**THE NEXT 1961**

[Photonic chip]

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***Abstract***: *In this report a brief introduction on the limitations of electronic circuits, the necessity for photonic chip and the design of passive/active optical components is discussed.*

**INTRODUCTION**

*(Time Travel, Need for Photonic chip & About Photonic Chip)*

In the year 1961, *Jack Kilby and Robert Noyce* invented ‘**Silicon chip**’*,* an invention that changed the course of computers. Shrinking a room sized computer into a handheld device, from 5.3Hz clock (Z3 computer-1941)/2.25MHz clock (UNIVAC I -1951) to 8722.78MHz clock (AMD FX-8370) this rapid advancement in technology is due to silicon chip technology. In 1965, *Gordon Moore* made a statement, he stated that “the number of transistors on a chip doubles every 24 months”[1].This statement was held true. But from the past few years, the number of transistors on a chip reached saturation due to technological limitation to fabricate transistors under 3nm. Even if we find a way around it in near future, there is always the problem of quantum tunneling of electrons. Because of this, controlling and maintain the state of the transistors under 3nm is something which won’t be achieved in the near future as well. Let us consider someone will come up with a way to solve this. Then The Switching speed of the transistor will say Hi!. The only reason we scale down the transistors is to achieve low power consumption, high speed and to improve efficiency. But there is a limit to how many times you can switch between the states of the transistor. “Now a days, it’s a feat for most elite of silicon to even maintaining 5GHz for more than a few seconds. Even if we manage the switching speed the prime thing that will get effected is efficiency. For instance a 10 core CPU (i9) uses 100W @4.4GHz and it will easily reach 300W @5.4GHz i.e. the inefficiency is tripled to get 20% increase in performance”[2].

Photonic Chipcan overcome the limitations of Integrated circuits. An integrated circuit (IC) consists of electric components such as resistors, capacitors, inductors and transistors. Similarly in **Photonic Chip** the optical components are made up of waveguides(similar to resistors and wires),Lasers(similar to transistors),phase shifters and polarizers. In IC’s electric flux flows through the circuit and similarly photos are the carriers in Photonic Chip.

***“A photonic integrated circuit (PIC) is a chip that contains photonic components, which are components that work with light (photons).”[3]***

**Fig.1**. shows the advantages and applications of Photonic Chip

**DESIGN AND SOFTWARE**

*(Leading approach in designing/simulating photonic chip components )*

“Synopsys offers a seamless design flow to help design and analyze, layout and verify photonic devices, systems, and integrated circuits”[3].

“The **RSoft Photonic Device Tools** can be utilized stand-alone and are integrated with Synopsys **Sentaurus TCAD** products to provide streamlined, multi-disciplinary simulations of complex optoelectronic devices. Sentaurus TCAD geometry can be imported into RSoft photonic design tools such as **FullWAVE FDTD** for finite-difference time-domain (FDTD) analysis, **BeamPROP** BPM for rapid analysis of silicon photonics devices, and **DiffractMOD RCWA** for diffractive optical structure analysis.”[3].

The passive/active device’s can be designed in Sentaurus TCAD, which is similar to normal graphical user interface TCAD and can be simulated using Rsoft Photonic Device Tools to find different optical properties of the device.

Benefits of using photonic chips for Machine learning:

* Low energy consumption
* Good Parallelism
* Small delay and short processing time
* Independent of unified clock
* Low transmission loss

**Fig.2.** Brief description of the tools (as specified in the website )

*The results couldn’t be duplicated as these software’s are not open source and will try to replicate the results as soon as we get access to these software.*

**References**

[1] Gustafson, John L. "Moore's Law." (2011): 1177-1184.

[2] Brett Bergan, Will CPU chips ever get to a base clock of 7 or 8 GHz, <https://www.quora.com/Will-CPU-chips-ever-get-to-a-base-clock-of-7-or-8-GHz>.

[3]<https://www.synopsys.com/glossary/what-is-a-photonic-integrated-circuit.html>

[4]<https://www.synopsys.com/photonic-solutions/rsoft-photonic-device-tools.html>

[5]<https://www.synopsys.com/photonic-solutions/rsoft-photonic-device-tools/passive-device-fullwave.html>

[6]<https://www.synopsys.com/photonic-solutions/rsoft-photonic-device-tools/passive-device-beamprop.html>