eVLBI and shared eInfrastructures

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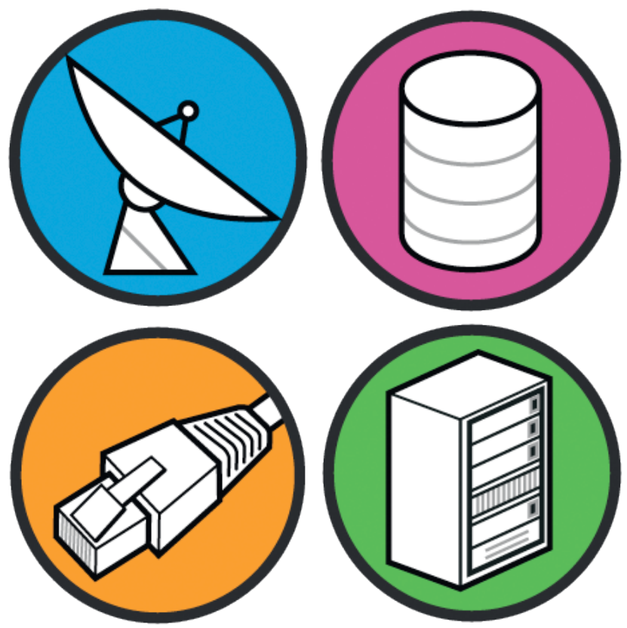
Overview

- NEXPReS
- Astronomy
  - Introduction to astronomy, radio astronomy and e-VLBI
- Astronomy in Latin America
  - TIGO, UdeC, CL
  - Future Possibilities
- The importance of e-Infrastructures as investment

NEXPReS

- **N**ovel **EX**plorations **P**ushing **R**obust **e**-VLBI **S**ervices
  - FP7 project involving radio astronomy, computing, storage and networking
- Radio astronomy project
  - Operational improvements to the complex array of tools supporting radio astronomy observations
  - Software Correlation (distributed, real-time computation)
  - High-speed data buffering between telescopes and correlator
  - Network technology development (Bandwidth on Demand)
- e-VLBI is a SKA pathfinder technology
- Successor to EXPReS: EXpress PRoduction e-VLBI Service



the TIGO antenna, provided by TIGO/Hayo Hase

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Basic Astronomy

Astronomy: Optical, Radio, to VLBI

Starry Night, Vincent van Gogh. Image shamelessly stolen from somewhere online…

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Basic Astronomy

Radio Astronomy

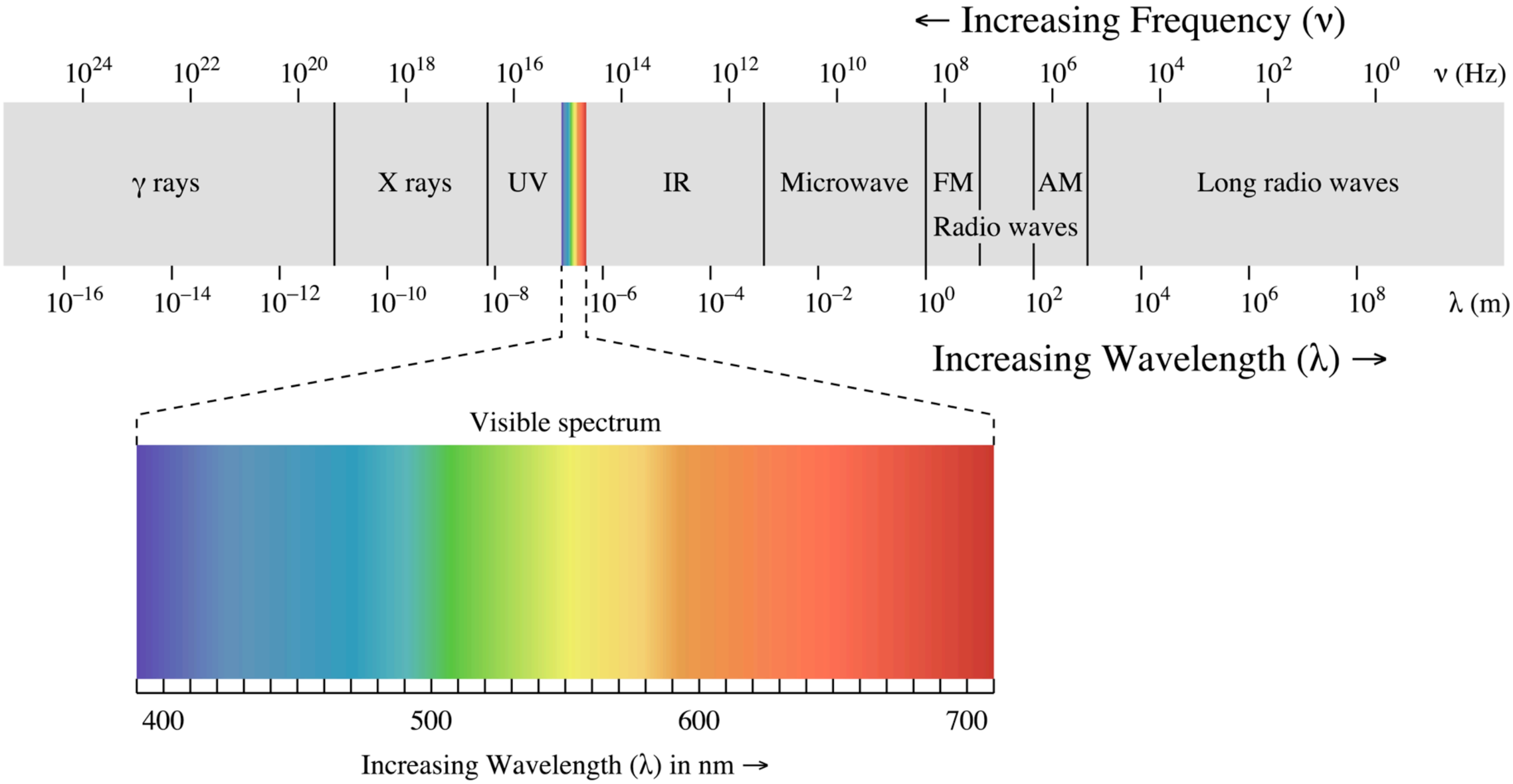

Image via: http://en.wikipedia.org/wiki/File:EM_spectrum.svg

40 meter Yebes Radiotelescope, Yebes, ES (about 50 km north-east of Madrid), photo courtesy of CNIG-IGN

100 m Effelsberg Radio Telescope, lcated outside of Bonn, Germany.
Image courtesy of MPIfR via http://www.mpifr-bonn.mpg.de/public/pr/luftbild_hires.jpg

300 m Areceibo Radio Telescope, Puerto Rico, U.S.A. EVN file photo

Image of the Westerbork Radio Telescop Array, Westerbork, the Netherlands via Google Maps

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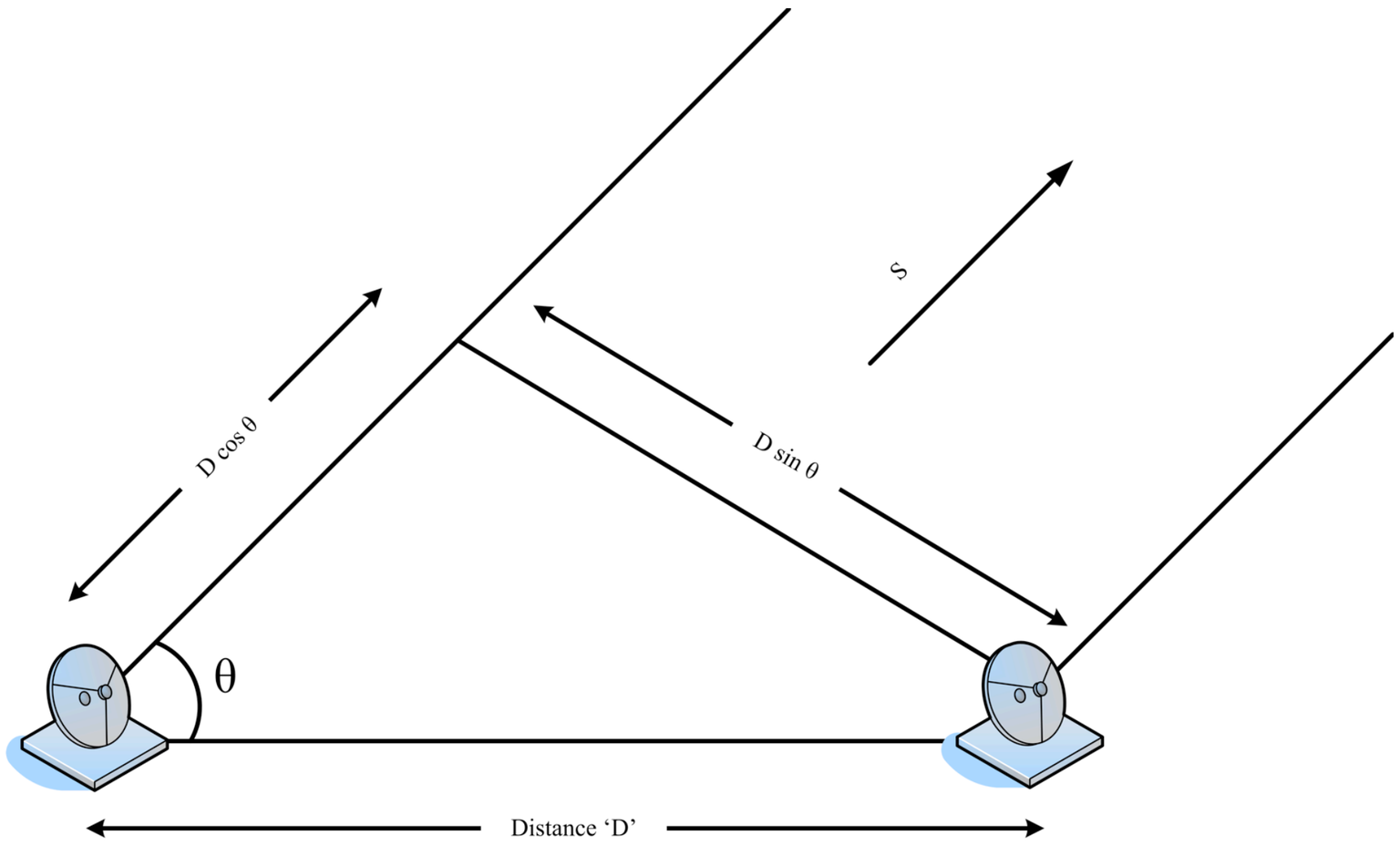
Image of the Westerbork Radio Telescop Array, Westerbork, the Netherlands, personal photo (tcyun)

VLBI- Very Long Baseline Interferometry

Multiple Telescope Observation

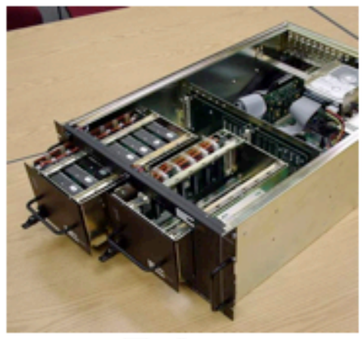
- Resolution increases with baseline
  - Physical geography
- Sensitivity increases with **bandwidth** (networking)
  - Data storage and transmission
  - e-VLBI assumes robust networks to transport data



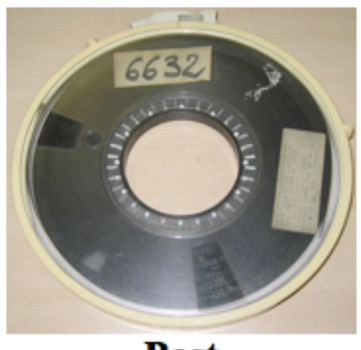
VLBI- Very Long Baseline Interferometry

Moving Data from Dish to Result

Today



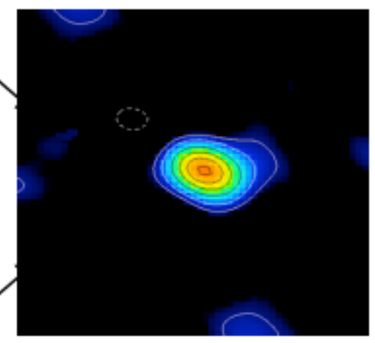
Today



Past

Recently Developed

Traditional



Results

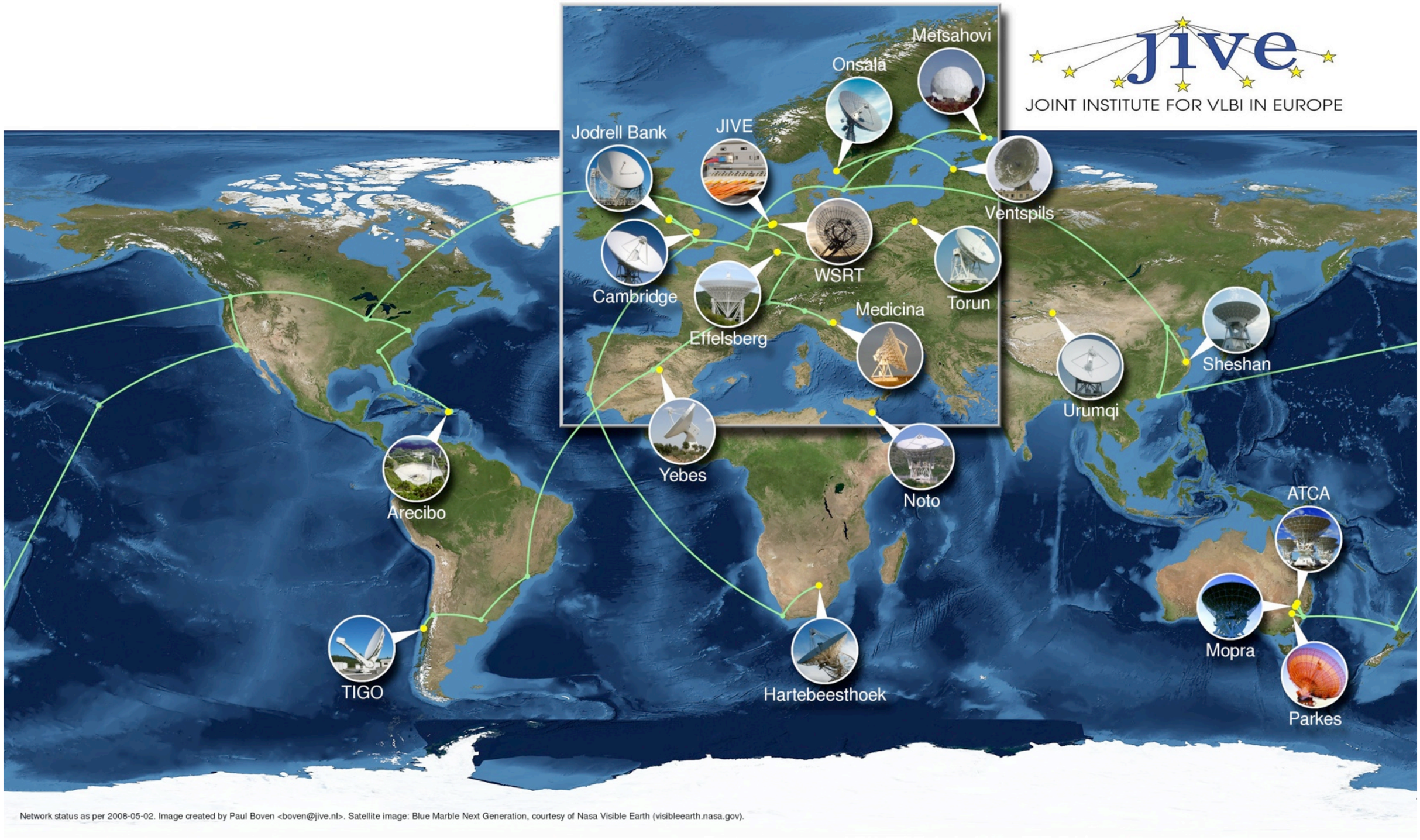
VLBI- Very Long Baseline Interferometry

Two Baselines, Virtual Telescopes

Virtual Baselines, JIVE file image.

VLBI- Very Long Baseline Interferometry

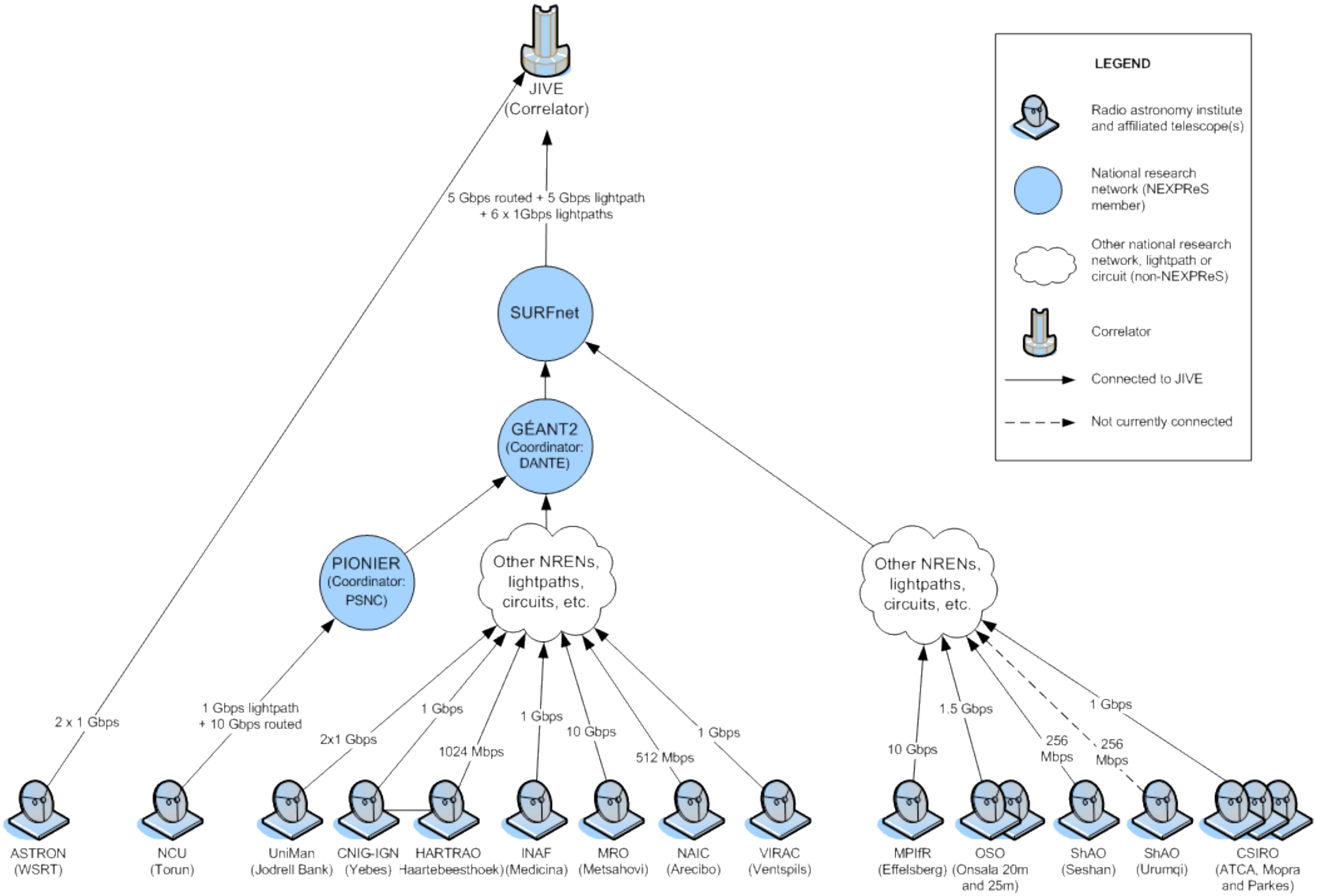
e-VBLI Relies on Intl Networks



EXPReS logical network map, from http://www.expres-eu.org/maps/worldmap-300dpi-A4landscape.jpg

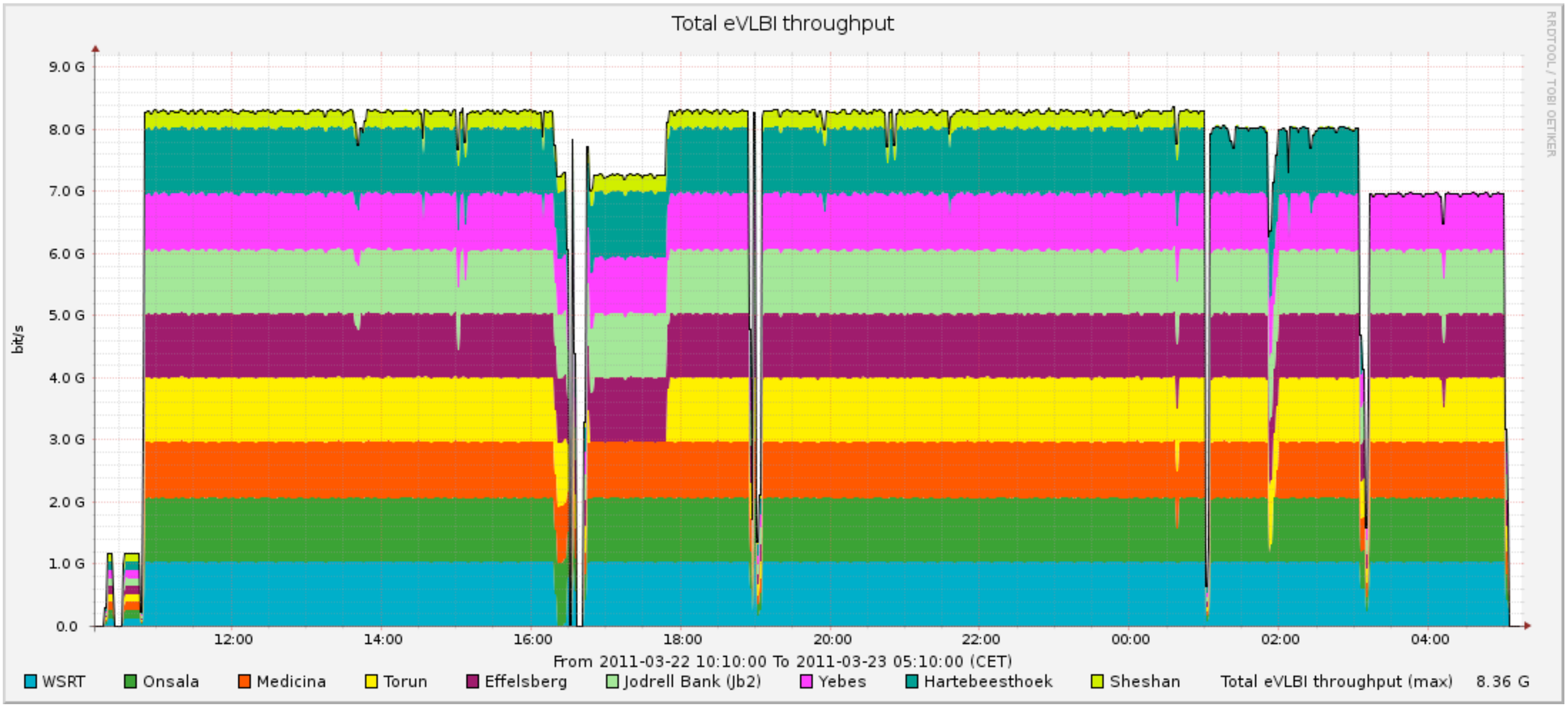
VLBI- Very Long Baseline Interferometry

Schematic- Network Routes



VLBI- Very Long Baseline Interferometry

But do we really use the network?



JIVE network graphs are available via: http://www.jive.nl/network-throughput-graphs-year-date

Looking at things very far away

- The following images try to show that we are looking at objects that are very small in the sky.
- To give a sense of a milliarcsecond, we start with a fairly large constellation (Ursa Major, the Big Dipper) and then zoom progressively inwards
- The final slide shows the parts that are scientifically interesting
  - AGN- Active Galactic Nucleus
  - Showing that the “jets” are active and associated with the AGN
  - The components that are further out can be traced back to the AGN

Sky map of Ursa Major region (big dipper, northern hemisphere) 10.67h 00m 00s, +55.38° 00′ 00″
from http://www.wikisky.org/?object=NGC+3690

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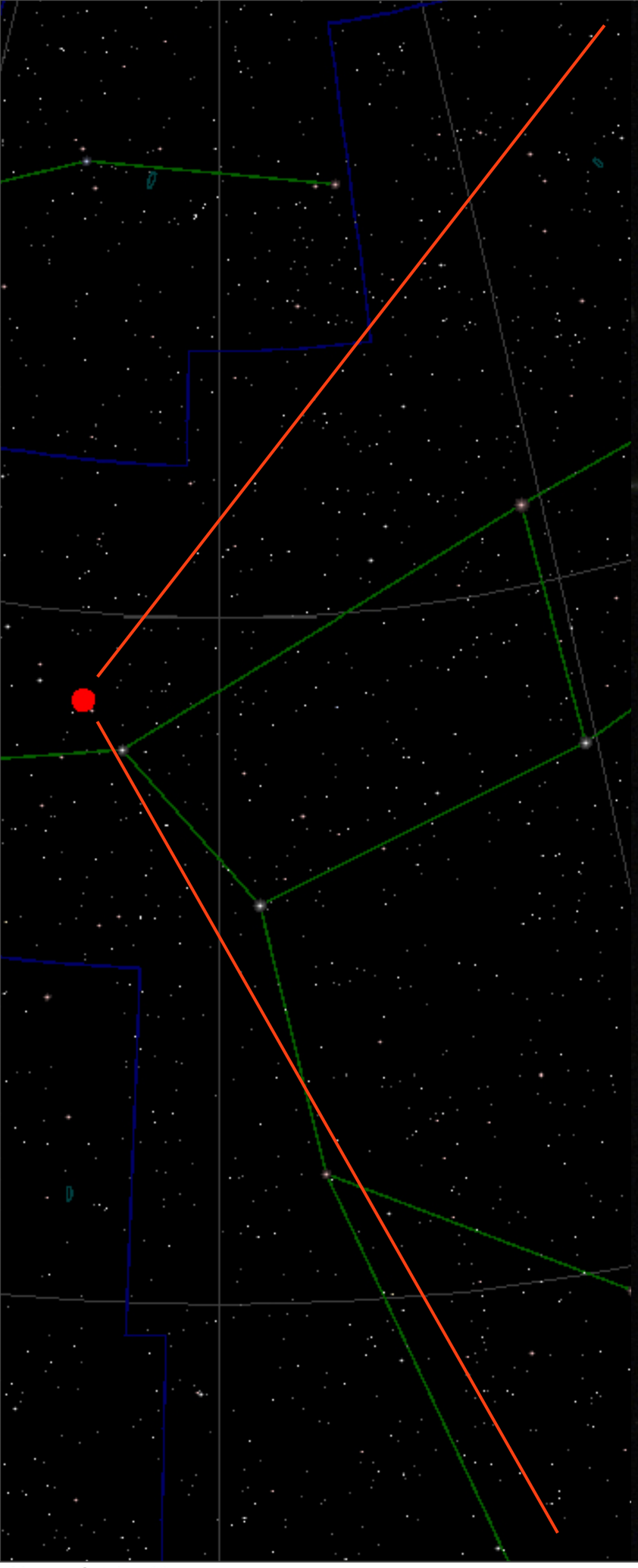

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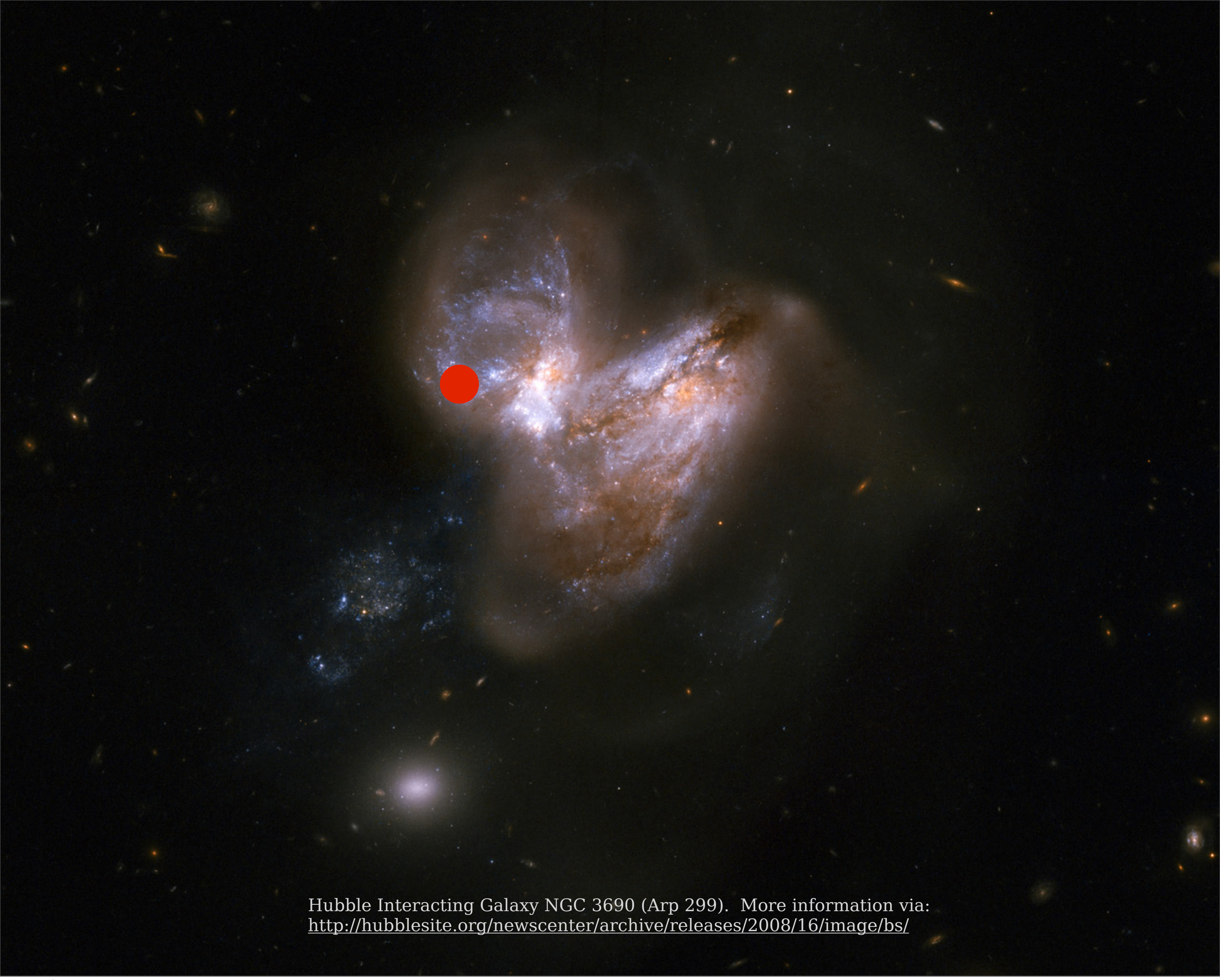
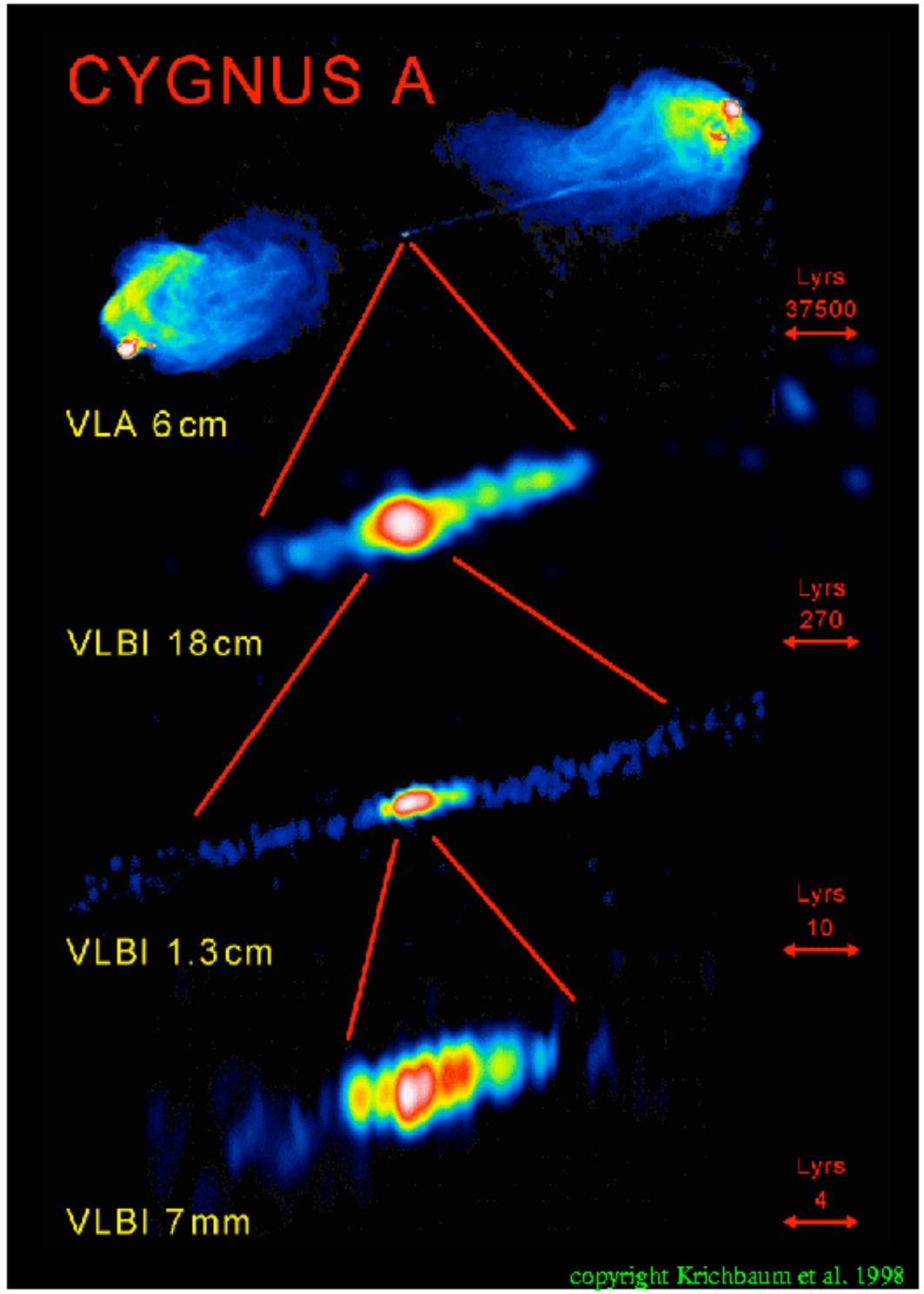


Hubble Interacting Galaxy NGC 3690 (Arp 299). More information via:
http://hubblesite.org/newscenter/archive/releases/2008/16/image/bs/

Miguel A. Perez-Torres, Antonio Alberdi, Cristina Romero-Canizales (IAA-CSIC,Granada, Spain), and Marco Bondi (IRA-INAF, Bologna, Italy)


CYGNUS A
VLA 6cm
Lyrs
37500
VLBI 18cm
Lyrs
270
VLBI 1.3cm
Lyrs
10
VLBI 7mm
Lyrs
4
copyright Krichbaum et al. 1998

Important locations in Latin America

TIGO and Fortaleza in (e-)VLBI

- TIGO and Fortaleza provide crucial baseline and sky coverage from the (huge) area otherwise not “served” by radio astronomy facilities;
- Both facilities are members of the International VLBI Service – prime global geodetic network
- TIGO and Fortaleza are indispensable in Space Science VLBI applications; Fortaleza, in particular (due to a larger size) – for deep space missions

Investing in more than Networks

- Connectivity alone is a worthwhile goal
  - International, national, last mile
  - The network more than just connectivity
- Investment in today and tomorrow’s possibilities
  - Science: Collaboration, connecting people, sharing data, creating knowledge
- Robust networking is also an investment into existing facilities
  - Extending the working life of expensive and unique instruments
  - Creating new opportunities, new science from existing tools

We want to saturate networks

- Hungry for: data capacity, connectivity, access into difficult “last mile” areas
- Need providers ready to experiment (service & collaboration) and innovate (must be more than cheap, must expand capabilities)
- Will deal with many different techniques or topologies
  - Keeping things compatible is essential
  - Local contacts and local expertise is much valued
- Radio-astronomy may be special case of big science, but not alone, sensor networks will generate similar problems
  - Need to integrate transport/storage/compute
  - Does not fit on classical e-Infrastructure categories
- Looking for partnerships, rather than client role

Questions & Contact Information

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