Express Production Real-time e-VLBI Service

EXPReS is funded by the European Commission (DG-INFSO), Sixth Framework Programme, Contract #026642

Monthly Report- April 2009

Date:	2009 June 01
Filename:	2009-apr-rev06.odt
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Summary:	Monthly report

Document Log

Version	Date	Summary of Changes	Author(s)
1.0	2009 Jun 1	final	tcyun
0.9	2009 May 22	Draft	tcyun
0.1	2009 May 15	Initial Draft	T. Charles Yun

Project Information

Project Acronym	EXPReS
Project Full Title	Express Production Real-Time e-VLBI Service
Proposal/Contract number	DG-INFSO #026642

Table of Contents

Section 1- Introduction

The IYA event is the most visible source of activity for the month. Many EXPReS partners participated directly with JIVE providing a great deal of hands-on presence at the Amsterdam meeting. However, other partners, notably PSNC also participated from their home locations.

The FABRIC activity that seemed to be quiet for so long is now starting to produce more documentation and text that is visible to people outside of the development core. The developers are now confident with their code base and have been producing materials that will be shared both in these monthly reports as well as on the wiki.

As a final note, preparations for the e-VLBI Workshop/end-of-project meeting in Madrid are going smoothly, but taking a large amount of time. We are estimating ~90 participants from a wide geography and covering a broad spectrum of VLBI related science and technology.

Section 2.1 – NA1 Management

The project received an email from Jean-Luc Dorel towards the end of the month informally indicating the the EXPReS project extension had been approved and was simply awaiting processing. A scanned copy was received electronically in early May[1] and the physical letter was received soon after. We thank the Commission for their understanding and ongoing support of EXPReS.

Partner Metsähovi signaled a temporary staffing change due to scheduled leave of one of their staff. (Mr) Bilal Chaudhry will work from 23 Mar 2009 until 31 Aug 2009 to substitute Minttu Uunila's position while she is on leave. We welcome Mr Chaudhry to the project.

The Project Manager discovered some errors in the monthly reports that stem from the use of a template. The typographical error left the year number unchanged at the beginning of 2009. The monthly reports have been updated and re-posted to the wiki. Aside from the single typo, no other content was changed in the reports.

VLBI, and thus e-VLBI, functions only if there is a correlator available to process the data from different telescopes. During internal conversations, the following graph was discussed showing the overall correlator work-division as analyzed by the head of the correlator group at JIVE. The information presented is not intuitive and is based on metrics that the JIVE Board of Directors have used historically. That said, the head

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1   This text was prepared after the end of the month and the note from the E.C. was received during the first week.

of the correlator group believed that there were improvements that could be attributed to the activities of e-VLBI via EXPReS.
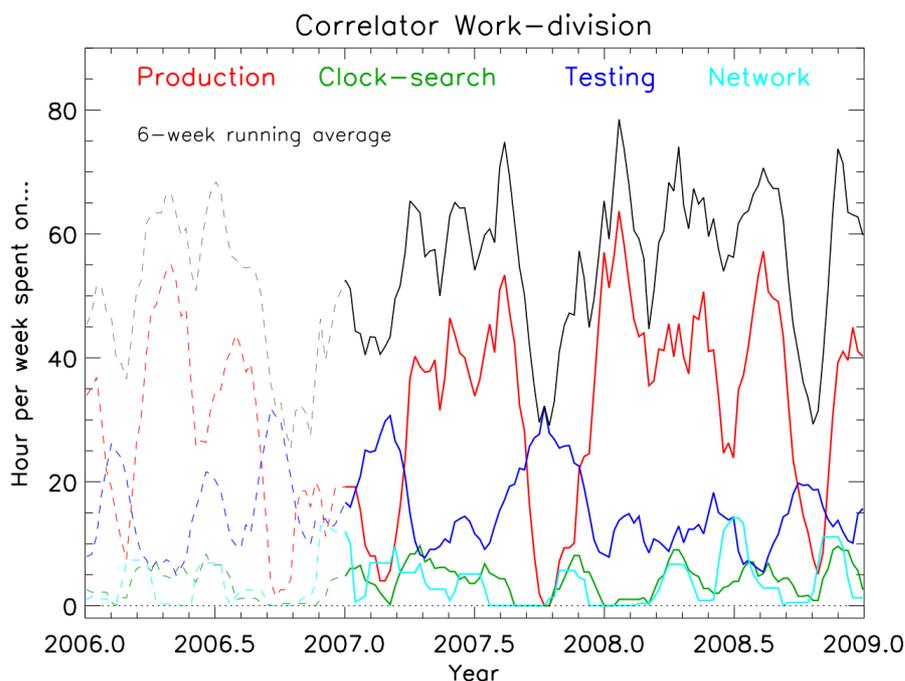

Figure: Correlator Work Hours over time, based on data collected for the JIVE biennial report

The Project Manager has spent most of the month of April preparing for the draft annual report. All partners have been contacted and text as well as financials have started to be sent into the project office. The annual report will be a 12 month draft, with the final 6 months of the project added later. The draft will remain in that form until the complete 18 month report is written and submitted at the end of the project.

Section 2.2 – NA2 EVN-NREN

The EVN-NREN is planning their meeting for the end of project meeting/e-VLBI Workshop in Madrid. The program is forming with NREN talks scheduled for Thursday afternoon. We plan to have a half-day of network focused talks with updates from both network partners and network representatives that are not EXPReS partners.

Section 2.3 – NA3 eVSAG

Zsolt Paragi provided a copy of his talk at JENAM (http://www.jenam2009.eu/default.asp?ContentID=1327) where in addition to explaining the activities of EXPReS, he highlighted some of the science done in the past few years. Of note is his list of science projects since the beginning of EXPReS:

- Cyg X-3, 20 Apr/18 May 2006, 128 Mbps, Tudose et al.
- GRS1915+105, 20 Apr 2006, 128 Mbps, Rushton et al.
- LSI +61.303, 256 Mbps, 26 Oct 2006, Perez-Torres et al.
- Algol, 26 Oct/14 Dec 2006, 256 Mbps, Paragi et al.
- Calibrators near M81, 14 Dec 2006, 256 Mbps, Brunthaler et al.
- INTEGRAL microquasar candidates, 14 Dec 2006, Pandey et al.
- "double header" run, 15 XRBs, 29 Jan 2007, Rushton & Spencer
- Calibrators, 21 Feb 2007, 256 Mbps, Tudose et al.
- J2020+3631 microquasar candidate, 28 Mar 2007, 256 Mbps, Martí et al.
- Cyg X-3, 12-13 Jun 2007, 256 Mbps, Tudose et al.
- Stellar maser search, 22-23 Aug 2007, 32 Mbps, Langevelde et al.
- INTEGRAL source redo, 6-7 Sep 2007, 256 Mbps, Pandey et al.
- Type Ib/c SN 2007gr, 6-7 Sep 2007, 256 Mbps, Paragi et al.

Also listed were many of the results from these observations. From a project deliverables/vision point of view, one of the more important slides was titled "Producing VLBI results on timescales comparable to other instruments" which points out the e-EVN has the confidence to talk about real time e-VLBI due to the work of EXPReS.

Section 2.4 – Public Outreach

Over the first weekend of April, EXPReS participated in the International Year of Astronomy 2009 event at NEMO (the science museum in Amsterdam). Members of EXPReS provided talks, in person interaction for children and adults, an interactive website <http://iya.expres-eu.org/>, and a real-time demonstration of a global e-VLBI array in action. The activities were highlighted in a variety of locations, including the AJPOD <http://www.astron.nl/dailyimage/index.html?main.php?date=20090403> and press releases <http://www.jive.nl/press_release_EVN_100Hrs.html>.

Much of the IYA events were to be shown online via the uStream service <http://www.ustream.tv/channel/100-hours-of-astronomy>. The video servers were initially overwhelmed by the interest and were unable to provide video. This problem was eventually corrected and IYA events were again viewable around the world.

The EXPReS project was contacted to participate in ICT Results <http://cordis.europa.eu/ictresults>. The outreach officer is working with the publishers to collect text and additional related materials so that a useful article can be published.

EXPReS will hosted a group of journalists organized by SURFnet to show them how JIVE and the e-VLBI community take advantage of networks and the European network infrastructure. The day's agenda involves introducing the journalists to the technology and terms that are used in e-VLBI. Further, we hope that the contact points made during this visit will help act as a foundation for future astronomy related articles that may be written. One immediate result of this visit was an article was published in the NRC as seen below.

Niet meer wachten op nieuws uit de ruimte

Wereldwijd kijken telescopen samen het heelal in. Dat levert een scherper beeld op, en sneller dan vroeger. Het combineren van de waarnemingen is nog een hele klus.

Door BENNIE MOLS

DWINGELOO, 7 APRIL. Tot voor kort was radioastronomie veel wachten. In het Drentse Dwingeloo vooral op postpakketten met kilometers lange opgerolde magneettapes of oude harde schijven, opgestuurd vanaf bevriende radiotelescopen. Maar tegenwoordig hoeven radiosterrenkundigen geen maanden meer te wachten om te zien wat andere telescopen waarnamen, maar uren. En het beeld is ook nog veel scherper dan vroeger. Want sinds 2006 combineert een glasvezelnetwerk radiotelescopen van over de hele wereld tot één grote virtuele telescoop. De combinatie geeft een honderdmaal zo gedetailleerd beeld als de beste optische telescoop.

„Afgelopen november zagen we bijvoorbeeld *live* hoe in tien dagen tijd een enorme hoeveelheid materie met eenderde van de lichtsnelheid werd uitgestoten door een zwart gat dat een ster aan het op-

eten is", vertelt sterrenkundige Zsolt Paragi. Dat 'live' moet tussen aanhalingstekens, want de astronomen kijken honderden miljoenen jaren terug in de tijd – zo lang duurt het voordat het licht van de objecten de aarde bereikt.

In de loop van de middag komt netwerkspecialist Paul Boven aanzetten met zijn laptop: na een paar uur rekenen heeft de supercomputer de waarnemingsresultaten van tien deelnemende e-VLBI-telescopen gecombineerd. Op het scherm verschijnt een blauwe, rood omrande stip. We kijken naar het actieve melkwegstelsel 3C120. Het licht heeft er 450 miljoen jaar gedaan om vandaag te worden waargenomen. Het blikveld op 3C120 is zo smal dat het overeenkomt met het waarnemen van een tennisbal in New York vanuit Nederland.

Het zenuwcentrum van deze virtuele intercontinentale telescoop bevindt zich in Dwingeloo, in het zogeheten JIVE – *Joint Institute for VLBI in Europe*; de gebruikte techniek heet namelijk *Electronic-Very Long Baseline Interferometry*, e-VLBI. Afgelopen vrijdag deed Dwingeloo mee aan de internationale sterrenkundemarathon 'Rond de wereld in tachtig telescopen' – een 24 uur lange live 'webcast', een soort tv-programma op internet. De webcast maakte een

De radiotelescoop bij Dwingeloo, Drenthe. Foto Sake Elzinga

rondgang langs telescopen over de hele wereld, in het kader van het Internationale Jaar van de Sterrenkunde. Tegelijkertijd was er een (niet-virtuele) rondleiding door het controlecentrum van JIVE en langs de supercomputer die de meetgegevens van alle aangesloten radiotelescopen (maximaal zestien tegelijk) verwerkt.

Op een wereldkaart in het JIVE branden lampjes op de plekken waar radiotelescopen live meedoen aan e-VLBI. In de ochtend lichten alleen twee lampjes in Australië en eentje in China op. Later op de dag – wanneer andere telescopen dezelfde bron kunnen zien

– gaan zeven lampjes in Europa aan. Nog later springen twee lampjes op het Amerikaanse continent aan. Uiteindelijk doen twaalf telescopen uit elf landen mee: Nederland, Engeland, Spanje, Zweden, Finland, Polen, Italië, Chili, Puerto Rico, China en Australië.

Waarnemingen via internet bij elkaar voegen klinkt gemakkelijker dan het is. „De kunst is om wetenschappelijke grootgebruikers snel en betrouwbaar te bedienen zonder de gewone internetgebruiker te hinderen", legt directeur Erik-Jan Bos van SURFnet uit. SURFnet ontwikkelt en exploiteert in Nederland een glasvezelnetwerk van ruim 8.000 kilometer. Het is een van de snelste en meest geavanceerde ter wereld, speciaal bedoeld voor universiteiten, hogescholen en academische ziekenhuizen. „Elke aangesloten radiotelescoop produceert ongeveer een gigabit per seconde aan data, die SURFnet vanuit het buitenland ontvangt en via het optische knooppunt NetherLight in Amsterdam naar Dwingeloo stuurt", vertelt Bos. Dat is ruwweg honderdmaal zo veel gegevens per seconde als bij een 'gewone' internetthuisgebruiker die met 10 megabit per seconde werkt.

Hoe blijf je de voortdurend toenemende datastroom van grote wetenschappelijke experimenten

de baas? „In 2002 hebben we het concept van lichtpaden ontwikkeld", vertelt Bos.

En dat zit zo: „Op een enkele glasvezel gebruiken we tot 72 'kanalen': 1 kanaal voor het gewone internetgebruik en de 71 andere kanalen voor het wetenschappelijke grootgebruik. Elk van die 71 kanalen gebruikt één bepaalde lichtfrequentie en vormt een lichtpad: een eigen optische snelweg die buiten het reguliere internet om loopt. We kunnen nu al tien gigabits per seconde per golflengte aan, en in de komende jaren wordt dat uitgebreid tot veertig en zelfs honderd gigabits per seconde."

„De Spaanse telescoop in Madrid heeft vandaag voor de eerste keer meegedaan aan e-VLBI", zegt JIVE-directeur en sterrenkundige Huib Jan van Langevelde. Maximaal voegt e-VLBI momenteel zestien telescopen samen. De komende jaren zal dat aantal toenemen. Het andere grote voordeel van de virtuele telescoop, opgestuwd door lichtpaden, is de snelheid waarmee hij kan reageren op wat er in de ruimte gebeurt. Van Langevelde: „Als er nu een ster ontploft, staat de virtuele radiotelescoop meteen op scherp."

Webcast 'Rond de wereld in tachtig telescopen' is te zien via www.nrc.nl/wetenschap

Figure: NRC newspaper article

Section 3.1 – Production e-VLBI

The NEMO event (described earlier) was a very labor intensive event with most of the EXPReS participants from JIVE participating. The event required the creation of website text as well as the logistics for the real time demonstration. As mentioned, the publicly available video of the event had some trouble, but the EXPReS demo was still able to provide web-cam video of the participating telescopes <http://iya.expres-eu.org/cams.html>.

Section 3.2 – Telescope Network Connections

No update at this time. Note that Paco Colomer, leader of this activity, is the local contact for the end of project meeting and is quite busy with preparations. Most of his work is not noted directly in this section, but will be reported implicitly when the meeting is completed in June.

Section 4.1 – FABRIC

ASTRON provided an update on the status of their LOFAR station report. LOFAR has chosen to pursue a 10 Gigabit Ethernet based on Foundry hardware for their datanet contract. The system upgrades the existing infrastructure and hardware to support faster and more flexible operations. Specifically, they indicate that the local-international interconnects have been greatly improved. This stated, there are still some issues regarding the synchronization of upgrades. For example, the German e-LOFAR infrastructure is running 3x1 GbE links. The expectation is that the German side will be upgraded to 10 GbE. Otherwise, the E-LOFAR connections are running or in advanced stages of testing. Formal documentation must still be completed (note: ASTRON delivered a complete, but informal report of the above information and plans a formal submission sometime soon).

As planned, Dominik Stokłosa of PSNC arrived at JIVE and has spent time working with the group in Dwingeloo. Stokłosa provided an initial presentation outlining his view of the current state of the work

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page 5 of 6

packages. The overview highlighted the current schematic of distributed correlation (pictured below) as well as the communication interfaces for the various modules.
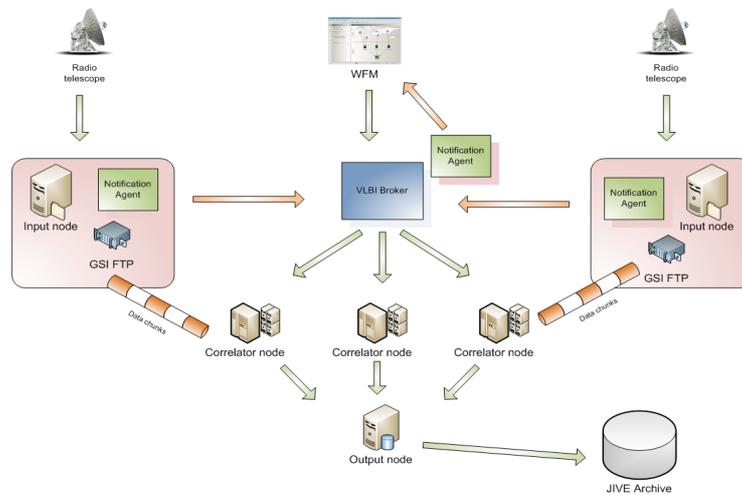

Figure: Distributed Correlation overivew, 2009 April

Stokłosa noted that there are a few items that still require some work that can not be completed until some final details are addressed (the purpose of his visit). Further documentation and notes on progress have been placed onto the wiki (http://www.jive.nl/dokuwiki/doku.php/expres:fabric:evlbisystem).