BER Analysis of Cooperative Relaying in Beamspace Massive MIMO NOMA System

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Abstract:- Exploring NOMA for regular downlink and uplink frameworks, the utilization of NOMA is examined in downlink multiuser numerous information different yield (MIMO) frameworks, by proposing a novel MIMO-NOMA model with direct beamforming method. In this MIMO-NOMA framework, clients' get receiving wires are progressively assembled into various disjoint bunches, and inside each group a solitary bar is shared by all the get reception apparatuses those embrace NOMA. The prevalence of the proposed model is represented through broad execution assessments. At long last, the utilization of facilitated multi-point (CoMP) transmission procedure is examined in downlink multi-cell NOMA frameworks, considering disseminated control assignment at every phone. In the proposed CoMP-NOMA model, CoMP transmission is utilized for clients encountering solid get signals from different cells while every phone autonomously receives NOMA for asset designation. The relevance and vital conditions to utilize diverse CoMP plans are recognized under different system situations, and the relating throughput equations are determined. The ghastly proficiency increases of the proposed CoMP-NOMA model are additionally evaluated.

Keywords: - NOMA, Fifth Generation, Spectral Efficiency, 5G Wireless System

I. INTRODUCTION

To guarantee the maintainability of portable correspondence benefits in the coming decades, new innovation arrangements are being looked for the fifth era (5G) and past 5G (B5G) cell frameworks. In the perspective on the foreseen exponential development of portable traffic, these advances are relied upon to give critical gains in the ghostly productivity (and consequently framework limit) and improved nature of client experience (QoE).

In this unique situation, non-symmetrical numerous entrance (NOMA) is considered as a promising various access innovation for 5G frameworks. By planning numerous clients over same range assets however at various power levels, NOMA can yield a noteworthy otherworldly proficiency gain and upgraded QoE when contrasted with customary symmetrical different access (OMA) frameworks.

The essential rule of NOMA is to all the while serve various clients over same range assets (for example time, recurrence, code and space) yet with various power levels, to the detriment of insignificant between client obstruction [1]. As opposed to traditional symmetrical numerous entrances (OMA), where each client is served on solely designated range assets; NOMA superposes the message sign of various clients in power area at transmitter end(s) by misusing the clients' separate channel gain [2]. Progressive obstruction abrogation (SIC) is then connected at the recipient (s) for multiuser location and translating. For a model, let us consider a downlink NOMA transmission where the base station (BS) plans m clients over a similar range assets B. Let additionally accept that the message signal for I-th client is si where E[|si|2] = 1, and transmit power is pi. At that point the superposed sign at transmitter end could be communicated as:

$$X = \sum_{i=0}^{m} \sqrt{p_i s_i} \qquad (1)$$

Where $\sum_{i=0}^{m} p_i \le p_i$ for BS total transmit power budget of p_i. On the other hand, the received signal at i-th user end could be expressed as:

$$y_i = h_i X + w_i \qquad (2)$$

Where h_i is the intricate channel gain between clients I and the BS. The term w_i indicates the recipient Gaussian clamor including the between cell impedance at the i-th client's collector [3, 4].

II. BEAMSPACE MASSIVE MIMO

In M-MIMO systems, beamspace is a technique to represent spatial channel of hybrid beamforming architecture into beamspace channel to perform computations effectively. They proposed virtual representation of channel w.r.t. fixed spatial basis functions defined by fixed virtual angles. Several research groups [5, 6] adopted the hybrid selection/MIMO approach (antenna selection) to reduce number of RF chains in MIMO. It found the impact of reconfigurable antenna arrays on maximizing capacity in sparse multipath environments. Authors also proposed a model for sparse multipath channel. They used analog beamforming via phase shifting network. It employed a novel antenna array architecture called discrete lens antenna array, also known as continuous aperture phased (CAP) MIMO architecture based on hybrid analog-digital architecture [7].

The researchers also claimed that this architecture was ideal for mmWave communication. It introduced new technique for designing low-profile planar microwave lenses known as miniaturized element frequency selective surfaces (MEFSSs). The proposed lenses consisted of numerous miniature spatial phase shifters distributed over a planar surface. Sayeed and Behdad (2011) provided mathematical framework for CAP MIMO in LoS links and compared capacity of CAP MIMO architecture with other state-of the-art architectures. In incorporated concept of beamspace M-MIMO into mmWave M-MIMO using lens antenna array. They proposed replacement of phase shifting network by lens antenna array to reduce energy consumption and hardware cost but with a limited angle resolution. It evaluated sum rate capacity of beamspace M-MIMO system. He proposed intra beam SIC by allocation of non-equal transmission power among beams (random beamforming). It developed hybrid analog-digital precoding at BS and analog combining at multiple receive antennas for downlink M-MIMO mmWave system.

III. 5G TECHNOLOGY

Radio technology has rapid evolution in analogue cellular system in 1980s. After analogue system digital wireless communication system comes to fulfil the increasing need of humans being. Voice and message services introduce in 1990s and mobile broadband and long term Evolution introduced in 2010.

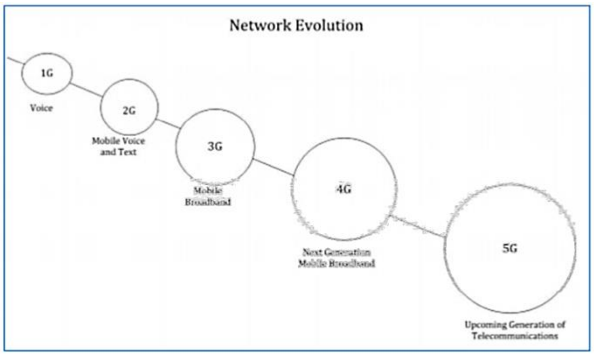

Fig. 1: Development in 5G System

After that in telecom industries demanding for mobile data and high speed services so they required to develop new generation of telecommunication system. That new generation is called Fifth generation technology. Here we discuss about the features, architecture, advantages, challenges and future scope of 5G technologies.

Each generation comes up with new ideas and introduces new services. First generation introduces voice; second generation comes up with mobile voice and text. In third generation use mobile broadband and a fourth generation is called Long Term Evolution. In 4G, all advanced features are introduced. Fifth generation, future of technology brings tremendous changes in technology. In the future, data transmission rate gets speedier as compare to previous technology similar improvement done in quality of services. 5G is based on IEEE802.11ac broadband standard. Some technological innovative done in this generation, such as Internet of Things (INTERNET OF THINGS) which is expected in 2020.Number of devices are connected to each other through the network. User equipment like smart phones or tablet can be replaced by smart devices.

Fig. 2: Various Hand-set used in all Generation

This thesis tells about evolution of communication technology in each generation, detailed study of LTE, detailed 5G frame work and explanation of various applications of 5G. With examples and detailed analysis it is proved that the data transmission in 5G is much better than 4G in terms of connectivity, there is relatively less end to end delay and it has enhanced packet delivery ratio. Various applications that will become popular in 5G technology are also discussed in detail. Many research laboratories and many mobile companies are examining new possible standards for new upcoming technology which nothing but 5G network to overcome disadvantages of 4G or LTE.

FEATURE OF 5G TECHNOLOGIES

Feature of 5G technology is much more than other cellular technology. It has ultra-high speed. Because of ultra-high speed, it changes the scenario in cellular world. With these innovative features your smart phone is similar to your laptop. Broadband connection can used in smart phone, available variety gaming options, broad multimedia option, you can connect every ever. Other most important feature is low latency, faster response time and high quality picture can be transferred from one cell phone to another cell phone without disturbing and with quality of video and audio.

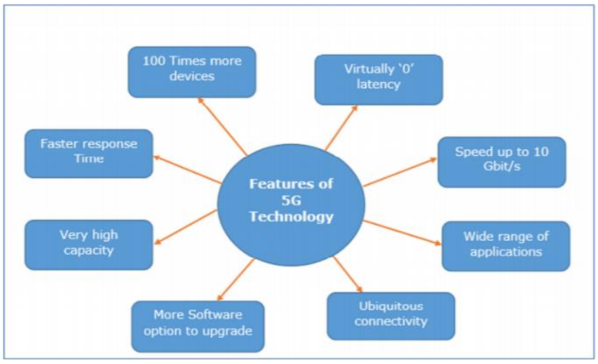

Fig. 3: Feature of 5G technology

IV. NOMA IN DOWNLINK TRANSMISSION SCENARIOS

Give us a chance to consider a downlink NOMA transmission with a solitary recieving wires BS and single reception apparatus m number of clients with particular channel gains. In such m-client downlink NOMA, the BS transmitter non-symmetrically transmits m various flag by superposing them over a similar range assets; though, all m UE collectors get their ideal flag alongside the impedances brought about by the messages of different UEs.

To get the ideal sign, each SIC recipient initially translates the dominant1 impedances and after that subtracts them from the superposed sign. Since every UE gets all sign (wanted and meddling sign) over a similar channel, the superposing of various sign with various power levels is pivotal to enhance each flag and to perform SIC at a given UE collector.

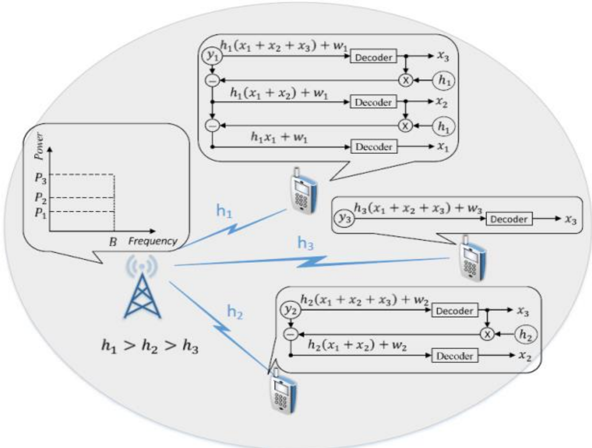

Fig. 4: Illustration of a 3-user downlink NOMA

Let us additionally think about that the messages of NOMA clients are superposed with a power level which is contrarily corresponding to the their channel gains, that is, a specific client is allotted for low power than the clients those have lower channel gain while that dispensed power is higher than every one of the clients those have higher channel gain than the specific client. All things considered, the most reduced channel gain client (who gets low impedances because of moderately low powers of the messages of high channel gain clients) can't stifle any obstruction. Notwithstanding, the most astounding channel gain client (who gets solid obstructions because of moderately high powers of the messages of low channel gain clients) can stifle every single meddling sign.

NOMA in Uplink Transmission Scenarios

The working standard of uplink NOMA is very not the same as the downlink NOMA. In uplink NOMA, numerous transmitters of various UEs non-symmetrically transmit to a solitary collector at BS over same range assets. Every UE freely transmits its own sign at either most extreme transmit power or controlled transmit power contingent upon the channel gain contrasts among the NOMA clients. Every single got signal at the BS are the ideal sign, however they make impedance to one another. Since the transmitters are extraordinary, each gotten sign at SIC beneficiary (BS) encounters unmistakable channel gain. Note that, to apply SIC and disentangle signals at BS, we have to keep up the uniqueness among different message signals. In that capacity, traditional transmit power control (commonly planned to even out the got sign forces everything being equal) isn't possible in NOMA-based frameworks.

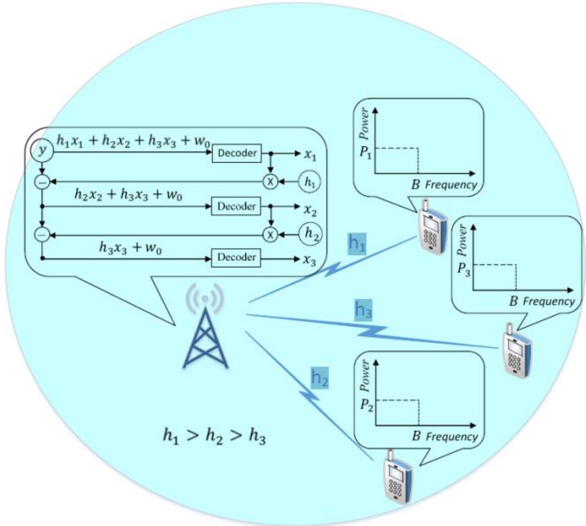

Fig. 5: Illustration of a 3-user uplink NOMA

Give us a chance to consider a general m-client uplink NOMA framework in which m clients transmit to a typical BS over similar assets, at either most extreme transmit power or controlled transmit control. The BS gets the superposed message sign of m various clients and applies SIC to unravel each sign. Since the got sign from the most astounding channel gain client is likely the most grounded at the BS; subsequently, this sign is decoded first. Thusly, the most astounding channel gain client encounters impedance from every single other client in the NOMA group. From that point forward, the sign for second most elevated channel gain client is decoded, etc. Subsequently, in uplink NOMA, the reachable information rate of a client contains the obstruction from all clients with generally more fragile channels. That is, the most noteworthy channel gain client encounters obstruction from all clients and the least channel gain client appreciates impedance free information rate.

V. PROPOSED METHODOLOGY

In this purposed CoMP-NOMA model for downlink transmission, CoMP transmission is utilized for clients encountering solid get signals from numerous phones under a downlink co-channel homogeneous system. Different CoMP plans are connected to the CoMP-clients encountering between cell obstruction under two-cell coMP set, while disseminated control portion for NOMA clients is used in each planning cell. This model initially decides the clients requiring CoMP transmissions from numerous phones and those requiring single transmissions from their serving cells. From that point onward, unique NOMA bunches are framed in individual cells in which the CoMP-clients are grouped with the non-CoMP-clients in a NOMA group.

In the proposed CoMP-NOMA model, I use the NOMA throughput equation in an unexpected request in comparison to past parts however the working rule is actually same. Here, in every NOMA group, the CoMP-clients are characterized earlier than the non-CoMP-clients in any case their separate channel gains, so as to guarantee the bunching of a CoMPuser at various cells in a the CoMP set. First I characterize the feasible throughput for a NOMA client as indicated by their deciphering request under the proposed COMP-NOMA model. From that point forward, various CoMP plans are talked about thinking about single radio wire BS and client gear (UE), and recognize their pertinence for a NOMA-based transmission model.

Give us a chance to accept a downlink NOMA group with n clients and the accompanying unraveling request: UE1 is decoded first, UE2 is decoded second, etc. Along these lines, UE1's sign will be decoded at all the clients' closures, while UEn's sign will be decoded distinctly at her own end. Since UE1 can just disentangle her own sign, it encounters the various clients' sign as obstruction, while UEn can translate every one of clients' sign and evacuates between client impedance by applying SIC. Accordingly, the reachable throughput for the I-th client can be composed as pursues:

$$R_i = B\log_2\left(1+\frac{p_i y_i}{\sum_{j=i+1}^{n} p_i y_i +1}\right) \qquad (3)$$

Where y is the standardized channel gain as for commotion control thickness over NOMA transmission capacity Bi, and pi is the assigned transmit control for UEi. The important condition for power portion to perform SIC is:

$$(p_i - \sum_{j=i+1}^{n} p_j)\ \ y_j \geq p_{tol} \qquad (4)$$

Where ptol is the base distinction in gotten control (standardized as for commotion control) between the decoded sign and the non-decoded between client impedance signals

VI. SIMULATION RESULT

The normal phantom effectiveness (in bits/sec/Hz) is assessed for all the serving cells in a CoMP. For all recreations, the non-CoMP-clients are considered at a fixed separation inside their circulation zones, while an irregular separation is considered for CoMP-clients outside the non-CoMP-client's inclusion regions (estimated as far as the cell-edge inclusion remove). Flawless channel state data (CSI) is thought to be accessible at the BS closes.

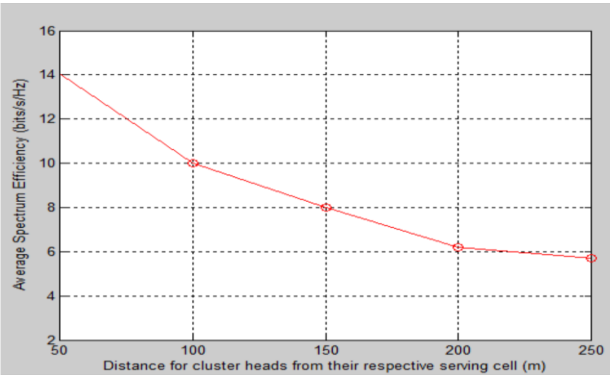

Fig. 6: Average Spectrum Efficiency for MIMO 2×2 System

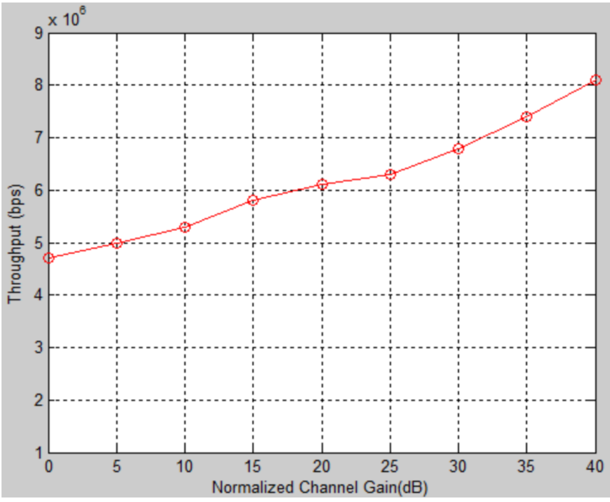

Fig. 7: Throughput for MIMO 2×2 System

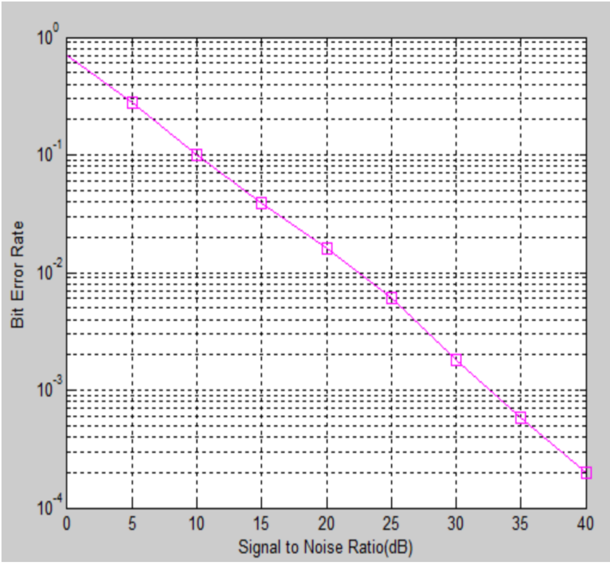

Fig. 8: BER for MIMO 2×2 System

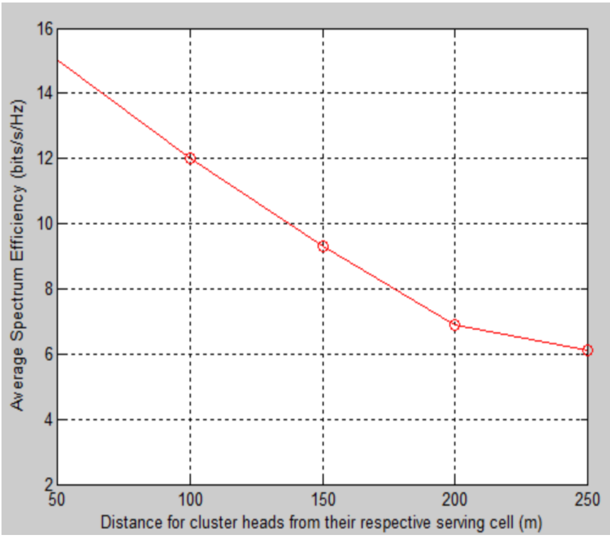

Fig. 9: Average Spectrum Efficiency for MIMO 4×4 System

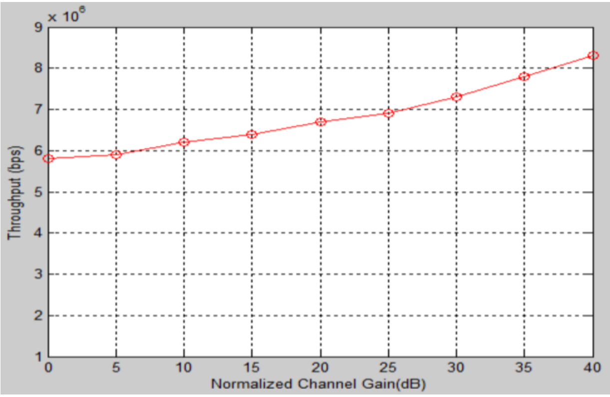

Fig. 10: Throughput for MIMO 4×4 System

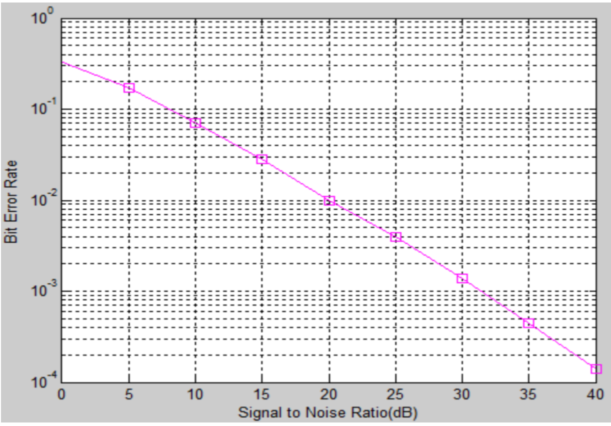

Fig. 11: BER for MIMO 4×4 System

The comparison result of different MIMO system in term of bit error rate is shown in table 1. It is clearly that the implemented NOMA system is best performance compared to conventional NOMA system.

Table 1: Comparison Result for BER

System		SNR = 0 dB	SNR = 40 dB
MIMO 2×2 System	Conventional NOMA [1]	0.93 dB	0.00078 dB
	Implemented NOMA	0.7 dB	0.0002 dB
MIMO 4×4 System	Conventional NOMA [1]	0.65 dB	0.00046 dB
	Implemented NOMA	0.3 dB	0.00015 dB

The comparison result of different MIMO system in term of throughput is shown in table 2. It is clearly that the implemented NOMA system is best performance compared to conventional NOMA system.

Table 2: Comparison Result for Throughput

System		SNR = 0 dB	SNR = 40 dB
MIMO 2×2 System	Conventional NOMA [1]	3.8×10^6 bps	7.3×10^6 bps
	Implemented NOMA	4.8×10^6 bps	8.0×10^6 bps
MIMO 4×4 System	Conventional NOMA [1]	5.1×10^6 bps	7.5×10^6 bps
	Implemented NOMA	5.9×10^6 bps	8.2×10^6 bps

VII. CONCLUSION

General structure is proposed to utilize CoMP transmission innovation in downlink multi-cell NOMA frameworks considering dispersed power assignment at every phone. In this structure, CoMP transmission is utilized for clients encountering solid get signals from numerous phones while every phone receives NOMA for asset designation to its dynamic clients. I likewise have identi_ed the essential conditions required to perform CoMP-NOMA in downlink transmission under conveyed control distribution. Distinctive CoMP-NOMA plans have been numerically broke down under different system organization situations. The majority of the recreation results uncover the predominant otherworldly productivity execution of CoMP-NOMA frameworks over their partner CoMP-OMA frameworks.

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