Work package number [9]	WP5	**Lead beneficiary** [10]	6 - MFOM-E
Work package title	Integrating new elements		
Start month	1	**End month**	48

Objectives

This work package will test and verify the performance of new telescopes in the EVN. This is important both for the new consortium members, as well as the EVN user community. A special focus will be on quality control and calibration

Description of work and role of partners

WP5 - Integrating new elements [Months: 1-48]
MFOM-E, JIV-ERIC
Background. From its birth as a consortium of five European radio astronomy observatories, the growth of the EVN has been a principal factor in being able to offer astronomers an ever more capable instrument. Additional telescopes provide improved imaging fidelity and sensitivity to fainter sources. Developments in digital back-end technology over the past few years, and, more recently, in the distribution of clock and frequency standards, are lowering the barrier for aspiring telescopes to participate in the EVN. Examples of such network enlargements in the new millennium are the - element KVAZAR network in Russia and the 3-element KVN in Korea, the latter operating at the higher frequencies covered by the EVN. In addition, new telescopes with significantly enhanced capabilities at existing EVN institutes have come on line (the 40m telescope at Yebes, Spain; the 65m telescope at Tianma, near Shanghai, China), as well as new or refurbished telescopes at institutes not previously associated with the EVN (the new 65m telescope in Sardinia; the 32m telescope in Irbene, Latvia). Characterising and monitoring the performance of these telescopes is a considerable effort.

Task 1. Significant enhancements at existing EVN and affiliated stations. Some of the new EVN telescopes are upgrading their receivers to better match the EVN observing frequencies. For example, the Kunming 40m telescope in south-west China has participated in very few EVN observations, as currently only one frequency band overlaps with the frequency coverage of the EVN. Recently, multifrequency front-end equipment has been purchased, but has yet to be tested with the EVN. The inclusion of this telescope at more frequency bands will provide an enhanced coverage in the eastern reaches of the EVN, improved image fidelity and the capability to track sources for longer periods of time, especially when conducting joint observations with the Australian LBA. JIVE's support team will need to verify the data quality and work with the station staff to determine a reliable calibration of
such observations. We also point out the exciting possibility of using the enormous FAST telescope in China for VLBI.

We will also work towards incorporating the short baselines formed by the individual eMERLIN telescopes in the UK. It is obvious that this will significantly improve the EVN's sensitivity to extended structure. As the signals from these telescopes go through the eMERLIN correlator before they can be processed for EVN correlation we can expect some subtle problems. With the implementation of this eMerlin mode recently completed, we will focus on verifying the data quality and calibration effects in detail. Similar work is anticipated for the Westerbork array as a VLBI element, after the deployment of the phased-array feed APERTIF system. APERTIF provides a multi-beam, wide-field capability for 18-21cm observations. The EVN could benefit from the full Westerbork array sensitivity at these frequencies with the new wider-field feature for projects conducting deep surveys. Similar workwould be needed for the SKA precursor telescope MeerKAT in South Africa.

In this task a dedicated support scientist at JIVE will serve as a contact person for the stations that use new receivers or data interfaces. He/she will make a plan for testing new capabilities and discuss the requirements for delivering calibration. When progress is deemed satisfactory, the new modes can be incorporated in the standard Network Monitoring Experiments. The support scientist's findings will be discussed with the stations in the EVN Technical and Operations Group (TOG). We note that the support scientist will also be an active scientist, pursuing a career in astrophysics.

Task 2. Supporting new telescopes. Several 30-m class telescopes are found throughout Europe that could greatly improve the EVN's image fidelity by providing baselines currently not available. The first step would be to conduct a census of such telescopes, their institutional situation and technical needs for a conversion to an EVN-ready radio telescope. We have had expressions of interest from the UK, Portugal, Finland, and Ireland. In addition there are a number of geodetic stations in European countries that have not participated (for a long time) in EVN observations. Besides dedicated support at the correlator, we propose to make provisions to support tiger teams comprising technical experts from EVN stations, that could accelerate the progress towards EVN participation. Note that the same expertise will be used in WP9 to facilitate African VLBI telescopes. This however we view as a special category, as an exchange programme on all levels is required.

The support scientist dedicated to this task will make an inventory of the telescopes that could benefit from this programme. For these a technical assessment will be made of potential bottlenecks that stand in the way of EVN participation. Where needed, special tiger team visits will be arranged to facilitate test observations. These efforts will be coordinated and reported at the EVN TOG (the Technical Operations Group). The support scientist will also be responsible for scheduling and data inspection.

Task 3. Station feedback from pipeline and archive. An asset of the central JIVE organisation at the heart of the EVN is a very complete, interactive and public archive. Through a pipeline, which runs after correlation, the archive is populated not only with the correlated raw data, but also with calibration data and preliminary images. We propose to make changes to this system that will allow telescope operators to query the archive for information on telescope performance. The focus will be on calibrator observations, which will allow a direct assessment of a specific telescope's performance.

Offering this capability will require re-engineering of the existing data flows and a careful evaluation by the experts in the JIVE telescope support team.

WP Leaders: IGN/MFOM-E (Pablo de Vicente), JIVE (Bob Campbell)

Participation per Partner

Partner number and short name	WP5 effort
1 - JIV-ERIC	50.40
Total	50.40

List of deliverables

Deliverable Number[14]	Deliverable Title	Lead beneficiary	Type[15]	Dissemination level[16]	Due Date (in months)[17]
D5.1	reports to TOG	1 - JIV-ERIC	Report	Public	18
D5.2	Changes in pipeline & EVN archive interface	1 - JIV-ERIC	Other	Public	42
D5.3	Final report on integrating new elements	6 - MFOM-E	Report	Public	46

Description of deliverables

D5.1 : reports to TOG [18]

Bundle of reports to the TOG on Task 1 and 2 activities

D5.2 : Changes in pipeline & EVN archive interface [42]

Pipeline and the EVN archive interfaces for monitoring station performance

D5.3 : Final report on integrating new elements [46]

Final report on integrating new elements

Schedule of relevant Milestones

Milestone number[18]	Milestone title	Lead beneficiary	Due Date (in months)	Means of verification
MS14	Reports to TOG	1 - JIV-ERIC	18	Reports to the TOG, minuted by EVN TOG
MS15	Changes in pipeline & EVN archive interface	1 - JIV-ERIC	42	Changes in pipeline & EVN archive interface, published to community
MS16	Final report on integrating new elements	6 - MFOM-E	46	Final report on integrating new elements, minuted by EVN TOG