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IEEE 802.11 WLAN Specific Energy Efficient Key Generator Design For Green Communication

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Abstract---
In this paper six different available WLAN channels are used for design an efficient key generator based on 802.11 WLAN standard. There are different WLAN channel in communication system. Therefore, our design should be capable to work with operating frequency of different WLAN channels. In reference [21], the device operating frequency of 802.11b/g/n, 802.11y, 802.11a/h/j/n/c, 802.11p, 802.11ad and 802.11ah is 2.4GHz, 3.6GHz, 5GHz, 5.9GHz, 60GHz, and 900MHz as shown in Table 1. In order to test the compatibility of our key generator design with these WLAN channel, we are going to operate our key generator with their respective frequencies of 2.4GHz, 3.6GHz, 5GHz, 5.9GHz, 60GHz and 900MHz for different I/O Standard and we find out the best energy efficient IO standard available on FPGA. Then, we shall use the most energy efficient IO standard in final design of energy efficient key generator. Finally, this energy efficient key generator will integrate in system of communication in order to deliver green communication for Wi-Fi protected access on FPGA.

Keywords –

I/O standard; WLAN Channels; SSTL; Fibonacci Generator; I/Os Power.

I Introduction

1.1 FPGA

A Field Programmable Gate Array comprises of a matrix of gate array logic circuitry which is reconfigurable. FPGA can be used to perform implementation of hardware for a software application. In the place of many thousands of discrete elements, one can use single FPGA by integrating millions of logic gates in a single IC chip. Logic elements, programmable interconnect and memory makes the basic structure of FPGA. FPGA does not have an operating system but for processing logic it uses dedicated hardware. The good thing in FPGA is that different processing logic will not do competition to get same resources because they are parallel in nature and therefore with the addition of any processing component in the circuit put no effect on the performance of the other processing part.

1.2 Wireless Network

Wireless networks are an integral part of day-to-day life for connectivity and communication. Reference [2] examines the problems relating to the topic of wireless security and the background literature. Characteristics of a new class of signal correcting Galois field codes are described that provide error detection and correction at the physical level of computer networks without additionally generating and transmitting cyclic redundancy-check (CRC) codes [3]. Wi-Fi enable-devices periodically broadcast in their unique identifier along with other sensitive information. Therefore, they are vulnerable to a range of privacy breaches such as the tracking of their movement and inference of private information[4]. The penetration of mobile phones and tablets to gain wireless access to the Internet has been accompanied by a similar growth in cyber attacks over wireless links to steal session cookies and compromise private users' accounts [6]. WPA and WPA2 (Wi-Fi Protected Access) key is generated by using Fibonacci generator [6].

II Need of green communication

2.1Thermal Efficient Green Fibonacci Generator

Here, thermal efficient green Fibonacci Generator is used to generate key for WPA under different room temperature for secure green communication. Thermal Scaling is a technique which is used to make energy efficient as well as thermal efficient design. Here, we want to see that how does an electronic device effects if we change the temperature in which it is working. For that purpose we have taken temperatures of four different regions. Furnace Creek Ranch is area of North America recorded the highest temperature of the world that is 56.7^0 C. Approximately 53.5^0 C is the maximum temperature recorded in Mohenjo-Daro situated in Sindh Pakistan. We have taken median temperature of Delhi i.e. 40^0 C and standard normal temperature 21^0 C. If we operate our device (Fibonacci Generator) in these mentioned areas under different operating frequencies, then we will see how does device performance and life effects while operating it in different regions and under different temperatures.

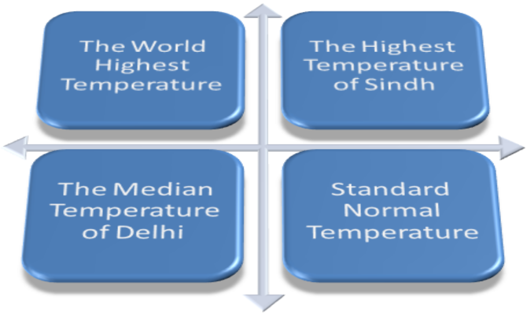

Figure 1: Temperatures of different regions [1]

Fibonacci Generator

We have taken Fibonacci generator as our target design and using LVCMOS I/O standards for our design. Fibonacci generator generates number in a sequence like 0, 1, 1, 2, 5, 8, 13 and so on. Mathematical expression for Fibonacci generator is

$\mathbf{F_n = F_{n-1} + F_{n-2}}$

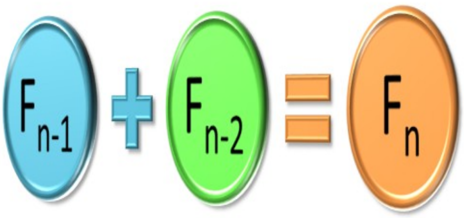

Figure 2: Mathematical Expression of Fibonacci Generator [1]

2.2 Junction And Ambient Temperatures

In an Electronic device, the maximum temperature of the actual device or silicon die is known as Junction temperature. Junction temperature tells about the life of a device. Mostly it is recommended that junction temperature should be less than 125^0 C.

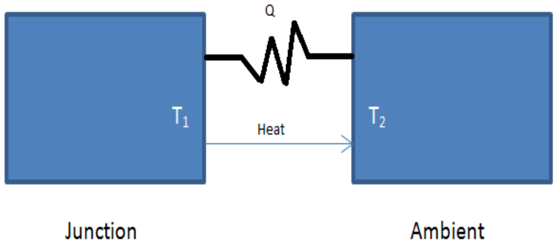

Figure 3: Junction and Ambient Temperature [1]

Ambient temperature is usually refers to standard normal temperature that is 21^0 C. Device extracts heat when the silicon die in device is powered up. The ambient temperature is directly proportional to junction temperature. Heat will continue to flow from die to surrounding environment (ambience). The mathematical expression for calculating junction temperature is

$T_J = T_A + R_{QJA} * \text{power}$

Where T_J refers to junction temperature, T_A refers to Ambient Temperature, R_{QJA} refers to junction to ambient thermal resistance.

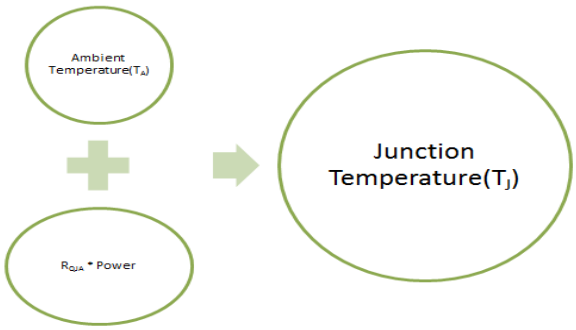

Figure 4: Mathematical Diagram for Junction Temperature

A significant increase in junction temperature may harm integrated circuit or may cause issue like unreliability. In order to design an efficient airflow of the system, it is important to calculate junction temperature of Fibonacci generator keeping LVCMOS as I/O standards.

2.3. Stub Series Terminated Logic Input Output Standards

In reference [2], Stub-Series terminated logic (SSTL) I/O standards technique for power efficient Fibonacci generator and it is implemented on virtex-6 FGPA, -2 speed grade, FF484 packages and XC6VLX75T device. We have picked six different classes of SSTL I/O standard among all

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available SSTL I/O standard namely SSTL18_I, SSTL18_II, S18ID, S18IID, SSTL15 and SSTL15_DCI. Number of flip-flops, multiplexer and demultiplexer is used in the Fibonacci generator.

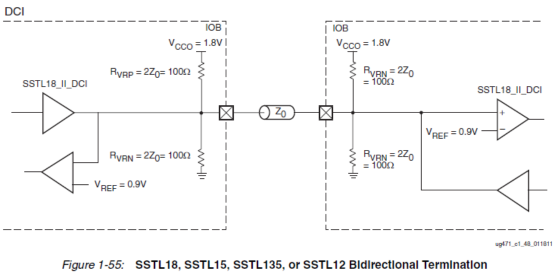

Figure 5: Block Diagram of SSTL [7]

The reference voltage for SSTL18_I, SSTL18_II, S18ID, and S18IID is 1.8V and reference voltage for SSTL15 and SSTL15_DCI is 1.5V.

2.4 WLAN Channel

There are different WLAN channel in communication system. Therefore, our design should be capable to work with operating frequency of different WLAN channels. In reference [21], the device operating frequency of 802.11b/g/n, 802.11y, 802.11a/h/j/n/c, 802.11p, 802.11ad and 802.11ah is 2.4GHz, 3.6GHz, 5GHz, 5.9GHz, 60GHz, and 900MHz as shown in Table 1. In order to test the compatibility of our key generator design with these WLAN channel, we are going to operate our key generator with their respective frequencies of 2.4GHz, 3.6GHz, 5GHz, 5.9GHz, 60GHz and 900MHz for different I/O Standard and we find out the best energy efficient IO standard available on FPGA. Then, we shall use the most energy efficient IO standard in final design of energy efficient key generator. Finally, this energy efficient key generator will integrate in system of communication in order to deliver green communication for Wi-Fi protected access on FPGA.

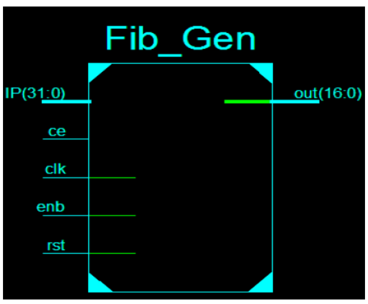

Figure 6: Fibonacci Generator

IV LITERATURE REVIEW

[1]. Tanesh Kumar et.al. (2014) [1]. In this paper, they analyzed how does life and reliability of an integrated circuit is affected when it is operated in different regions under different temperatures. They have taken Fibonacci generator as our target circuit and LVCMOS as I/O standards. WPA and WPA2 (Wi-Fi Protected Access) key can be generated with Fibonacci generator. Here, thermal efficient green Fibonacci Generator is used to generate key for Wi-Fi Protected Access in order to make green communication possible under different room temperature. By analysis it is observed that at standard normal temperature (21^0 C), LVCMOS12 have 24%, 17.3% and 95.53% less junction temperature than LVCMOS25 at operating frequencies of 1 GHz, 10 GHz, and 100 GHz respectively.

[2]. Lu Liu et.al. (2014) [2] Wireless networks are an integral part of day-to-day life for many people, with businesses and home users relying on them for connectivity and communication. This paper examines the problems relating to the topic of wireless security and the background literature. Following this, primary research has been undertaken that focuses on the current trend of wireless security. Previous work is used to create a timeline of encryption usage and helps to exhibit the differences between 2009 and 2012. Moreover, a novel 802.11 denial-of-service device has been created to demonstrate the way in which it is possible to design a new threat based on current technologies and equipment that is freely available. The findings are then used to produce recommendations that present the most appropriate countermeasures to the threats found.

[3]. Y. M. Nykolaychuk et .al. (2014) [3] A systematic analysis of data transmission in sensor and local area networks is performed. Characteristics of a new class of signal correcting Galois field codes are described that provide error detection and correction at the physical level of computer networks without additionally generating and transmitting cyclic redundancy-check (CRC) codes. Methods are presented for processing harmonic signals by a digital processor with neurocomponents.

[4]. Amerah Alabrah et.al. (2013) [4]. The exponential growth in the use of mobile phones and tablets to gain wireless access to the Internet has been accompanied by a similar growth in

cyber attacks over wireless links to steal session cookies and compromise private users' accounts. The popular one-way hash chain authentication technique in its conventional format is not optimal for mobile phones and other handheld devices due to its high computational overhead. In this paper, they propose and evaluate the use of sparse caching techniques to reduce the overhead of one-way hash chain authentication. Sparse caching schemes with uniform spacing, non-uniform spacing and geometric spacing are designed and analyzed. A Weighted Overhead formula is used to obtain insight into the suitable cache size for different classes of mobile devices. Additionally, the scheme is evaluated from an energy consumption perspective. They show that sparse caching can also be effective in the case of uncertainty in the number of transactions per user session. Their extensive performance tests have shown the significant improvement achieved by the sparse caching schemes.

.Study about different logic families and their IO standards have been done from this 7 Series FPGA Select IO Resources User Guide.

[5]. Kumar, T et.al. (2014) [6] In this work, they are making energy efficient ALU using the most energy efficient LVCMOS IO standard for the highest frequency of i7 processor. It is observed that LVCMOS12 is the most energy efficient than all available LVCMOS having 26.23, 58.37 and 75.65 % less IO power reduction than LVCMOS18, LVCMOS25 and LVCMOS33 respectively at 1 GHz.

V Objective

- Design an efficient key generator for IEEE 802.11 WLAN standard.
- Enery Efficiency
- Calculate total power consumption
- Getting the most productivity from every unit of energy.
- Network monitoring
- Data compression

VI Methodology

- First of all coding of the key generator is being done on Xilinx tool in **Verilog Programming Language.**
- The coding will be solely depending upon the key as shown in the table below

Table 1: Table representing the formation of Cipher text from plane text with the **Fibonacci key generator**

PLANE TEXT	CIPHER TEXT IF KEY=1	CIPHER TEXT IF KEY=2	CIPHER TEXT IF KEY=3	CIPHER TEXT IF KEY=5
S	T	U	V	X
O	P	Q	R	T
N	O	P	Q	S
A	B	C	D	F
M	N	O	P	R

- After the generation of code the code will be tested at various technologies ranging from 90nm to 28nm and then the most energy efficient technique will be find out. Different FPGA's are shown in the figure below.

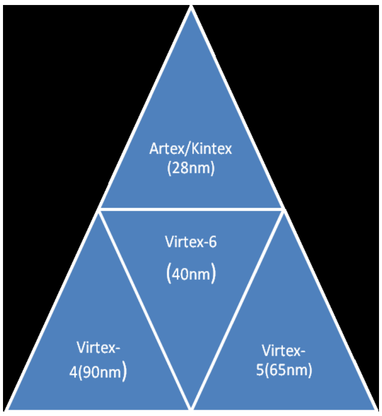

Figure 7: Different types of FPGA

- In this step the best design goal is being optimised out of the following techniques shown in the figure below.

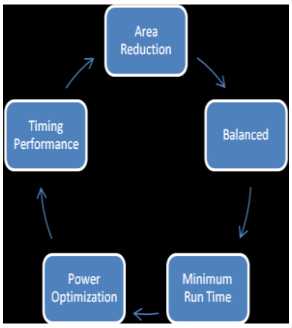

Figure 8: Different types of Design

IV CONCLUSION

IEEE 802.11 WLAN Specific Energy Efficient Key Generator Design For Green Communication" will be designed.

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