A Variant MIMO-OFDM VLC (VMOV) Optimization model for WiMaX Network

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Abstract- Wireless Sensor Networks (WSNs) utilizes small low power sensor nodes to sense physical phenomena and transfer the information by using radio frequency (RF) technology that faces few issues in several operating environments. The optical wireless communication (OWC) systems like visible light communication (VLC) are taken as candidates to sort out the issues of current radio frequency communications. In this paper, we propose a novel Multiple Input Multiple Output Orthogonal Frequency Divisional Multiplexing Visible Light Wireless Communication Model (MIMO-OFDM-VLWC) for high-speed applications along with adaptive modulation scheme in VLC communication model for WiMaX network. In this paper we consider optimal channel allocation and interference minimization was considered to avoid the transmission delays.

Indexed Terms- VMOV, OFDM, MIMO, LEDs, WiMaX, TIA, AWGN

I. INTRODUCTION

Visible Light Communication technology is one of the emerging optical wireless communication technologies, from which light in the visible region is utilised as a medium for data transmission, is very secure and it gains huge data rates when compared with conventional wireless technologies like Wi-Fi, Bluetooth etc., which communicates through radio waves. Visible Light Communication rely on Light Emitting Diodes (LEDs), which are promising for wireless networks, since LEDs would be used for both illumination [1] and wireless transmission at a time. At the time of using wireless webs, where more than one device is dropped into the network, then bandwidth get weak at the slow speeds. To overcome the issue, we can use light to share the data which can be known as "Data through illumination". VLC provides various benefits like low cost, license free, immunity to electromagnetic interference. VLC also gets benefits from its easy structure and very low cost. Because of the integration of illumination and combination, a huge number of researches has been done on indoor high-speed transmission in VLC applications [4-6]. Moreover, the low bandwidth of LEDs constraints the transmission data rate [7]. Hence, it is very essential to employ efficient techniques to gain high data rate for indoor VLC system.

Researchers have performed many techniques on visible light communication. Among them orthogonal frequency division multiplexing (OFDM), multiple input multiple output (MIMO) techniques have been seriously considered in the improvement of high data rate, which can be integrated in the VLC system [8-10]. Orthogonal frequency division multiplexing is a technique of digital signal modulation where a single data stream is decomposed across various narrowband channels at different frequencies to decrease the interference and crosstalk. The very important technique to discuss here is MIMO. It is used in conjunction to improve the capacity of transmitted signals.it means they produce less power while transmitting data, then it gains high energy efficient system. MIMO energy efficient technique enables to find individual users. MIMO technique increases the channel capacity and enhances the reliability depend on the simple idea of transmitting multiple data streams at same time on multiple LEDs.

But the major disadvantage about MIMO is the complexity in structure [4]. In existing multiplexing MIMO scheme, it transmits the data simultaneously on various LEDs, which is proved to be useful with less channel correlation. When the channel become heavily correlated, channel gets benefited among different transmitters and receivers are highly similar to one another.

Therefore, the other famous MIMO technique is proposed to apply to the high channel correlation... as the data is sent from various LEDs, they get benefits of high reliability and efficiency. Recently a powerful MIMO scheme has been introduced in [13]., where MIMO mode switches among spatial multiplexing and transmit diversity adapting to the channel correlation. In the same way, we can get the benefits of both MIMO schemes. Moreover, the switching MIMO technique is introduced in a specific-rate MIMO OFDM system, where modulation orders are maintains consistency on all OFDM sub channels. Therefore, the transmit diversity scheme has to use a larger signal constellation size to support a high data rate, resulting in worse bit error rate (BER) performance.

Finally, here we enhance the goal of switching MIMO technique to a variable rate MIMO OFDM system. In this paper we propose a visible light wireless communication to the typical wireless sensor network indoor lighting model by minimizing the interference to avoid the latency and to improve the throughput rate. In this research we propose a novel Multiple Input Multiple Output Orthogonal Frequency Divisional Multiplexing Visible Light Wireless Communication model (MIMO-OFDM-VLWC) by maximizing the transmission rate by combining the OFDM sub-carrier feature set to minimize the delay.

The major objective of this paper is to design a Variant MIMO-OFDM VLC (VMOV) communication model with adaptive OFDM modulation. Multiple input, multiple output (MIMO) systems provides high data rate capabilities over longer distances in VLC networks. The integration of MIMO and OFDM produces a powerful physical layer solution for high-speed WiMaX VLC network for high bandwidth applications Initially we made use of OFDM modulation to reach the maximum channel capacity through the bit allocation under the constraints of a target bandwidth. Then the MIMO mode is also switched among spatial multiplexing and transmit diversity. Particularly the modulation is sorted by adaptive OFDM modulation, as this technique is more preferable because it has the higher modulation order.

II. NETWORK MODEL

Here, let us take the WiMaX MIMO-OFDM network employees M-LEDs and set of n-photodiodes with l-optical channel. The OFDM modulations allow to access the channel frequency spectrum to transmit the signals to the receivers through OFDM modulation. There are K subcarriers in OFDM network and the available bandwidth is W. There are K subcarriers in VLC MIMO-OFDM network and the available bandwidth is W. $\boldsymbol{g_k^n}$ represents channel state information (CSI) between WiMaX BS and the nth LED on the kth subcarrier.

In this work, we study the bandwidth resource allocation issue of WiMaX VLC network based on underlay mode. To prevent the intolerable work degradation of Transmitters during distributing data streams to the receivers, the interference introduced by sub-carriers should be carefully handled in a way that we define an interference threshold for transmitters. An optical WIMAX MIMO-VLC transmission system employs five transmitters on over the intensity modulation and direct detection (IM/DD) with four independent and simultaneously transmitted data streams using multiple incoherent light sources and photodetectors. In this paper, the receiver's device consists of p-photodetectors (PD). The receivers collect the light from transmitters, estimate the channel matrix and recover the original data using MIMO signal processing. The converter subsequently supplies outputs that are parallel data streams, which are then DC-level shifted and intensity modulation through the LED transmitter Txj Imagine that WiMaX BS has the exact CSI between transmitter BS and the transmitter sub-carriers. Because of less interaction among the cognitive network and the initial network, only statistical CSI among WiMaX BS and transmitters could be used. To grab the uncertainty of $\boldsymbol{g_k^n}$, we imagine the immediate channel coefficient of the kth subcarrier between WiMaX BS and the nth transmitters is explained by complex Gaussian random variable $\boldsymbol{f_k^n}$. Hence, the CSI $\boldsymbol{g_k^n} = |\boldsymbol{f_k^n}|2$ is an exponential random variable with chance of density function which is given by (1).

$f_g^n n_k(\eta)=\frac{1}{\sigma n}+\exp\left(-\frac{n}{\sigma n}\right)$ (1)

Where σn is the long-term average CSI for the nth transmitters.

III. CHANNEL MODELLING

Light from the LED transmitter source is acquired by means of the receiver through the Line-of-Sight (LOS) channel model. Higher records fee, minimum path loss, dispersion, Inter Symbol Interference (ISI) is achieved using the LOS channel version. The received optical power from the led supply.

p h(0) p r i = (1) (1)

Where h(0) is the channel DC gain,

pi is the transmitted optical power

The noise model has to also be covered with the indoor LOS channel model. Optical background noise assets that make contributions to the indoor VLC machine includes ambient light noise, sign and ambient mild precipitated shot noise within the image-diode and thermal noise generated through the trans-impedance amplifier (TIA). Thus, the VLC channel is modelled as a linear optical additive white Gaussian noise (AWGN) channel and the photo-detector current is given by the following equation (2)

$I(t)=\eta p_i(t)*h(t)+n(t)$ (2)

Where I(t) is the photo detector current,

η is the photo sensitivity of the Photo detector,

$p_i(t)$ is the instantaneous input power,

h(t) denotes the impulse response,

n(t) denotes the noise and

it is the sum of contributions from shot noise and thermal noise

$n = \sigma^2 shot + \sigma^2 thermal$ (3)

The signal and ambient light induced shot noise variance as described, is given by the following equation

$\sigma^2 shot = 2qR(P_r + P_n)B$ (4)

Where q the charge of the charge on electron is,

R is the photo-diode responsivity,

P_n is the received noise power,

P_r is the received optical power and

B is the receiver bandwidth.

Trans-impedance amplifier (TIA) is used as the first stage amplifier in VLC system. Thermal noise is the most prevailing component of TIA electrical noise. Thermal noise variance as described in [10] is given by the following equation (5)

$\sigma^2 thermal=4\frac{4KT}{BRf}$ (5)

Where K is the Boltzmann's constant,

T is the absolute temperature and

R_f is the TIA feedback resistance.

The optical sign from the LOS channel is detected by way of the photo-diode used inside the receiver aspect. Commonly, two exceptional types of picture-diodes including an avalanche picture-diode (APDS) and positive-intrinsic-negative (PIN) image-diodes are used [4]. SI PIN picture-diode is favoured in our works because of low cost, linear response characteristics over the huge ranges, low voltage operation and tolerance to high temperature fluctuations to enhance the receiver overall performance. VLC receiver consists of image-diode which converts the detected mild to electric current, optical clear out is located before the image-diode to lessen the noise from ambient light, TIA converts the electric modern-day into voltage, electrical low pass filter out is used to clear out other unwanted noise factor, the acquired sign is very weak so an electrical amplifier is used to extend the signal, the demodulator is used to recover back the authentic facts transmitted.

IV. INTERFERENCE MINIMIZATION

Noise is the time period used to refer to any spurious or undesired disturbances that mask the obtained signal in a communication system. In optical fibre conversation systems, we're usually concerned with noise because of spontaneous fluctuations as opposed to erratic disturbances. The closing performance of verbal exchange system is typically set by means of noise fluctuations gift on the enter to the receiver. Noise degrades the signal and impairs the application overall performance. In an optical receiver, the crucial resources of noise are associated with the detection and amplification approaches. The subsequent parent depicts the diverse resources of noise associated with the detection and amplification tactics in an optical receiver using direct detection. Detection of the weakest feasible optical indicators requires that the image detector and its following amplification circuitry be optimized in order that a given signal-to noise ratio is maintained. The power signal-to-noise ratio (S/N) at the output of an optical receiver is defined through,

$$\frac{S}{N} = \frac{signal\ power\ from\ photo\ current}{photo\ detector\ noise\ power + amplifier\ noise\ power}$$

(6)

The noise assets within the receiver comes from the photo detector noises resulting from the statistical nature of the photon-to-electron conversion procedure and the thermal noises associated with the amplifier circuitry. To attain an excessive signal-to-noise ratio, the photo detector should have a high quantum performance to generate a large signal power and the picture detector and amplifier noises must be saved as little as feasible. The principal noises associated with photo detectors are quantum noise, darkish-contemporary noise generated in the bulk fabric of the photodiode and surface leakage modern noise. The quantum or shot noise arises from the statistical nature of the manufacturing and collection of photoelectrons when an optical sign is incident on a photo detector. The quantum theory suggests that atoms exist handiest in certain discrete strength states such that absorption and emission of light causes them to make a transition from one discrete energy nation to any other. The frequency of the absorbed or emitted radiation is related to the difference in electricity E among the higher energy state E2 and the lower energy state E1 through the expression:

E=E_2-E_1=hϑ (7)

Where h is the plank's constant.

Those discrete strength states for the atom can be considered to correspond to electrons going on specifically energy stages. This quantum nature of mild should be taken into account at optical frequencies. Those quantum fluctuations dominate the thermal fluctuations. The detection of light through a photodiode is a discrete system since the advent of an electron-hollow pair outcomes from the absorption of a photon, and the sign rising from the detector is dictated via the information of photon arrivals. Subsequently, the facts for monochromatic radiation arriving at a detector follows a discrete possibility distribution which is impartial of the variety of photons formerly detected.

The imply rectangular shot-noise

i_{NS}=2eiΔf (8)

Where e is the magnitude of the charge of an electron,

I is the average detector current and

f is the receiver's bandwidth.

From the above equation shot noise increases with current. Thus, shot noise increases with an increase in the incident optic power. This differs from thermal noise, which is independent of the optic power level.

The current I in equation involves both the average current produced by the incident optic wave and the dark current I_D . Then,

i_{NS}=2e$(i_S + i_{D)}\Delta f$ (9)

Where i_s is the photocurrent.

The photodiode dark current is the current that continues to flow through the bias circuit of the device when no light is incident on the photodiode. This is a combination of bulk and surface currents. The bulk dark current i DB arises from electrons and/or holes which are thermally generated in the P_N junction of the photodiode. The surface dark current is also referred to as a surface leakage current or simply the leakage current. It is dependent on surface defects, cleanliness, bias voltage and surface area. Thermal noise, also called Johnson noise originates within the photo detector's load resistor R_L . Electrons within any resistor never remain stationary. Because of their thermal energy, they continually move, even with no voltage applied. The electron motion is random, so the net flow of charge could be toward one electrode or the other at any instant. Thus, a randomly varying current exists in the resistor.

This is the thermal noise current i_{NT}.

The average noise power generated within the resistor is 2 i_{NT},

where $2i_{NT}$ is the mean-square value of the thermal noise current.

The noise current adds to the signal current generated by the photo detector. The mean-square value of the thermal noise current is

$$i_{NT=}\frac{4kT\Delta f}{R_L} \qquad (10)$$

Where k is the Boltzmann's constant,
T is the absolute temperature ()
K and Δf are the receiver's electrical bandwidth.
The thermal noise power delivered to the load is

$$P_{NT=}4kT\Delta f \qquad (11)$$

Amplifier normally follows the photodetector to reinforce the receiver signal to a useful level. In a super scenario, each signal and noise powers might be improved via the amplifier's energy benefit G. Then, the signal-to-noise ratio at the amplifier output would same that on the input. Unknowingly actual amplifiers not simply multiply the input noise but also produce noise in their personal. This reduces the signal-to-noise ratio. Allow the brought noise is represented by P out watts. Now the amplifier-noise temperature T_A is defined in the sort of way to provide this power with the aid of the use of equation 11

$$P_{in}=\frac{P_{out}}{G}4kT_A\Delta f \qquad (12)$$

Combining this with the load resistor's thermal noise yields the equivalent input thermal noise power

$$P_N=4k(T+T_A)\Delta f = 4kT_e\Delta f \qquad (13)$$

where T is the temperature of the resistor and

$$T_e\text{=T+}T_A \qquad (14)$$

T_e is the equivalent system-noise temperature.

The actual thermal noise appears to come from a resistor operating at temperature e .

Signal-to-noise ratios are computed by simply replacing the actual system temperature T with the effective system-noise temperature T_e.

Considering the noise figure F rather than the noise temperature T

F is the property defined by

$$\text{F=1+}\frac{T_A}{T\ S} \qquad (15)$$

where Ts is some reference temperature.

The equivalent system-noise temperature is

$$T_e = T + T_A = T + (F-1)T_S \qquad (16)$$

where we eliminated $T_A$by using equation

If reference temperature equal to the system temperature,

Then, TF T_e, and the total output noise power becomes

$$P_O = GP_N = G4kT_e\Delta f = G4kFT\Delta f \quad (17)$$

solving for the noise figure yields

$$\text{F=}\frac{P_O}{G4kT\Delta f}\text{=}\frac{P_O}{GP_{NT}} \qquad (18)$$

where the load resistor's thermal noise power $P_{NT}$is identified by the equation (18).

This allows to define the noise determine as the thermal-noise strength at the output divided by means of the made of the electricity benefit and the input thermal noise. To use this definition, F must be measured at the temperature of the resistor. For an ideal amplifier, P GP o NTΔ and the noise figure is unity.

V. 3 VARIANT MIMO-OFDM VLC (VMOV) OPTIMIZATION

In this work, we use the statistical CSI in between BS and to control the interference and it considers the proportional resource allocation issue which increases the spectral performance of VLC OFDM network and which guarantees the probabilistic interference constraint condition based on the transmitters LED's sensor condition. The proposed optimization model minimizes the communication interference by minimizing the transmission delay with the adoption MIMO channel switching model.

Let cm, k denotes the subcarrier allocation denotes for the m^{th} transmitter sub-carrier on the kth subcarrier. For example, if cm, k = 1, the kth subcarrier is allocated to the m^{th} transmitter sub-carrier. And also imagine every subcarrier can only be allocated to one transmitter sub-carrier and that is the constraint condition (2).

$$\sum_{m=1}^{M} C_{m,k} \leq 1, C_{m,k} \geq 0, \forall_{m}, k \quad (2)$$

Let P_{m}^{k} indicates the transmission power for the m^{th}-sub-carrier on the kth subcarrier, P_{max} indicates the high transmission power for cognitive OFDM network and P_{k} max indicate the high transmission power for the kth subcarrier. To guarantee the feasibility of power allocation, here, we add the constraint condition (3)

$$\sum_{m=1}^{M} \sum_{k=1}^{k} C_{m,k} P_{m,k}, k \leq P_{max}\,, 0 \leq P_{m,k} \leq CP^{k}{}_{m,k}, \forall_{m}, k \quad (3)$$

Let b_{m}^{k} indicates the transmission cost for the mth transmitter sub-carrier on the k^{th}sub carrier.

Ik is the interference power on the k^{th} subcarrier and η is the background noise power.

Then, b_{m}^{k} could be expressed as

$$b_{m,k} = \frac{W}{K} \log_{2}\left(1 + \frac{P_{m,k} h_{m,k}}{\Gamma(l_{k}+\eta)}\right) \quad (4)$$

Where hm, k denotes the immediate CSI among WIMAX BS and the mth transmitter sub-carrier on the kth subcarrier.

I is the capacity gap which is related to the bit error rate (BER) and has a relationship with BER target

$$\Gamma = -\frac{\ln\left(5BER_{m}^{target}\right)}{1.5} \quad (5)$$

Where BER target m is the target BER for the mth transmitter sub-carrier.

Let In max denote the interference threshold for the nth transmitters and $\in_{n}$ denote the required upper bound on the chances of crossing the interference threshold for the nth transmitters. Because $g_{k}^{n}$is uncertainty, the transmitters interference constraint condition is casted as a chance-constrained condition. Hence, we add a constraint condition.

$$\Pr\left\{\sum_{m=1}^{M} \sum_{k=1}^{K} C_{m,k} P_{m,k} g_{k}^{n} < l_{max}^{n}\right\} \geq 1 - \varepsilon_{n,} \forall_{n} \quad (6)$$

Where Pr {·} represents the possibility.

Let {φm} $\frac{M}{m=1}$ indicates the predefined values which are used to ensure the proportional fairness rate desire for transmitter sub-carriers. In the resource allocation issue of cognitive OFDM system, the proportional fair is normally defined by the ratio of the mth sub-carrier's strength to the (m+1)th sub-carrier's strength. Moreover, we adopt the ratio of the mth sub-carrier's capacity to the (m+1)th sub-carrier's capacity as the proportional fair definition in this work. Therefore, the proportional fair rate requirement could be guaranteed by

$$\frac{\sum_{k=1}^{K} c_{m,k} b_{m,k}}{\sum_{k=1}^{K} c_{m+1,k} b_{m+1,k}} = \frac{\emptyset_{m}}{\emptyset_{m+1}}, \forall_{m} \quad (7)$$

With the above considerations, we formulate the chance-constrained optimization problem as following.

$$max_{c_{m,k} P_{m,k}} \sum_{m=1}^{M} \sum_{k=1}^{K} c_{m,k} b_{m,k}$$

S.t.C1.$\sum_{m=1}^{M} C_{m,k} \leq 1\,, and\ C_{m,k} \geq 0, \forall_{m}, k$ (8a)

C2.$\sum_{m=1}^{M} \sum_{k=1}^{K} C_{m,k} \leq 1,\ and\ 0 \leq P_{m,k} \leq P_{max}^{k}\,, \forall_{m}, k$ (8b)

C3. $\Pr\left\{\sum_{m=1}^{M} \sum_{k=1}^{K} C_{m,k} P_{m,k} g_{k}^{n} < l_{max}^{n}\right\} \geq 1 - \varepsilon_{n,} \forall_{n}$ (8c)

C4. $\frac{\sum_{k=1}^{K} c_{m,k} b_{m,k}}{\sum_{k=1}^{K} c_{m+1,k} b_{m+1,k}} = \frac{\emptyset_{m}}{\emptyset_{m+1}}, \forall_{m}$ (8d)

where the objective function (8) maximizes the spectral efficiency of cognitive OFDM network and (8a)–(8d) are the constraint conditions.

VI. ADAPTIVE MIMO SWITCHING MODEL

Here we tend to design a MIMO switching technique which is based up on the modulation. While comparing with the switching criteria relies on BER bounds in fixed-rate system, is known that absolutely wrong. This switching technique can be ignored easily because the modulation order denotes the data rate of the present system. Apart it is important to use such switching criterion, because the modulation order is the pre-defined solution of adaptive VLC-OFDM modulation.

Hence crosstalk occurring in between the collocated channels, at that time, MIMO channel must be decorrelated into single-input-single-output channels. And finally, every SISO has been categorized into several sub channels by using OFDM modulation technique.

To discuss about variant VLC-OFDM system two symbols are transferred from two LEDS at same time on single symbol period. Therefor MIMO channel is decorrelated by Zero-forcing algorithm, where represented as

F[a] G[a]=L[a] +F[a] N[a], a =1,2,3……., M (1)

a is the index of the sub channel,

It indicates the matrix Inversion and vectors of received signals, transmitted signals, it is the matrix of the K^{th} sub channel

And then, the VLC-OFDM channel capacity can be improved by allocating their related energy on each and every sub channel from lot of decorrelated SISO channels in the power constraint

F[a]=H^{-1}[a] and (·) −1 denotes the matrix inversion, and

G[a], L[a], and N[a] denotes the vectors of received signals, transmitted signals, and noise

$$\underset{P_i[\mathrm{a}]}{max} \sum_{i=1}^{2} \sum_{a=1}^{m} C_i[a]$$

$$= \underset{P_i[a]}{max} \sum_{i=1}^{2} \sum_{a=1}^{m} \log(1 + P_i[a] SNR_i[a]) \qquad (2)$$

Subject to

$$\sum_{i=1}^{2} \sum_{a=1}^{m} P_i[a] = 2M, P_i \geq 0 \qquad (3)$$

Where P$_i$[a], and represents the power, the signal to noise ratio (SNR)

Where SNR can be simply be computed with the assist of feedback CSI. we resolve the optimized power coefficients depend up on the classic water filtering algorithm, and next the bits are assigned to the various sub channels to identify the huge capacity in the aspects of various constraints of a BER.

Where Q$_i$[a] is the modulation order on the kth sub channel of the ith SISO channel and is the assigned target BER.

$$Q_i[a] = 1 - \frac{1.5 P_i[a] SNR_i[a]}{\log(5 BER_T)} \qquad (4)$$

Where Qi[a] is the modulation order on the kth sub channel of the ith SISO channel and BERT is the given target BER

In the Alamouti coding technique, two symbols are transferred from two LEDs on two symbol periods. Hence the MIMO channel can be simply corelated by matrix transformation by integrating the signals from various receivers from several symbol periods, which can be represented as [12]

$$\begin{aligned} J_1^J[a] Y_1[a] + J_2^J[a] Y_2[a] &= (J_1^J[a] J_1[a] + J_2^J[a] J_2[a]) X_a \\ &+ J_1^J[a] N_1[a] + J_2^J[a] N_2[a], a \\ &= 1, \ldots M \qquad (5) \end{aligned}$$

where G$_j$[a] and N$_j$[a] represents the vectors of received signals and noise from two symbol periods on the sub channel at the jth receiver. stands for the orthogonal channel matrix corresponding to the jth receiver.

According to (5), we discover that SNRs on the associated sub channels from the two decorrelated SISO channel are similar to each other. however, the Alamouti coding system is unable to experience the gaining because there is only one symbol is actually transmitted on single symbol period. Therefore, the high channel capacity of the Alamouti coding system is similar to their assigned power on sub channels of one decorrelated SISO channel, which is given by

$$\max_{P_i[a]} \sum_{a=1}^{M} C_i\,[a] = \max_{P_i[a]} \sum_{a=1}^{M} \log(1 + P_i[a] SNR_i[a]) \qquad (6)$$

subject to

$$\sum_{a=1}^{M} P_i[a] = M, \;\; P_i \geq 0 \qquad (7)$$

After bit allocation depends on (4), the supported modulation order for Alamouti coding system is computed by adding all bits over sub channels of one SISO channel.

It is to be noted that the switching criteria in variable-rate system is highly correlated to the channel correlation. When the channel correlation capacity is very low, the modulation order of Variant VLC-OFDM is larger than the Alamouti coding system. As the channel capacity is highly correlated, noise must be improved by ZF algorithm. Hence, less bits can be assigned, due to the worse SNR in Variant VLC-OFDM system. However, the efficiency of Alamouti coding system maintains at a consistent level, as the SNR value of Alamouti coding system relies on the 2-norm of channel matrix. Therefore, this technique is considered as the better one.

VII. EXPERIMENTAL RESULTS AND DISCUSSION

7.1 SIMULATION MODEL

In this paper we consider a NS2 simulation software to configured the WiMAX OFDM model. In this experiment we design a WiMAX OFDM network with set of transmitters and set of receivers with WiMAX channel interferences. The given table-1 presents the simulation parameters, we employ a VMOV protocol model to organize the multipath transmission with the configuration of set of channels and each transmitter node contains a set of sub-carriers to organize the transmission. In this experiment we consider a Multipath propagation with one reflection is considered[3]. All the reflectors surfaces are assumed to have the same reflective factor. For simulating the proposed VLC channel and to reduce the signal distortion, the MIMO switching is used for balancing the load. Each sensor node light (LED) is considered as a transmitter. The proposed system performance is analysed by considering various bit rate transmission parameters of the OFDM schemes. The distributions of bit- and power-loading of the VLC-OFDM for m-subcarriers with an 8 dB and 10 dB bias is assigned to the sub-carriers. In this simulation we compared the results with asymmetrically clipped optical OFDM (ACO-OFDM) [13] by varying different transmission rates.

7.2 Simulation Results

No. of Nodes	50.100.150.200
Area Size	1000 X 1000
Mac	IEEE 802.15.6
Transmission Range	250m
Simulation Time	200 sec
Traffic Source	CBR
Packet Size	128 bytes
Initial Energy	10J
Transmission power	0.066 w
Receiving power	0.039 w
Idle power	0.035 w
Antenna	Omni Antenna
Routing Protocol	VMOV

Table 7. Simulation Parameters

The proposed system is simulated with the Network Simulator-2 (NS-2) with the simulation parameters as given in Table 1. In this experimental model the VLC-WiMaX is simulated with the variation of number of nodes, and transmission rates. In this simulation the network area size of 1000m x 1000m is considered. The initial energy rate is 10J. The performance of the proposed protocol is based on the performance metrics: packet delivery ratio, throughput, energy consumption, end to end delay and routing overhead.

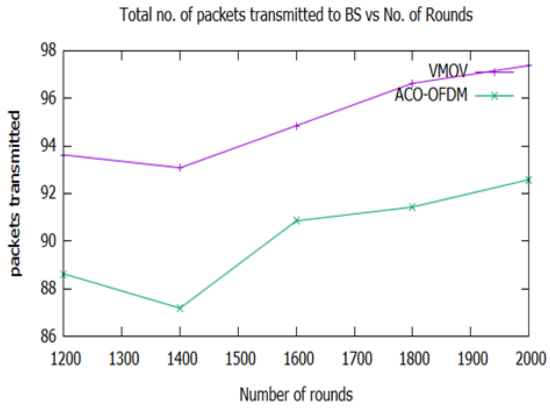

Fig1. Total Number of packets Transmitted to BS

Fig.1 represents the total number of packets transmitted to the receiver based on the number of rounds, the above simulation results determine the packet delivery ratio of VMOV is increased with respective of number of rounds the performance is slightly better compare to ACO-OFDM

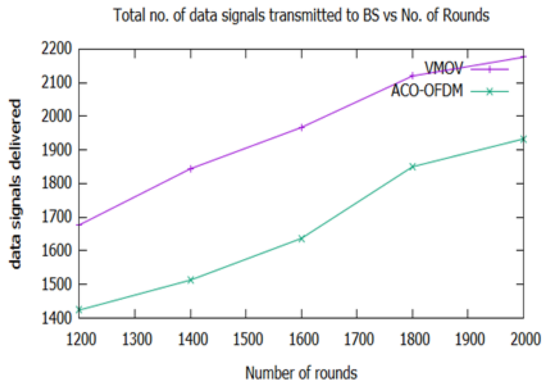

Fig.2 Total no of data signals transmitted to Receiver

Fig.2 represents the total number of data signals transmitted to the receiver based on the number of rounds, the above simulation results determine the data signals of VMOV is increased with respective of number of rounds the performance is slightly better compare to ACO-OFDM

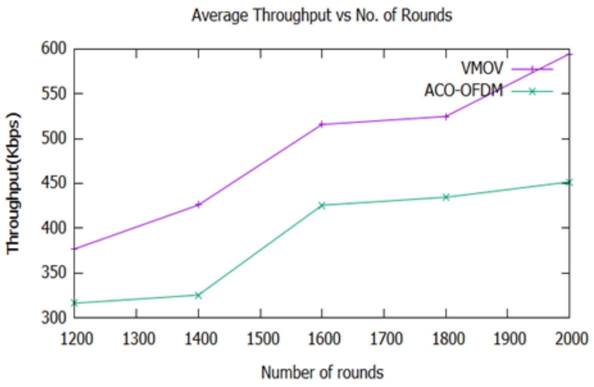

Fig 3: Average Throughput vs Number of rounds

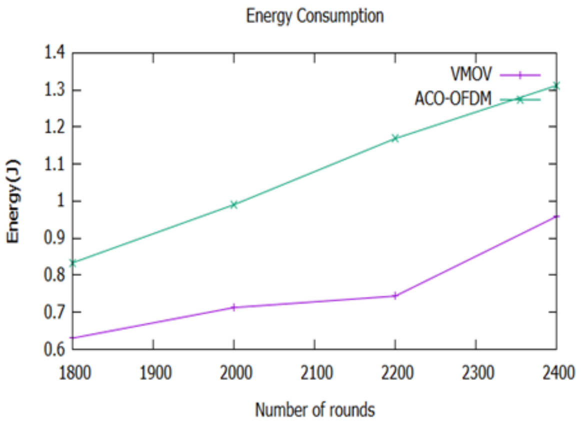

Fig 4: Energy consumption vs Number of rounds

Fig. 3 and Fig. 4 represents the average throughput and energy consumption of both model's performance by varying number of rounds. Hence, the energy consumption and throughput of VMOV is better than ACO-OFDM

CONCLUSION

This paper presented, a Variant MIMI-OFDM VLC based WiMaX system by configuring OFDM and WiMAx technique. The channel resource allocation environment was deployed by adopting MIMI switching status based on the data streaming at transmitters. The proposed VMOV minimize the channel interference and the delay during the signals transmission, based on the simulation results. The proposed VMOV proven better results for different data transmission rates. The performance comparison between fixed and adaptive modulation schemes is also performed, and superiority in terms of BER is shown for the latter

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