NITI Aayog Calls for Quantum Strategy

For Prelims: Quantum Computing, National Quantum Mission, Post-Quantum Cryptography (PQC), atomic clocks, Quantum Communication.

For Mains: National Quantum Mission, Other India's Initiative in Quantum Computing.

Source: ET

Why in News?

A research paper titled ***"Quantum Computing: National Security Implications & Strategic Preparedness"*** by **NITI Aayog's Frontier Tech Hub (NITI-FTH)**, highlights the importance of **quantum computing** for India's security and economy, urging a multi-pronged approach to address **national security risks** from quantum advancements.

Quantum Computing

- It refers to a **class of technologies that leverage the principles of quantum mechanics** to perform computations and achieve capabilities not possible with traditional technology.
- It uses **qubits (quantum bits)**, which govern the behavior of matter at the atomic level. Unlike classical systems, which work in a **predictable way, qubits behave unpredictably,** enabling quantum computers to perform tasks that traditional technologies can't.

What are the Key Highlights of NITI Aayog's Report on Quantum Computing?

- **Global Quantum Investments:** Over **40 billion USD pledged by 30+ governments** worldwide. **China leads** with a **15 billion** USD investment, followed by the **US** and **Europe**.
- **India's Scenario:** The **National Quantum Mission (NQM)** was launched with a **budget allocation of Rs 6,003 crore** to **develop indigenous capabilities** in quantum technology and position India as a global leader in this emerging field.
- **Implications:** It has **dual-use applications** in the military and intelligence sectors, quantum technology can enhance **encryption, improve surveillance systems, and advance weaponry,** giving nations a technological edge in defense and national security.
    - Economically, they can drive innovation, create high-tech industries, and attract investment.

What are the Challenges Highlighted By Niti Aayog Report on

Quantum Computing?

- **Lower Funding Compared to Global Peers:** India has **allocated ₹6,003 crore (~USD 750 million) for the NQM**, which is significantly **lower than that of other global players.** This **limits India's ability to compete in quantum infrastructure**, cutting-edge research, and talent acquisition.
    - **Funding gaps hinder large-scale commercialization**, delaying India's progress in building quantum supremacy.
- **Weak Domestic Supply Chain:** Quantum computing relies on highly specialized components, such as **Cryogenic systems for cooling quantum processors, High-purity materials** for building stable quantum circuits. India lacks indigenous manufacturing capabilities, leading to heavy dependence on foreign suppliers.
- **Limited Startup and Industry Participation:** Unlike the **US and Europe**, where **tech giants like Google, IBM, and Microsoft** drive quantum innovation, India's quantum ecosystem is **primarily driven by academia**.
    - Lack of private sector investment and venture capital funding limits the scalability and commercialization of Indian quantum innovations.
- **Cybersecurity Risks:** Quantum computers will eventually be capable of **breaking current encryption standards**, making **existing cybersecurity frameworks obsolete**.
    - **Sensitive government, military, financial, and personal data** stored using traditional encryption methods will be at risk.
    - Online banking, digital payments, and secure communications could be compromised, leading to economic instability and cyber fraud.
- **Intelligence & Espionage:** Quantum computing will significantly improve **Signals Intelligence (SIGINT)**, allowing nations to **decrypt intercepted communications at an unprecedented scale**.
    - Confidential diplomatic cables, military strategies, and classified intelligence could be exposed, posing serious risks to national security.
    - Nations with quantum decryption capabilities will gain a strategic advantage in intelligence gathering and cyber warfare.
    - **Adversaries equipped with quantum-powered defense systems** could gain an upper hand in military strategy and warfare technologies.

What is Quantum Technology?

Click Here Read More: Quantum Technology

Click Here Read More: Challenges and the Way Forward Related to Quantum Computing.

What is the National Quantum Mission?

- **About:** The Union Cabinet approved the National Quantum Mission (NQM) on 19th April 2023 for the period from **2023-24 to 2030-31.**
    - It aims to seed, nurture and scale up scientific and industrial R&D and create a vibrant & innovative ecosystem in Quantum Technology.
- **Key Objectives:**
    - **Development of Quantum Computers:** Create intermediate-scale quantum computers with **50-1000 physical qubits over 8 years,** using platforms like superconducting and photonic technologies.
    - **Secure Communications:** Satellite-based secure quantum communication between ground stations over 2000 km within India.
        - Long-distance secure quantum communications with other nations.
    - **Quantum Sensing and Metrology:** Development of high-sensitivity magnetometers and **atomic clocks** for precision timing, communications, and navigation.
    - **Establishment of Thematic Hubs (T-Hubs):** Set up 4 T-hubs in top academic and national R&D institutes in the domains of:

- [Quantum Computing]
- [Quantum Communication]
- **Quantum Sensing & Metrology**
- **Quantum Materials & Devices**

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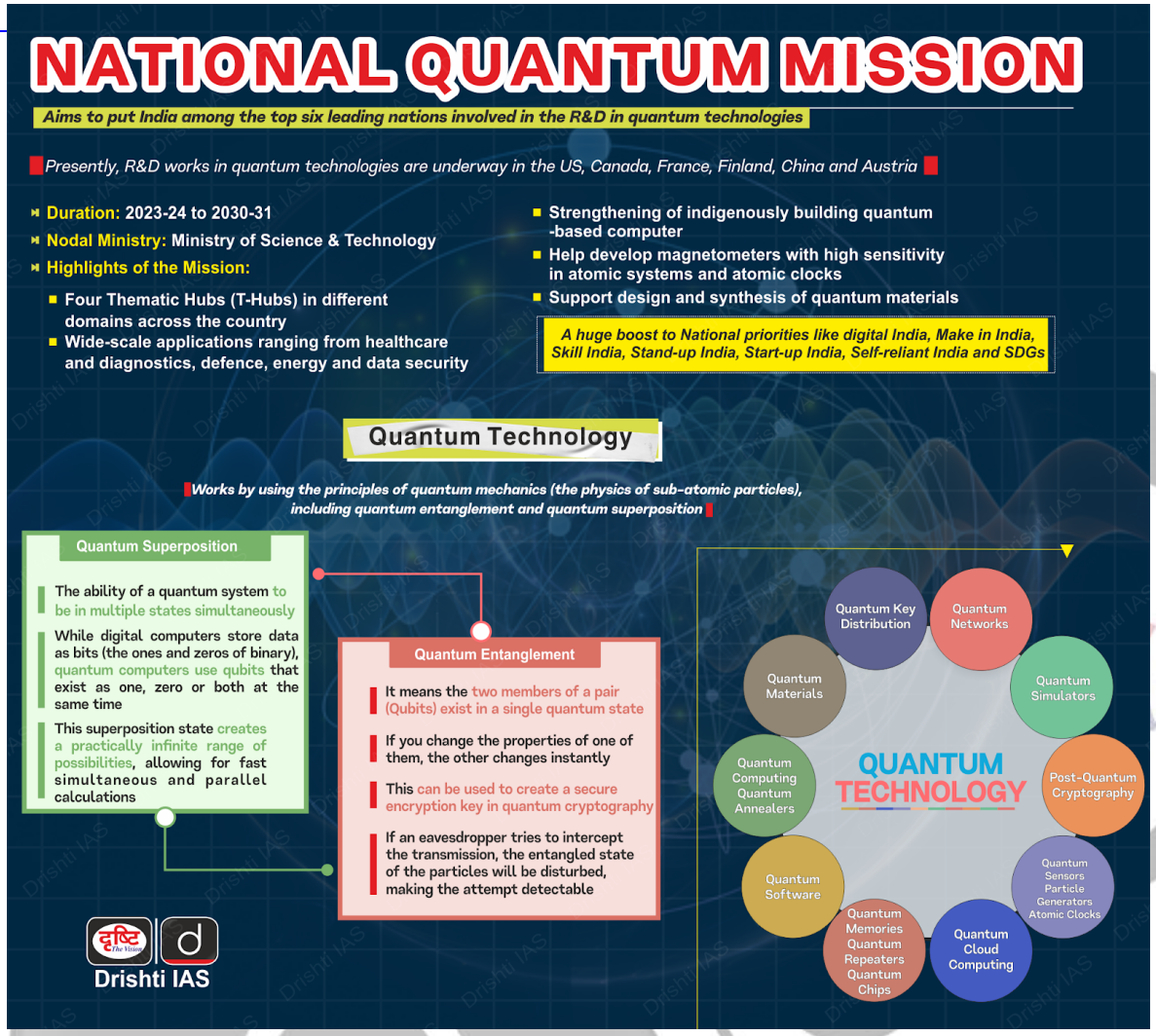

What are the Recommendations Suggested by Niti Aayog on Quantum Computing?

- **Enhancing National Security Policy:** Establish a Task Force to continuously track global quantum advancements and assess potential threats.
    - Develop an **Early Warning System to identify and mitigate emerging quantum threats** before they impact national security.
    - Implement a [Post-Quantum Cryptography (PQC)] **Transition Plan** to secure government, financial, and industrial data against future quantum cyberattacks.
- **Boosting R&D:** Increase R&D funding to accelerate quantum startups and support indigenous hardware development.
    - **Encourage private sector involvement** to bridge the gap between academia and industry for faster commercialization.
- **Strengthening Domestic Supply Chain:** Develop a robust domestic manufacturing ecosystem for critical quantum hardware components **such as cryogenic systems, high-purity materials, and specialized lasers.**
    - Reduce dependency on foreign imports by investing in **quantum chip fabrication** and

hardware production facilities.

- **Expanding Global Partnerships:** Forge bilateral agreements with **leading quantum nations** such as the **US, European Union, and Japan** to gain access to cutting-edge research, hardware, and expertise.
    - **Advocate for relaxed export controls** on critical quantum components to **ensure uninterrupted access to essential technologies**.

Drishti mains Question

Q. Quantum technology is set to reshape global security and economic landscapes. Discuss the security challenges posed by quantum computing and suggest measures India should take to safeguard its national interests.

UPSC Civil Services Examination Previous Year Question (PYQ)

Prelims

Q. Which one of the following is the context in which the term "qubit" is mentioned?

(a) Cloud Services

(b) Quantum Computing

(c) Visible Light Communication Technologies

(d) Wireless Communication Technologies

Ans: (b)

Mains

“The emergence of the Fourth Industrial Revolution (Digital Revolution) has initiated e-Governance as an integral part of government”. Discuss. (2020)