Work package number [9]	WP7	**Lead beneficiary** [10]	5 - INAF
Work package title	The VLBI future		
Start month	6	**End month**	48

Objectives

Because of the progress in the field of astrophysics and the changes in the radio astronomy landscape it is timely to revisit the EVN science case. In consultation with the user community and global partners we will define the most important science areas for future VLBI arrays.

Description of work and role of partners

WP7 - The VLBI future [Months: 6-48]
INAF, JIV-ERIC, CHALMERS
Background. Very Long Baseline Interferometry (VLBI) arrays are the only instruments that reach angular resolutions of the order of a milli-arcsecond and less, allowing unique studies of the central black holes of active galactic nuclei and their evolution, star formation and stellar evolution, gamma-ray bursts, searches for extra-solar planets, and ultra precision astrometry, to name just some of the many research areas and applications. The European VLBI Network is one of the world's most sensitive VLBI arrays over a broad range of frequencies. This has been achieved by the close collaboration and communication between the scientific and technological/engineering staff, and by long-term coordinated investment and development programme among all partners. Science and technology need to progress hand in hand to ensure the most outstanding scientific output. Moreover, the continued effort of JIVE, particularly in providing user support at many stages, has ensured a considerable growth of the VLBI scientific community, making the intrinsic complex observational technique and data analysis broadly accessible to all.

Radio-astronomical facilities are currently undergoing a rapid evolution, which in many cases involves VLBI as a key ingredient. Beyond the ALMA-VLBI connection, most relevant to the current proposal are the potential developments in Africa (African VLBI Network, AVN, addressed in WP9) and the construction phase of the SKA (addressed in WP10). In particular, the establishment of a 30m class of radio telescopes throughout Africa would ensure an almost continuous distribution of radio telescopes from Northern Europe to South Africa, with a resulting substantial increase in that portion of the sky accessible for high-fidelity milli-arcsecond resolution imaging. In addition, the possibility of a phased SKA for VLBI observations would provide a step change in sensitivity, and hence in the scientific potential of VLBI.

Many (European) partners realise the potential of radio astronomy and are joining up with the VLBI community (WP3, 5) or are joining complementary SKA pathfinders (WP4). In this rapidly evolving framework it is essential that the tight synergy between science and development is continued, and that a scientific roadmap is defined, to fully exploit the forthcoming generation of VLBI arrays. The prospect of this project is timely as the SKA is being designed and the establishment of an AVN has started. Defining a new roadmap for VLBI is urgent.

Task 1. VLBI science case. The main deliverable will be a document, in the form of a White Paper, that will address and explore several relevant points in setting the future priorities of VLBI science capabilities. Besides the global developments it is also important to take technical capabilities into consideration. One example is the question how to implement a "large-survey mode" for VLBI in order to address the wishes of the scientific community and thus ensure the best scientific returns. Another is the feasibility of transient surveys. Deep surveys of individual targets, or somewhat shallower surveys with a large field of view, are scientifically profitable, but the question is in which case the EVN resources are best used. The first would benefit from the large telescopes in the EVN and the traditional observing mode (limited to the EVN sessions), while the latter would be better implemented by adding smaller dishes to the array. Those would provide large field of view, would be available most of the year and would better complement the SKA. Other technical aspects that need to be considered are the frequency coverage and bandwidth available, but also the capabilities of the central data processor, the correlator, which forms the final science products. Maybe in the future it will become possible to do VLBI observations with array feeds, providing multiple beams per station.

The synergy with the new astrophysical frontiers which will become accessible with future space missions and ground facilities (some remarkable examples include LSST, GAIA, XIPE) will play a major role in shaping the White Paper. Beyond the challenges raised above, we should keep in mind that astronomy is undergoing a major revolution at another level: namely the massive increase in the data volumes which are becoming prevalent in the new state-of-the-art facilities. This is the case in many wave bands, but particularly in radio astronomy, requiring the development of data archiving and data mining tools. In this rapidly evolving framework it is important to propose future directions for the development of the EVN data archive at JIVE.

We expect the VLBI community to be aware of the future challenges. So it is our task to engage the user base in an efficient feedback process and involve them actively in the discussion. However, it is essential that the needs of the next generation of radio astronomers are also identified, in terms of the development of software tools, user-support, and data analysis. How this should be implemented at JIVE to enhance and improve its invaluable role in supporting user access to the EVN to maximize the scientific return will be part of the process and discussion.

To achieve the goal of the White Paper, and ensure that at least all the above points are properly addressed we propose to set up a team which includes both members from the partners in the project, and external experts in other fields of astronomy as well as from the technology and engineering community. To keep the feedback process with the VLBI community alive, some members of the WP may attend key science meetings and workshops, such as for instance the EVN Symposia, whose scientific discussions and results will be relevant for our purpose. This WP will work in synergy with WP6 - to include astrometry and geodesy in the VLBI revised science case - WP9 (to link up with the science developments in Africa) and will provide input to WP10 (that aims to define an operational SKA-VLBI and to develop global VLBI science for it).

WP leader: INAF (Tiziana Venturi) with support from JIVE and in coordination with the EVN PC chair (Michael Lindqvist, CHALMERS-OSO)

Participation per Partner

Partner number and short name	WP7 effort
1 - JIV-ERIC	3.60
3 - CHALMERS	3.00
5 - INAF	9.00
Total	15.60

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D7.1	Minutes of Kick-off meeting	1 - JIV-ERIC	Report	Public	7
D7.2	Minutes of meeting 2	5 - INAF	Report	Public	15
D7.3	Minutes of meeting 3	5 - INAF	Report	Public	30
D7.4	White paper	5 - INAF	Report	Public	45

Description of deliverables

D7.1 : Minutes of Kick-off meeting [7]

Meeting 1, kick-off meeting among the WP members

D7.2 : Minutes of meeting 2 [15]

Meeting 2, here we will invite external experts to take part in the discussion

D7.3 : Minutes of meeting 3 [30]

Meeting 3, the available draft of the white paper will be discussed and improved

D7.4 : White paper [45]

White paper delivered

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS20	Minutes of Kick-off meeting	1 - JIV-ERIC	7	Minutes of Kick-off meeting, noted by EVN CBD
MS21	Minutes of meeting 2	5 - INAF	15	Minutes of meeting 2, noted by EVN CBD
MS22	Minutes of meeting 3	5 - INAF	30	Minutes of meeting 3, noted by EVN CBD
MS23	White paper	5 - INAF	45	White paper, approved by EVN CBD