

Review of Techniques in Massive MIMO For 5G Communications

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ABSTRACT

The worldwide data transfer capacity deficiency in the wireless correspondence area has spurred the investigation and investigation of wireless access innovation known as massive Multiple-Input Multiple-Output (MIMO). Massive MIMO is one of the key empowering innovation for cutting edge organizations, which groups together reception apparatuses at both transmitter and the recipient to give high spectral and energy effectiveness utilizing generally straightforward handling. Spectral proficiency is consistently a critical factor to be improved and advanced along portable correspondence networks developing age by age. 5G empowering advancements should think about spectral proficiency. The exhibition of three key 5G innovations in feeling of spectral proficiency improvement is high. Sparse code multiple access (SCMA), Polar codes and separated filtered orthogonal frequency-division multiplex (f-OFDM) are novel multiple entrance innovation, channel coding plan and waveform, individually. In massive MIMO (M-MIMO) systems few hundred quantities of antennas are sent at each base station to serve a generally modest number of single-reception apparatus terminals with multiuser, giving higher information rate and lower inertness. An M-MIMO correspondence system with countless base station reception apparatuses with zero-constraining bar shaping is proposed for the improved spectral productivity execution of the system. The zero driving shaft shaping strategy is utilized to beat the impedance that restricts the spectral efficiency of M-MIMO communication systems. The recreation results validate the improvement in the spectral efficiency of M-MIMO system.

Keywords: Multiple-Input Multiple-Output (MIMO), Massive MIMO; Base station, Spectral Efficiency, 5G, beamforming, orthogonal frequency-division multiplex

I. INTRODUCTION

Massive multiple-input multiple-output otherwise called enormous scope reception apparatus systems is another examination region in wireless communications, is recognized as the most ideal approach to expand the spectral effectiveness of wireless correspondence system. Massive MIMO in which the base stations are outfitted with enormous number of soundly working antennas gives both variety acquire and multiplexing acquire. Massive MIMO builds the information rate to an enormous degree in light of the huge number of radio wires. Every radio wire can convey free information streams and more number of terminals can be served at the same time giving full band width to every terminal. It can build the ability to multiple times or more due to the multiplexing utilized. Massive MIMO can be worked with cheap, low force segments in light of the fact that the costly ultra linear 50W speakers utilized with traditional systems are supplanted by many low force enhancers of mW range. It lessens the imperatives on precision, linearity and RF acquire necessities of the speakers utilized. It gives exceptionally improved energy proficiency as the BS can center the radiated energy to the spatial headings where the clients are actually found. Since it utilizes the sharp pillar to the terminal it decreases the obstruction to different channels. A MIMO system having NT communicate antennas wires and the NR get reception apparatuses are thought of. Figure 2.1 is the square chart of a MIMO design.

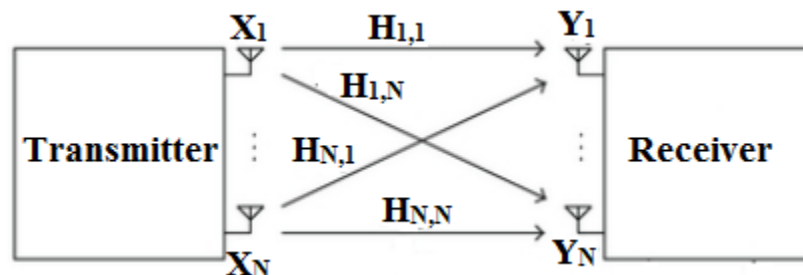


Figure 2.1 General Architecture of a MIMO

Massive MIMO empowers a huge decrease of idleness noticeable all around interface since it depends on the law of enormous numbers and bar framing to try not to blur plunges. Massive MIMO improves on the multiple entrance layer in light of the fact that the channel solidifies so recurrence space planning no longer pays off and furthermore every terminal can be given with the full data transmission, which delivers the vast majority of the actual layer control flagging repetitive. Massive MIMO builds the vigor to purposeful sticking in light of the fact that it offers numerous abundance levels of opportunity that can be utilized to drop signals from deliberate jammers. These huge overflow levels of opportunity can be successfully utilized for equipment agreeable sign forming. All these astounding additions can be accomplished with extremely low intricacy direct sign handling techniques. The highlights of such Wireless correspondence incorporate, (1) The adequacy of cost: Wired correspondence networks are more affordable and needn't bother with any detailed support or foundation. In wireless correspondence, interest as expected for arranging and work isn't fundamental. Despite the fact that wireless correspondence incorporates cabling, the cost included is a little part of what is needed for wired correspondence. (2) Flexibility: A wireless correspondence empowers individuals to remain in an office or a pay phone for sending and getting messages. Any wireless transmitter can oblige various collectors in which the wired correspondence system is restricted to the actual associations of the hardware. Besides, this likewise has an arrangement for fiasco recuperation. (3) Convenience: Wireless specialized gadgets, for example, cell phones are very simple to utilize. This grants anybody to utilize the telephone with no respect to their place. There is no prerequisite for actual communication to pass messages. The consistent availability guarantees the capacity of individuals to react to crises rapidly.

2.1 Mobile communication systems

The Mobile correspondence unit can perform correspondence through the public organization through radio association with a base station which is associated with a host network with a versatile correspondence unit, in systems, for example, vehicle phone or convenient phone. In these sort of versatile correspondence systems, when a portable correspondence unit is available outside at which a radio wave effectively communicates. Regardless, it is beyond the realm of imagination to expect to perform radio correspondence with the base station, when the versatile unit is in a no man's land, for example, within an underground road.

From 2017–2022, cell phone traffic is relied upon to increment by multiple times, and generally speaking, versatile traffic will be expanded by multiple times. Figure 2.2 shows the development in versatile information traffic and the quantity of associated gadgets from 2017–2022. Before the finish of 2022, in excess of 90% of the traffic will come from cells. This epic measure of versatile information traffic is trying to make do with the abilities of past wireless generation systems.

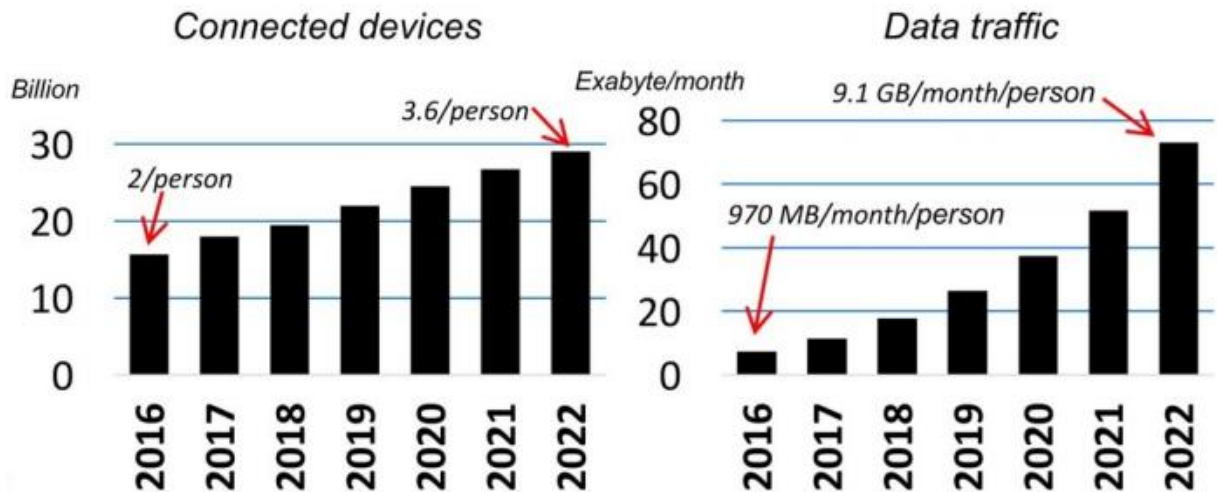


Figure 2.2. Global mobile data traffic and growth in connected devices from 2017 to 2022

2.2 Massive MIMO for fifth generation (5G)

The development in wireless correspondence is sorted in Generations with the advancement from First Generation (1G) to Second Generation (2G) and from Third Generation (3G) to Fourth Generation (4G). The innovation offered has additionally move from media transmission to sight and sound correspondence corresponding with the development. Cell correspondence systems have encountered quick improvement since the time its beginning, first and foremost with voice administrations, and as of late, with the most recent age of versatile information benefits that permit high information transmission rates. The dangerous development of wireless systems coupled with the advancement of PC and palmtop PCs has developed into a time of wireless systems administration. Modern wireless local area networks (WLANs) are actualized in a colossal number of utilizations since WLANs present advantages like improved adaptability, versatility and simplicity of establishment. Cell phones and WLANs are likely the most famous wireless system; nonetheless, the utilization of other wireless gadgets has additionally expanded.

Current wireless correspondence innovation is being pushed as far as possible by the massive development in rush hour gridlock requests for portable information benefits because of the ceaselessly advancing necessities and assumptions for the two clients and administrators. Expanding information traffic has likewise determined the limit requests for presently sent 3G and 4G wireless advances. The Long Term

Evolution (LTE) in 3GPP is arriving at development and Long Term Evolution - Advanced exemplifying 4G has just been sent with the information rates drawing near to Gbps, where just steady upgrades and modest quantities of new range can be considered typical. As indicated by portable information traffic developed to 69%, creating 2.5 Exabytes of information each month, contrasted with 1.5 Exabytes each month toward the finish of 2013. The ascent in portable information traffic in 2014 was accounted for to be multiple times more than all traffic across the worldwide Internet in 2000. The GSMA Mobile Economy 2015 – Global revealed that, there are 3.6 billion novel versatile endorsers toward the finish of 2014. Further, expansion of one billion supporters is anticipated by 2020, taking the worldwide entrance rate to roughly 60%.

2.3 Interference in cellular networks

There are many types of interference available in cellular networks. Some of them are discussed as below.

2.3.1 Adjacent Channel Interference

Adjacent Channel Interference (ACI) is the impedance caused when signal from the neighboring recurrence divert spills in to the ideal recurrence signal. The neighboring recurrence can utilize the equivalent or distinctive innovation. At the point when two distinct advances like the LTE innovation working at the upper edge of the 2.3 GHz band and WiFi or some other innovation communicated in the lower edge of unlicensed 2.4 GHz band makes ACI each other as these advances exist together in a similar gadget. At the point when two administrators sends utilizing similar innovation in adjoining groups, it may not reason genuine ACI when frequency division duplexing (FDD) is utilized. In any case, when time division duplexing (TDD) is utilized by two administrators with various DL and UL proportion, or they progressively adjust the Down Link (DL) and Up Link (UL) proportion contingent upon their down link and UL traffic needs, ACI will be caused between the Base Station (BS) to BS of both the administrators or User Equipment to User Equipment obstruction..

2.3.2 Inter Carrier Interference

The OFDM range shows that every transporter comprises of a fundamental projection followed by various side flaps with diminishing amplitude. However long orthogonality is kept up there is no impedance among the transporters in light of the fact that at the pinnacle of the each transporter, there exist a spectral invalid, for example by then the segment of any remaining transporters is zero. Thus the individual transporter is effectively isolated. When there is a frequencyorthogonality the symmetry is lost since now the spectral invalid doesn't match to the pinnacle of the individual transporters. The Inter Carrier Interference (ICI) increments as the recurrence balance increments. Additionally, when an OFDM signal is communicated over a wide band channel because of recurrence selectivity of the channel the symmetry will be lost prompting ICI, which could be dealt with utilizing recurrence balance adjustment procedures and channel leveling methods. Likewise, when the signs are not inspected at the top because of recurrence synchronization blunders will likewise prompt Inter Carrier Interference.

2.3.3 Co Channel Interference

The utilization of recurrence reuse to use the range productively in cell networks lead to the significant wellspring of obstruction called Co Channel Interference (CCI). This is further more terrible when MIMO was utilized to build the limit of these system. CCI is the obstruction caused to the ideal information of the serving eNodeB from adjoining eNodeB information serving their individual clients on a similar recurrence. It will restrict the addition that can be accomplished by recurrence reuse and MIMO. This is taken care of in cell networks by proper transmitter and additionally beneficiary strategies utilizing signal preparing joined with fitting asset the executives utilizing booking.

2.3.4 Inter Symbol Interference

Generally, ISI is caused when communicate and get channel reaction that isn't a Nyquist beat is utilized as far as possible the sign inside a transmission capacity. It brings about a non-level exchange work in recurrence area with the end goal that all recurrence parts in the sent sign may not experience comparative amplitude and stage varieties. Nonetheless, with more extensive band activity with CDMA transmission, or any single transporter transmission, the communicated sign will keep on showing up at the collector when the progressive images are being gotten, and meddles with them because of the way that the sign goes through multiple ways and the more drawn out reflected sign will show up with huge deferral.

This will prompt multiple tap in the motivation reaction of the channel, and in the frequency space it won't be a level range. Subsequently, ISI channels are additionally called as recurrence particular channels. ISI happens when the defer spread of the channel is huge contrasted with the length of regulated image. Nonetheless, OFDM changes over the wide band channel into symmetrical and equal narrowband channels and afterward use strategies like CP to deal with ISI. OFDM misuses the multipath variety in the recurrence space utilizing recurrence specific planning, which designates the assets to clients in bit of the band that is useful for that client, this is additionally called as multi user variety.

III. LITERATURE REVIEW

Noor Hidayah Muhamad Adnan et al (2020):In this paper the creator clarifies about the Massive MIMO for Fifth Generation. MIMO is an innovation that uses multiple antennas at transmitter/collector to improve the throughput, limit and inclusion of wireless system. Massive MIMO where Base Station is furnished with significant degrees more antennas have appeared more than 10 times spectral productivity increment over MIMO with less difficult sign preparing calculations. Massive MIMO has advantages of improved limit, spectral and energy productivity and it very well may be worked by utilizing minimal effort and low force parts. In spite of its expected advantages, this paper additionally sums up certain difficulties looked by massive MIMO, for example, radio wire spatial connection and shared coupling just as non-direct equipment disabilities. These difficulties experienced in massive MIMO uncover new issues that need further examination. Multiple-input and multiple-output (MIMO) is a wireless innovation that can give critical execution improvement over the conventional single input and single-output system, has pulled in developing interest since being presented in the previous twenty years. It is a key innovation that exploits multiple antennas at transmitter and additionally collector that can significantly improve the organization throughput, limit, and inclusion without requiring extra data transmission or send power level. The thought is to use multiple antennas at both the communicating closes and getting closures to isolate autonomous wireless directs in a rich multipath climate, and utilizations them to send multiple information streams at the same time to expand the channel limit by applying variety consolidating approach. Until now, MIMO innovation has been used in the fourth generation(4G) wireless correspondence guidelines, like Long Term Evolution (LTE), wireless LAN (IEEE 802.11n), and Worldwide Interoperability for Microwave Access (WiMAX).

Jian Wang et al (2020):This paper clarifies about the three 5G empowering advancements, i.e, sparse code multiple access (SCMA), Polar codes and sifted OFDM (f-OFDM), are executed into a massive MIMO system in the field preliminary directed by HUAWEI and NTT DOCOMO to research their effects on the system spectral productivity. Taking massive MIMO with OFDMA and Turbo codes as the baseline, we see about 30% downlink spectral effectiveness improvement in the preliminary. Results from test field are summed up and broke down in this paper, which confirmed that sparse code multiple access, Polar codes and f-OFDM are likewise doable for massive MIMO systems regarding spectral proficiency improvement. An enormous scope field preliminary has been led by HUAWEI and NTT DOCOMO to examine the 5G empowering advancements, for example, sparse code multiple access (SCMA), Polar codes and separated OFDM (f-OFDM). SCMA, Polar codes and f-OFDM have been checked to be helpful in improving SE in a 2x2 MIMO system with space frequency block coding (SFBC). The following inquiry is normally what

about massive MIMO system. In this paper, we actualize the previously mentioned advances into our 5G field test stage with massive MIMO and direct a few preliminaries to assess the presentation of them in feeling of spectral effectiveness improvement. The LTE settings, for example OFDMA, Turbo codes and no channel, are taken as the baseline. Same definitions as LTE are utilized in this paper for simple agreement. After the baseline runs steadily, we turn on SCMA, Polar codes and f-OFDM individually to perceive how much every innovation impacts on the general system spectral effectiveness.

Jiayi Zhang et al (2020): This paper the creator clarifies about the Low-Resolution ADCs in Practical 5G Millimeter-Wave Massive MIMO Systems. These days, mmWave MIMO systems are great possibility for 5G cell systems. In any case, a key test is the powerful utilization forced by its various RF chains, which might be alleviated by picking low-goal ADCs, while enduring a moderate execution misfortune. In this article, we examine a few significant issues based on the latest exploration on mmWave massive MIMO systems depending on low-goal ADCs. We talk about the key handset configuration challenges, including channel assessment, signal locator, channel data input and send precoding. Besides, we present a mixedADC engineering as an elective strategy of improving by and large system execution. At last, the related difficulties and likely usage of the viable 5G mmWave massive MIMO system with ADC quantizers are examined. To ease this issue, on one hand, we can utilize a few high-goal, low-speed sub-ADCs working in equal. However, this ADC design may force blunder floors on the system's exhibition because of the bungle among the sub-ADCs. Then again, we can decide on rapid however low-goal (i.e., 1-3 pieces) ADCs to diminish both the force utilization and the equipment cost. The engineering of mmWave massive MIMO systems based on low-goal ADCs where each RF bind is associated with two low-goal ADCs instead of high-goal ADCs.

Berthold Panzner et al (2020): This paper clarifies about Massive MIMO has arisen as one innovation empowering influence for the cutting edge versatile communications 5G. The increases guaranteed by massive MIMO are forecasted to conquer the limit smash in the present versatile organizations and to prepare for the aspiring focuses of 5G. The test to acknowledge massive MIMO for 5G is an effective and cost-proficient mix in the general organization idea. This work features arrangement and execution techniques for massive MIMO with regards to 5G indoor little cell situations. Distinctive massive MIMO organization situations are broke down for a standard 3GPP indoor office situation. Specifically independent MIMO at a solitary area, circulated MIMO without collaboration and organization MIMO with full participation are researched for shifting exhibit setups. For the exhibition investigation of the distinctive MIMO setups the proportion of complete communicate antennas to spatial streams is changed stepwise from fairness to a factor of ten. For usage of massive MIMO in 5G organizations drifts in beamforming methods, commonly coupled sub clusters, over the alignment technique and assessed ADC execution in 2020 time span are talked about. Based on the discussion the paper shows how to incorporate huge scope exhibits in future 5G organizations. Massive MIMO is broadly considered as one key empowering influence for filling the limit hole towards the cutting edge versatile communications. A significant essential for fruitful massive MIMO coordination into 5G is proportional the absolute expense for the individual reception apparatus component down by similar factor as the quantity of receiving wire components is expanded.

Lavish Kansal et al (2019): This paper clarifies about the Multiuser Massive MIMO OFDM System Incorporated with Diverse Transformation for 5G Applications. Wireless systems and guidelines are currently advancing towards the execution of fifth generation (5G) to battle with a normal and hazardous development of requests of wireless administrations in future. Thusly, the orthogonal frequency division multiple access (OFDMA) innovation is being used for the uplink and downlink transmission to manage the cost of the high spectral effectiveness in blurring conditions. Be that as it may, the 5G execution requires extra enhancements to meet the modern pressure. This work proposes an inventive arrangement that consolidates orthogonal frequency division multiple access innovation with multi-client massive multiple input multiple output (MIMO) innovation to meet the necessary raised information rates as wanted by the

developing application needs of 5G. Massive MIMO is able to satisfy the vision of 5G to understand an enormous number of base stations outfitted with countless terminals to be served in a similar time–frequency asset without extreme between client obstruction. Moreover, the proposed system is exhibited joining with discrete wavelet change, and fragmentary Fourier changes. The assessed results epitomize an extensive improvement in spectral productivity and BER execution conversely with the previous detailed work. The customary orthogonal frequency division multiple access actual layer based on FFT for giving the symmetrical subcarriers. In any case, with the headway in sign handling methods other changes like FRFT and DWT comes out to be a productive option in contrast to FFT. The DWT can be used in the multi-transporter adjustment methods to give high information rates, just as lower likelihood of mistake. The FFT had the option to introduce the frequency area portrayal of the sign though the DWT will empower us to dissect the sign in both time and frequency space.

Tadilo Endeshaw Bogale et al (2019): This paper clarifies about the Massive MIMO and mmWave for 5G Wireless HetNet. There has been dynamic exploration worldwide to build up the future, i.e., fifth-age (5G), wireless organization. The 5G organization is required to support a fundamentally enormous measure of portable information traffic and countless wireless associations and accomplish better expense and energy-effectiveness just as nature of administration (QoS) as far as correspondence postponement, unwavering quality, and security. To this end, the 5G wireless organization should misuse the capability of new turns of events, including super thick and heterogeneous sending of cells and massive radio wire clusters [i.e., massive multiple-input, multiple-output (MIMO) technologies] and usage of higher frequencies, especially millimeter-wave (mmWave) frequencies. This article examines the possible advantages and difficulties of the 5G wireless heterogeneous network (HetNet) that consolidates massive MIMO and mmWave advances. To determine these difficulties, it is fundamental to embrace an organization framework that can productively coordinate different disruptive wireless advances and to empower internetworking of existing and recently sent innovations. Such advancement ought to think about the arising wireless applications and administrations in the short, medium, and long terms. Specifically, the 5G organization should empower us to understand the really arranged society with limitless access of data for anybody, anyplace, and whenever. It ought to likewise permit us to support different keen frameworks and shrewd urban communities that are green, protected, versatile, associated, and explained.

Imran Khan et al (2019): Massive MIMO (multiple-input-multiple-output) is one of the vital advances of 5G versatile cell organizations, which can shape a tremendous radio wire cluster by giving an enormous number of antennas at the cell base station. It will enormously improve the channel limit and range usage and has become an area of interest in the field of wireless communications lately. Focusing on the high intricacy of channel assessment calculation for massive MIMO system, a scanty channel assessment calculation with low intricacy is proposed based on the characteristic sparsity of wireless correspondence channel. The calculation isolates the channel taps from the commotion space based on the customary discrete Fourier change (DFT) channel assessment, with the goal that the channel assessment just necessities to ascertain the piece of the channel tap, so the computational intricacy of the calculation is significantly diminished. The recreation results show that the proposed calculation can accomplish close to minimum mean square error (MMSE) execution while keeping up low intricacy. Besides, the Bit Error Rate and Inter-Cell Interference additionally demonstrates that the proposed improved calculation shows preferable generally speaking execution over the traditional calculations which makes it reasonable from commonsense point of view. In this paper, another calculation based on Fast Fourier change direct assessment is proposed in the uplink (UL) TDD mode by utilizing the inadequate qualities characteristic in the wireless channel. The most least square (LS), MMSE and DFT are contrasted and the proposed FFT calculation. The recreation results show that the proposed FFT calculation can accomplish the exhibition of MMSE while keeping up low intricacy. Also, the calculation can be applied in multi-cell helpful MIMO and hand-off MIMO systems.

IV. CONCLUSION

The massive development in rush hour gridlock requests for versatile information administrations has made Massive MIMO is viewed as one of the vital advances in fifth era (5G) supplanting the ordinary MIMO system. Massive MIMO depends on the law of enormous number of antennas that can immensely improve the sign strength, increment information rates and improve signal unwavering quality. The quantity of antennas with significant degrees, e.g., at least 100 can build the system limit, spectral and energy proficiency simply by performing straightforward direct beamforming/precoding procedures like MRT/ZF. Massive MIMO can lessen sent force, the intricacy of the equipment and energy utilization of the sign preparing with more productive utilization of the radio range. The M-MIMO accomplished a high amount of spectral proficiency which conveys among all clients. The distinction among MR and ZF as far as gain is moderately little, the ZF gives the addition execution proportion between the 4% and half however relies upon the user too.

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