



# GÉANT2 User Support for eVLBI

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Connect. Communicate. Collaborate

# User Support in GÉANT2

- GÉANT2 has 3 million+ users in 34 countries in Europe and beyond
- How to support them?
- Pan-European projects with 'demanding' requirements
  - International user groups
  - High bandwidth requirement?
  - Specialised service requirement?
  - Projects of mutual importance/interest
- Aim to introduce new levels of accountability, transparency and service
- Custom solutions for the particular user group
- To liaise with NRENs to generate end-to-end solutions for user groups
- To manage the lifecycle of the networking aspects of each user project
- Customer focused



# User Support Mechanism for GÉANT2



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- Initial Contact
  - *Establish eligibility of user application*
  - *Inform all NRENs involved*
  - *Assign point of contact*
- User Questionnaire
  - *Requirement gathering*
- Evaluation
  - *Consultation between DANTE and NRENs*
  - *Define stakeholders*

# User Support Mechanism for GÉANT2 (II)



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- Planning and Implementation
  - *Action plan*
  - *Design of E2E Network Solution*
  - *Risk Register*
  - *Implementation and operation of service*
- Continued Support
  - *A service charter for the user*
  - *Change management*

QUALITY OF CUSTOMER SERVICE IS VITAL!



# GÉANT2 User Case Study: Networking for eVLBI in Europe



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- VLBI: Very Long Baseline Interferometry
- European eVLBI Network: collaboration of radio observatories in Europe, Asia and South Africa
- The most sensitive VLBI array in the world
- Currently 5 telescopes collaborating on eVLBI experiments: Torun (PL), Onsala (SE), Cambridge (UK), Westerbork (NL), Jodrell Bank (UK)
- Many more to be connected soon
- Large data flows, monitoring required
- A demanding user!



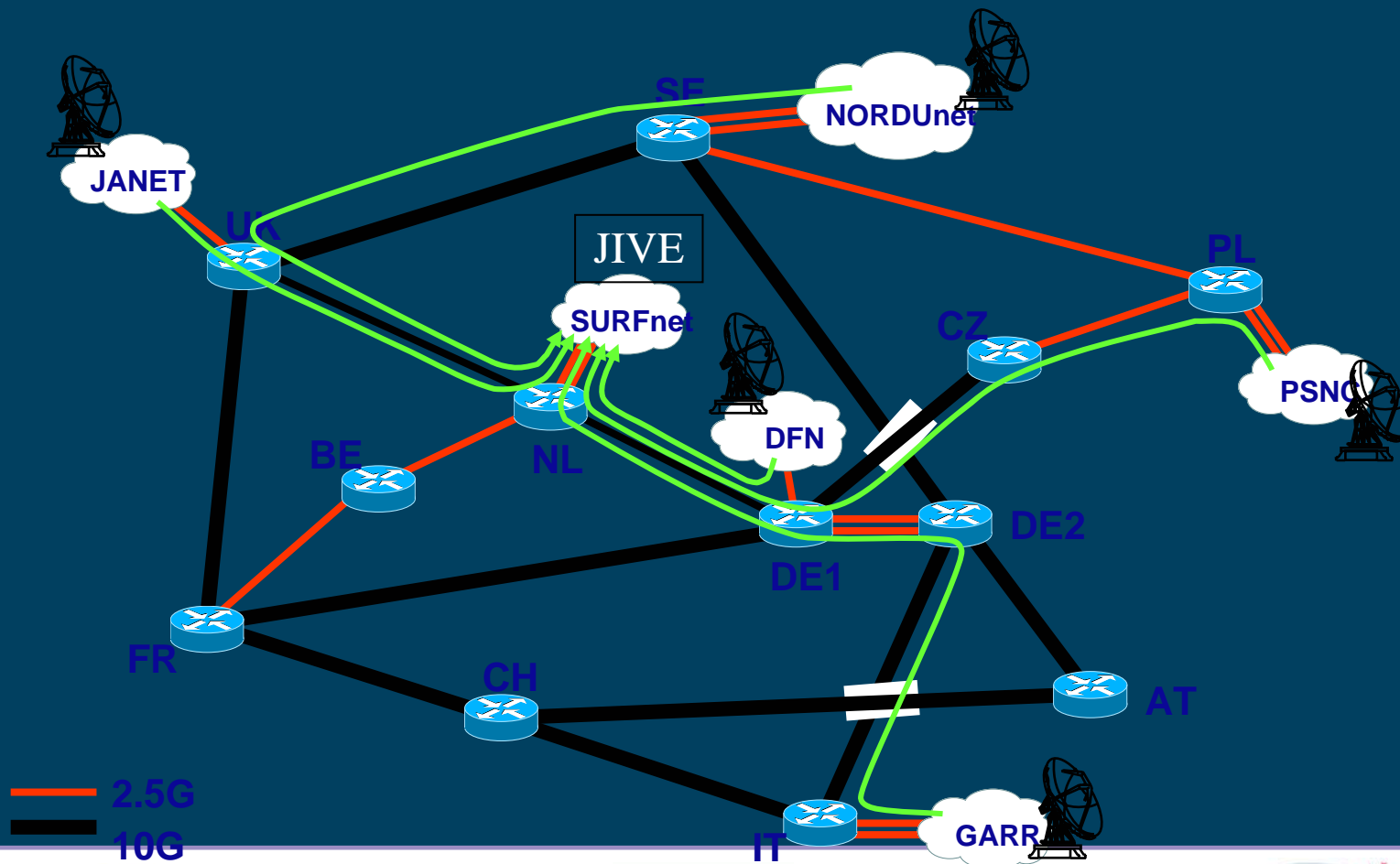
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# Background on VLBI

- Uses multiple radio telescopes to improve image resolution
- Data is collected simultaneously at different telescopes, all observing the same area of sky
- Raw data from telescopes is sent to a central supercomputer and correlated to produce detailed images
- Resolution of the images is proportional to the separation of the telescopes
- Observation of the most distant parts of the universe
- ...and also Geodesy, Spacecraft Navigation etc

# The VLBI Network in Europe

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# The future of the distant past: using networks for VLBI



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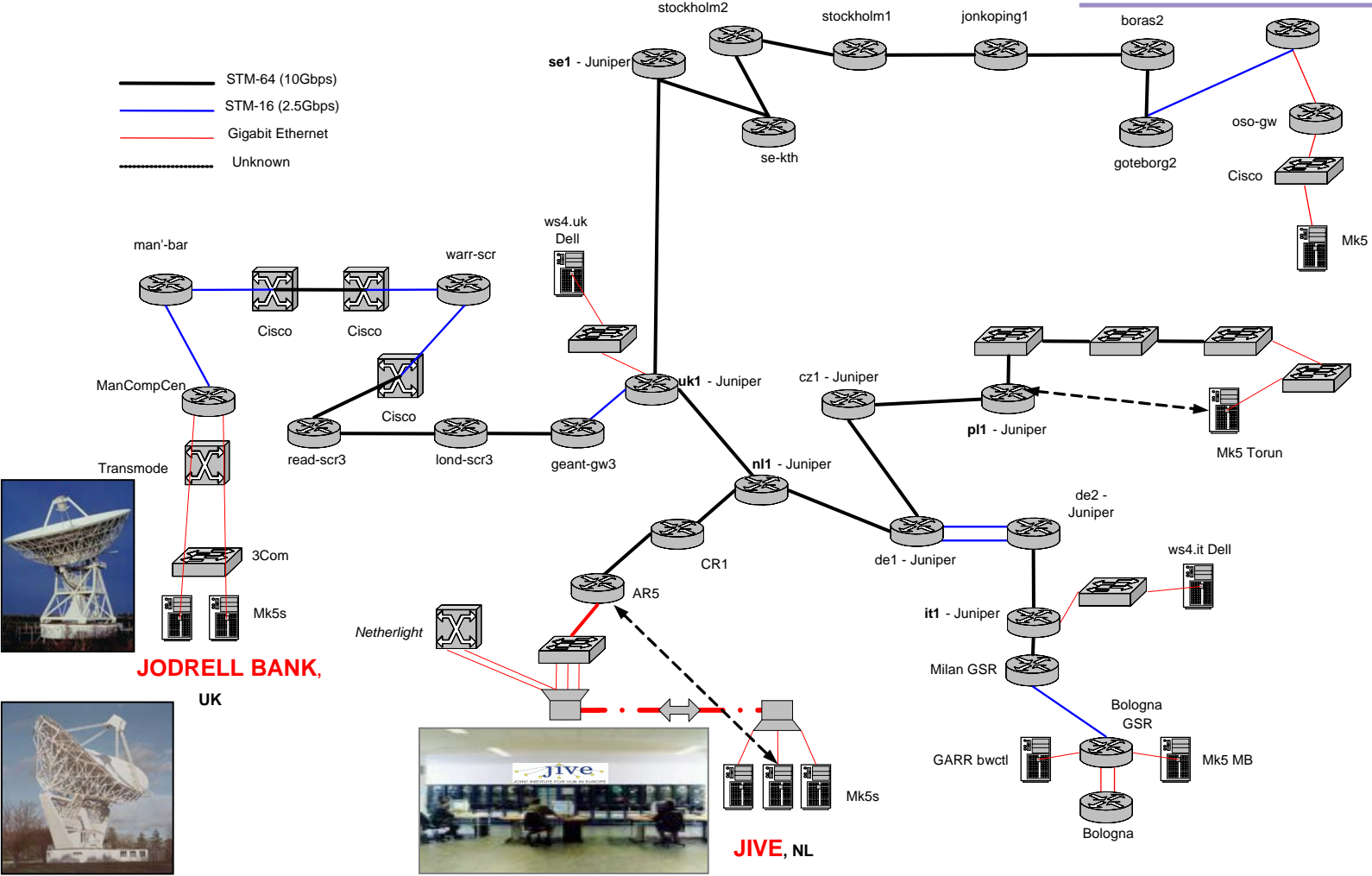
- Using networks to connect observatories to create a telescope as big as Europe!
- Continental-scale baselines produce the most detailed images ever of the most distant objects!
- Eliminating out-moded tape technology and speeding up results
- Harnessing the power of many radio telescopes in real time – only possible with GÉANT2
- Allowing new ‘Window of Opportunity’ experiments: dynamic scheduling
- Distributing results from the correlator to users across the world



# GEANT2/NREN eVLBI Network

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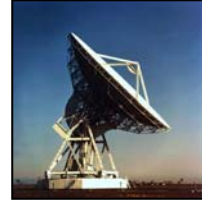
- STM-64 (10Gbps)
- STM-16 (2.5Gbps)
- Gigabit Ethernet
- - - Unknown



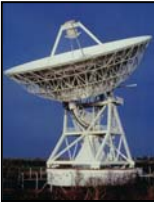
**ONSALA, SE**



**TORUN, PL**



**BOLOGNA, IT**



**JODRELL BANK, UK**



**JIVE, NL**





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# GÉANT2 User Support for eVLBI

- The EVN-NREN forum: the communities meet face-to-face!
  - Planning
  - Problem solving
  - Discussion of results
  - Increasing mutual understanding between communities
- GÉANT Weathermap and Taxametro monitoring tools
- Counters on GÉANT links
- Diagnostic tools (BWCTL) in GÉANT and NREN network nodes
- PERT account created –letting SMEs loose on the problem!
- Also use of specialised tools eg UDPmon



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# Progress in eVLBI 2004-2005

- 01/04 First disc-buffered eVLBI image
- 04/04 Three-telescope eVLBI session
- 06/04 eVLBI network stress tests (iPerf)
- 09/04 4 telescope eVLBI
- 09/04 First real-science eVLBI
- 12/04 Fringes at 256 Mbps JB-Tr
- 02/05 Network data transfer tests (BWCTL) between 6 eVLBI sites
- 03/05 eVLBI science session involving 6 telescopes: Wb, Ar, JB, Cm, On, Tr
- 03/05 EXPReS Proposal:
  - ‘Production’ eVLBI
  - 16 telescopes
  - High Data Rates
  - Global eVLBI
- 06/05 Connection of Medicina observatory: brings total to 6 telescopes in 5 countries across Europe
- 10/05 LSL work commences (with GÉANT2 SA3)

# eVLBI: fast transfers over GÉANT2 and NRENs



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- TCP introduces a level of ‘fairness’ into shared IP networks
- Uses a congestion control algorithm to reduce flows when packet loss occurs
- TCP a problem with high bandwidth-delay networks
- A problem for international high-throughput projects such as eVLBI
- Possible solutions:
  - Dedicated network links (lightpaths) eg UKLight, GÉANT Plus
  - Logistical Session Layer (LSL) over existing IP network



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# LSL Expectations

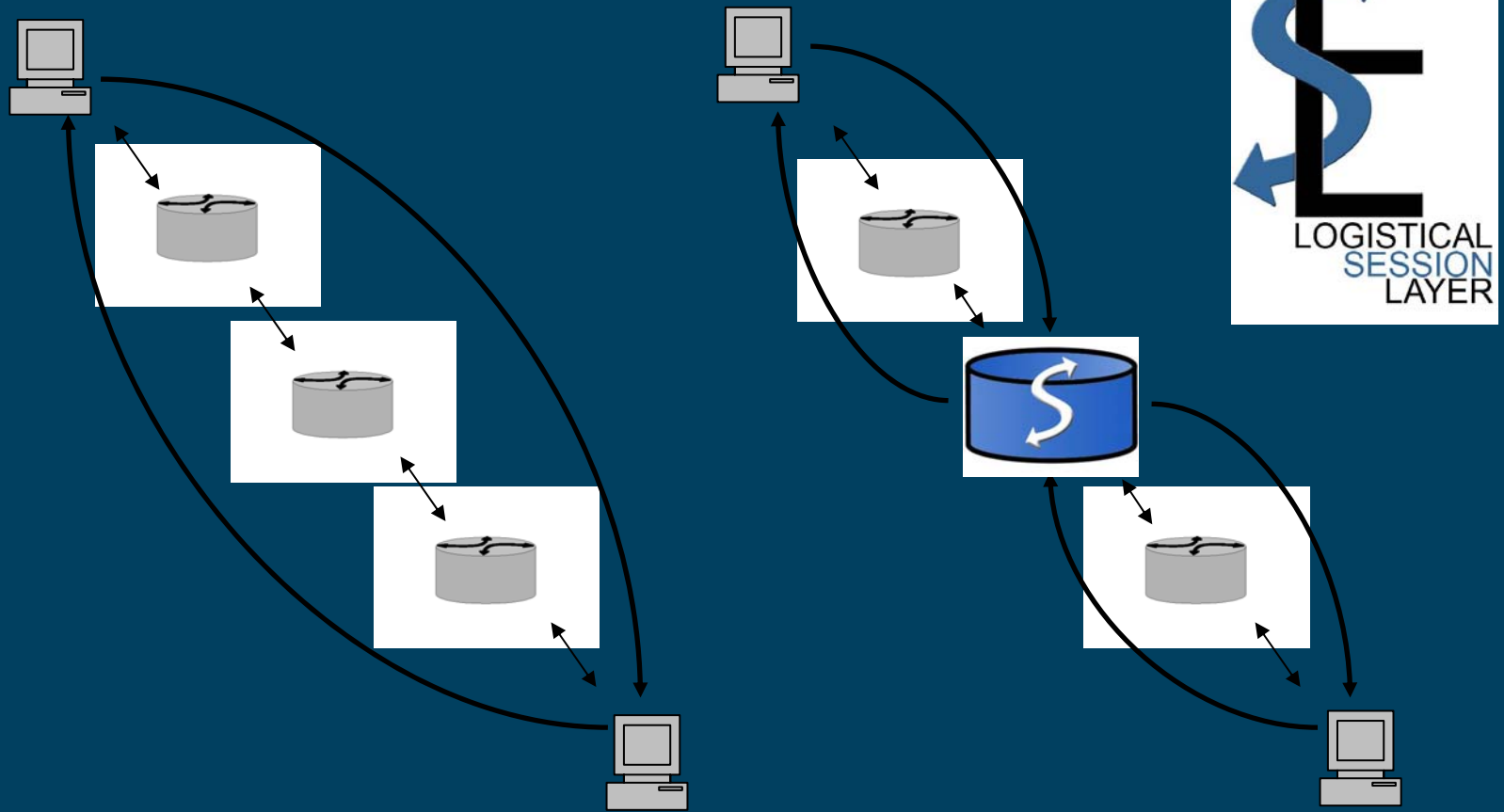
- LSL: Logistical Session Layer
- Developed by Martin Swamy (University of Delaware)
- A method of improving the throughput of TCP over long distances
- TCP is only 'fair' for traffic on the same length path
- LSL will address this by breaking up long paths into multiple sessions
- LSL provides 'depots' for the storage and forwarding of data packets
- The aim is to provide improved data throughput
- By introducing the LSL servers, the congestion control loop is shorter and more responsive
- Can adapt to conditions and react locally to congestion
- Local buffering means that retransmission need not come from source
- Currently being tested on GÉANT2 under SA3
- We await the results with interest!

# Logistical Session Layer

(courtesy of M. Swamy, University of Delaware)



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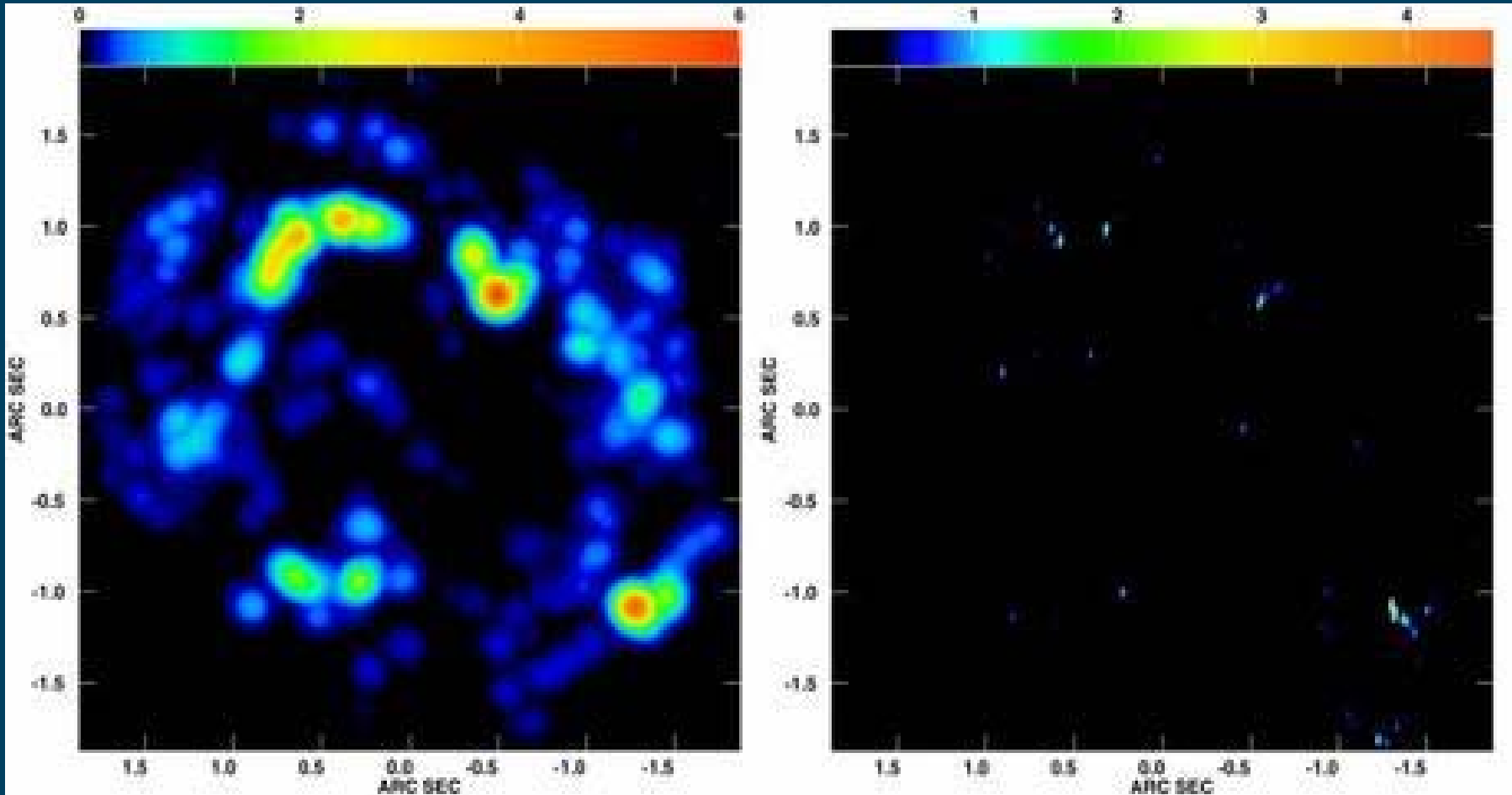
# The Future of eVLBI: EXPReS

- Partners include: AARNET, DANTE, PSNC, SURFnet and many Radio Telescopes
- Proposed goals:
  - Making e-VLBI an operational astronomical instrument
    - 16 telescopes connected to JIVE at 1 Gbps
    - Transparent inclusion of e-MERLIN antennas within e-EVN
    - Target of Opportunity Capability
  - *Arpad Szomoru, JIVE.*
  - Co-ordination between Astronomy and Networking communities
    - *John Chevers, DANTE*
  - Expanding the network of telescopes that are on-line –
    - *Paco Colomer, OAN.*
  - Future developments in e-VLBI > 1 Gbps data rates, distributed correlation, extended LOFAR etc.
    - *Huib Jan van Langevelde & Arpad Szomoru, JIVE.*

# Scientific Results: the real purpose of eVLBI



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# Conclusions and the FUTURE



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- An important aspect of GÉANT2 is a focus on the user community
- User support framework and processes beginning to be implemented
- To achieve optimum solutions GÉANT2 U-S must work closely with NRENs, JRAs, TERENA TFs etc.
- eVLBI an important and 'demanding' user
- High bandwidth network environment allows both new techniques and new science for Radio Astronomers
- The EXPReS eVLBI proposal: 16 telescopes in Europe, Asia, Australia, Latin America and North America + improved transfer rates
- PERT and LSL work show dedicated support for future high data rate eVLBI
- eVLBI will be routine in 2006!!





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- Questions? ....Or Lunch?

