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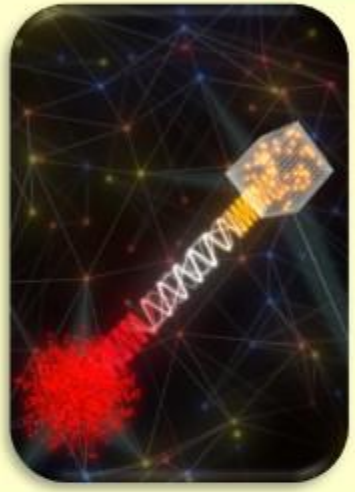
NEWSPAPER

ITEM WISE EDITORIALS

27th NOV, 2018

48th WEEK




AN INTRODUCTION TO QUANTUM COMPUTING

UPSC CSE – GS III

GS III ... Science and Technology

Learning Space

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THE HINDU

NEWSPAPER EDITORIALS ... DISCUSSION

27th NOVEMBER, 2018

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FOR QUANTUM INTERNET, WE NEED NEW PROTOCOLS

livemint

27th November, 2018

UPSC CSE – GS III

GS III ... Science and Technology

Awareness in the fields of IT, Space, Computers, robotics, nano-technology, bio-technology and issues relating to intellectual property rights.

2 FOR QUANTUM INTERNET, WE NEED NEW PROTOCOLS

Some months ago, I introduced the idea of quantum computing in this column. All of today's computing takes its root from the world of "bits", where a transistor bit, which lies at the heart of any computing chip, can only be in one of two electrical states: on or off. When on, the bit takes on a value of "1" and when off, it takes on a value of "0", constraining the bit to only one of two (binary) values. All tasks performed by a computer-like device, whether a simple calculator or a sophisticated computer, are constrained by this binary rule.

Eight bits make up what is called a "byte". Today, our computing is based on increasing the number of bytes into kilobytes, megabytes, gigabytes and so on. All computing advances we have had thus far, including artificially intelligent programmes, and driverless cars are ultimately reduced to the binary world of the bit.

This is a natural extension of western thought; for centuries, western philosophy has followed the principles of Aristotelian logic, which is based on the law of identity (A is A), the law of contradiction (A is not non-A), and the law of the excluded middle (A cannot be both A and non-A at the same time, just as non-A cannot be both non-A and A at the same time).

This axiom is so deeply imbedded in our thinking that to us, a statement that something is both A and non-A at the same time seems absurd. Paradoxically, however, the idea that something can be both A and non-A at the same time, the crucible of most eastern philosophical thought, is the essence of quantum computing. This idea was first proposed in 1985 by British physicist David Deutsch, but has gained currency only recently. With quantum computing, information is held in "qubits" that can exist in two states at the same time. Incredibly, a qubit can store a "0" and "1" simultaneously. If you build two qubits, they can hold four values at once—11, 10, 01, and 00.

...Contd.

2 FOR QUANTUM INTERNET, WE NEED NEW PROTOCOLS

So, adding on more qubits can greatly increase the computing capability of such a machine. IBM now has a new machine with a 50 qubit processor.

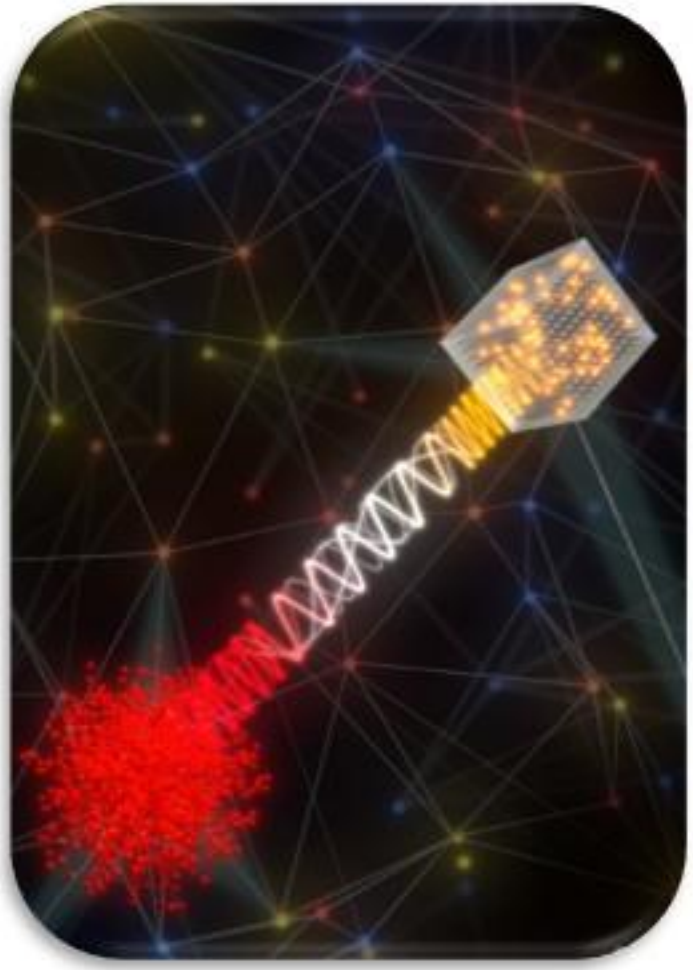
The logical extension of quantum computing is a quantum internet, where computers don't just compute in isolation, they also communicate with one another. Scientists are now working on how a quantum internet might work. To accomplish this, they are beginning by providing a vision of fundamentally new technology protocols to enable network communications between any two quantum computing machines on Earth. They say that such a quantum internet will—in synergy with the "classical" internet that we have today—connect quantum computers in order to achieve unparalleled capabilities that are impossible today.

As with any radical new technology, it is hard to predict all uses of the future quantum internet. In a recent issue of Science magazine, theoretical physicist Stephanie Wehner et al say that several major applications for the quantum internet have already been identified, including secure communication, secure identification, achieving efficient agreement on distributed data, as well as secure access to remote quantum computers in the cloud.

Obviously, the ability of a quantum internet to transmit "qubits" that are fundamentally different than classical "1" and "0" bits is what is paramount. According to the scientists' paper qubits also cannot be copied, and any attempt to do so can be detected. This makes qubits well suited for security applications. At the same time, the authors feel this makes the transmission of qubits require radical new concepts and technology, requiring concerted efforts in physics, computer science, and engineering to succeed. They propose the need for a unified framework for quantum internet researchers.

The authors say that although it is hard to predict what the exact components of a future quantum internet will be, it is likely that we will see the birth of the first multi-node quantum networks in the next few years. If so, all the ideas that so far only exist on paper may indeed turn out to be the dawn of a functional, large-scale quantum internet.

FIRST QUANTUM SATELLITE BY CHINA ... TWO YEARS PASSED!



1. Two years ago, Chinese physicists launched the world's first quantum satellite.
2. It doesn't beam radio waves.
3. Instead, the physicists designed it to send and receive bits of information encoded in delicate photons of infrared light.
4. It's a test of a budding technology known as quantum communications, which experts say could be far more secure than any existing information relay system.

WHAT ABOUT THE PRESENT DAY COMPUTING?

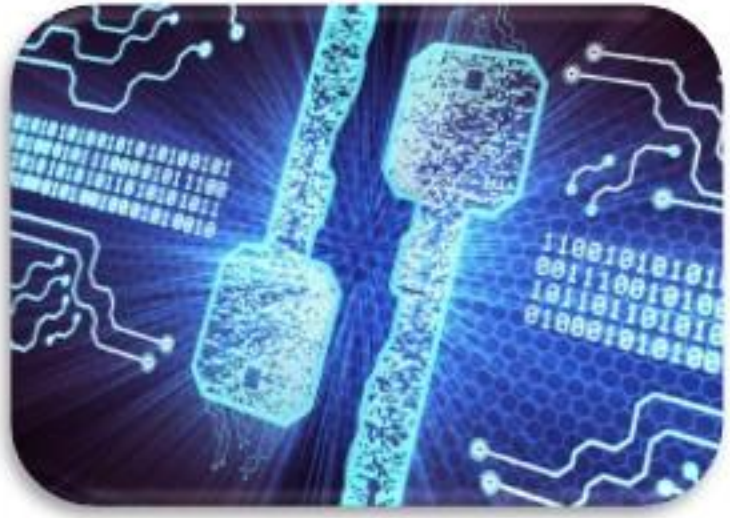
1. The present day computing is based on “Bits”.
2. They can be in one of two electrical states, On or Off.
3. When On, the bit takes a value of “1” and when Off, it takes value of “0”.
4. Hence, the bit is confined to only one of two values, which we call one of two binaries. These binary digital electronic computers based on transistors.
5. All the tasks performed by a computer-like device, whether a simple calculator or a sophisticated computer are constrained by this Binary Rule.

Eight bits make a “byte”. So, our computing is based on increasing the number of bytes into kilobytes, megabytes, gigabytes and so on. All the computing advances so far, including Artificial Intelligence programmes and driverless cars are ultimately reduced to the binary World of the bit.

CAN 1 & 0 EXIST SIMULTANEOUSLY?

DAVID DEUTSCH

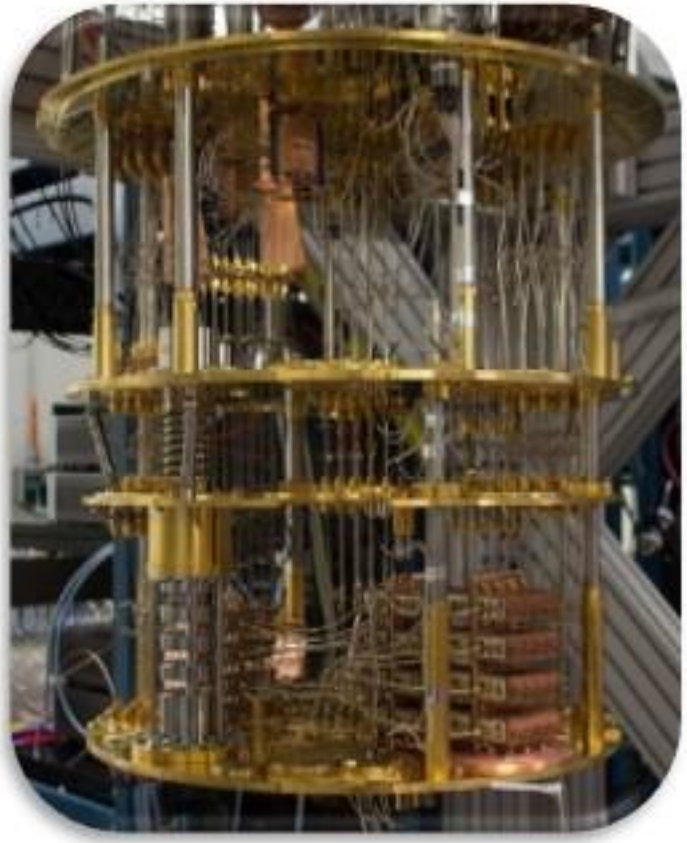
BRITISH-ISRAELI PHYSICIST



1. It looks absurd. A statement that something is both X and non-X at the same time looks absurd.
2. But, having them simultaneously is the essence of "Quantum Computing".
3. The idea was first proposed by British Physicist David Deutsch, in 1985.

In a quantum computer, a number of elemental particles such as electrons or photons can be used with either their charge or polarization acting as a representation of 0 and/or 1. Each of these particles is known as a quantum bit, or qubit.

MORE ON QUANTUM COMPUTING



1. Information is held in "Qubits", that means, they can exist in two states at the same time.
2. A qubit can store a "0" and "1" simultaneously, if you build two qubits they can hold four values at once; 11, 10, 01, and 00.
3. So, adding more qubits can greatly increase the computing capability of such a machine.

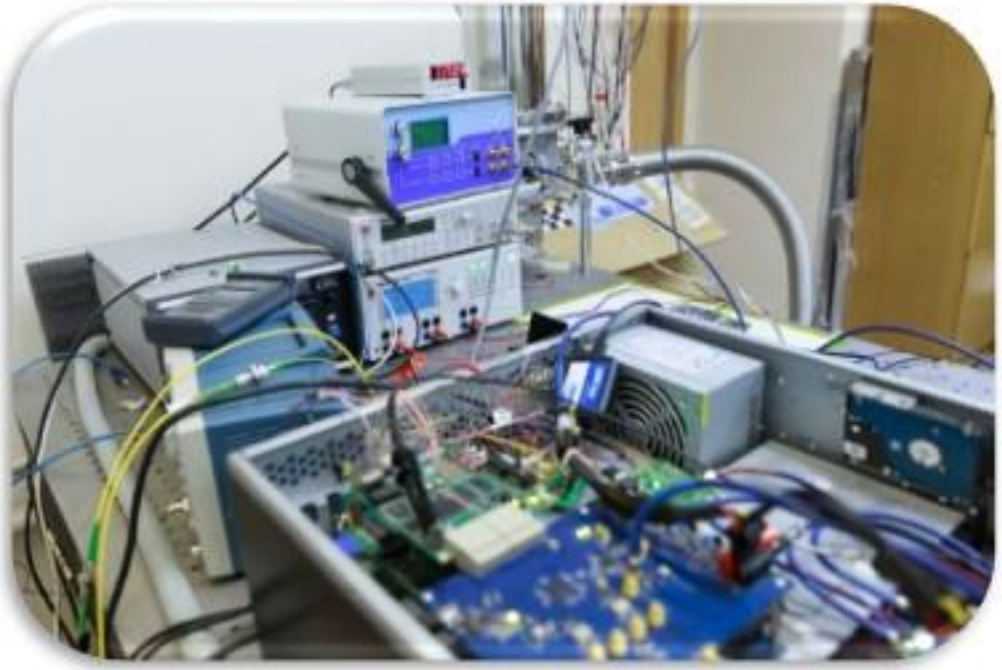
IBM now has a new machine with a 50 qubit processor.

NATURAL EXTENSION IS QUANTUM INTERNET!

1. The logical extension is quantum internet.
2. Here, computers don't just compute in isolation, they also communicate with each another.
3. Scientists are now working on how a quantum internet might work.
4. To accomplish this, they are beginning by providing a vision of fundamentally new technology protocols to enable network communications between any two quantum computing machines on Earth.
5. Qubits cannot be copied and any attempt to do so can be detected.
6. This makes qubits well suited for security applications.

Such a quantum internet will, in synergy with the classical internet connect quantum computers in order to achieve unparalleled capabilities that are impossible today.

BUT, WHAT IS REQUIRED?



1. Qubits require radical new concepts and technology.
2. They require concerted efforts in physics, computer science, and engineering to succeed.
3. They propose the need for a unified framework for quantum internet researchers.

It is likely that we see the birth of the first multi-node quantum networks in the next few years.

WE EXPRESS OUR SINCERE THANKS FOR VIEWING THIS VIDEO

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