Users Selection Report

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I. Introduction

In the paper [1], authors proposed to operate massive Multiple Input Multiple Output (MIMO) cellular Base Stations (BSs) in unlicensed bands (mMIMO-U). they design a procedures required at a cellular BS to guarantee coexistence with nearby WiFi stations in the same piece of unlicensed band via interference alignment technology. Fig. 1 show the flow of mMIMO-U proposed.

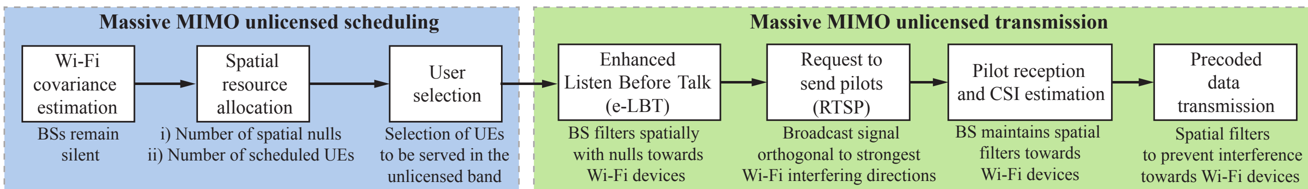

Fig. 1: Flow chart of the proposed mMIMO-U

Step1:
1) acquire channel state information from the neighboring WiFi devices.
2) allocate spatial resources for WiFi interference suppression and user equipment (UE) multiplexing.
3) select a suitable set of UEs to be served in the unlicensed band.

Step2:
1) an enhanced LBT phase.
2) procedures for UE pilot request and channel estimation.
3) precoder calculation.

II. System Model

WE consider the downlink of a cellular network where massive MIMO cellular BSs are deployed to operate in the unlicensed band in a synchronous manner, and communicate with their respective sets of connected cellular UEs, while WiFi devices also operate in the same unlicensed band. Each BSs equipped with a larger number of antennas N, and simultaneously serves K UEs. Each BS transmit with power P_b. On the WiFi side, L is denoted by the set of WiFi devices. We assume that all WiFi device transmit with power P_w. It worth nothing that both UEs and WiFi devices are equipped with one antenna.

$$\begin{aligned} y_{(i,k)}[m] = &\sqrt{P_b} h_{[i,(i,k)]} w_{(i,k)} s_{(i,k)}[m] + \sqrt{P_b} \sum_{k' \in K_i \setminus k} h_{[i,(i,k)]} w_{(i,k')} s_{(i,k')}[m] + \\ &\sqrt{P_b} \sum_{i' \in J \setminus k} h_{[i',(i,k)]} w_{(i',k)} s_{(i',k)}[m] + \sqrt{P_w} \sum_{l \in L} g_{[l,(i,k)]} s_{(l)}[m] + \eta[m] \end{aligned} \tag{1}$$

where $h_{[i,(j,k)]} \in C^{N \times 1}$ is denoted as the channel vector between BS i and UE k in cell$j$. $g_{[l,(j,k)]} \in C$ is denoted as the channel coefficient between WiFi device l and UE k in cell j.

A. WiFi Channel Estimation

In this phase, all the BSs remain silent, and thus each BSs i receives the signal from WiFi devices. We can obtain the interference by estimation:

$$
\begin{aligned}
z_i[m] &= \sum_{l \in L} \sqrt{P_l} g_{i,l} s_l + \eta_i[m] \\
Z_i &= \frac{1}{M_c} \sum_{m=1}^{M_c} z_i[m] z_i^{\dagger}[m],
\end{aligned}
\tag{2}
$$

which consists of all transmission form active WiFi devices and noise term is ADWN. The M_c is the length symbol intervals BS keep silent. $g_{i,l} \in C^{N \times 1}$ is denoted as the channel vector between BS i and WiFi l.

$$
Z_i = U_i \Lambda_i U_i^{\dagger}, \tag{3}
$$

where $\Lambda = diag(\lambda_{i,1},,,\lambda_{i,N})$, such that $\lambda_{i,1} > \lambda_{i,1},,,> \lambda_{i,N})$. In order to allocate dof, let define the matrix

$$
\Sigma_i = [u_{i,1},,,u_{i,D_i}], \tag{4}
$$

whose columns contain the D_i dominant eigenvectors of Z_i. For a sufficiently large D_i, $range\{\Sigma_i\}$ represents the channel subspace on which BSs i receives most of the WiFi transmitted power. Therefore, the power transmitted by BS i on $range\{\Sigma_i\}$ represents the major source of the interference for one or more WiFi devices.

REFERENCES

[1] G. Geraci, A. Garcia-Rodriguez, D. López-Pérez, A. Bonfante, L. G. Giordano, and H. Claussen, “Operating massive mimo in unlicensed bands for enhanced coexistence and spatial reuse,” *IEEE Journal on Selected Areas in Communications*, 2017.