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Advances towards Brain like Cloud Computing Environments with Molecular Circuits

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Abstract: **Miniaturization of electronics of which is core to computer architecture is trending towards small, fast and cooler circuits through solid state semi conductor technology. Traditional micro electronics has not designed technologies small and fast enough to fit in the nano scale supersonic speed based current research. The theory of nanocomputers where molecules through electrolytes are used to create circuits which work as logic gates, the backbone of decision making memory based circuits is currently being studied with good promises. Advances in scientific research in areas like the DNAs are hampered by the big size and "non thinking" traditional circuits. Cloud computing with Logic enabled molecular circuited computers are discussed including areas of application like robots, medicine and scientific research. Analysis of previous studies showing great strides made are used to predict future development. Diagrammatic illustrations included in the discussion section.**

Keywords: **Cloud Computing, Miniaturization, Molecular circuits, Logic gates, nanocomputing, Electrolytes**

I. Introduction

Technology is moving towards smaller ratios of components to produce smaller, faster and less heat producing circuits promising complex systems doing tasks which couldn't be imagined years before. Moletronics i.e. Molecule based information processing being harnessed to act as logic switches which can be exploited to make decision making circuitry. Memory resistors (Memristor) a major component of electronic circuits with storage or memory features can be used to revamp the nano-circuits to information storage capabilities. According to Moore, several components can now be crammed into a single silicon chip hence the latter's capabilities enhancement. Technological jump referred to as singularity where artificial intelligence through non biological means has been achieved with indications of surpassing humans. Towards the end of the decade, market forces will demand nanosytems based on quantum theory hence trends to traditional microelectronics will fizzle out. Cheaper hardwares with these systems will emergently follow suit. Cloud robotics will be mainstream i.e. robots that upload and download their tasks on nano cloud systems.

II. Literature Review

Kompa et al (2001) proposed a scheme for molecule-based information processing by combining well-studied spectroscopic techniques and recent results from chemical dynamics. Specifically it discusses how optical transitions in single molecules can be used to rapidly perform classical (Boolean) logical operations. In the proposed way, a restricted number of states in a single molecule can act as a logical gate equivalent to at least two switches. It is argued that the four-level scheme can also be used to produce gain, because it allows an inversion, and not only a switching ability. The proposed scheme is quantum mechanical in that it takes advantage of the discrete nature of the energy levels but, we here discuss the temporal evolution, with the use of the populations only. On a longer time range we suggest that the same scheme could be extended to perform quantum logic, and a tentative suggestion, based on an available experiment, is discussed. The need for increasing miniaturization of logical circuits is foreseen to soon reach the physical limit of MOSFET (Metal Oxide Semiconductor Field Effect) Transistors. There is therefore a worldwide search for alternatives. Single-molecule-based switches rectifiers and wires have indeed been recently reported. The switch reported allows an electrical current to flow or not, by causing a conformational change in catanane type molecules. The molecule was incorporated in a solid state device and could be recycled many times. A different route, which has been studied for some time is to combine chemical inputs with optical outputs. These are typically solution phase experiments, which have been used to advantage the progress in supramolecular chemistry for the construction of molecular machines. They discuss a molecule-based scheme for logical operations, which is different in its features. One merit of their scheme is that it involves well-established and well-characterized photo physicochemical processes. This enables them to know that we could anticipate eventually an ultrafast processing and can expect a rather fast (picoseconds time scale) response, even in preliminary studies. A point of chemical importance is that the scheme operates with the kind of molecules for which one has a great scope for organic synthesis so as to tailor the molecule to specific responses, both optical and kinetic. An important limitation, common to their scheme and to other proposals for computing with molecules, is the challenge of connecting the molecules. Their paper however provides an introduction to their proposal for molecular information processing, stressing the fundamental issues and avoiding mathematical formalism. In the background to the discussion is the observation by Shannon that there is an analogy between switches and Boolean logic operations. In fact, Shannon's proposal predates the invention of transistors and was first applied to electromechanical switches. The point is that it takes at least two switches to represent a logic operation. Transistors have replaced mechanical switches, but, in principle, the amplification ability of a transistor is not strictly essential for such applications. It is sufficient that the voltage applied to the gate can determine whether the transistor does or does not allow a current to flow. The output of existing gates can be used as input to other gates, thereby allowing concatenation. It has not escaped attention that a molecular coordinate, typically the reactive one, could be used as a bus and so several gates could be accommodated on one molecule although they restrict the actual discussion to one single gate per molecule.

Williams et al (2008) work discusses the development of a Memristor and how it works. A Memristor is a contraction of a memory resistor and is a two-terminal device whose resistance depends on the voltage applied to it and the length of time that voltage has been applied. This device remembers its history, that is, when you turn off the voltage, the memristor remembers its most recent resistance until the next time you turn it on. Moore (1965) “The future of integrated electronics is the future of electronics itself”. The advantages of integration will bring about a proliferation of electronics, pushing this science into many new areas. Integrated circuits will lead to such wonders as home computers. Or at least terminals connected to a central computer .automatic controls for automobiles, and personal portable communications equipment. The electronic wristwatch needs only a display to be feasible today. But the biggest potential lies in the production of large systems. In telephone communications, integrated circuits in digital filters will separate channels on multiplex equipment. Integrated circuits will also switch telephone circuits and perform data processing. Computers will be more powerful, and will be organized in completely different ways. For example, memories built of integrated electronics may be distributed throughout the machine instead of being concentrated in a central unit. In addition, the improved reliability made possible by integrated circuits will allow the construction of larger processing units. Machines similar to those in existence today will be built at lower costs and with faster turn-around. By integrated electronics, I mean all the various technologies which are referred to as microelectronics today as well as any additional ones that result in electronics functions supplied to the user as irreducible units. These technologies were first investigated in the late 1950s. The object was to miniaturize electronics equipment to include increasingly complex electronic functions in limited space with minimum weight. Several approaches evolved, including micro assembly techniques for individual components, thin film structures and semiconductor integrated circuits. Each approach evolved rapidly and converged so that each borrowed techniques from another. Many researchers believe the way of the future to be a combination of the various approaches. The advocates of semiconductor integrated circuitry are already using the improved characteristics of thin-film resistors by applying such films directly to an active semiconductor substrate. Those advocating a technology based upon films are developing sophisticated techniques for the attachment of active semiconductor devices to the passive film arrays. Both approaches have worked well and are being used in equipment today. IBM’s Blue Gene brain simulation has made gains in one of the most sophisticated tasks man has ever taken on—creating artificial intelligence (AI). With the true AI milestone comes the dawn of the singularity, when computers overtake humans. Contributing editor Glenn Reynolds looks into the future and wonders; what happens after the singularity? For some time now**,** futurists have been talking about a concept called the Singularity, a technological jump so big that society will be transformed. If they're right, the Industrial Revolution—or even the development of agriculture or harnessing of fire—might seem like minor historical hiccups by comparison. The possibility is now seeming realistic enough that scientists and engineers are grappling with the implications—for good and ill. When I spoke to technology pioneer and futurist Ray Kurzweil (who popularized the idea in his book The Singularity Is Near), he put it this way: "Within a quarter-century, nonbiological intelligence will match the range and subtlety of human intelligence. It will then soar past it."

Even before we reach that point, Kurzweil and his peers foresee breathtaking advances. Scientists in Israel have developed tiny robots to crawl through blood vessels attacking cancers, and labs in the United States are working on similar technology. These robots will grow smaller and more capable. One day, intelligent nanorobots may be integrated into our bodies to clear arteries and rebuild failing organs, communicating with each other and the outside world via a "cloud" network. Tiny bots might attach themselves to neurons in the brain and add their processing power—and that of other computers in the cloud—to ours, giving us mental resources that would dwarf anything available now. By stimulating the optic, auditory or tactile nerves, such nanobots might be able to simulate vision, hearing or touch, providing "augmented reality" overlays identifying street names, helping with face recognition or telling us how to repair things we've never seen before. Scientists in Japan are already producing rudimentary nanobot "brains." Could it take decades for these technologies to come to fruition? Yes—but only decades, not centuries. The result may be what Kurzweil calls "an intimate merger between the technology creating species and the technological evolutionary process it spawned." If scientists can integrate tiny robots into the human body, then they can build tiny robots into, well, everything, ushering in an era of "smart matter." Nanobots may be able to build products molecule-by-molecule, making the material world look a lot like the computer world—with just about everything becoming smart, cheap and networked to pretty much everything else, including your brain. It's almost impossibly futuristic-sounding stuff. But even that scenario is just the precursor to the Singularity itself, the moment when, in Kurzweil's words, "nonbiological intelligence will have access to its own design and will be able to improve itself in an increasingly rapid redesign cycle." Imagine computers so advanced that they can design and build new, even better computers, with subsequent generations emerging so quickly they soon leave human engineers the equivalent of centuries behind. That's the Singularity—and given the exponential acceleration of technological change, it could come by midcentury. It seems like a tall order, but lots of people think that such predictions are likely to come true. I asked science-fiction writer John Scalzi about Singularity issues and he pointed out that the Skype video we were using to chat would have seemed like witchcraft a few centuries earlier. Profound technological changes once took millennia, then centuries, and then decades. Now they occur every few years. The iPhone and pocket-size 12-megapixel digital cameras would have seemed amazing a decade ago. Web browsers are only about 15 years old. People (including my wife) have computers implanted in their bodies already, in the form of defibrillators, pacemakers and other devices. Still, I'm describing a world in which nanotechnology makes us (nearly) immortal, in which robots can make almost any object from cheap raw materials (basically, dirt) and in which ordinary people are smarter than Einstein thanks to brain implants—but still nowhere near as smart as fully artificial intelligences. That's a world that's hard to imagine. And what we do imagine can sound either good or bad. On the upside, what's not to like about being super-smart and healthy, with access to most products essentially for free? On the downside, could always-on links from our brains to the computing cloud lead to Star Trek's über-totalitarian Borg collective or something equally scary? And, what happens to those computer-brain interfaces and nanobots when they're taken over by the descendants of the Conficker worm? Now there's an argument for strong antivirus software. Dramatically enhancing human capabilities for good, alas, also means enhancing human capabilities for evil. That's something famed computer science professor and writer Vernor Vinge warns about: technology that could, as he wrote in his novel Rainbows End, "put world-killer weapons into the hands of anyone having a bad-hair day." Then there's the mind-control problem. Nanorobots floating around in your bloodstream could keep your coronary arteries from clogging, but they also could release drugs on command, making you, say, literally love Big Brother. Knowing what we know about human history, do such abuses seem terribly unlikely? Of course, the problem may never come up. Vinge, who originated the Singularity idea, has written about why it may never arrive —though he's betting the other way. So what can we do now to affect how things turn out? Some people are trying. The Foresight Institute has published guidelines for developing nanotechnology, such as a ban on selfreplicating nanobots that function independently (potentially turning the whole world into more nanobots, something known in the trade as the gray-goo problem) and sharp limitations on weapons-related nanotech research. Researchers in artificial intelligence are working on guidelines for producing “friendly AI” that would be well-disposed toward humans as part of their programming, thus foreclosing any pesky robotic world domination ambitions. NASA, Google and others have even started something called the Singularity University to study ways to avoid problems while still reaping the benefits. Some have suggested that we ought to go slow on the so-called GRAIN technologies (Genetics, Robotics, Artificial Intelligence and Nanotechnology). Sun Microsystems’ Bill Joy has even called for “relinquishing” some technologies he sees as dangerous. But I wonder if that’s such a good idea. Destructive technologies generally seem to come along sooner than constructive ones—we got war rockets before missile interceptors, and biological warfare before antibiotics. This suggests that there will be a window of vulnerability between the time when we develop technologies that can do dangerous things, and the time when we can protect against those dangers. The slower we move, the longer that window may remain open, leaving more time for the evil, the unscrupulous or the careless to wreak havoc. How fast and powerful can computers become?

Reed (2000) Will it be possible someday to create artificial "brains" that have intellectual capabilities comparable-or even superior-to those of human beings? The answers to these questions depend to a very great extent on a single factor: how small and dense we can make computer circuits. Few if any researchers believe that our present technology semiconductor-based solid-state microelectronics-will lead to circuitry dense and complex enough to give rise to true cognitive abilities. And until recently, none of the technologies proposed as successors to solid-state microelectronics had shown enough promise to rise above the pack. Within the past year, however, scientists have achieved revolutionary advances that may very well radically change the future of computing. And although the road from here to intelligent machines is still rather long and might turn out to have unbridgeable gaps, the fact that there is a potential path at all is something of a triumph. Even supported by nanotechnologies and nanomaterials, indicators in solid-state integrated electronics, such as the number of transistors, the power dissipation and the number of interconnections per chip, point out that progresses in microelectronics will slow down by 2015–2020. By 2025, the market may demand the exploitation of quantum behavior in nanoscale systems and the development of a picotechnology in order to put all the power of the computer in a single molecule, Joachim (2002). Moravec (1997) paper describes how the performance of AI machines tends to improve at the same pace that AI researchers get access to faster hardware. The processing power and memory capacity necessary to match general intellectual performance of the human brain are estimated. Based on extrapolation of past trends and on examination of technologies under development, it is predicted that the required hardware will be available in cheap machines in the 2020s.

Guizzo (2011) several research groups are exploring the idea of robots that rely on cloud computing infrastructure to access vast amounts of processing power and data. This approach, which some are calling "cloud robotics," would allow robots to off-load compute-intensive tasks like image processing and voice recognition and even download new skills instantly. A Google researcher argues that cloud computing could make robots smaller, cheaper, and smarter.

III. Commit to memory

Whereas combinational logic devices are indifferent with respect to the history of input application, sequential logic is related to a memory function, Pischel (2010). A proof-of-principle of the sequential logic concept at the molecular level was demonstrated recently with a surface-confined osmium complex (Figure 1). This is an important conceptual advance toward molecular information processing.

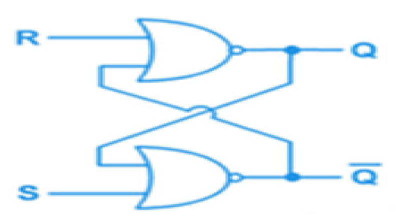

Figure 1. Logical circuits

Tian(2010) **En route to bits and bytes**: The integration of complex logic functions within individual molecules allows data processing at the molecular level, as demonstrated by recently reported molecular encoder and decoder devices. This research on decision-making molecules has great potential for future applications and more complex computing on a functional unimolecular platform. Kovtyukhova (2002) The concept of assembling electronic circuits from metal nanowires is discussed. These nanowires are synthesised electrochemically by using porous membranes as templates(Figure 2). High aspect ratio wires, which range from 15 to 350 nm in diameter and contain "stripes" of different metals, semiconductors, colloid/polymer multilayers, and self-assembling monolayers have been made by this technique. By using the distinct surface chemistry of different stripes, the nanowires can be selectively derivatized and positioned on patterned surfaces. This allows the current-voltage properties of single and crossed nanowire devices to be measured. Nanowire conductors, rectifiers, switches, and photoconductors have been characterized. Techniques are still being developed for assembling sublithographic scale nanowires into cross-point arrays for memory and logic applications.

Powell (2012) Anybody can find out how to crack the codes protecting your bank transfers and online credit card purchases. The step-by-step instructions for stripping away the secrecy were published years ago. Nobody is very worried about a possible security breach, though, because the code-cracking formula runs only on quantum computers. These contraptions, which exploit the rules governing the fuzzy world of quantum mechanics, have so far remained laboratory curiosities, less powerful than a slide rule. New blueprints could change all that. Rival technologies that have steadily matured in recent years--but failed to produce powerful quantum computers on their own--are now being married. Physicists playing matchmaker hope to build hybrid devices greater than the sum of their parts, dynamic duos in the spirit of Batman and Robin. "There's no

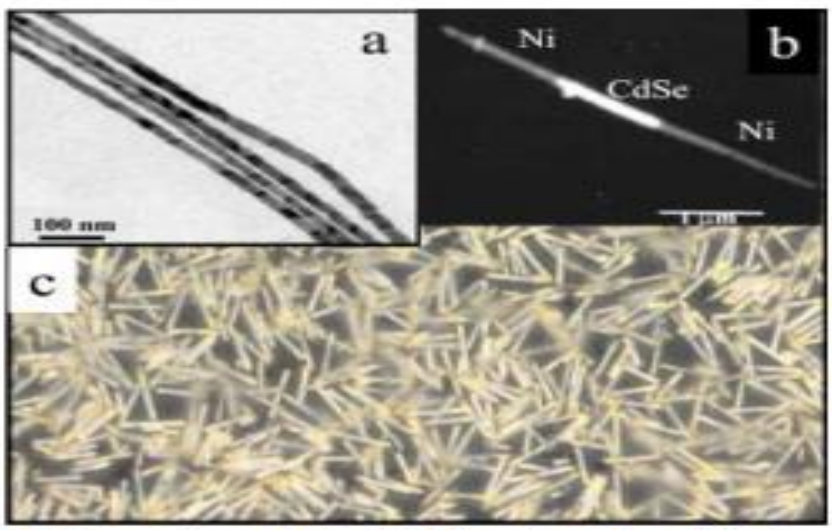

Figure 2. Electron micrographs of a) 20 nm diameter gold wires grown in polycarbonate membranes, and b) a 70 nm diameter Ni-CdSe-Ni wire grown in polycarbonate. An optical micrograph of 350 nm diameter Au-Pt-Au wires is shown in c).

clear map for the road ahead," says Jorg Wrachtrup, a physicist at the University of Stuttgart in Germany. "But some quantum processors will be a kind of hybrid system for sure."

Designs currently on the drawing board mimic the division of labor found in today's computers, where the hard drive is a magnetic material good for storing information and the processor is a silicon chip where information can be quickly manipulated. Quantum versions of these components would bring together objects of different sizes and personalities, from atoms to super-conducting circuits to chips of diamond as in Figure 3.

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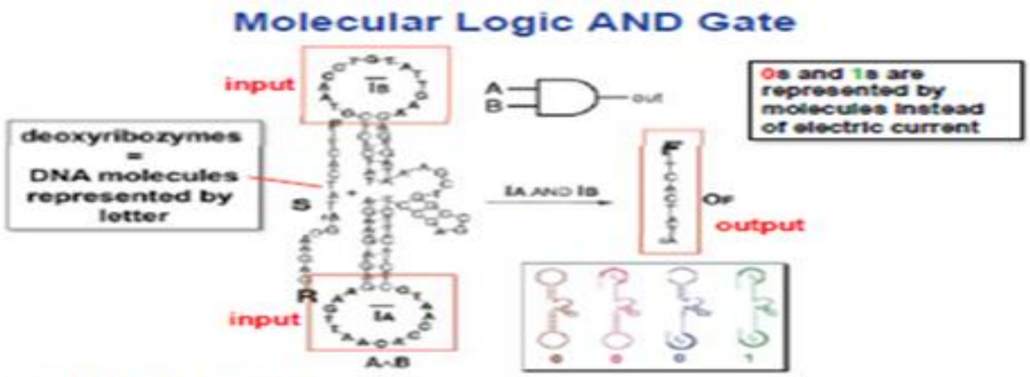

Fig.3 Molecular Logic Gates

Early research has shown that these would-be components can communicate with one another. A hybrid approach that stitches them together might one day yield a powerful quantum computer, useful not just for breaking codes. Such a computer could also tackle other problems difficult or impossible for today's ordinary computing machines from searching through piles of data faster than a conventional computer to simulating how molecules chemically react. "We can't promise a functional computer in five years," says Klaus Molmer, a quantum physicist at Aarhus University in Denmark. "But the very first experiments are promising." A matter of size Today's computers, whether PC or Mac, work with bits of information that are either a 0 or a 1. But quantum computing, an idea that can be traced to physicist Paul Benioff about three decades ago, works with the quantum analog of classical bits.

Figure 4. Organismic circuits created by the paths taken by the organism. This may be exploited into nano circuits and eventually nano computers

IV. Discussion

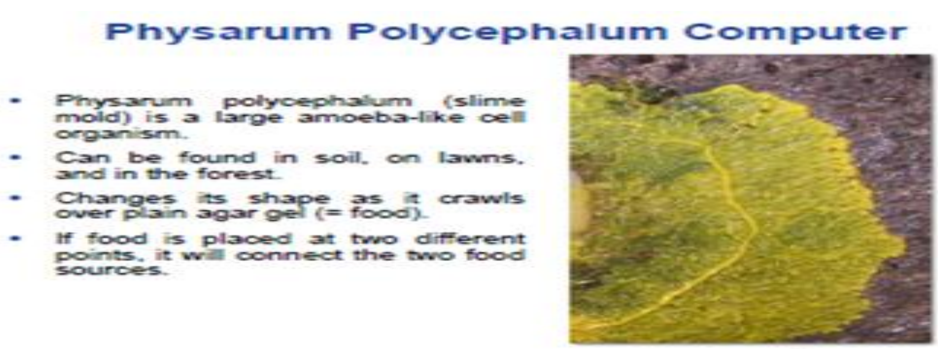

Figure 5. Food used to attaract the organism thereby making a circuit

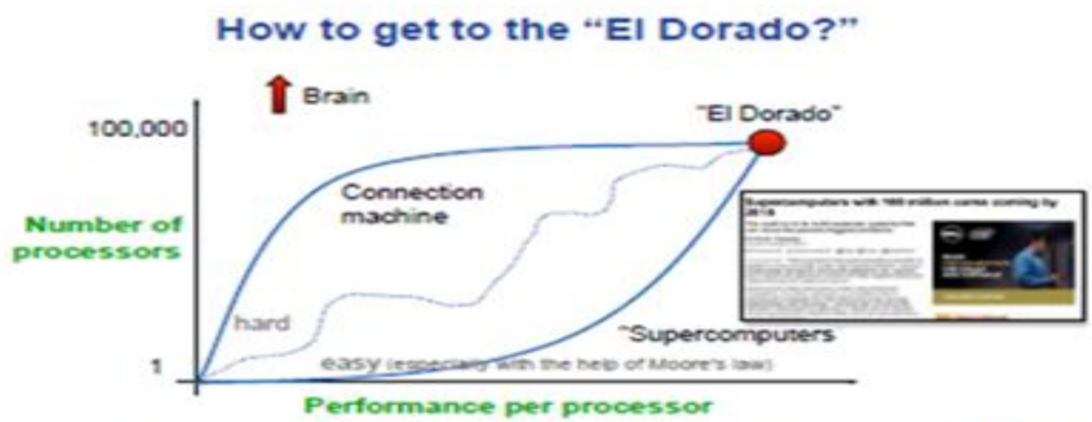

Figure 6. Eldorado, the place where the number of Processors and their Performance are closely like the brain

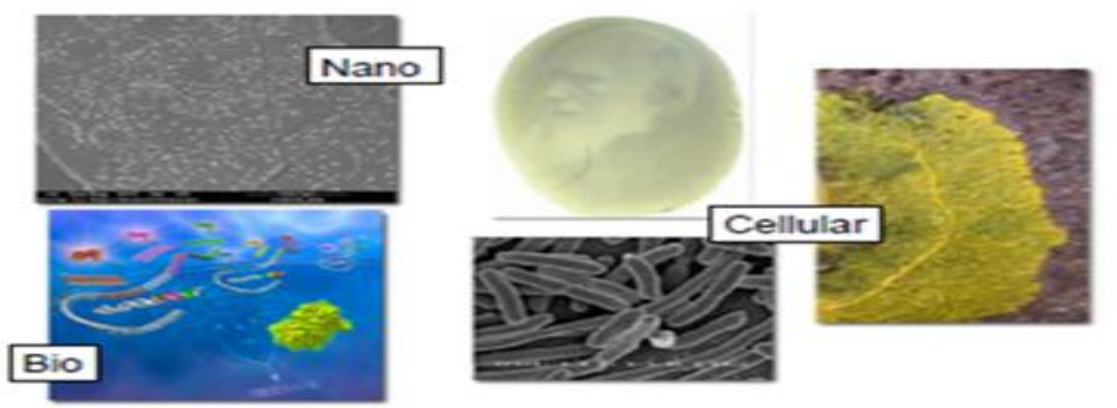

Figure 7. Framework for molecular circuits include nano, bio and cellular environments.

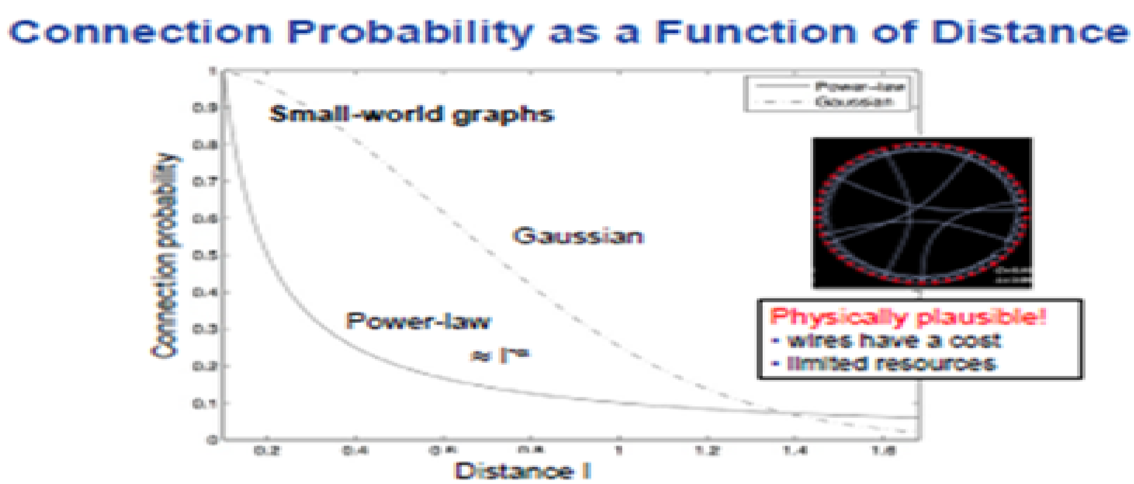

Figure 8. Gaussian and power law graphs used to illustrate the probability of having a connection relative to distance

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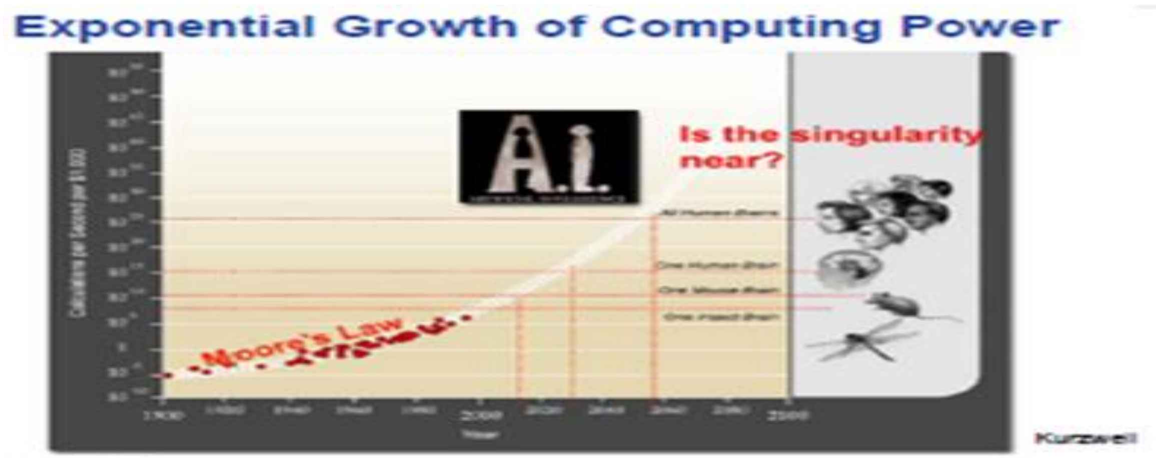

Figure 9. Singularity phase is when AI is surpassing computers in terms of resonating

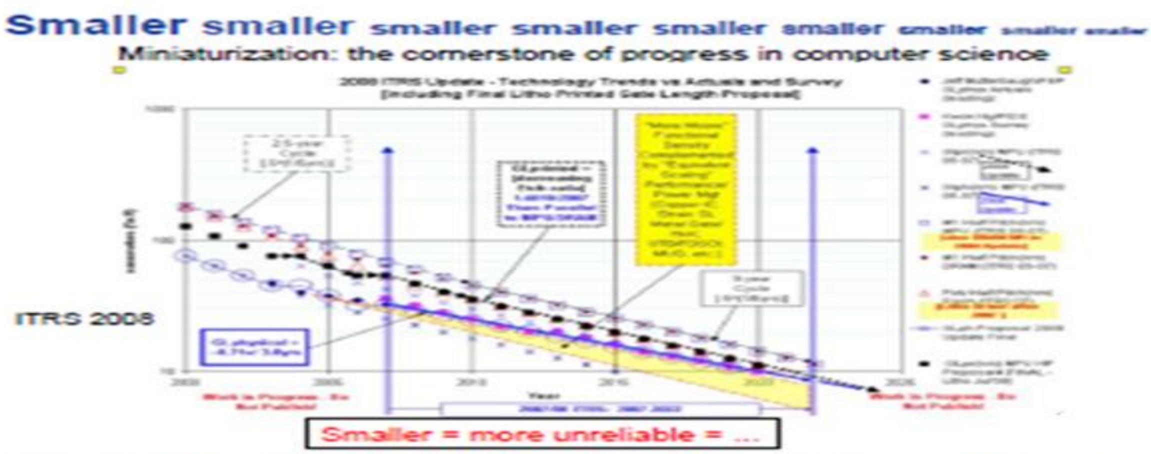

Figure 10: Miniaturization has led to smaller fast and cooler devices over the years

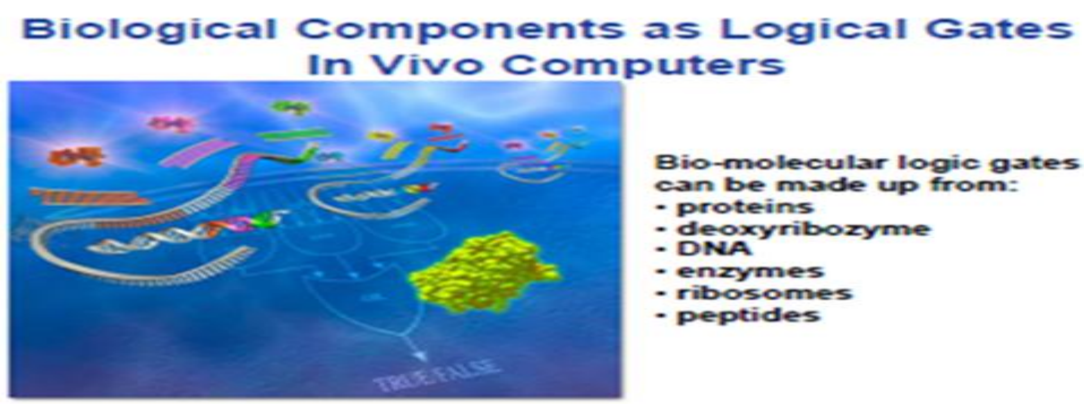

Figure 11. Bio circuits with resonating capacities

The above pictorial illustration gives the various advances in molecular circuits research and respective discussions having been captioned.

V. Conclusion

This paper establishes the fact that already advances in science have isolated molecules which have been demonstrated to act like logic gates which basically is decision theory. They can memorise and remember occurrences. They are also small, fast and consumer less energy i.e cooler. Cloud computing therefore is bound to follow suit since it is a product of computers. Ethics doesn't allow mimics of the human brain but some form of brain capacity has been established by researchers. This is a sensitive concept and no doubt requires more experimentation and research as most of the previous studies have also shown.

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