GENERATION AND IMPLEMENTATION OF IRNSS SPS SIGNAL

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Abstract : The 2 types of services which is provided by IRNSS. They are SPS and RS. The Two frequencies are allotted for these services which is operated on L5 band (1164.5MHz) and S band (2472.5MHz) band. Thet code is utilized, some part of SPS is Psedo Ranging Noise codes. It utilizes gold codes, gold codes is used for transmission of the navigational data in downlink SPS. PRN code sequences is a secondary code and that gold code defined as a primary code. The GPS works based on CDMA in that Pseudo Random Clamour sequences which are required for the systems. In this letter a study is made on generation and Analysis of SPS pseudo random clamour codes from the view point of navigational system. This letter shows the design and analysis of Pseudo random clamour code on Spartan-6 FPGA board. The obtained Pseudo random clamour code outputs, which are approved from hardware with the simulation results. The simulations of SPS Pseudo random Noise codes were obtained utilizing Xilinx ISE test system and the simulated results are within the theoretical limits.

Index Terms **- Spartan-6 FPGA Kit, HDL and Gold code.**

I. INTRODUCTION

The Operation of Global Navigation Satellite Systems (GNSS) has been in operation since 1994. This Global Navigation Satellite system includes some heavenly body of satellites spinning around the Earth transmitting with numerous entrance system signals on apportioned frequency for non military ranging reason with suitable ground collectors. The fruitful operation of the GNSS has opened a large number of Personal and Vehicular navigation Gadgets that is accessible for a common man. In any case, for a few nations, the current worldwide situating Systems (GPS) are given by non-non military departments of different nations and are not ensured to be accessible 24x7 for a nation like India. The issue with the current constellations is that they are controlled by defence organizations in those nations. While Galileo is a pay-to-utilize system, Compass is military-controlled. Keeping in mind the end goal to uproot the reliance on such Systems, India hit upon the IRNSS (Indian provincial Navigation Satellite System) thought, which gives the position, navigation and timing (PNT) administrations, free of other worldwide and local Navigation Systems. Every one of the contraptions and gadgets showed up as an equipment part for any sort of GPS where its software algorithm is not uncovered. Understanding the innovation behind the equipment will require a few studies. The software modelling is a whole's perception system that is a decent estimated representation of the genuine thing that is being assembled.

This paper will build up a model that will permit client/(s) to have a stage to simulate and generate the SPS Pseudo-Random Noise code. The satellite will be represented to by the IRNSS transmitter demonstrate and is intended to simulate SPS PRN information originating from numerous IRNSS Satellites. So we are going to create the SPS PRN succession produced by 7 satellites, every satellite will transmits L5 and S Band signals. The paper will show the confirmation of the PRN code with the given documentation and diverse properties of the SPS PRN. This venture requires information of SIGNAL In Space Interface Control that indicates the 2 segments interface difference namely user segment and space segment, Different sort of Codes that are utilized as a part of CDMA with a specific end goal to build up the model and finish it effectively. The paper gives a general thought of how the strategy of the SPS SIGNAL generator works where the comprehension of IRNSS innovation can be seen in the recreation's flow. This paper concentrates on the IRNSS signal plan that is represented by the spreading sequences codes. The codes are Standard Positioning administration codes and Restricted Service codes (RS).

IRNSS (Indian Regional Navigation Satellite system) is ISRO's drive to construct a free satellite navigation system that will give independent geo-spatial situating with territorial scope in view of a group of stars of GEO and GSO satellites, which would be under aggregate control of Indian government. The prerequisites of such a navigation system driven by the way that entrance to worldwide navigation satellite Systems, GPS, is not ensured in unfriendly stations. The IRNSS fundamentally gives two sorts of administrations

1. Standard Positioning Service (SPS)
2. Limited Service (RS)

Both of these administrations will be given at two frequencies of L5 (1176.45 MHz) and S band (2492.028 MHz).The SPS signal will be tweaked by 1 MHz BPSK SIGNAL. The exactness administration will utilize BOC (5, 2) in L5 and S1 frequencies. The Navigation signals themselves would be transmitted in the S-band frequency (2.4 GHz) and telecast through a staged cluster receiving wire to keep up required scope and signal.

II. LITERATURE REVIEW

As per the reference number 1, the receiver receives data and communication from PC using software from Xilinx Company (Micro laze). The information is demodulated to control FPGA load different software which generates the navigational signals that meets radio system navigation. Fulfilled the design target like flexibility, expansibility and accuracy. The new idea of this paper for system test and design for the navigation system generator which is applied for debugging use for military as well as civilian plane radio navigation.

This needs ADC, RAM, MBlaze, synthesized unit and DDS for selecting modulation technique and a DAC. As a result, this letter generates the radio navigation digital signal and which is analyzed by software pracessor MicroBlaze wose key portion are acheived in a single FPGA chip and it provided high accuracy. This paper also concludes that different types of signals which are loaded in this system loaded, with providing flexibility and expandability. This paper undergoes modulation technique like AM, FM, BPSK and QPSK. [1]

In this paper author describes about the generator of digital signal in navigation radio system is implemented by using soft processor Micro Blaze whose output is achieved by using in a single FPGA Chip, which provided high accuracy and overcome with flat tuning in a traditional method. Simultaneously various kinds of signals can be loaded in the system obtaining more flexibility AM, FM, BPSK and QPSK modulation have been done. Through the numerical values. The analog circuits, presents the accuracy will be low and the poor reliability. The signal is designed for digital circuits in this letter, It receives is demodulated for data to manage management FPGA load totally different package to come up with guidance signals, that absolutely meets general radio navigation system take a look at technical demand by providing full play to the system hardware and software advantages. [2].

Satellite navigation system provides autonomous positioning with global coverage which is being called global navigation satellite (GNSS) most of the system work on the principle of code division multiple access (CDMA), where Pseudo Random Code (PRN) sequences are heart of the system. The generation and properties of PRN codes form navigation system perspective. The paper also guides the design and implementation of PRN code on Virtex-2P FPGA hardware. The results of generation from hardware are validated with the simulation results and the properties of the PRN codes are analyzed. This paper concludes generation of properties of the PRN codes is completed. This paper presents the design and implementation of PRN code on Matlab, Xilinx ISE and Vertex-2P FPGA hardware environments. The results of generation from hardware are validated with the simulated results and also the properties of the PRN codes are analyzed[3].

This paper deals with the generation of GPS signals with FPGA based Xilinx system generator 9.2. The frequency band L1 is used mainly for commercial civil aviation and other purposes once the GPS signals are generated in the simulated laboratory environment we can test the proper working of multichannel GPS receiver which is an extension of this project after we obtain accurate laboratory results, we can go for real GPS signals. The board that has been used for the hardware implementation is Lyr tech SFR-SDR board, which is having three functional layers. The digital processing layer, the ADAC master 3 layer and RF layer having a transmission and receiving capacity of 1 Ghz this will lead to the development of indigenous digital GPS signal generator using reconfiguration. [4]

III. IRNSS SIGNAL STRUCTURE

Generation of PRN Sequence

A pseudo clamor (PN) arrangement is a parallel succession of 1's and 0's and it is intermittent. It has a few attributes that are like arbitrary parallel sequences, very low connection between's any two moved variant of the grouping and low cross-relationship between's any two successions. Pseudo-Random grouping is not arbitrary (deterministic) but rather it searches arbitrarily for the client who doesn't know the code. The bigger the time of the PN spreading code, will be more arbitrary double wave and it is harder to distinguish it. A PN arrangement is created by a Feedback movement register.

The heart of PN grouping generator is typically comprised of straight criticism movement registers (LFSR). Each SPS code is created utilizing a tapped LFSR and it produces a maximal-length succession of length N = 2n – 1 components. The SPS PRN codes are frequently alluded to as Gold codes named after Robert Gold furthermore alluded to as Pseudo-Random clamor succession, or just PRN arrangements. The pseudo random clamour codes chose for Standard Positioning systemare like GPS C/A Gold codes. The length of every code is 1023 chips. The code is chipped at 1.023Mcps.

Generation and analysis of Gold code

IRNSS uses Gold codes for the SPS SIGNAL. The era of Gold codes utilizing two favored m-succession generators of degree n, with an altered non-zero seed in the first generator, 2^nGold codes are gotten by changing the seed of the second generator from 0 to2^n-1. Another Gold setting so as to group can acquired every one of the zero to the first ganarator, which is thet second m-arrangement itself. In total, 2^n+1 Gold codes are accessible. For SPS code generation the two polynomials G1 and G2 are defined below:

G1= X10+X3+1 and
G2= X10+X9+X8+X6+X3+X2+1

Polynomal g2 and g1 are like the ones utilized by GPS C/A signal. The G1 and G2 generators are acknowledged by utilizing 10 bits Maximum Length Feedback shift Register(MLFSR).The beginning conditions of G2 gives the chip delay.G1 and G2 are only OXRed for the era of the last 1023 chip long PRN grouping. The time of the PRN succession is 1ms. Taking the illustration of Gold code era, the SPS PRN code generator can be demonstrated as appeared in the figure. These movement registers G1 and G2 have 10 cells each producing succession of length 1023. The two coming about 1023 trilling long groupings are modulo-two added to produce a 1023 chip long SPS PRN code. It works just if the polynomial has the capacity produce code of most extreme length.

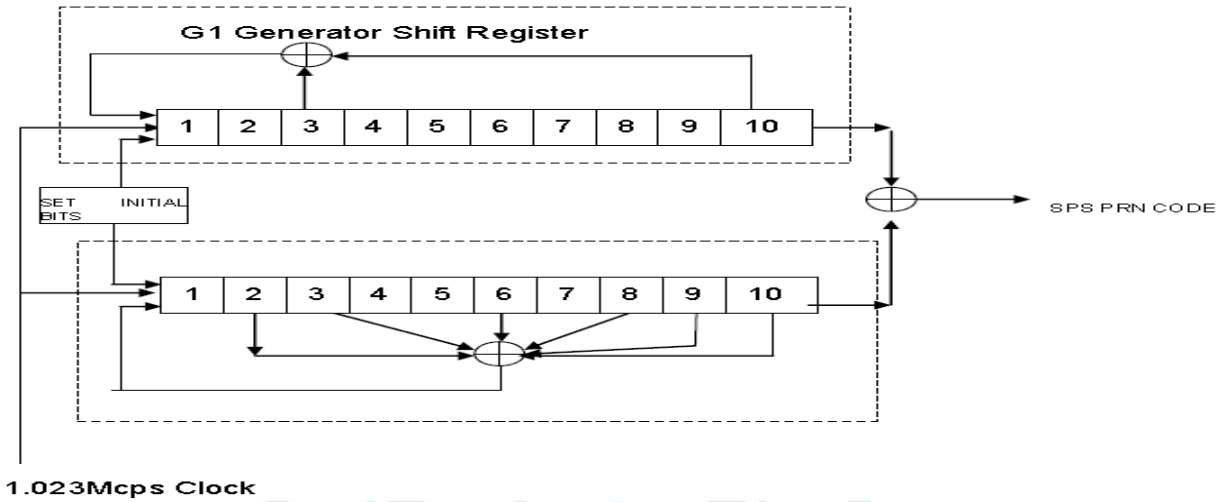

Fig 1: SPS PRN Code generator

The G1 enlist dependably has a criticism designal with thet polynomial f(x)=1+x^3+x^10, implying thet the 3 state and 10 state are nourished back to the info. In the same way, G2 register as thet polynomial f(x)=1+x^2+x^3+x^6+x^8+x^9+x^10 importance states 2,3,6,8,9 and 10 are bolstered back to the input. To make distinctive SPS PRN coded for thet satellites, thet output of the 2 movement registered are consolidated in an extremely extraordinary way. The G1 enlist dependably supplies with the introductory conditions of all one's , yet the G2 register supplies 14 distinctive starting states as per required Satellite and its band (L5 or S1) ,G1 and G2 gets modulo-2 added to produce its SPS PRN output.

Code phase Assignment for SPS PRN Signal

Amid the pre-instatement, there are two sections to execute so that the parameters are setup for Standard Positioning Service Code Generation. We require to make the model of the m-grouping movement registers for producing the SPS code of a specific satellite. The movement register is represented to by the unit postponement square. With reference to the Figure 4-4, the SPS PRN generator can be made. As indicated by the Table 4-2, the Initial States are decided to create the PRN flag number. The Figure 6-5 demonstrates the model of SV L5-1 34E

Table 1: Code Phase assignment for SPS PRN Code

PRN ID	SV Location	L5 –SPS		S-SPS	
		Initial Condition for G2 Register	First 10 Chips in Octal2	Initial Condition for G2 Register	First 10 Chips in Octal2
1	55°E	1110100111	130	0011101111	1420
2	55°E	0000100110	1731	0101111101	1202
3	83°E	1000110100	0713	1000110001	0716
4	111.75°E	0101110010	1215	0010101011	1524
5	111.75°E	1110110000	0117	1010010001	0556
6	32.5°E	0001101011	1624	0100101100	1323
7	131.5°E	0000010100	1753	0010001110	1561

In the SPS PRN code generator, all unit defer bits' introductory conditions must be pre-characterized once the model is opened. All the beginning conditions are characterized in each unit postponement obstruct at the Callbacks utilizing Init function (Initializes the qualities amid re-enactment)

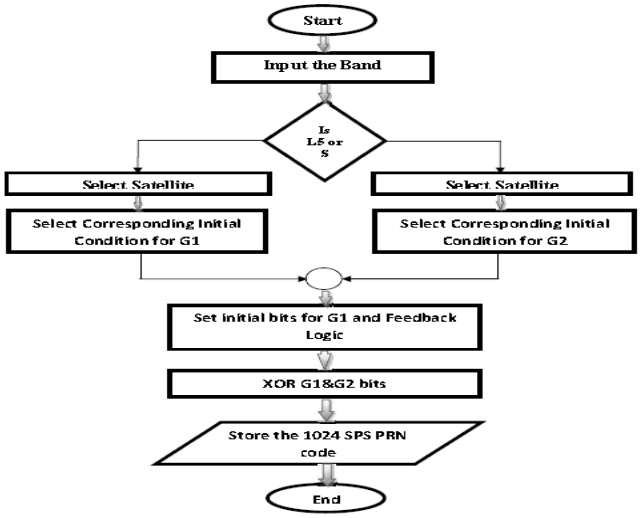

Fig 2: Flow Chart for code Phase assignment

Firstly one band is selected out of two bands (L5 & S), after selecting either of the band, the initial condition G2 must be selected for the respective band. Then the G1 initial condition is set. The logical feedback is given and particular bits as per the polynomial are selected to perform xor operation. So that all the 1024 bits are obtained.

IV. SIMULATION RESULTS

The Verilog language have been used to analyse the SPS Pseudo random clamour code waveforms, where Verilog result shows 1024 SPS Pseudo random clamour binary waveform and code is done to implement on a SPARTAN 6 FPGA kit. The Pseudo random clamour code generation and analysis has been done using Xlinx ISE simulations. The results are shown below.

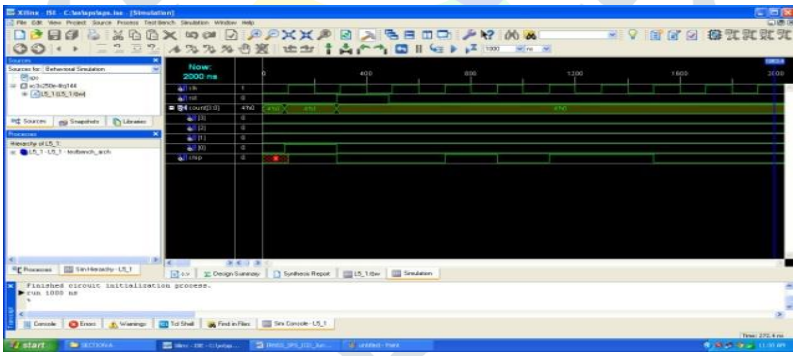

Fig 3: Shows the generation of Pseudo random clamour code for L5-Band, Satellite-2 in the Xilinx ISE environment.

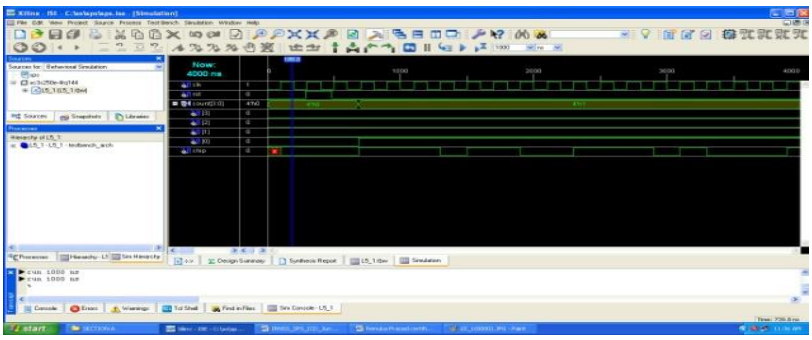

Fig 4: Shows the generation of PRN code for L5-Band, Satellite-3 in the Xilinx ISE environment.

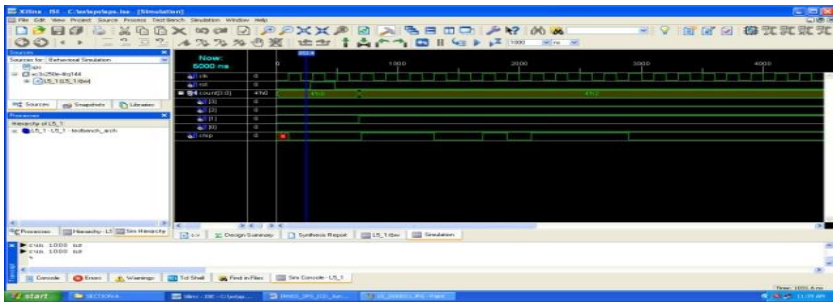

Fig 5: Shows the generation of PRN code for L5-Band, Satellite-4 in the Xilinx ISE environment.

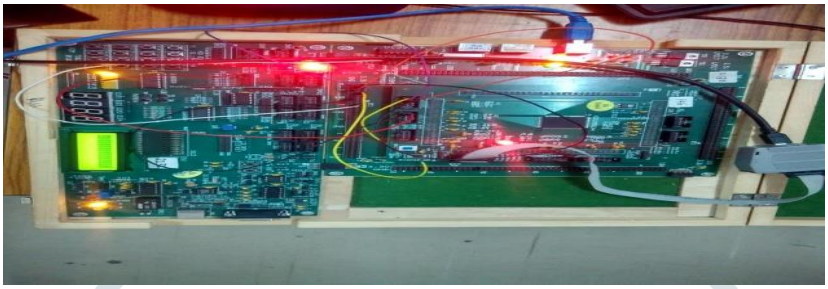

Fig 6: Shows the zoomed view of Spartan-6 kit, which has been used for hardware implementation in this project.

Thet necessary user constrain files(ucf) are avalable from the user manual of the Spartan-6 FPGA kit. Below Shows the process(To Generate Programming File) followed to obtain the output on hardware. Shows the PRN code generation in FPGA kit.

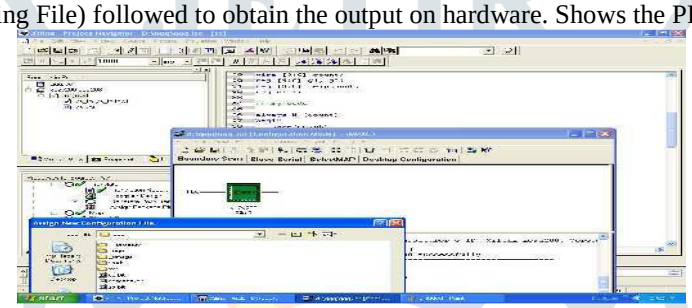

Fig 7: Shows to select a particular bit file compilation for configuration of Device

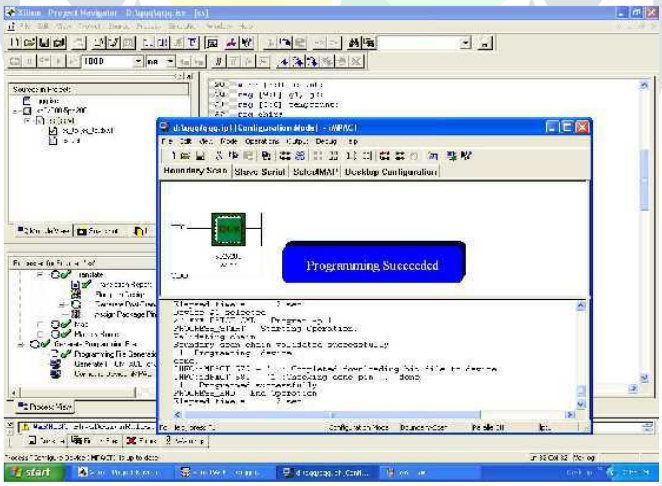

Fig 8: Shows that the program was succeeded on an hardware

V. CONCLUSION

In this paper a stady made on the generation and analysis of pseudo random clamour code is completed. This results introduces that outline and usage of Pseudo random clamour code on Xilinx ISE Simulator and Sparton-6 FPGA Hardware environments. The Great results have been ganerated from hardware equipment as in practical application and are approved with the simulation results.

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