Post Silicon Computer Architecture

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1 Introduction

Computer architecture is the science and design of computer processors and computer systems. It deals with the organisation, path of execution, interconnection of different components in computer.

Silicon is used in large proportions in the computers due to its availability and properties. It is used to make very small transistors, chips which are the main building blocks of computer. Transistor mainly work as switches, memory elements with capacitors. Presently the size of transistors being used in the high end computers is 7-10nm. We are about reach the size limit of practically usable transistors which is expected to be 5nm. The size is limited due to overheating, imperfection in making small Si transistors. So, we need to come up with new computer architecture which can make the computers even faster[4].

2 Future of computer architecture

2.1 Graphene

It is a monolayer of graphite. It has strong electric field effect (modulation of electrical conductivity of the surface by electric field), high carrier mobility and high thermal conductivity which make it a potential material for use as a transistor. Due to its high thermal conductivity, it is safer to fit large number of transistors in small area. Due to small and fast transistors, the clock frequency achievable is expected to be 475 GHz[6]. But the band gap of the pure material is almost negligible (0.25eV max[2]) which is a major hurdle for its use in transistors and research is being done to create a bandgap.

2.2 Quantum computing

Quantum computing is the use of quantum phenomena such as superposition (it is the mixing of two states to give a state which has partial properties of both) and entanglement (state one depends on the other despite of physical separation) to perform computation. Computers being used right now use bits at the core

but the quantum computers use the superposition of bits (qubits) and multiple bits are entangled. But these devices require very stable conditions, stable in the subatomic atomic level. Because slight disturbance leads to decoherence of qubits. So, presently these are operated only by large companies in the world[3].

2.3 Spintronics

In this architecture we use the spin of the electrons to represent the bit. This leads less power consumption and less heat. To implement this, we use a thin layer of insulator that is sandwiched between a fixed ferromagnetic material and free layer (which can change its magnetic moment). A one will be represented by both layers having same spin and zero by opposite spins. To change the state, we use spin transfer torque technique (passing current from the fixed state side to induce similar state to the free state)[5].

2.4 Computers using photons

This is a concept of using the photons instead of electrons to communicate and process. The advantages of using photons is, it is much faster than electrons thus enabling more number of cores to work simultaneously which is difficult with electrons, it dissipates lesser energy as compared to electrons. We can process the information parallelly i.e., different wavelengths can be allotted to different works and information. Transistors using light have been designed, but they are larger than the present electrical transistor[1].

3 Conclusion

It is observed that most of the above discussed technology deal with quantum effects because they work with sub atomic properties. There is large amount of research to take place in order to bring it into use. Substitution to present computers and methods will not happen any soon.

References

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[5] SciToons. What is spintronics and how is it useful?

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