



Advancing scientific research connecting e-Infrastructures across Europe and India

In Autumn 2010 a group of researchers of the HBNI (Homi Bhabha National Institute) were able to carry out an experiment for protein crystallography in Grenoble, France directly from their laboratories in Mumbai. Thanks to remote control facilities supported by the EU India Grid connection between the two countries they were able to operate robots in a French laboratory almost 10.000 km away from their lab in Mumbai. Since the establishment of the *Remote Data Collection Facility*, fifteen good quality data sets, each comprising of 180 oscillation frames, have been collected on protein samples that are part of the collaboration between Dr. Hosur M. V. at BARC (Bhabha Atomic Research Centre), Mumbai and Dr. Jean-Luc Ferrer at IBS/ESRF (Experimental Synchrotron Research Facility at the Structural Biology Institute), Grenoble, France. For example, 180 frames were collected on crystals of drug-resistant M36I mutant HIV-1 protease, and the structure could be refined to very low R-factors. More recently, data on HIV-1 protease substrate complexes have been collected. The diffraction data collected is stored temporarily on a local computer at ESRF, before it is transferred to HBNI computer through FTP.

Experiments like the one performed by HBNI and ESRF demonstrate how researchers increasingly require access to the top cutting-edge communication technologies. They are part of a spectacular growth in e-Science of international scientific collaborations which require substantial bandwidth and computing power. This dimension to the world of research and education contributing to the development of a national knowledge base that can help close the digital divide, potentially countering the loss of highly qualified researchers and delivering research to benefit society more quickly and efficiently.

Bridges between Europe and India. The development of Grid Computing has gone hand-in-hand with advances in global computing connectivity and also e-Infrastructures. Innovative research environments now allow researchers shared access to unique, distributed scientific facilities including data, networks, tools and computing resources, whether they are working in their home institutions or in national or multinational scientific initiatives. A series of European initiatives are involved in

deploying and operating the European-wide e-Infrastructure. These initiatives cooperate with national programs at European and extra-European level. ERNET is partner in EU-IndiaGrid2, a European Commission funded 7th Framework project that supports and fosters collaboration between researchers from Europe and India in a wide range of scientific areas. Global networks are the glue that hold together scientific research communities around the world. Networks such as GÉANT (The Pan-European Education and Research Network), TEIN3 (The Trans-Eurasia Information Network) and the NKN (National Knowledge Network of India) are all key to this process.

Thanks to EU-IndiaGrid2 an environment that virtualizes experiments, data access, data processing & data analysis is now available for European and Indian researchers, providing them access to a number of remote functionalities. Through EU-IndiaGrid2 a bridge now links European grid infrastructures (via EGI, the European Grid Infrastructure) and Indian grid infrastructures, namely the Indian national grid GARUDA), with networks such as GÉANT, the pan-European data network dedicated to the research and education community, and NKN facilitating such collaboration.

EU-IndiaGrid: from the scientist to the man on the street. The connectivity provided by TEIN3 to India has opened the floodgate for immense opportunity to Indian scientists and researchers for collaborative research with their counterparts in Europe. The TEIN3 network will provide high-speed transfer data for environmental research programmes and disaster management, as well as health and education with vital access to remote expertise and services through tele-medicine and e-learning that can benefit all walks of society

EU-IndiaGrid2 sustains a diverse set of scientific applications including high energy physics, material science and climate modelling with resulting cooperation initiatives already established between India and Europe.

EU-IndiaGrid2 has been able to establish a number of concrete examples of exploitation of this Euro-Indian e-Infrastructure network for research applications in domains where international collaboration and sharing of e-Infrastructures are most valuable. For example the



“Remote Data Collection Facility” mentioned above which supports remote access and control of synchrotron beam line at Grenoble, France by the Scientists at BARC, Mumbai exploiting NKN/TEIN3/GÉANT connectivity; the cooperation at EU-IndiaGrid2 Interoperability Workshop (Delhi December 2010) with CDAC (Centre for Development of Advanced Computing), BARC (Bhabha Atomic Research Centre) and INFN (Italian Institute of Nuclear Physics) to make GARUDA nodes transitioning from ERNET to NKN, accessible for e-Infrastructures outside India; the cooperation with the Tata Institute of Fundamental Research (TIFR) for exploiting NKN-TEIN3 link for Large Hadron Collider data transfers.

The role of ERNET. Within the scope of action of EU-IndiaGrid2 project, Europeans and Indian researchers are actively collaborating with ERNET and with the Indian National Informatics Centre (NIC, <http://www.nic.in/>). In particular, since the launch of the final phase of the National Knowledge Network of India (NKN) in January 2010, ERNET has led the operational support for the regional Worldwide LHC Computing Grid (WLCG) network in India and is also currently involved in migrating this network to NKN. The cooperation between

ERNET and NIC is currently operational and was instrumental for the interoperation of GARUDA nodes with the rest of the world and for the exploitation of TEIN3 link for LHC data to TIFR, for the use of NKN-TEIN3 connectivity to remote access and control of synchrotron beam line at Grenoble, France by the Scientists at BARC, Mumbai. ERNET has been supporting Indian partners in EU-India Grid to solve their network related problems and make full use of available e-infrastructure.

A dedicated conference. The objective of the APAN (Asia-Pacific Advanced Network) Fellowship Program is to promote global collaboration through applicants participation in APAN meetings, held twice yearly, in order to provide them with the right environment to network with other researchers and promote global collaboration among their local community after the meeting.

Within the next edition of the APAN Meeting, next 22-26 August in Delhi, a Workshop on Research Applications of High Speed Connectivity Across Europe, India and the Asia-Pacific Area will be organized by EU-IndiaGrid2 in collaboration with CHAIN project. This conference will showcase achievements made by EU-IndiaGrid2 to participants mainly from Asia Pacific region.

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About the APAN32 Meeting

The 32nd New Delhi meeting of APAN, organized by ERNET India and National Knowledge Network, will highlight tutorials, presentations and demonstrations covering advanced network technologies and applications. The programme spans network and application technologies, as well as case studies of advanced networking in areas such as Medical, High Definition TV, Middleware, e-Culture, Agriculture, Earth Monitoring and Earth System, IPv6, Network Security, Future Internet Testbed and more. The Meeting will start on 22nd August until 26th at the India Habitat Centre in New Delhi. The Meeting schedule and registration procedure is available at the APAN32 website www.apan.net/meetings/India2011.

About the EU-IndiaGrid2-CHAIN workshop

The Workshop on Research Applications of High Speed Connectivity Across Europe, India and the Asia-Pacific Area will be organized by EU-IndiaGrid2 in collaboration with CHAIN project (www.chain.eu) and will be held on 24th August as part of 32nd APAN meeting. The event will address researchers, technical experts in ICT, policy makers and project/Institution leaders. Presentations will include use cases highlighting the benefits of such connectivity in cases of High Energy Physics - data transfer to and from the Large Hadron Collider at CERN; Protein Crystallography – remote use by scientists at BARC, Mumbai, of an FIP beamline in Grenoble, France. The workshop will also highlight the far-reaching potential of Indian – European and Asian grid collaboration including climate change/weather simulations and realtime classroom applications. The status and perspectives of NKN-GÉANT connectivity through TEIN3 will also be examined. The impact on Euro-India collaboration in Research activities, and the contribution of EU-IndiaGrid2 support to collaboration between researchers from Europe and India in a wide range of scientific areas will be discussed, as well as the possibility offered by the gateway the Asia-Pacific e-Infrastructures offered by the TEIN3 connectivity. More information are available here <http://www.euindiagrid.eu/index.php/events>.