ATOMIC CLOCKS

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Context:

Recently,India is taking a significant step by deploying atomic clocks across the nation to synchronize all digital devices with Indian Standard Time (IST).

Background:

This initiative aims for “one nation, one time,” enhancing uniformity and national security.

About ATOMIC CLOCKS:

1. An atomic clock is a highly accurate timekeeping device that combines a quartz crystal oscillator with an atom (typically caesium or hydrogen).
2. It uses the consistent frequency of atoms to maintain accurate time, making it more stable than conventional quartz clocks.
3. These clocks were invented in 1955 by Louise Essen.

How Do Atomic Clocks Work?

1. Atomic clocks use atoms, specifically the electronic transition from one state to another, as their “pendulum.”
2. The vibrations of atoms (such as caesium or rubidium) serve as the basis for precise time measurement.
3. By sending microwaves to these atoms, we can make them vibrate even more regularly. We then compare these vibrations with the vibrations of a quartz crystal in a regular clock.

Types of Atomic Clocks:

1. Caesium Atomic Clocks: These are widely used and serve as the primary standard for defining the SI second.
2. Hydrogen Maser Atomic Clocks: Even more accurate than caesium clocks, hydrogen maser clocks find applications in scientific research.

Atomic Clocks in India:

1. The Council of Industrial and Scientific Research (CSIR)-National Physical Laboratories (NPL) in New Delhi maintains Indian Standard Time (IST) using caesium and hydrogen maser clocks.
2. To enhance uniformity and national security, India is deploying atomic clocks nationwide.
3. New atomic clocks are being set up in Bhubaneswar, Jaipur, and Hyderabad, in addition to existing ones in Faridabad and Ahmedabad.
4. By June, these new clocks will be installed, and the government will require all device

manufacturers to sync with Indian Standard Time.
5. The goal is to connect all atomic clocks using optical cables for enhanced security.

Why Indigenous Atomic Clocks?

1. Ensures national security and independence in timekeeping.
2. During the Kargil War in 1999, the US turned off GPS for the Indian Army, causing location inaccuracies. This incident prompted India to develop its own precise clock.
3. Currently, most software operating modules rely on US-based Network Time Protocol servers.
4. Only four countries—the United States of America, the United Kingdom, Japan, and South Korea—have developed their atomic clocks.

Indian Standard Time (IST):

1. IST was adopted on September 1, 1947, with only one time zone for the entire country.
2. It is calculated from 82.5 degrees East longitude, near Mirzapur (Allahabad), Uttar Pradesh.
3. IST is 5.30 hours ahead of Greenwich Mean Time (GMT) .