MATLAB Simulation and HDL Implementation of DVB-S2 Modulator

Dhwani Brahmbhatt, Yogesh Parmar

Abstract: Ongoing improvements in the region of satellite communication are making conceivable minimal effort information transmission and TV broadcasting to gently populated zones spread over a huge environmental district. As a result of direct and non-direct manner of satellite subsystems and station, audio and video transmissions through satellite transponders face corruption. These damages make an antagonistic impact on the end to end interface execution. This Project is centered around reproduction of the Digital Video Broadcasting – Satellite second era computerized TV transmission. For this simulation, an application in MATLAB is created. It tends to be utilized for re-enactment of entire preparation in DVB-S2 transmitter including stream adjustment, FEC coding with interleaving, modulation, channel damage & also opposite tasks in the receiver. The main aim of this model is to manage Digital Video Broadcasting – Satellite second era parameters using filter in different modulation scheme like QPSK, 8PSK, 16APSK and 32APSK, to get better roll off factor, with all the possible code rates, and use Hardware Description Language to prepare this model, since this way of implementation will make the model cost efficient and also enables the user for the customized code rates.

Keywords: DVB-S2, BCH, LDPC, QPSK, 8PSK, 16APSK, 32APSK, PLSCRAMBLER

I. INTRODUCTION

The DVB innovation is being utilized by a great many clients over the globe so as to watch TV. This innovation forms the sign produced in unique piece of the world by method for encoding it in various layers & directing them on a transporter wave which is being reproduced by a satellite which is then projected via the receiving wires at our home. DVB is a generally acknowledged & very much demonstrated computerized transmission innovation that offers great TV instead of its simple analog broadcasting. As far as innovation, it has taken the T.V. a significant and imperative step forward. This accomplishment has been conceivable because of the improvement made in ICs and DSP [1]. In a rationally developing satellite world, new advances (HTS, HEVC, UHDTV) rise, leading to the significant increase in data rates, which enables the users to get connectivity anywhere on earth.

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Inside applications, for example, Contribution and IP Trunking, the productivity necessities are now trying the points of confinement of the DVB-S2 standard. There is practical hazard for a huge take-over by selective advances with better execution. Scatter of the satellite business, lead to increase in the expense of satellite communication and also prevention of interoperability and seller lock-in would be the consequences of such restrictive situation [15].

The DVB-S2 standard has been created and existing as an advancement of the DVB-S waveform for European satellite telecom by the ETSI in March 2005.

The structure has been intended designed for various kinds of uses:

- Broadcasting of SDTV and HDTV;
- For customer applications Interactive Services including Internet access;
- Also as advanced Television commitment and news gathering like Professional applications;
- Internet trunking & Spreading of Data content

There are four modes accessible, with QPSK and 8PSK planned for broadcast applications. The 16APSK and 32APSK are mainly targeted at professional applications such as news collecting and interactive services. [11].

II. LITERATURE REVIEW

This segment talks about different related works previously done in DVB-S2 Modulator.

According to paper reference [1] DVB is a technology that allows one to enter the new era of the HDTV. This technology is accepted and is currently used worldwide by millions of people. This technology enables channel encoding at the low SNR condition and the appreciable multimedia transmission capability for the all the types of data. Here the testing of DVB-S technology for all data formats, with different channel conditions also considering the multipath errors with open range testing. According to author, the described technology is the most reliable for real time communication of text, audio and image data. However, this paper doesn't include much information on video data transfer [1].

According to paper reference [2] important methodological structures & standards of the Digital Video Broadcast - Satellite, Second Generation system is defined. Simulation of Digital Video Broadcast - Satellite, Second Generation broadcast through AWGN channel has been completed by utilizing modulations QPSK with and without filter.

Simulation has indicated that QPSK modulation with filter is increasingly strong on noise compare to without filter DVB-S2 system [2]. According to paper reference [3] DVB-S2 demonstrated the climate conditions that affect satellite signal. It does the comparison study of DVBS and DVBS2 based on performance during the climatic surroundings. On climatic surroundings, studies showed that DVB-S2 remained steady at estimation of 1E-08, whereas Digital Video Broadcast – Satellite the estimations of Bit error rate reformed, however, stayed around 3E-04. DVB-S2's signal level was higher than DVB-S, whereas for both DVB-S and DVB-S2 levels of SNR and MER are comparable. Because of its adaptive coding and modulation abilities, the standard of DVB-S2 accordingly gives better quality and throughput [3].
According to paper reference [4] in digital satellite TV transmission, comparison of main parameters of the DVB-S and DVB-S2 signals were made. SNR and BER are inversely proportional to each other. By utilizing signal of DVB-S2 with higher C/N ratio, a similar estimation of BER can be acquired. Both of parameters, MER and signal level is descending by decreasing value of C/N. Signal quality is 100 % up to C/N ratio equivalent to 6 dB and higher for DVB-S signal. If there should arise an occurrence of DVB-S2 signal under C/N equivalent to 10 dB the signal quality is less, than 100 % [4].
According to paper reference [5] the similar study is being done, but with respect to the QPSK and 8PSK modulation techniques. Outcomes of simulation indicated that QPSK modulation is increasingly strong on noise compare to 8PSK modulation. 8PSK modulation gives higher spectral efficiency but requires enlargement of required SNR value for error-free reception [5].

III. METHODS & MATERIALS

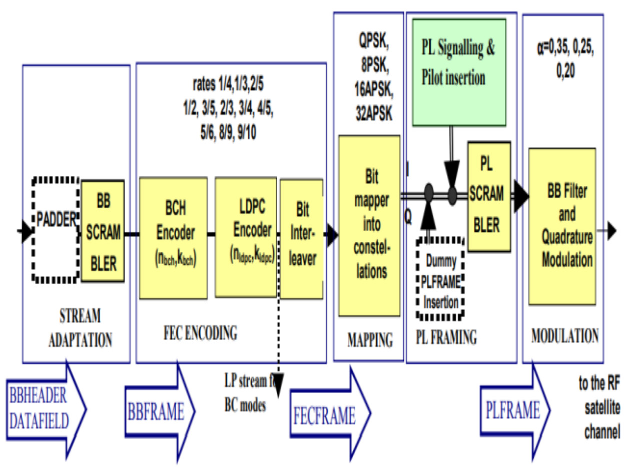


Figure 1: DVB-S2 System's functional block diagram

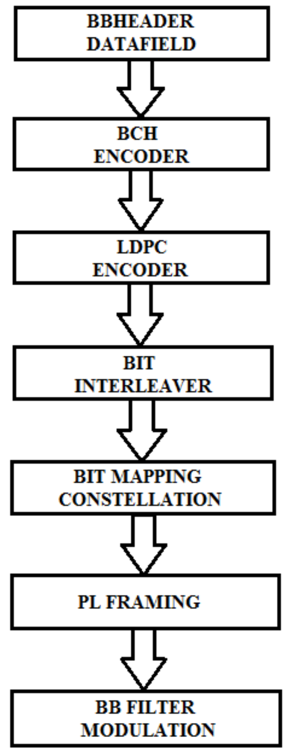


Figure 2: DVB-S2 flow diagram (TX)

BCH Encoder

This model is to execute the BCH encoder. Each terminating, N bch bits as output and K bch bits as input used [12].
The FEC sub-system will perform BCH, LDPC and Bit interleaving. The data stream will be made of BBFRAMEs & the output stream of FECFRAMEs. The FEC coding subsystem will handle each BBFRAME to create a FECFRAME. After the BBFRAME the equality checks bits of the effective BCH external code will be fixed and, as shown in the following figure, the LDPCFEC of the interior LDPC encoder will be involved after the BCHFEC field [12].

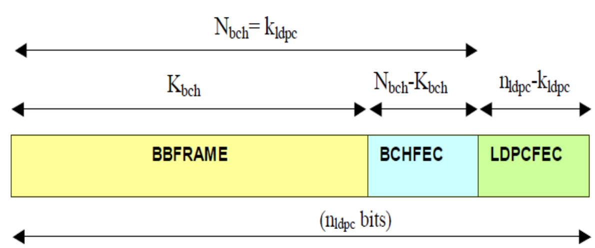


Figure 3: Before bit interleaving data format

LDPC Encoder

LDPC encoding is the last block of the error correction processing. It executes internal error correction encoding dependent on equality bit computation and their inclusion into the data bit arrangement. In this simulation the output FEC frame will consistently hold a fixed size of 64800.

Bit Interleaving

The output of the LDPC encoder will be bit interleaved utilizing a block interleaver for 8PSK, 16APSK, and 32APSK balance designs. Performs interleaving of bits from got FEC outlines so as to convey vitality & diminish burst errors. In the recreation, it is achieved by composing the casing information into sections and perusing three back to back segments as columns.

Bit mapping into constellation

Bit mapping of star groupings will be utilized for QPSK and 8PSK. Mapping into QPSK, 8PSK, 16APSK and 32APSK groups of stars will be applied, contingent upon the application region.

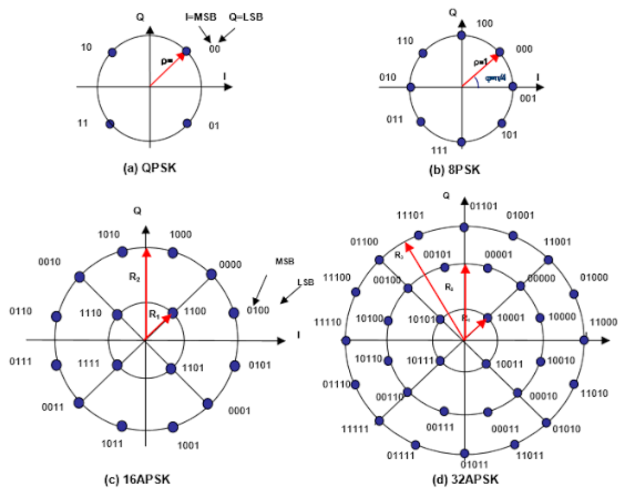


Figure 4: Bit mapping into constellation

Physical Layer (PL) framing

Will be applied, synchronous with the FEC outlines, to give Dummy PLFRAME insertion, PL Signaling, pilot images addition & PL Scrambling for energy spreading. Dummy Physical Layer FRAMEs are transferred when not one valuable information remains fit to be sent on the channel. The System gives an expected PL framing structure, in light of M = 90 SLOTs balanced symbols, permitting dependable recipient synchronization on the FEC block arrangement. An opening is given to PL signaling, including SOF limitation and broadcast mode definition. Carrier recuperation in the recipients might be encouraged by the presentation of a customary raster of pilot symbols, while a pilot-less broadcast mode is likewise accessible, proposing an extra 2,4% helpful limit [12].

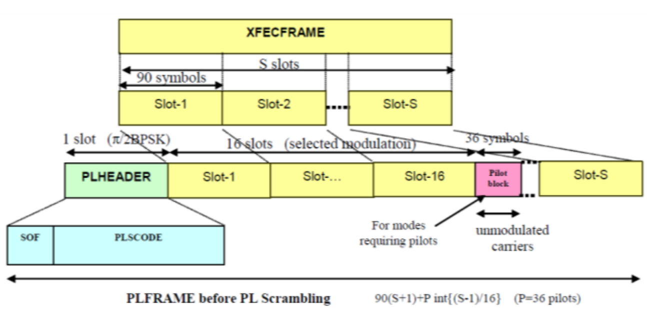


Figure 5: PLFRAME Format

PL Scrambling

Before balance, each PLFRAME, excepting the PLHEADER, will be randomized for energy spreading by replicating the (I+jQ) tests by a multifaceted randomization order (CI+jCQ): I_SCRAMBLED = [I CI – Q CQ]; Q_SCRAMBLED = (I CQ +Q CI)
The randomization order will be reinitialized toward the finish of each PLHEADER. The PLFRAME length relies upon the modulation chosen, in this manner the randomization arrangement length will be shortened to the current PLFRAME length.

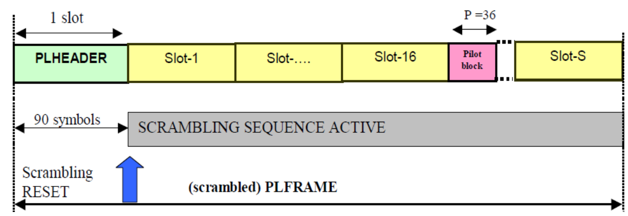


Figure 6: Physical Layer Scrambling

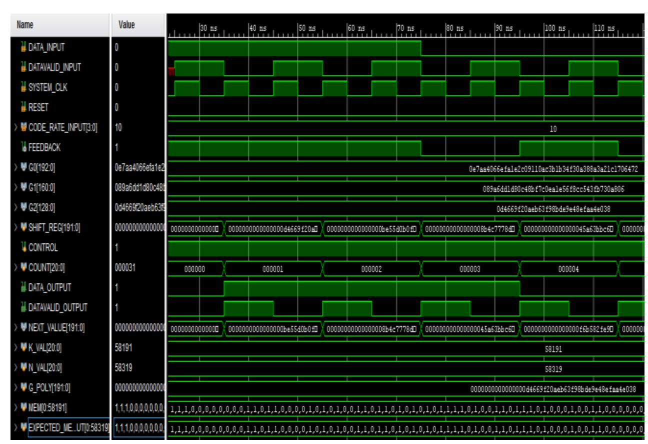
By Merging 2 genuine m-orders into a complex arrangement the scrambling code arrangements will be developed. The subsequent arrangements consequently comprise sections of a lot of Gold arrangements. At long last, the n^{th} complex scrambling code arrangement CI(i) + jCQ(i) is characterized as: CI(i) + jCQ(i) = exp (j R*n* (i) pi/2) [13].

Filter

To shape the signal range (SRRC, roll off elements 35% or 25% or 20%) and to produce the RF signal, Base-Band Filtering and Quadrature Modulation will be applied [13].

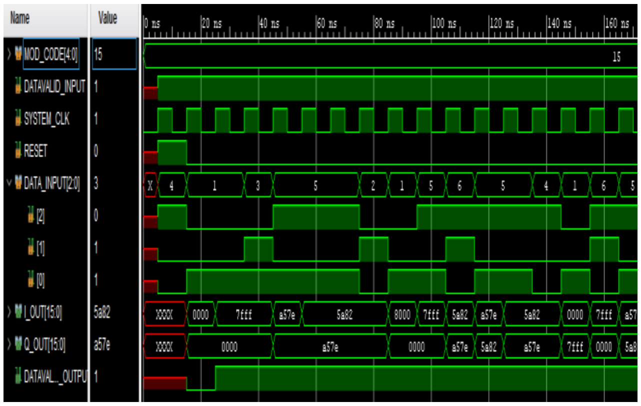
IV. EXPERIMENTAL RESULTS

1. BCH Encoder



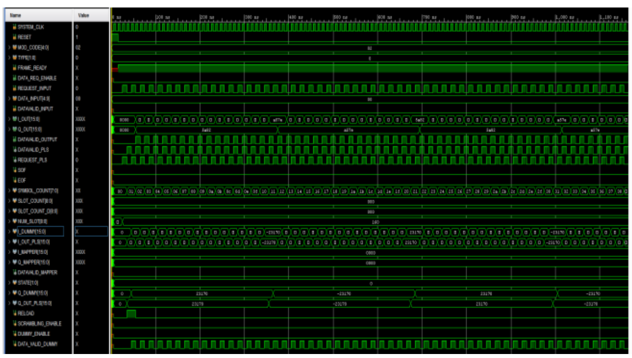
- Code rate=9/10 (10)
- K_VAL=58191
- N_VAL=58319
- G_POLY=h0000000000000000D4669F20AEB63F98B DE9E48EFAA4E038

2. Bit mapping into constellation



- MODCODE=15[0-11(QPSK),12-17(8PSK),18-23(16 APKS),24-28(32APSK)]
- Modulation=8psk

3. PL framing



- SOF='h18D2E82
- DATA_INPUT=random
- MODCODE=02
- TYPE=0
- I MAPPER= base on MODCODE and TYPE
- Q MAPPER= base on MOD CODE and TYPE
- COUNT(LSB)=1 [I_OUT='h5A82, Q_OUT='h5A82 OR I_OUT='hA57, Q_OUT='hA57E]
- COUNT(LSB)= 0 [I_OUT='hA57E; Q_OUT='h5A82 OR I_OUT='h5A82; Q_OUT='hA57E]

V. CONCLUSION

In this paper DVB S2 system is successfully stimulated using hardware description language, system has utilized all the possible code rates, best simulation strategies by using filter for quality enhancement & better roll off factor. This model seems more affordable than other models, effectively modify this module based on our requirements.it also enables the future work on diff code rates as well as system noise analysis.

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