

EXPreS

Summary: EXPreS (EXpress Production Real-time e-VLBI Service) employs high-speed communication networks in order to create a globally distributed, large-scale astronomical instrument of continental and inter-continental dimensions, a Very Long Baseline Interferometer (VLBI) operating in real-time, and connecting some of the largest and most sensitive radio telescopes on the planet. EXPreS will realise a production-level “electronic” VLBI (e-VLBI) service, in which the telescope sites are reliably connected to the central data processor at the Joint Institute for VLBI in Europe (JIVE, NL) via optical fibres. The telescope network connectivity relies on the pan-European Research Network (GÉANT2) and various National Research Networks, in particular SURFnet6 in the Netherlands. The e-VLBI infrastructure will be a unique facility in the world, generating high-resolution images of cosmic radio sources in real-time, providing astronomers with a reliable and Target of Opportunity (rapid-result) service, well matched to the study of transient phenomena such as active stars, supernovae and Gamma-Ray bursts.

Objectives: The main objectives of EXPreS include:

- To develop an operational, production-grade, real-time e-VLBI network openly accessible to the international astronomical community
- To expand the number of e-VLBI capable telescopes across the globe by supporting the provision of additional last-mile (local-loop) connections or upgrading existing connections to Gigabit Ethernet standard
- To reliably service and robustly correlate (in real time) e-VLBI aggregate data flows of up to 16 Gbps to the central European VLBI Network (EVN) data processor at JIVE
- To realise high performance networking capabilities (via the pan-European Network GÉANT2 and National Research Networks) by using dedicated lambda networks and employing new, congestion tolerant transport protocols
- To transparently include the UK e-MERLIN radio telescope array within the larger EXPreS e-VLBI facility
- To develop an e-VLBI Target of Opportunity (Rapid Response) Science capability, reacting reliably and flexibly to transient, unexpected astronomical events,
- Research into advanced networking and computing technology that could support the creation of a next-generation e-VLBI network in which the aggregate data flows will be many hundred of Gbps
- To investigate the feasibility of processing e-VLBI data using distributed Grid-based computing resources
- To support the expansion of new radio telescope facilities (e.g. e-MERLIN and LOFAR) via public communication networks
- To generally promote and demonstrate the way in which advanced communication research networks can be used to create enhanced, large-scale distributed scientific facilities of global significance



Project acronym: EXPreS

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JIVE	NL
SURFnet	NL
AARNET	AU
PSNC	PL
DANTE	UK
ASTRON	NL
IGN	ES
JBO	UK
OSO	SE
MPIFR	DE
MRO	FI
INAF-IRA	IT
TCfA	PL
ShAO	CN
HRAO	SA
VIRAC	LV
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Information Technology,
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Collaboration with other

EC funded projects:

GÉANT2

RadioNet

SKADS

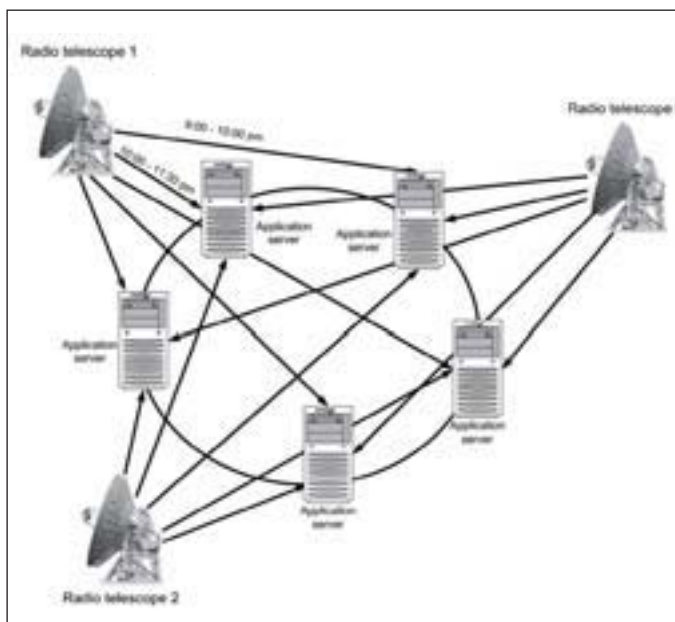


Project planning & Technical challenges: EXPreS closely integrates the service engineering and research aspects of the project within the standard instruments of Specific Support, Joint Research and Networking Activities:

Service Activities: EXPreS includes interdependent Specific Service Activities that form the core of the overall service project goals. These aim to realise a production-level e-VLBI service in which data can be transparently transferred to the data processor at JIVE, generating net data flows of up to 16 Gbps. An important part of the overall effort will be to ensure that when the data arrives at JIVE, it can be processed in real-time in a robust manner, with a level of reliability that closely approaches that achieved via traditional (non-realtime) VLBI data processing. A cornerstone of the project is to ensure that the telescopes of the e-MERLIN National Facility (operated by Jodrell Bank Observatory in the UK), participates transparently within this larger e-VLBI network. Another important aspect of the project is to expand the number of radio telescopes that have direct access to the GÉANT2 network, and thus the EVN data processor at JIVE in the Netherlands (via SURFnet6). In particular, one plans to stimulate and partially finance «last mile» connections to some of the largest and most sensitive radio telescopes in the world. In some cases existing communication services to these telescopes are improved and enhanced. The vast majority of the radio astronomy partners within EXPreS already participate in VLBI observations, and are operated by institutes that are members of the European VLBI Network (EVN). The creation of links to radio telescope facilities in other areas of the world is also an important project goal. Radio telescopes are located in Australia, China, South Africa, South America & the USA. The EXPreS infrastructure fully exploits the network bandwidth provided by the European research network GÉANT2 and the National Research and Education Networks (NRENs). The EXPreS project seeks to capitalise on the potential of lambda networking resources.

Research Activities: EXPreS Research Activities focus on the development of e-VLBI towards the use of high data rates, aiming to demonstrate the feasibility of data rates well in excess of 1 Gbps. Future e-VLBI arrays will require data rates in excess of 10 Gbps per telescope, implying aggregate data rates of 100 Gbps or more. Servicing such large data flows will require the construction of a new data processor. The EXPreS project will investigate whether it is possible to consider a Grid based approach to VLBI data processing.

Networking Activities: Within EXPreS the various networking activities support the overall management of the project and public outreach. The latter is extremely important, especially given the interest of the general public in all aspects of astronomy, not to mention its relevance in attracting young people into the study of the physical sciences. Critical review of the progress made by the EXPreS Service Activities is also provided by two additional networking activities; these are focused on supporting the activities of the e-VLBI engineers (drawn from both the radio astronomy and research networking communities) and the e-VLBI astronomical/scientific community.



Innovation: An important aspect of EXPreS is its intrinsic technical innovation that impacts the project and the e-Science community in terms of its high networking demands and its ambition to create a large (real-time) distributed astronomical research infrastructure. The research into the day-to-day use of photonic high speed links and in optimised data communication protocols is also Innovative.