Clock distribution for VLBI?

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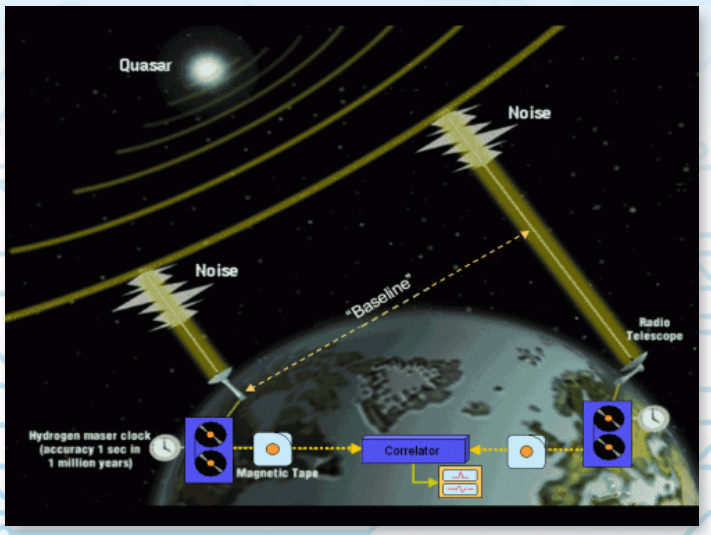
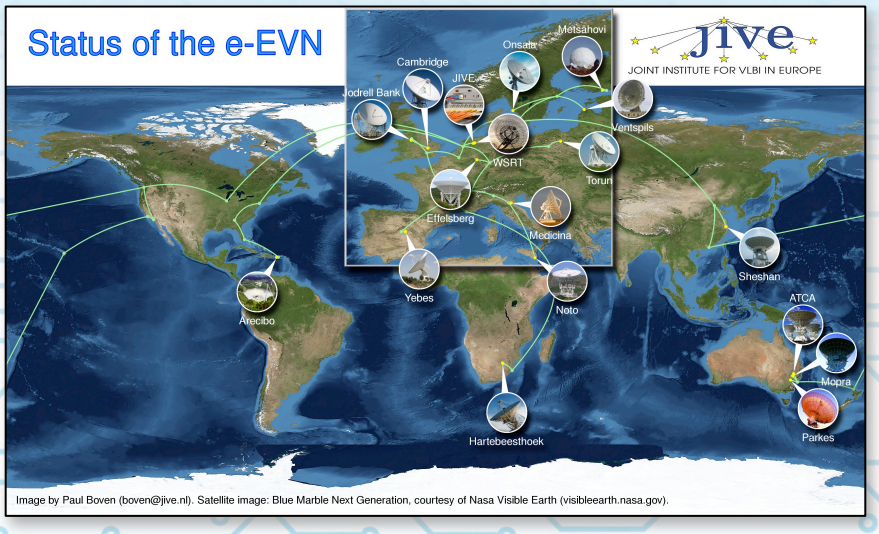


Cartoon of VLBI operations. Note that tapes are not being used anymore..



Very Long Baseline Interferometry (VLBI)

VLBI is an astronomical method by which multiple radio telescopes located hundreds or thousands of kilometers apart observe the same region of sky simultaneously. Data from each telescope is recorded and shipped to a central "correlator", a purpose-built supercomputer which processes the data. In this way a single telescope is simulated with a diameter as large as the longest distance between the telescopes which produces images with higher resolution than the most powerful optical telescopes.

Electronic VLBI (e-VLBI)

e-VLBI improves upon the traditional disk-based method by streaming data directly from the telescopes and correlating it in real-time, currently at a rate of one Gigabit per second (Gb/s) from each telescope, and eventually tens of Gb/s. The speed of e-VLBI allows immediate identification and correction of problems during an observation, and astronomers receive data in a matter of hours rather than weeks. If so-called transient activity is detected, such as a supernova or gamma-ray burst, the astronomer can quickly schedule additional observations, something not possible with traditional VLBI.

As a result of the development of e-VLBI, many radio telescopes nowadays have high-bandwidth internet connectivity.

Hydrogen maser in use at Yebes (Spain) observatory

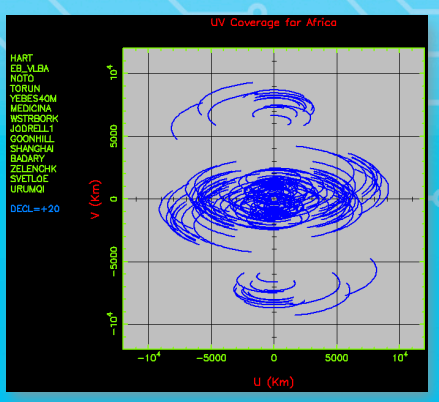
Some telecom dishes being refurbished: Kutunse (Ghana), Warkworth (New Zealand), Goonhilly (UK)

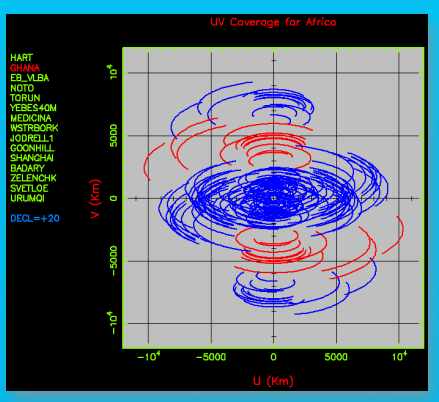
VLBI and Clocks

Very accurate timekeeping and stable reference frequencies are essential for VLBI. For this, GPS and atomic clocks are used. At frequencies up to ~1GHz, Rubidium clocks are adequate, beyond this, Hydrogen maser clocks are needed. These represent a major investment for new stations wishing to participate in VLBI operations.

New VLBI stations, UV coverage

Around the world, de-commissioned telecommunication dishes are being refurbished for radio astronomy. A few examples are Kutunse (Ghana), Warkworth (New Zealand) and Goonhilly (UK). Making these new observatories VLBI-capable will greatly improve the UV coverage of existing VLBI networks. On the right the UV coverage of the European EVN + Hartebeesthoek (which is an existing VLBI station in South Africa) is shown, below that of the same stations but now with Ghana added.





Right: UV coverage of EVN without (top) and with Ghana station (bottom)

Right: de-commissioned telco dishes across Africa

Potential for SKA

Kutunse in Ghana is just one of the many sites with un-used telecommunication dishes across Africa. With SKA Phase 1 being built in South Africa, an African VLBI network could play an important role as SKA pathfinder.