

<b>Work package number</b> <sup>9</sup>	WP8	<b>Lead beneficiary</b> <sup>10</sup>	1 - JIV-ERIC
<b>Work package title</b>	Global VLBI interfaces		
<b>Start month</b>	3	<b>End month</b>	45

**Objectives**

In order to support the globalisation of VLBI it will be necessary to update tools and methods that allow the telescopes to be addressed in a uniform way. This work package will take charge of scheduling and monitoring tools, adapting and modernising them as needed, while taking care to continue to adhere to international standards and requirements.

**Description of work and role of partners**

**WP8 - Global VLBI interfaces** [Months: 3-45]  
**JIV-ERIC, CHALMERS, TUM**

Background. VLBI, by its very nature, depends on the seamless interaction of many elements spread around the globe. Over many years, various mechanisms and tools have been put in place to make this possible. Some of these tools, although still functional, have now become very hard to maintain, let alone upgrade to new functionality. With new telescopes coming online and being added to VLBI networks, and observing modes and standards rapidly evolving, it has become essential to address these issues. Moreover, the VLBI user experience is seriously affected by the scheduling experience; new tools to involve scientists at various stages with a modern interface can currently not be implemented.

This work package will deal with two most outstanding problems. The first is scheduling of observations, which today is (mostly) handled through a programme called SCHED, dating from the early eighties and entirely written in FORTRAN. The second is the continuous monitoring of the status of stations participating in VLBI sessions. This is not only important for the early detection of technical problems, thus preventing the waste of valuable observing time, but also could prove very useful during the commissioning phase of new VLBI telescopes, for example in Africa. Resolving these issues will help to enable truly global operations, and prepare VLBI for the inclusion of the large instruments of the future, notably the phased up MeerKat and SKA arrays.

Task 8.1: Re-factoring of legacy scheduling software. The program SCHED was written in the early eighties in order to provide a common, generalised user interface for scheduling VLBI observations. It does so by combining observing parameters, source catalogues and frequency setup catalogues, which describe the detailed settings at all different stations. This is by no means trivial, considering that all telescopes are different, in terms of location, architecture, hardware limitations, equipment and frequency coverage. The resulting schedule comes in the form of a so-called VEX file, for which an international standard was defined, a plain-text human-readable equivalent of a database. This file is sent to the stations, where the control computer parses the schedule and translates it into a series of commands to the telescope control system and the recording/transmitting equipment. The decades-old code base makes the program extremely hard to modify in order to adapt it to the modern-day demands of VLBI networks. And in spite of the fact that several VLBI networks around the world depend on it, there is no formal support for SCHED in place.

The aim of this task will be to re-factor the existing code, rather than re-writing all from scratch. This will be done by separating out well-defined bits of functionality and re-writing these as individual modules in a modern language, most likely Python. In this way a “gold standard” will remain available throughout the process, enabling an incremental replacement of the original code base. Static parts of the code that do not need frequent modifications will be kept as they are. The end product will be a modernised version of SCHED that will be far easier to adapt, written in a widely used and well-known programming language. It will be usable for all aspects of the proposal-observational cycle, which means during the proposal phase, the programming by the PI and finally the actual generation of an observing schedule by the JIVE staff. This functionality will be essential for VLBI users in the SKA era. As an aside, we will set up a forum of SCHED experts and users, to ensure that the engineering effort will keep the different needs of different VLBI networks in mind.

Task 8.2: Remote access and monitoring In the past, monitoring of the elements of a VLBI array during observations used to be virtually impossible. Equipment failures, human mistakes or other mishaps would often only be noted during or even after correlation by inspecting the data, which might take place months after the actual observations. The advent of e-VLBI, transferring data in real time to the correlator, brought with it a considerable improvement in the communications between stations and correlator. However, VLBI observations are still mostly done using recorders, during sessions that hardly have any central overview of the network as a whole. This will be unavoidably the case for the proposed global VLBI, involving remote stations all over the world.

During the EC-funded NEXPReS project, a remote control and monitoring system was developed and deployed at a number of geodetic stations. This task will evaluate this product and other existing monitoring systems to find a common ground in order to ensure interoperability. It will adapt existing software for integration into a central infrastructure and set up web-based access techniques. The final product will be a central, web-based monitoring system, usable for both astronomical and geodetic VLBI. This system will be accessible to all involved, correlator and stations, and will serve to continuously monitor and assess the status of the VLBI network, enabling automated warnings in case of failures and providing the information needed to continuously improve the performance of the network. Such a system will also be of great value when helping with the commissioning of new VLBI telescopes, in particular in areas of the world where radio astronomy is not well-established yet.

Work on these tasks will be carried out at JIVE and TUM, while CHALMERS-OSO will provide hardware and personnel for testing the results in the field.

WP leader: JIVE (Arpad Szomoru)

### Participation per Partner

Partner number and short name	WP8 effort
1 - JIV-ERIC	36.00
3 - CHALMERS	4.00
10 - TUM	24.00
<b>Total</b>	<b>64.00</b>

### List of deliverables

Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D8.1	Setting up of SCHED re-factoring forum	1 - JIV-ERIC	Other	Public	3
D8.2	Document of SCHED	1 - JIV-ERIC	Report	Public	8
D8.3	Re-factored SCHED	1 - JIV-ERIC	Other	Public	36
D8.4	Evaluation software packages	10 - TUM	Report	Public	4
D8.5	Integration existing software into central infrastructure	10 - TUM	Other	Public	12
D8.6	Completed monitoring schedule	10 - TUM	Other	Public	24

### Description of deliverables

D8.1 : Setting up of SCHED re-factoring forum [3]

Setting up of SCHED re-factoring forum

D8.2 : Document of SCHED [8]

document detailing what functionality of SCHED will be re-written, and method to be followed, based partly on input from SRFF

D8.3 : Re-factored SCHED [36]

re-factored SCHED

D8.4 : Evaluation software packages [4]  
 Evaluation of different monitoring software packages

D8.5 : Integration existing software into central infrastructure [12]  
 Integration of existing software into central infrastructure

D8.6 : Completed monitoring schedule [24]  
 Completed monitoring system, deployed at JIVE and Geodetic obs. Wettzell

**Schedule of relevant Milestones**

<b>Milestone number<sup>18</sup></b>	<b>Milestone title</b>	<b>Lead beneficiary</b>	<b>Due Date (in months)</b>	<b>Means of verification</b>
MS24	Setting up of SCHED re-factoring forum	1 - JIV-ERIC	3	Setting up of SCHED re-factoring forum, noted by exec.
MS25	Document on SCHED	1 - JIV-ERIC	8	Document on SCHED, published to global community
MS26	Re-factored SCHED	1 - JIV-ERIC	36	Re-factored SCHED, available to user community
MS27	Evaluation software packages	10 - TUM	4	Evaluation software packages, noted by exec.
MS28	Integration existing software into central infrastructure	10 - TUM	12	Integration existing software into central infrastructure, noted by exec.
MS29	Completed monitoring schedule	10 - TUM	24	Completed monitoring schedule, available to telescope operators