

MANCHESTER
1824

The University of Manchester

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A little history...

“Those that have not understood history are doomed to repeat it!” - W. Churchill.



We should get that right!

A little history

We have been here before...

- “EVN 2010” [started in 2000 as TOG initiative] (Baan et al.)
- “EVN 2010” => EVN 2015 (in 2007)
- “EVN 2015” delivered in 2009 (Baan, Paragi et al).

No workshop photo!

MAG archive - earliest mention of EVN2010 ca. 2000

The Roadmap to EVN2010 – version 7 June 2006

The European VLBI Network

The EVN mission is to enable discovery in radio astronomy through innovative VLBI instrumentation and the management of shared radio astronomy facilities within Europe and affiliates in other countries.

The operational performance of the European VLBI Network depends on the effective collaboration of national observatories, the large collecting areas available at those observatories, and its success in following the trends in technology. The success in coming years will lie in EVN's ability to continue following these trends and its ability to facilitate world-class science by operational and technical advances.

Science Case for VLBI ==> waiting for input

[Transformational Science => What are important science questions & how can EVN contribute?](#)
[Which parameters would enlarge the impact of EVN?](#)

[New opportunities with new capabilities for lower surface brightness science \(broadband in RFI environment & UV coverage & MERLIN and EVN & EVN and Global\)?](#)

[Wide-field mapping applications](#)

[TOO & eVLBI applications](#)

[What to do with Higher sensitivity ?](#)

The EVN Vision

The strength of EVN is based on achieving scientific impact by means of high data quality, operational flexibility and high-sensitivity for the array. Continued excellence for the EVN will be served by robust array operation with high-quality data serving innovative scientific research for a growing VLBI community. Facilitation of target-of-opportunity capability and e-VLBI operation will contribute to generally robust and flexible operational procedures. Increased operational bandwidths and the use of more antennas will further increase the array sensitivity. Fast correlation at the EVN correlator at JIVE will facilitate innovative research and wide-field mapping operations with VLBI.

The following integral components may be identified in order to achieve the objectives of the EVN:

1. Enabling new capabilities in technology and techniques
2. Objectives for e-EVN
3. Position JIVE in the world of VLBI
4. Continued service to the Users
5. Position of EVN for SKA and other facilities
6. EVN and its role for all of RA in Europe

Enabling new capabilities in technology and techniques

1. Continued development of disk-based data storage systems and internet-based data transport needs to be supported and is essential for the future of the EVN.
2. The EVN supports further development and regular re-evaluation of digital backend and acquisition systems, including digital Base-Band Converters (dBBC), requires the adoption

of simplified VSI (VLBI Standard Interface) standards, of operational bandwidths of 1 GHz and over with 8-bit sampling, and of recording systems at data rates reaching 64 GBps.

3. The current frequency coverage of the EVN ranges from UHF to 43 GHz with selected numbers of systems and with a most elaborate system between 21 cm and 8 GHz. Expansion of the system is sought at 6 GHz, 15 GHz, 22 GHz, and at 43 GHz.

4. The technical objectives of the EVN can only be achieved if each of the EVN Observatories achieves broad-banding the receivers, improve frequency agility, and implement smart feeds. Incorporation of RFI mitigation capability in the dBBC backends will have far-reaching consequences for the data quality. Each observatory needs to continue to achieve highest-speed access to the backbone network.

5. Adding to EVN system sensitivity by means of adding collecting area with additional antennas can be achieved by reducing technical and operational barriers for participation.

6. Robustness and further improving the data quality are a major objective for EVN.

Objectives for e-EVN

7. JIVE and the EVN have been very successful in using the advances digital technology and networking capacity to establish real-time e-EVN VLBI capability (2005-2007) with proof-of-concept operation at 1 Gbps involving 5-7 telescopes, and employing routine pseudo-real-time fringe tests for network verification. Solving last-mile problems and enhancing network reliability are underway under the EU EXPRoS Program led by JIVE. Immediate goals include the use of the Géant/NREN infrastructure to establish routine 1 Gbps/RT for the whole EVN including the Asian and South African telescopes and to the Arecibo Observatory. Long-term goals are to continue to match the growth of the EVN networking capacity with that of the NREN infrastructures.

8. Seamless EVN – MERLIN integration as the shorter baseline core of EVN operations can be achieved with a 30 Gbps pipe from one EVN telescope into the e-MERLIN system and multiple 1 Gbps connections of e-MERLIN telescopes into the EVN correlator at JIVE.

Positioning JIVE

9. Continuous advances in data rates and data volumes necessitate a new generation EVN correlator at JIVE with a capability of 8-64 Gbps per RT for routine network operation with station capacity to accommodate stations in Asia, Africa and the USA. Considering the rapid changes in computing capabilities, both software and hardware options need to be considered and the experience of data processing for LOFAR, ALMA, and SKA need to be used optimally.

10. Further opportunities need to be explored tracking and calibration of spacecraft in support of science related activities.

Continued service to the Users

Reducing the barriers - Services and capabilities

11. The user community is a most valuable asset of the EVN and plays an important role in setting its user requirements. User support before, during & after observations are essential for the EVN and should be well-advertised in the community.

12. Because the EVN is not a homogeneous array more complex calibration and data reduction routines are required. The development of software tools are essential for new and improved data products, advanced data reduction pipelines, storage-Grid and compute-Grid applications, and Virtual Observatory applications. In particular, the user community would benefit from improved astrometry and improved high- and low-frequency calibration procedures. JIVE plays an important role in serving the user community. These efforts should build on the activities started under the FP5 and FP6 RadioNet and EXPRoS umbrellas.

13. EVN needs to continue to support and enlarge the user community by means of teaching networks, workshops, and symposia.

14. EVN needs to organize and streamline public relations activities, facilitate the dissemination of information to the users, and organize press office activities.

15. EVN should seek to continue a certain fraction of over-subscription in order to assure that the best science is being done and a wide range of topics is covered. The Program Committee should continue to be composed of a broad representation of research interests.

Improved EVN Operations

16. Technical developments in the EVN must result in a better service to the users, better data products, and easier access to the data and to processing facilities. Disk-based and real-time e-VLBI operations constitute major improvements in system and data reliability and system accessibility.

17. Real-time e-VLBI operational capability need to serve the user with more robust and automated operation, easier data transfer logistics, and flexible (dynamic) scheduling allowing target-of-opportunity observations triggered by other ground-based and space-based facilities.

18. The EVN needs to further investigate how the frequency and length of its observing sessions be optimized for the benefit of the community.

19. The role of the Technical Operations Group and further technical exchange and cooperation efforts need to be continue and strongly supported in order to further improve the robustness of the EVN system.

Positioning of EVN for SKA and other facilities

20. The large EVN collecting area and its geographic location are important factors for the role of the EVN as a very-long-baseline component of the Square Kilometre Array. After SKA site selection, the EVN needs to develop those components that provide optimal complementarity for the SKA.

21. The EVN should serve as a technology testbed for data transport, streaming data reduction, and advanced imaging techniques for SKA under the RadioNet and SKADS programs.

22. The importance of EVN and of VLBI serving as a scientific counterpart for facilities at other wavelengths, terrestrial and space-based, will grow with increasing numbers of participating telescopes, increasing operational bandwidth, wide-field imaging, and the new culture of real-time and on-demand VLBI.

EVN and its role for all of Radio Astronomy in Europe

23. The EVN augmented by RadioNet has played a coordinating role and brought together the radio observatories of Europe and beyond, which forms a strong basis for the formation of a European Radio Astronomy Observatory. EVN should continue to seek rapprochement with the MM-wave community, the MM-wave VLBI community, and the single-dish observatories.

24. EVN needs to seek increased harmonisation in technical and operational developments with the VLBI communities on other continents in order to facilitate joint operations and provide common goals.

unpublished!

N.B. EVN2010 (IVS2010) technology driven...

Lessons (see aHJvL)

- VLBI is very much technologically driven -
 - Need to do much more wrt technology road mapping (see Astronet)
 - Easy (tech) wins (cheap, universally adopted etc)
 - Be ambitious e.g. e-VLBI... , 1.49 μ Jy (rms)
-
- Produce a glossy document (see SKA Sci. case)
 - Produce a handy brochure.
 - Distribute *W I D E L Y!*

MAG archive

EVN VISION 2015

Sponsored by ASTRON, JIVE, and RadioNet

Date: **Thursday and Friday 1-2 March 2007**

Location: **ASTRON & JIVE building Dwingeloo**

Preliminary Program:

Thursday 1 Mar	09:00 - 09:15	Organizing the work
	09:15 - 12:30	Presentations & Discussions JIVE – technical advances in VLBI ASTRON - Deep Fields, surveys Bordeaux - astrometry MPIFR - astrometry Discussion
		Cormac Reynolds Mike Garrett Patrick Charlot Andreas Brunthaler
		Simon Garrington Ben Stappers Josep Martí Zsolt Paragi
	14:00 - 17:30	Presentations & discussions OAN - molecular line Manchester - stellar sources, masers ASTRON - megamasers, molecules Manchester - spectral line Manchester - starbursts Discussion
		Javier Alcolea Anita Richards Willem Baan Rob Beswick Tom Muxlow
	19:00	Dinner & discussions
Friday 2 Mar	09:00 - 11:30	Presentations & Discussions IRA - active nuclei Cork - active nuclei, polarization JIVE - lensing MPIFR - high frequency applications MPIFR - active nuclei MPIFR Discussion
		Marco Bondi Denise Gabuzda Olaf Wucknitz Thomas Krichbaum Andre Lobanov Anton Zensus
	11:30 - 12:30	Discussion of main research areas & organization of output document
	14:00 - 16:00	Production Preliminary Output
	19:00	Dinner for remaining participants
Other contributions		Oxford - surveys/MM via Willem Baan Manchester, pulsars/transients via Ben Stappers IAA Granada – Radio supernovae OSO - spectral line IRA - theory via Marco Bondi
		Hans-R Klockner Michael Kramer Antxon Alberdi John Conway Gianfranco Brunetti

Before:

- Radio transients (FRBs)
- GW events
- ...

What are we “missing” today?

- feedback (HI abs)
- local EVN synergies e.g. SRT, APERTIF/LOFAR surveys
- “thermal” science?
- precision spacecraft navigation (e.g. Huygens)
- Multi-messenger astrophysics (ASTERICS)
- SETI?

What are we “missing” today (cont.)?

- technology
- operations (access, flexibility, cadence, e-VLBI, EVN lite, data)
- AI (machine learning)
- training
- impact
- Point & shoot vs Large KSPs
- Service surveys (making the most of data we have!)
- Truly global (inc. Asia) - “World Array” - WB... Earth VLBI Network (AL)

SKA - on the EVN horizon!

- OPPORTUNITIES

- CHALLENGES

- THREATS



Don't forget the community...

“EVN is mostly for Extragalactic stuff” - Anna B.

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