

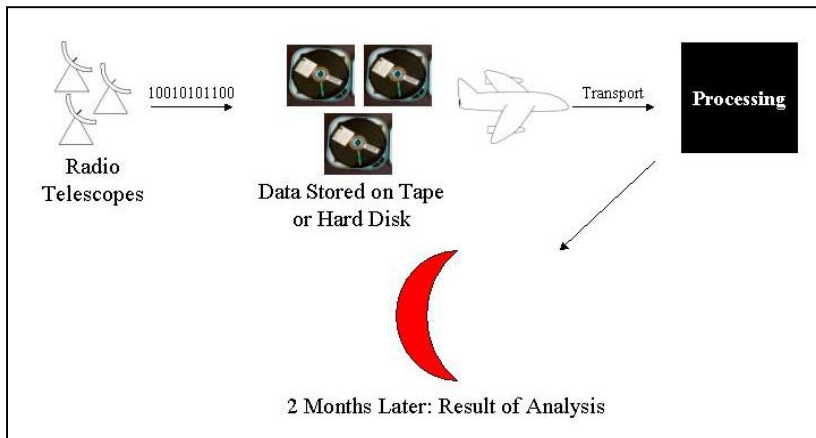


Internet2 Applications Overview

eVLBI Over Advanced Networks

Very-Long-Baseline Interferometry (VLBI) is one of the most powerful techniques for high-resolution imaging of distant radio sources in the universe and for making accurate measurements of the motion of the earth in space. Multiple radiotelescopes scattered over the surface of the earth are used simultaneously in a powerful array to record data from a radio source, such as a distant quasar. VLBI makes a direct measurement of the earth's orientation in space from which geoscientists then model such phenomena as atmospheric angular momentum, ocean tides and currents, and the elastic response of the earth. After VLBI data is gathered, it is stored on tape or hard disk and then shipped to a central processing site for correlation analysis. Advanced networks

are now making electronic transmission of VLBI data (dubbed “eVLBI”) a reality.



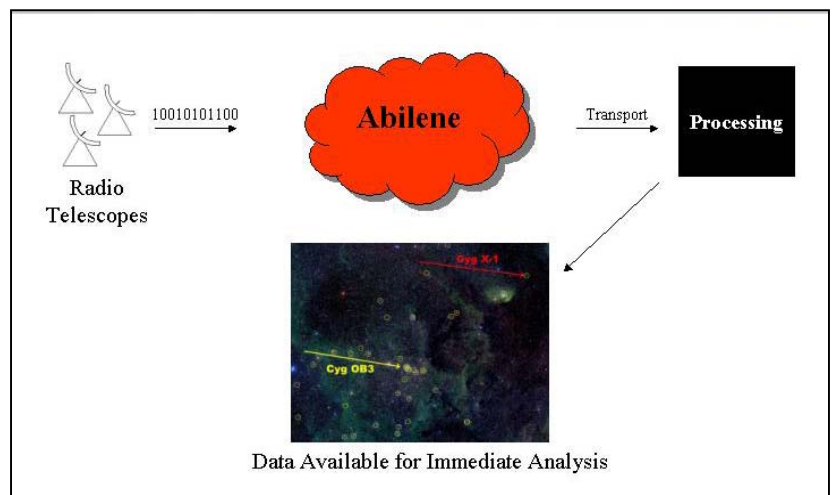
Traditional VLBI Practices

After VLBI data is gathered, it is stored on tape or hard disk and then shipped to a central processing site for correlation analysis. The bandwidth of the FedEx/Boeing 747 “transport protocol” does allow transfer of multiple petabytes of data at a

time; however, there are serious limitations to this approach. For example, VLBI experiments must be completed in full, with no opportunity for ongoing or immediate analysis of the data. Furthermore, data must be processed and “packaged” before it can be shipped to the central processing facility, increasing the risk that data can be lost or damaged. For most astronomical experiments using this approach, it can take up to two months for the data to get in to the hands of the scientists who can use it. (Priority experiments or “intensives” are given a higher turnaround time, with observations running 4 times a week and a turn around time of 1-2 weeks for processing, including shipping time.)

A Glimpse at the Future

Although tapes served as the long time standard for VLBI research, and hard drive-based storage was only recently introduced, advanced networks are now making the realtime electronic transmission of VLBI data (“eVLBI”) a reality. The network-based eVLBI approach allows scientists to have immediate access to data, even while



experiments are in progress. Immediate analysis of the data even allows scientists to correct or reposition the telescopes in real-time, rather than waiting until the conclusion of the experiment to realize the telescopes may have been positioned incorrectly. The higher bandwidth available via the network connection allows data to be collected at a higher data rate, resulting in clearer, sharper images than were possible using traditional VLBI methods. Dynamic, network-based collaboration also allows telescopes to enter and exit observations based on their availability, ensuring that these valuable resources are being used optimally.

Who Is Doing This?

MIT Haystack Observatory is among the early adopters of networked data transmissions as a result of the eVLBI tests they ran during 2002 and reported at the first eVLBI workshop. Following MIT's earlier work, the VLBI community as a whole is contributing to efforts and standardization of network-based eVLBI technologies with the goal of moving beyond a proof-of-concept into an operational model.

Participants Communications Research Laboratory, Kashima, Japan Goddard Geophysical and Astronomical Observatory, Goddard Space Flight Center, NASA, Greenbelt, Jodrell Bank Observatory, University of Manchester, United Kingdom Joint Institute for VLBI in Europe, The Netherlands Metsähovi Radio Observatory, Helsinki University of Technology, Metsähovi, Kylmäla, Finland, MIT Haystack Observatory, Westford, MA		
Networks Abilene APAN/Transpac DREN GEANT/DANTE REUNA SURFnet	Resources The Gbps e-VLBI Demonstration Project, 28 February 2003 report published by Alan Whitney and collaborators ftp://web.haystack.edu/pub/e-vlbi/demo_report.pdf eVLBI Station List http://science.internet2.edu/telescope/	
Funding National Science Foundation NASA	Links http://science.internet2.edu/vlbi.html http://web.haystack.edu/e-vlbi/ http://www.jb.man.ac.uk/ http://www.astron.nl/wsrt/ http://www2.crl.go.jp/ka/radioastro/index.html http://www.evlbi.org/	Contact T. Charles Yun, Internet2 Program Manager for Science and Engineering tcyun@internet2.edu