



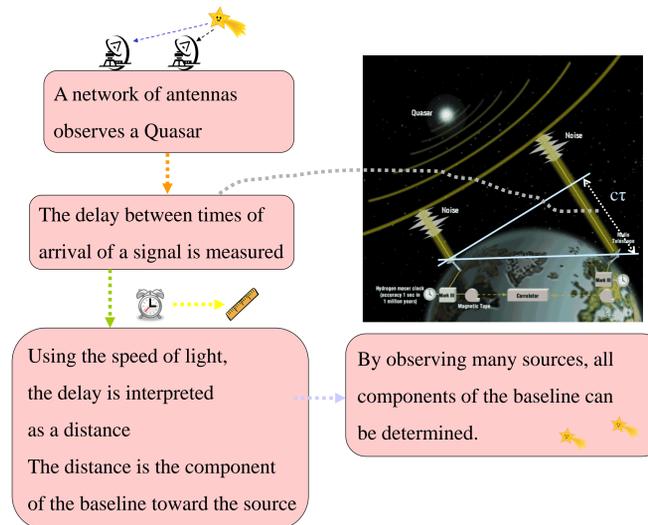
VLBI2010: Next Generation VLBI System for Geodesy and Astrometry

D. MacMillan¹, B. Petrachenko², A. Niell³, B. Corey³, D. Behrend¹, H. Schuh⁴, and The Broadband Development Team^{1,3,5}

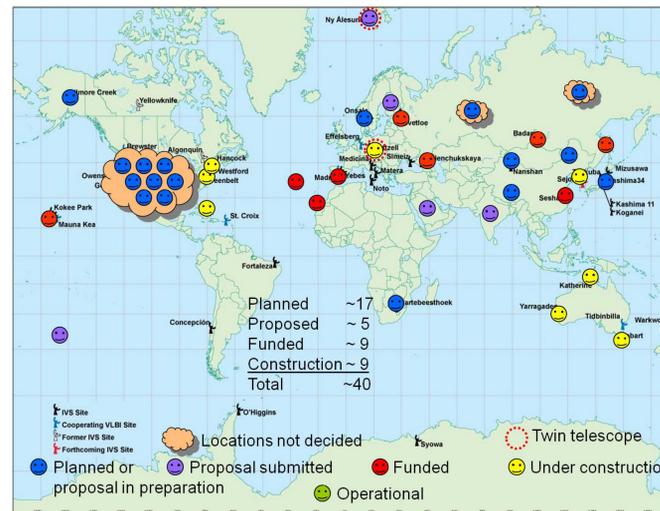


¹ NVI, Inc., NASA Goddard Space Flight Center, ² Natural Resources Canada, ³ MIT Haystack Observatory, ⁴ Vienna University of Technology, ⁵ HTSI, Inc.

Geodetic VLBI: How does it work?



VLBI2010 Global Network

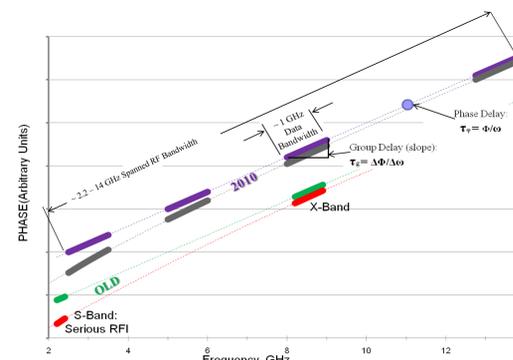


Snapshot of the evolving VLBI2010 network as of December 2010

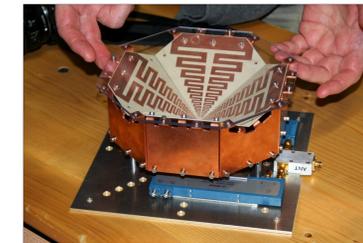
- The IVS (International VLBI Service for Geodesy and Astrometry) is designing a new observing system called VLBI2010
- One goal is to choose antennas that are both mechanically reliable and cost effective enough to be reproduced economically so that more international groups can afford to install antennas.
- Another goal is to expand the current global network of VLBI stations to provide superior global coverage compared to the current network of antennas that is dominated by Northern Hemisphere sites.
- Clearly more sites are needed below the equator than what we show above

How is VLBI2010 different from current systems?

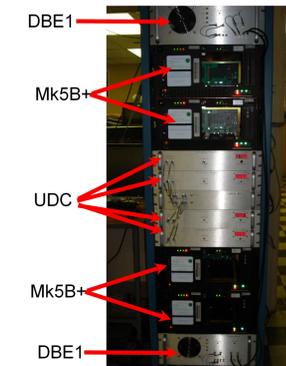
- Antennas are smaller but move to different parts of the sky much faster
 - Monte Carlo simulations demonstrated that atmosphere delay variations are the limiting noise source, but
 - Minimize effect of noise by rapid sampling in many different directions
- Dual linear polarization is intrinsic to the broadband feed
- Four bands instead of the current two bands (X and S)
 - Delay precision will be improved by recording in four bands across 2-14 GHz
 - SNR will be increased by recording at 8 Gbps or higher (Current X/S data rate is 0.256-0.512 Gbps)



Status of NASA VLBI2010 Development



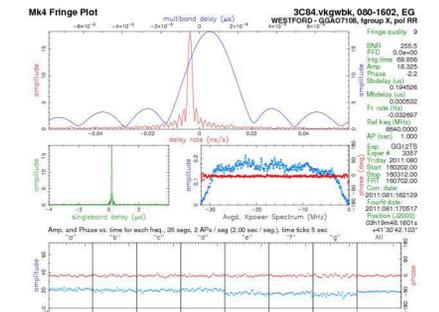
The Eleven feed: 2-12 GHz dual linear polarization; frequency independent phase center and beam shape.



First generation broadband back-end hardware: 8 Gbps RF-to-IF and data acquisition system for VLBI2010.

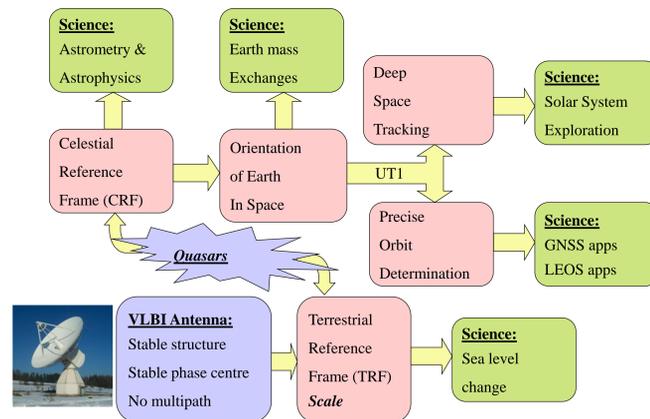


12m antenna at Goddard Geophysical and Astronomical Observatory, Greenbelt, Maryland, finished in late 2010.



Fringe detection plot from first successful broadband delay observation on March 28!!

Roles of VLBI



What is VLBI2010?

- VLBI2010 is the next step in the evolution of geodetic VLBI.
- Addresses recognized changes in infrastructure: existing VLBI system is aging (~30-40y old); much equipment obsolete
- Responds to new science requirements
 - Terrestrial reference frame with 1-mm accuracy and 0.1 mm/yr stability
 - For example: monitoring global change, sea level rise
- Takes advantage of technological advances of the last decade
 - Fast cheap antennas (12 meter class)
 - Digital electronics
 - High speed networks
 - Automation
- Based on studies and modeling that point to a new philosophy for the design of antennas and the way data are taken

Next Steps

- Understand loss of signal and lower than expected antenna sensitivity
- Measure performance over full frequency range
- Replace digital back end with newer version
- Install alternative quadridge feed from CalTech when dewar is ready