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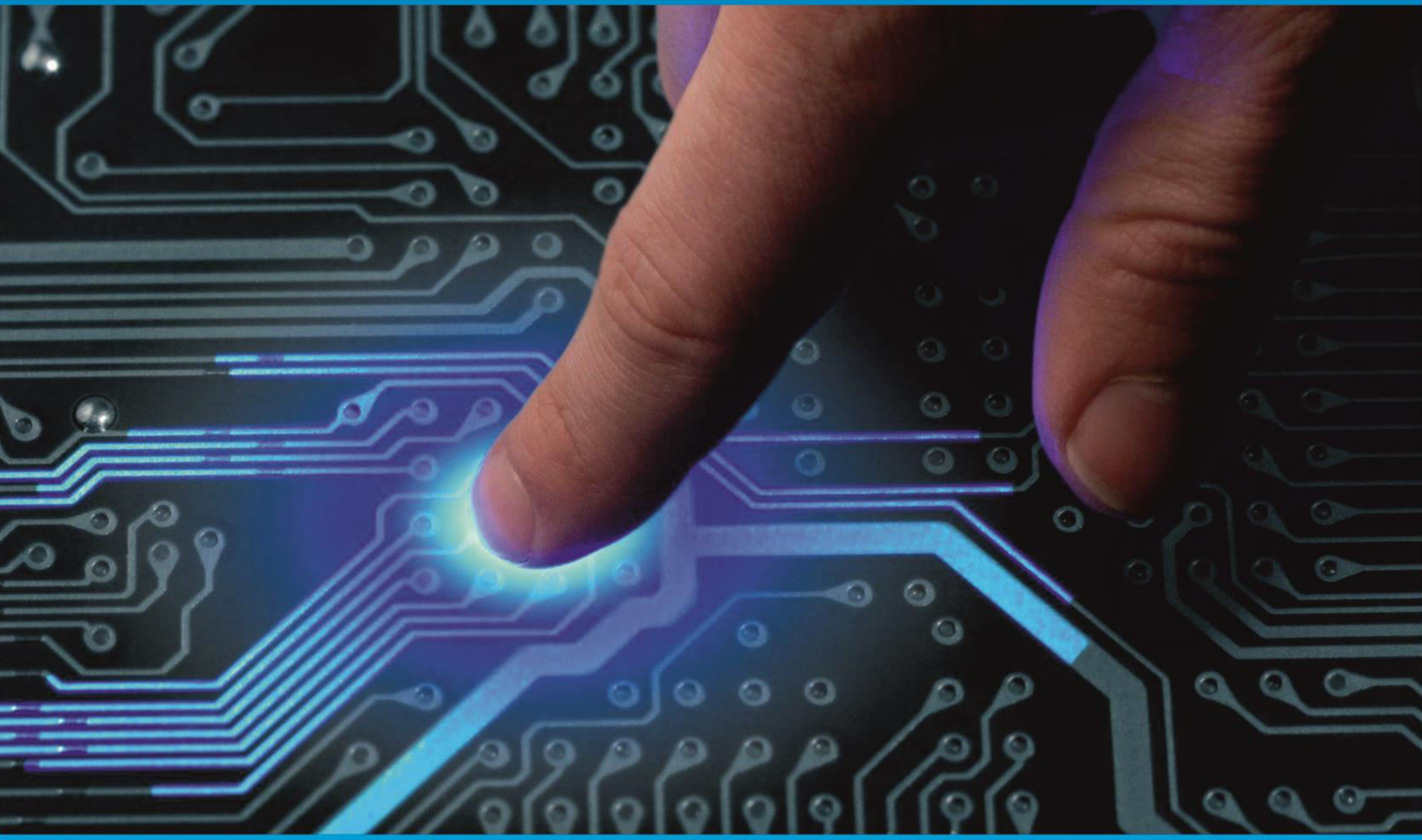

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Resource Allocation Using Hybrid Cluster in NOMA Based Cognitive Radio Network

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ABSTRACT: A novel resource allocation scheme for non-orthogonal multiple access (NOMA) based cooperative cellular networks where in each cell, two pairs of transmitter–receiver want to communicate via the base station (BS) which serves as a decode-and-forward (DF) relay. In the first hop, the transmitters simultaneously transmit their information and the BS applies joint decoding method. The BS transmits the received information towards the receivers based on NOMA technique. The receivers apply the successive interference cancellation (SIC) where the SIC ordering of receivers is determined based on the direct channel gain. Finally, the performance of our scheme by simulations and compare it with existing transmission schemes like the orthogonal frequency multiple access (OFDMA) and the case where both of the first hop and the second hop adopt PD-NOMA as well as the case where a special sort of subcarrier pairing is performed between the first and second hops.

KEYWORDS: NOMA , SIC AR, 5G , OFDMA , SCMA, QOS

I. INTRODUCTION

The concept of non-orthogonal multiple access (NOMA) method for the upcoming 5G networks. All of the current cellular networks implement orthogonal multiple access (OMA) techniques such as time division multiple access (TDMA), frequency division multiple access (FDMA) or code division multiple access (CDMA) together. However, none of these techniques can meet the high demands of future radio access systems.The characteristics of the OMA schemes can be summarized as follows. In TDMA, the information for each user is sent in non-overlapping time slots [1], so that TDMA-based networks require accurate timing synchronization, which can be challenging, particularly in the uplink. In FDMA implementations, such as orthogonal frequency division multiple accesses (OFDMA), information for each user is assigned to a subset of subcarriers. CDMA utilizes codes in order to separate the users over the same channel. NOMA was proposed as a candidate radio access technology for 5G cellular systems. Practical implementation of NOMA in cellular networks requires high computational power to implement real-time power allocation and successive interference cancellation algorithms.

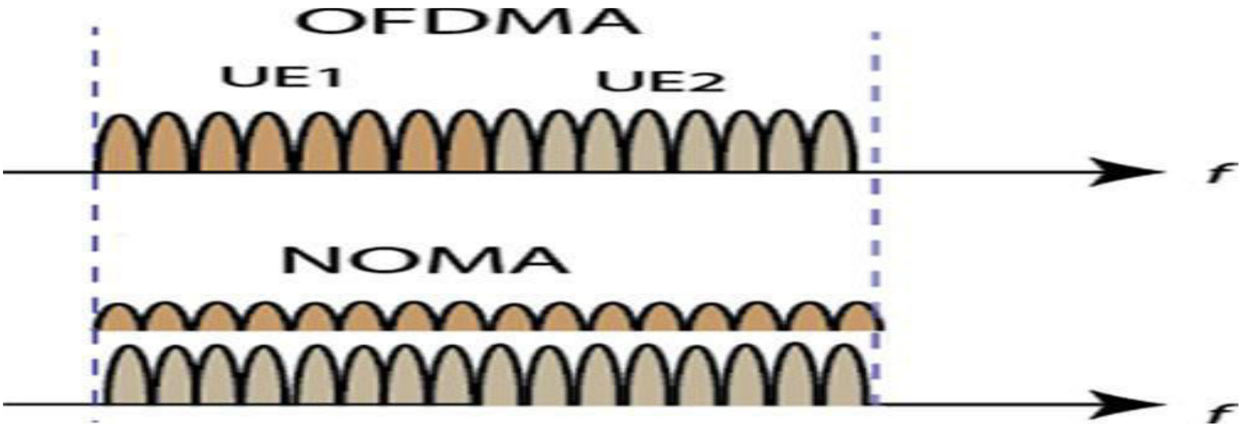


Figure 1 Spectrum sharing for OFDMA and NOMA for two users.

By 2020, the time that 5G networks are targeted to be deployed, the computational capacity of both handsets and access points is expected to high enough to run NOMA algorithms.We consider orthogonal frequency division multiplexing (OFDM) as the modulation scheme and NOMA as the multiple access scheme. In conventional 4G networks, as natural extension of OFDM, orthogonal frequency division multiple access (OFDMA) is used where information for each user is assigned to a subset of subcarriers. In NOMA, on the other hand, all of the subcarriers can be used by each user. Figure 1 illustrates the spectrum sharing for OFDMA and NOMA for two users. The concept applies both uplink and downlink transmission. The main objective of this work is to perform user clustering and power allocation such that the energy efficiency of the network is maximized.To improve the spectral efficiency of the network where two pairs of users share the same channels over which they send their information.To cancel the interference of users whose signals are transmitting over the same spectrum. To tackle the non-convexity using the successive convex approximation. To alleviate the interference and increase the network efficiency.

II. RELATED WORK

The resource allocation problem in [6] NOMA enhanced relaying networks involving the subcarrier assignment (subcarrier pair and subcarrier-user assignment) as well as power allocation. The resource allocation problem is formulated as a mixed integer nonlinear programming problem. As aforementioned, it is difficult to solve the resource allocation problem due to the strong coupling between the subcarrier assignment and power allocation in NOMA system.

The contributions of this paper are listed as follows: The application of NOMA uplink transmission to MEC is considered, where the impact of NOMA on the latency of MEC is foused first. When there are multiple users and a single MEC server, the use of NOMA can ensure that multiple users complete their offloading at the same time, which effectively reduces the offloading latency. The probability for a strong user to complete its offloading by using the time which would be solely occupied by a weak user in the OMA mode is characterized first and then used to identify the impact of the users' channel conditions and transmit powers on the offloading latency.

Compared to traditional NOMA or OMA technique, hybrid NOMA exploits a range of advantages, including supporting diverse services, being more spectrum efficient than OMA, less susceptible to interference than NOMA, as well as requiring less successive interference cancellation (SIC) complexity than NOMA. To the best of our knowledge, very limited studies are devoted to resource allocation in hybrid NOMA systems, especially the investigation of EE motivated resource allocation in hybrid NOMA systems. Against this background, in this paper, we focus on efficiently managing spectrum and power resources in the downlink hybrid NOMA systems.

III. PROPOSED ALGORITHM

The proposed resource allocation framework for PDNOMA- based cooperative multicarrier multicellular networks in which a set of transmitting users want to transmit information towards their corresponding destinations with the help of a BS which acts as a DF BS. The NOMA transmission technology is used where in the first phase transmitters simultaneously transmit and the BS performs joint decoding. The BS decodes the received signals of all the carriers, and in the second phase, the BS sends the superimposed decoded signals towards the destinations. The destinations perform SIC to mitigate the interference from other users. We formulate our proposed resource allocation scheme as an optimization problem which is non-linear and non-convex. We exploit successive convex approximation (SCA) method with difference of two concave functions (D.C.) approach as the approximation method to approximate the main problem by a convex one.

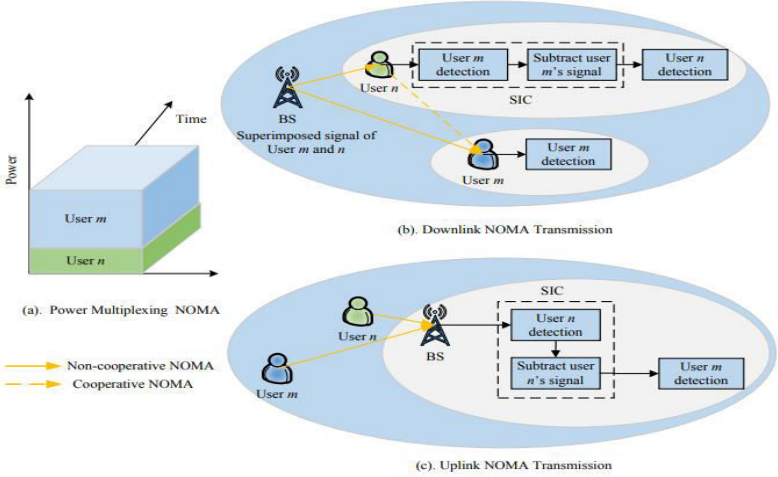
We consider the NOMA technology as the transmission technology to improve the spectral efficiency of the network where two pairs of users share the same channels over which they send their information. In the first hop, the non-orthogonal transmission of users constitutes the multiple access channel whose rate region is well known. In the second hop, the transmission is based on power domain NOMA technology. Since the transmission is non-orthogonal, interference management should be performed to achieve the desired QoS and design metrics. We consider a multicell scenario, in each of whose cells, two pairs of users transmit their information over the shared channels.

UPLINK NOMA TRANSMISSION

In uplink NOMA transmission, multiple users transmit their own uplink signals to the BS in the same RB. The BS detects all the messages of the users with the aid of SIC. Note that there are several key differences between uplink NOMA and downlink NOMA, which are listed as follows:

- Transmit Power

- SIC Operations
- Performance Gain



(a). Power Multiplexing NOMA

(b). Downlink NOMA Transmission

(c). Uplink NOMA Transmission

Figure 2 Proposed Block diagram

A uplink (UL) non-orthogonal multiple access (NOMA) systems equipped with multiple antennas to enhance the sum capacity of UL. In the proposed UL NOMA system, a base station (BS) with N antennas can support 2N users by sharing the space resource. However, sharing the space resource leads to interference between users. Therefore, to mitigate the interference and improve the sum capacity, we additionally propose a set selection algorithm and power control scheme.

In uplink NOMA systems, pilot symbols, as well as data symbols can be superimposed onto shared resources. The error rate performance can be severely degraded due to channel estimation errors, especially when the number of superimposed packets is large.A uplink NOMA schemes with channel estimation errors, assuming that quadrature phase shift keying (QPSK) modulation is used.The set selection algorithm, which selects 2N users based on orthogonality and gain-difference between their channels, reduces the interference between users. Furthermore, the power control scheme can maximize the sum capacity with ensuring minimum target rate.

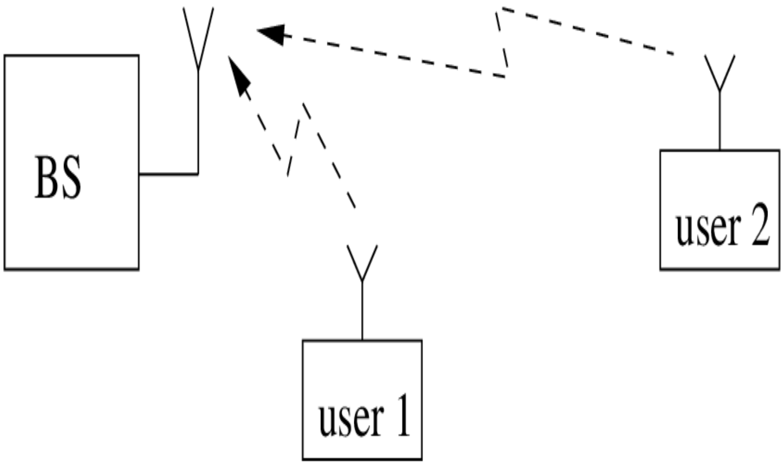


Figure 3 Uplink Transmission

Numerical results show that the proposed system improves the sum capacity over that of the conventional orthogonal multiple access (OMA) system. One of the key requirements for next generation wireless or cellular communication systems is to efficiently support a large number of connections for Internet of Things (IoT) applications, and uplink non-orthogonal multiple access (NOMA) schemes can be used for this purpose.

DOWNLINK NOMA TRANSMISSION

Downlink NOMA transmission employs the SC technique at the BS for sending a combination of the signals and the SIC technique may be invoked by the users for interference cancelation. Numerous valuable contributions have investigated the performance of NOMA in terms of downlink transmission. NOMA downlink transmission relying on SIC receivers was proposed. Upon considering a range of further practical conditions in terms of the key link-adaptation functionalities of the LTE.A practical method for user grouping and decoding-order setting in a successive interference canceller (SIC) for downlink non-orthogonal multiple access (NOMA). While the optimal user grouping and decoding order, which depend on the instantaneous channel conditions among users within a cell, are assumed in previous work, the proposed method uses user grouping and a decoding order that are unified among all frequency blocks.

The proposed decoding order in the SIC enables the application of NOMA with a SIC to a system where all the elements within a codeword for a user are distributed among multiple frequency blocks (resource blocks). The unified user grouping eases the complexity in the SIC process at the user terminal. The unified user grouping also reduces the complexity of the efficient downlink control signaling in NOMA with a SIC. The unified user grouping and decoding order among frequency blocks in principle reduce the achievable throughput compared to the optimal one. However, based on numerical results, the proposed method does not significantly degrade the system-level throughput in downlink cellular networks. Furthermore, the power control scheme can maximize the sum capacity with ensuring minimum target rate.

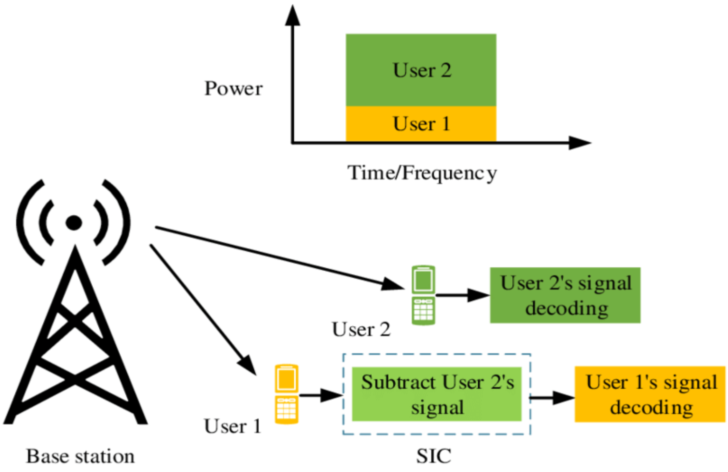


Figure 4 Downlink Transmission

Figure 5 Cluster-Based MIMO-NOMA

SYSTEM MODEL

In cellular mobile communications, the system performance is usually limited by the low received signal-to-noise ratio (SNR) of the cell edge users. In the case of OMA transmission, if the objective of the system design is to maximize the system capacity, then those users located at the cell edge will rarely be scheduled. Therefore, it results in an unfair resource allocation and user starving. This section improves this situation by NOMA. In particular, we examine the detection algorithm of the SIC receiver using the power domain in the channel and the power allocation strategy taking into account user rate fairness requirement in the system. The closed form solution of the power allocation of NOMA system and the corresponding detection algorithm of the user power allocation and the corresponding detection algorithm are deduced, and the relationship between the system and the rate gain and the power distribution factor is explained.

SUCCESSIVE INTERFERENCE CANCELATION (SIC)

It has been widely exploited that the network capacity can be substantially improved with the aid of efficient interference management, hence SIC is regarded as a promising IC technique in wireless networks. By invoking the following procedure, it enables the user having the strongest signal to be detected first, who has hence the least interference-contaminated signal. Then, the strongest user re-encodes and demodulates its signal, which is then subtracted from the composite signal. The same procedure is followed by the second strongest signal, which has in fact become the strongest signal.

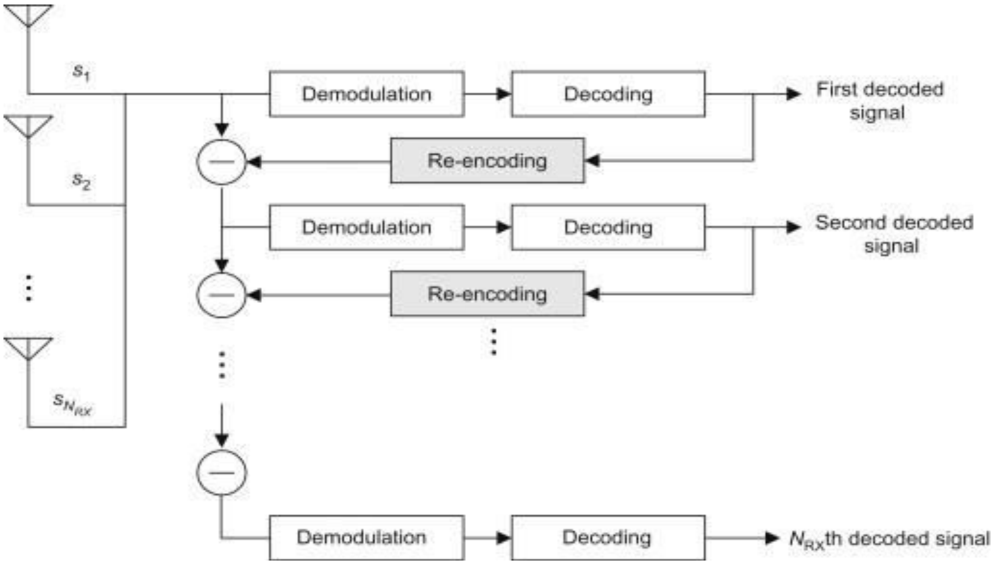


Figure 6 Successive interference cancellation

IV. SIMULATION RESULTS

Assume that there are two users in the network for the sake of discussion and analyze the boundaries of the achievable rate regions for these two users. We consider a symmetric downlink channel so that the users are at equal distance to the BS. SNR1=SNR2=10dB. Figure 5.1 shows the boundaries of the achievable rate regions R1 and R1 for NOMA and OFDMA. As illustrated in Figure 5.1 to Figure 5.4, NOMA achieves higher rate pairs than the OFDMA except at the corners points (where the rates are equal to the single user capacities). When the fairness is high, both users experience 1.6 bps/Hz throughputs with both NOMA and OFDMA. However, when the fairness is lower, both sum capacity and individual throughputs are higher with NOMA. Figure 5.2 shows rate pairs when the channel is asymmetric, that is, SNR1=20dB and SNR2=0dB. NOMA achieves much higher rate pairs than OFDMA, particularly for the farther user, UE2.

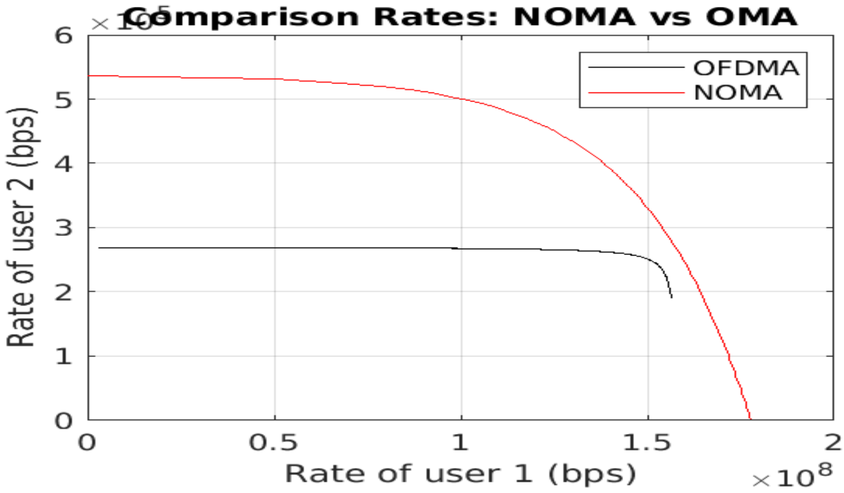


Figure 7 Rate pairs with OFDMA and NOMA for downlink PD-NOMA for Small urban areas

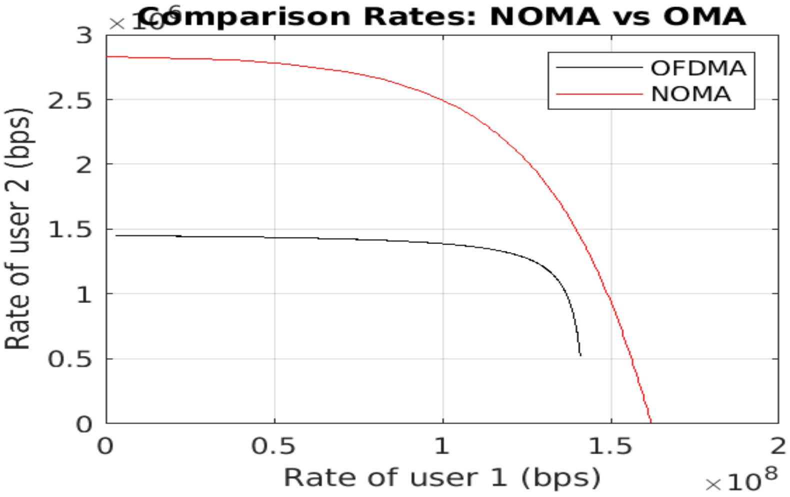


Figure 8 Rate pairs with OFDMA and NOMA for downlink PD-NOMA for Metropolitan urban areas

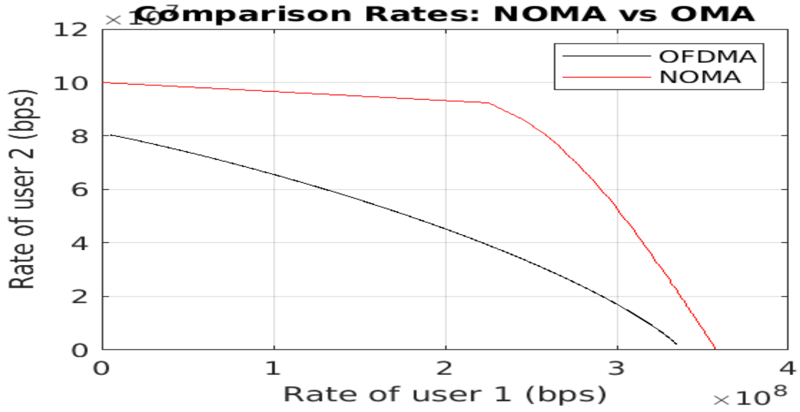


Figure 9 Rate pairs with OFDMA and NOMA for downlink PD-NOMA for Sub-urban areas

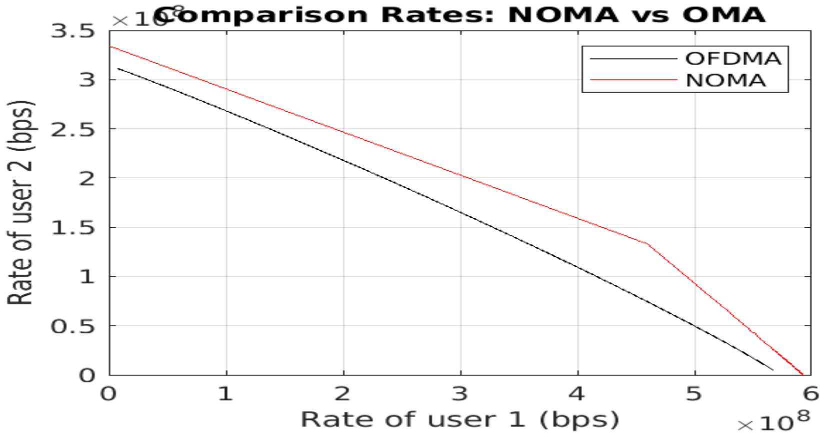


Figure 10 Rate pairs with OFDMA and NOMA for downlink PD-NOMA for Rural areas

SE-EE trade-off with NOMA

Here, we compare the EE and SE of NOMA with OFDMA. We again consider the downlink. The system bandwidth is taken as W= 5 MHz. The channel gains for UE1 and UE2 are, respectively, taken as g21=−120dB and g22=−140dB. Noise densityN0 is taken as −150 dBW/Hz. We assume that the static power consumption at the BS is Pstatic=100W. Figure 5.2 shows the obtained EE-SE curves for this setup. It is seen that NOMA achieves higher EE and SE than OFDMA system. The green-points occur for NOMA and OFDMA when PT is at 17 W and 18 W, respectively. At these points, both systems achieve their maximum EE. NOMA clearly outperforms OFDMA at green point and beyond for both EE and SE.

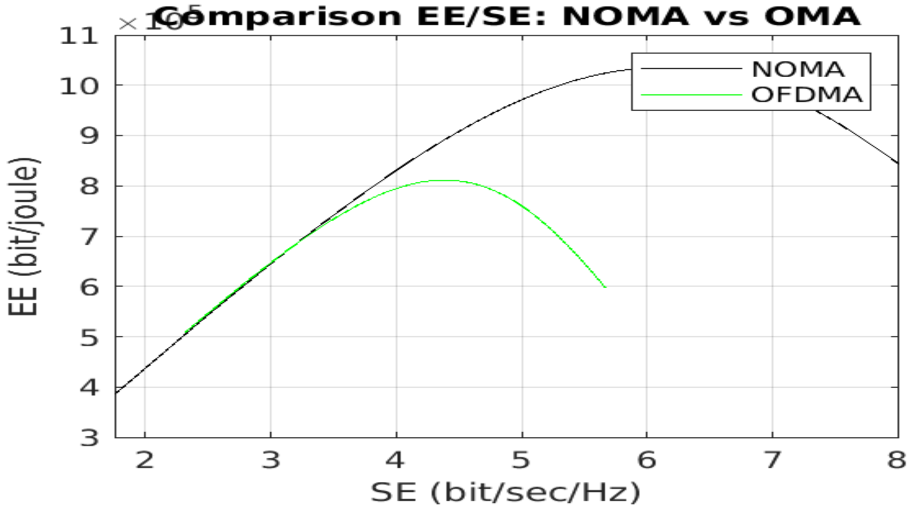


Figure 11 EE-SE trade-off curves for PD-NOMA OFDMA for Small urban areas

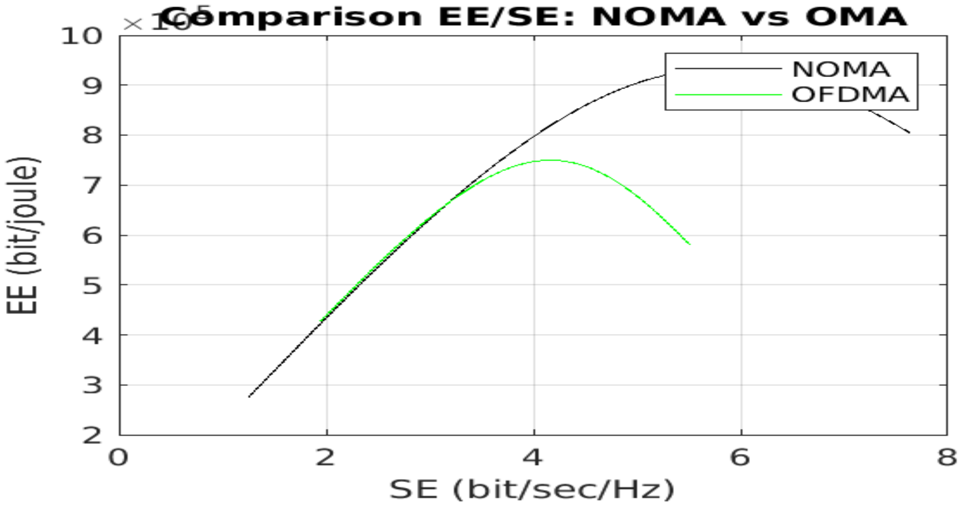


Figure 12 EE-SE trade-off curves for PD-NOMA OFDMA for Metropolitan urban areas

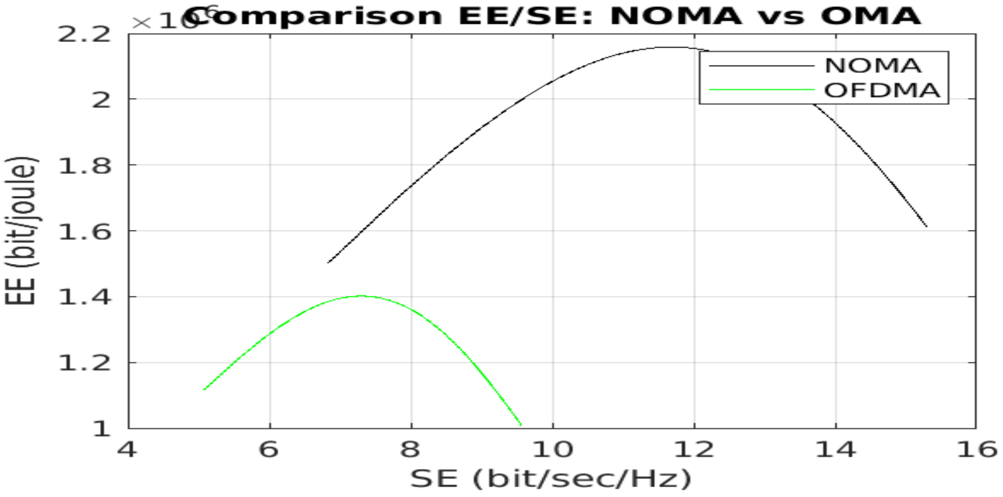


Figure 13 EE-SE trade-off curves for PD-NOMA OFDMA for Sub urban areas

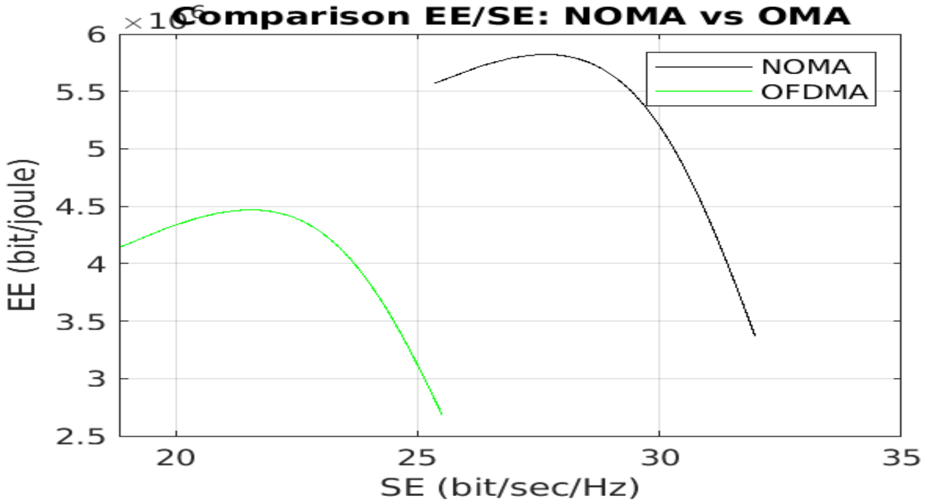


Figure 14 EE-SE trade-off curves for PD-NOMA OFDMA for Rural areas

V. CONCLUSION AND FUTURE WORK

A new resource allocation framework for PD-NOMA-based multicellular networks and presented the fundamentals of NOMA and demonstrated its superior performance over conventional OFDMA in terms of sum capacity, energy efficiency and spectral efficiency. We have further mentioned the impact of imperfectness at the SIC receiver on the system performance. With its distinct features, PD-NOMA stays as the strongest candidate for the future 5G networks. There are, however, still some challenges for successful implementation of PD-NOMA. First of all, it requires high computational power to run SIC algorithms particularly for high number of users at high data rates. Second, power allocation optimization remains as a challenging problem, particularly when the UEs are moving fast in the network. Finally, SIC receiver is sensitive to cancellation errors which can easily occur in fading channels.Future works that implement MIMO for NOMA the impact of channel state information (CSI) is studied in capacity maximization problem and outage probability expressions are derived. The current state of the art for NOMA, however, is still far from its potential and requires further investigation.

REFERENCES

[1] Jameel, F., Wyne, S., Jayakody, D.N., et al.: 'Wireless social networks: a survey of recent advances, applications and challenges', IEEE Access, 2018, 6, pp. 59589–59617
[2] Zhang, L., Xiao, M., Wu, G., et al.: 'A survey of advanced techniques for spectrum sharing in 5G networks', IEEE Wirel. Commun., 2017, 24, pp. 44– 51
[3] Dai, L., Wang, B., Ding, Z., et al.: 'A survey of non-orthogonal multiple access for 5G', IEEE Commun. Surv. Tutor., 2018, 20, pp. 2294–2323
[4] Zeng, J., Lv, T., Liu, R.P., et al.: 'Investigation on evolving single-carrier NOMA into multi-carrier NOMA in 5G', IEEE Access, 2018, 6, pp. 48268– 48288
[5] Zhang, Y., Wang, X., Wang, D., et al.: 'NOMA-based cooperative opportunistic multicast transmission scheme for two multicast groups: relay selection and performance analysis', IEEE Access, 2018, 6, pp. 62793–62805
[6] Wang, Q., Zhao, F.: 'Joint spectrum and power allocation for NOMA enhanced relaying networks', IEEE Access, 2019, 7, pp. 27008–27016
[7] Lv, L., Chen, J., Ni, Q., et al.: 'Design of cooperative non-orthogonal multicast cognitive multiple access for 5G systems: user scheduling and performance analysis', IEEE Trans. Commun., 2017, 65, pp. 2641–2656
[8] Ding, Z., Fan, P., Poor, H.V.: 'Impact of non-orthogonal multiple access on the offloading of mobile edge computing', IEEE Trans. Commun., 2019, 67, pp. 375–390
[9] Bawazir, S.S., Sofotasios, P.C., Muhaidat, S., et al.: 'Multiple access for visible light communications: research challenges and future trends', IEEE Access, 2018, 6, pp. 26167–26174
[10] Yu, Z., Zhai, C., Liu, J., et al.: 'Cooperative relaying based non-orthogonal multiple access (NOMA) with relay selection', IEEE Trans. Veh. Technol, 2018, 67, pp. 11606–11618
[11] Zhang, Y., Yang, Z., Feng, Y., et al.: 'Performance analysis of cooperative relaying systems with power-domain non-orthogonal multiple access', IEEE Access, 2018, 6, pp. 39839–39848

[12] Shi, J., Yu, W., Feng, Y., et al.: 'Energy efficient resource allocation in hybrid non-orthogonal multiple access systems', IEEE Trans. Commun., 2019, 67, pp. 3496–3511

[13] Chen, X., Jia, R., Ng, D.W.: 'On the dsign of massive non-orthogonal multiple access with imperfect successive interference cancellation', IEEE Trans. Commun., 2019, 67, pp. 2539–2551

[14] Zhang, J., Ge, J., Ni, Q., et al.: 'Performance analysis of user ordering schemes in cooperative power-domain non-orthogonal multiple access network', IEEE Access, 2018, 6, pp. 47319–47331

[15] Liang, G., Zhu, Q., Xin, J., et al.: 'Joint user-channel assignment and power allocation for non-orthogonal multiple access relaying networks', IEEE Access, 2019, 7, pp. 30361–30372

[16] Li, Y., Jiang, M., Zhang, Q., et al.: 'Cooperative non-orthogonal multiple access in multiple-input-multiple-output channels', IEEE Trans. Wirel. Commun., 2018, 17, pp. 2068–2079

[17] Cover, T.M., Thomas, J.A.: 'Elements of information theory second edition solutions to problems', Internet Access, 2006

[18] Grant, M., Boyd, S.: 'CVX: Matlab software for disciplined convex programming', 2016. [Online] Available at: http://cvxr.com/cvx, last accessed in Feb. 16, 2020.

[19] Nader, M., Faezeh, A., Saeedeh, P., et al.: 'Limited-feedback resource allocation in heterogeneous cellular networks', IEEE Trans. Veh. Technol, 2016, 65, pp. 2509–2521

[20] Liu, X., Wang, X., Liu, Y.: 'Power allocation and performance analysis of the collaborative NOMA assisted relaying systems in 5G', China Commun., 2017, 14, pp. 50–60.

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