aware cellular networks, communications systems is designed to reduce the health risks due to the radio frequency (RF) radiation from cellular networks. In [1], two orthogonal frequency-division multiplexing (OFDM) based systems have been proposed to minimize uplink (UL) exposure while guaranteeing predefined throughput of users. Recently, reconfigurable intelligent surfaces (RISs), which can reflect the incident electromagnetic wave toward the specified direction, have been proposed to reduce exposure [2]. Although the use of fixed deployed small cells (SCs) and RISs can effectively reduce EMF exposure, the network cannot adapt to user distribution changes. In [3], the authors proposed an efficient cell-based allocation method, which provides an optimized unmanned aerial vehicle (UAV) positioning to enhance the performance of communication systems. But the limited onboard energy and flight time impose a critical challenge for the deployment of UAVs. In contrast to existing works, we propose a novel architecture for cellular networks that exploit green TUAVs as an efficient tool to minimize the EMF exposure while achieving a target data rate. We optimize the position of the TUAVs and the resource allocation problem on a large scale, neither of which have been investigated before.

2. CONCLUSION

The evaluation scenario is composed of a BS and several TUAVs that can be connected to several ground stations (GSs) within an area of 1000 m × 1000 m. The BS is fixed in the middle of the area, and the GSs are evenly distributed in the area. The locations of users follow a superposition of Poisson point process (PPP) with and Poisson cluster process (PCP), where each cluster represents one hotspot with a radius 100 m, and the average number of clusters in the area is four. From the figure, the UL exposure from the mobile device is the dominant factor, e.g., 6 orders of magnitudes higher than the downlink (DL) exposure from the BS for the considered simulation settings [4]. The simulation results illustrated that using green TUAV to densify UL can provide good results when the number of RBs is limited. However, comparing fixed green small cells (SCs) to mobile green TUAVs, the latter tend to provide a better performance. For instance, when the required UL data rate is 100 Mbps, the proposed scheme reduces the EMF exposure by 23% and boosts the satisfied-users ratio by 400% compared to BS only. Regarding the proposed scheme for maximizing the rate with EMF constraint, it can significantly improve the average UL rate by almost 15% and 350% compared to SCs and BS only architectures when considering the ICNIRP exposure limit. Therefore, we believe that the proposed architecture can be of interest for the public, cellular operators, and research community, as reducing the exposure can be considered as a precautionary measure.



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