

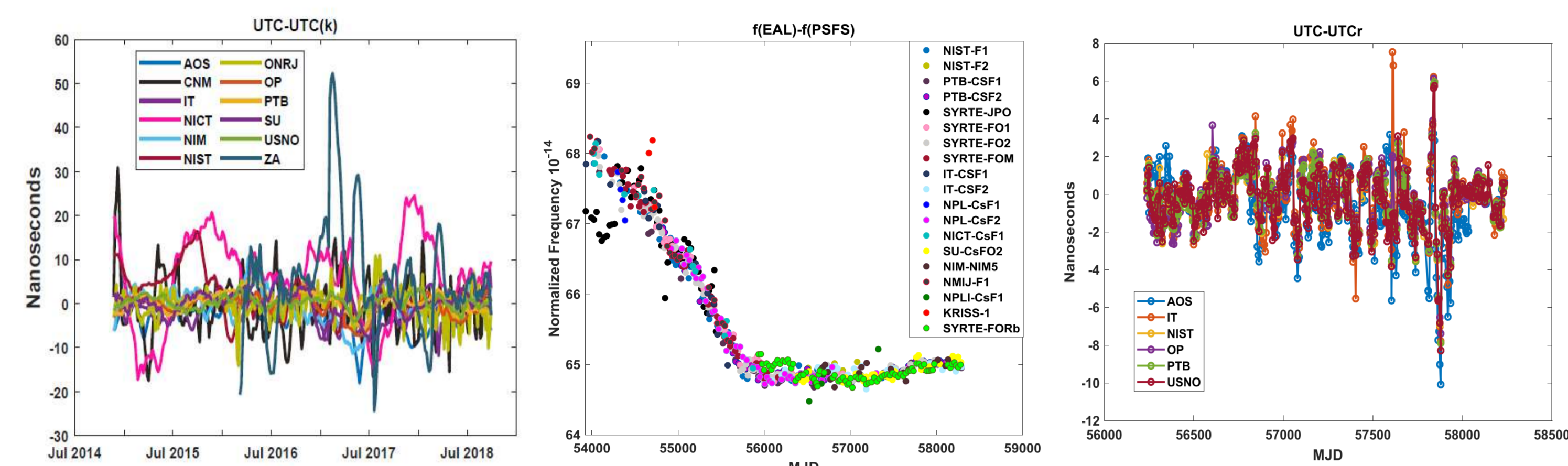
Time and Frequency

The Consultative Committee for Time and Frequency (CCTF)

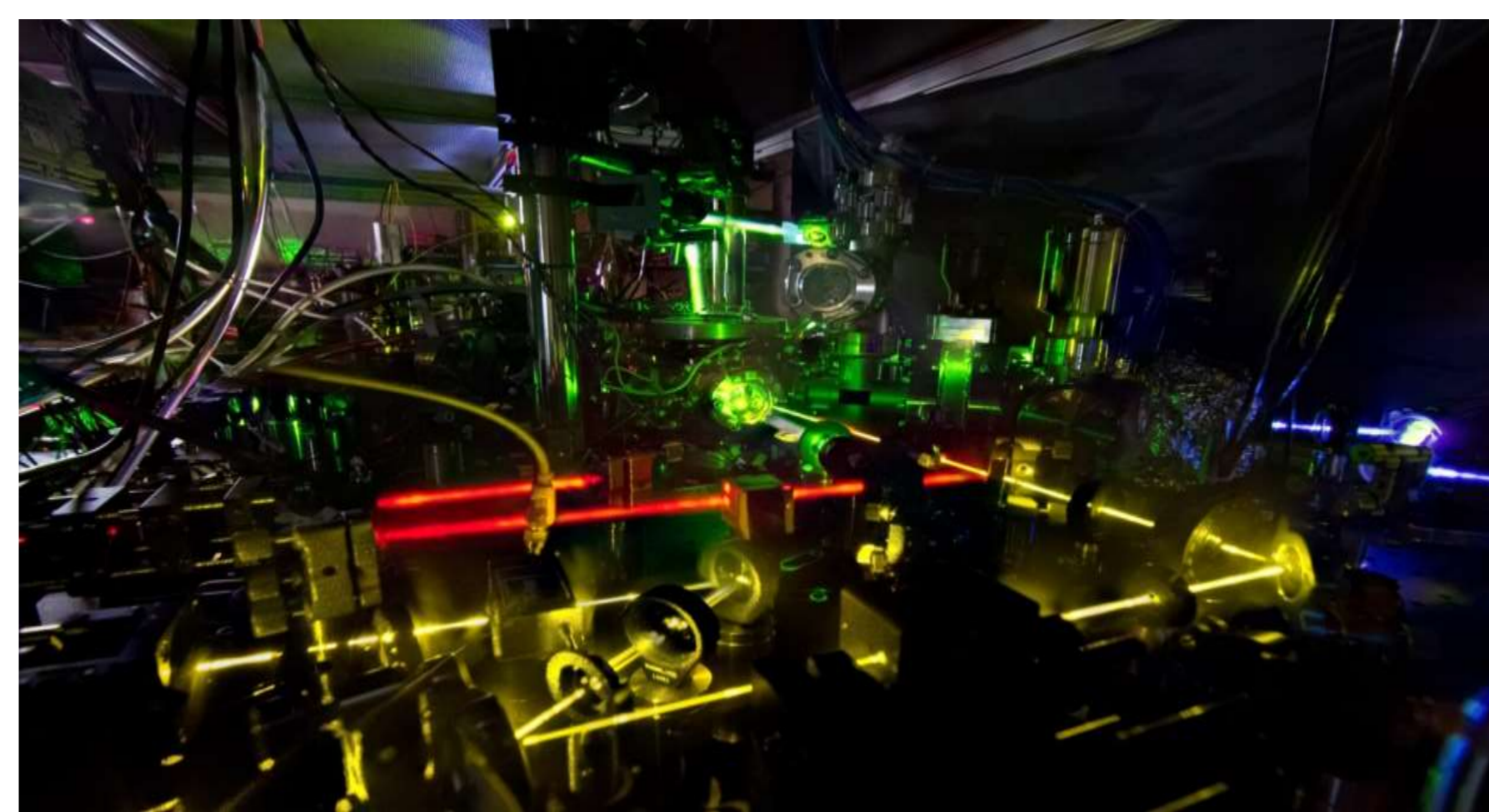
Global forum for NMIs on best practices, innovations and state of the art

A recent example is the successful coordination of a set of **formal definitions** of the international time scales **TAI** and **UTC** (Draft Resolution B - 26th meeting of the CGPM (2018)).

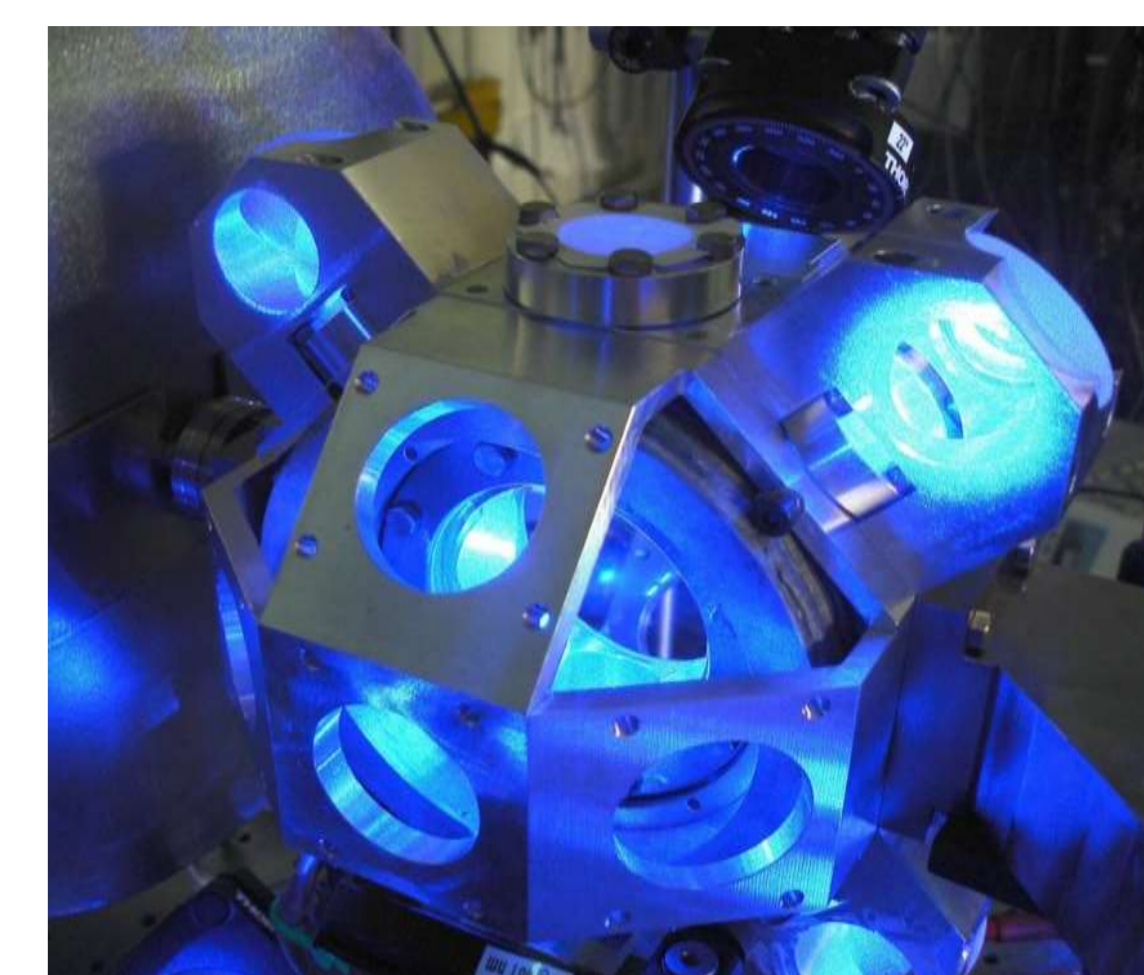
CCTF relies on the **BIPM** for computing and maintaining the international time scales (**TAI, UTC, UTCr, TT(BIPM)**), and manages the key comparison **CCTF-K001.UTC**.



The CCTF promotes research on **time scales, primary and secondary frequency standards, time and frequency transfer techniques** and their applications.



Yb Lattice Clock (Photo: NIST)

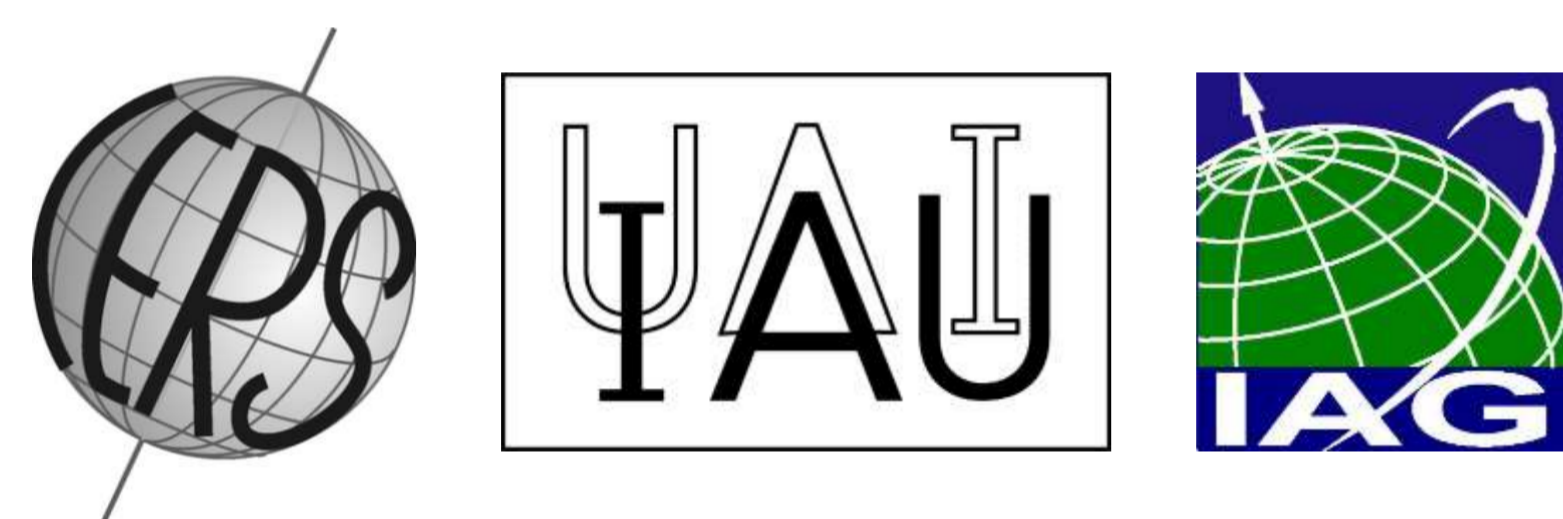


Sr Clock (Photo: LNE - SYRTE)

Recent achievements at the NMIs...

- ✓ New primary and secondary standards reported for use in TAI (Cs and Rb microwave fountains, Sr optical standards).
- ✓ Research on optical transitions, development of very accurate clocks with 10^{-18} intrinsic accuracy (Sr, Yb, Hg, Al, Ca...).
- ✓ Development of optical fibre links for T and F comparisons on national and continental scales.
- ✓ Involvement in global or regional satellite navigation systems by supporting their timing systems

Promotion of dialogue between NMIs and stakeholders on new emerging technologies



Earth and space sciences need precise timing for observation, research, and modelling in the fields of geodesy, geophysics and astronomy.

Geodesy and Astronomy ↔ Provide precise data to timekeeping



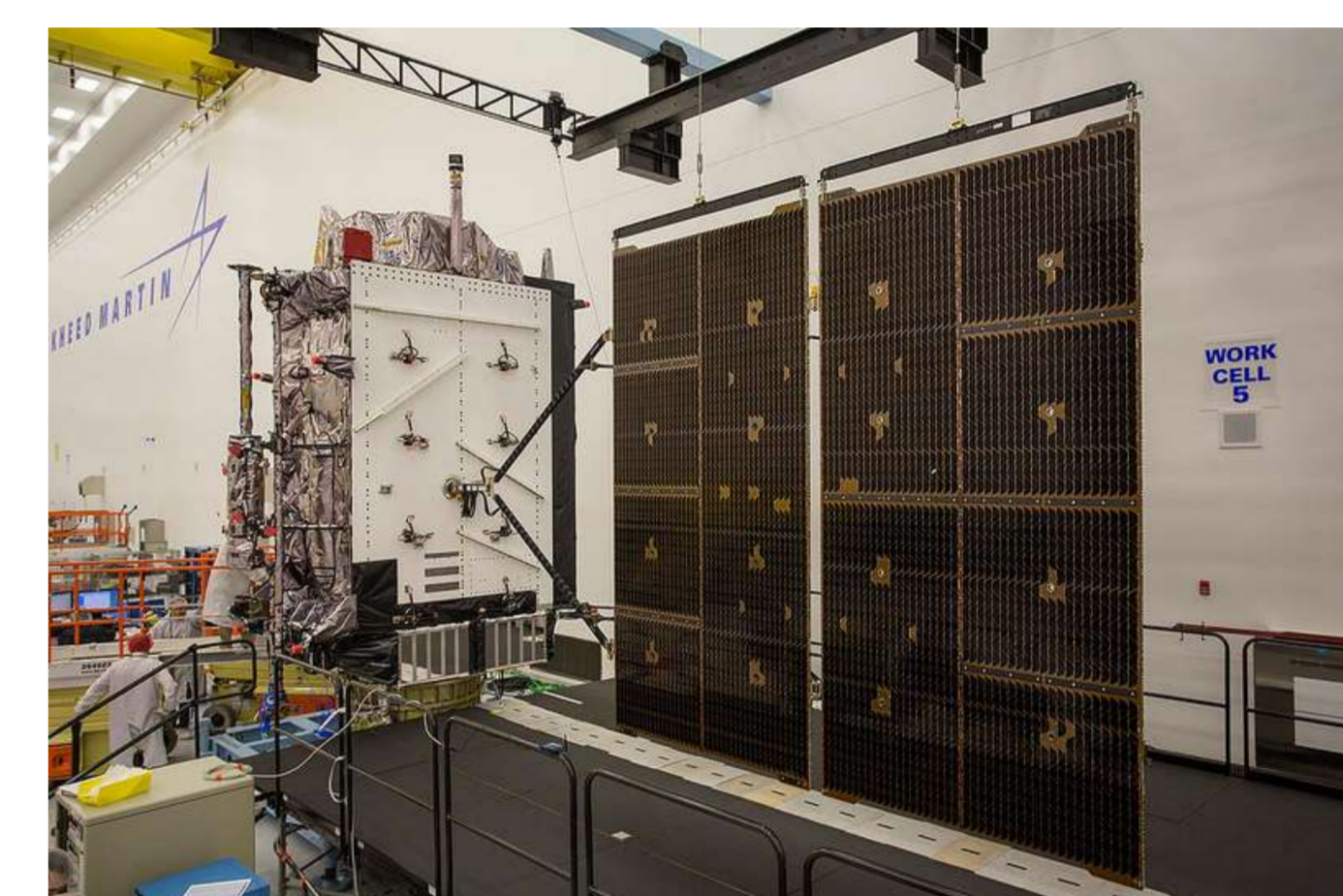
- **Telecommunications** are based on precise network synchronization. Telecom techniques allow UTC dissemination.
- UTC is the reference for **financial market** coordination and **cross-border energy transmission**

- **Global Navigation Satellite Systems (GNSS)** are based on precise timing and are **synchronized to UTC**

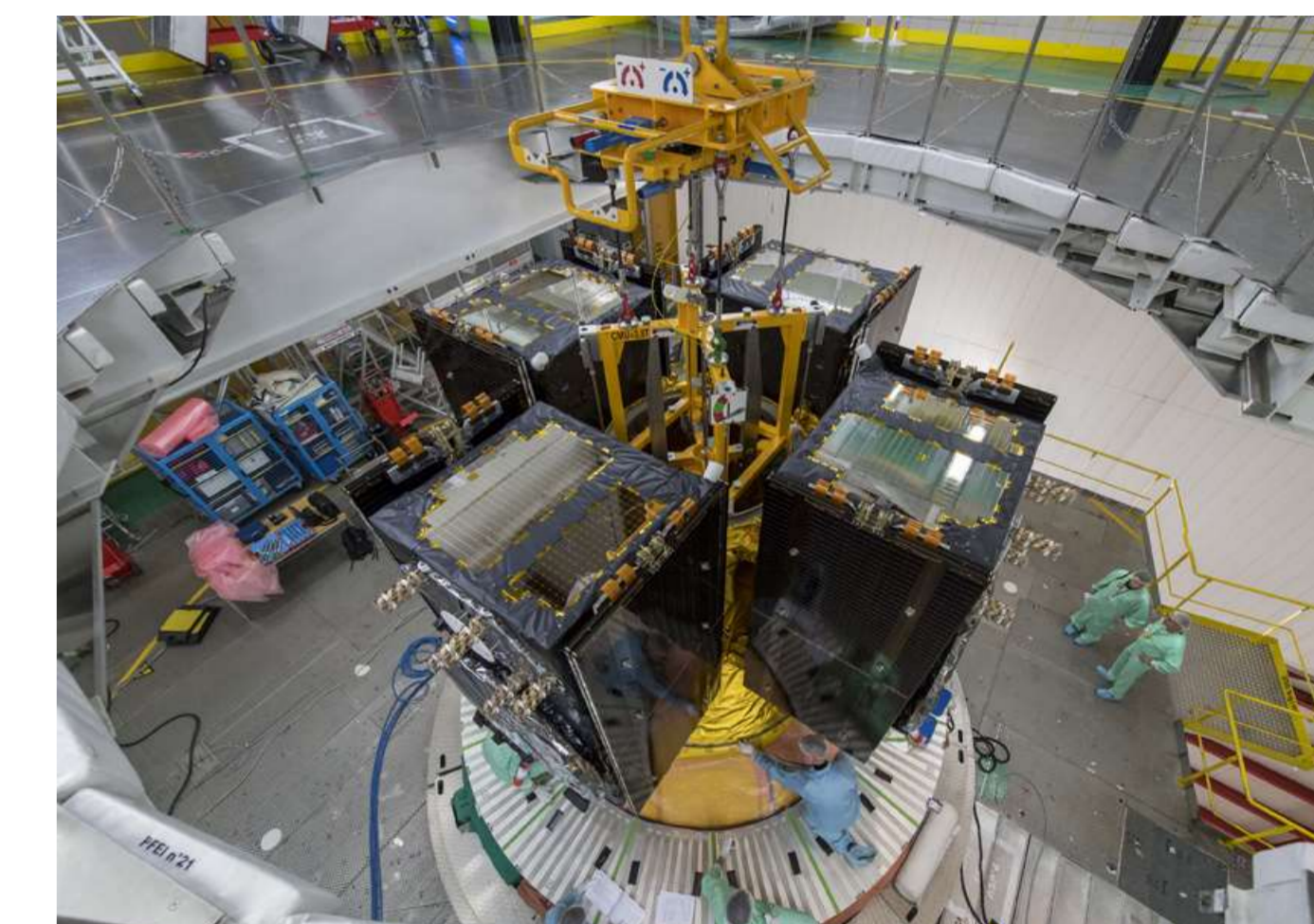
Dissemination of UTC

Positioning and Timing

- **Civil time keeping** and legal times are based on UTC.



GPS III SV02 Array Deployment Test (Photo: Lockheed Martin)



Galileo quartet placed atop an Ariane 5 (Photo: ESA/CNES)



Data centre

In collaboration with the RMOs, support CMCs for mutual recognition

The CCTF coordinates the strategies for time and frequency **comparisons** and **dissemination** with NMIs and relevant international and regional organizations.

1174 **CMCs** in 19 service categories
1 **KC CCTF-K001.UTC**, 1 Supplementary Comparison (**GULFMET.TF-S1**)



Participants in CCTF-K001.UTC

Future challenges

- ✓ **Moving towards a new definition of the second**, achieving 10^{-18} accuracy.
- ✓ Improving **UTC** in terms of stability, accuracy, and accessibility.
- ✓ **Promoting** the important benefits of a unique reference time UTC to the international scientific and industrial communities.