A SURVEY ON ANTENNA SELECTION

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Abstract **– Next generation 5G and 6G seek to achieve all-time connectivity for heterogeneous devices. This implies that the devices must stay connected irrespective of channel status. Using diversity in multi-antenna devices, communicating nodes explore different channel paths to improve link reliability. Due to prohibitive implementation costs, antenna selection has been adopted for mobile telecommunication. In the work presented here the authors consider the various approaches in antenna selection, and develop accurate taxonomy to represent current efforts. The rest of the work is organised as follows: section I is the introduction, section II the system model, section III contains discussions on the antenna selection taxonomy, section IV analysis methodology, section V open research areas and section VI concludes the work.**

Keywords – 5G, 6G, Multiple in multiple out MIMO, Suboptimal, Sum rate, JASUS

INTRODUCTION

5G and 6G wireless communication promises to further improve cellular communication performance with increased bit-rates in orders of gigabits/seconds, extremely low latency for communication networks and quality of service. One technology that has made the expected improvements possible is the multiple-in multiple-out (MIMO) system in which communicating nodes may have more than one antenna.

Having more antennas at either ends of the communication link of a MIMO system can improve both link quality and signal-to-noise ratio (SNR). However, despite the immense benefits of MIMO in 5G and beyond, the MIMO technology comes with very high implementation cost because of the sheer number of radio frequency (RF) chains required to be connected to the antennas. Well known components of the RF chain include the digital/analogue converters (DAC), intermediate frequency generator, analogue-to-digital converter (ADC), mixer, RF filter, RF amplifier, local oscillator and modulator.

In antenna selection, algorithms are developed to search a device for antennas based on specific objectives for a user or group of users. The antennas are then connected to available RF chains for transmission or reception. The search may be optimal or sub-optimal, where the former yields better objective output for users but is known to be computationally intensive, while the latter trades marginally poorer outcomes with lower computational difficulty. It has been observed that when the right subset of antennas are selected in the devices, communication can be conducted reliably as if all antennas were indeed used to transmit or receive [1][2]. Consider the forward and reverse link communication between a multi-antenna base station and users within the cell range, as represented in figure 1 below.

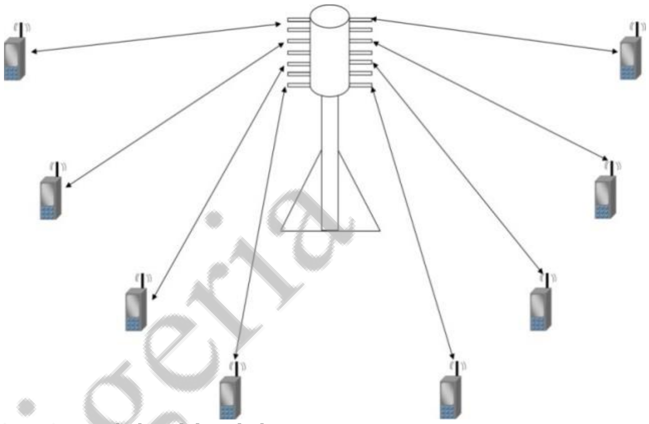

Figure 1: Uplink and downlink in massive user MIMO system

Contributions of the paper

The objective of this work is to offer insight into possible research areas in this field while providing readers a comprehensive overview of the taxonomical classification in the field of MIMO antenna selection.

SYSTEM MODEL

The relationship between the input and output in a MIMO antenna selection is expressed below: [2]

$$y_k(t) = H_k x_k(t) + n_k(t)$$

Where y_k is signal intercepted at the user equipment at time t, H is the channel gain matrix, x is the transmitted bit and n is the white Gaussian noise present. Most of the surveyed works considered Rayleigh fading wireless communication environment. Both $yk, Hk \in \mathbb{C}Nrk \times 1$

MIMO capacity can be expressed as:

$$C = \log_2(1 + \rho H)$$

Where C is the capacity, H is the channel matrix, and ρ is the signal-to-noise ratio (SNR). Since more than one antenna is capable of exploiting channel condition in a MIMO system, the achievable capacity is therefore higher. With the implementation of antenna selection, only the most suitable