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An Efficient Scheduling Algorithm for NOMA in LTE and 5G Networks

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***Abstract*—** The expanding interest of mobile Internet and the Internet of Things stances testing necessities for 5G wireless communications, such as high spectral efficiency and massive connectivity. In this article, a promising technology, non-orthogonal multiple access (NOMA), is discussed, which can address some of these challenges for 5G. Non-orthogonal multiple access (NOMA) has been perceived as a promising different get to strategy for the next generation cellular communication networks. This paper review about NOMA basic, performance and key features of NOMA was discussed. For this work, paper identified with execution examination of new scheduling algorithm weighted round robin (WRR) to improve QoS in LTE and 5G networks are picked and concentrated on.

***Keywords*—** *Non-Orthogonal Multiple Access, NOMA Basics, Features of NOMA, Scheduling Algorithm, Weighted Round Robin (WRR).*

I. INTRODUCTION

In the history of wireless communications from the First Generation (1G) to 4G, the multiple access schemes have been the key technology to distinguish different wireless systems. It is well known that Frequency-Division Multiple Access (FDMA) for 1G, Time-Division Multiple Access (TDMA) mostly for 2G, Code-Division Multiple Access (CDMA) for 3G, and Orthogonal Frequency-Division Multiple Access (OFDMA) for 4G are primarily Orthogonal Multiple Access (OMA) schemes. In these regular multiple access schemes, different users are distributed to orthogonal assets in the time, frequency, or code domain in order to avoid or alleviate inter user interference. In this way, multiplexing gain can be achieved with reasonable complexity. However, the fast growth of mobile Internet has propelled 1000-fold data traffic increase by 2020 for 5G. Future cellular networks can become denser with tiny cells. Compared to ancient macro cellular systems multi-layered networks with macro-cell layer covering relays, pico-cell and femto-cell layers, is changing into one choice for higher coverage, capability and spectral potency [1] [2]. Overall targets for 5G systems area unit higher output per space and per user, and lower latency. The 5G systems can support vast quantity of devices, and with energy consumption lower compared to current systems. Hence, the spectral efficiency becomes one of the key challenges to handle such explosive data traffic. Also, because of the quick improvement of the Internet of Things (IoT), 5G needs to support massive connectivity of users and/or devices to meet the demand for low latency, low-cost devices, and diverse service types. To satisfy these requirements, enhanced technologies are necessary. So far, some potential candidates have been proposed to address challenges of 5G, such as massive MIMO, millimeter wave communications, ultra dense network, and Non-Orthogonal Multiple Access (NOMA) [1]. In this article, we focus on NOMA, which is highly expected to increase system throughput and accommodate massive connectivity. Note that Third Generation Partnership Project (3GPP) Long Term Evolution (LTE) Rel-13 is doing ongoing studies toward NOMA in the form of Multi-User Superposition Transmission (MUST). NOMA enables different clients to share time and frequency resources in the same spatial layer via power domain or code domain multiplexing. Recently, several NOMA schemes have attracted lots of attention, and we can generally divide them into two categories, that is, power domain multiplexing [2–4] and code domain multiplexing, including multiple access with Low-Density Spreading (LDS) [5, 6], Sparse Code Multiple Access (SCMA) [7], Multi-User Shared Access (MUSA) [8], and so on. Some other multiple access schemes such as Pattern Division Multiple Access (PDMA) and Bit Division Multiplexing (BDM) [9] are also proposed. Key features and advantages of NOMA are discussed.

II. NOMA BASICS

In order to better illustrate the concept of NOMA, we take NOMA downlink transmission with two users as an example.

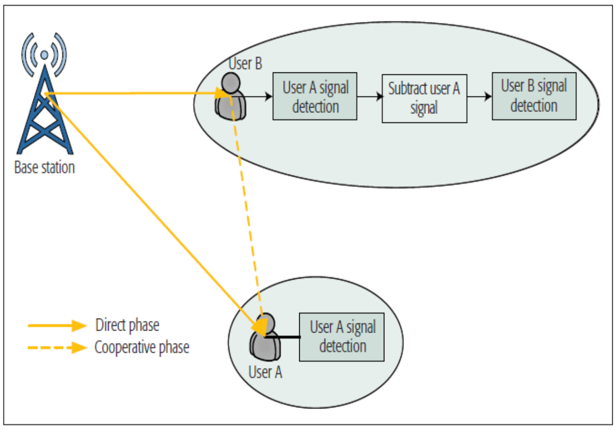

Figure 1: NOMA Network.

As shown in Figure 1, the two users can be served by the base station (BS) at the same time/code/frequency, but with different power levels. Specifically, the BS will send a superimposed mixture containing two messages for the two users, respectively. Recall that conventional power allocation strategies, such as water filling strategies, allocate more power to users with strong channel conditions. Unlike these conventional schemes, in NOMA, users with poor channel conditions get more transmission power. In particular, the message to the user with the weaker channel condition is allocated more transmission power, which ensures that this user can detect its message directly by treating the other user's information as noise. Then again, the client with the more grounded channel condition needs to first distinguish the message for its partner, then subtract this message from its observation, and finally decode its own information. This procedure is called successive interference cancellation (SIC) as shown in Figure 1.

III. FEATURES OF NOMA

In this section, we present the performance characteristics of NOMA in existing works, and then discuss the pros and cons of NOMA schemes.

A. Performance of Noma

It has been shown that NOMA offers considerable performance gain over OMA in terms of spectral efficiency and outage probability. Initially, the performance of NOMA was evaluated through simulations given perfect CSI by utilizing the proportional fairness scheduler, fractional transmission power allocation (FTPA), and tree search based transmission power allocation (TTPA). These works showed that the overall cell throughput, cell edge user throughput, and the degrees of proportional fairness achieved by NOMA are all superior to those of OMA. In, the author analyzed a two user SC-NOMA system under statistical CSI from an information theoretic perspective, where it was proved that NOMA outperforms native TDMA with high probability in terms of both the sum rate and individual rates. In, for a settled power portion, the execution of a multiuser SC-NOMA framework regarding of outage probability and ergodic sum rates under statistical CSI was investigated in a cellular downlink scenario with randomly deployed users. With the proposed asymptotic analysis, it showed that user n experiences a diversity gain of n and NOMA is asymptotically equivalent to the opportunistic multiple access technique. Moreover, the creators analyzed the performance degradation of a multiuser SC - NOMA system on outage probability and average sum rates due to partial CSI. It showed that NOMA based on second order statistical CSI always achieves a better performance than that of NOMA based on imperfect CSI, while it can achieve similar performance to the NOMA with perfect CSI in the low SNR region. In summary, most of the existing works on performance analysis of NOMA focused on a SC-NOMA system since the user scheduling in MC-NOMA complicates the analysis due to its combinatorial nature. A remarkable work in [31] characterized the impact of user pairing on the performance of a two user SC-NOMA system with fixed power allocation and cognitive radio inspired power allocation, respectively. The creators demonstrated that, for settled power distribution, the execution pick up of NOMA over OMA increases when the difference in channel gains between the paired users becomes larger. However, further exploration on performance analysis of MC-NOMA system should be carried out in the future since user scheduling is critical for performance of NOMA.

IV. PROS

A. Higher Spectral Efficiency

By abusing the power space for client multiplexing, NOMA systems are able to accommodate more users to cope with system overload. In contrast to allocate a subcarrier exclusively to a single user in OMA scheme, NOMA can utilize the spectrum more efficiently by admitting strong users into the subcarriers occupied by weak users without compromising much their performance via utilizing appropriate power allocation and SIC techniques.

B. Better Utilization of Heterogenity

As we mentioned before, NOMA schemes intentionally multiplex strong users with weak users to exploit the heterogeneity of channel condition. In this way, the execution pick up of NOMA over OMA is bigger when channel additions of the multiplexed clients turn out to be more particular.

C. Enhanced User Fairness

By relaxing the orthogonal constraint of OMA, NOMA enables a more flexible management of radio resources and offers an efficient way to enhance user fairness via appropriate resource allocation.

D. QoS Requirements

NOMA is able to accommodate more users with different types of QoS requests on the same subcarrier. Therefore, NOMA is a good candidate to support IoT which connects a great number of devices and sensors requiring distinctive targeted rates.

V. CONS

- The BS has to know the ideal channel state information (CSI) to arrange the SIC decoding order, which builds the CSI criticism overhead.
- The SIC process introduces a higher computational complexity and delay at the receiver side, especially for multicarrier and multiuser systems.
- The strong users have to know the power allocation of the weaker users in order to perform SIC, which also increases the system signaling overhead.
- Allocating more power to the weak users, who are generally in the cell edge, will introduce more inter cell interferences into the whole system.

VI. METHODOLOGY

According to new proposed approach to improve Quality of Service using Weighted Round Robin algorithm. There are following steps as follow as

Step 1: Initializing input parameters for 5G
Step 2: Generate 5G scenario
Step 3: Establish Communication System
Step 4: Introduce a transmission and reception module
Step 5: Modeling based on Weighted Round Robin Algorithm
Step 6: Calculating output parameters
Step 7: Comparison with other scheduling algorithm

VII. SCHEDULING ALGORITHMS

In this article, a pro After Packet Switching (PS) systems appeared, need was perceived to separate between various sorts of bundles. From that point forward parcel planning has been a hot examination subject its as yet being researched at numerous foundations. This is basically because scheduling means bandwidth sharing [13]. Customarily, the First Come First Served (FCFS) plan had been utilized for bundle booking. Bundles originating from all the info connections were enqueued into a First in First out (FIFO) memory stack, and after that they were dequeued one by one on to the yield join.

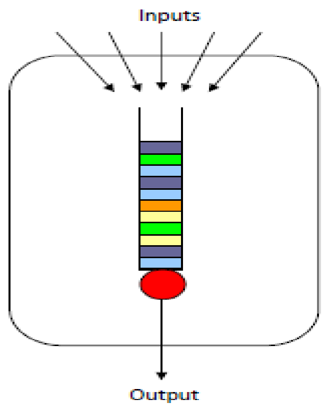

Figure 2: FCFS FIFO Stack.

This is appeared in Figure 2. Since dissimilar to bundles were blended and treated similarly, parcels requiring pressing conveyance couldn't be accomplished. So there is no scheduling move making place for this situation.

In the present time diverse lines are indicated to non comparative bundles for accomplishing parcel grouping. For this situation booking ought to be finished. The fundamental assignment of the implanted scheduling algorithm is to pick the following parcel to be dequeued from the accessible multi lines and sent onto the yield join. This is outlined in Figure 3 demonstrated as follows

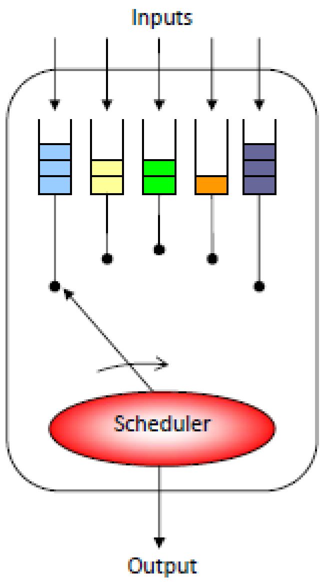

Figure 3: Multiple Queue Scheduling.

VIII. ROUND ROBIN (WRR)

Round-Robin as a scheduling algorithm is considered the most basic and the least complex scheduling algorithm. It has an unpredictability estimation of O.

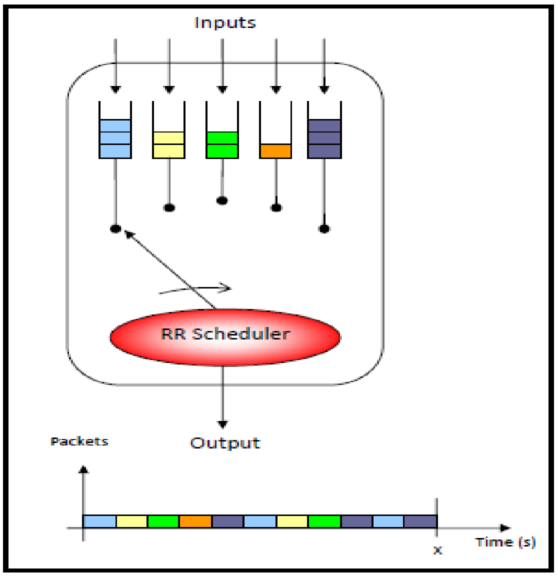

Figure 4: Round Robin Scheduler.

Fundamentally the calculation benefits the multiplied lines in a round robin style. Every time the scheduler pointer stop at a specific line, one parcel is dequeued from that line and afterward the scheduler pointer goes to the following line. This is appeared in Figure 4. Note that for this situation all bundles are of same length. Be that as it may, for occasion a MPEG video application may have variable size parcel lengths. This case is appeared in Figure 5.

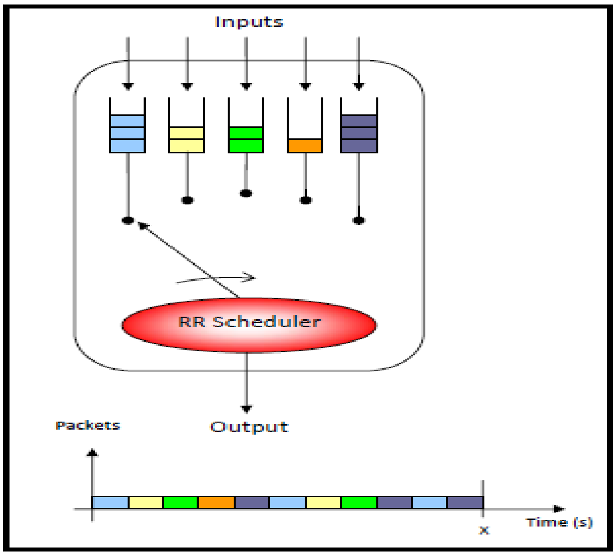

Figure 5: Round Robin Scheduler.

IX. WEIGHTED ROUND ROBIN (WRR)

Weighted round robin was intended to separate streams or lines to empower different administration rates. It works on the same bases of RR scheduling. In any case, not at all like RR, WRR doles out a weight to every line. The heaviness of an individual line is equivalent to the relative offer of the accessible framework data transfer capacity. This implies, the quantity of parcels dequeued from a line differs as indicated by the weight allocated to that line. Subsequently, this separation empowers prioritization among the lines, and consequently the SSes. In any case, the drawback of a WRR scheduler, much the same as a RR scheduler is that, diverse parcel lengths being utilized by SSes would prompt the loss of its decency basis.

X. SIMULATED RESULTS

In this section, the proposed algorithm is evaluated via computer simulation using MATLAB simulator. All simulation results are obtained on the basis of proposed approach weighted round robin algorithm as scheduling algorithm for throughput and range in LTE and 5G system. Figure 6 show the clusters/cells area distribution for cellular network or 5G mobile and wireless communication systems using approach weighted round robin algorithm as scheduling algorithm.

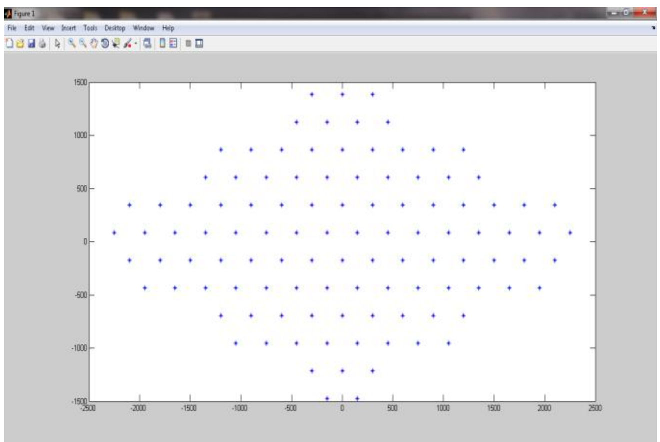

Figure 6: Scheduling Method for Cluster/Cells Area Distribution.

Figure 7 show the intensity and histogram adaptive distribution of network based on proposed approach weighted round robin algorithm as scheduling algorithm requests.

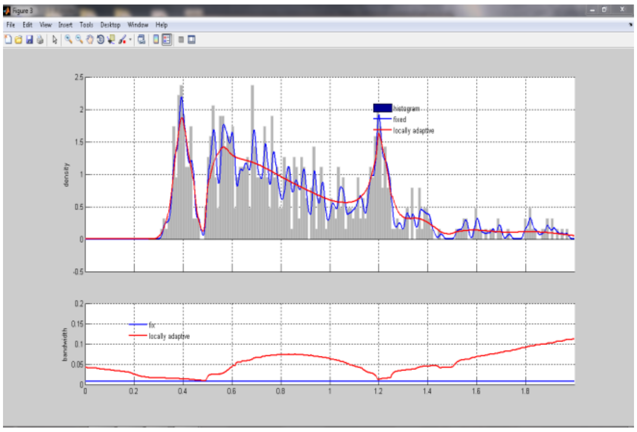

Figure 7: Adaptive Request Scheduling.

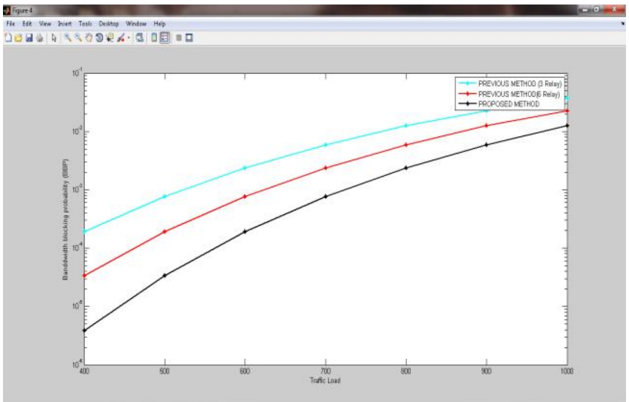

Figure 8: Comparison between Relay and Scheduling Method on the basis of Bandwidth BP versus Traffic Load.

Figure 8 show the bandwidth blocking probability versus traffic load of 3 and 4 relay based scheduling and proposed approach weighted round robin algorithm as scheduling algorithm. Figure 9 show the average throughput versus traffic load of 3 and 4 relay based scheduling and proposed approach weighted round robin algorithm as scheduling algorithm.

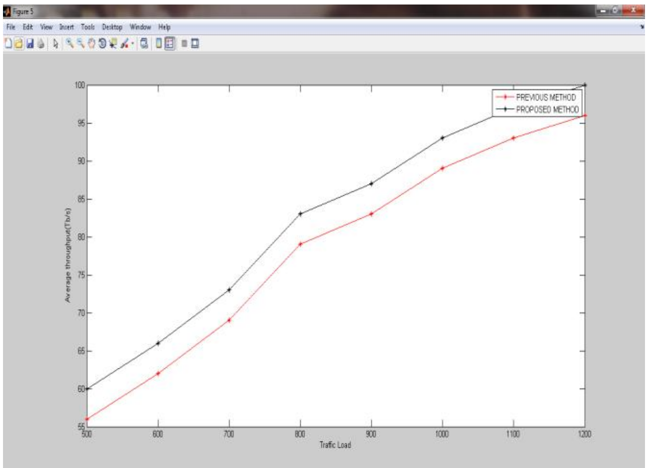

Figure 9: Comparison between Relay and Proposed Scheduling Method on the basis of Average Throughput versus Traffic Load.

CONCLUSION

In this article, a promising multiple access technology for 5G networks, NOMA, is discussed. A literature review about NOMA basic, performance and key features of NOMA was discussed. Besides, it displayed the key elements and potential research difficulties of NOMA. It is normal that NOMA will play an important role in future 5G wireless communications. Designing a scheduler that is less unpredictable, more efficient and gives a superior Quality of Service is of incredible significance to LTE and 5G systems.

Weighted Round Robin (WRR) scheduling algorithm has been concentrated on inside and out. Be that as it may, further simulations must be done to guarantee that the scheduler is also able to provide the QoS requirements with a larger number of subscriber stations with respect to the QoS constraints that were achieved in this work. For further extent of the work, the proposed scheduler might be taken forward and applied on other distinctive systems. This will test the versatility of the algorithm to various situations.

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