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High speed connectivity, common networks and Internet: Sustaining scientific research across Europe and India

A workshop at the APAN32 Meeting in Delhi will showcase some EU-IndiaGrid2 cooperative experiments

In Autumn 2010 a group of researchers of the 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. On 24 August at the APAN32 2011 conference, New Delhi, the "CHAIN - EU-IndiaGrid2 Workshop on Research Applications of High Speed Connectivity Across Europe, India and the Asia-Pacific Area" will showcase this and a number of other experiments carried out thanks to the cooperation between Indian and European eInfrastructures established under the umbrella of the EU-IndiaGrid2 EC funded project.

With the increasing demands of domain specialists, precision scientific instruments and the current global financial situation it is becoming increasingly challenging for individual research institutes to continue funding scientific projects. It is therefore, imperative that "laboratories will have to become *collaboratories*", conducting experiments, and having access to scientific instruments, datasets, software and hardware tools across geographical and administrative boundaries.

Thanks to EU-IndiaGrid2, a European Commission 7th Framework project, an environment that virtualizes experiments, data access, data processing & data analysis is now available for European and Indian researchers, providing them access to an array of remote functionalities.

"Cyber technology gives the opportunity to pool resources and collaborate with Indians working in different streams of scientific arena so that the common man is benefitted" said Indian Prime Minister, Dr. Manmohan Singh, at the launch of the Indian National Knowledge Network (NKN) at the beginning of the year[1]. The workshop will explore how such pooling of resources is also possible between India and Europe. Through EU-IndiaGrid2, a bridge now links European grid infrastructures via EGI (The European Grid Infrastructure), and Indian grid infrastructures (namely GARUDA, the national grid in India). This collaboration is facilitated by key national and international networks such as GÉANT (The pan-European Education and Research Network), dedicated to the research and education community; TEIN3 (The Trans-Eurasia Information Network), the only internet network in the Asian region dedicated to research and education, and the Indian NKN (National Knowledge Network) which connects research and education institutions across India and allows the sharing of High Performance Computing facilities.

Among the diverse scientific applications that EU-IndiaGrid2 aims to sustain, high energy physics, material science and climate modeling are some of the areas where tangible cooperation initiatives have already been set up between India and Europe. Participants will gain insight into showcases the best examples for the network exploitation for research applications in domains where international collaboration and sharing of e-Infrastructures have been most valuable.

[1] Source: http://articles.economictimes.indiatimes.com/2011-01-03/news/28427924_1_indian-scientists-manmohan-singh-science-education

From Mumbai to Grenoble and return: the remote experiment for collecting crystal X-ray diffraction data

The experiment carried out by the Homi Bhabha National Institute in Mumbai was a great example of extended grid infrastructure used for scientific purposes and of using fast Internet access to carry out remote experiments for protein crystallography studies. The experiment "Remote Data Collection Facility" was performed at the experimental station on the FIP beam line (French beam line for Investigation of Proteins), which is dedicated to crystallography of biological macromolecules. The FIP beam line is fully automated and has been enabled for remote access from Mumbai laboratories, in India. Under an on-going collaboration, Dr. Jean-Luc Ferrer at IBS (Institut de Biologie

Structurale) / ESRF (European Synchotron Radiation Facility), Dr. M.V. Hosur and colleagues at BARC (Bhaba Atomic Research Centre) have collected single crystal X-ray diffraction data by remotely operating the FIP beam line from BARC in India. This radiation, which is available in only a very few countries, has been used to determine the three dimensional structure of molecules by crystallography, enabling studies on structure-function relationships in biological macromolecules and in the design of new drugs.

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 and Dr. Jean-Luc Ferrer at IBS/ESRF, 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, and the refined map shows clear density for the ligand molecules in the active site. The diffraction data collected is stored temporarily on a local computer at ESRF, before it is transferred to HBNI computer through FTP.

Another advantage of remote data collection is that the younger members of the laboratory can participate and get trained in using the mega facility such as the ESRF synchrotron.

How Europe helps India in understanding Monsoon rains

From heat waves across Europe to cold snaps in Delhi and the massive devastation of extreme rainfall across Asia, extreme weather is becoming a global issue which researchers believe is caused by climate change. Research into issues such as monsoon rainfall is now based on simulating models which rely on advanced computing infrastructures (eInfrastructures) and high-speed networks. These enable researchers, irrespective of their geographical location, to make swift and accurate calculations and projections based on massive data sets. This has seen the growth of Virtual Research Communities (VRC) from around the world which depend upon policy makers and experts to ensure eInfrastructures are interoperable, efficient and work across countries and continents.

Obtaining reliable information about the climate change on a local, regional or global scale is the challenge behind research in this area. An application designed to meet this demand and successfully deployed on the GARUDA grid, the Indian national scientific eInfrastructure, has been developed thanks to cooperation between Europe and India through the EU-IndiaGrid2 project funded by the European Commission. Focusing on Monsoon simulations, the application is an example of an optimal use of resources. Professor S.K. Dash and his team of researchers from the Centre for Atmospheric Sciences, IIT Delhi, have completed a series of sensitivity experiments on Indian summer monsoon Regional Climate Model version 3 (RegCM3) on the Bangalore cluster of GARUDA and have obtained significant results for the Indian Climate Change research.

"Many universities in India have young scientists waiting to use the very high amount of data available on Indian climate – explains professor S.K. Dash, IIT Delhi (in the picture) - Despite that, they are often limited in their research activities because of the lack of computing power available in their universities. Thanks to the links provided via NKN our scientists could access other bigger computing systems both in India and in Europe to submit their jobs. IIT Delhi has benefitted a lot from this cooperation established thanks to EU-IndiaGrid2 project. For our regional climate modelling studies on Indian Monsoon we could access Regional Climate Modelling facilities, such as the RegCM software, available on the computing machines at the International Centre for Theoretical Physics in Trieste, Italy, simply through the web. A strong inter-continental collaboration has thus been established".

Virtual Research Communities have been established to support the global drive to address climate change issues. However, robust and reliable e-Infrastructures that are accessible from all over the world are required for these communities to operate successfully. This concern has a special impact in developing countries, which are the most vulnerable. Grid Infrastructures have the potential to help developing countries in closing the ICT gap empowering a large number of their researchers to actively participate in leading edge scientific challenges such as Climate Change.

Running faster towards worldwide challenges: exploiting Euro-India connectivity for the benefit of High Energy Physicians

High Energy Physics, through the Large Hadron Collider (LHC) programme at CERN, Switzerland, represents a unique

science and research facility which is shared between India and Europe in the field of scientific research in general through the Worldwide LHC Computing Grid[1] (WLCG) project.

WLCG is the largest grid infrastructure worldwide, created to address the data requirements of the LHC (15 million GBytes per year). India has established a regional WLCG Grid network with two Tier-2 centres, one at the Tata Institute of Fundamental Research (TIFR) in Mumbai for Compact Muon Spectrometer (CMS) and another at VECC/SINP Kolkata for ALICE (A Large Ion Collider Experiment), plus a number of Tier-3 centres at various Indian universities and of the Indian Department of Atomic Energy (DAE) aided institutions. The migration of WLCG connectivity to NKN in India and the establishment of the 2.5 Gbps TEIN3 link interconnected to NKN has provided a substantial burst to the activity of Indian LHC research community allowing these researchers to full access LHC data, widening their possibilities to contribute to the ambitious physics goals of the LCG program.

At CMS T2 at TIFR almost 10 Billion events have been processed since the beginning of 2011. Over thousands of terabytes of CMS data have been retrieved and / or transferred at T2 within last three months. CMS T2 has been specially chosen to be part of LHCONE, the LHC Open Network Environment whose aim is to ensure better access to the most important datasets by the worldwide High Energy Physics community through a collection of access locations that are effectively entry points into the network, and hence improve the data analysis.

The HEP community in India (Government labs & Universities) worked hard to set up the CMS & ALICE detector at LHC, CERN and have collected good quality data sets. The results from the experimental run from both CMS and ALICE have yielded excellent publications in reputed international journals (CMS community has reached a count of 100 papers, all in peer-reviewed journals, out of which 75 are from LHC collision data, 24 from cosmic-ray runs and one from CMS detector paper).

“Large volume of data (multiple of terabytes) generated from LHC experiments could be transported & distributed easily to all Indian participants through low latency, high bandwidth NKN and TEIN 3 connectivity – explains P.S. Dhekne from BARC and working at Office of The Principal Scientific Adviser to Indian Government - Being part of WLCG, both CMS & ALICE Tier II centres contributed to process power (over 1000 cores) and storage capacity (over 800 Terabytes) & worldwide HEP community could use these resources very effectively. The experience gained in operation & use of this e-infrastructure has benefited immensely, allowing faster adoption of Grid technology & implementation of many new applications such as Open source drug discovery, Climate Change modelling, and e-classrooms, Cancer Grid, Health Grid etc. in India”.

About the 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 part of APAN32, the Asia-Pacific Advanced Network 32nd Meeting, in Delhi. Addressing 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 potential of India – Europe – Asia grid collaboration for simulations. With 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 during the workshop. 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 .

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