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Mitigate Bit error rate in OFDM using CMB-STFC for wireless communication

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Abstract— **Despite the fact that cooperative communication has been seriously analyzed for general wireless systems, such as mobile ad-hoc networks, it has been almost explored on account of Space-Time frequency multiplexing and De-multiplexing. MIMO decoders have been conferred that can surpass Orthogonal Frequency Division Multiplexing (OFDM) in intensely frequency-selective channels in-forms of coded frame error rate (FER). This paper proposes a system of cooperative communication in such systems where nodes are equipped with one antenna. Here we configure STFC-MDX (space-time-frequency coding method with multiplexing de-multiplexing) with cooperative communication for MIMO OFDM systems. The simulation outcome shows that STFC-MDX with cooperative communication may, now and again, give preferable error performance over non-cooperative communication without additional transmission power. The performance of CMB-STFC is better than STFC-MDX even without channel state information.**

Keywords— OFDM, Fading Channels, Space-Time Frequency, QAM, STFC-MDX, Cooperative comm., CMB-STFC

I. INTRODUCTION

Combination of the rising innovations Multiband OFDM Ultra-Wideband (MB-OFDM UWB) [1], Multiple Input Multiple Output (MIMO) [2], [3], and Space-Time Codes (STC) [4], [5], [6] may give a critical change as most extreme achievable communication event, bit error performance, system capacity, data rate, or a combined form of those. While the combination of OFDM, MIMO, and STCs, which is attributed to as Space-Time-Frequency Coded MIMO-OFDM (STFC-MIMO-OFDM), has been all around inspected in the literature [7], [8], [9], the combination of MB-OFDM UWB, MIMO, and STC has been inadequately analyzed with only few distributed papers, such as [10], [11].

There are two primary contrasts between channel characteristics in ordinary OFDM frameworks and in MB-OFDM UWB ones. First, channels in the last are substantially more dispersive than those in the previous, with the average number of multipath in some channel models achieving exactly thousands [12]. Second, channel coefficients in the former are usually considered to be Rayleigh distributed, while those in the last are log- ordinarily appropriated [12]. In this manner, the frameworks joining MB-OFDM UWB, MIMO, and STCs must be more particularly analyzed; however there exist few similarities between those frameworks and the conventional STFC-MIMOOFDM ones.

Generally, the most popular technique to combat fading has been the exploitation of diversity. Space-time (ST) coding has been proved effective in combating fading, and enhancing data rates; see e.g., [23], [25], and references therein. Exploiting the presence of spatial diversity offered by various transmit as well as get receive antennas, ST coding depends on concurrent coding across space and time to accomplish diversity gain winds up accessible when recurrence selectivity is available. Two-run of some cases of ST codes are ST trellis codes [25] and ST block codes [24], [23]. In ST coding, the most extreme achievable diversity advantage is equivalent to the result of the quantity of transmitting and receiving antennas; therefore, it is constrained by the size and cost a system can afford. The latter motives for exploitation of extra diversity dimensions like multipath diversity. Multipath diversity becomes available when frequency selectivity is present, which is the typical situation for broadband wireless channels [23]. Among them, [22] and [17] rely on combining ST codes with redundant or non-redundant linear pre-coders. Maximum diversity gain is achieved in [22] and [17] at the expense of bandwidth efficiency [22] or increased decoding complexity [22], [17]. On the other hand, [23], [24], [21], [23], and [22] are based on space-frequency (SF) coding, which adds up to at the same time coding over space and frequency. In [21], an SF code is proposed to achieve maximum diversity gain at the expense of bandwidth efficiency. Additionally, issues relating to maximizing the coding increase of ST-coded transmissions over particular channels presently can't seem to be addressed. Focusing on multi-antenna orthogonal frequency-division multiplexing (OFDM) transmissions through frequency-particular Rayleigh fading channels, this paper pursues a novel way: joint space-time-frequency (STF) coding over space, time, and recurrence. Resorting to sub-channel gathering [22], [23], [20] and by choosing legitimate system parameters, we initially isolate the arrangement of for the most part associated OFDM sub-channels into groups of sub-channels.

II. SPACE-TIME FREQUENCY CODED OFDM SYSTEM

We consider an STF-coded MIMO-OFDM system $Mt$for transmitting antennas; receive antennas and N subcarriers. Assume that the particular selective fading channels between each pair of transmitting and receiving antennas have L autonomous delay paths and the similar power delay profile. The MIMO channel is thought to be constant over each OFDM block period, however, it may fluctuate starting with one OFDM block to another. The Space-Time Frequency (STF) coding scheme [26] [28] [4] [27] is utilized to enhance the system execution by exploiting the advantage of diversity in space, time and frequency inherence in the MIMO-OFDM system. In the STF coded OFDM system, the info information arrangement is convolution encoded and interleaved by a block interleaver. After the image mapping is performed by the modulator, the tones enter the STF encoder and then are connected to OFDM transmitters of the different antennas. Each antenna of the OFDM system comprises of M subcarriers. The M tones at every antenna are gone through Inverse Fast Fourier Transform blocks (IFFT) with a cyclic prefix added to each of the signal components. To stay away from the inter-symbol interference, the monitor time is been longer than the channel delay spread. The resultant signal is frequency up changed over to the coveted transmission frequency and transmitted through the remote channel. The code rate of the STF encoder is / where the encoder takes p sequences of M tones and outputs n groupings of M tones.

A. Space-time-frequency coded Multiplexing De-multiplexing

STFC-MDX system is not essential channel estimation symbols for transmission is depicted in Figure.1, two novel blocks are introduced one is multiplexing and demultiplexing. These two novel blocks are transparent if the constant envelop modulation schemes are used, but in DCM scheme the novel blocks are not transparent. Multiplexing is the procedure in which data streams, originating from various sources, are consolidated and transmitted over a solitary data channel. It is done by equipment called Multiplexer. It is set at the transmitting end of the correspondence interface. At the receiving end, the composite signal is isolated by equipment called Demultiplexer. The Demultiplexer performs the switch procedure for multiplexing and routes the isolated signals their corresponding destination.

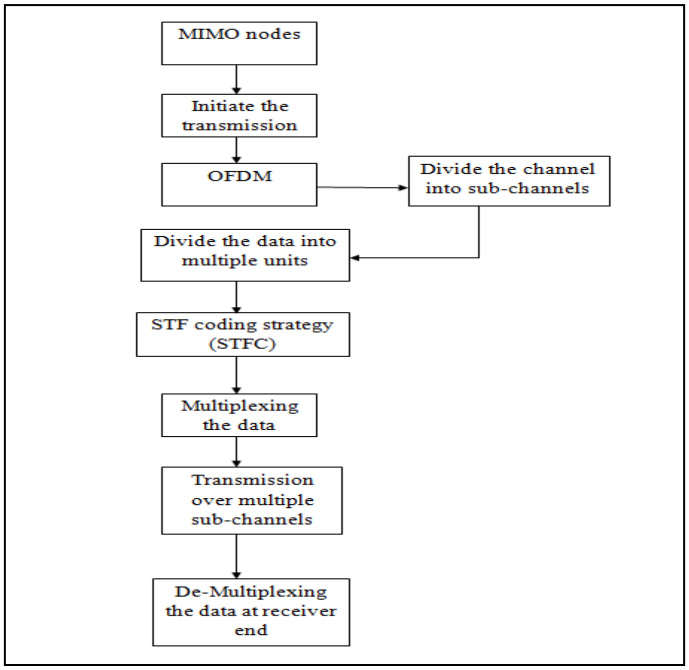

Figure1. STFC-MDX Flowchart

The process of the proposed system starts from MIMO nodes as shown in Figure.1. Here initial transmission occurs then goes for OFDM system, which divides the channels into sub-channels. Then considers this data and divides into multiple units. In this particularly space-time-frequency coding is applicable and then multiplexing of the data is done. Here transmission over multiple sub-channels is based on system performance. At the receiving side of system, de-multiplexing of the data and other processes improve the system performance.

B. Comparison with existing schemes

In this section, we compare the proposed scheme with several existing schemes. For ease of comparison, we only consider the case of full cooperation between nodes in all schemes. Simplified process of Neeraj Shrivastava et. Al's coding scheme [29], Maximilian Matthe et. al.'s GFDM (Generalized Frequency Division Multiplexing) scheme [30], these are distributed space-time coding schemes. In STF-TC, we denote a turbo convolution code as TC (n, k, K), where n is the number of output coded bits, k is the number of input bits and K is the constraint length. The information bits are then encoded by channel coding schemes. Different modulation schemes are employed, namely Binary Phase Keying (BPSK), Quadrature Phase Shift Keying (Q incorporates PSK). In GFDM, a promising non-orthogonal waveform includes 3-dimensional obstruction which was appeared to be beneficial regarding exploiting time, frequency and space diversity for enhanced execution while iterative receivers have been presented to attain this gain. In GSTF [26], empowers improvement of STF coding within inside GSTF system. They determine outline criteria for STF coding and adventure before existed ST coding techniques to construct both STF block and trellis code. In [31], DSTFC (Differential Space-Time-Frequency Code) for multiband-OFDM ultra-WB communications expands the efficiency of expands. This system does not require channel state data (CSD).

The CDMA approach [32] also needs only one frequency band, but it requires two spreading sequences for two nodes. Each transmission period includes three time slots and more diversity is only provided for the information transmitted in the second time slots, instead of the whole transmitted signal in each transmission period. As a result, diversity and thus error performance have to be sacrificed. The distributed space-time coding scheme [33] is the mixed TDMA and FDMA approach, along these lines as yet requiring two frequency bands. Additionally, the system resources cannot be completely dispensed to nodes and their arrangements of relays since the transmission and reception in TDMA cannot be concurrent. More importantly, if there is only single potential hand-off for each node *A* and *B*, the circulated space-time coding scheme reduces to the repetition-based scheme. Consequently, the advantage of space-time codes over the repetition-based scheme (higher diversity order for larger spectral efficiencies [32]) vanishes in this case. This is because node *A* (or *B*) itself does not involve in the space-time code, but only its relays do. In this reduced case, the conveyed space-time coding scheme not just accomplishes the comparable advantage as in the redundancy-based scheme, but also is more complicated for implementation than the latter.

The proposed scheme is maybe the more straightforward collaboration one for application than the previously mentioned schemes, which is fundamental for ease frameworks such as CMB-STFC ones. The transmission and gathering at nodes are concurrent thanks to the STFC approach, thus full system resources are allocated for cooperation between nodes. In addition, more diversity is not provided for only a part of the transmitted information, but for the whole transmitted information. These two advantages have never been achieved in the previous schemes. The advantages of space-time codes (over the repetition-based scheme) in the proposed scheme are still retained even in the case of one existing relay for each node, that is not the case for the distributed space-time coding scheme in [33] since the source nodes themselves involved in the generation of space-time codes.

III. HYBRID ALGORITHM

In our model, two nodes are paired to cooperate with one another. The issue of how to decide which nodes to be paired with each other is out of extent of this paper. At the first schedule slot, node *A* communicates its symbol $\overline{s_1}$ to its partner (node *B*) and the destination node *D*. At the same time, node *B* broadcasts its symbol $\overline{s_2}$ to its partner (node *A*) and the destination node *D*. In the process of receiving their partner's symbol, nodes *A*, and *B* decode the partner's symbol. We indicate the decoded symbols at nodes *A* and *B* to be $\overline{\acute{s}_2}$ and $\overline{\acute{s}_1}$ individually. At that point, two nodes retransmit the symbols to the destination in the form of $-\overline{\acute{s}_2^*}$ and $\overline{\acute{s}_1^*}$, respectively, during the 2nd time slot. The procedure proceeds until all data are transmitted. This proposed scheme is thus referred to as decode-and-forward scheme.

Here our proposed system considers the communication in OFDM system and checks all nodes share the data based on criteria. In this paper, we set the cooperative communication with demultiplexing the data process. The system says source and destination symbols, whether it's equal or not and before, share the data broadcasting based on key symbols. Figure 2 indicates our proposed system. From channel dividing process to data de-multiplexing, data should be shared based on partner node. In our model, two nodes are paired to cooperate with one another. At the availability, node A communicates its symbol to its partner node B and the destination node D. At the same time, node B broadcasts its symbol to its partner node A and the destination node D. After receiving their partner's symbol, nodes A, and B decode the partner's symbol. Then these two nodes retransmit the symbols to the destination during the 2nd time slot.

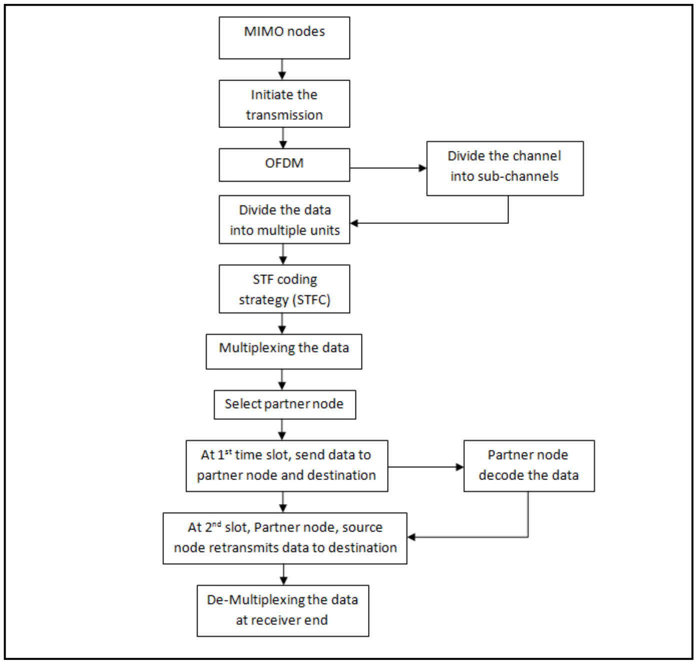

Figure2: Flowchart of CMB-STFC

IV. RESULT AND ANALYSIS

The simulation process starts with the network process in OFDM system. Here a MIMO node indicates how to request for a channel and to share the data in possible ways using proposed methodology. The process of simulation begins with the parameters, library files and object files. The simulation was carried out in a network simulator (NS2). By using AOMDV protocol, the comparison was done between CMB-STFC, STFC-MDX, and STFC.

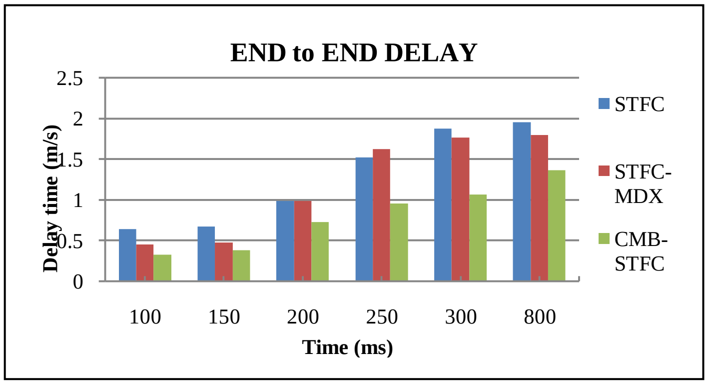

Figure 3: Routing Delay

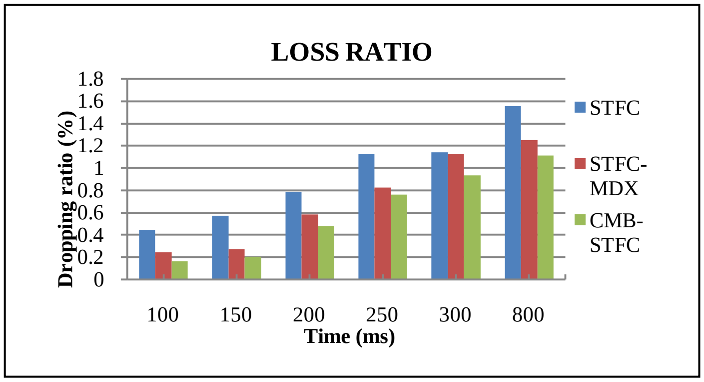

Figure4: Loss ratio in network

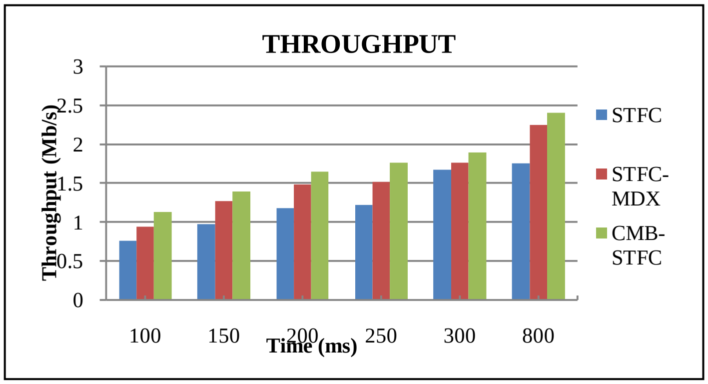

Figure5: Network performance

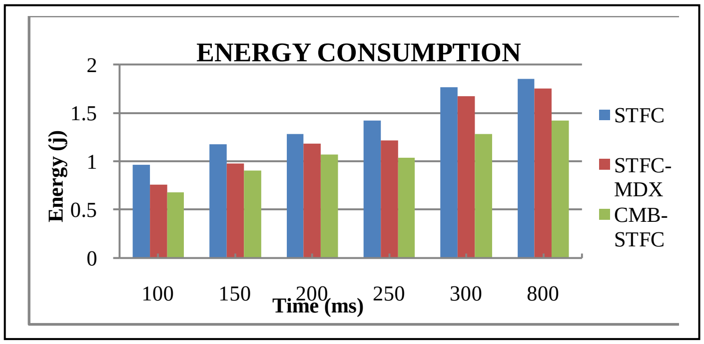

Figure6: Network lifetime

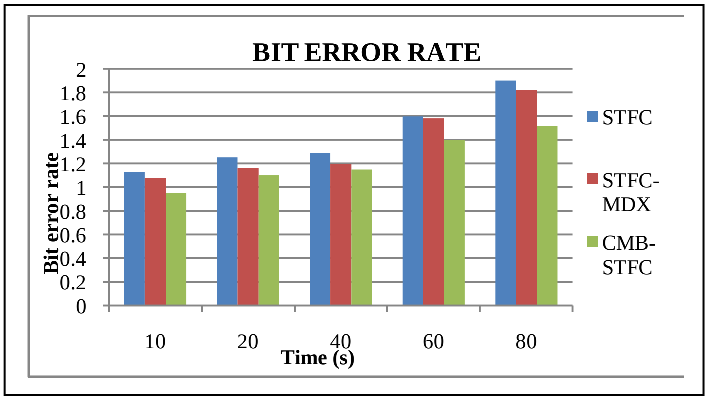

Figure 7: Bit error rate

The end2end delay is shown in figure 3; it shows the simulation time versus delay. The performance of CMB-STFC method improves delay time it means to decrease the delay between communications nodes compare to STFC-MDX and STFC. Dropping ratio of the network is shown in Figure 4; it is drawn between simulation times versus dropping packets. In this graph, the comparison between the proposed method with STFC-MDX and STFC approaches. Figure 5 shows and represents throughput and it shows a simulation time versus throughput. The performance of CMB-STFC method improves the throughput compared to STFC-MDX and STFC. Figure 6 shows and represents energy consumption and it shows a simulation time versus energy. The performance of CMB-STFC method improves energy values compare to STFC-MDX and STFC. Figure 7 represents Bit error rate. Here the graph shows the complexity of the network and it indicates error rate of the packet flow. In this graph, the packets are delivered without any errors but compare to existing approaches our proposed system is better.

The network process executed based on some parameters. Table 1 show that different parameters utilized as a part of our simulation environment. Here transmission, traffic and routing these are depending on different protocols. For example, 20 nodes network we can be considered so here we set the interfaces for more transmissions occur and applicable wise 60 nodes network environment. In this, we used TCP for transmission during the period of network point and measuring traffic based on FTP protocol. We setup channel data rate, simulation time of network, the area of the network, speed of processing and radio range throughout the network. Here network routing based on AOMDV (Ad-hoc On-Demand Multiple Path Distance Vector). This protocol helps for routing level and whole transmission process depends on this.

Table1: Simulation Table

PARAMETER	VALUE
Application traffic	FTP
Transmission protocol	TCP
Transmission rate	20 packets/ms
Radio range	250m
Packet size	1024 bytes
Channel data rate	10Mbps
Maximum speed	30m/s
Simulation time	8000ms
Number of nodes	20
Number of interfaces	3
Area of network	500x500
Methods	STFC,STFC-MDX,CMB-STFC
Routing protocol	AOMDV

V. CONCLUSION

This paper has presented the framework for cooperative communication in STFC-OFDM systems. Various other tasks must be done to fully examine the topic. Therefore, our further examinations would be the thought of the defective synchronization between nodes, the node-pairing mechanism, and the transmission calculation on account of at least one connection between nodes being corrupted. In this, our proposed framework supports multiple communications between the source and destination and it is integrated for more signals in single transmission range. We examined the results of proposed system compare to existing STFC-MDX, STFC-TC, GSTF and DSTFC so here proposed system is better than existing schemes. We have used NS-2 simulation tool and executed the process of the network. In this paper, we have calculated bit error rate, throughput, delay, loss ratio and energy consumption, which show our system is efficient.

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