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Pilot Based Channel-Estimation 4G LTE OFDM Utilizing Time Space Procedure in Video Transmission

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Abstract: ***Current system for communications utilize wireless for data transmission to exchange the information between associated mobile devices. The researchers are exploring novel methods to use the devices efficiently, faster and accurate. The ever increasing demand for new features by the user is making the industry standards to grow at a faster pace. The parameter like Bit Error Rate (BER) and Signal to Noise Ratio (SNR) are considered to understand the network performance. In this research paper, the transmission of different formats of video over the 4G LTE is carried amongst two systems using Wi-Fi. Different frames having various colour, size, black and white and video of different formats like .avi, mov, mpeg4 videos are transmitted. The frames are transmitted with and without channel. The transmission time and end delay parameters are observed. The performance of LSE algorithm in the OFDM channel is estimated. BER is estimated for low SNR using M-PSK modulation and LS algorithm. The M-PSK& BPSK are compared with each other and M-PSK found to give better result for low SNR with low BER. Rayleigh, Rician& AWGN noise is compared with each other and it is observed that Ricon gives better result. The channel length of 4, 16, 64 is taken to compare the SNR with BER. For low SNR, BER is low with less number of channels.***

Keywords: SNR, BER, Pilot Channel

I. INTRODUCTION

In video transmission over the wireless network, the low Bit Error Rate(BER) with good signal to noise ratio (SNR) is needed so that all the transmitted frames will be received without any loss. Additionally, when sending and receiving through WSN the transmission and delay time is to be analysed.For the large data rates the Orthogonal Division Frequency Multiplexing (OFDM) is used as the developing technology. In Wireless Sensor Network(WSN) the OFDM grounded systems are WiMAX, Wi-Fi, WiBro etc., as well as the developing fourth-generation mobile systems. The OFDM is basically a multi carrier modulation combined, and makes use of innumerable spaced orthogonal sub carriers which are practical for the frequency selective channels along with more information rates [1, 2].

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The OFDM transfers different fast signals concurrently on the rarely identified orthogonal carrier frequencies. The OFDM majorly improves the best use of bandwidth along with robust communications in the middle of disorder and several other interferences.

OFDM has the capacity to direct the data in multiple paths. The rapid data stream gets separated into narrowband data streams, with sub channels. At receiver, information about the channel above which the signal gets transferred is needed. In an OFDM framework like 3.9/4G, WiMAX, Wi-Fi, and WiBro for boosting the estimation of the direct, the identified signals could be inserted within the transferred OFDM image. Later the unique approaches may be associated for assessing the channel using these identified pilots [3].

Performance of BER of AWGN, Rayleigh, Ricon is compared for the video transceiving. The channels are discussed in the following section.

- **Rayleigh Fading**

Basically it's a rational model in the presence of several objects. The transmitted signal is scattered before received by the receiver. In case of adequate scattering the impulse response of the channel has to undergo Gaussian process [4]. For a larger number of paths, by the application of central limit theorem, we can model every path as a circularly symmetric complex Gaussian random variable along with time.[5].

In absence of leading component to the scatter, mean is zero and the phase regularly distributed amongst 360degrees which is Rayleigh distributed.

- **Ricianchannel Fading**

It is a non-deterministic model for the irregularity which follows whenever a signal after transmission gets cancelled on its own.

The signal comes to the receiver by various paths in which any one path is varying. It happens when any one path is stronger than the rest of the path. The Rician distribution describes the gain of amplitude. In the event of non-existence of any path between the OFDM transmitter also with receiver the Rayleigh fading can applied for categorising the Rician fading [6].

By using the two parameter K and Ω Rician fading [7] channel is defined. The K, or the Rice factor, can be defined to be the ratio between the straight path powers with the scattered power paths. The overall power is Ω which is a distribution scaling factor. Without considering the power R at receiver side, then Rice scattered with parameters:

$$V^2 = K/1+K^2 \ \Omega \quad \text{----------(1)}$$

and

$$\sigma^2 = \Omega/2(1+K) \quad \text{----------(2)}$$

If Rice Factor K is 0, the Rician Faded Envelope decreases to Rayleigh faded Envelope.

- **AWGN Channel**

The values at any pair of times for a white Gaussian noise gets distributed identically as well as statistically free with one another. The fading or some additional system parameters are not associated by AWGN channel. During the travelling of the modulated signal in OFDM, the noise is added.

The M-PSK& BPSK are compared. Also Rayleigh, Rician& AWGN noise is compared and found that Ricon give better result, 45 Frames of video is transmitted and received with and without channel, observed transmission time and end-delay. Various video formats like .avi,.mov,.mp4 transmitted and received with and without channel. Graph is plotted for SNR vs BER for the various channel length(eg:4,16,64). For the lower SNR, BER is low with less number of channel [8].

II. RELATED WORK

The author [9] estimate the channel by applying the pilot based method along with spatial variety with several quantity of antennas are used at the side of transmitter and receiver for making better system at different behaviour of the channel. The result found to be better in comparison to the related works. The system employs a multi antenna variety with 4xM and 2xM configurations in which M=receiver antenna number and the modulation scheme used is 32-PSK.This scheme proves to be better BER with higher range of signal power. When the receiver number is improved above the transmitter BER, the signal power execution is improved in comparison to the related work based on pilot supported STBC MISO system.

The performance can be improved using Multiple In Multiple Out architecture than Multiple In Single Output which is used through 32-PSK modulation, and QAM as a substitute of PSK [9].

It is [10] proposed to address the estimation of the channel grounded on time domain channel statistics, with a common model-least square (LS), minimum mean square estimation (MMSE) besides best linear unbiased estimation (BLUE) for slow declining channel. The comparison of the several type of estimation algorithm is carried out and the results obtained after simulation using Mat lab, the difference of BER is analysed. With prior knowledge of channel statistics, the channel estimation in OFDM system can be achieved. Increase in the carrier number increases MMSE exponentially. For higher SNRs the bit error rate is almost constant for MMSE.

The researcher [11] examined the M-array of different PSK modulation methods, the performance of BER is calculated by the multipath Rayleigh fading channel. Compared to the regular modulation techniques M-army modulation methods give improved bandwidth efficiency along with more data rate..When the bits numbers are combined to form the symbol data, it also enhances with the M value increased. The increasing bandwidth efficiency and data rate is advantage for communication system. The rate of error decreases with increasing signal power. The channel type defines the error rate. The higher error rate is given by the multipath fading channel during transmission in comparison to AWGN channel. Wireless channels are generally considered by dissimilar fading channels. In the case of communication by short distance the modulation of higher order is preferred and for the communication of long distance the modulation technique of lower order is preferred.

In order [11]to carry out the reliable communication by means of several channels the modulation technique selection should be based on balance amongst the bit error rate and higher data rate.

The time [12] selectivity and frequency make the wireless channel complex. The estimation of the channel needs to be carried out to eliminate the opposing outcome of multipath fading. By using data symbols channel is estimated in pilot based type. The entropy of channel are used in blind channel type. By combining the data symbol and statistical property the semi blind channel estimation is carried and used for high frequency selection. More data can be used in MIMO systems with few pilot bits.

In mobile[13] wireless technique, to increase the capacity and quality the MIMO and OFDM can be combined. The author discusses about the channel estimation grounded on MIMO-OFDM system training symbols. The channel estimation centred on Recursive Least square (RLS) of MIMO-OFDM, least square and Minimum Mean Square Least mean square (LMS) systems are deliberated. The estimator RLS shows better performance but it is more complex. The MIMO-OFDM shows less BER in comparison to the other systems. RLS performance is largely unaffected by the noise with respect to the channel estimation.

The author[14] reviewed the implementation of estimation of the channel by different algorithms. The inter-carrier interference (ICI) is due to the sub channel orthogonally loss. For a 16-QAM modulation, the LMMSE algorithm performs well in achieving a good estimation. However, when the SNR is high, all four algorithms (LS, MMSE, LMMSE, and Lr-LMMSE) perform similarly. This is not the case for other types of modulation. The LMMSE algorithm is found to be convenient to comb – pilot.

The author[16] discussed two kinds of channel estimation methods (LS & MMSE) that are centred on comb pilot insertion organization in fast fading channels setting containing channel models Rayleigh &Rician. MMSE estimator contains an enhanced performance compared to LS estimator.

III. METHODOLOGY

The research work is related to the transmission of different formats of video over the 4G LTE between two systems using Wi-Fi. The 45 frames of different size of video, color, black and whitevideo, with different format like .avi, .mov, mpeg4 videos is transmitted and received.. The performance of LSE algorithm in the OFDM channel is estimated[15, 17].

Low BER is estimated for low SNR using M-PSK modulation and LS algorithm.

The M-PSK& BPSK are compared with each other and M-PSK found to give better result for low SNR with low BER. Rayleigh, Rician& AWGN noise is compared with each other and it is observed that Ricon gives better result. In total 45 numbers of frames are transmitted and received with and without channel. The parameter transmission time and end-delay are observed. The different formats such as .avi,.mov,.mp4 are tested for same 45 frames with and without channel. The result graph is plotted for SNR vsBER. The channel length of 4, 16, 64 is taken to compare the SNR with BER. For low SNR, BER is low with less number of channels.

In order to transmit the various types of videos through 4G network. Various service providers are used and compared. Transmission delay and the end delay are compared for the various videos using different service providers. The delay is slightly higher in the peak hour in comparison to the non-peak hour.

Up to 100 frames were able to be transmitted through the 4G network without any loss for low SNR with less BER.

System Model for Multi user Uplink and downlink OFDMA

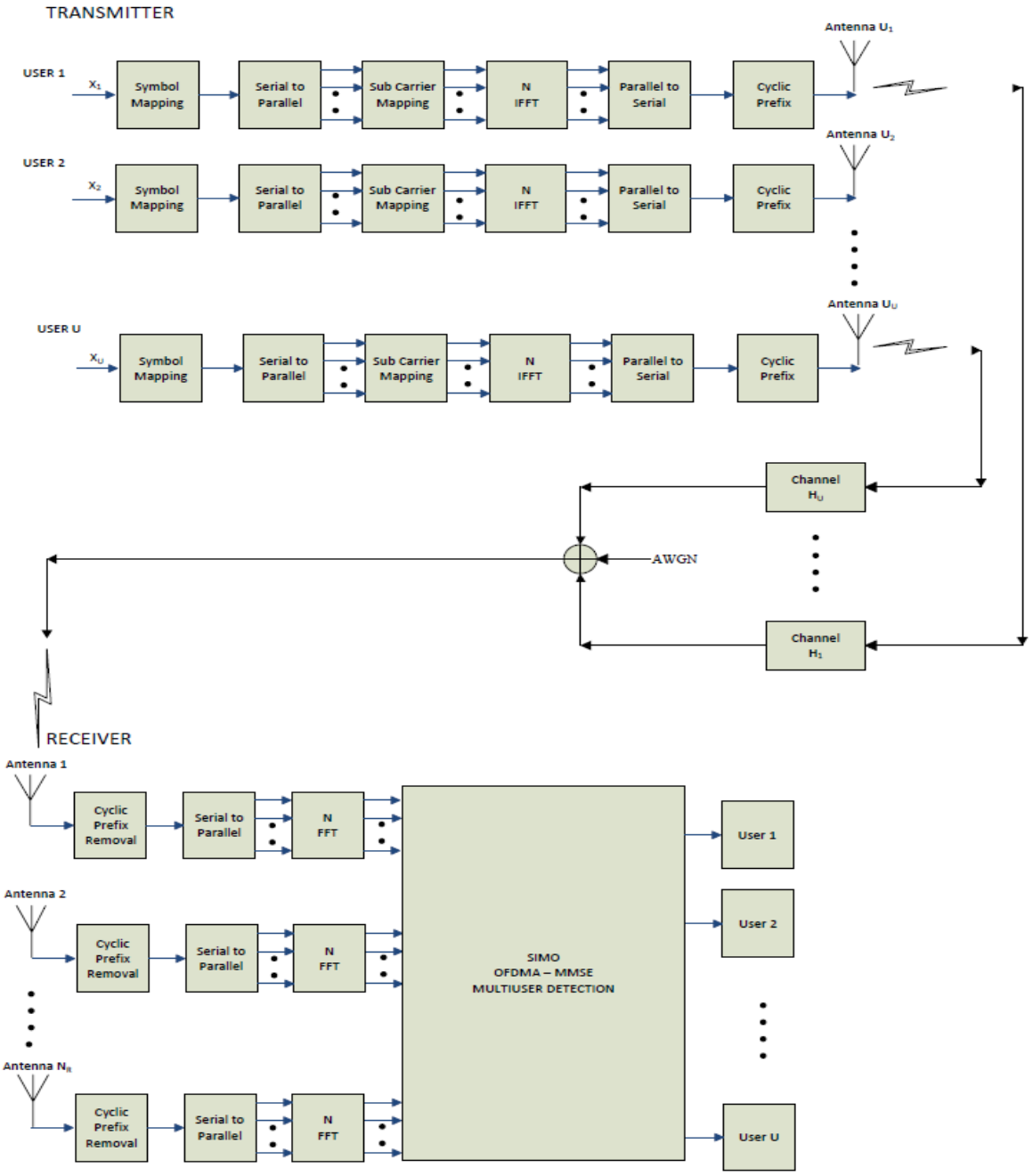

Fig. 1 Detailed Block Diagram of Video Transmission and Receiving

Figure 1 shows detailed block diagram used for video transmission and reception and also 4G LTE wireless is used. The original video is transmitted by each user and each user symbol vector is mapped onto the signal constellation. Then that data is converted into complex parallel bit streams and resulting to the user across subcarriers.

In the figure 1, every bit stream is modulated by the IDFT block on separate subcarrier along with orthogonal frequencies. IDFT block joins both in the time domain signal to constitute the original OFDM symbol. It is achieved by the multiplication of IDFT matrix $F^{-1}$with the bit loaded bit-stream.

IV. Results

The result obtained after conducting the simulation is discussed in this section.

The GUI windows at Transmission and receiving side are shown in the figures. Video is transmitted using 4G from one end and received at other end. Figure2 shows GUI window at transmission and receiving window where IP address of two different users with same service provider is entered, also port number, transmitted video of 45 frames of different format and received without any loss of frames. Transmission time and end delay is observed at different time in a day, using different service providers and observed the output and graph is plotted.

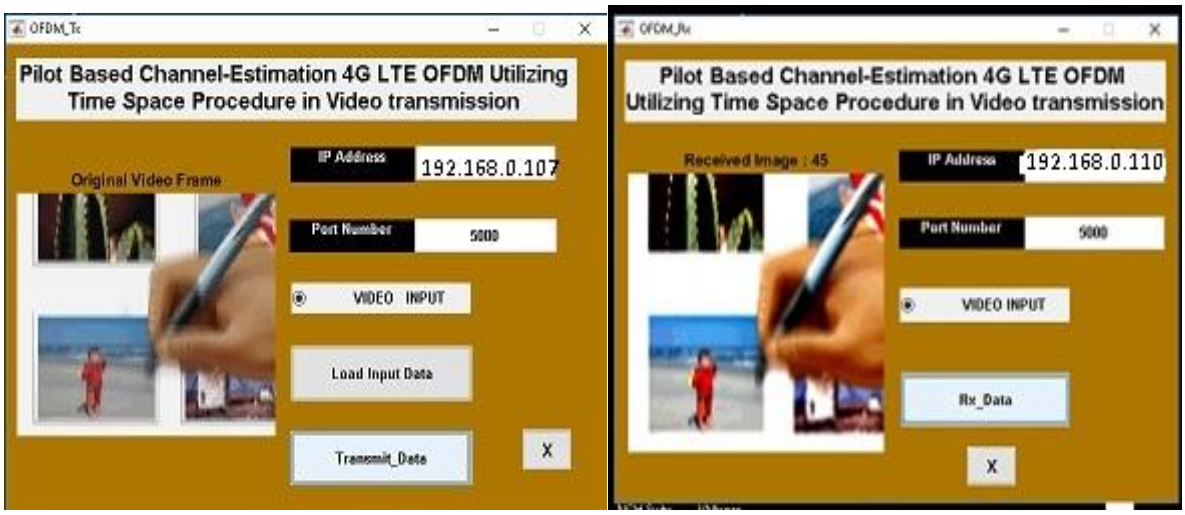

Fig. 2 GUI window at Transmission and receiving end

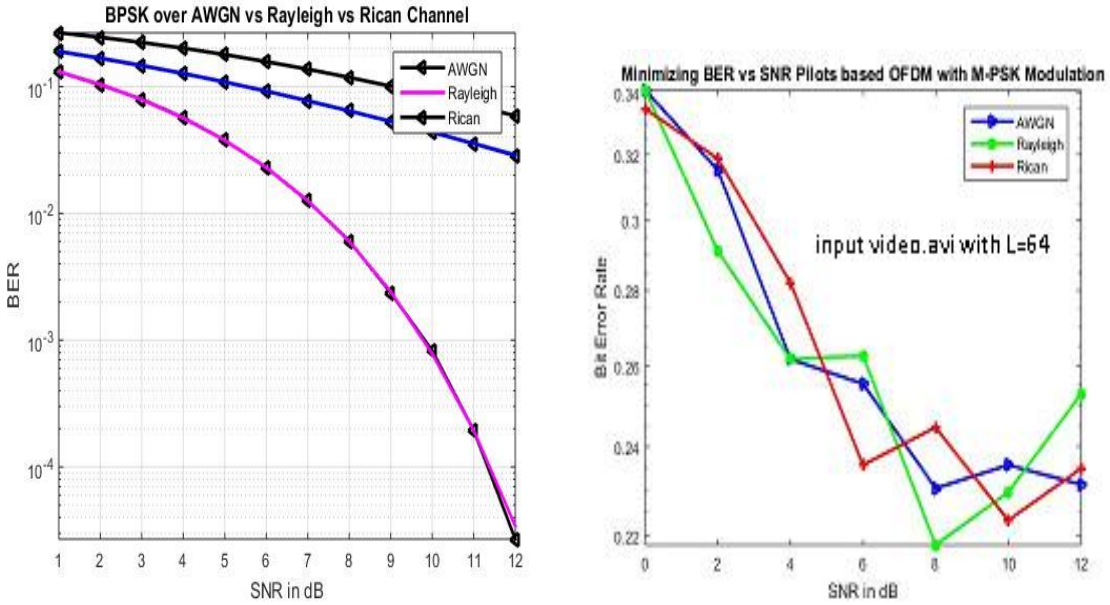

Fig. 3(a) BPSK and Fig3(b). MPSK over AWGN, Rayleigh, Ricon for Input Video

In figure3a, BPSK over AWGN, Rayleigh, Ricon for the Input Video.avi format is compared which shows BER is more for the same SNR compared to M-PSK shown in Figure4. Figure 3b shows when channel length is increased to L=64 compared to L=16, BER is more for the given SNR.

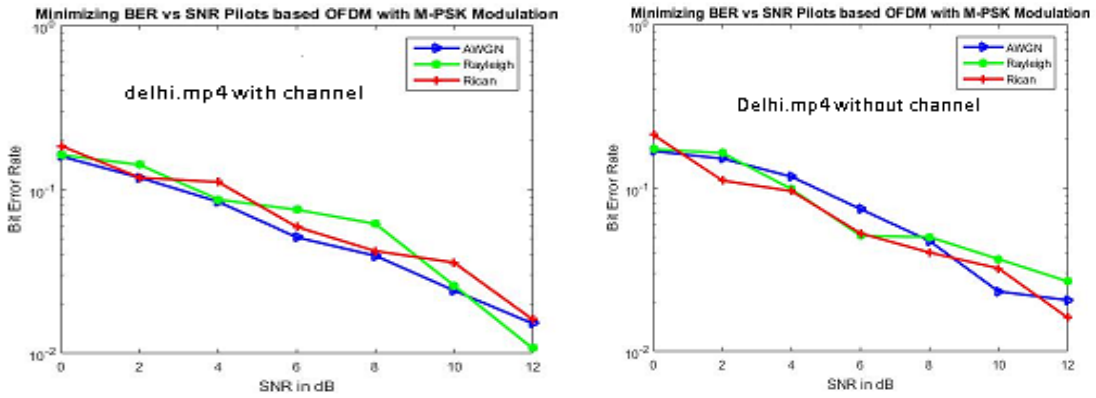

Fig. 4 M-PSK over AWGN, Rayleigh, Ricon for delhi.mp4 video of L=16 with and without channel

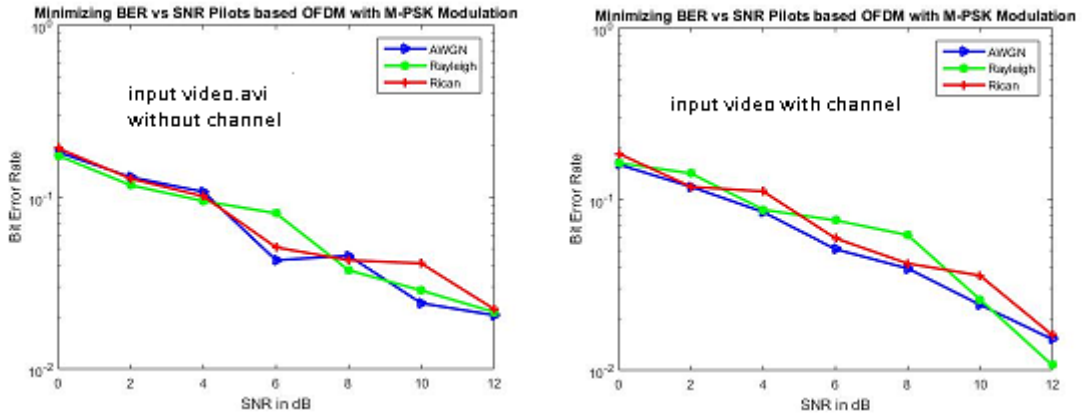

Fig. 5 M-PSK over AWGN, Rayleigh, Ricon for input video.avi of L=16 with and without channel.

Figure 4 and 5 shows two different video format which compares with and without channel and also AWGN, Rayleigh, Ricon channel fadindsare compared. BER is more with channel than without channel for the same SNR.

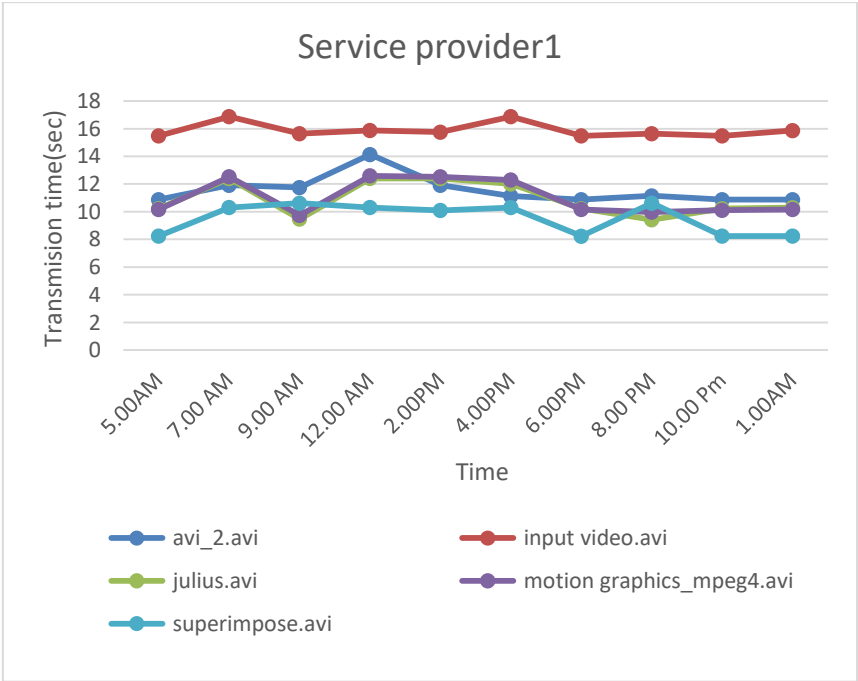

Fig. 6 Time vs Transmission time of all five videos using service provider1

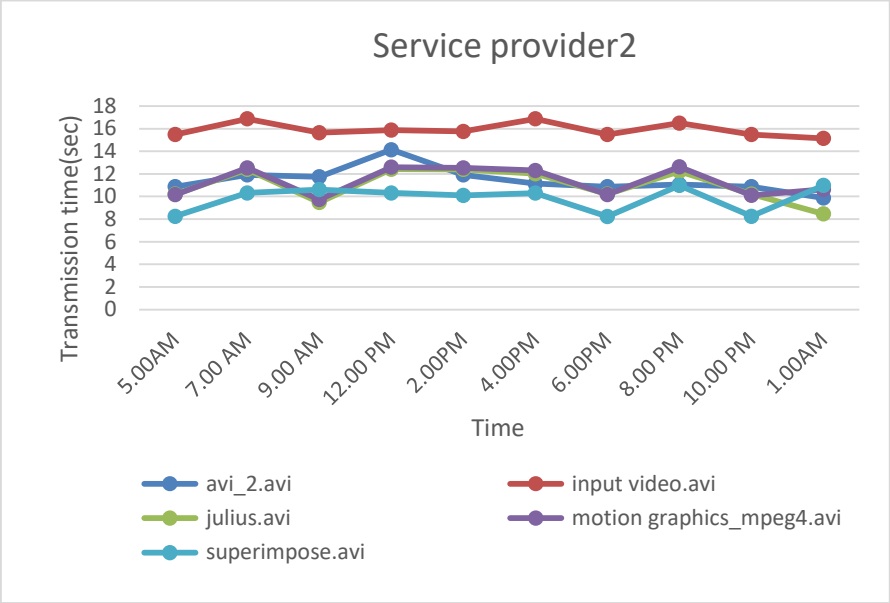

Fig. 7 Time vs Transmission time of all five videos using service provider2

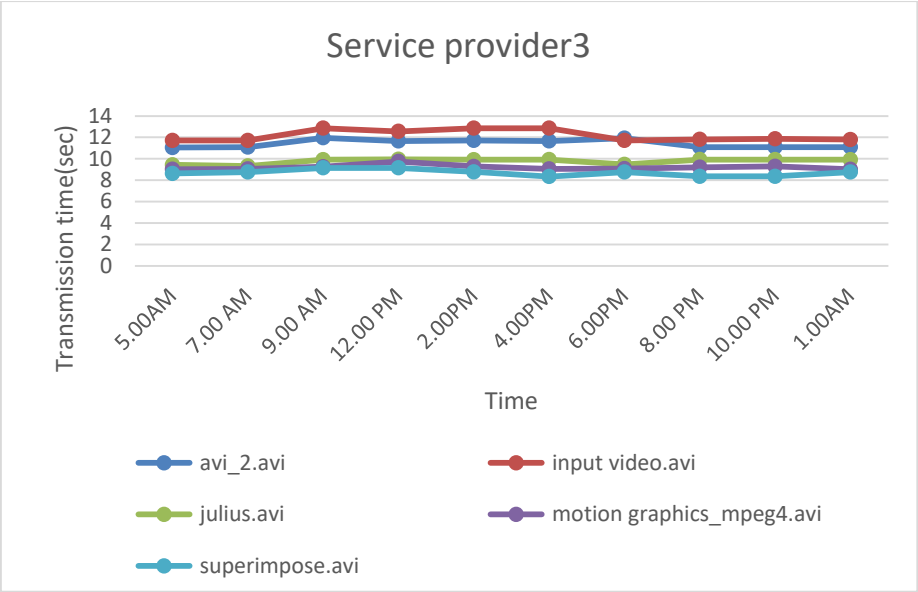

Fig. 8 Time vs Transmission time of all five videos using service provider3

Figure 6, 7, 8 shows transmission time at different time that is early morning, middle of the day and peak hours and late night, using three different service providers for the various videos tested. Different videos of different format are analysed video avi.avi has less change as background is with less color variations compared to inputvideo.avi where background is different for every frame. During peak hours like. During peak hours like morning and evening the transmission and end delay is little more due to traffic congestion.

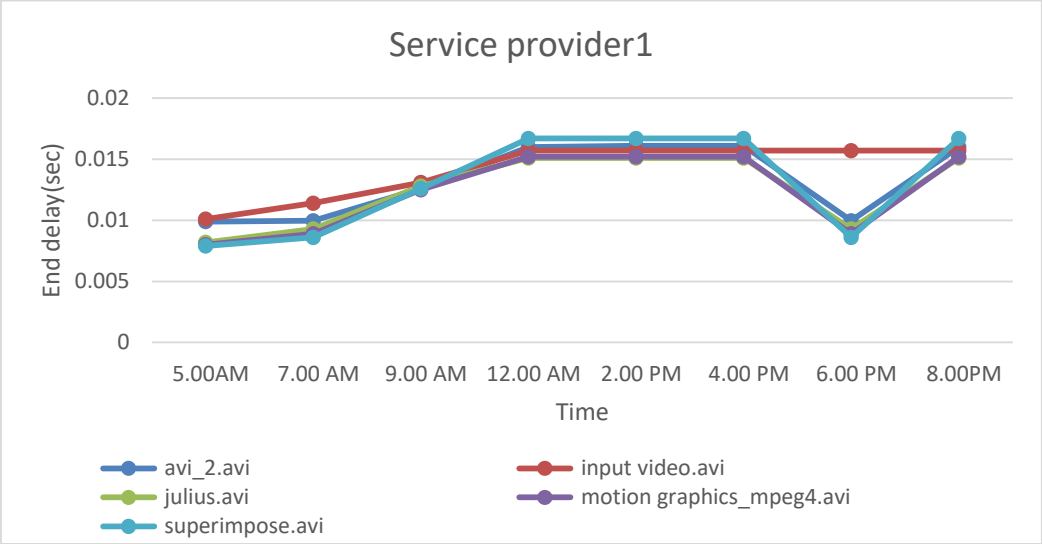

Fig. 9 Time vs End Delay Time of all five videos using service provider1

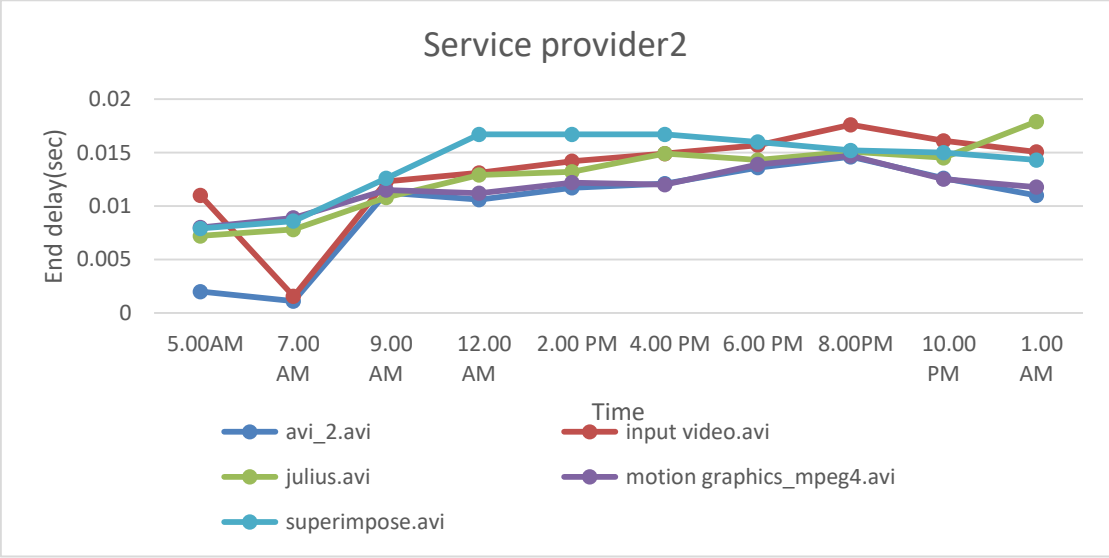

Fig. 10 Time vs End Delay Time of all five videos using service provider 2

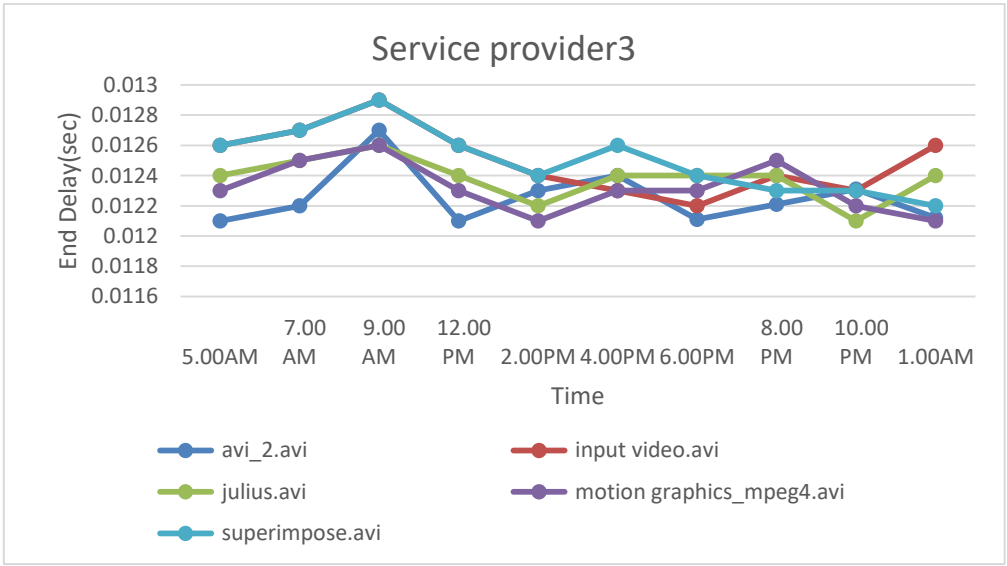

Fig. 11 Time vs End Delay Time of all five videos using service provider3

Figure 9, 10, 11.shows end delay s Time for various video using three different service providers. There is not much difference between the three service providers. It depend on the video colour, quality and the background.

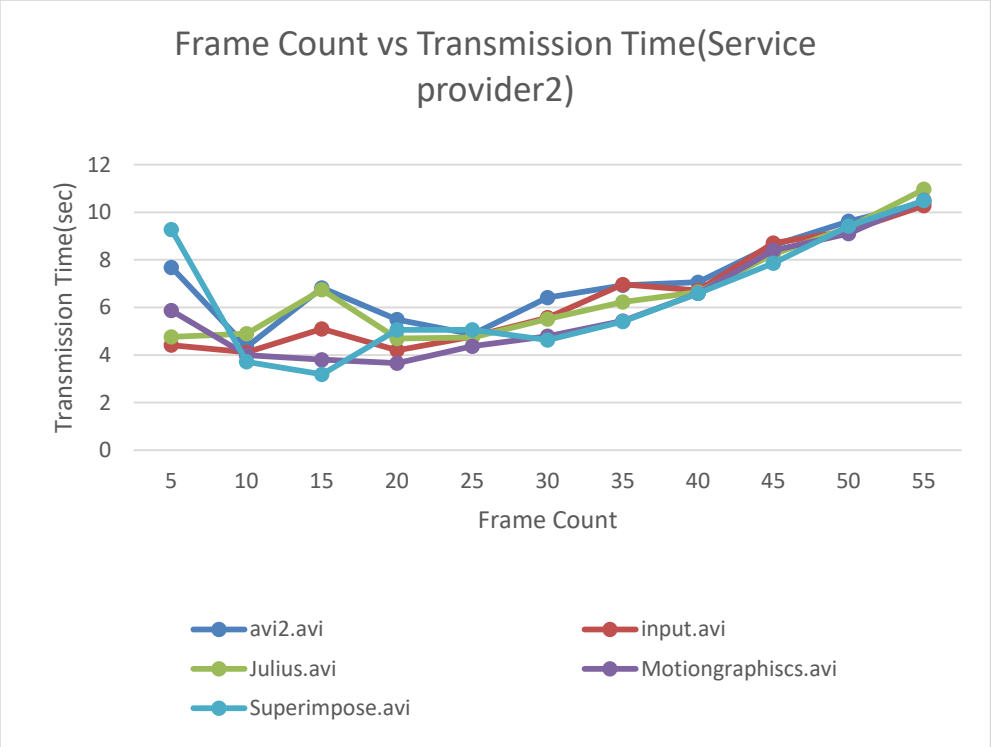

Fig. 12 Frame count vs Transmission time for five video using service provider2

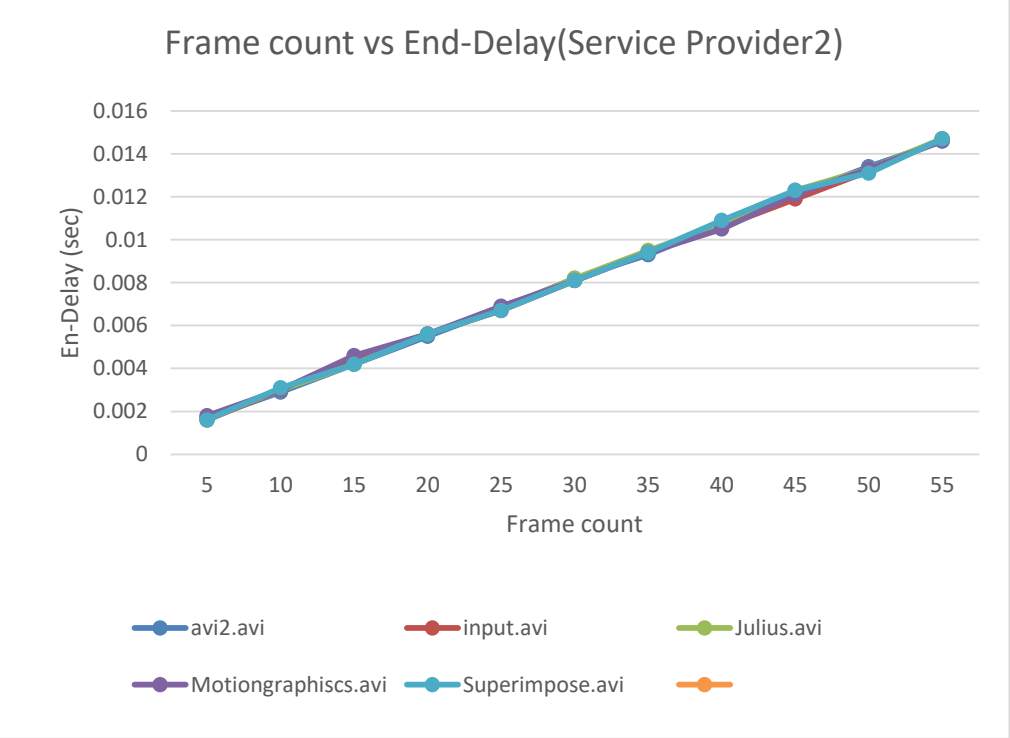

Fig. 13 Frame count vs End Delay time for five video using service provider 2

Figure 12, 13 shows as the frame count increases transmission and end delay increases.100 frames are transmitted without much delay and also no loss of any frames.

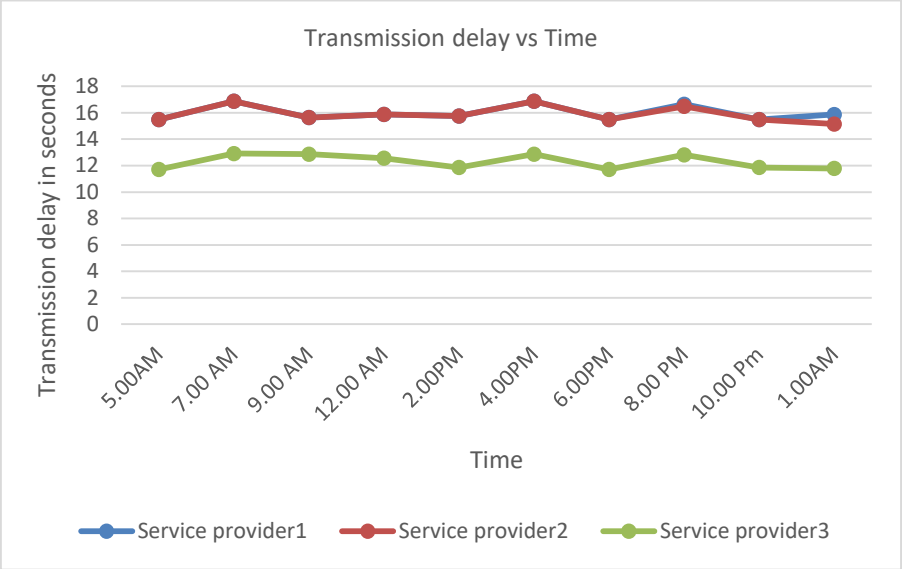

Fig. 14 Time vs Transmission time of Input Video.avi using all three service provider

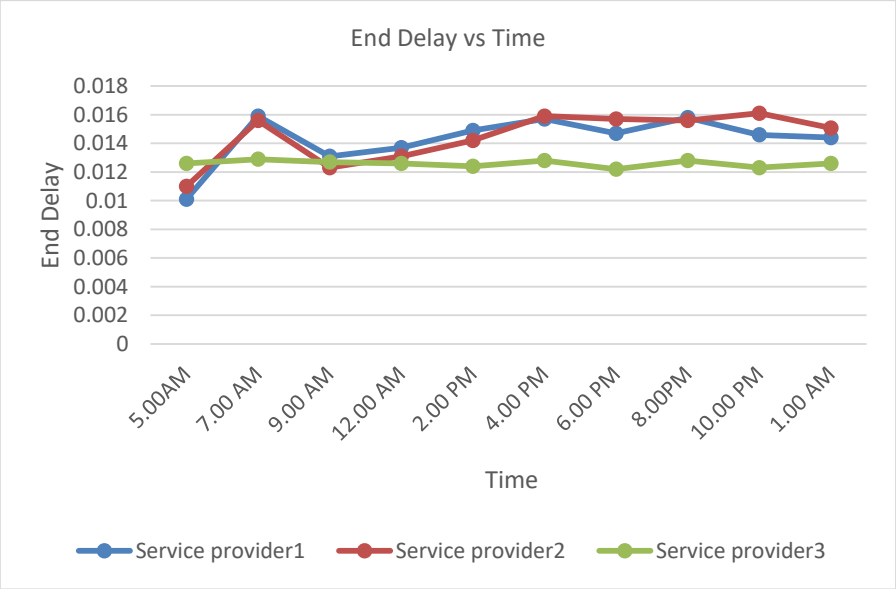

Fig. 15 Time vs End Delay time of Input Video.avi using all three service provider

Figure 14,15 shows for a video input video.avi transmitted using three service providers. Service provider 3 is giving less transmission time and also end delay at the receiving end.

At the peak time like transmission and receiving delay is little more due to the traffic congestion.

Table. 1 Transmission Time and End Delay Time

Sl.No.	Video	Transmission Time(sec)		End Delay Time(sec)	
		Without Channel	With Channel	Without Channel	With Channel
1	Input Video.avi	6.79	15.14	0.0796	0.1285
2	avi.avi	6.13	9.11	0.0775	0.1294
3	julius.avi	6.56	11.5	0.0788	0.632
4	motor.mov	6.53	10.18	0.083	0.1202
5	delhi.mp4	7.42	16.88	0.0995	0.175

Table 1 shows video transmission using with channel and without channel for the various videos using one of the service provider, transmission and end delay time is more for with channel in compared to without channel.

V. CONCLUSION

In this approach, the investigation of the framework with spatial decent variety engineering utilized presume that the methodology gives satisfactory result with framework. The 2xM, 4xM, 8xM setup giving greater BER for big flag control for recipients (M) with less or equivalent to value of transmitters. However, when collectors values is expanded than the transmitters BER for all the flag powers perform efficiently than the current work which was pilot helped STBC MISO framework. The MIMO design shows the execution is superior to anything MISO utilized for 64-PSK regulation. It tends to be all the more advantages with proficient balance system like QAM rather than PSK, and the computerized separating or recognition's procedures is the most satisfactory framework.

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