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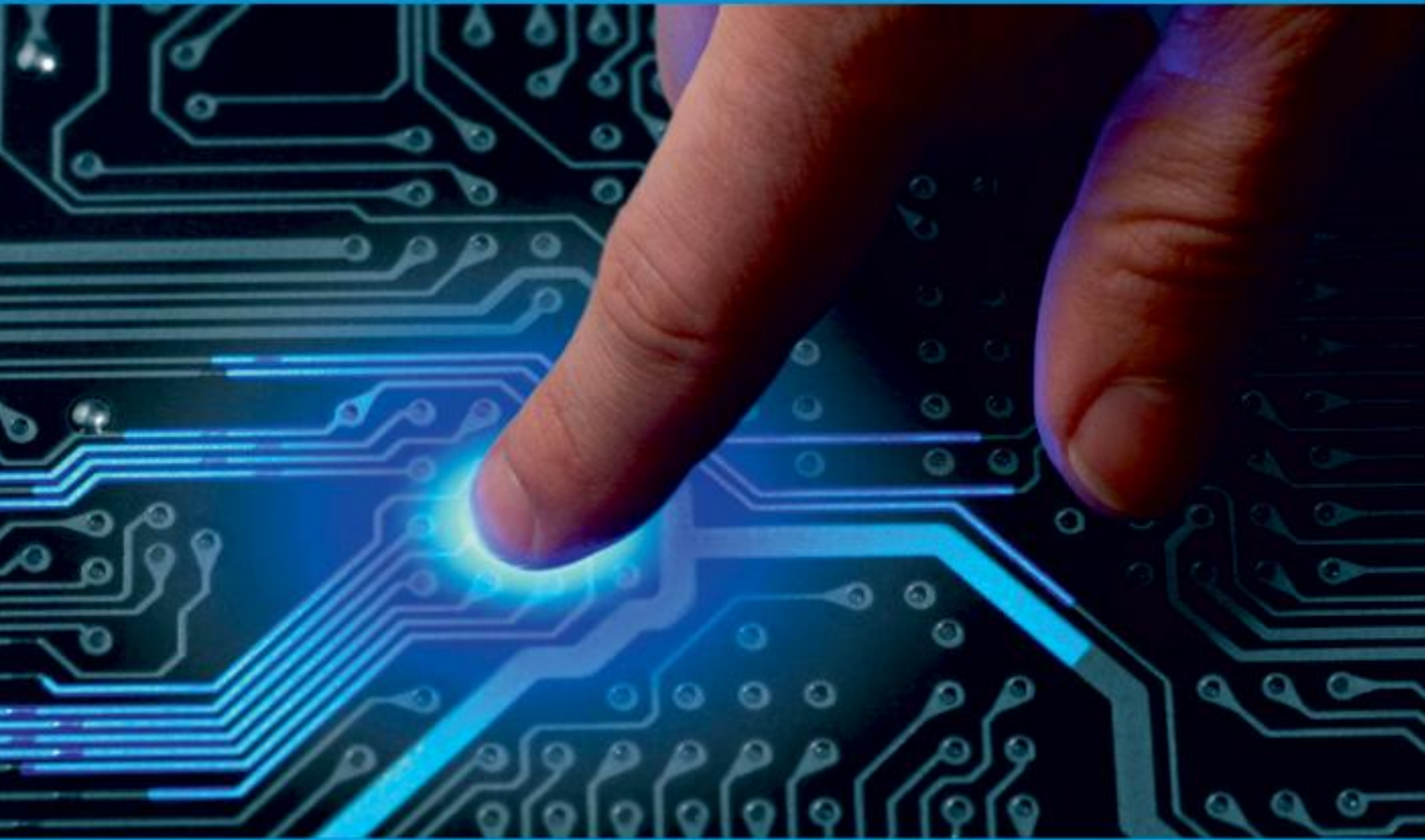

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Implementation of High Efficiency Video Coding

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ABSTRACT: Digital Communication systems i.e. Transmissions of video, data transmissions through satellite open the technology to a wide variety of applications with its large range and high transmission rate. However, to compete with other existing digital communication system that has higher transmission rate, the error rate should be as low as possible. Seeing the present status of traditional digital communication system, this paper enhances the present status of digital communication system along with modeling of suitable wireless channels i.e. Additive white Gaussian noise (AWGN) and modulation techniques to control the bit error rate (BER) of the system. Along with the variations of different channel parameters, the structure compatible to practical scenario can also be implemented through this modeling using antenna diversity principles to control the bit error rate (BER) of the system. As a whole the simulation results of this work will enable the researchers to understand the concept of digital Communication system modeling with the finest selection of various types of wireless channels, modulations schemes and Forward error correction (FEC) techniques under appropriate circumstances.

KEYWORDS*:* Mat lab, Forward error correction, channel coding, Modulation, Mapping, Interleaver

I.INTRODUCTION

Firstly we consider a video signal generated using a capturing device. The camera scans the frame line by line. After that the signal is digitized using a digitizer. The Common Intermediate Format is the most commonly used digital frame format. Sampling and Quantizing of video signal is done through digitizer. The frame is generated at a rate of 30 frames per second.

Prediction (inter/intra), Discrete transform, Quantization parameters, Data Scanning and Entropy source coding are the technologies used in mainstream video for efficient coding.

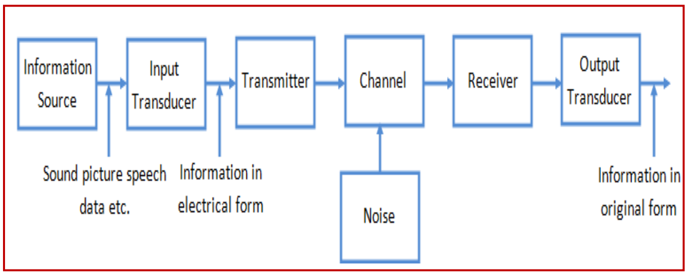

Fig.1: Digital communication system

In comparison with other digital video communication systems, which are sensitive to delay and cannot make use of retransmission efficiently does not ensure free delivery of bit stream. They are more subjected to channel noise and produce the streams that cannot be decoded. Hence, to implement a successful video communication system which transmits the bit stream even in the presence of errors we require a careful design of the system and its subsystems. The

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block diagram of a video communication system is Fig. 1 employing video compression using forward error correction.

The source video is compressed using video compression scheme and packetized. The video stream is passed to the error correction coding technique to reduce the error in bit stream. The redundant bits are added at the encoder side for the receiver to detect the errors at the decoder. At the receiver side, the redundant bits are omitted and source video is reconstructed efficiently.

Generally, a compressed digital video is considered more vulnerable to transmission errors, due to the use of entropy coding. A single error in bit is enough to damage the entire block or set of blocks.

II.RELATED WORK

H.265 vs H.264: When compared with H.264, H.265 can reduce up to 50% bit storage by encoding video stream at the transmitter at a bit rate as low as possible while managing the quality level of video as shown in Fig. 2.

H.265 vs VP9: VP9 is an open platform for free video encoding. This format was developed by Google. It maintains higher competition level with High Efficiency Video Coding (H.265). Both coding schemes decreases the bitrate and improves the efficiency of compression ratio. However H.265 is better than VP9 in terms of coding efficiency and error resilience tools.

H.265 vs AV1: AV1 is an open run platform for free video encoding. It is designed for the transmission of video over the network terminal. Examples like Amazon, WhatsApp and YouTube etc. are using AV1 to compress information streaming contents.

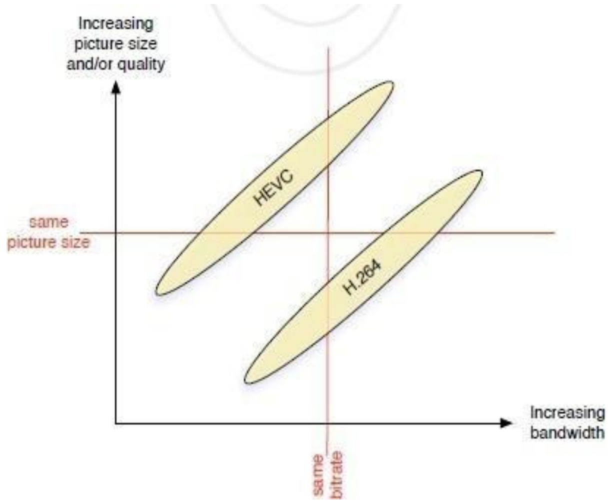

Fig. 2: The potential gain of HEVC vs H.264(nottoscale).

II.FORWARD ERRORCORRECTION

Forward error correction (FEC)is an error correction technique to detect and correct a certain number of errors in data transmitted which does not require retransmission.

Here, in this technique the redundant data bits are passed through FEC encoder and encodes to a code word. The same code word passes through FEC decoder at the receiver side to obtain the data bits as shown in Fig. 4.

At the received end, the receiverpackets are FEC codedand unpacked, and the resulting bit stream is then input to thevideodecodertoreconstructtheoriginalvideo

The basic elements of forward errorcorrectionisshowninFig. 3.

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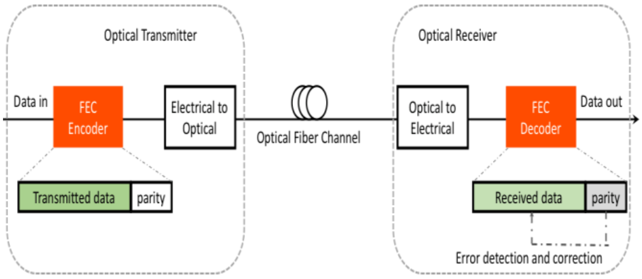

Fig. 3: Essential elements in forward error correction.

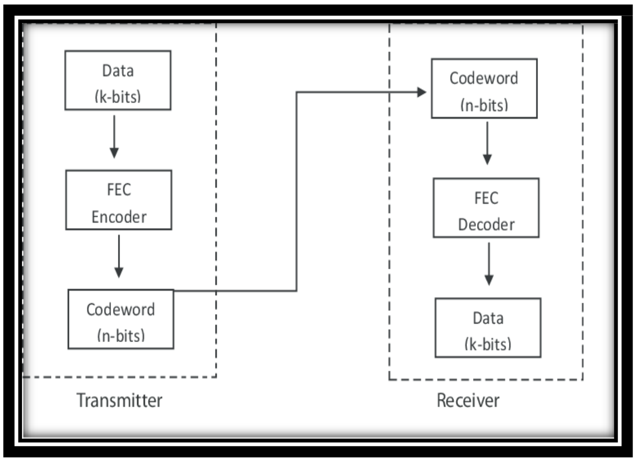

Fig.4:FEC Block diagram

The different types of error control techniques are listed below:

Splitting

This error control scheme optimize the bandwidth in a high priority stream. It also sends data in two or more parallel layers, with not similar priorities level. Splitting can also work together with the B-frames which depends onto one another. The technique is called as data segmenting.

Forward Error Handling

It insert redundant bits in the bit stream to help the decoder to predict which source might have sent it. It also adds some redundancy to detect and correct various other types of errors. Even though it has a redundant bits the errors can still be controlled by varying different coding scheme strengths. Hence there is a tradeoff between video quality and the overhead bits to be controlled. One of the popular FEC algorithm is BCH.

Retransmission

A good error resilience can be obtained by retransmission based error recovery. The packets are only retransmitted when there is a retransmission request without incurring much bandwidth overhead. It also involves additional delay in transmission and therefore cannot be used widely for video applications such as video gaming. We need to allow retransmission due to the need of play out. Hence the delay can be tolerable for such applications.

Hybrid ARQ and other advanced options

Due to its high latency ARQ has been rejected. Several of other ARQ procedure was proposed to reduce the retransmission request and delivery of packets delay. The most important one is the ARQ procedure in hybrid

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procedure. It has two types of schemes available.

When a frame is sent from the transmitter and it gets lost while passing over communication channel, the receiver can still function in a designed way if the frame sent is not used at the upcoming step.

IV.IMPLEMENTATION OF HEVC

High Efficiency Video Coding (HEVC) or H.265, is a compression standard designed for video streaming acts as a descendant to Advanced Video Coding (AVC or H.264). In comparison to AVC, it offers better compressionof data from 30% to 50% at the same level of video quality, or substantially even improved version of video quality at the same code rate. It holds up the resolutions up to 8192×4320.

In HEVC, a source video comprises of a sequence of frames, is encoded by a HEVC video encoder to create a compressed bit stream. The compressed stream is either stored or passed. A video decoder performs the reverse steps by decompressing the video bit stream to generate a sequence of decoded frames at the receiver as shown in Fig. 5.

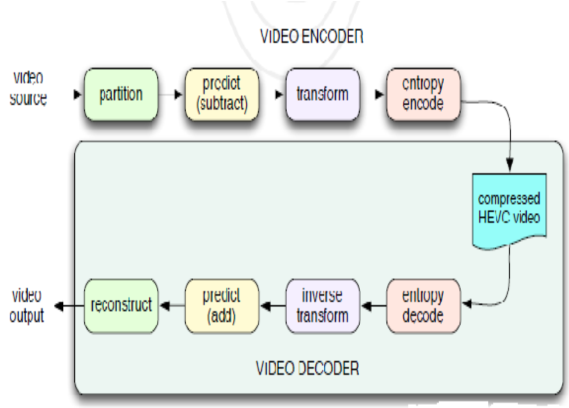

Fig. 5. Block diagram of High Efficiency Video Coder

A source video bit-stream is encoded using channel coding to produce a compressed stream. The compressed video bit stream is passed over the erroneous channels such as a packet lossy network. Due to the presence of error in the channel it is possible that the video stream is corrupted. Hence all information which is contained in the packets lost cannot be decoded and the video reconstruction is of a degradable quality.

HEVC also employs various new error resilience techniques to fight against the channel errors. However, there is still no guarantee of a good reconstructed video.Hence, an error concealment techniques also known as an image processing technique is used at the receiver side as a post processing module to reduce the degradation quality of video.

The implementation of High Efficiency Video Coding technique includes the application of sequence of video transmission over erroneous channels using forward error detection and correction schemes as shown in Fig. 6.

HEVC uses parameters like the peak signal to noise ratio (PSNR) and the Bit Error Rate (BER) to compare different coding techniques.

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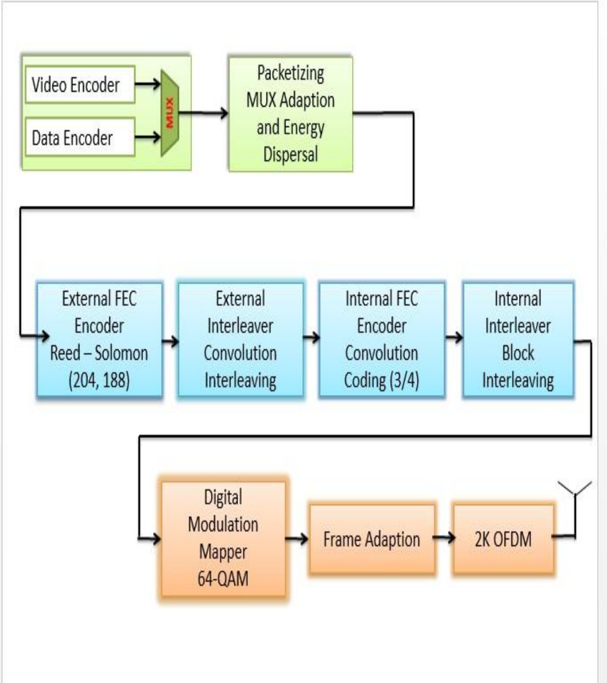

Fig. 6:Block diagram of implementation of High Efficiency Video Coding

Requirements

Software

- OperatingSystem: WindowsXPorHigher OperatingSystems.
- Tool:MATLAB2013bandabove.

Methodology

Implementation of HEVC compression standard along with its components:

- **Source encoder and multiplexer**: Source video or audio are compressed by transmitting through encoder. The compressed video or audio streams are multiplexed into moving picture program streams.
- **Packetizing**: The program stream is divided into 188-bytes long packets sequence. The bytes sequence is cross correlated using an energy dispersal technique.
- **External FEC encoding**: The first level of encoding scheme applied to the data transmitted is called Reed-Solomon coding.It is a block level coding, which allows the detection and correctionof up to a maximum of 8 additional bytes for each 188-byte long packet i.e. a Reed-Solomon RS (204, 188) code.
- **External Interleaving**: It rearranges the sequence of data so that the error is uniformly distributed. Here we use a convolutional interleaver.
- **Internal FEC encoding**: The second level of encoding scheme applied for error correction is a convolutional encoding for bit level. Here we use ¾ coding rate.
- **Digital modulation mapper**: QPSK, 16-QAM, or 64-QAM with 2 K OFDMA is used at the system

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mapper to map the sequence of bits into a chain of complex symbols.

- **Frame adaption**: The complex symbols obtained are grouped using fixed length coding in blocks. A chain of 1512, 3024, or 6048 symbols forms a block.

- **OFDM modulation**: The chain of blocks is modulated using the OFDM modulation technique. The proposed system uses 2048, 4096, or 8192 OFDM subcarriers i.e. 2k, 4k, 8k mode, respectively.

V.RESULTS AND DICUSSION

The HEVC simulation is carried out by varying the SNR values for different Forward error correction coding techniques such as Reed-Solomon coding, Convolutional encoding, Interleaver etc. to evaluate the bit error rate (BER) at the output. The BER for different values of SNR with respect to different coding scheme is tabulated in the Table I.

MATLAB is used in writing the block matching algorithm for HEVC. The HEVC encoding, compresses the bit stream at the encoder which are further FEC encoded using Reed-Solomon, Convolutional encoder, interleaver etc. These encoding techniques are digitally modulated using 64-QAM and OFDM transmitted. Additive white Gaussian noise is added to the resultant bit streamwhen passed through the channel.

Table I: BERvs SNR values for different Coding techniques

	Bit error rate (BER)			
SNR	Without channel coding	Reed-Solomon coding	Convolutional interleaving	Convolution encoding
15	5.354	5.220	5.0523	4.95
16	4.21	4.122	4.005	0.965
17	3.120	3.053	3.9	0.1865
18	1.85	1.789	2.02	0.0095
19	1.225	1.234	1.21	0.0001
20	0.785	0.650	0.632	0
21	0.432	0.045	0.407	0
22	0.215	0.0043	0.1632	0
23	0.045	0.00	0.0056	0

The HEVC simulation is carried out by varying the SNR values for different Forward error correction coding techniques such as Reed-Solomon coding, Convolutional encoding, Interleaver etc. to evaluate the peak signal to noise ratio (PSNR) at the output. The PSNR for different values of SNR with respect to different coding scheme is tabulated in the Table II.

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Table II: PSNR vs SNR values for different coding techniques

	Peak signal to noise ratio (PSNR)			
SNR in decibels	Without channel coding	Reed-Solomon coding	Convolutional interleaving	Convolution coding
15	- 47.85	-47	-46.01	-41.5
16	- 44.65	-45.23	-45	-32.5
17	-42.50	-41.5	-42	27
18	-41.50	-41	-41.5	42
19	-40.50	-40.5	-40	Inf
20	-40.63	-38	-38	Inf
21	-37.5	17.29	-36	Inf
22	-34.83	35.6	-29	Inf
23	22.57	Inf	Inf	Inf

The peak signal to noise ratio and bit error rate is plotted against different value of SNR with respect to different coding scheme such as Reed-Solomon coding, Convolutional encoding, Interleaver etc. for comparison and performance analysis shown in the Fig. 7 and Fig. 8.

It can be inferred from the graph that higher the signal to noise ratio, higher is the peak signal to noise ratio.

It can be inferred from the graph that higher the signal to noise ratio, lesser is the bit error rate.

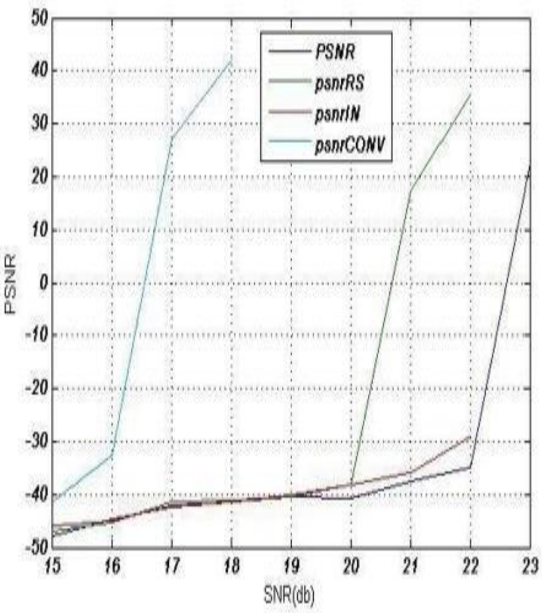

Fig.7: Plot of PSNR versus SNR

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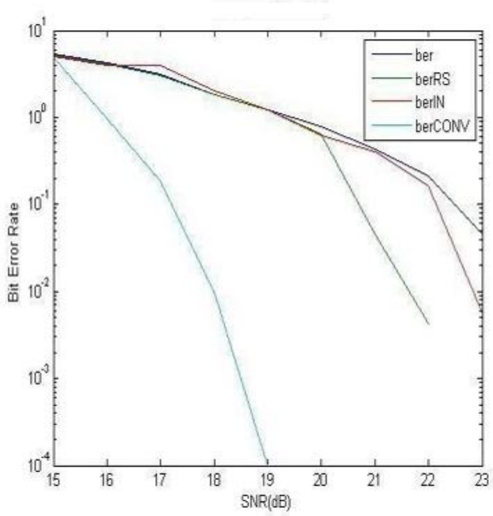

Fig. 8: Plot of BER versus SNR

VI.CONCLUSION AND FUTURE SCOPE

In this thesis, we tried to provide better quality of video to transmit over wireless channels. Similar to the other applied compression scheme, HEVC is much endangered to bit errors due to fading in radio channels. Hence extra effort is required to control the bit error rate in the transmission of video stream.

The overall High Efficiency Video Coding is simulated using MATLAB with respect to different FEC techniques like Reed-Solomon coding, Convolutional encoding, Interleaver etc. is implemented to combat the bit error rate in the transmitted video stream.

Different strength of Forward error correction (FEC) technique is used to observe the effect of SNR on BER and PSNR. The robustness of FEC coding scheme provides a degree of freedom in improving quality of video.

In this thesis video transmission is only considered with AWGN channel. The evaluation of performance of the same system using Rayleigh and other channels can be considered in the future work.

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