

First Quantum Computing Network Opens in India [UPSC Current Affairs]

Quantum computing is a form of computing which employs technology based on quantum theory.

Quantum theory explains the behaviour of energy and material on the atomic and subatomic levels.

Employment of quantum theory will make sure computers work far beyond their binary code, as in they can only process information in bits that take the value of 1 or 0, restricting their ability in the process.

This article will give details about quantum computing within the context of the [IAS Exam](#). It is part of the Science and Technology segment.

Quantum Computing Latest Updates

Telecom Minister Ashwini Vaishnaw announced that the **country's first quantum computing-based telecom network link** is operational in the national capital, during the first international quantum enclave. He stated that a quantum communication link between Sanchar Bhawan and the National Informatics Centre office in the CGO Complex is now active. The Minister also offered prize money of ₹10 lakhs for ethical hackers who can successfully break the encryption of the system.

About quantum communication:

- Quantum communication is a method of transmitting information that relies on the principles of quantum mechanics.
- Unlike classical communication methods, which use electromagnetic waves to carry information, quantum communication uses individual particles of light, known as photons, to transmit data.
- Because photons are governed by the laws of quantum mechanics, they can be used to create unbreakable encryption keys. This is because any attempt to intercept the transmission would disrupt the photons and reveal the eavesdropper's presence.
- This makes quantum communication highly secure, as it is impossible to intercept or tamper with the transmitted information without disturbing the quantum state of the photons and alerting the sender and receiver to the intrusion.
- The most common type of quantum communication is called quantum key distribution (QKD), which involves using photons to create an encryption key that is shared between two parties. This key can then be used to encrypt and decrypt messages using classical communication methods.

- QKD has already been demonstrated over long distances, with researchers transmitting quantum-encrypted data over hundreds of kilometres of fibre-optic cable.
- However, quantum communication is still in the experimental stage and is not yet widely used for commercial purposes. This is because the technology is complex and expensive, and requires specialized equipment and infrastructure.
- Nevertheless, quantum communication is seen as a promising area of research with many potential applications, including secure communication for government, military, and financial institutions, as well as in the field of quantum computing.
 - Example: The Indian government decided to run pilot projects for communications networks and Indian Railways.

Significance of this breakthrough:

- **Secure communication:** One of the primary advantages of quantum communication is its ability to provide secure communication. It ensures that any information sent through quantum communication channels cannot be intercepted or accessed by any unauthorized party. This makes it an ideal technology for applications that require high levels of security, such as military and defence, government, and finance.
- **Data privacy:** With the increasing amount of data being generated and transmitted over networks, data privacy has become a significant concern. Quantum communication technology can help address this concern by providing an additional layer of security to data transmitted over networks. This can be particularly beneficial for businesses and organizations that deal with sensitive data.
- **Cybersecurity:** [Cybersecurity](#) is a significant concern in today's digital world. Quantum communication technology can help address this concern by providing a more secure way of transmitting data over networks. It can also help prevent cyber attacks, data breaches, and other security threats.
- **Healthcare:** Quantum communication technology can also be beneficial in the healthcare sector. It can be used for the secure transmission of medical data, including patient records and other sensitive information. This can help improve the efficiency and accuracy of healthcare services.
- **Research and development:** Quantum communication technology can also be beneficial for research and development activities. It can be used for the secure transmission of research data, including scientific papers, experimental results, and other sensitive information. This can help promote collaboration among researchers and ensure that research data remains secure and confidential.

Conclusion: Quantum communication technology can offer significant benefits to India in various sectors, including defence, government, finance, healthcare, and research and development. Its

ability to provide secure communication and data privacy makes it an essential technology in today's digital world.

Overview of Quantum Computing

Quantum computing is based on two features of quantum physics: Superposition and entanglement.

Superposition means the ability of a quantum system to exist in multiple states at the same time. Entanglement, on the other hand, is the ability of two members of a pair (Qubits) to exist in a single quantum state.

Both these features allow quantum computers to handle operations beyond the limits of conventional computers while consuming lesser amounts of energy.

Research in quantum computing began in the 1980s when it was discovered that some computational problems could be solved efficiently with the help of quantum algorithms as opposed to their classical counterparts.

Quantum computing would help immensely in fields of finance, military, intelligence, drug design, discovery, artificial intelligence and digital manufacturing.

Difference between Quantum Computing and Classical Computing

Quantum computers are able to process information differently. While classical computers can only process data as either 1 or 0 at different times, quantum computers can process 1 or 0 at the same time. This is known as qubits. When qubits are linked together, this increases the processing power of quantum computers greatly.

Classic computers are good at completing everyday tasks that do not involve complex amounts of data to be processed. Quantum computers are better for running complex simulations, chemical or drug trials or any form of tasks which involve processing complex levels of data. However, quantum computers are expensive to build and maintain.

Quantum computing can help in developing new drugs to fight diseases like cancer or run simulations that can test the effectiveness of such drugs. They also help in improving radars and in keeping an eye on the environment using chemical sensors.

While some companies have built personal (although expensive) quantum computers, there is still nothing available on the commercial side. And there is interest in quantum computing and its

technology, with JPMorgan Chase and Visa looking into the technology. Once developed, Google could launch a quantum computing service via the cloud.²

India and Quantum Computing

In the Union Budget of 2020-2021, the Central Government has allocated Rs. 8000 crore for the [National Mission on Quantum Technology and Applications \(NMQTA\)](#).

The mission seeks to develop quantum computing linked technologies amidst the second quantum revolution and make India the world's third-biggest nation in the sector after the US and China.

- The areas of focus of the NM-QTA Mission will be fundamental science, translation, technology developed and towards fulfilling natural properties
- The mission can help prepare next generation skilled manpower, boost translational research and also encourage entrepreneurship and start-up ecosystem development.
- Quantum principles will be used for engineering solutions to extreme complex problems in computing, communications, sensing, chemistry, cryptography, imaging and mechanics
- Their applications will be boosted include those in aerospace engineering, numerical weather predictions, simulations, securing the communications & financial transactions, cybersecurity, advanced manufacturing, health, agricultural, education
- It can bring Indian in the list of a few countries with an edge in this emerging field and will have a greater advantage in garnering multifold economic growth and a dominant leadership role.