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CCSDS SATELLITE DATA SIMULATOR AND FSC DETECTOR

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***Abstract*-: National Remote Sensing Centre (NRSC) receives data from different remote sensing satellites like OCEANSAT, CARTOSAT-2a, RESOURCESAT etc., and processes it depending on the user requirements. The data comes in a particular format in X-band which changes from satellite to satellite. The data has to be frame synchronize with the hardware. Before launch of a satellite into its orbit, it is important to check all health parameters of Ground Station equipments are proper. To test hardware units developed for receiving satellite data and to maintain these hardware units a standard format simulator is required which will generate data in satellite data format. CCSDS gives the satellite format depending on the type of satellite .Satellite launching involves huge cost, so the designing of a data format simulator importance is so high. This project is implementing and testing on ALTERA EPM7160SLC84-7 EPLD. To know the frequency of the satellite frequency reader is used. The required software is developing using the ALTERA VHDL language. The hardware required for this has to be wired on the wire wrap board and tested.**

Keywords: Consultative Committee for Space Data System(CCSDS),Very High Speed Integrated Circuit Hardware Description Language (VHDL), Electrically Programmable Logic Device (EPLD).

I.INTRODUCTION

As earth reflects daylight , the reflected light vitality will fluctuate contingent upon the earth qualities like soil, water, rock, and so forth. From this reflected light the satellites get vitality from earth. Satellites use photograph identifiers to recognize this light. The yield of a photograph indicator is enhanced by photograph multipliers and encouraged to a simple to perform analog to digital conversion. The word size of this digital data will differ from satellite to satellite and can be of 8-bit, 12-bit width. This parallel information will be changed over to serial information.

The serial information is modulated in (PCM) QPSK or BPSK and transmitted to earth with a carrier frequency (8GHz, 4GHz). The got signal at the earth is down converted over to transitional recurrence 375MHz and bolstered to a demodulator.

The information obtained from the satellite is in serial structure. This serial information will be fed to front-end hardware, which will feed this data to a computing device. To test this front-end hardware, data will be generated in the satellite data format by using Generic Satellite Data Simulator. The upcoming remote sensing satellites will come in a standard CCSDS format. This is a standard format which is getting implemented in different Indian and foreign satellites. The design of the simulator depends on the satellite features. Data simulator will be designed in the CCSDS 131.0-B1 format.

The proposed project is designed to develop both encoder and decoder of the Generic data simulator. In the encoder side Frame Sync code is generated as every satellite has its particular fixed frame sync code Data is taken as all zeros till know,

but can also generate data patterns and operate on different modes which will be implemented later.

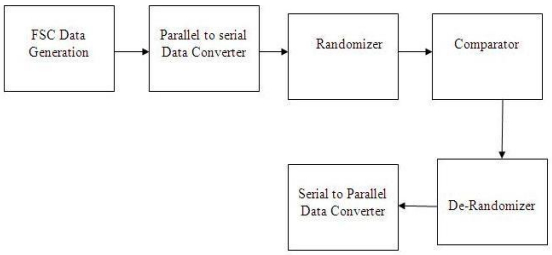

Fig:1.,signal flow diagram for Data Simulator and FSC detector

II LITERATURE SURVEY

The Consultative Committee for Space Data Systems (CCSDS) is an association formally settled by the administration of its individuals. The Committee meets intermittently to address information frameworks issues that are regular to all members, and to define sound specialized answers for these issues. See that interest in the CCSDS is totally intentional, the aftereffects of Committee activities are termed Recommended Standards and are not viewed as tying on any Agency.

This Recommended Standard is issued by, and speaks to the agreement of, the CCSDS individuals. Underwriting of this Recommendation is altogether deliberate. Support, notwithstanding, shows the accompanying understandings:

At whatever point a part builds up a CCSDS-related standard, this standard will be as per the significant Recommended Standard. Building up such a standard does not block different procurements which a part may create.

At whatever point a part sets up a CCSDS-related standard, that part will furnish different CCSDS individuals with the accompanying data:

- ✓ The standard itself.
- ✓ The foreseen date of beginning operational capacity.
- ✓ The foreseen length of time of operational administration.

Particular administration courses of action might be made by means of memoranda of understanding. Neither this Recommended Standard nor any following standard is a substitute for an update of assertion.

ADVANTAGE OVER PREVIOUS TECHNOLOGY:

In the development of space communication, there used to be no security for the secret information/documents which is crucial for military reason and space correspondence purposes. Keeping in mind the end goal to conquer this issue, CCSDS has advanced by giving a security code called "Frame synchronization code. As the information from the satellite comes as X-band (8GHZ to 12GHZ) which is regularly known as remote sensing satellites. Frame Sync Coding (FSC) is utilized as a part of satellite communication to keep the first information secured. At receiver side, the sent F.S.C code is gotten by reception apparatus' in the space station's situated on the earth. At receiver side, the 8GHZ sign is minimized to 750 MHZ and is then decoded . The FSC code which is gotten by antenna will experience methods like COMPARATORS and CORRELATORS which contrasts the sign and the space station's code. On the off chance that the code matches with the received signal through reception apparatus, then the sign experiences corruption process in which a high frequency signal is then changed over to low frequency signal. The degrade signal is then decoded and it uncovers the classified information which is kept mystery. F.S.C code can contains both audio and video data .Frame Sync Coding assumes a vital part in space applications by keeping the data secure.

III DATA SIMULATOR:

3.1Format Generation:

Data is attached to the frame sync code, which is fixed for every satellite and known. This is to indicate the start of the frame that consists of FCS, auxiliary data and video data. Line length of the frame will be specified according to the CCSDS format. Line length gives us the information about the number of words (bytes) in a frame. It is

impractical to handle data bit wise as the line length or the data format for satellites would be of the order of some 1024 bytes or even more than that .It is more preferable to handle it one byte at a time, for this purpose we make use of a word counter. Word counter counts the number of bits in a word.

3.2Line length generation:

Line length of the frame will be specified according to the CCSDS format. Line length gives us the information about the number of words (bytes) in the satellite data format

3.3Serialization:

Since the data coming from the satellite is in serial form, it is necessary to convert parallel data into serial data. To convert this parallel data to serial an 8-bit Parallel-in Serial –out Shift register is used.

3.4Randomization:

In order to maintain symbol or bit synchronization with the received communications signal, every data capture system at the receiving end requires that the incoming signal have a minimum bit transition density i.e., to eliminate long sequence of zeros and ones to ensure accurate timing recovery without redundant line coding.

On sending end, the code block or Transfer frame is randomized by exclusive –oaring the first bit of the code block or transfer frame with the first bit of the pseudo-random sequence followed by the second bit of the code block or transfer Frame with the second bit of the pseudo-random sequence and so on. The pseudo-random sequence shall not be ex-or ed with the FCS.

The pseudo-random sequence shall be generated using the following polynomial

$$h(x)=X^8+X^7+X^5+X^3+1$$

This sequence begins at the first bit of the code block and repeats after 255 bits ,continuing repeatedly until the end of the code block. The sequence generator is initialized to the all-ones state at the start of the code block and the sequence will be continued by the implementation of the polynomial

IV FRAME SYNCHRONISATION DETECTOR:

This Randomized data is received by the earth stations .This incoming data is taken is taken for FSC detection process. The FSC is a 32 bit code which is to be detected .This detection is important for knowing the start of the video data transmitted by the satellite. As FSC is unique for a given satellite, the detection is achieved by implementing the following procedure.

The Frame Sync code which is to be detected is stored in an register. For the detection of FSC we need to convert serial data to parallel so that it would be easier for comparing bytes .Hence, the incoming data is converted form serial bits to parallel bytes using a Serial in parallel out shift register(SIPO).inputs to the SIPO are clock and sin where as output will be sout. Now the running bytes are sent through one of the input of the comparator and another input of the comparator is fixed. The output of the comparator will be a high or a low pulse which says that if a high pulse occurs a maximum match has happened and vice versa. After FSC has been detected ,the concern now is to convert the randomized incoming data to de-randomized data. For de-randomizing the incoming data, the randomized data is EXOR ed with the PN sequence. But, the randomized data consists of original FSC and randomized video data, So, FSC need not be randomized. In order to perform de-randomization of randomized video data, a pulse is generated to mask the FSC bits. A pulse is generated as high after FSC completion and from there de randomization takes place .This implies that the exclusive or function is performed on the incoming randomized data and the PN-sequence generated, only when this low. Thus, de-randomizing is performed on the data received. This data is sent for further processing.

V RESULTS

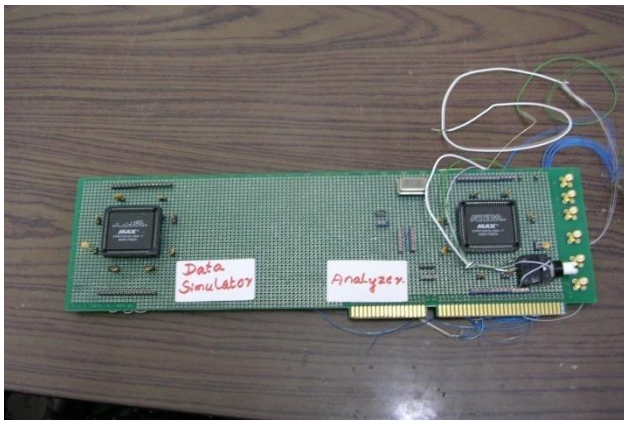

Fig 2 Data simulator and frame sync detector

Fig 5 shows the hardware part of data simulator and frame sync detector . It consists of an EPLD in which the program has to be dumped. After dumping the program we can get the desired sequence by using a logic analyzer

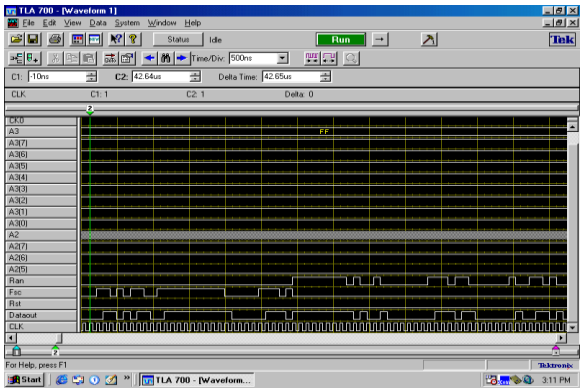

Fig 3 Data simulator

The Hardware output of Data simulator It contains the FSC data ,Randomized data.

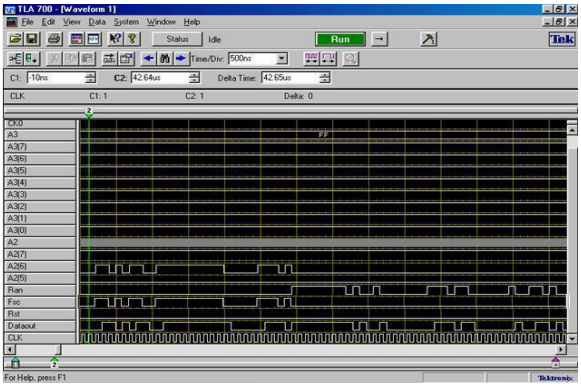

Fig 4 Frame sync detector

The Hardware output Frame sync Detector

VI CONCLUSION

C.C.S.D.S Frame synchronization code plays major roles in providing separate data transmissions for several countries i.e., the data is sent with the frame synchronization code and at the receiver side, the Earth stations have to decode the original information sent from the satellite. In order to decrease the usage of huge bandwidth, all countries have decided to maintain an unique code [1ACFFC1D],which can be used for common purposes, in which the data can be used (retrieved) by every Earth station in the World. By this decision, they have decreased the spectrum of bandwidth which can be used for other purposes.

This frame synchronization code will differ for different countries satellites, So as to maintain the separate channel to retrieve their data from their country's satellite. By using this technology we can restrict authentication of retrieving data from other satellites.

CCSDS Data simulator , Frame Sync Detector and Frequency Reader were done using Quartus software and testing was done using TTLA and results were as expected.

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