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PERFORMANCE ANALYSIS AND CAPACITY ENHANCEMENT OF MIMO-OFDM SYSTEM FOR MULTI MEDIA TRANSMISSION

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ABSTRACT: MIMO-OFDM (Multiple Input Multiple Output Orthogonal Frequency Division Multiplexing) system has been perceived as one of the most mainstream and competitive technique in a remote domain these days. With the fast improvement in remote correspondence systems, the systems are relied upon to give high information rates to excellent interactive media transmission. For high information rate accomplishment one must improve the limit of the media transmission. The limit of a correspondence system can be upgraded by utilizing MIMO and OFDM system. MIMO OFDM is generally utilized for correspondence system because of its high transmission rate and power against multipath blurring while transmission. OFDM might be joined with radio wire exhibits at the transmitter and collector to expand bandwidth productivity and strength utilizing multipath signal propagation, bringing about a MIMO-OFDM arrangement. This paper survey on various channel limit upgrade techniques utilized in MIMO OFDM system are Singular Value Decomposition, Forward Error Correction, Water Filling Algorithm, Optimal Training Sequence, Least Square Method and Recursive Least Mean Square.

KEYWORDS: MIMO (Multiple Input and Multiple Output), OFDM (Orthogonal Frequency Division Multiplexing), Enhancement, Water Filling Algorithm, ISI (Inter Symbol Interference), channel capacity.

I. INTRODUCTION

With the progression in the technology, wireless communication has created its new inventive methodology for the various applications in different fields. The enthusiasm for higher data rates and ascend in the scope of wireless gadgets put a growing enthusiasm on information transmission. This necessary such sort of communication system which has higher limit and enormous throughput. The blend of orthogonal frequency division multiplexing with multiple inputs multiple outputs is a method which can fulfill this necessity. It is taken as an essential technique in different systems with high information rate, for instance IEEE norms, for example, 802.16.which outcomes in enormous throughput and high productivity of framework. Additionally there is no need of any extension in bandwidth or transmission power. Because of this combinational methodology, there might be extraordinary unrest in the field of communication. MIMO and OFDM can work as the physical layers of two key progressions for future adaptable communication framework. These are LTE and WIMAX. For greatest usage of accessible range in the framework and to improve the capability of framework Water filling algorithm joined with SVD approach has been utilized. This examination likewise attempts to investigate the trademark boundaries influencing execution of up and coming Massive MIMO technology for 5G systems. In this part, basic musings and study on MIMO-OFDM frameworks have been introduced.

Overview of 4G, OFDM and MIMO:

The new time framework "4G"is otherwise called LTE for example long haul development. This is imaginative advance for research in the field of communication in telecom industry. The primary objective of this sort of framework is to furnish the entrance of radio with minimal effort and great execution. MIMO and OFDM the two methodologies structure the foundation of LTE. These two methodologies are answerable for dependable and great execution.

Wireless transmission is impaired by blurring. Further limitations of scant bandwidth and confined force make the way toward growing quick wireless systems further requesting. OFDM changes frequency particular channel into a gathering of equal level blurring channels and thusly is solid against multipath channel bends and narrowband obstruction. Further merits of OFDM incorporate more ghastly proficiency, enormous adaptability in allotment of assets and capacity to help versatile regulation methodology.

MIMO is prestigious for upgrade of limit and increment in inclusion extend the instance of wireless communication. During high information rate, the communication of multipath channels of MIMO are kinds of frequency particular and along these lines progressed evening out is required. MIMO with mix of OFDM offers answers for the issues of multipath blurring and obliged assets. The blend of OFDM and MIMO gives more information throughput and higher ghastly proficiency. Presently a day, this mix has become a promising methodology in the field of broadband wireless. Next time of cell systems and broadcasting standard are totally founded on mix of MIMO-OFDM. For instance, the physical layer of 3GPP-LTE, DAB and DVB depend on MIMO-OFDM.

OFDM:
OFDM is best multicarrier modulation approach that sends the signals starting with one end then onto the next. This methodology gives superb points of interest when contrasted with past. It is obvious from the name of approach that it utilizes the multiple transporters with the end goal of regulation. Figure 1.1 shows the essential square graph of OFDM approach. This is a decent methodology for transmission of high information rate. This methodology has the capacity in it to moderate the impact of ICI and ISI. In Figure 1.2 range is appeared for five changed frequency ranges with legitimate subcarrier dividing.

$$\frac{1}{NT_s} = subcarrier\ spacing$$

System Model:

OFDM is widely employed in following:

1) A wireless environment

2) A wired environment.

At the point when it is utilized to send signals through wires for instance coaxial link and wound wire sets, at that point it is known as advanced multi-tone. Yet, if there should be an occurrence of a domain with no wire-like wireless neighborhood and radio telecom system, it is known as OFDM.

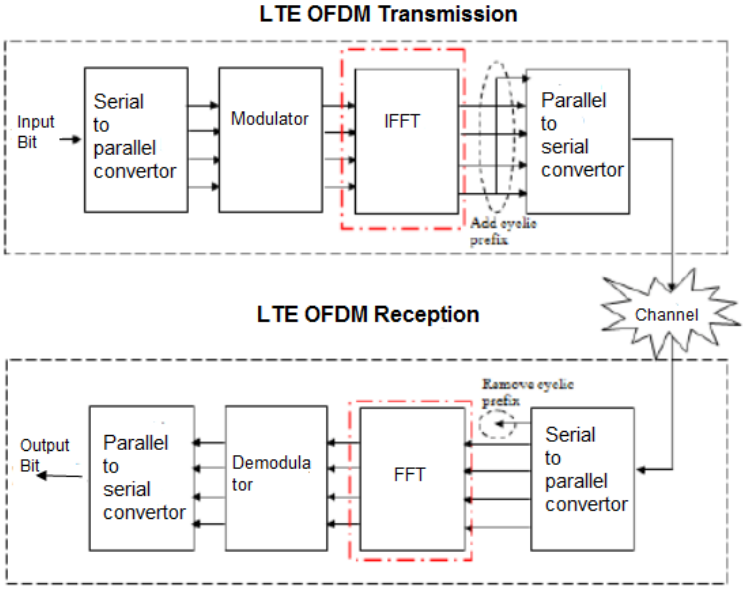

Figure 1: Block diagram of an OFDM system

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Basic principle of OFDM:

In OFDM one high-information rate stream is isolated into an assortment of lower rate streams. These streams are at the same time communicated over some smaller sub channels. OFDM isn't exclusively a regulation technique, moreover a multiplexing technique. A graphical portrayal will make clearer the working of OFDM as its first letters in order may be "O", this represents orthogonal. Because of this property, orthogonal frequency division multiplexing contrasts from Frequency division multiplexing.

From Figure 2, it tends to be inferred that for the cycle of move of information with frequency division multiplexing, idea of gatekeeper band ought to be used to eliminate ICI. Accordingly in mid of 1960s, it animated the looking for a frequency division multiplexing plan with covering multicarrier balance. For usage of that approach, there is a necessity of ideal orthogonality in the different balanced transporters. This can be clarified with the assistance of cycle of orthogonality

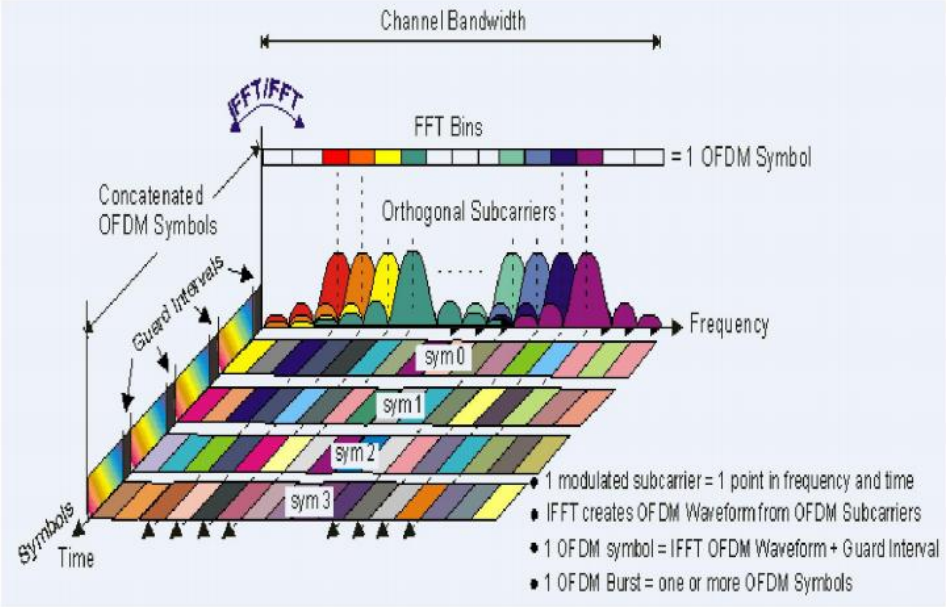

Figure 2: Frequency-Time Representation of OFDM Signal

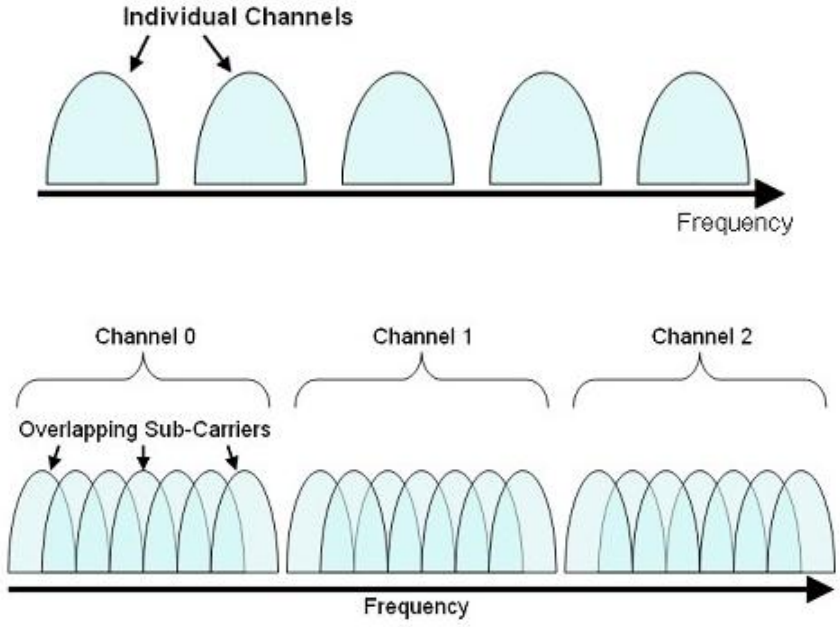

Figure 3: Graphical presentations of FDM and OFDM

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II. LITERATURE REVIEW

In 2013, Nisha Achra, Garima Mathur, Prof. R.P. Yadav considered MIMO-OFDM (Multiple Input Multiple Output Orthogonal Frequency Division Multiplexing) system has been perceived as one of the most famous and competitive technique in a wireless domain these days. The exhibition is determined as far as Bit Error Rate (BER) versus the Signal to Noise Ratio (SNR). In this paper we examine the BER execution of the MIMO-OFDM system with two distinct equalizers (ZF and MMSE) for different balance techniques for example BPSK, QPSK, 16-QAM and 64-QAM utilizing multipath blurring channels for example AWGN (Additive White Gaussian Noise), Rayleigh and Rician channel. The multicarrier regulation is utilized, which gives preferences like bury image impedance (ISI) decrease, high information rate, higher unwavering quality, and better execution in multipath blurring. The reproduction results show that, with MMSE and ZF equalizers, the BER exhibitions is better in MMSE equalizer. Further we broke down in various blurring channels for different regulation techniques in both the equalizers.

In 2015 Matsuoka, H.; Doi, Y.; Yabe, T.; Sanada, Y introduced the exhibition of an over-burden multiple-input multiple output (MIMO) orthogonal frequency division multiplexing (OFDM) system with a redundancy code. It has been shown that assorted variety with square coding forestalls the presentation debasement initiated by signal multiplexing. However, the computational multifaceted nature of a joint unraveling plan increments exponentially with the quantity of multiplexed signal streams. Along these lines, this exploration work proposes the utilization of a reiteration code in the over-burden MIMO-OFDM system. Likewise, QR decomposition with M-algorithm (QRM) greatest probability unraveling (MLD) is applied to the disentangling of the reiteration code. QRM-MLD essentially diminishes the measure of joint deciphering unpredictability. Likewise, virtual recieving wires are utilized so as to expand the throughput that is diminished by the redundancy code. It is uncovered that the proposed plot decreases the unpredictability by around 1/48 for 6 signal streams with QPSK tweak while the BER corruption is under 0.ldB at the BER of 10-3

In 2018 S.Alexander introduced the portable communication technology has a colossal development in an exceptionally brief timeframe period. Advanced wireless change based communication systems have been supplanted the Analog communication systems. Voice change administrations are more muddled than information transmission administrations and backing rapid and information move rate regarding Giga-bits every second. Overall Inter-operability for Microwave Access (WiMax) and Long Term Evaluation (LTE) based wireless communication systems give a far reaching IP answer for transferred sight and sound and voice change administrations, any place it needs higher information rates in the request for 200 Mbps to 2.5 Gbps.
Now a day MIMO-OFDM has been huge development in the current wireless communication systems so as to perform fast information transmission [Chen, C et al 2007]. It is a multi-transporter transmission technique in which higher information rate single streams is splited into multiple lower rate information streams and every information streams has been adjusted by an alternate high frequency information stream. In OFDM based wireless information transmission plot, adjustment of multiple signals can be sent by multiplexing them over countless frequency ranges. OFDM frequency multiplexing signals are orthogonal to one another. Various kinds of regulation techniques, for example, Quadrature Phase Shift Keying Modulation (QPSK), Binary stage move keying (BPSK), Orthogonal QPSK and Quadrature Amplitude Modulation (QAM) are generally utilized for performing adjustment of MIMO-OFDM. Tweak is the way toward fluctuating the attributes of data signals as per high-frequency transporter signals. In frequency adjustment technique, frequency of message signals changing as per frequency of transporter signals. The balance cycle has indistinguishable exhibitions at indistinguishable force levels. In OFDM information transmission, the impacts of impedance and clamor are displayed by Additive White Gaussian Noise (AWGN). Moreover, limited bandwidth can be displayed by a sifting activity. In the majority of the MIMO-OFDM handset, channel can be demonstrated by multi-way Rayleigh blurring channel. Quadrature Amplitude Modulation (QAM) technique is favored in this exploration work for its possibility of 450 stage move synchronization.

III. PROPOSED METHODOLOGY

In this area we are talking about on the performance analysis and the capacitive upgrade of the Multiple Input Multiple Output - Orthogonal Frequency Division Multiplexing. We are utilizing the accompanying techniques in MIMO - OFDM utilized for channel limit improvement for Multimedia transmission.

A. Singular Value Decomposition
B. Water Filling Algorithm
Variants of water filling algorithm are
1. Iterative Water Filling Algorithm
2. Improved iterative Water Filling Algorithm

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3. Centralized Iterative Water Filling Algorithm
4. Cluster Water Filling Algorithm
5. Cooperative Water Filling Algorithm
6. Genetic Algorithm based Water Filling
C. Forward Error Correction (FEC)
D. Least Square Method
E. Optimal Training Sequence
F. Recursive Least Mean Square (RLMS)

A. Singular Value Decomposition (SVD)
SVD decomposes a solitary client system MIMO channel into multiple equal sub channels, and afterward communicating force can be circulated to these sub channels to get channel limit. SVD decouple the channel network into spatial space as DFT coupling the direct in frequency area. This is a significant technique to abuse the full capacity of MIMO OFDM wireless system.

The SVD technique decouples the divert network in spatial space in a route like the DFT decoupling the direct in the frequency area. The channel framework H is the T x R channel grid. In the event that H has free lines and segments, SVD yields:

$$H = U \sum V^h$$

where U and V are unitary matrices and V^h is the hermitian of V. U has dimension of R x R and V has dimension of T x T. $\sum$ is a T x R matrix.

Case (i): If **T = R**, then $\sum$ become a diagonal matrix.

Case (ii): If **T** > R, it is made of R x R diagonal matrix followed by T – R zero columns.

Case (iii): If **T < R**, it is made of T x T diagonal matrix followed by R – T zero rows. This operation is called the singular value decomposition of H.

Case (iv): In case, where **T ≠ R**, the number of spatial channels become restricted to the minimum of T and R. If the number of transmit antennas is greater than the receive antennas (T > R), U will be an R x R matrix, V will be a T x T matrix and $\sum$ will be made of a square matrix of order R followed by T-R zero columns.

B. Water Filling Algorithm
Water filling algorithm is an overall name given to the thoughts in communication system structure and practice for evening out. As name proposes, similarly as water locate its level in any event, when filled in one piece of a vessel with multiple opening as an outcome of Pascal's law. Water filling is utilized to decide the force communicated in each channel to accomplish most noteworthy conceivable limit. Water filling is the arrangement of different streamlining issue identified with channel limit. Water filling algorithm tackles the issue of greatest shared data among input and output of a channel.

1. Iterative Water Filling Algorithm: So as to locate the specific estimation of water level iterative water filling was proposed. As without water filling the absolute force is assigned similarly between all sub transporters. Water filling algorithm distributes power among all the sub transporters as per channel gain that more noteworthy segment of intensity goes to sub channel with higher increase and less or even none to the channel with little addition. The iterative water filling algorithm merges to get the optimal arrangement. When there is negative estimation of intensity portion stop emphases.

2. Improved Iterative Water Filling Algorithm: As iterative water filling power distribution among all the clients could bring about enormous computational intricacy. To get the fast and precise estimation of channel limit and decent variety. Its essential thought is to choose few dynamic clients, and afterward to designate the absolute force among the powerful clients utilizing water filling algorithm, hence to process the channel limit.

3. Centralized Iterative Water Filling Algorithm: This algorithm expands the system limit throughput subject to per Base Station power requirements in downlink OFDM arrange. It is expected that focal unit could gain admittance to consummate channel state data and information everything being equal.

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4. Cluster Water Filling Algorithm: Water Filling offers answer for just subcarrier while for the entire sub transporter it isn't water filling, as estimation of intensity may fluctuate from one sub transporter to other named as Cluster Water Filling on the grounds that in each bunch estimation of intensity doesn't differ. Group water filling was proposed to tackle the issue of vigorous handset plan as strong structure is better than non-hearty plan.

5. Cooperative Water Filling Algorithm: In cooperative water filling two transmitter and multiple collector were utilized to expand the limit of the system as one recipient ought to mutually communicate by two transmitters, and all different beneficiaries are sent uniquely by one of two transmitters. Transmitters have their own ideal CSI (Channel State Information), first collaborate by trading CSI and afterward mutually enhance the force assignment in the measurement of total throughput (limit).

6. Genetic Algorithm based Water Filling: Water Filling algorithm boost the bit rate for whole MIMO-OFDM transmission system and hereditary algorithm is an organically enlivened technique motivated by normal development, for example, legacy, choice and hybrid. Water Filling is joined with hereditary algorithm to locate the ideal force vector that amplify the general throughput of OFDM system while fulfilling the all out force limitations, bit assignment and notwithstanding nature of administration.

C. Forward Error Correction (FEC)

FEC is the method of including excess pieces so errors can be recognized effectively and amended without the need of retransmission yet at the expense of expanded bandwidth which can be overwhelmed by penetrating. Penetrating decrease the quantity of repetitive information to be communicated by utilizing penetrating grid. FEC performs superior to other customary techniques.

D. Least Square Method

This method was picked for starting channel assessment on the grounds that lone a couple of channel qualities are known at the recipient dependent on pilot image subcarrier. In light of starting channel assessment it can acquire the general channel assessment using channel data. The assessed channel limit has the worth that is near the known channel limit.

E. Optimal Training Sequence

Optimal training grouping cautiously chooses the training successions to dispense with entomb recieving wire impedance. Training succession disentangles the underlying channel assessment as well as accomplish the best assessment performance. Optimal training grouping is utilized to acquire introductory channel boundaries, timing and frequency balance. Optimal training grouping technique is more adaptable than different techniques.

F. Recursive Least Mean Square (RLMS) Technique

To get higher exactness and accuracy in channel assessment another technique RLMS was proposed which is the blend of LMS (Least Mean Square) and RLS (Recursive Least Square) algorithm. LMS is versatile channel assessment technique utilized for system ID. This is a straightforward technique however has moderate union speed. RLS implies that LS (Least Square) is utilized recursively in which recently determined evaluations are utilized to locate the new gauge. RLS give high rate assembly however have enormous calculation unpredictability. So both of these techniques are joined to get another technique which conquer these impediments is RLMS. In RLMS algorithm the error signal of one LMS algorithm is taken care of back to different RLS algorithm, so the weight vectors are refreshed twice that is first time by RLS and second time by LMS. In this manner consolidated method speeds up and give low error rate than single LMS and RLS algorithm for system limit upgrade.

PERFORMANCE ANALYZES

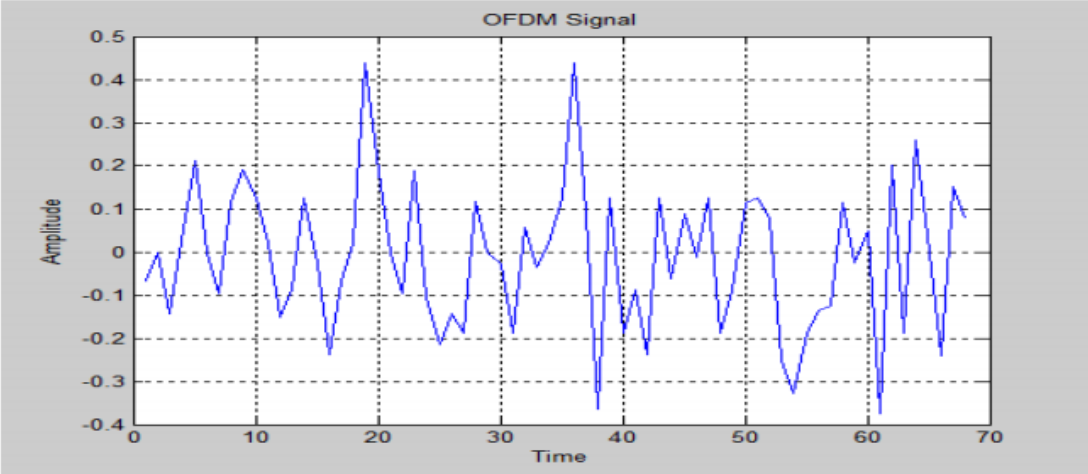

Figure 4: Spectral Analyzes of Modulated OFDM Signal

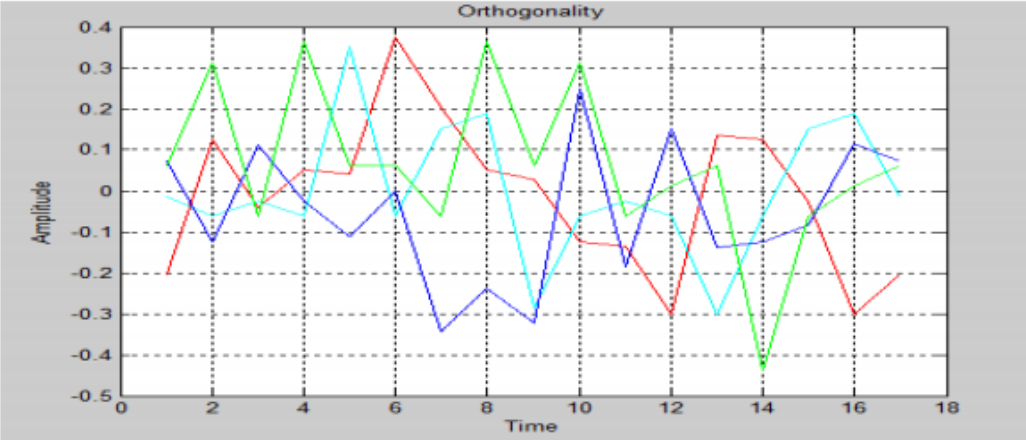

Figure 5: Orthogonality between different modulated OFDM signals

IV. CONCLUSION

In this paper we can come to the conclusion that by using MIMO OFDM which is the promising technique for achieving the high data rate. So we discussed different technique which significantly enhances the capacity of the MIMO OFDM for multimedia transmission. MIMO inherently possess spatial diversity, which increases robustness of the system by eliminating fades. Using MIMO the effective SNR of the system, there by system throughput can be increased with the aid of spatial multiplexing. But in other hand it impose challenge for designing such a cost effective end user MIMO system. So by applying water filling algorithm the MIMO performance is improved.

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