International Journal of Latest Trends in Engineering and Technology
Vol.(10)Issue(2), pp.387-389
DOI: http://dx.doi.org/10.21172/1.102.61
e-ISSN:2278-621X

EXTENSIVE REVIEW ON DESIGN OF IMPROVED COMMUNICATION NETWORK WITH MULTIPLEXING

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Abstract- Spatial multiplexing is a transmission technique in MIMO wireless communication to transmit independent and separately encoded data signals, so-called streams, from each of the multiple transmits antennas. Therefore, the space dimension is reused, or multiplexed, more than one time.

In this paper, we review the various spatial multiplexing techniques and investigate a hybrid scheme for next generation WLANs and. This scheme combines spatial multiplexing and STBC (space-time block coding) to provide both increased throughput and diversity.

Keywords – Spatial Multiplexing, Diversity, Bit Error Rate, QPSK.

1. INTRODUCTION

The development of wireless technologies [1] has significantly changed our way of communicating and sharing information. Easy access to networks is available at any time, and at any location, as long as we can build wireless connections among devices that are capable of transmitting and receiving signals in the open air. Wireless devices are usually allowed to move, while wireless connections can still be set up and maintained. Movement of devices and other objects in the propagation medium introduces dynamics in the connection quality of a wireless network. The connectivity may vary over time due to change of device location, moving speed, or time-varying interference in the area, etc.

In telecommunications and computer networks, multiplexing is a method by which multiple analog message signals or digital data streams are combined into one signal over a shared medium. The aim is to share an expensive resource. For example, in telecommunications, several telephone calls may be carried using one wire.

In telecommunications, frequency-division multiplexing (FDM) is a technique by which the total bandwidth available in a communication medium is divided into a series of non-overlapping frequency sub-bands, each of which is used to carry a separate signal. These sub-bands can be used independently with completely different information streams, or used dependently in the case of information sent in a parallel stream.

Apart from the antenna configurations[2], there are two flavors of Multiple Input Multiple Output systems (MIMO) with respect to how data is transmitted across the given channel. Existence of multiple antennas in a system means existence of different propagation paths. Aiming at improving the reliability of the system, we may choose to send same data across the different propagation (spatial) paths. This is called spatial diversity or simply diversity. Aiming at improving the data rate of the system, we may choose to place different portions of the data on different propagation paths (spatial-multiplexing). These two systems are listed below.

- MIMO – implemented using diversity techniques [3]– provides diversity gain – Aimed at improving the reliability
- MIMO – implemented using spatial-multiplexing techniques – provides degrees of freedom or multiplexing gain – Aimed at improving the data rate of the system

In diversity techniques, same information is sent across independent fading channels to combat fading. When multiple copies of the same data are sent across independently fading channels, the amount of fade suffered by each copy of the data will be different. This guarantees that at-least one of the copy will suffer less fading compared to rest of the copies. Thus, the chance of properly receiving the transmitted data increases. In effect, this improves the reliability of the entire system. This also reduces the co-channel interference significantly. This technique is referred as inducing a “spatial diversity” in the communication system.

In spatial multiplexing, each spatial channel carries independent information, thereby increasing the data rate of the system. In this we enhance the multiplexing gain through explicit orthogonalization. This can be compared to Frequency Division Multiplexing (OFDM) technique, where, different frequency sub channels carry different parts of the modulated data. But in spatial multiplexing, if the scattering by the environment is rich enough, several independent sub-channels are created in the same allocated bandwidth. Thus the multiplexing gain comes at no additional cost on bandwidth or power. The multiplexing gain is also referred as degrees of freedom with reference to signal space constellation.

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2. LITERATURE REVIEW

Wei Huang et al. [4] introduced the wavelet packet division multiplexing (WPDM) to visible-light communication (VLC) system. They provide the transceiver system model for the WPDM based visible light communication, as well as the associated optimal waveform design under the lighting emitting diodes (LEDs) dispersion. The dispersion specific to each LED shows that such waveform design is done in an off-line manner. Numerical results show the performance gain of the WPDM over the OFDM, in terms of improved out-of-band power leakage, smaller PAPR, more robust to LED nonlinearity and the channel dispersion. Moreover, the optimized waveform for the LED distortion shows performance gain over the conventional wavelet function, e.g., Daubechies wavelet functions. Such advantages make WPDM a good candidate for future VLC systems.

Nicola Michailow et al. [5] discussed that Cellular systems of the fourth generation (4G) have been optimized to provide high data rates and reliable coverage to mobile users. Cellular systems of the next generation will face more diverse application requirements: the demand for higher data rates exceeds 4G capabilities; battery-driven communication sensors need ultra-low power consumption; and control applications require very short response times. We envision a unified physical layer waveform, referred to as generalized frequency division multiplexing (GFDM), to address these requirements. In this paper, we analyze the main characteristics of the proposed waveform and highlight relevant features. After introducing the principles of GFDM, this paper contributes to the following areas:

1) the means for engineering the waveform's spectral properties; 2) analytical analysis of symbol error performance over different channel models; 3) concepts for MIMO-GFDM to achieve diversity; 4) preamble-based synchronization that preserves the excellent spectral properties of the waveform; 5) bit error rate performance for channel coded GFDM transmission using iterative receivers; 6) relevant application scenarios and suitable GFDM parameterizations; and 7) GFDM proof-of-concept and implementation aspects of the prototype using hardware platforms available today. In summary, the flexible nature of GFDM makes this waveform a suitable candidate for future 5G networks.

Quentin H. Spencer et al. [6] discussed that the use of space-division multiple access (SDMA) in the downlink of a multiuser multiple-input, multiple-output (MIMO) wireless communications network can provide a substantial gain in system throughput. The challenge in such multiuser systems are designing transmits vectors while considering the co-channel interference of other users. Typical optimization problems of interest include the capacity problem—maximizing the sum information rate subject to a power constraint—or the power control problem—minimizing transmitted power such that a certain quality-of-service metric for each user is met. Neither of these problems possesses closed-form solutions for the general multiuser MIMO channel, but the imposition of certain constraints can lead to closed-form solutions. This paper presents two such constrained solutions. The first, referred to as "block-diagonalization," is a generalization of channel inversion when there are multiple antennas at each receiver. It is easily adapted to optimize for either maximum transmission rate or minimum power and approaches the optimal solution at high SNR. The second, known as "successive optimization," is an alternative method for solving the power minimization problem one user at a time, and it yields superior results in some (e.g., low SNR) situations. Both of these algorithms are limited to cases where the transmitter has more antennas than all receive antennas combined. In order to accommodate more general scenarios, we also propose a framework for coordinated transmitter-receiver processing that generalizes the two algorithms to cases involving more receive than transmit antennas. While the proposed algorithms are suboptimal, they lead to simpler transmitter and receiver structures and allow for a reasonable tradeoff between performance and complexity.

Angel Lozano et al. [7] provided a contemporary perspective on transmit antenna diversity and spatial multiplexing. It is argued that, in the context of most modern wireless systems and for the operating points of interest, transmission techniques that utilize all available spatial degrees of freedom for multiplexing outperform techniques that explicitly sacrifice spatial multiplexing for diversity. Reaching this conclusion, however, requires that the channel and some key system features be adequately modeled and that suitable performance metrics be adopted; failure to do so may bring about starkly different conclusions. As a specific example, this contrast is illustrated using the 3GPP Long-Term Evolution system design.

Gulshan Jaiswal et al. [8] discussed that communication system with multiple transmitters and receiver architecture is called MIMO (Multiple input and multiple output). Capacity-wise, bit-rate wise and reliability – wise MIMO has many advantages as compared to the SISO (Single input and single output). MIMO can be classified in three different categories i.e. Spatial diversity, Spatial multiplexing and Beam Forming. Spatial multiplexing is used to get the higher data rate while spatial diversity is used to reduce the bit error rate. Here in this literature review paper authors are mainly focused on space time coding technique. In this paper various techniques channel coding, space time coding for frequency flat fading channels, MIMO, MIMO OFDM channel were discussed.

Angela Doufexi et al. [9] discussed that current WLAN systems such as IEEE 802.11a and 802.11g Wireless Local Area Networks (WLANs) employ Coded Orthogonal Frequency Division Multiplexing (COFDM) and provide data rates of up to 54 Mbps in a 20MHz bandwidth. In this paper, space-time block coding (STBC) and spatial multiplexing MIMO techniques are considered as a means of enhancing the performance of COFDM WLANs. A hybrid 4x4 schemes is presented that combines spatial multiplexing and STBC to provide both increased throughput and diversity. Results showed that the proposed scheme can provide good performance even under correlated channels.

Nikfar et al. [10] explained that in MIMO-PLC channels, a spatial correlation is inevitable and channels are not spatially independent. A physical as well as a mathematical description of the spatial correlation in MIMO-PLC is provided. In addition, two receive diversity techniques, Maximum Ratio Combining (MRC) and Equal Gain Combining (EGC) are studied and numerical results were presented.

Kamboj et al. [11] discussed that in recent years Free-space optics (FSO) communication has received much attention as a reliable and free access technique for high data rate applications. The performance of FSO communication, however, severely suffers from turbulence caused by atmospheric conditions. Multiple photo detectors can be placed at the receiver to moderate the turbulence and exploit the advantages of spatial diversity combining. In this work, they analyzed the bit error rate (BER) performance of an FSO communication system employing binary phase-shift keying with additive non-Gaussian noise over negative exponential distributed atmospheric turbulence and spatial diversity at the receiver. The Laplace distribution is used to model the non-Gaussian impulsive noise. We consider the case when perfect channel state information is available at the receiver for implementation of coherent detection.

3.CONCLUSION

In this paper various multiplexing techniques and a hybrid scheme was investigated for next generation WLANs. This scheme combines spatial multiplexing and STBC (space-time block coding) to provide both increased throughput and diversity. Bit Error Rate and Signal to noise ratio performance results under different channel conditions showed that the hybrid algorithm can provide enhanced performance relative to a standard spatial multiplexing approach. In addition, the hybrid algorithm has the advantage of providing good performance even in correlated channels.

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