

AN OVERVIEW OF MIMO FOR VARIOUS FIELDS

(Theory Prospective)
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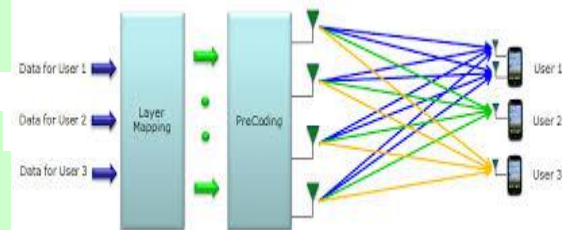
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Abstract-This research article presents an overview of MIMO(Multiple input and Multiple output) in all different aspects of fields and its Applications which open the Door for Future Trends like(5G).The key technologies in this paper includes all the concepts related to MIMO which extensively used in Relay communications, Power line Communications , Cognitive Radio ,Heteterogeonous Networks, Multipath Propagation Environment and for all indoor and outdoor Environments. This paper also represent In which Field what are all the Advantages and Challenges for Future Enhancements are discussed.

Keywords: MIMO, Beam forming, Cognitive radio, Power line Communications, Relay communication.

INTRODUCTION:

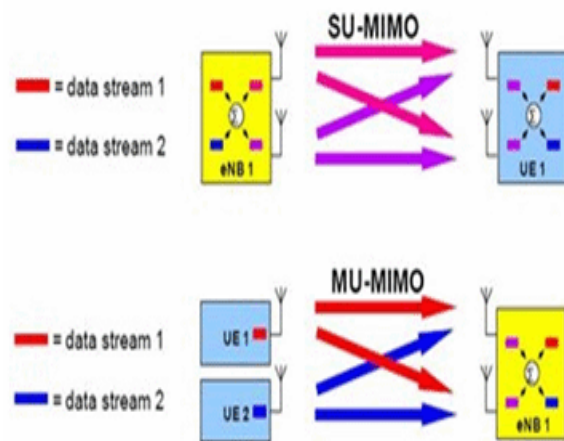
Multiple input Multiple output (MIMO) has many benefits, such as reliable communication, higher data rate, larger communication range, Improved spectral Efficiency, improved channel capacity, and interference-handling capabilities. Under this MIMO 2 spatial streams WLAN 802.11n and 802.16e Wimax(World interoperability for Microwave access) is extensively used and of 4 to 8 spatial streams WLAN802.11ac and Wimax 802.16m are also using because of its tremendous applications. Basically MIMO Broadly Classified as MU-MIMO(MULTI USER) and MASSIVE(Large scale of antennas) MIMO.The fig Shows the Classification.



MASSIVE MIMO

In mimo increased capacity is achieved by introducing additional spatial channels. Link Reliability is improved by spatial Diversity. Sensitivity to fading is reduced by spatial diversity.MIMO channels can provide multiple parallel channels. Increasing a number of independent channels can be consider as Spatial multiplexing gain and in which multiple antennas can offer a Diversity gain.[7][2][5].

In MU-MIMO the no of users that can be simultaneously served is limited by the Base station Antennas. Whereas in Massive MIMO For scattered environment, the merits of massive MIMO technology could be further developed by using simple ZF(zero forcing) or MRT(maximum ratio transmission). Practically, for orthogonal channels the reception and transmission data lacks the channel coherence time. If more than one base stations (antenna) exist in this scenario, the devices renders these channels to various machines maintaining orthogonality optimal multiplexing.

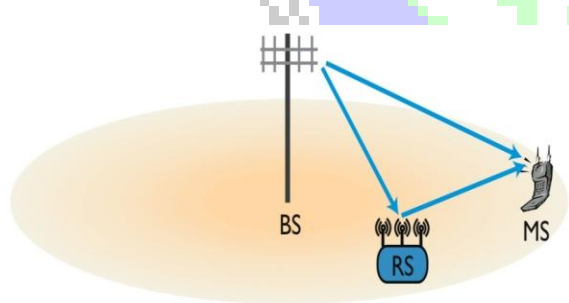


It can be argued that in the current text of disruption of emerging technologies massive - MIMO is the best choice for future generation wireless communication of wireless cellular networks and evaluation of 5G. In the next sector I,II ,III and IV this paper explains brief overview of relay communication, Power line communication ,Cognitive Radios and in Beam forming networks how MIMO technology is used is Introduced and also Discussed the Issues need to take attention also has been Overviewed.

(I).In Relay Communication:

Multiple-input multiple-output (MIMO) relay systems provide the high capacity of MIMO communication with the coverage extension capability of relay transmission. Current and future generations of commercial wireless systems, such as the Third Generation Partnership Project's Long Term Evolution-Advanced (3GPP LTE-Advanced) and the Institute of Electrical and Electronic Engineer's (IEEE) 802.16m, will use MIMO relays for providing better coverage for high data rate services. In the future cellular deployments, MIMO relays will be joined by distributed antenna systems and femtocells creating a truly heterogeneous network.

Relays can Improve the quality of the Received signal at the destination when the channel gain between the source and the destination not strong enough and it increases the data rate also. so that MIMO technology widely been exploited in Relay communication.[1]The Fig shows MIMO Relay station Network;

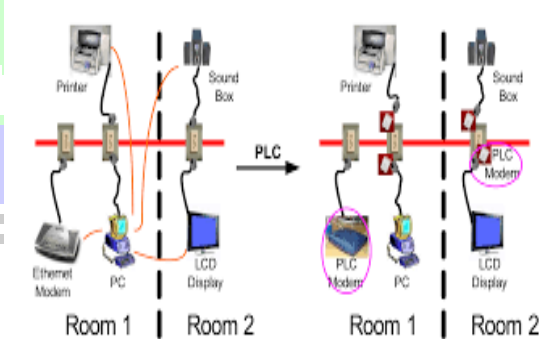


In MIMO Relay communication ,many precoding techniques have been developed to approach the theoretical bounds on the achievable rate. According to Duplex methods, Relays are Full Duplex(FD) and Half Duplex(HD) methods.IN FD Transmit and receive data at the same time in single frequency

band. However isolation between transmitter and receiver on the same antenna is consider very difficult to be implemented. In HD the transmitter and receiver are separated by Time or Frequency. Despite their spectral efficiency loss HD are popularly used in relay communication due to their practical feasibility and cost.

(II).Wireless Power line communications:

To enable real broadband throughput for “room-to-room” connectivity, an in-home backbone network that connects individual devices or clusters in the house with minimum installation effort is desirable. PLC fulfills these requirements. However, common place single-input–single output (SISO) PLC systems lack in coverage, especially on long links in large homes. Here, the utilization of the third wire in conjunction with multipleinput–multiple-output (MIMO) signal processing,the eigenbeam-forming is the best choice for MIMO PLC: the full spatial diversity gain is achieved for highly attenuated channels, and maximum multiplexing gain is achieved for channels with low attenuation by utilizing all spatial streams. It is shown that upgrading from a conventional single-input-single-output PLC configuration to a 2×2 MIMO configuration, the throughput can be more than doubled while coverage is increased.[2][3]. The survey concludes with a review of specific MIMO PLC system implementations in the specifications ITU-T G.9963 and Home Plug AV2.ng is capable of boosting coverage and capacity of the PLC transmissions.



The Research challenges in MIMO PLC are; Channel and noise characterization and Modeling, Channel and noise Emulsion,MU-MIMO Spatial Precoding,EMC &cognitive Methods and Cooperative,relaying and network coding. These all

are the Issues need to take into consideration and Expect more research work to reduce these all issues.

(III).BEAMFORMING Technology:

For many years antenna technology has been used to improve the performance of systems. Directive antennas have been used for very many years to improve signal levels and reduce interference.

Directive antenna systems have, for example, been used to improve the capacity of cellular telecommunications systems. By splitting a cell site into sector where each antenna illuminates 60° or 120° the capacity can be greatly increased - tripled when using 120° antennas. With the development of more adaptive systems and greater levels of processing power, it is possible to utilize antenna beam forming techniques with systems such as MIMO. Beam forming techniques can be used with any antenna system - not just on MIMO systems. They are used to create a certain required antenna directive pattern to give the required performance under the given conditions.[10]

Smart antennas are normally used - these are antennas that can be controlled automatically according the required performance and the prevailing conditions.

Smart antennas can be divided into two groups:

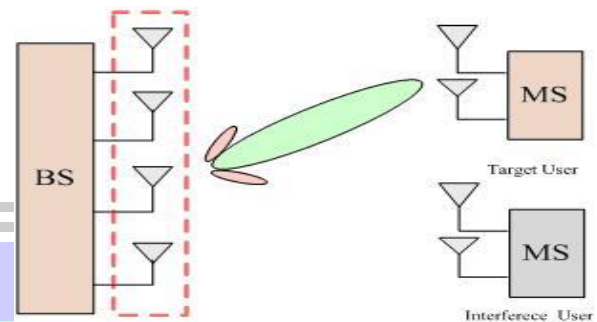
Phased array systems: Phased array systems are switched and have a number of pre-defined patterns - the required one being switched according to the direction required.

Adaptive array systems (AAS): This type of antenna uses what is termed adaptive beamforming and it has an infinite number of patterns and can be adjusted to the requirements in real time.

MIMO beam forming using phased array systems requires the overall system to determine the direction of arrival of the incoming signal and then switch in the most appropriate beam. This is something of a compromise because the fixed beam is unlikely to exactly match the required direction.

Adaptive array systems are able to direct the beam in the exact direction needed, and also move the beam in real time - this is a particular advantage for moving systems - a factor that often happens with mobile

telecommunications. However the cost is the considerable extra complexity required. The fig;shows MIMO Beam forming schematic;

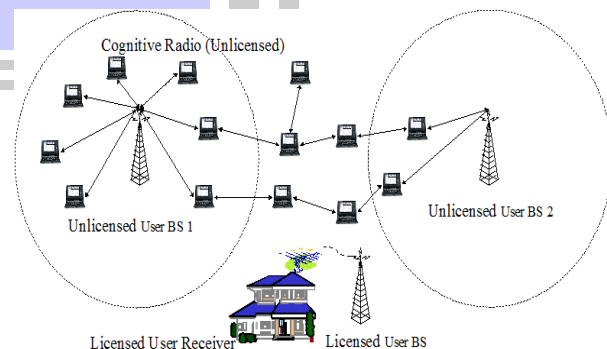


(IV).Cognitive Radios:

In early decades In MIMO system ,Several AM based link adaption schemes have been proposed to improving achievable system performance both under continuous and discrete scenarios. Cognitive Radios(CR) are used to enable flexible and efficient access to a radio spectrum. In CR Networks, Unlicensed users(second) are allowed to access the licensed band opportunistically, whereas primary user gainly collecting revenue for spectrum leasing. It is used for enhancing spectrum Efficiency.

To exploit MIMO for enhanced primary and secondary transmission this CR Research is required.[9].

As MIMO has been widely accepted as a key technology to improve wireless capacity. Extensive research work has been done in physical layer in MIMO for cellular networks but it is limited in CR.In CR it mainly focus on Physical layer and it needs to fulfill the gap between physical and cross layer.



The Benefits are Improved spectrum Utilization and Improved Quality of Service. But in this adaption of one radio can impact the others. so in MIMO there is lot of Adaptability issues will come and so much difficult to predict the performance of all the antennas. Not only in this MIMO are capable of achieving substantial diversity and/ Multipath gains and increased robustness leads to use in different Multipath propagation environments , heterogeneous Networks and all Indoor and Outdoor environments also.

Conclusion:

MIMO, is a radio communications technology or RF technology that is being mentioned and used in many new technologies these days. Wi-Fi, LTE; Long Term Evolution, and many other radio, wireless and RF technologies are using the new MIMO wireless technology to provide increased link capacity and spectral efficiency combined with improved link reliability .Even now there are many MIMO wireless routers on the market, and as this RF technology is becoming more widespread, more MIMO routers and other items of wireless MIMO equipment will be seen. In MIMO Technology Extensive Research work is going on in all various fields.. Eventhough it is a complex technology since while dealing with large antennas which subset to use is always a big Question to Researchers.

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