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JUMPING JIVE

Project ID: 730884

Workshop boards discussing position paper

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1. Introduction

Scientifically and organizationally there are similarities between the Joint Institute for VLBI ERIC (JIVE) and the International LOFAR Telescope (ILT). Both support a distributed telescope network spread over a number of countries and rely on a central facility for correlation and data curation, quality control and users interface. The objectives of WP4 are to carry out an assessment to be presented to the JIVE and ILT governing bodies and stakeholders, describing the possible merits and pitfalls of a closer operational alignment of these two facilities, and even the merging as a single ERIC. The present document covers the activities carried out in the first 20 months of the project and outlines the future steps in this process.

2. Activities

2.1. Interviews and questionnaire

The first part of WP4 consisted of an assessment study covering the current structure of ILT and JIVE in order to evaluate the similarities and differences between both infrastructures, with a focus on their operational models. The assessment was done in a 2-stage interviewing process covering the structure, procedures, and operations at JIVE and ILT.

During the first stage, the ILT and JUMPING JIVE policy officers interviewed face to face the head staff of the different departments at both institutions, including their directors, and asked them to provide an overview of the work at their department and how it has evolved with time. Information was gathered about the resources available, the organization of the work, the interactions between the teams, and with the other departments in each organization. Furthermore, it was discussed the relations with the other members of the networks, with the users, and the scientific community in general.

The second part consisted of a written questionnaire with specific and more focused questions directed at the same people. Table 1 shows the summary of the people interviewed and their role within each organization. The questionnaire in full-length is presented at the end of this document as an Appendix.

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Department	ILT	Department	JIVE
Director	R. Vermeulen	Director	F. Colomer H. van Langevelde (*)
Science Operations and Support	R. Pizzo	Science Operations	R. Campbell
Operations and Maintenance	M. Drost	Technical Operations	A. Szomoru
Software Support	J. Annyas	User Support	Z. Paragi
		Space Science & Innovative Applications	L. Gurvits

Table 1: Structure of ILT and JIVE. (*) Director until December 2017.

2.2. Workshop

After collecting the initial information, WP4 organized two workshops with all the people interviewed. During the first meeting in March 2018, the goals of the project were presented and the participants discussed the purpose of the exercise in the broader context of JUMPING JIVE.

A second workshop was organized on the 11 of April 2018. The attendance was almost complete, only one of the invited participants was not available (Table 2).

Workshop participant list		
Institution	Department	Name
ILT	Director	R. Vermeulen
ILT	Science Operations and Support	R. Pizzo
ILT	Software Support	J. Annyas
ILT	Director Radio Observatory	H. Jense
ILT	Policy Officer	C. Baldovin
JIVE	Director	F. Colomer
JIVE	Former director	H. van Langevelde
JIVE	Science Operations	R. Campbell
JIVE	Technical Operations	A. Szomoru
JIVE	User Support	Z. Paragi
JIVE	Space Science & Innovative Applications	L. Gurvits
JIVE	Project Manager Jumping Jive	G. Cimò
ILT	Operations and Maintenance	M. Drost (not available)

Table 2: List of participants and their roles

During the meeting, the participants had the chance to present their own view of the work done in their department and the challenges they face. It was a moment for a good exchange between the teams in both organizations. The slides presented during the workshops are available on an access-restricted page on the project wiki[1].

[1] http://www.jive.eu/jumpingjive/doku.php?id=lofar:wp-workshop

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2.3. Board meetings

This study is intended to be presented and discussed at the respective Board and Council of ILT and JIVE.

The discussion was scheduled at the ILT Board meeting in April 2018, however, due to tight agenda constraints, only a brief update of the activities was possible. The Board acknowledged the importance of this assessment and expressed the interest in having a detailed account of the findings and to discuss the possible synergy scenarios at the Board meeting scheduled for the end of September 2018.

JIVE Council has also acknowledged the work done in this work package and it will discuss the synergies between the two facilities at a future meeting scheduled in November 2018.

3. Summary of ILT and JIVE similarities and differences

In the course of this study, some major similarities and differences between ILT and JIVE have been identified:

- JIVE is formed by member countries whereas ILT is formed by consortia (1 country = 1 consortium).
- JIVE has ERIC status, ILT is a non-profit organization under Dutch law.
- To join the ILT, interested institutes need to buy (at least) one LOFAR station that will remain connected to the ILT network for at least 90% of the time. To join JIVE, new members can use already existing facilities, but the commitment must be made at a state level.
- While the ILT partners pay a fixed annual contribution according to the number of stations, JIVE contribution scales with local operation costs.
- The highest governance bodies are the ILT Board and the JIVE Council, their constitution slightly differs, but all country members are represented and have the same voting rights. The Directors have the executive tasks. The director of JIVE is supported by the Management Team, formed by the heads of each department. The ILT constitution designates ASTRON as the operational institute for all its facilities.
- The two facilities share some of their members (Table 3), but while ILT has only European partners, JIVE has also non-European members such as China and South Africa.

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- In ILT mode, stations are centrally operated from Dwingeloo (NL). The telescopes in the EVN network are always controlled locally. EVN sessions run for a limited period of 3 weeks, 3 times per year, while the ILT uses the whole network close to 90% of the time, stations owners can use their stations privately the remaining of the time.
- The ILT and JIVE have a process of peer review for the projects that wish to use observing time (and computing resources in the case of the ILT). EVN has full open skies policy during their sessions of operation, while the ILT is partially open skies; the national consortia obtain reserved access share of the observing time in return to the investment that represents installing a LOFAR station. This time share decreases with time and consortia are free to give part of their reserved time back to the ILT for allocation by the panel committee.
- Both facilities provide a strong user support from the proposal stage to the data analysis and there is a wish to increase their respective users base. There are different tools available to the users to prepare observations and check the quality of the data. Users can contact the staff to request direct support. Meetings with the participation of the users are organised periodically (workshops, schools, symposia).

Members	ILT	JIVE
The Netherlands	Y	Y
UK	Y	Y
Sweden	Y	Y
France	Y	Y
Spain	N (interest)	Y
Latvia	N*	Y
Germany	Y	Associated
Poland	Y	N
Ireland	Y	N
Italy	Y	Associated
China	N	Associated
South Africa	N	Associated

*Table 3: Member countries of JIVE and ILT. *: in the process of becoming a member*

4. Future activities

In the upcoming months, WP4 will start working on a second study that will focus on institutional partnerships, financing, and governance models. It will first clearly describe the

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current governance and partnerships of the respective facilities. It will then explore plausible national, European, and international developments in the next decade with regard to funding and collaboration on operating large-scale research facilities in radio astronomy, keeping the ESFRI priorities in mind. The study will assess the possible places and roles of both facilities against the evolution of research infrastructures.

The document will conclude with an analysis of the future risks, challenges, and opportunities for both organizations and explore different evolution paths; among which the possibility of the ILT becoming an ERIC, and the discussion of merger scenarios with JIVE. This second study will include workshops with experts and representatives from governing bodies and funding agencies (e.g., NWO, EC) and will produce a document to be presented and discussed at both the ILT Board and JIVE Council by mid-2019 (Deliverable 4.2).

5. Appendix

Questionnaire on the current structure at ILT and JIVE

1. Legal status and Partnership

1.1 When was the organisation established? Where are the Headquarters?

ILT
The International LOFAR Telescope was established on June 2010 to operate the network of LOFAR stations. The Headquarters are located in ASTRON, Dwingeloo, the Netherlands. LOFAR website:
JIVE
JIVE, the Joint Institute for VLBI ERIC, is the central organisation in the European VLBI Network (EVN). JIVE implements the core data processing and user services that turn the network of distributed telescopes into a single observatory to study the radio sky at the highest possible resolution. The Institute is located in Dwingeloo, the Netherlands, and is hosted by ASTRON - the Netherlands Institute for Radio Astronomy. JIVE Website: http://www.jive.eu/

1.2 What is the legal status of the organisation?

ILT
ILT is a non-profit foundation under Dutch law.
JIVE
JIVE is an ERIC (European Research Infrastructure Consortium). JIV-ERIC replaces the JIVE foundation (Joint Institute for VLBI in Europe), which was created in 1993 by the EVN. The ERIC was established in the last

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weeks of 2014 and inaugurated on April 16 2015. The ERIC is a legal entity established by the EC and automatically in effect in all EC countries. For most operational aspects (finances, personnel) it follows the practices of the host country, ie the Netherlands.

1.2 How many and which countries belong to it?

ILT
There are 7 countries partners in the ILT: The Netherlands, Germany, France, UK, Poland, Sweden, and Ireland. Currently, Latvia is in the process of becoming a member; a contract to purchase a LOFAR station was signed in December 2017. Italy is in negotiations to enter the ILT in early 2018. Recently, Spain has shown interest in joining in a near future, but at the moment no funding is available.
JIVE
The current 6 member countries in the ERIC are **France, Latvia, the Netherlands, Spain, Sweden and the United Kingdom**. Each country is represented by the following national research councils and facilities: ● The Netherlands Institute for Radio Astronomy (ASTRON), and the Netherlands Organisation for Scientific Research (NWO), the Netherlands (Host) ● Centre Nacional de la Recherche Scientifique (CNRS), France ● Ventspils Augstskola (VeA), Latvia ● Instituto Geográfico Nacional (IGN), Spain ● Vetenskapsrådet (VR), Sweden ● The Science and Technology Facilities Council (STFC), UK JIVE is also supported by the following participating research institutes: ● National Astronomical Observatories (NAOC), China ● Max Planck Institute for Radio Astronomy (MPIfR), Germany ● National Institute for Astrophysics (INAF), Italy ● National Research Foundation (NRF), South Africa

1.3 Which is the (main) mission/vision of the Research Infrastructure (RI)? Are other activities considered?

ILT
The objectives of the ILT Foundation are: - To operate under a joint scientific policy, the full range of LOFAR facilities for radio astronomy in The Netherlands and abroad. - To maximise the scientific productivity of the ILT to the partners and the global astronomical community, as a world-leading facility with a long-term perspective. In order to achieve the objectives, the policies will specifically: - Safeguard the execution of key science programmes that drove the LOFAR design - Give appropriate recognition for efforts and investments during the development, construction, and operations - Offer a common-user observatory interface to the global astronomical community - Strive to keep the LOFAR facilities at the state-of-the art.

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JIVE
The mission of JIVE is “to promote and implement the use of VLBI and other radio astronomical techniques”. A (nonofficial) vision is “to be identified as a stable base for European collaboration in VLBI and related radio astronomy techniques, providing excellence in scientific research, technological development, resources management and support to users and partners”. The core business in JIVE is the correlation of EVN data (including R&D for maintaining a state-of-the-art facility), support of EVN stations, and support of EVN users.

1.4 Is there an Open Skies policy?

ILT
The ILT has a partially open skies policy. The MoU that establishes the ILT Foundation foresees a minimum of 10%, with the purpose of gradually increase to at least 50%, of the observing resources to be allocated on solely scientific merit. As a recognition to the investment and contribution to the development of the ILT, when countries join receive Reserved Access to observing resources for a period of at least 5 years. The distribution of such resources is based on the number of operational LOFAR stations connected to the ILT network in each of the partner countries.
JIVE
The policy for observations and data access is that of the EVN and set by the EVN consortium agreement. The EVN is a network of radio telescopes located primarily in Europe and Asia, with additional antennas in South Africa and Puerto Rico, which performs high angular resolution observations of cosmic radio sources. JIVE is a member of the EVN. An overview of the EVN can be found in: http://www.evlbi.org/intro/intro.html The EVN is a large scale astronomical facility which offers observing time to astronomers from all over Europe and the rest of the world (“Open Skies” policy). Users can download the data from the EVN Data Archive: http://www.jive.eu/select-experiment Data are made public once the 12-month proprietary period has expired (6 months for Target-of-Opportunity observations), as explained in the EVN Data Access Policy: http://www.evlbi.org/user_guide/archive_policy.html

1.5 Is the RI included in the National roadmaps?

ILT
LOFAR is mentioned in the strategic plan for astronomy in The Netherlands (2011-2020) produced by the Dutch committee for Astronomy.
JIVE
JIVE is really a European Research Infrastructure, thus it leaves the advocacy of the facility on national levels, including the Netherlands, to the national organisations. In many countries the landmark telescopes and their inclusion in the VLBI network are recognised national priorities, sometimes the synergy with SKA developments has been noted.

2. Governance

2.1 Can you describe the governance model at your organisation?

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ILT
The ILT is governed by the Executive board and the Executive director (Dr. R. Vermeulen). Each partner country has a national LOFAR consortium that coordinates the participation of the national community in the exploitation of LOFAR and that represents its interests at the board.
JIVE
JIVE is governed by a Council, composed by two persons (one vote) nominated by each of the member countries. The Council has a Chair (currently Prof. Simon Garrington, Jodrell Bank Centre for Astrophysics, Manchester, UK) and a ViceChair (Prof. John Conway, Onsala Space Observatory, Sweden). Many aspects of the Council's operation are described in the JIVE Statutes, in addition a Rules of Procedure document has been approved by the Council, which describes its activities in more detail. It should be noted that all JIVE staff are employed through NWO, NWO-I from January 2018. The JIVE director is the hierarchical leader of all JIVE staff. He reports to the JIVE council and is supposed to implement all activities within the constraints defined by the NWO personnel guidelines. The JIVE Management Team (MT) consists of the Director and the Heads of the Departments: ● Dr. Francisco Colomer (Director of JIVE) ● Dr. R.M. Campbell (Head of Science Operations) ● Prof. L. Gurvits (Head of Space Science and Innovative Applications group) ● Dr. A. Szomoru (Head of Technical Operations and R&D) ● Dr. Z. Paragi (Head of User Support) Additionally, the EVN is governed by a Board of Directors. Members are (usually) the directors of the institutes which operate a radio telescope for the EVN, as described in the EVN MoU; among other responsibilities, EVN members guarantee at least 45 days/year of telescope observing time for the EVN. Details in: http://www.evlbi.org/evncbd/evncbd.html

2.2 Is there a board, council, external advisory board, or any other committees? Organigram.

ILT
The ILT board is composed by the general director of ASTRON (given its pivotal role in the development, construction and operations of LOFAR), 2 members delegated from the Dutch consortium (NL-LAC, given the highly dominant resource contribution from the Netherlands to the ILT), and one representative from each of the other member countries: Germany (GLOW), France (FLOW), Sweden (LOFAR-SE), UK (LOFAR-UK), Poland (POLFAR), and Ireland (I-LOFAR). There are no other committees or external advisory board.
JIVE
See 2.1 above. Other committees are: - the EVN Program Committee (EVN PC), which is a group of expert astronomers, nominated by the EVN Board, who rate the proposals on scientific merit and submits such priorities to the EVN Scheduler within 6-8 weeks prior to the observing session. JIVE has a member in this committee, who checks the technical feasibility of the proposals. - the EVN Technical Operations Group (TOG), which members of all EVN components. JIVE is structured in four departments, plus the office of the director. ● Science Operations Group ● Technical Operations and R&D Group ● User Support Group ● Space Science and Innovative Applications Group

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As required by Dutch law JIVE has an employee's representation body. Because JIVE is small, this does not need to be an elected committee, instead the JIVE General Meeting can take the role of advising the director on matters that affect working conditions.

JIVE organigram:
http://www.jive.eu/sites/jive.nl/files/cms/about-jive/2017-04-28%20organogram%20JIVE.pdf

2.3 Are there statutes for the organisation or terms of reference?

ILT
The ILT Foundation was established through a Memorandum of Understanding (MoU) and later on a Constitution that set the guidelines for the governance, resource allocations, and operations.
JIVE
Yes, statutes are available. In addition, the Statutes call for a number of Rules of Procedure documents of which only the one on the Operations of the Council has been established.

2.4 How/when are the GA/Council meetings organized?

ILT
The ILT board meets 4 times per year, 2 meetings are held face to face (typically in The Netherlands) and 2 on video conference.
JIVE
The JIVE Council meets 2 times per year, face to face. The JIVE Director also participates in the meetings of the EVN Board (2 times per year, face to face.

2.5 Describe the relation with ASTRON and NWO.

ILT
ASTRON plays a key role in the ILT. The institute started the LOFAR project leading its design, development, construction, operations, and now upgrade. In addition, ASTRON is the owner of 16 of the 38 Dutch LOFAR stations. The ILT constitution designates ASTRON as the operational facility for the ILT and the institute has one representative – the ASTRON general director - at the executive board. The ILT director, who is appointed by the executive board, is candidate by ASTRON and is an ASTRON employee during the 5-year mandate. ASTRON operates both the ILT and the Westerbork Synthesis Radio Telescope (WSRT), part of the EVN, through its Radio Observatory division. There is no formal relationship between ILT and NWO or NWO-I.
JIVE
JIVE in an international organization, hosted by ASTRON, who participates in the governing Council together with a representative of NWO. All staff at JIVE is formally employed by NWO-I.

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2.6 How projects are evaluated and selected?

ILT
The Radio Observatory issues a call for proposals twice a year (with deadlines in March and September) for both the Open Skies and the Reserved Access observing time. The proposals are submitted through the online submission tool NorthStar. In a first stage, all proposals are evaluated by ILT operations experts based only on their technical feasibility. This evaluation is made available to the experts of the Programme Committee (PC) that review the proposals according to their scientific value. The PC is composed by no less than 10 and no more than 16 scientists appointed by the executive board. The PC members first evaluate independently all proposals, the ranks are then averaged to a pre-PC meeting rating. After the proposal deadline, all consortia declare the percentage of their reserved access that they contribute to the Long-Term queue, the minimum is 30% for new consortia and 70% for older ones. Before the ILT PC meets, consortia make primary allocations of their retained reserved access, to the list of cycle proposals. The PC then meets face-to-face to discuss each proposal and reach a consensus rating for each of them. The PC allocates all Open Skies projects and all Long-Term projects, which are a mixture of Open Skies and consortium contributed reserved access. In addition, individual consortia can allocate their own cycle-by-cycle time.
JIVE
The observing proposals are submitted to the EVN in deadlines on 1st of February, June and October). The actual observation runs are organized in three “sessions” of approximately 3 weeks duration, with additional 10x24h eVLBI days, plus OoS (Out of Session) and ToO (Target of Opportunity) projects. Details can be found in the “call for proposals”: http://www.jive.eu/proposals/ The EVN Program Committee (EVN PC) is a group of expert astronomers, nominated by the EVN Board, who rate the proposals on scientific merit and submits such priorities to the EVN Scheduler within 6-8 weeks prior to the observing session. All full members of the EVN have the right to appoint a member in the EVN PC (but not all do at the same time, to keep the size manageable). The technical feasibility of the proposals is checked by JIVE. The EVN PC meets after each of the three annual deadlines mentioned above to evaluate the proposals. Proposals are evaluated purely on scientific merit and technical feasibility. Prior to the meetings, each EVN PC member makes written comments about each project and assigns a "pre-grade". In the face-to-face meetings, opinions about the astronomical and technical aspects of each proposal are discussed, to reach a consensus numerical grade. The EVN PC also decides how much observing time a project should be awarded; due to the over-subscription of the facility, this is sometimes less than the original request. For multi-epoch proposals, intermediate progress reports may be required before granting subsequent epochs. Once the proposals have been evaluated, the PC chairman contacts the group leaders. This feedback includes the consensus grade, a summary comment, and a list of all the individual members' comments. A proposal may receive a grade of "resubmit", if its likelihood of receiving time would be boosted by further attention to a specific set of points in a revised proposal, addressing comments made by the PC. The EVN User Guide for help with proposing, scheduling, observing and reducing EVN data is available at: http://www.evlbi.org/user_guide/user_guide.html Observing time is requested through the EVN Proposal Tool “Northstar”: http://proposal.jive.eu/

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3. Evaluation

3.1 How is the RI evaluated?

ILT
There is no formal evaluation of the ILT, however ILT (LOFAR) is indirectly evaluated in each country through the evaluations to specific institutions. At ASTRON, LOFAR and ILT activities are evaluated through the 6-year evaluation process.
JIVE
JIVE's financial evaluation is performed annually by an external auditor. Also, some of the larger, externally funded projects are subject to auditing. In principle the ERIC itself is established indefinitely. The partner contributions, that are listed in the Annex, are subject for renewal. This calls for a review of JIVE every 5 years, as was done in the foundation time. Typically, an independent committee of experts reviews the science perspective and effectiveness of the organisation. Unfortunately, there are no homogeneous criteria and often the findings of the committee need to be re-formulated to meet the requirements of national funding agencies. Sometimes, additional effort is needed during the 5 year periods.

3.2 Are Key Performance Indicators (KPIs) identified and monitored?

ILT
RO staff monitors the overall telescope efficiency (currently between 35-40% with a goal to reach 65-70% in the coming years) and number of publications that include LOFAR data, this information is then made available to the board.
JIVE
Besides the financial results, of the institute as a whole and for specific projects, some other numbers are monitored. These include the correlator throughput (number of hours of observing data), the distribution of researchers that use the facility, the proposal pressure, the publication output of the staff and that of the EVN users.

3.3 Is there an Annual Report produced? Other?

ILT
No annual report is produced.
JIVE
Yes, this is a requirement of the ERIC construct. Before biennial reports were produced.

4. Finances

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4.1 Which are the sources of funding for the organisation?

ILT
The source of funding for the ILT comes mainly from the yearly contribution of the individual partners. Additional contribution comes from EC projects where ILT is a direct beneficiary and from RADIONET's transnational access program (~100 keur/yr).
JIVE
Being an ERIC, JIVE is supported by contributions of the member countries, which constitutes the budget for its "core business" (to run the EVN correlator and support its users). See below. Additional budget is obtained from participation in competitive projects, from the different EC programs (now H2020) and other (e.g. Dutch national calls). Notably, there is a long-standing agreement among the EVN partners that the return of the EVN TNA (trans-national access) programme is to benefit the user services, centrally implemented at JIVE. This has been a key contribution to deploy support scientists that make the EVN accessible to many outside users. Because the EVN consists of large dish telescope, its hourly rate is high and because the return of the programme is a fraction of the overall EVN operations costs, this is a substantial source of funding.

4.2 What is the annual budget (for 2018)? Describe (if broad terms).

ILT
The budget for 2018 is 4.9 MEur. It covers the operational costs, maintenance, staff salaries, correlator, computing resources, and archive facilities. About half of the budget goes to staff salaries.
JIVE
The total budget for 2016 was around 2 MEuro. But it has fluctuated between 2 and 3.5 M€.

4.3 What are the operational costs? If relevant, include an explanation of the contribution of the partners (e.g. for the telescopes)

ILT
Since ILT does not own facilities, the partners (ASTRON mainly) contribute with the LOFAR infrastructure, personnel, archive and processing resources. ILT, however, owns the stations spare supplies which is also maintained with part of the ILT budget.
JIVE
The budget covers the operational costs, maintenance, staff salaries, correlator (including depreciation), computing resources, and archive facilities.

4.4 Is there any entrance fee/annual fee? How is it established?

ILT
One of the conditions to enter the ILT is to have at least 1 LOFAR operational station connected to the ILT network and to contribute annually to the costs of the integrated operations of the ILT in proportion to the number of stations. Currently, each partner contributes with an annual fee of 92.5 kEur per year and per LOFAR station.

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In addition, the board can decide on a contribution from a country that equals the total value of one station plus continued proportional annual operational contribution. The details of such contribution are discussed case by case.
JIVE
The contribution of each member country is settled every 5 years, and reflected as an annex to the JIVE statutes. The value of such contribution is reflected in the JIVE statutes. Substantial effort has been made to establish a guiding principle for these contributions. In principle partners that want to join JIVE are supposed to contribute a fraction of their local operation costs to the central JIVE operations. Thus, the members obtain the right to have their data correlated. This principle benefits from the fact that most stations had their operations audited for the EVN TNA programme in RadioNet. Because operational budgets are much lower for the stations in weak economies, the resulting distribution is fair. For stations that participate in multiple networks the contributions are scaled accordingly. But the system is not very transparent for countries with multiple telescopes and for the host country.

4.5 How are the fees paid, are in-kind contributions allowed?

ILT
Part of the annual fee can be paid in-kind, for example with personnel, data processing, storage capacity. This is discussed in a case by case basis
JIVE
The annual member contributions are paid in cash. We have discussed the option, but in-kind contributions are only used for ASTRON; its contribution is valued explicitly and consists of office use and the services of the local building support, personnel, finance and ICT departments.

4.6 Are the accounts audited?

ILT
The accounts are audited annually, a financial report is produced and needs to be accepted by the Executive board.
JIVE
Yes, annually.

5. Facilities

5.1 Which facilities compose your organisation?

ILT
The ILT operates the international network of LOFAR telescopes. LOFAR observes the sky at frequencies between 10-250 MHz, although due to the strong radio frequency interference, this range is actually reduced to 30-240 MHz. The LOFAR telescope is an array of two types of antennas: LBA (Low Band antennas 30-80 MHz) and HBA (High Band antennas, 110 – 240 MHz). In the Netherlands, there are 38 LOFAR stations; 24 distributed in a core densely sampled within a 2km wide area, and 14 remote stations that extend to a radius of 90 km. In addition, there are 13 international stations. Germany (6): Effelsberg (MPIfR), Unterweilenbach (MPIA), Tautensburg (Thüringer Landessternwarte), Postdam-Bornim (Astrophysikalisches Institute Postdam), Norderstedt (U. Hamburg), Jülich (U. Bochum, Jacobs U. Bremen & Froschungszentrum Jülich) France (1) : Nancay (Obs. Paris & CNRS)

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UK (1): Chilbolton (STFC) Poland (3): Borowiec (Space Research Centre of Polish Academy of Sciences), Baldy (U. Warmia and Mazury in Olsztyn), Lazy (Jagiellonian U. Krakow) Sweden (1): Onsala station (Onsala Space Observatory) Ireland (1): Birr Castle (Trinity College, Dublin) The longest distance between stations is ~2000 km. Besides the LOFAR stations, the ILT facilities include the central processing facility (CEP) at the Univ. of Groningen, where the data are further processed by the correlator (COBALT), a cluster of 32 NVIDIA Tesla GPUs and stored in the CEP4 cluster for off-line processing. The final data products are then transferred to the long-term archives (LTA) in the Netherlands, Germany, and Poland.
JIVE
JIVE is the central organization for the EVN. It comprises the EVN correlator and the R&D facilities. The EVN radio telescopes, essential in the Research Infrastructure, are often National Facilities owned and operated by the member countries.

5.2 Which services are provided?

ILT
Prepare the call for proposals, schedule the observations, operate the LOFAR telescope, process the data, ingest observations to the archive, test the system and the pipelines, provide support for the maintenance of all, Dutch and international stations. Provide support to the users.
JIVE
Correlation of EVN data, station support (calibration, R&D), pipelines, data archive, user support (preparation of proposals, preparation of schedule files, data analysis). Also, policy at national and European levels, project coordination, banking, organization of events, etc. JIVE also contributes to new research capabilities through hardware and software development.

5.3 Heterogeneity and compatibility of the facilities.

ILT
All LOFAR stations are perfectly compatible. ASTRON, through its AstroTec holding is the provider of all LOFAR station components for all partners so all stations almost identical.
JIVE
EVN radio telescopes are all different, however compatibility of receivers and data backends is ensured.

5.4 Data archive, FAIR principles. Is the archive available at the VO?

ILT
The PI of the observed projects are granted exclusive rights on the data for a period of 1 year, after which the data become public. Under certain circumstances, if requested by the PI, this period can be extended. We are working to make (part of) the date to become available through the VO.
JIVE
The PI of the observed projects are granted exclusive rights on the data for a period of 1 year, after which the data become public (6 months for ToO observations). Under certain circumstances, if requested by the PI, this period can be extended.

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6. Staff

6.1 How many people work at your organisation?

ILT
Formally, the ILT does not have employees. The partners, mainly ASTRON and GLOW, commit with personnel (25 FTE and 3 FTE respectively). The ILT board sets the priority for the personnel's work.
JIVE
Formally, JIVE does not have employees, all the staff (24 persons) are employed by NWO-I.

6.2 How is the staff hired? Who signs the contracts? Is the RI liable in case of staff end of contracts?

ILT
The staff is hired locally, following the institutes regulations and procedures. The ILT is not liable in case of end of contracts.
JIVE
The staff is hired through NWO. Through the MOU with NWO the JIVE director has the mandate to sign the contracts. JIVE is charged with all employment costs like sick leaf and employer-side unemployment benefits. Over the years JIVE has built up enough reserves to cover these liabilities. Every second year the height of the reserves is evaluated to cover a realistic scenario, including the termination of JIVE.

6.3 How many have permanent and how many are on temporary contracts?

ILT
It depends on the institution where the staff is hired, at ASTRON some employees have permanent contracts but support scientists and software engineers typically have short-term contracts.
JIVE
In the past the number of permanent contracts was capped to match the basic partner contributions. Changes in the EC rules for spending project money changed the JIVE budgetary practices and for a while there was a consensus to have no more than 16 permanent staff members. Now JIVE has to observe the employment laws for companies and the scope for fixed-term contracts has been reduced. At the same time the nature of permanent contracts has also changed. Also because of the location in a remote place, JIVE is forced to have people on indefinite contracts whose appointment depends on soft project money.

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6.4 Which is the source of funding for the staff?

ILT
The sources of funding are mixed; ASTRON has a base budget, but money comes also from the external projects. In Germany, the staff hired for ILT purpose is paid with grants.
JIVE
All JIVE staff is paid from the JIVE budget. Hour registration ensure that external money is used for the appropriate activities. In some cases, students are employed through contracts at Universities. In some cases, ASTRON and JIVE have shared personnel costs for some staff.

6.5 What is the fraction of time dedicated to science and service in the contracts?

ILT
Telescope Scientists currently have about 40% of their time dedicated to science, but the group is moving towards a new structure that will allow this to increase to 50% for people with temporary contracts (more information in Sec. 9). The other functions do as good as no direct science.
JIVE
Support scientists have typically 50% of their time dedicated to service. Senior scientific staff may have 40% science time in their function description.

7. Operations

7.1 Description and size of the team

ILT
At ASTRON's Radio Observatory, the "Operations and Maintenance" group is in charge of both ILT and Westerbork. The team is composed by 4 operators, 6 maintenance engineers, 2 system level engineers. The head is M. Drost.
JIVE
The Science Operations group (SOG) consists formally of 3 persons, the Head of SOG (Dr. Bob Campbell) and 2 operators of the correlator (one shared with the Technical Operations group), but has also access to the Support Scientists of the User Support group (USG).

7.2 How is the instrument operated? Please describe the whole process (data transport, correlation, pipelines, data archival, etc.).

ILT

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The ILT has different modes of operating:
- In ILT mode, all LOFAR stations are connected to the ILT network and are operated centrally from Dwingeloo. As part of the agreement with ILT, station owners need to make available their stations at least 90% of their time for ILT activities; observations, maintenance, etc.
- Single station use through ILT, where the data are initially collected and processed on a per-station basis.
- Sub-arrays, stations can be partitioned into groups (sub-arrays) that can be assigned to different independent observing projects running in parallel.
- Stand-alone observations use by the owner, the control of the operations is passed to the local owner, the stations remain completely out of the control of the ILT. The data from stand-alone operations are not stored in the Long-term Archives and their distribution and use rights are decision of the owner.

The LBA and HBA antennas are connected to the electronics housed in a cabinet located on the edge of each LOFAR station. The cabinet contains the receiver unit (RCU), digital signal processing (DSP) hardware, local control unit (LCU). This section is mainly responsible for the beam-forming. Further processing is done by the remote station processing (RSP) boards. After beam-forming, the data is streamed over the wide-area network at a speed of 10 Gbits/s to the Central Processing Facility (CEP) at the CIT Univ. of Groningen.
At the CEP data are aligned, combined and further processed by the COBALT system. Processing operations include correlation for standard interferometric imaging, tied-array beam-forming for high time resolution observations, real-time triggering on incoming data-streams. Combinations of these can be done in parallel.
After on-line processing, raw data products are written to a storage cluster, the CEP4 cluster (LOFAR phase 4 cluster). The CEP4 is composed by 50 computing nodes, 4 GPU nodes, 18 storage nodes, 2 meta-data nodes, 2 head nodes, 1 management node.
At the cluster, off-line processing is possible using a variety of reduction pipelines depending on the type of observation. In the case of standard imaging observations, processing includes flagging of the data for the presence of radio frequency interference, averaging, calibration, creation of final images. The pipelines run on a dedicated computer cluster with a processing power of 10 Tflop/s. Data are stored for about a week.
Processed data might be copied to the CEP3 cluster upon request for further analysis. The CEP3 cluster is used for running science processing close to the CEP4 facility as well as commissioning of work.
Observing time, CEP4 processing time and usage of CEP3 are allocated by the LOFAR Programme committee and ILT director during regular proposal evaluation stages, or DDT.
Access and use of CEP3 is under sole control of the R.O. Science operations & Support.
Access to CEP3 is given for a limited period of time (typically 2 months).
After processing, the final scientific data products are transferred to the LOFAR long-term archives (LTA) for cataloguing and distribution to the community. LTA currently includes sites in Amsterdam (NL), Jüllich (DE), and Poznan (PL).

JIVE

The process of operating the EVN can be divided into pre-correlation, correlation, and post-correlation stages. The "kick-off" event for JIVE is the appearance of the EVN block schedule (see S 7.5). With this in hand, SOG:

1) prepares a plan for distributing recording media, based on the stations' observing load and reported on-hand supplies. Finite disk-pack resources imply that there has to be a balance between possible and achievable observing (iterations between SO and EVN scheduler). Separate sets of packs are allocated per destination correlator, to avoid correlators having to ship packs among each other (and thus possibly delaying correlation). Shipping costs are generally paid by EVN stations for both legs of the journey from and to the correlator; the shipper pays costs for non-EVN stations (e.g., NRAO stations). More and more stations are shifting to the FlexBuff system, essentially a non-transporting disk-bank at both a station and at JIVE, that relies on e-shipping. In e-VLBI, there are issues of total network capacity coming into the building and capacity per network "subsets" (e.g., routed light paths) that may affect the number/bit-rate of stations participating, but so far this has not set any practical limit.
2) provides PIs of observations with plug-ins customized for their observations to use in running the sched program. PI craft their own schedules, possibly requesting additional help from SOG/USG. Support Scientists review the submitted schedules, and if necessary iterate with the PIs. If there has been any change on the station side of things since the plug-ins were made, SOG can adjust the schedules prior to uploading them to

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the central server, from where stations download them. In e-VLBI, in which there is generally more than one PIs experiment within the single schedule covering the e-EVN day, JIVE (currently USG) makes the schedule following liaison with the various PIs (e.g., in order to manage more sensibly the telescope motions in the inter-experiment boundaries).
3) There is a network-monitoring experiment (NME) at the beginning of each frequency band within a session, which includes several ftp fringe-test segments that enable near real-time feedback back to stations, prior to any user experiments. Support Scientists make the NME schedules, and correlate the ftp fringe-test segments and liaise with the stations during while the NME is running.
4) User experiments observe "in absentia" from the PI's point of view, and also largely from JIVE's. There is work underway to provide automated ftp fringe-test segments within user experiments, in the same spirit as those in the NME's as a means to provide more timely feedback to stations.
For correlation, SOG:
5) tracks status of incoming data (disk packs, FlexBuff e-shipping) via various tools (NRAO track for packs; local scripts for e-shipping).
6) confers with PIs about correlation parameters and the public/private designation of specific sources when they are ultimately archived.
7) prepare correlation-control files, jobs
8) The correlation itself is also run in absentia from the PI's point of view. Centering the individual stations' clocks and rates occurs for each observation prior to production correlation. For pulsar observations, gate-fitting checks also take place prior to production: clock-search / PSR-gate / production (multiple passes).

Once the correlation of an observation has been completed, the head of SOG assigns it to a Support Scientist for the post-correlation processing. The division of observations among Support Scientist's aims to balance the load per Support Scientist (number/size/complexity of observations) while considering individual-Support Scientist areas of expertise and past experience working with specific PIs. In the post-correlation review process, the Support Scientist:

9) collects the "good" correlator jobs, and creates one or more Measurement Sets. At this stage, some operations on the data are carried out, and diagnostic plots are made.
10) converts the Measurement Set(s) into set(s) of FITS files. Runs the EVN pipeline, which among other things creates the a priori amplitude calibration and flagging tables to apply to the raw FITS files, various other tables and plots (considerably more extensive than the standard plots), through to automatically generated images.
11) archives the results for the observation. The EVN Archive at JIVE is the central location for PIs to obtain the data from their projects. It contains feedback from the stations, standard plots from the correlation review, pipeline results, and the FITS files themselves. The FITS files and pipeline results for sources that the PI identified as "private" are password protected for a one-year proprietary period, with the "clock" starting at the time the PI is informed of the availability on the Archive of the final epoch of the experiment (the proprietary period is 6 months for target-of-opportunity experiments). The Archive also currently provides a FITS-finder utility to search for data meeting specified criteria (e.g., position, frequency, correlation parameters, etc.) and links to VO archives for the Aladin Sky Atlas and the SDSS.
12) communicates with the PI via a cover letter describing the correlation pipelining, and archiving of the observation, and begins the discussion about the possibilities for user support and data-reduction visits.

The head of SOG keeps statistics related to EVN network hours, e-VLBI hours, hours per station/observation for RadioNet trans-national access reporting, etc. Also, SOG sends out one-month warnings to PIs about the imminent expiry of their proprietary period (PIs may request extensions from the EVN PC chair; if granted SOG adjusts the appropriate public-release date(s)).
General flow of events:
1) preparation of NMEs
2) creation of user-experiment schedules
3) process of observing, plus the pre-observing issues of media distribution
4) rules of thumb for overall EVN media-pool increase

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5) correlation preparation, but also archiving & distribution of correlated data to PI 6) process of correlation 7) specific automatic-trigger mode (of e-VLBI) 8) archive, via some under-the-hood details 9) keeping various reporting statistics An EVN "pool" has been created, all stations participate by purchasing 7.5 kEuro/year. Typical costs are 40 Euro/Tb, in (8 x 8 Tb)/module. A total of 100 Tb is needed per session; the goal is to move operations to full 2 Gbps. The disks packs at JIVE are organized by "PaterNoster". An "automatic response" (trigger) system is in place, built during EC NEXPReS, but is not used since several EVN telescopes do not allow remote change their current observations. The SO also controls the down time of telescopes for maintenance etc. (which may not happen coordinated in time).

7.3 How many people work on your department and what is their background?

ILT
The team is composed by 4 operators and 6 maintenance engineers at engineer education level, 2 system level engineers which have an academic degree in engineering and physics.
JIVE
The Head of Department, and two Support Scientists (PhD, astronomers), plus 1.5 operators (MBO in electronics).

7.4 How is the work organised in your department.

ILT
Operators work on shifts of 2 weeks in a cycle of 6 weeks of which 2 weeks LOFAR, 2 weeks WSRT and 2 weeks general development tasks.
JIVE
The head of SOG assigns experiments to Support Scientists (both groups) for schedule checking and post-correlation processing, sets correlation priorities/ordering (PIs requesting as fast as possible turn-around, need for pack recycling, etc.).

7.5 Can you describe the type of observations and how are they scheduled?

ILT
The major observing modes include: 1. Interferometric Mode provides correlated visibility data. Sub-modes: LBA and HBA. 2. Beam-formed mode; array beams are calculated from the data streams from one or more stations to produce time-series and dynamic spectra for high time resolution observations. Sub-modes: Coherent Stokes, Incoherent Stokes, and Fly's Eye.

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3. Direct storage Mode (only for experts), Data from the single stations are recorded locally or copied directly to the storage and post-processing sub-cluster CEP and from there to some other facility for further analysis. Sub-modes: Transient Buffer Boards, Single Station Observations.

Each observing mode has its own data analysis pipelines.

Projects can be either Cycle, DDT (Director Discretionary time) or commissioning projects. Regular Cycle projects are submitted in answer to the regular call for proposals, which are issued twice a year. Requests for DDT projects can be submitted at any time during the year and are associated with programs that need to be performed with urgency. Also commissioning proposals can be submitted at any time during the year. These are aimed at commissioning a specific aspect of the instrument, they are evaluated by two LOFAR experts (Dr. R. Pizzo and Dr. M. Brentjens). Contrary to Cycle and DDT projects, publications resulting from commissioning experiments are expected to be reviewed internally by the LOFAR Publication Committee and to include in their author lists the full list of people who have contributed to the building and development of LOFAR (the Builders list).

Following the PC meeting at the end of each Cycle review process, the schedule for the entire upcoming observing semester is prepared by the SOS team using a few scheduling scripts. At least one week before a planned run, observing and processing templates are prepared by SOS according to the observation settings entered by the PIs in their proposals. A few scripts are used to extract the relevant information from the proposal submission tool. The final templates are eventually uploaded into the system and are ready to be scheduled by the Operators. Following an observation, the SOS team performs the initial inspection of the data and notifies the PIs of the outcome of the run. If successful, the data of the observations are further handled through processing and ingestion into the Long-term archive.

International stations are usually in ILT mode (and therefore available to join LOFAR observations along with the rest of the array) during working days. Currently, the international stations are switched to stand alone mode during week-ends.

JIVE

All observations are VLBI. Various ways of categorizing observations include: EVN or global, disk or e-VLBI, in-session or out-of-session, proposed at a regular deadline or as a target-of-opportunity.

Scheduling EVN observations is the domain of the EVN scheduler. Given the set of grades resulting from the EVN programme committee review, the EVN Scheduler will place experiments in the next feasible observing session consistent with the PC grade. The ability to schedule a specific project is a complex mix of resource availability (time available at a given wavelength band, competition for GST ranges, antenna availability, recording media availability etc.) in addition to relative grades. Approved proposals may be dropped from the scheduling-queue after a period of time (depending on how many opportunities it had to observe, considering network configurations), and the PI may re-propose (taking into account progress in the field in the meantime). Successful target-of-opportunity (ToO) proposals observe as quickly as possible, without waiting for the next EVN observing session; this may limit participation as some telescopes may have conflicting commitments.

7.6 How is the observation period/session organised? Number of periods per year, number of observing hours per period.

ILT

The ILT works with cycles of 6 months, each cycle has ~1600 hours devoted for science observations.

Cycle 9 runs from mid-November 2017 to mid-May 2018. In a period, there are typically 2700 processing hours.

JIVE

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There are three 3-week sessions per year (Feb/Mar, May/June, Oct/Nov), which house typically disk-based observations. There are ten e-EVN days per year spread as evenly throughout the year as possible (scheduled on week-days). Out-of-session observations are also possible if specifically requested in proposals -- up to 144 hr per year in no more than 12 blocks. These do not form an extra observing commitment from the stations, but in principle any out-of-session hours observed are removed from one of the three "normal" sessions. The above observing sessions are planned well in advance (i.e., months). Target of opportunity observations are also possible, with no fixed proposal deadlines or observing sessions. These are scheduled based on trying to achieve the best possible array for a date satisfactory to the proposal, in light of the stations' non-EVN obligations outside of the sessions. The link to the EVN target-of-opportunity policy is: www.evlbi.org/proposals/too.2011.pdf

7.7 Are operations done also on night shifts or during weekends?

ILT
The operations team works from Monday to Friday, there are no night and weekend shifts. However, observations are scheduled to continue during the weekends and the operations team monitors them remotely.
JIVE
The operations team works from Monday to Friday. Evening shifts are usually no longer required except for the most complicated observations. Unmanned correlation for recorded observations has grown more robust with larger disk-pack capacities and the advent of the FlexBuff systems, as well as with improvements in the correlator; a job that is started at the end of the day shift now is most likely to run to successful completion (or continue into the following day shift if long enough). Operators can monitor the system remotely. Unless there's a specific need to run something over the weekend, we typically disengage the power to the back-planes of the Mark5 bays over the week-end for safety and energy-efficiency reasons. However, e-VLBI observations continue to be manned round-the-clock, given the need for more careful real-time monitoring and the intrinsic inability to re-correlate the incoming (non-recorded) e-VLBI data streams.

7.8 Can observations be done automatically or the presence of staff is required?

ILT
Observations can be done automatically, this happens during nights and the weekends.
JIVE
EVN observations require personnel at the stations to start, but often run unattended (of course, if they are manned, the response time to any issue that may arise is considerably better). For correlation at JIVE, operators are required to start jobs and mount physical media, but as discussed above, unmanned disk-based correlation can be a productive "mode".

7.9 Does your system allow for triggered observations, Targets of Opportunity (ToOs)?

ILT

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Starting from Cycle 9 the LOFAR system allows users to trigger observations within 5 minutes, overriding any lower priority observations. This feature, called the LOFAR Responsive Telescope V1.0 is currently under development.
JIVE
Yes, the EVN allows ToO proposals. Target-of-opportunity observations were discussed 7.6. Triggered observations are possible in e-EVN. In general, a triggered observation is one whose proposal enumerates a set of criteria that must be met to go ahead with the observations. A standard trigger proposal would have a finite set of possible targets; a "generic" trigger proposal is one for which a specific target list can't be provided at the time of proposing. The deadline for "pulling the trigger" for these two types is 08UT the day before the e-EVN day. Of course, a triggered observation can over-ride only a lower-graded observation that may already be scheduled. A new category of automated trigger observations aims to shorten considerably the lead time for "pulling the trigger" to perhaps as low as 10 minutes. To do this, it is important that the triggering criteria are posed such that they can be monitored via VOEvents and autonomous criteria evaluation. At the moment, only two EVN stations have declined to participate in automatic triggers. Considerably more details about the various triggered e-EVN observations can be found in the proposal guidelines: http://www.jive.eu/jivewiki/doku.php?id=evn:guidelines#triggered_e-vlbi_observations

7.10 Who is responsible for purchases? How are they performed?

ILT
The O&M department purchases the replacement parts and necessary tooling needed to do maintenance. The general purchase department of ASTRON does the ordering.
JIVE
Each Head of Department is responsible for purchases and travel authorization, while the payments are authorized by the director.

8. Maintenance

8.1 Description and size of the team

ILT
In the Operations and Maintenance department there are 6 maintenance engineers.
JIVE
JIVE Technical Operations (TO) group is responsible for R&D and maintenance. This department consists of 8 people (was 12 at max), most engineers, led by Arpad Szomoru, with main focus on (predictable) maintenance and upgrade of the correlator hardware and software (new modes, data transport, scheduling software, CASA user software, SFXC correlator control code), and large efforts in R&D.

8.2 How are the repairs identified, decided and carried out?

ILT
The maintenance group carries out system tests every week for all LOFAR and ILT stations. The RO maintenance team together with the operators decide which stations gets priority. International stations are

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visited annually if in need of repairs. Most of the maintenance activities are executed during the spring, summer and autumn seasons, the weather needs to be dry and above 5 degrees Celsius to perform effective maintenance.
JIVE

8.3 Who decides on any upgrades to the correlator and network?

ILT
JIVE

8.4 How is the work in the team organized?

ILT
JIVE
The self-motivated team works as a “pool of staff”, with weekly meetings (plus the “RanDom”/RnDm every 1.5 months) and work organized by Arpad (using a big spreadsheet). There is a strong relation with the SO group (sometimes by direct request!). But the JIVE MT sets the directions.

8.5 Who is responsible for purchases? How are they performed?

ILT
The O&M department purchases the replacement parts and necessary tooling needed to do maintenance. The general purchase department of ASTRON does the ordering.
JIVE

9. Science Support

9.1 Description and size of the team

ILT
The Science Operations and Support group (SOS) is a vital link between internal Observatory processes and the external astronomical user community. The group is responsible for optimizing the scientific output of the ASTRON-operated observing instruments and telescopes, by on the one hand supporting with their astronomical knowledge the operations,

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maintenance, and technical development work by internal operators and instrument engineers, and on the other hand supporting with their instrument and technical knowledge the external users/scientists with their research projects. Telescope Scientists furthermore carry out a high-level personal or collaborative astronomical and/or technical research programme that contributes to the scientific reputation and output of ASTRON. The head of the department is Dr. R. F. Pizzo. The team has 4 FTEs dedicated exclusively to LOFAR and 1 FTE dedicated to APERTIF (WSRT upgrade). The structure of the team is currently evolving into a scheme where there will be 2 groups: a core team that will count 4 people in a near future, with 70% of their time dedicated to support and 30% for science. At the moment, three people are on the path to become part of the core team. The second sub-group is the rotating component, temporary staff that typically have 2+1 yr contracts with 50% of their time dedicated to support and 50% to science.
JIVE
It consists of 3 people, the Head of User Support group (Dr. Zsolt Paragi) and, ideally minimum 2 Support Scientists (the total is 4, shared with the SOG). Typically, these are young postdocs who are the beginning of their career and have a great potential to stay in astronomy. Diversity is very important for the group: besides the usual considerations of gender and nationality etc., it is substantial that the group members bring a diverse set of skills, and represent various fields of science. This comes handy when JIVE has to support science projects with very different goals and using different techniques. They devote a nominal 50% of their time to science (also using the EVN, therefore pushing its limits), and 50% to service; they are contracted for 1+2 years. The group supports all aspects of research with the EVN: they help to prepare the observing schedule, process, pipeline and archive the correlated data, and assist the user with the final data reduction if needed; they also help maintaining the EVN status table, EVN calculator, EVN data reduction guide, etc.

9.2 How is the user support organised, guidelines, instructions, scientific visits to the facility.

ILT
Telescope Scientists are assigned to specific (external) user/astronomer groups for advice and support in using ASTRON's telescopes and facilities at all stages of their research programme, from project planning and proposal writing, to specific observing tactics, instrumental specifications and scheduling, to data analysis techniques. Documentation is provided and maintained online on the ASTRON Radio Observatory pages. Active support is given through e-mail, answering the user's requests. The group is moving to a ticketing system (JIRA). Additionally, the group is involved in the education and training of users in more formal settings (e.g., reporting in "Status Meetings", lecturing and demonstrating in "Data schools", hands-on participation in "Busy Weeks" etc.)
JIVE
Most of the daily work of the support scientists are very much tied to the progress with EVN experiment correlation. All experiments ("yellow folders", containing all relevant information on the specific experiment) are assigned to a support scientist. Priorities are determined as well. In case an experiment requires rapid processing because it requires rapid feedback (a Target of Opportunity project for example, or if the user has a scheduled visit to JIVE), or for any other reason, then it gets priority. The distribution of the yellow folders follows the relevant experience of the support scientists as much as possible. The other factor that affects

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the daily work of the group if there is an EVN session starting or going on - these times are always very busy. It requires a careful organization of our resources. These activities of the group are reported at the Science Support meetings from time to time, where we also discuss e.g. data processing challenges and experiences, and inform about expected visitors.
When scientists visit JIVE for data reduction, we first check if computer resources are available for the time of the visit, if the required tools are installed on the computer that is assigned to the user. Usually the main support is provided by the person who processed the relevant "yellow folder", but the group as a whole assists the user if needed. We feel it is important that the users feel at home at JIVE: we introduce them at JIVE coffee, at ASTRON/JIVE astro-lunches, and often encourage them to present the status of their research while at our institute.

Another important aspect of our user support and education is training users for example during the European Radio Interferometry School (ERIS), and introducing a new generation of users during the ASTRON/JIVE summer student programme, or when we have other long-term visits from partner institutes. The support scientists travel themselves to scientific conferences (usually 1 overseas plus 1 European trip per year), EVN Technical Operations Group meetings, and other workshops if their presence is required. These are very much justified in light of the fact that we aim to maintain a scientifically competent and competitive group.

9.3 What tools and procedures are available to the users?

ILT

Most information necessary to users to prepare their observations, follow their observing programmes, and the status of the instrument is provided on the ASTRON RO web pages: http://www.astron.nl/radio-observatory/radio-observatory

Particularly relevant, there are several web-based tools available to the users at this web page:
https://www.astron.nl/radio-observatory/lofar/lofar-tools/lofar-tools

- Online proposal submission tool NorthStar.
- Several LOFAR calculators for preparing proposals: data size and processing time calculator, LOFAR frequency to subband converter, Image noise calculator, target visibility calculator.
- LOFAR Management of Measurements, GUI tool for inspection of observing and processing templates.
- System validation plots, automatically generated after an observation. They show the performance of the system during an observing run.

JIVE

As described above, the group advices and helps EVN users with their projects (proposal preparation, scheduling, correlation and data analysis: initial data check and calibration, full pipeline into FITS, and archiving). Since they have built up a substantial expertise in their field of research within JIVE, support scientists are often invited to be part of research teams as well.

Within JIVE there are five powerful workstations waiting for visitors in our guest room, with plenty of hard disk space to accommodate a number of projects. These are all equipped with the most common software packages used for EVN research (AIPS, CASA, Python, ParselTongue, Difmap, astropy etc.). Users receive a visitor account, and they can use the guest WiFi network in-house. The visitors room is equipped with a white board as well.
The corresponding sections of the EVN and JIVE websites are created and maintained by the group.
All information on using the EVN is available through the EVN User's Guide:
http://www.evlbi.org/user_guide/user_guide.html

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The EVN Calculator is an important tool users use during proposal preparation, to estimate the sensitivity of their observations with a particular array and observing setup, as well as the resulting field of view:
http://www.evlbi.org/cgi-bin/EVNcalc
The EVN Data Reduction Guide describes how to calibrate the data in AIPS:
http://www.evlbi.org/user_guide/evn_datareduc.html

Users of the EVN can consult the group by email, and also have the possibility to visit JIVE to further analyze their projects:
http://www.jive.eu/european-vlbi-network-user-support-jive

The group is involved in training events such as the ERIS school and the ASTRON/JIVE Summer Student Program, see:
http://www.evlbi.org/meetings/
http://www.astron.nl/eris2017/
https://www.astron.nl/astronjive-summer-student-programme-2018

9.4 Is there an archive available to the users? Is the archive available at the VO, and support offered?

ILT
The LOFAR long-term archive is at available at https://lta.lofar.eu/ Instructions on how to search and retrieve data are available at the LOFAR wiki pages and the SOS group can assist users in case of issues. LOFAR data is currently not publicly exposed to the VO
JIVE
JIVE SOG runs the EVN data archive, based on Drupal web content manager. The archive is currently organized by experiment. It includes several utilities, such as a search engine. Upgrades are being studied (such as incorporate FITS images). Currently, the archive is accessible without specific registration. Statistics of access are available. http://www.jive.eu/select-experiment Besides PIs downloading their own data, data are made public and anyone can download any data once the proprietary period has passed for an experiment (12-month for regular projects, 6 months for Target-of-Opportunity observations), as explained in the EVN Data Access Policy: http://www.evlbi.org/user_guide/archive_policy.html The archives provide some VO support (Aladin Sky Atlas, Sloan Digital Sky Survey).

9.5 What tools do you have to communicate with your users? Helpdesk?

ILT
Users can contact the Science Operations and Support team through email (sos@astron.nl)

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The Radio Observatory organises the LOFAR mailing list (lofar-news@astron.nl) to inform the user community about the status of LOFAR and make important announcements. The LOFAR newsletters with updates on LOFAR activities are distributed every other month and are all collected online at http://www.astron.nl/radio-observatory/news/lofar-newsletters/lofar-newsletters). Main events such as stop days, roll-outs, and proposal deadlines are published on the LOFAR Google Calendar.
JIVE
Users of the EVN can consult the group by email, and also have the possibility to visit JIVE to further analyze their projects: http://www.jive.eu/european-vlbi-network-user-support-jive

9.6 Is there any involvement of the support scientists in users' projects?

ILT
Each project has a Telescope Scientist as a 'friend of the project'. When the Telescope Scientists become involved in users' projects, to a level that goes beyond the standard support, they can become collaborators in the project and expect to have co-author rights in any publication that comes out from that project. There is no policy about this. Occurrences are discussed on a case by case basis.
JIVE
The support scientist will normally not be part of the team publishing the results from the data, unless he/she had been involved in an earlier step (e.g. was already part of the proposing team). There are however exceptions when the support scientist is invited to become part of a project and contribute to the interpretation of the science results as well.

10. Projects (collaboration, external funding)

10.1 Does your organisation benefit from funding from EC projects, national funding, other? List and describe briefly.

ILT
The ILT is partner in different EU funded projects. JumpingJive LOFAR4SW Aeneas Radionet One or two employees are sometimes payed by funding from local (regional) cooperation funds.
JIVE
JIVE becomes involved in several projects, which is essential for the development of activities *not included* in the core business/budget: AENEAS (Data center for the SKA in Europe) ASTERICS (Coordination of large infrastructures in ESFRI) BlackHoleCam ERC (Black Holes)

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JUMPING JIVE (Ensuring JIVE sustainability) RadioNet (Coordination of radio astronomy in Europe) SKA-NL (Consortium in the Netherlands for participation in SKA) Brochure: https://www.astron.nl/nieuwe-brochure-nederlandse-bijdrage-aan-ska SKA-DOME (SKA and Big Data) There is some relation with industry, developed "White Rabbit" for SKA/ASTERICS (CERN networking system): https://www.ohwr.org/projects/white-rabbit/wiki/WRUsers UNIBOARD, a new generation hardware correlator which has already produced two versions, as "AstroTech" company: http://www.jive.nl/jivewiki/doku.php?id=uniboard:uniboard Also searching new opportunities of projects in NWO and EC calls.

10.2 How are funding opportunities coordinated?

ILT
Not really
JIVE

11. Outreach

11.1 Which are the outreach activities, and in which channels? (website, social networks, brochures, press releases, etc)

ILT
Website, twitter, press releases, all coordinated by the ASTRON communication team. The users are encouraged to contact ASTRON for help on preparing press releases. In addition to this, we offer tours of the WSRT, LOFAR and the RO Control Room following explicit requests to ASTRON PR.
JIVE
Website, Facebook, twitter, press releases, flyers, all coordinated by the JIVE Outreach Officer.

11.2 Who is responsible for outreach?

ILT
The communication team at ASTRON.
JIVE
Dr. Gina Maffey, JIVE Outreach Officer.

11.3 How Is outreach coordinated or distributed to other members in the consortium?

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ILT
JIVE
Through an "outreach contact network" that identifies a contact person in each EVN telescope or JIVE partner institute.

12. Meetings

12.1 How many and which kind of meetings there are? Who participates?

ILT
There are several meetings organised at different levels; from daily internal meetings to weekly, monthly and yearly meetings involving all ILT partners (more details in the following questions).
JIVE
There are several meetings organised at different levels; from weekly internal meetings to yearly meetings involving all JIVE partners (more details in the following questions). http://www.evlbi.org/meetings/

12.2 Internal meetings (e.g. Management Team meetings, operations, intradepartmental, etc)

ILT
Daily: • RO stand-up meetings in the control room with representatives from each of the RO departments. Weekly: • SOS team meeting • RO coordination meeting with heads of 3 sub departments, every Monday afternoon • RO coffee every Monday afternoon SOS team meeting. • Meetings organized in relation to specific projects/activities (CITT2, Data Quality Working Group,...) • Wednesday lunch, where a scientific talk is presented. Open to all employees, especially astronomers • Colloquia - Thursday afternoon. Open to all employees. Monthly: • ZMT - Zakelijk MT meeting • RO management meeting with the heads of each department, followed by a meeting with the director of the ILT. • AG meeting, attended also by SOS. To discuss matters related to the post doc and Telescope Scientist scientific activities Yearly • SOS mini-retreats: do discuss strategic topics related to the group • RO mini-retreat: do discuss strategic topics related to the RO

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For the software development there are the Scrum meetings: Daily stand up meetings per team and per sprint (3 weeks) a retro and planning meeting. A demo presentation is given when applicable. A monthly Software Development meeting is held for all covering all ASTRON departments
JIVE
- JIVE General Meeting (usually 2 per year) - JIVE Coffee meeting (every Tuesday, at 10:30h) - JIVE MT (usually every month) - RnDm: Technical Operations group (every 1.5 months) - Science (every 1.5-2 months) - Sched - CASA

12.3 External meetings (e.g. General Assembly / Council meetings)

ILT
LOFAR Status meetings, to give an overview of recent LOFAR activities and science results (every 4 Wednesdays) Every 2 weeks, Software Support team meets with people from the ICT facility in Groningen. Every 2 months, teleconference with all ILT partners to discuss technical issues with members from the Maintenance and Support and Software Support departments. ILT Technical operations meeting, held once per year face to face, to discuss different aspects of operations, maintenance, and software with representatives from all ILT stations. Typically, 40-50 people attend. LOFAR Community Meeting - organized by SOS and open to the community LOFAR User Meeting - organized by SOS and open to the LOFAR Users Committee and the community
JIVE
The JIVE Council meets 2 times per year, face to face. The JIVE Director also participates in the meetings of the EVN Board (2 times per year, face to face). JIVE staff is represented in the EVN Program Committee (meets 3 times per year, after every proposal deadline), and the EVN Technical Operations Group (meets every 9 months).

12.4 Are User meetings organized? (symposia, schools, workshops)

ILT
There are different meetings organised targeting different audiences: LOFAR Users Meeting (4th held in 2017), meeting between the user's community and ASTRON RO staff. LOFAR Community Science Workshop (5th in 2016), the workshops bring together all active LOFAR users. LOFAR Data Processing Data School (4th was held on 2016), aims at introducing LOFAR to new users.
JIVE
There are different meetings organised targeting different audiences: EVN Symposium and Users Meeting (every 2 years, next in 2018). Other may be organized: ERIS school in 2017

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CASA workshop in 2017 YERAC in 2018 ADASS in 2019, etc.

13. Innovative applications (this department exists only in JIVE)

13.1 Description and size of the team

ILT
N.A.
JIVE
The Space Science and Innovative Applications (SSIA) group is currently composed by 2 persons, the Head of SSIA (Dr. Leonid Gurvits) and one astronomer (at 25% dedication). It was born as space science interface to VSOP (1997-2003) and RadioAstron (1999-2011 and beyond). A current activity is Near Field VLBI, building tools to track ESA probes (e.g. Huygens on Titan, in 2005; but relations with ESA are not easy since JIVE is not a Space Agency.). This group coordinates a larger (9-11 people) group involving Delft TU, and other is France, India, Russia, Finland, Sweden, Hungary, Romania, South Africa, USA, etc, which proposes VLBI observations to the EVN.

13.2 Activities

ILT
N.A.
JIVE
Specific relations with ASTRON wrt LOFAR, on a spin-off activity towards JUICE, and a joint Dutch-Chinese project for interferometry in space. There is training on WSRT for ExoMars. There are incentives in JIVE partners for Space activities: China (know-how for lunar mission), Poland (a JJ WP3 priority, interested in space agency, and TCFA interested in JUICE), or Finland (at Metsahovi, interested in Space Weather). As of innovative applications, develops a project to study fundamental physics with VLBI. Maintains communication/networking with IAU (in synergy with IVS for ICRF3), URSI, IAA (Astronautics).

14. Software Support (this department exists only in ILT, at JIVE belongs to R&D and maintenance)

ILT
Group of 15 people, includes software developers and system administrators, head J. Annyas. There are currently 3 teams, 2 software developers and one system administrators. This groups supports all ASTRONs instruments in production; The FTEs that work on LOFAR are estimated at 12 after APERTIF is brought to the production state. Added to that is an extra added 3 FTE of system and network administrators that are hired internally in ASTRON and via an SLA with the CIT in Groningen.

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They provide support for the software that runs the telescope, provide the scripts to go from ILT to local mode, and provide further support to local stations. They also coordinate the relations with the computing facility in Groningen (CIT). The team does not support data reduction pipelines. They are in charge of administrating software and coordinate standard releases. The contact with the user's is done by the SOS team. The team follows the Scrum method for software development, the work is organised in Backlogs (a list with different prioritised tasks). Projects are organised on sprints, which are 3-weeks periods. There is no manager overlooking the work, the team picks up the top priority issues each sprint. The backlog is prioritised by a leader from the user community (Product Owner), appointed to the teams per project. There is a coordinator per team (Scrum master) and the coordinator communicates with the head of group.
JIVE
N.A.

14.2 Who are the users you give support to?

ILT
RO staff and local stations teams
JIVE
N.A.

14.4 Which tools do you have to communicate with your users? Helpdesk?

ILT
The software support is organised in such way that every day, one team member is in charge of replying to the users' queries. The requests are managed with the issue tracking software (JIRA).
JIVE
N.A.

14.5 Who is responsible for purchases? How are they performed?

ILT
The head of the Software Support group is responsible for purchases. Half a year in advance a budget is created for the coming year, which has to be approved by the financial department. During the year all members of the group may ask for purchases in hard and- software and the head of the group approves (or rejects). Large non-budgeted expenses will have to be approved by the head of the RO
JIVE
N.A.

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