

Recent Research on Multi Input Multi Output (MIMO) based Mobile ad hoc Network: A Review

Swati Chowdhuri, Department of ETCE, Jadavpur University, Kolkata, India

Sayan Chakraborty, Department of CSE, JIS College of Engineering, Kalyani, India

Nilanjan Dey, Department of ETCE, Jadavpur University, Kolkata, India

Ahmad Taher Azar, Faculty of Computers and Information, Benha University, Qalyubia, Egypt

Mohammed Abdel-Megeed M. Salem, Computer and Information Sciences, Ain Shams University, Cairo, Egypt

Sheli Sinha Chaudhury, Department of ETCE, Jadavpur University, Kolkata, India

Pranab Banerjee, Department of ETCE, Jadavpur University, Kolkata, India

ABSTRACT

Mobile ad hoc Network (MANET) and Multi Input Multi Output (MIMO) communication are emerging techniques in modern communication system. MIMO and MANET have various applications in the wireless communication system. This paper presents a survey on recent advancement of MIMO implemented mobile ad hoc network. A review of more than 40 papers on MIMO communication based mobile ad hoc network and most of the related topics is presented in this work. This paper shows the significant contribution in the field of MIMO communication and mobile ad hoc network. Previous works in this domain can be categorized into four major areas: (a) Mathematical modeling of MIMO channel and Ad hoc networks, (b) Physical Scattering Model of MIMO channel considering fading (c) Spatial multiplexing (OFDM) technique with MIMO channel, (d) Analysis of transmission efficiency of packet radio network. The review paper establishes the advancement in these four areas as well as recent changes in advance communication and networking environments.

Keywords: CDMA, Channel Characteristics, Fading, Information Efficiency, MANET, MIMO, Spectral Efficiency

1. INTRODUCTION

The proliferations of research activities in wireless communication stimulated researchers develop a new technology to enable efficient and purposeful application in mobile ad hoc network. This new technique was developed by invention of MIMO technology and its tremendous potential in wireless network. The advantage of MIMO technology is its high data rate and improved transmission efficiency in wireless communication, Wi-Fi IEEE 802.11n and WiMAX IEEE 802.16e standards. Mobile ad hoc network (MANET) has several significant applications in infrastructure-less wireless network (ad hoc network). MIMO technology has played a key role to improve the transmission efficiency in MANET. This current work studied several works in this domain and build up a review report on the performance of MANET and MIMO technology. Analysis of this work can further help to implement an integrated network or MIMO based mobile ad hoc network. Mobile ad hoc network not only asks for randomly distributed mutual communication in the nodes but also requires transmission of information to distant receivers through multiple hops that may have extremely low SNR. Previous works have proved that each node in MIMO system of ad hoc network receives multiple signals from different nodes during flooding of information. This phenomenon often causes identical effect in multipath wireless communication which later leads to Rayleigh fading.

Previously, a number of researchers have tried to address the problem with the help of special multiplexing techniques/algorithms. The constant and continuous movement of nodes also causes time varying fading as well as Doppler shift in MIMO ad hoc network that reduces the spectral efficiency of the network. None of the previous works or activities was successful to overcome this problem. Analysis of MIMO channels as well as implementation of MIMO technology in MANET was required to address this problem. The analysis of channel characteristics refers to the concept of ergodic channel capacity. This operation can be done

using the outage capacity with or without the Channel State Information (CSI). In many of the previous works, spatial multiplexing technique with MIMO channel has been implemented to obtain maximum spectral efficiency or to minimize the fading effect. Analysis of transmission efficiency of mobile ad hoc network has also been evaluated in previous works. The usefulness of this network in market scenarios has been given by Mora, et al. (2011); Tuunanen, et al. (2012); Cocca, et al. (2013). The cooperative MIMO approach is implemented by Rapaka et al. (2014).

Section 2 summarizes the previous works that remained focused on Mathematical Modeling of MIMO channel and Ad hoc networks. Physical Scattering Model of MIMO channel considering fading is discussed in section 3. Section 4 describes the Spatial Multiplexing (OFDM) technique with MIMO channel. Section 5 analyzes the transmission efficiency of packet radio network or first generation mobile ad hoc network. Limitation and future works are described on section 6 and paper concludes in section 7.

2. MATHEMATICAL MODELING OF MIMO CHANNEL AND AD HOC NETWORKS

The rate at which the users can receive data is user-dependent and time-varying because of unpredictable channel fading and user mobility. This is the most important feature of these systems. In particular, when a user is close to the transmitter they can receive data at higher rate compared to when they are further away from the transmitter. In recent years, lot of work has been carried out to develop effective and efficient mobile ad hoc network.

Wireless ad hoc networks can be operated without the benefit of fixed infrastructure. The nodes are responsible for relaying data, as well as being sources and sinks of data. The nodes may act as a router and in special situations. These nodes can also act as a server. Paulraj et al. (2004), Basagni et al. (2003), Chlamtac

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