Long-distance quantum communications link

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Long Distance Satellite Communications is the solution to the security and the cost of data transmission in the future. The exploration in this field by Chinese and Elon Musk's SpaceX is commendable. It is advisable for the UPSC CSE aspirants to update themselves about these from the exam's point of view and as a quest for knowledge as well.

In news China's quantum satellite
Placing it in syllabus

1. Science and Technology- developments and their applications and effects in everyday life
2. Awareness in the fields of Space

Static dimensions

1. Long-distance satellite communication
2. Quantum communications

Current dimensions

1. China's quantum satellite
2. SpaceX Starlink

Content

What is Long Distance Satellite Communication?

- If the communication takes place between any two earth stations through a satellite, then it is called satellite communication. In this communication, electromagnetic waves are used as carrier signals.
- These signals carry information such as voice, audio, video or any other data between ground and space and vice-versa.

What is Quantum computing?

- All computing systems rely on a fundamental ability to store and manipulate information. Current computers manipulate individual bits, which store information as binary 0 and 1 states.
- Quantum computers leverage quantum mechanical phenomena to manipulate information. To do this, they rely on quantum bits or qubits.

What is Quantum entanglement?

- This leads to correlations between observable physical properties of the systems.
- For example, it is possible to prepare two particles in a single quantum state such that when one is observed to be spin-up, the other one will always be observed to be spin-down and vice versa, this despite the fact that it is impossible to predict, according to quantum mechanics, which set of measurements will be observed.
- As a result, measurements performed on one system seem to be instantaneously influencing other systems entangled with it.
- But quantum entanglement does not enable the transmission of classical information faster than the speed of light.
- Quantum entanglement has applications in the emerging technologies of quantum computing and quantum cryptography, and has been used to realize quantum teleportation experimentally.

Chinese Satellite Micius

- It is the world’s first quantum communications satellite and has, for several years, been at the forefront of quantum encryption. It sends particles of light to Earth to establish the world’s most secure communication link.
- It was launched in 2016.

- It serves as the source of pairs of entangled photons, twinned light particles whose properties remain intertwined no matter how far apart they are. If one of the photons is manipulated, the other will be similarly affected at the very same moment.
- It uses entanglement-based quantum key distribution.
- Micius has previously produced entangled photons and delivered them to two ground stations (observatories) 1,200 kilometres apart via special telescopes. Scientists showed the photons reach Earth as entangled as they were in orbit.
- This gave a robust, unbreakable cryptographic protection. Until now, this had never been done via satellite or at such great distances.
- Secure long-distance links such as this one will be the foundation of the quantum internet, the future global network with added security powered by laws of quantum mechanics, unmatched by classical cryptographic methods.
- Any country could theoretically trust Micius to provide entangled photons to secure its communications. But the satellite is a strategic resource that other countries are likely to want to replicate, just as Europe, Russia and China now have their own versions of the US-controlled GPS.

SpaceX Starlink Network

- It is one of several on-going efforts to begin beaming out space-based data signals.
- Under the project, the company intends to evolve into a constellation of nearly 12,000 satellites to provide low-cost and reliable space-based Internet services to the world.
- The project launched in 2015.
- The project ensures that reliable and uninterrupted Internet services are universally available in every part of the globe.

- The existing conventional methods of internet access have not been able to reach all locations, so this space-based technology will be able to solve this problem and provide a network to all.
- Lower Earth Orbit (LEO) has been preferred over the geostationary orbit as this area is far away and latency problems would arise.

Mould your thought What is long distance communication? What all are the breakthroughs that have been achieved in the recent past?