AN OPTIMAL SOLUTION FOR ALLOTMENT OF PILOT SEQUENCE RESOURCES IN 5G MASSIVE MIMO

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Abstract—**Wireless network in which many antennas at the base station and it connected with many users, known as Massive MIMO system, which is one of the best key to handle the rapid growth of data traffic.as the number of users increases, the random access in concurrent network will be flooded by user collision. In the"5G" massive MIMO setting, The terminals are assumed fully loaded and a main impairment to the performance comes from the inter-cell pilot contamination, i.e., interference from terminals in neighbouring cells By using the same pilots as in the home cell. This Type of pilot overhead can be reduced by reusing pilot sequences in nearby cells, however this method introduces interference in the channel estimation phase, the so-called "pilot contamination" effect. In this Paper, we study the effect of pilot contamination in 5G environments and we can resolve this problem by using SUCR protocol. The proposed SUCR protocol can, expeditiously and distributively resolve the huge majority of all pilot collisions.**

Keywords—**MIMO,5G massive MIMO, pilot contamination, random access protocol ,collision resolution**

I. INTRODUCTION

The MIMO antenna technology has become an efficient Way in modern cellular wireless Network. MIMO (multiple input, multiple output) is an antenna technology for wireless communications in which multiple antennas are used at both the side transmitter and receiver. There are several other antennas technology like MISO,SIMO apart from MIMO technique. but this all technique cause problems with multipath effects [1]. In upcoming years the demand for wireless data services is increase. so The number of wirelessly connected devices and their own data traffic are also increase as we transition into the fully loaded networked society [2]. A fair amount of the traffic is expected to the 5G Communication. Hence, future cellular networks need to handle urban deployment with massive numbers of connected users which is request more data volumes [3]. . **Massive** multiple-input, multiple-output, is an extension version of **MIMO**, which essentially groups together antennas at the both side to provide better throughput and better spectrum efficiency[4]. Massive MIMO, as illustrated in fig (1)**.**

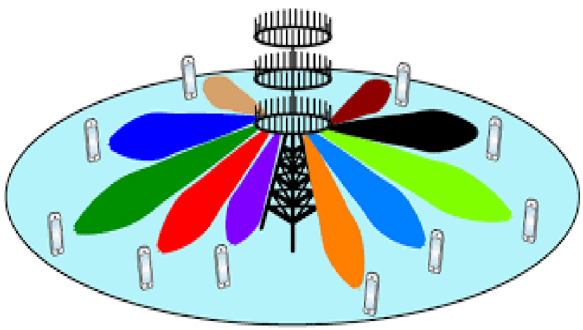

FIG: 1 STUCTURE OF MASSIVE MIMO

In the wireless communication system. Massive MIMO wireless system refers to a very large number of antennas with orders of magnitude, e.g., 100 or more [5] which are equipped at the cellular Base station to enhance the system capacity, spectral and energy efficiency at both side the downlink and uplink communications [6]. When the number of BS antennas goes to infinity, the system capacity is largely limited by the inter-cell interference because of the pilot contamination Therefore, pilot pollution has become one of the main reasons for the performance loss in massive MIMO systems. The paper is organized as follows. In Section II,the Basic information about pilot contamination. The effect of pilot contamination and the Random access protocol, the proposed SUCRE protocol & the example of proposed method and simulation result are presented in section III and finally Section IV concludes this paper.

II. PILOT CONTAMINATION

In multi-cell systems, we cannot assign orthogonal pilot sequences for all users in all cells, Due to the limitation of the channel coherence interval. Orthogonal pilot sequences have to be reused from cell to cell. There for, The channel estimate obtained in given cell will be contaminated by pilots transmitted by users in other cells. This effect, called ―Pilot Contamination‖[7].

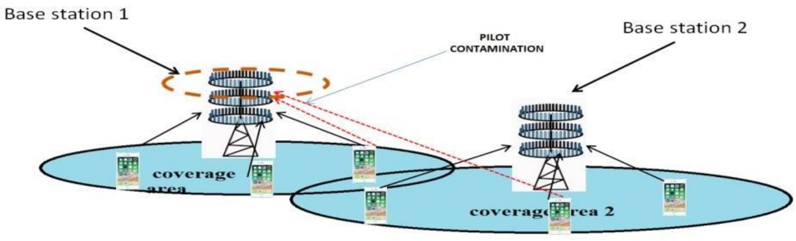

FIG: 2 PILOT CONTAMINATIONS

A. Effect Of pilot Contamination

- When estimating the channel from the desired terminal, the base station cannot easily separate the signals from the two terminals. This has two key implications:

1. The interfering signal acts as noise that reduces the channel estimation accuracy.

2. The base station unintentionally estimates a superposition of the channel from the desired terminal and from the interferer.

- Which is reduced the system performance
- Increase the Interference between Users.

III. RANDOM ACCESS PROTOCOL

To set This Protocol into atmosphere, first we analyse the protocol used on the Physical Random Access Channel (PRACH) in 5G, summarized in Fig(3).

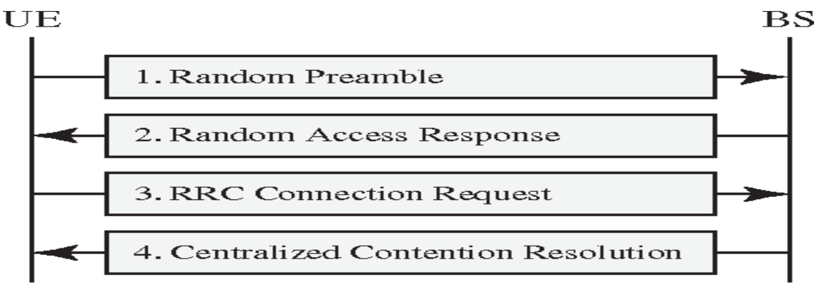

FIG: 3 THE PRACH PROTOCOL OF THE 5G

- **Random access protocols can Initialize In 4 steps**

1st,

The accessing UE picks randomly a preamble from a predefined set. The preamble is a robust entity that enables the BS to gain synchronization. It does not carry a specific reservation information or data and thus has a role as a pilot sequence. Since multiple UEs pick preambles in an uncoordinated way, a collision occurs if two or more UEs select the same preamble. However, at this stage the BS only detects if a specific preamble is active or not.

2nd,

The BS sends a random access response corresponding to each activated preamble, to convey physical parameters (e.g., timing advance) and allocate a resource to the UE that activated the preamble.

3rd,

Every UE who has received a response to its transmitted preamble sends a RRC Connection Request in order to obtain resources For the subsequent data transmission. If more than one UE activated that preamble, then all UEs use the same resource to send their RRC connection request in Step 3 and this collision is detected by the BS.

4th,

It is called contention resolution and contains one or multiple steps that are intended to resolve the collision. This is a complicated procedure that can cause considerable delays.

A. REASON BEHIND TO SELECT THE RANDOM ACCESS PROTOCOL

The Random access is performed for the sole purpose of being granted a pilot sequence that can be used in a collision-free transmission. A special set of non-dedicated access sequences are used and collisions happen in the pilot domain. When a pilot access is collision-free, the corresponding device can be identified, Admitted to the network, and assigned a cell unique pilot. It is henceforth allowed to transmit and receive data, without intra-cell pilot contamination. Collision-free access is enabled by a mechanism that is iterative in general, implying multiple transmission phases between the BS and the devices

B. STRONGEST-USER COLLISION RESOLUTION (SUCR)

- In a Random access mechanism The Intra –cell Pilot collision becomes unavoidable. To Address This Issue we need to one Protocol which called ―SUCR‖.
- SUCR Protocol, which is an efficient way to operate the RA blocks in LTE Massive MIMO system. The four main steps of the SUCR protocol are illustrated in fig (4).

FIG: 4 THE SUCRE RANDOM ACCESS PROTOCOL FOR 5G MASSIVE MIMO

There is also a preliminary Step 0 in which the BS broadcasts a control signal. Each UE uses this signal to estimate its average channel gain and to synchronize itself towards the BS.

1st,

A subset of the inactive UEs in cell i want to become active. Each such UE selects a pilot sequence at random from a predefined pool of RA pilots. BS i estimate the channel that each pilot has propagated over. If multiple UEs selected the same RA pilot, a collision has occurred and the BS obtains an estimate of the superposition of the UE channels. The BS cannot detect if collisions occurred at this point, which resembles the situation in 5G.

2nd,

The BS responds by sending DL pilots that are pre coded using the channel estimates, which results in spatially directed signals toward the UEs that sent the particular RA pilot. The DL signal features an array gain of M that is divided between the UEs that sent the RA pilot. Due to channel reciprocity, the share of the array gain is proportional to their respective UL signal gains, particularly when M is large, which enables each UE to estimate the sum of the signal gains and compare it with its own signal gain (using information obtained in Step 0). Each UE can thereby detect RA collisions in a distributed way. This departs from the conventional approach in which collisions are detected in a centralized way at the BS and broadcasted to the UEs.

3rd,

This mechanism is illustrated in Fig. (12). The probability of non-colliding pilot transmission in Step 3 is vastly increased in the SUCR protocol, which enables the network to admit UEs also in crowded scenarios. The transmission in Step 3 also contains the identity of the UE and a request for payload transmission, resembling the RRC Connection Request in 5G.

4th,

It grants these resources by assigning a pilot sequence that can be used in the payload blocks or starts further contention resolution (e.g., in an 5G fashion or by repeating the SUCR protocol) in the few cases when RA collisions remain. Hence, the SUCR protocol both stands on its own and can complement conventional contention resolution methods.

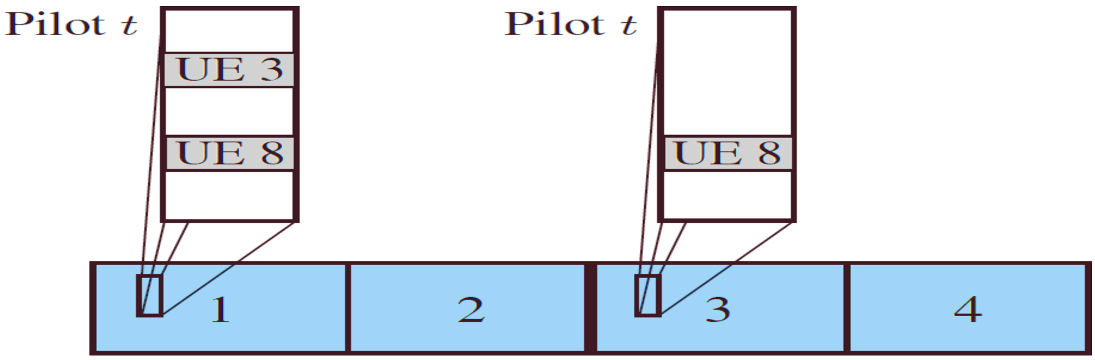

FIG: 5 PICTURE OF A REPEATATION OF THE PILOT IN STEP 3, WITH THE HELP OF SUCRE PROTOCOL

C. RESOLV THE COLLISION OF TWO USER'S

- Consider a scenario in which there are two User's and they are collide. In which The first User has the fixed pilot SNR, while for the second user's SNR2 is varied.

- **MATHEMATICAL ASSUMPTION**

S_T ={1,2}(two users collide)

SNR SNR1= $\rho_1\beta_1 r_p$ = $q\beta_1 r_p$=10 dB(fixed pilot of first User)

4 dB and 16 dB (second users SNR), s_k = 0,M = 100,500 (BS antennas)

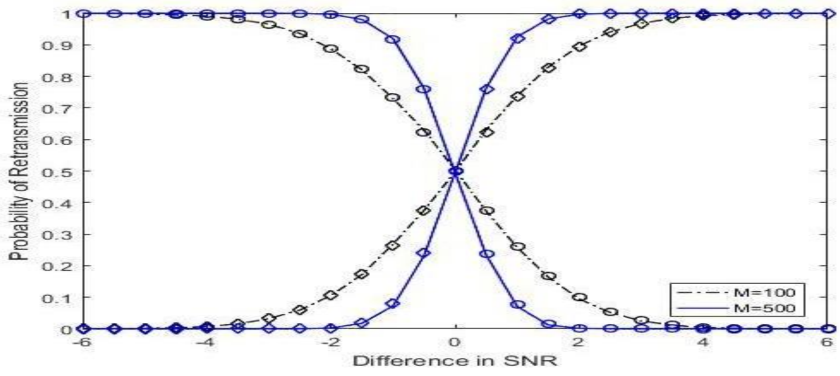

FIG: 6(A) PROBABILITY OF THE PILOT TRANSMISSION REPEAT WHEN TWO-UE COLLISION

Fig. 6(A) shows the probability at where the UEs repeat their pilot transmissions in Step 3(SUCRE steps),in which The horizontal axis shows the SNR difference SNR2-SNR1 between the UEs, which is between -6 dB and +6 dB. and vertical axis show the probability of Retransmission.

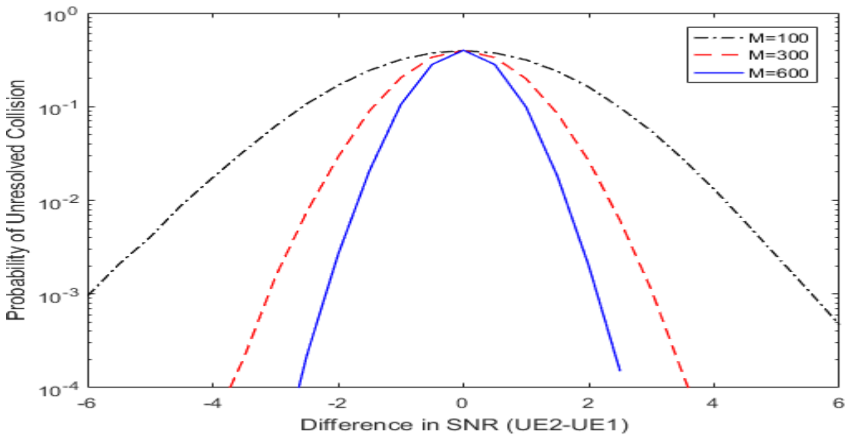

FIG:6(B) PROBABILITY OF AN UNRESOLVED COLLISION

FIG.6(B) Represent the probability of unsolved collision. This Problem is done whenever both the use's has same SNR, That means SNR1 = SNR2.

IV. *CONCLUSION*

We have considered a communication scenario with 5G massive MIMO and random terminal activity.in such a case it is not possible to allocate orthogonal pilot sequence to all the users present in the cell, due to that the collision is occurs between users, to overcome this problem we have proposed SUCR random access protocol which is provides an efficient way for Users to request pilots for data transmission, and it is suited for 5G Massive MIMO systems and overloaded scenarios. and the numerical result present that The Proposed SUCR Protocol Resolves Almost All Collisions When SNR1 And SNR2 Are Sufficiently Different With Large Number Of Antennas.

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