

SPOTLIGHT

Jacob Koshy

Indian Standard Time (IST) is created at the CSIR-National Physical Laboratory (NPL) in a room the size of an office cubicle on a sprawling Delhi campus. This, not in the Einsteinian way of space and gravity doing mysterious things, nor in the pejorative way about Indian time being stretchable. Time here emerges as a consensus of a parliament of clocks.

On August 27, the Department of Consumer Affairs notified the Legal Metrology (Indian Standard Time) Rules, 2026, which make IST the only permissible time reference in the country for legal, administrative, commercial and official purposes, require that it be drawn from an authorised Indian source, and come into force in the last week of February 2027.

It is easy to forget that a second does not exist. Not in the existentialist, what-really-is-time sense, but in the same way that a decibel is just a ratio of perceived sound to the quietest imaginable quiet. The 'second', that way, is a mathematical derivative and a unit of repetition.

Take anything that repeats regularly, divide its duration into equal parts, and those parts become 'units'. For millennia that thing was the Earth:

86,400 seconds made a day. Nothing could seem more regular, until it emerged that it was not. The Moon's pull, ocean currents, the breathing atmosphere and the churn of magma deep inside the planet all, incrementally, upset its rotation.

Atoms are steadier. If elements were musical genres, the soft silvery-golden caesium would be punk; it melts at room temperature and reacts violently with water. In a vacuum, however, it is unusually well behaved. Its atoms possess a switch between two internal states, triggered by radiation, at one exact frequency. In 1967, the General Conference on Weights and Measures ordained that a second was 9,192,631,770 cycles of that radiation.

An atomic clock does not count seconds by watching anything move. NPL's are beige boxes stacked on two grey racks, and inside each is a sealed tube under vacuum. The clock needs a signal at roughly the right frequency, and something to tell it when that signal is exactly right. The signal comes from an ordinary quartz oscillator, of the sort in a ₹2,000 watch, whose hum the electronics multiply up into microwaves. The second is caesium. Atoms boil in a small oven and fly the length of the tube through those microwaves; if the frequency is exactly

Making every second count

From February 2027, Indian Standard Time — ascertained in one room in Delhi — will become the country's only legal time. Getting there means audits of every bank, telco, and data centre, and reviving India's home-grown satellite network



CSIR-National Physical Laboratory Director Venu Gopal Achanta flanked by senior scientists Poonam Arora and Sumit Kumar Mishra on the NPL campus in New Delhi. SHASHI SHEKHAR KASHYAP

right, some flip to their other state, and a detector counts how many did. Otherwise the count falls, and the electronics nudge the oscillator back. The atoms are a referee. They do not keep time and only judge the crystal that does.

Governing time

The atom may be incorruptible but the apparatus around it is not. Caesium clocks drift, and adding

more does not fix that. So NPL governs time the way its birth twin — India — has governed itself since 1952. It holds elections. Five caesium clocks and three hydrogen masers run together weighted by a secret in-house algorithm and re-weighted as individual clocks misbehave. Caesium alone defines the second, so the five set the rate; the masers, smooth over hours, dispense it.

What results is a local realisation of Coordinated Universal Time (UTC), plus five and a half hours. UTC itself is computed at Sèvres, outside Paris, from 450 clocks at 85 laboratories — and is never broadcast, because it does not exist in real time. It is published monthly, as backlog, telling each laboratory how far off it was 30 days ago. Every timekeeper is thus steering towards a tar-

get that will not be known for another month. "We need to steer it as close to the UTC, predicting it — that is the art," says Professor Venugopal Achanta, Director, CSIR-NPL.

"The problem now comes in the dissemination," Achanta says, and this is where the achievement leaks away.

The clocks are good to one part in a hundred trillion but what leaves the building by satellite is good only to a few billionths of a second. Fibre does better — BSNL lost just 40 picoseconds carrying a signal 460 km from Bengaluru to the National Stock Exchange in Chennai. For everybody else, who do not need fastidious fidelity, there is a ping: NPL's 20-odd servers field 30,000 requests a second.

GPS has broadcast excellent time, free for four decades and virtually every network in India takes it from there. "At the user level, there's nothing much we have to do," he says.

The government has decided otherwise. On August 27, it notified the Legal Metrology (Indian Standard Time) Rules, 2026, making IST the only permissible time reference for legal, administrative, commercial and official purposes, requiring that it be drawn from an authorised Indian source, and coming into force in the last week of February 2027.

"The Akashvani bulle-

tins used to start with a beep, a time check — that was from NPL," Achanta muses. "We evolved standards for everything except time."

Inspectors who for decades weighed the sweet-shop's scale will now audit whether a bank's servers are traceable to IST.

Why bother? GPS is a U.S. Air Force asset, and its signal can be denied, jammed or falsified. "We don't know what Trump will say next second. He may say 'Block all signals', or 'Pay me for using the satellite'," Achanta says.

Timestamps are also evidence: if two parties dispute when a bid was made, "both are correct, because one is taken from some other country and this guy is taking it from IST".

NavIC experience

Those same fears produced NavIC, approved in 2006. But its rubidium clocks came from a single European vendor and began failing from 2016. On March 13 this year, only three satellites were left transmitting navigation signals against a minimum of four. NavIC is, for now, not a navigation system though the rules name it an authorised source of time.

The rules also put responsibility on the end entity rather than its supplier, requiring it to monitor its drift from IST and hold auditable records. Rule 11 says non-compliance is

"punishable", without naming the section. Achanta thinks compliance runs through the network of Internet service providers: "At the level of Airtel and Jio, all they have to do is just update this to NPL".

The industry is less sure. Operators use a variety of architectures to synchronise time across their networks, says one telecom source, declining to be identified. "There are some challenges since there are multiple systems aligned in a different way," the executive says, adding that telcos were in discussions with NPL. "There are also issues with latency and the timeframe under which this has to be implemented. The functionality of NavIC is also a concern."

And the clocks themselves? "Russian is better, cheaper, faster," Achanta says. The masers that carry IST between caesium verdicts are made by Vremyach in Nizhny Novgorod, cheaper still since the invasion of Ukraine pushed European laboratories towards American suppliers. NPL builds its own caesium fountain and is designing an optical clock, but the lasers, mirrors and cavities inside them are imported. "We in the country, unfortunately, are not making any of these things," he says.

(With inputs from Aroon Deep)

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