Energy Life Sarl *Grid Computing Technologies*	

SUMMARY OF CONTRIBUTIONS

A) Project Budget

Description	**US$**
Project Manager*	
Mission Costs	
Needs Ass'mt Study	
Cap. Bldg Wkshops	
Feasibility Study	
Regional Centers	
Miscellaneous	
Total:	

Project Number:

Project Title: Deployment and regional integration of e-Infrastructures and applications in the developing countries

Estimated Start Date: September 2011/November 2012

Estimated End Date:

Government Coop. Agency: Designated Authorities of Participating Countries and/or Institutions

Executing Agency:

Project Site:

Beneficiary Countries: Global

1 Brief Description:

This project aims to identify and understand the ongoing efforts of the "global grid communities" to explore synergies and define areas that could be applied in the developing countries such as cyber security, emergency telecommunications, climate change and services such as online education, e-health, e-agriculture, e-commerce and etc., which can significantly contribute to the consolidation of interoperability and global connectivity.

Connectivity at present is delivered by National Research and Education Networks (NRENs) and underpins the work of researchers and academics, providing a dedicated high-speed network and high quality internet access that enables vital collaboration across countries and continents. Their existence also enables research into networking itself, ensuring users always benefit from leading-edge technology.

The pan-European infrastructure that interconnects Europe's NRENs and connects European research networking to the rest of the world is the high-capacity and high-performance communication network called GÉANT. As many other countries have inter-connected their NRENs into regional networks such as Red CLARA in Latin America, EUMEDCONNECT in the Mediterranean, CAREN in Central Asia, BSI in the Black Sea region, Africa Connect in Southern and Eastern Africa or TEIN across the whole of Asia, or to other individual NRENs through dedicated bilateral links, the project will benefit all the regions of the developing world by deploying special applications developed from the grid communities.

This initiative of creating a fast broadband network spread worldwide enabling the creation of other NRENs in the framework of supporting basic research and technological innovation with the support of public funds. ITU could play supporting role to the governments of developing countries to achieve total connectivity with the deployment of specific distributed applications in these regions such us applications from e-health and natural resources domains, so a Grid/Cloud infrastructure equipped with a layer of services to meet specific requirements.

The applications to be deployed have reached a high level of complexity that now require ongoing collaboration between academics, professionals from governmental institutions with the private sector to provide the necessary technology transfer and to allow a proper use of these applications. In this context, technology transfer and exchange of innovation of the project aims to transfer knowledge from research experience to civil society, especially professionals, to facilitate technological innovation, to carry out local research and strengthen existing partnerships between the networks of scientists and technologists in regions from the developing countries with industrialized countries. To achieve these objectives, the intention is to introduce a service that exploits the results of the project, while the researchers also learn from the applications and of their ideas in a real environment.

"Broadband applications and services are becoming more and more embedded in our societies. And they will be essential — not only in efforts to reach the MDGs by the target year of 2015, but also to help sustain our quality of life into the future.

http://www.broadbandcommission.org/report2/overview.pdf

	Signature	Date	Name/Title
On Behalf of	_____	_____	_____
ITU	_____	_____	_____

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2 Goal and expected results

This project aims to deploy e-infrastructures and applications developed by the research and scientific communities to provide high level technological support and expertise to the developing countries using Cloud/Grid/HPC technologies through public and private partnerships.

In the context of the ITU/BDT, the method of deploying electronic infrastructures and applications for the benefit of the developing regions of the world will be described as a framework project that will include a detailed analysis of existing different e-applications developed by the scientific community (Global toolkit).

To carry out a global connectivity and interoperability with the use of electronic infrastructure, this project aims to conduct a study of a set of important applications and heterogeneous needs of these applications in e-science, which today make it difficult to create an appropriate method of implementing these applications in developing countries.

Furthermore, this project believes that the deployment of e-science applications can take place through a "gridification process" to support effective cooperation between professionals working in the regions of developing countries.

3 E-Infrastructures

e-Infrastructure is the environment where the scientific research with the support of advanced high-speed broadband networks has the possibility of sharing “in silico” powerful tools and computational resources (hardware, software and content), remote access to massive datasets, research centers, distributed database infrastructures and the use of digital platforms for cross-border collaborations between researchers across the world and to conduct top level research activities in all fields of science. E-infrastructures foster the emergence of e-Science, i.e. new working methods based on the shared use of ICT tools and resources across different disciplines and technology domains. Furthermore e-infrastructures enable the circulation of knowledge online.

The Grid infrastructure for e-Science in Europe is based on the GÉANT network (Figure 1). E-Infrastructures are often also used beyond research, for example in education or public services. They include today high-capacity and high-performance communication networks (GÉANT), cloud and grid-empowered resource sharing infrastructures and supercomputing facilities (PRACE), combined with scientific application software, data repositories and services.

The further development and adoption of e-Infrastructures requires structured interaction between computational scientists and ICT engineers and a broad range of scientific disciplines as well as catering for the specific needs of scientific and industrial user communities.

The Secretary General of the ITU (International Telecommunication Union), the UN agency responsible for the information technology and telecommunication issues, has challenged world leaders to ensure that more than half the world population should have access to broadband networks in 2015 and that access to high speed networks must be "a basic civil right."

With the financial support of the European Commission many projects have been funded to create or expand the e-Infrastructures in other regions of the world and make them connected and interoperable with Europe. These projects or initiatives have contributed to create a "global grid" network, as shown in Figure 2.

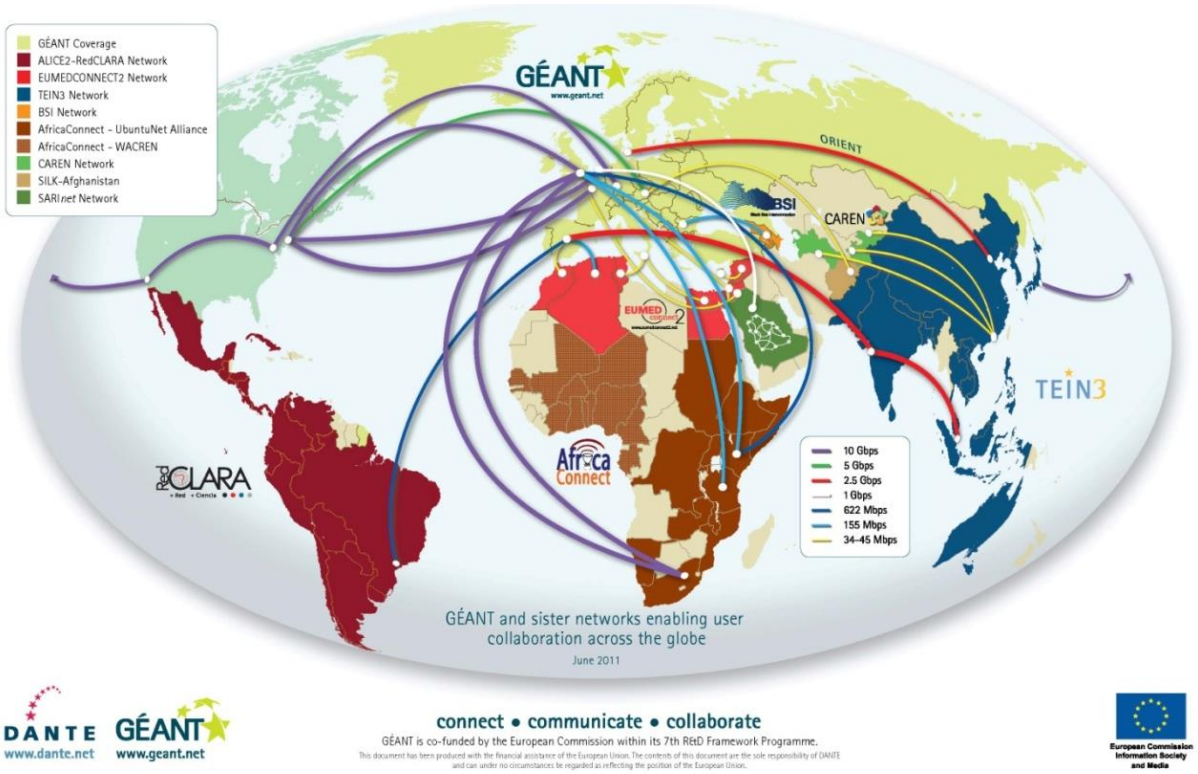

Figure 1: GEANT – Global connectivity

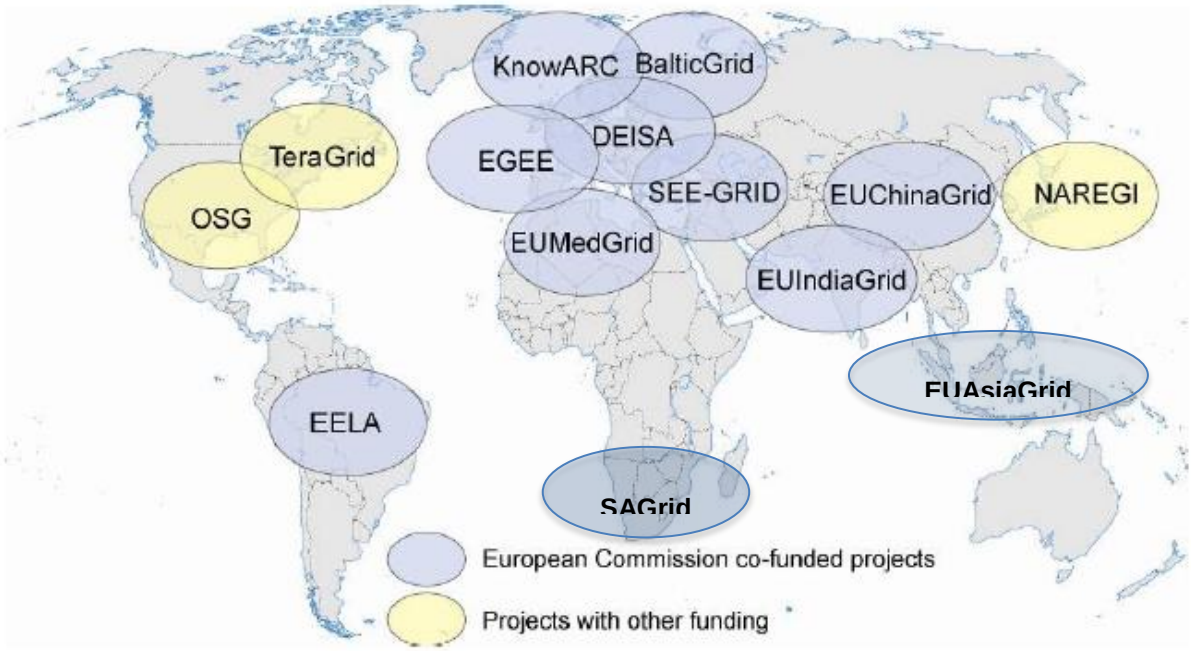

Figure 2: Grid communities in the world

3.1 Regional e-Infrastructures

In order to understand and to define the applications that could be deployed in the regions in the developing countries is important to review the status of the e-infrastructures in the world.

3.1.1 Europe

> *"The European Commission has proposed to spend almost €9.2 billion from 2014 to 2020 on pan-European projects to give EU citizens and businesses access to high-speed broadband networks and the services that run on them. The funding, part of the proposed Connecting Europe Facility (CEF), would take the form of both equity and debt instruments and grants. It would complement private investment and public money at local, regional and national level and EU structural or cohesion funds. At least €7 billion would be available for investment in high-speed broadband infrastructure." (Digital Agenda for Europe)*

As a world leader in developing and maintaining e-Infrastructures, Europe has become a hot spot for innovation and research. In Europe, under FP7, the e-Infrastructures activity is part of the Research Infrastructures programme, funded under the FP7 'Capacities' Specific Programme. It focuses on the further development and evolution of the high-capacity and high-performance communication network (GÉANT), distributed computing infrastructures (grids and clouds), supercomputer infrastructures, simulation software, scientific data infrastructures, e-Science services as well as on the adoption of e-Infrastructures by user communities. Furthermore, FP7 addresses the deployment of new scientific infrastructures, in line with the recommendations of the European Strategy Forum on Research Infrastructures (ESFRI). In this context, the deployment of new supercomputing facilities, reaching peta-flop computing performance, will be supported.

3.1.1.1 FP7

It is the short name for the Seventh Framework Programme for Research and Technological Development. This is the EU's main instrument for funding research in Europe and it has started in 2007 until 2013. The EC budget for these 7 years is 50 billion euros plus the Euratom budget of 2.7 billion euros (Figure 3). The FP7 consists in 4 main blocks of activities with four specific programs plus a fifth specific programme on nuclear research.

3.1.1.1.1 Cooperation – Collaborative research

- Health
- Food, Agriculture and Biotechnology
- Information and Communication Technologies
- Nanosciences, Nanotechnologies, Materials and new Production Technologies
- Energy
- Environment (including climate change)
- Transport (including Aeronautics)
- Socio-economic sciences and Humanities
- Security
- Space

3.1.1.1.2 Ideas - European Research Council

- Frontier research actions
- People - Human Potential, Marie Curie actions
- Initial training of researchers - Marie Curie Networks
- Life-long training and career development - Individual fellowships
- Industry-academia pathways and partnerships
- International dimension - outgoing and incoming fellowships,

- international cooperation scheme, reintegration grants
- Excellence Awards

3.1.1.1.3 Capacities - Research capacities

- Research infrastructures
- Research for the benefit of SMEs
- Regions of Knowledge
- Research Potential
- Science in Society
- Support to the coherent development of research policies
- Specific activities of international cooperation

3.1.1.1.4 Nuclear research and training

- Fusion energy - ITER
- Nuclear fission and radiation protection

3.1.1.1.5 Joint Research Centre

- Direct actions in Euratom
- Non-nuclear actions

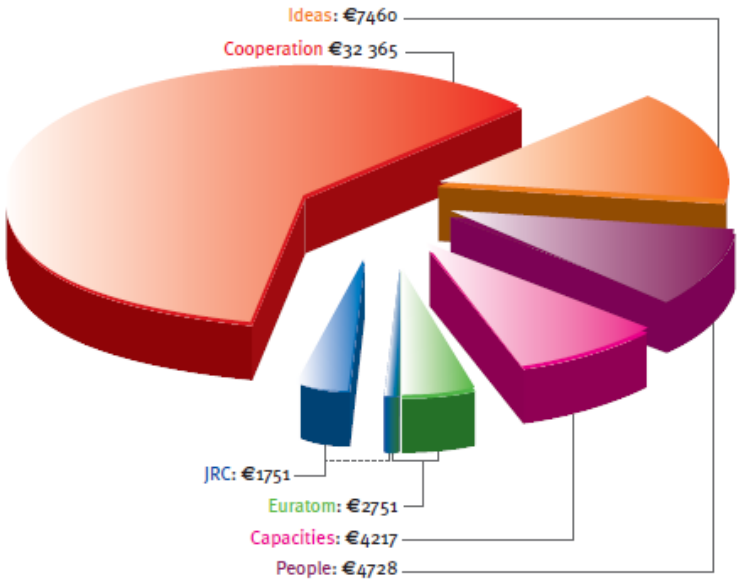

Figure 3: The indicative breakdown (million of euros) of FP7

Research infrastructures from Research Capacities programme play an increasing role in the advancement of knowledge, technology and their exploitation. These facilities, resources or services have the ability to bring together people and investment and to contribute to national, regional and European economic development. They are therefore important for research, education and innovation. Research infrastructures can be seen as strategic Centres of Excellence for research and training as well as facilitators of public-private partnerships in research. The benefit of cross-disciplinary and institutional collaboration lies in the personal interactions of researchers coming from different countries, disciplines and work places.

The current e-infrastructure initiatives in Europe, such as GEANT, EGEE and DEISA, enhance European research and development potential by rationalizing investments in expensive scientific resources.

3.1.1.2 GEANT

GÉANT is the world-leading pan-European high bandwidth data network dedicated to the research and education community. Together with Europe's national research networks, GÉANT connects 40 million users in over 8,000 institutions across 40 countries.

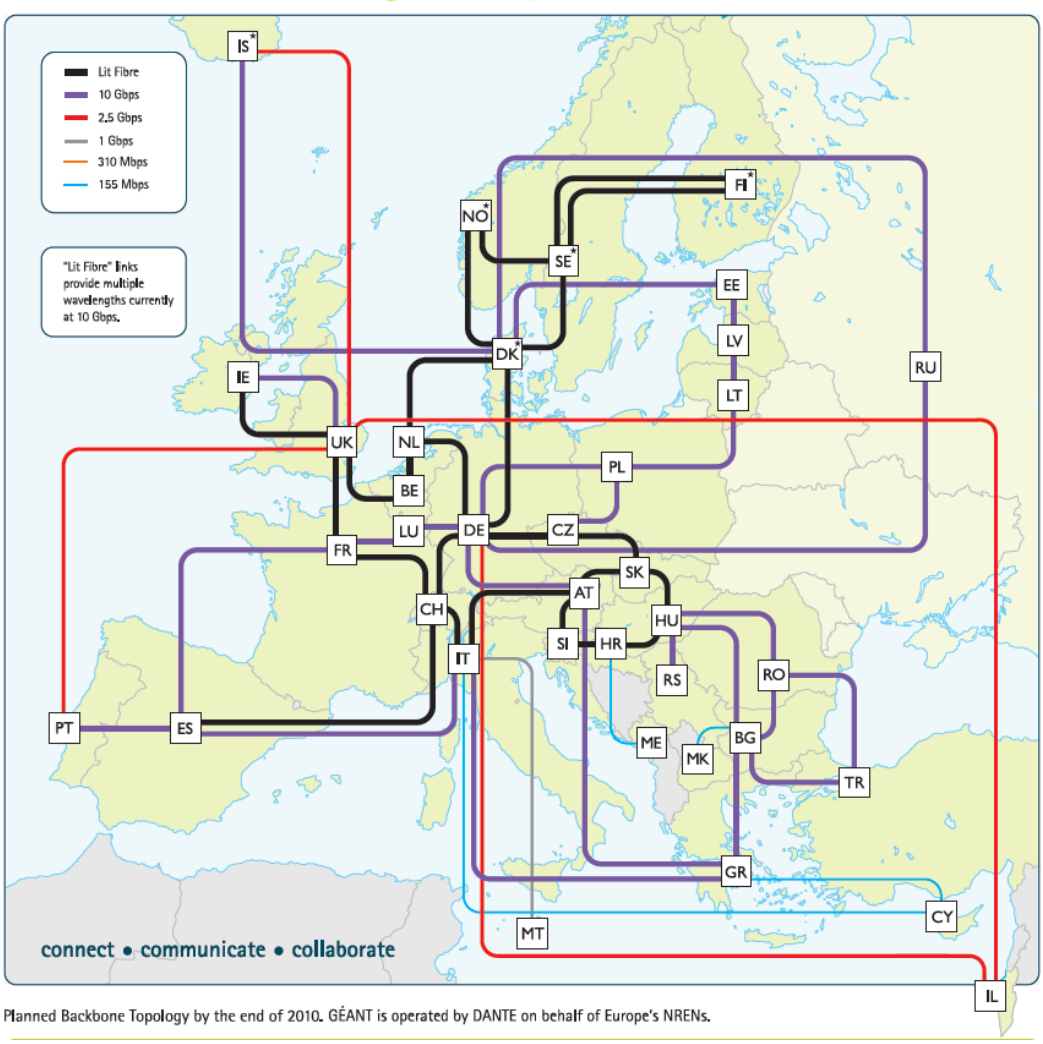

Figure 3: GEANT Topology (September 2010)

GÉANT and the NRENs compose an advanced communications' infrastructure serving research and education community in Europe. The infrastructure is organized in a multilayer fashion, connecting research and education end-institutions and end-users. The network connection between two end-users in two end-institutions in different countries is provided through several networks. One of the main aims within the GÉANT-NREN environment is the delivery of advanced connectivity, network support and access services for projects, institutions and end users. Seamless end-to-end service delivery in such multi-domain environment with multitude of different technologies in use, operational procedures, network management subsystems and procedures presents a significant challenge.

GÉANT2 is the high-bandwidth, academic Internet serving Europe's research and education community. Connecting over 30 million researchers with a multi-domain topology spanning 34 European countries and links to a number of other world regions, GÉANT2 is at the heart of global research networking. GÉANT2 is co-funded by the European Commission and Europe's national research and education networks, and is managed by DANTE.

3.1.1.3 EGEE

The EGEE project (The Enabling Grids for E-SciencE Project) officially ended on April 30 2010. This project was based on national and thematic Grid efforts, as well as the pan-European network provided by GÉANT and the National Research and Education Network (NRENs), brought together experts from all over Europe and the rest of the world (more than 50 countries) with the common aim of building on recent advances in Grid technology and developing a service Grid infrastructure.

The distributed computing infrastructure built and nurtured by the projects DataGrid (2002-2004), EGEE-I, -II and -III (2004-2010) is now supported by the European Grid Infrastructure (EGI).

3.1.1.4 DEISA

DEISA – Distributed European Infrastructure for Supercomputing Applications is a consortium leading national supercomputing centres that aims at fostering the pan-European world-leading computational science research.

DEISA2, funded by the European Commission in FP7, continues to develop and support the pan-European distributed high performance computing infrastructure established since 2002 within the predecessor project, DEISA1 that was funded in FP6. The DEISA infrastructure is based on a tight coupling of eleven national supercomputing centres from seven European countries, using dedicated network interconnections of GÉANT2 and the NRENs.

The DEISA consortium is currently consolidating the existing HPC infrastructure and services.

3.1.1.5 EGI

EGI – The European Grid Infrastructure enables access to computing resources for European researchers from all fields of science, from High Energy Physics to Humanities. EGI created on 2010 is a foundation established under Dutch law to create and maintain a pan-European Grid Infrastructure (EGI) in collaboration with National Grid Initiatives (NGIs) and European International Research Organizations (EIROs), to guarantee the long-term availability of a generic e-infrastructure for all European research communities and their international collaborators.

As a result, Europe's research communities have a pan-European e-infrastructure that is available to communities ranging from astronomy and astrophysics, life sciences, computational chemistry, material sciences, fusion, earth sciences and high energy physics. This European-wide e-Infrastructure is transitioning to a federation of national e-Infrastructures thanks to the EC funded EGI-InSPIRE project (European Grid Infrastructure: an Integrated Sustainable Pan-European Infrastructure for Researchers in Europe – FP7, started in May 2010 for 4 years).

Today, EGI integrates over 300,000 processors and more than 100 PB of storage space located at 350 sites in 50 countries (Figure 4). This production quality platform provides a flexible solution for many distributed storage and computing use cases. EGI currently supports over 13,000 researchers in their intensive data analysis needs in almost every e-Science discipline, and can extend this support to other e-Science communities and beyond such as e-Government. EGI's innovative technology and procedures address many of the issues identified in the Digital Agenda for Europe. Through its European wide federation of national resource providers it is ideally placed to provide an e-Infrastructure (grids of computing storage and cloud resources) for the general benefit of society.

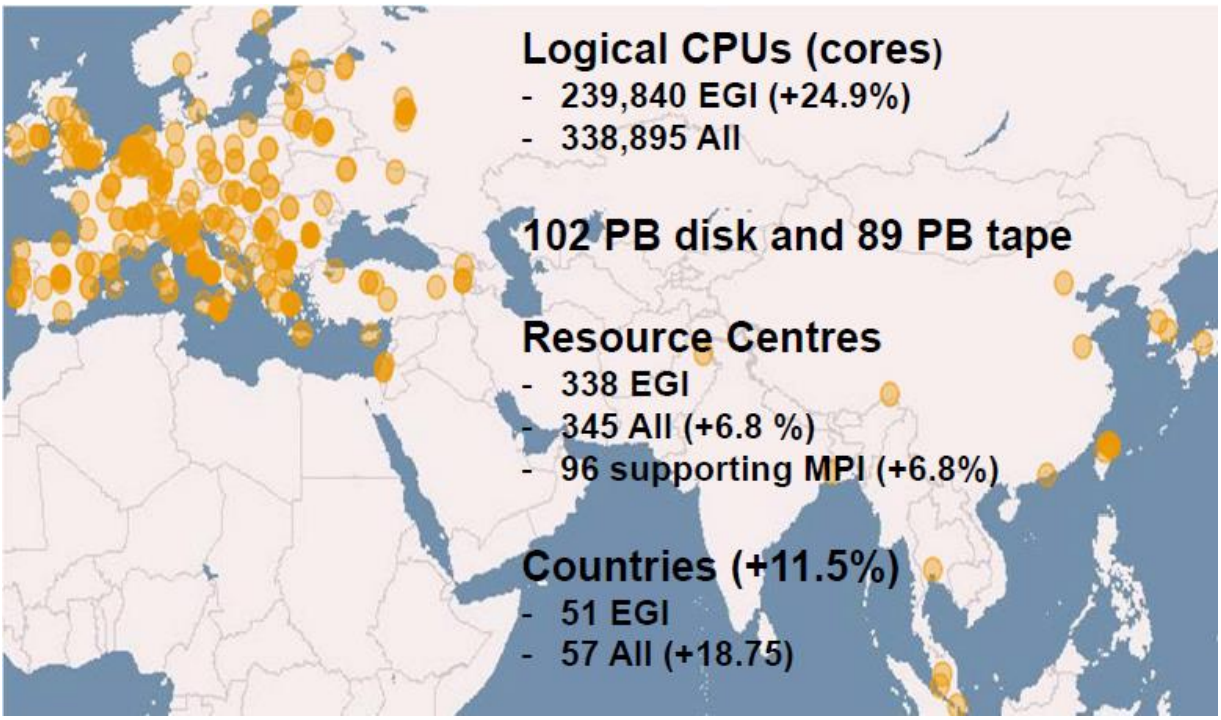

Figure 4: European Grid Infrastructure (May 2011)

To support science and innovation, a lasting operational model for e-Science is needed − both for coordinating the infrastructure and for delivering integrated services that cross national borders. The EGI-InSPIRE project[1] will support the transition from a project-based system to a sustainable pan-European e-Infrastructure, by supporting "grids" of high-performance computing (HPC) and high-throughput computing (HTC) resources. EGI-InSPIRE will also be ideally placed to integrate new Distributed Computing Infrastructures (DCIs) such as clouds, supercomputing networks and desktop grids, to benefit user communities within the European Research Area (ERA).

3.1.1.5.1 EGI Applications Database

The EGI community is a federation of independent national and community resource providers, whose resources support specific research communities and international collaborators both within Europe and worldwide. EGI.eu, coordinator of EGI-InSPIRE, brings together partner institutions established within the community to provide a set of essential human and technical services that enable secure integrated access to distributed resources on behalf of the community.

Currently there are 10 disciplines and 36 scientific areas that are being supported, among them:

1. Astronomy and Astrophysics
2. Computational Chemistry
3. Earth Sciences
4. Fusion
5. High Energy Physics
6. Life Sciences

[1] The ultimate goal of EGI-InSPIRE is to provide European scientists and their international partners with a sustainable, reliable e-Infrastructure that can support their needs for large-scale data analysis. This is essential in order to solve the big questions facing science today, and in the decades to come.

Some of the LHC projects at CERN are part of the EGI Application Database High Energy Physics. In Life Sciences and Earth Sciences there is a significant participation of Latin America (GISELA Project).

3.1.2 North America

The research networking connectivity in North America are provided by CANARIE in Canada, and four main research and education networks in the USA: ESnet, Internet2[2], National LambdaRail (NLR) and the NASA Integrated Services Network (NISN).

The connection between North America and Europe is playing a key role in enabling the research collaboration on intercontinental projects, and is for instance important for the Large Hadron Collider (LHC) at CERN for its scientific collaboration with a number of institutions on High Energy Physics located in North America.

Researchers in Europe can connect to their counterparts on the various North American networks via transatlantic IP capacity totaling 25 Gbps.

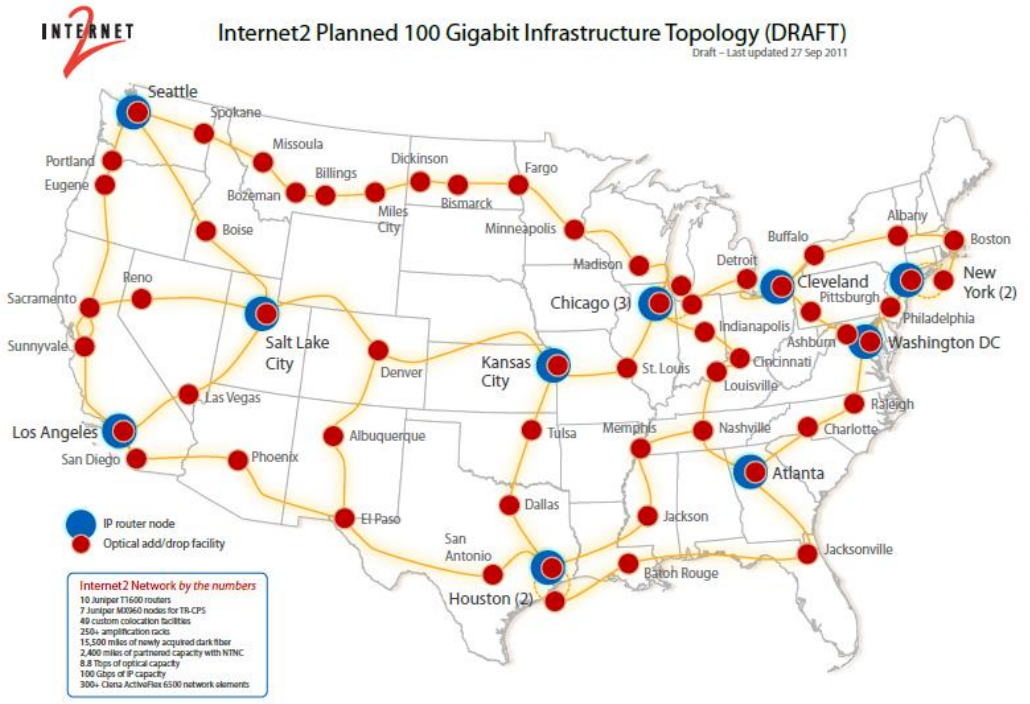

Figure 5: Internet2 – planned 100G infrastructure Topology (draft)

Internet2 is an innovative and cost-effective hybrid optical and packet network designed to deliver the research and education community next-generation production services as well as a development platform for new networking ideas and protocols. Internet2 is going to be the first platform to deploy 100 Gigabit Ethernet waves and will become one the most sophisticated research and education platform in the world.

[2] Internet2 provides the U.S. research and education community with a dynamic, innovative and cost-effective hybrid optical and packet network. The network was designed to provide next-generation production services as well as a platform for the development of new networking ideas and protocols. With community control of the fundamental networking infrastructure, the Internet2 Network provides the necessary scalability for member institutions to efficiently provision resources to address bandwidth-intensive requirements of their campuses such as, collaborative applications, distributed research experiments, grid-based data analysis and social networking.

3.1.2.1 OSG – Open Science Grid

The goal of the Open Science Grid (OSG) is to transform processing and data intensive science through a cross-domain, self-managed, nationally distributed cyber-infrastructure that brings together community resources and enables effective computational resource sharing at the academic and research campuses. The OSG promotes science by enabling a framework of distributed computing and storage resources (Table 1), a set of services and methods that enable better access to ever increasing computing resources for researchers and communities, and principles and software that enable distributed high through-put computing (DHTC) for users and communities at all scales. In addition, OSG represents and promotes these concepts and technology with other international partners on behalf of US science collaborations including the US-LHC experiments.

OSG is jointly funded by the Department of Energy and the National Science Foundation.

Table 1: Current OSG resources

Number of Grid interfaced processing resources on the production infrastructure	**131**
Number of Grid interfaced data storage resources on the production infrastructure	61
Number of Campus Infrastructures interfaced to the OSG	9 (GridUNESP, Clemson, FermiGrid, Purdue, Wisconsin, Buffalo, Nebraska, Oklahoma, SBGrid)
Number of National Grids interoperating with the OSG	3 (EGI, NGDF, XSEDE)
Number of processing resources on the integration testing infrastructure	28
Number of Grid interfaced data storage resources on the integration testing infrastructure	11
Number of Cores accessible to the OSG infrastructure	~70,000
Size of Disk storage accessible to the OSG infrastructure	~29 Petabytes
CPU Wall Clock usage of the OSG infrastructure	Average of 56,000 CPU days/ day during May 2011

Different scientific areas are covered by OSG:

- particle and nuclear physics
- astrophysics
- bioinformatics
- gravitational-wave science
- computer science
- mathematics
- medical imaging
- nanotechnology
- Potentially any other science.

3.1.2.2 TeraGrid → XSEDE

The Extreme Science and Engineering Discovery Environment (XSEDE) replaces and expands on TeraGrid.

XSEDE is the most advanced, powerful, and robust collection of integrated advanced digital resources and services in the world. It is a single virtual system that scientists can use to interactively share computing resources, data, and expertise. (https://www.xsede.org/web/guest/overview).

Scientists and engineers around the world use these resources and services—things like supercomputers, collections of data, and new tools—to make us all healthier, safer, and better off. XSEDE, and the experts who lead the program, will make these resources easier to use and help more people use them.

XSEDE integrates these resources and services, makes them easier to use, and helps more people use them.

Modeling complex phenomena and analyzing extremely large quantities of data are key tasks required to advance many areas of research. That's why the National Science Foundation provides shared resources to enable scientists and engineers to carry out these important tasks, first through the TeraGrid (until April 2011) and now through the new eXtreme Digital (XD) project.

"With XSEDE there is a slightly different perspective: a researcher-centric point of view. The focus now is much more on creating an infrastructure in which researchers can create their own environment in which all the resources they need are embedded to facilitate their work and allow them to be more productive. The resources of interest might be HPC systems, but will also be data stores, visualization capabilities, collaboration tools and resources that distributed teams might wish to share among themselves. This approach opens the door to provide support for a much larger community of researchers." John Towns, principal investigator for the National Science Foundation's new Extreme Science and Engineering Discovery Environment project, about the vision for XSEDE and how it will build on the TeraGrid (June 2011).

XSEDE is composed of multiple partner institutions known as Service Providers or SPs, each of which contributes one or more allocatable services. Resources include High Performance Computing (HPC) machines, data storage, gateway systems, and instruments.

3.1.2.3 ExTENCI

The Extending Science Through Enhanced National Cyberinfrastructure (ExTENCI) Project is a joint Open Science Grid (OSG) and TeraGrid project, funded by the National Science Foundation Office of Cyberinfrastructure (NSF OCI).

The goal of this project is to develop and provide production quality enhancements to the National CyberInfrastructure that will enable specific science applications to more easily use both OSG and TeraGrid or broaden access to a capability to both TeraGrid and OSG users.

3.1.3 Latin America

3.1.3.1 Network infrastructure

The ALICE (America Latina Interconectada Con Europa) project was set up in 2003 to develop the RedCLARA network, which provides IP research network infrastructure within the Latin American region and towards Europe. It was managed by DANTE, and was 80% funded by the European Commission. It had 4 European and 19 Latin American partners, including the Latin American research networking association CLARA (Latin American Cooperation of Advanced Networks).

The ALICE2 project led to the creation of RedCLARA, as a network infrastructure that interconnects Latino American NRENs which is a non-profit International Law Organization, whose legal existence is dated on 23 December 2004, when it was acknowledged as such by the legislation of Uruguay.

ALICE2 creates user communities supporting MDG (UN – Millennium Development Goals) and FP7 (EC 7th Framework Programme) oriented applications.

Alice2 Objectives:

- To identify and select major application areas, with great impact in the region, where University research and development and RedCLARA can contribute to help meet the Millennium Development Goals
- To identify and select FP7 programmes, with greater impact in the region, where University research and development and RedCLARA can contribute.
- To identify or create groups/communities working in the selected thematic areas to meet the Millennium Development Goals, and define a list of initial potential projects that would benefit from the use of RedCLARA.
- To identify or create groups/communities working in the selected areas in order to participate in FP7 activities and programmes, and define a list of initial potential projects that would benefit from the use of RedCLARA
- To **develop, deploy and maintain applications and services** which are useful to communities, according to WP5 Marketing and Services, such that these become an open platform upon which interested scientists/educators can build up new applications
- To Identify ongoing projects that would have the highest impact, i.e. in agriculture, health, education, disaster prevention, etc., on satisfying the objectives of the Millennium Development Goals initiative, AIDCO and other programmes and carry out case studies to help communities with proposals in these areas to apply for selected funding sources.
- Actively to disseminate and promote FP7, ALFA, CYTED and other donor programme calls among higher development communities and research groups, in order to help groups/communities to participate in the elaboration and development of research projects in the FP7 and other programme areas , contributing to an increase the interaction and collaboration between the European Union and Latin America.

Inclusion:

In ALICE2 to ensure regional inclusion is one of the main objectives. This goal is divided in the following objectives:

- Negotiate access to the new telecommunications infrastructures being deployed in Central and South America.
- Invite to participate Bolivia, Cuba, Costa Rica, Honduras, Nicaragua and Paraguay
- To provide Technical and Management Support to the NRENs
- To outreach to, and maintain close cooperation with, the Caribbean Advanced Networks initiative (CKLN - Caribbean Knowledge and Learning Network).

REdCLARA backbone:

- RedCLARA (Figure 6) develops and operates the only Latin-American advanced Internet network that was established for regional interconnection and linked to GÉANT2 via the ALICE Project (which –until March 2008- was co-funded by the European Commission through its @LIS Programme) in 2004.
- RedCLARA is constituted by 15 Latin American countries and its Assembly meets every six months to define courses of action and the policies to be implemented.
- RedCLARA interconnects the national advanced academic networks from Latin America (Table 2) among themselves and with networks in Europe (GÉANT2) via the link Sao Paulo (Brazil) and Madrid (Spain), the United States (Internet2) thanks to the WHREN-LILA project, Asia (APAN) and the rest of the world, providing scientists, academics and researchers in the region with an infrastructure that allows them to effectively collaborate with the global scientific community.
- RedCLARA offers IPv4, Multicast, IPv6 and IPv6 Multicast and broadband availability (QoS) services, and specialized services -such as Grids and others- for specific projects.
- With an unprecedented traffic capacity, RedCLARA is an ideal infrastructure for the growth of national research networks in the region and a unique platform for the development of regional and intercontinental collaborations. By encouraging regional cooperation, the promotion of scientific and technological development and the direct integration of the world's scientific communities, RedCLARA is fundamental for research and education in Latin America: it links twelve countries and 729 universities (more than 671.986 academics, 104.607 researchers and 3.763.142 students) throughout the continent, at speeds of up to 622 Mbps.

3.1.3.2 Grid Technologies

3.1.3.2.1 EELA Project:

Through the share of expertise and computing resources available in Europe (Italy, Portugal, and Spain), already integrated within the framework of EGEE) and Latin America (Argentina, Brazil, Chile, Cuba, Mexico, Peru and Venezuela), the "E-Infrastructure shared between Europe and Latin America" – EELA - project is creating a powerful research network developing an e-Infrastructure for e-Science applications.

Table 2: The Latin American NRENs connected to RedCLARA

NREN Name	Country	Mbps Connection
INNOVA|Red	Argentina	connected at 210 Mbps
RNP	Brazil	connected at 622 Mbps
REUNA	Chile	connected at 210 Mbps
RENATA	Colombia	connected at 130 Mbps
Red CONARE	Costa Rica	connected at 155 Mbps
CEDIA	Ecuador	connected at 45 Mbps
RAICES	El Salvador	connected at 10 Mbps
RAGIE	Guatemala	connected at 18 Mbps
CUDI	Mexico	connected at 45 Mbps
RedCyT	Panama	connected at 10 Mbps
RAAP	Peru	connected at 14 Mbps
RAU	Uruguay	connected at 132 Mbps
REACCIUN	Venezuela	connected at 90 Mbps

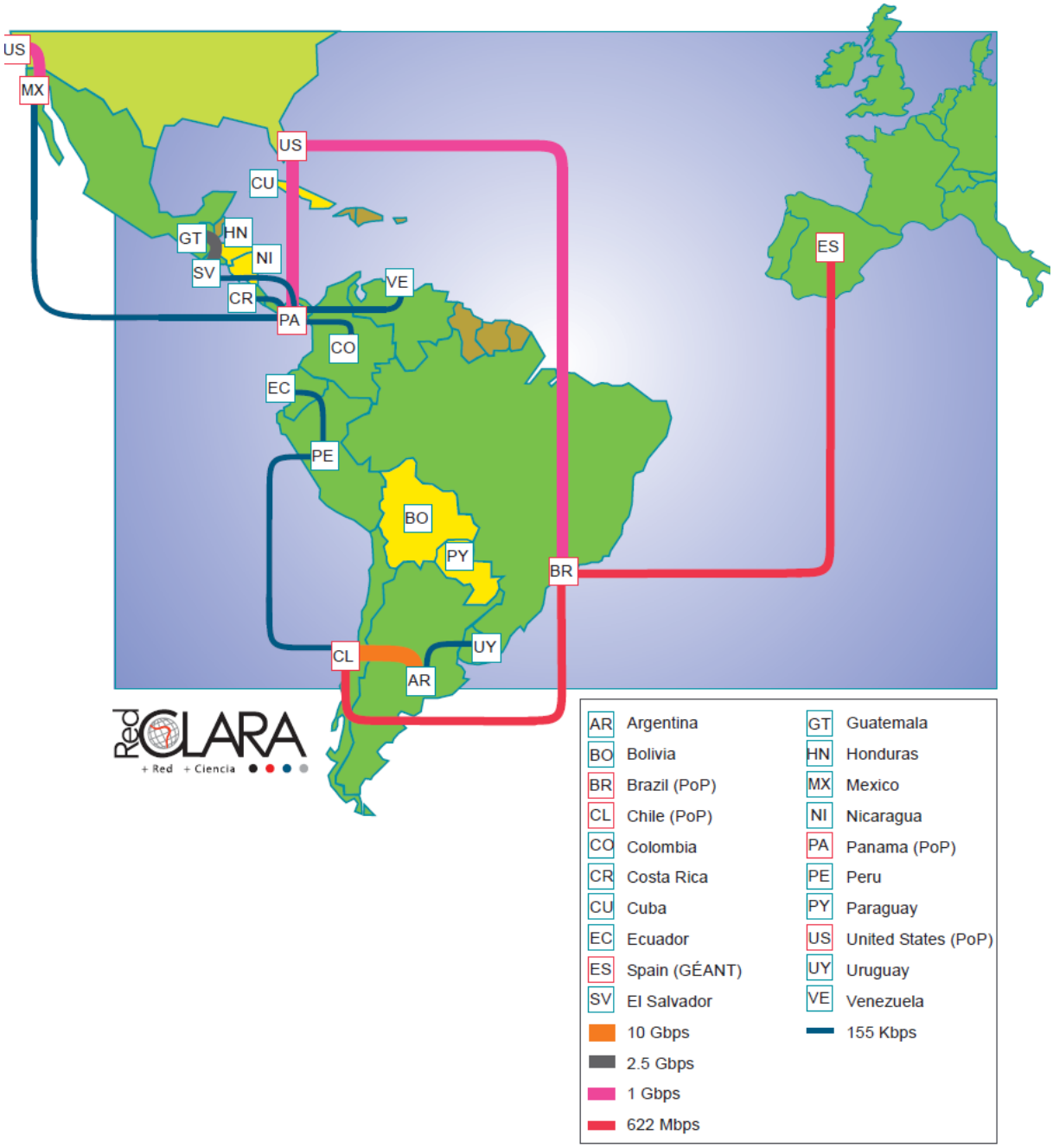

Figure 6: RedCLARA Topology and connected NRENs countries.

EELA (e-Science grid facility for Europe and Latin America), initiated on the 1st of January 2006 and coordinated by CIEMAT (Spain), is a 2-year project run by 21 institutions of Europe and Latin America under the 6th Framework Programme for Research, Technological Development and Demonstration (FP6) of the European Commission (EC).

EELA2 a second phase of this project has ended on March 31, 2010 and aimed at building a high capacity, production quality, scalable Grid to answer the needs of a wide spectrum of applications from European-Latin American scientific collaborations.

Its focus was on:

- Offering a complete set of versatile services fulfilling Applications requirements;
- Ensuring the long-term sustainability of the e-Infrastructure beyond the term of the project.

3.1.3.2.2 GISELA Project

The GISELA Project (Figure 7)(Grid Initiatives for e-Science virtual communities in Europe and Latin America) aims at:

- Implementing the Latin American Grid Initiative (LGI) sustainability model rooted on National Grid Initiatives (NGI) or Equivalent Domestic Grid Structures (EDGS), in association with CLARA, the Latin American NRENs and collaborating with the European Grid Initiative (EGI)
- Providing Virtual Research Communities (VRCs) with the e-Infrastructure and Application-related Services required to improve the effectiveness of their research.

The GISELA consortium has many things in common with EGI, including a mission to provide sustainable e-Infrastructure resources to its community of scientists and researchers.

GISELA has signed two Memoranda of Understanding (MoUs): one project MoU between GISELA and EGI-InSPIRE, and one infrastructure MoU between the Universidade Federal do Rio de Janeiro (on behalf of the GISELA partners) and EGI.eu. With these agreements GISELA becomes an EGI Infrastructure Provider.

Figure 7: GISELA Project, 19 partners from 15 countries in Europe and Latin America

3.1.3.3 Applications

Overall, 61 applications from 8 different scientific domains (Bioinformatics, Civil Protection, Computer Science and Mathematics, Earth Science, Engineering, Fusion, High Energy Physics, and Life Sciences) were supported by the EELA project during its lifetime.

Table 3: Applications deployed and interfaced with Grid Middleware

Application	Scientific Domain	Country
AeroVANT	Engineering	Argentina
BiG (Blast)	Bioinformatics/Genomics	Spain
bioNMF	Bioinformatics/Genomics	Spain
Dist-SOM-PORTRAIT	Bioinformatics/Genomics	Brazil
DistBlast	Bioinformatics/Genomics	Brazil
G-HMMER	Bioinformatics/Genomics	Colombia
G-InterProScan	Bioinformatics/Genomics	Colombia
GenecodisGrid	Bioinformatics/Genomics	Spain
GrEMBOSS	Bioinformatics/Genomics	Mexico
Grid Bio Portal	Bioinformatics/Genomics	Spain
META-Dock	Bioinformatics/Genomics	Mexico
CROSS-Fire	Civil Protection	Portugal
Aiuri	Computer Science and Mathematics	Brazil
Cinefilia	Computer Science and Mathematics	Italy / Brazil
gSATyrus	Computer Science and Mathematics	Brazil
PILP	Computer Science and Mathematics	Portugal
AERMOD	Earth Sciences	Cuba
BRAMS	Earth Sciences	Brazil
C/CATT-BRAMS	Earth Sciences	Chile / Brazil
CAM	Earth Sciences	Spain
CIS - Classification of Satellite Images with neural networks	Earth Sciences	Ecuador
gCSMT	Earth Sciences	France
SATCA	Earth Sciences	Mexico
Seismic Sensor	Earth Sciences	Mexico
SEMUM3D	Earth Sciences	France
WAM	Earth Sciences	Ireland
WRF	Earth Sciences	Spain
gRREEMM	Engineering	Cuba
Industry@Grid	Engineering	Brazil
LEMDistFE	Engineering	Mexico
MAVs-Study	Engineering	Argentina
Portal de Porticos	Engineering	Venezuela
PSAUPMP	Engineering	Mexico
DKEsG	Fusion	Spain
FAFNER2	Fusion	Spain
BioMD	Life Sciences	Brazil
DicomGrid	Life Sciences	Brazil
GAMOS	Life Sciences	Spain
GRIP - Grid Image Processing for Biomedical Diagnosis	Life Sciences	Chile
Heart Simulator	Life Sciences	Brazil
HeMoLab	Life Sciences	Brazil
Integra-EPI	Life Sciences	Brazil

InvCell	Life Sciences	Brazil
InvTissue	Life Sciences	Brazil
Phylogenetics	Life Sciences	Spain
PhyloGrid	Life Sciences	Spain
ProtozoaDB	Life Sciences	Brazil
CATIVIC	Life Sciences (Chemistry)	Venezuela
GROMACS	Life Sciences (Chemistry)	Brazil
DRI/Mammogrid	Life Sciences (e-Health)	Spain
eIMRT	Life Sciences (e-Health)	Spain
fMRI	Life Sciences (e-Health)	Portugal
CardioGrid	Portal Life Sciences	Argentina

3.1.4 Mediterranean and Middle East

3.1.4.1 Network infrastructure

3.1.4.1.1 EUMEDCONNECT

The EUMEDCONNECT project is a pioneering initiative to establish and operate an IP-based network in the Mediterranean region. Countries in the Mediterranean region able to benefit from the EUMEDCONNECT project are Algeria, Cyprus, Egypt, Israel, Jordan, Lebanon, Malta, Morocco, the Palestinian Authority, Syria, Tunisia and Turkey (Figure 8 & Table 4). The EUMEDCONNECT network serves the research and education communities of the Mediterranean region, is linked to the pan-European GÉANT2 network and is providing essential support to projects in the Mediterranean region, in particular in the fields of e-science and e-learning.

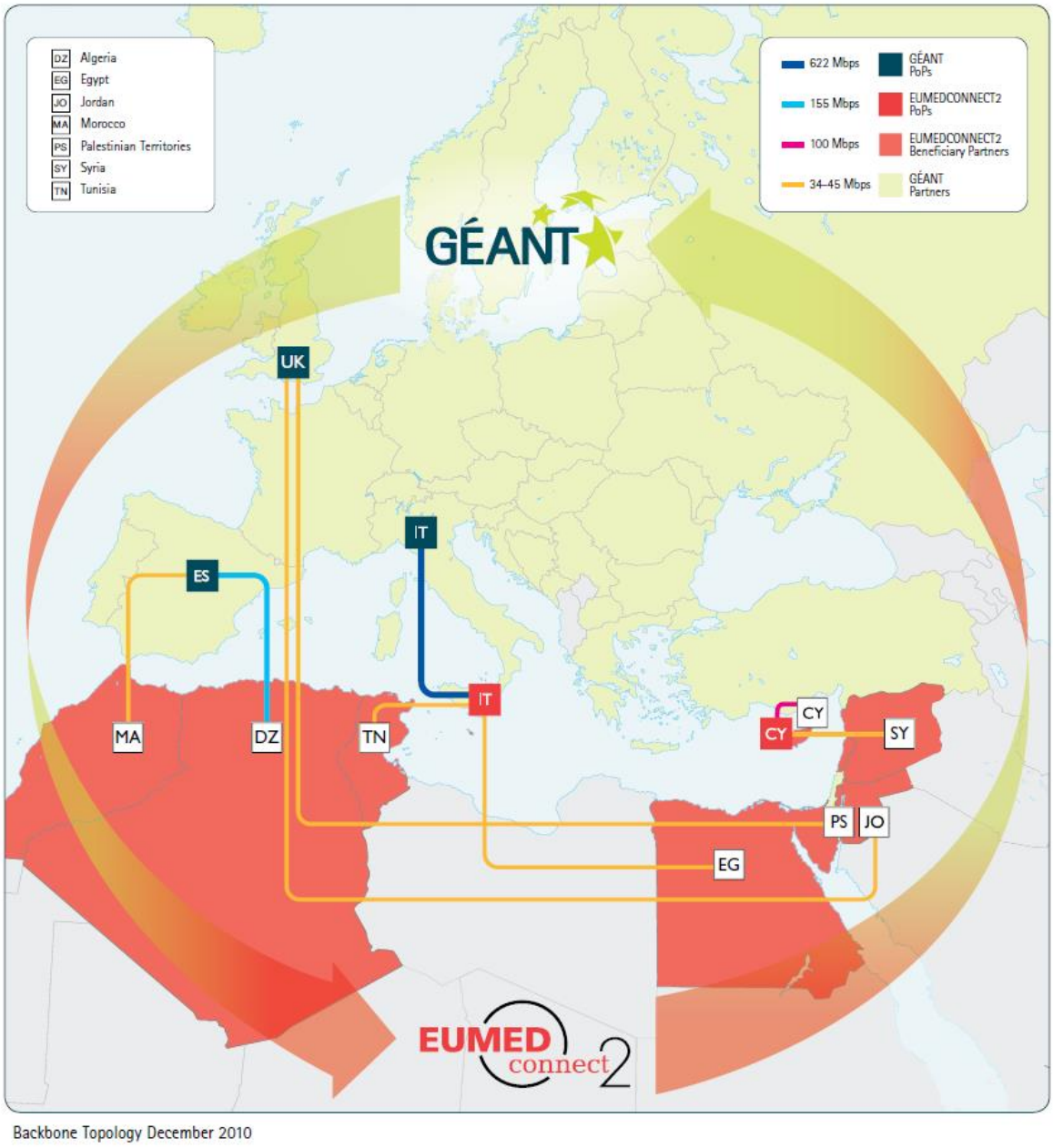

Figure 8: The research and Education Network for the Mediterranean

Table 4: Mediterranean NRENs connected to GEANT Network

Country	Name of NREN	International Research Connectivity (in Mbps)	Status
Algeria	CERIST	155	In service
Cyprus	CYNET	200	In service
Egypt	EUN	34	In service
Israel	IUCC	622	In service
Jordan	UniCo	45	In service
Malta	University of Malta	20	In service
Morocco	CNRST	155	In service
Palestinian Territories	Birzeit University/Al Quds Open University	45	In service
Syria	HIAST	8	In service
Tunisia	RFR	45	In service
Turkey	ULAKBIM	622	In service

EUMEDCONNECT has created the first regional data-communications network for the Mediterranean. The project officially ended in December 2007 but, thanks to the ongoing interest of the European Commission and the commitment of the project partners, a smooth transition to EUMEDCONNECT2 has been ensured. The importance of the network's seamless continuation was highlighted at a major EU-MED e-infrastructures event in Brussels in October 2007 and further endorsed at the Euro-Med ICT Ministerial Meeting held in Cairo in February 2008.

EUMEDCONNECT2 is a high-capacity IP-based data-communications network serving the research and education communities across the southern Mediterranean, enabling them to participate in collaborative projects.

Offering a direct link to GÉANT, its pan-European counterpart, EUMEDCONNECT2 allows approximately 2 million users in around 700 institutions across North Africa and the Middle East to collaborate with their peers at more than 4000 research and education establishments in Europe.

EUMEDCONNECT2 provides the Mediterranean with a gateway to global research collaboration.

3.1.4.1.2 ASREN

Arab States Research and Education Network (ASREN) is the association of the Arab region National Research and Education Networks (NRENs) and strategic partners, that aim to implement, manage and extend sustainable Pan-Arab e-Infrastructures dedicated for the Research and Education communities and to boost scientific research and cooperation in member countries through the provision of world-class e-Infrastructures and E-services.

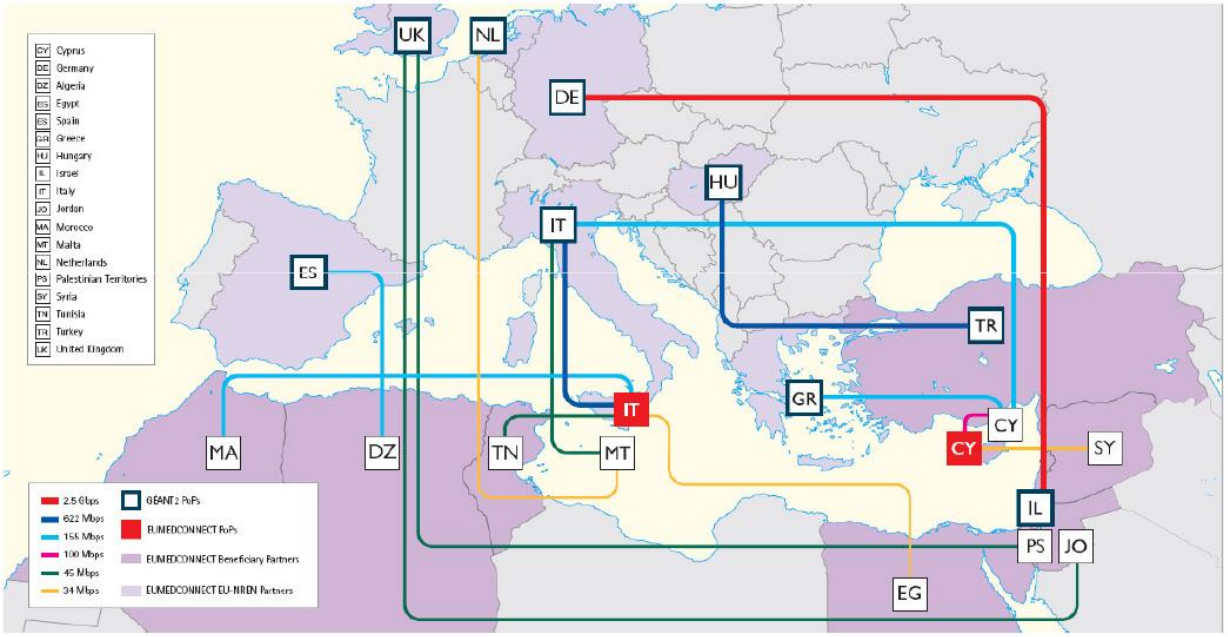

Figure 9: Status of e-Infrastructure – EUMEDCONNECT2

More and more MED/Arab R&E networks emerged in recent years: Algeria (ARN), Egypt (EUN/ENSTINET), Jordan (JUNET, Lebanon (NCSR), Morocco (MARWAN), Palestinian Terr. (PadI2), Qatar (Qatar FN), Syria (HIAST), Tunisia (MRST), U.A.E. (ANKABUT), Saudi Arabia (SREN- SRENKAUST) and a series of new cables in the region were laid (e.g. JADI), so become more economical to connect NRENs in the region and to the world.

"The ASREN initiative will connect our researchers and scholars allowing them to share knowledge and to collaborate. It is a unifying network for the Arab region, and I commend it."

Amre Moussa

Secretary General of the League of Arab States

3.1.4.2 Grid Technologies

3.1.4.2.1 EUMEGRID

The EUMEDGRID has run in parallel but in conjunction with EUMEDCONNECT project and has supported the development of a Grid infrastructure in the Mediterranean area.

The EUMEDGRID also promoted the porting of new applications on the Grid platform, thus allowing Mediterranean scientists to collaborate more closely with their European colleagues.

The EUMEDGRID has disseminated Grid awareness and competences across the Mediterranean and, in parallel, identified new research groups to be involved in the project, helping them to exploit Grids' enormous potential to improve their own research activities.

The EUMEDGRID-Support Science Gateway is a community-developed set of tools, applications, and data which is integrated via a portal that is further customized to meet the needs of a specific community. The strength of the Science Gateway is that it gives grid users the possibility to execute well-known scientific software exploiting a distributed computing environment whilst hiding complexities and technicalities which lie behind it.

EUMEDGRID-Support (2010-2012), kicked off on 1 January 2010, with its launch event held 25-28 January 2010 in Cairo, Egypt wants to build on the successful outcomes of EUMEDGRID (2006-2008) and spotlight Europe and the Mediterranean and Middle-east regions through an open dialogue aimed at increasing stakeholder and community awareness on the fundamental importance of e-Infrastructures with the ultimate goal of ensuring long-term sustainability.

EUMEDGRID-Support project participated in the process of building the ASREN - Arab States Research and Education Network - organization in conjunction with EUMEDCONNECT2 and GEANT2.

3.1.4.3 Applications

Several applications have been deployed on the EUMEDGRID (Table 5) infrastructure spanning different fields of interest: High Energy Physics, Biology and Biomedicine, Hydrology, Archaeology, Seismology and Volcanology. New communities and applications of regional interest were also discovered during the lifetime of the project by means of a survey based on a web questionnaire.

Table 5: Applications deployed on the EUMEDGRID e-infrastructure

Application	Country	Institute
ARCHAEOGRID	Italy	University of Florence
CODESA-3D	Italy – Tunisia	CRS4
GROGET	Morocco	Faculté des Sciences de Meknes
HERO	Egypt	Helwan University
HuM2S	Turkey	Bogazici Univerisy
JP2_GRID	Tunisia	ESSTT
MINSP	Syria	HIAST
PAREL ¨	Tunisia	ESSTT
SACATRIGA	Morocco	UAE/FST Laboratory of Radiation & Nuclear Systems
SimCommsys	Malta	University of Malta
Grid Taxation	Greece	University of Macedonia
McStas	Italy	University of Roma TRE
An evolutionary model with Turing machines	Italy	University of Roma TRE
ASTRA	Swiss/Italy	CERN, INFN, Conservatorio di Salerno

Research collaboration key areas are:

- Climate Change and global warming
- Environment and natural resource management
- Energy systems and smart grids
- Cloud computing
- Genome applications
- Multi-agent system modeling and simulation
- Educational content and repositories

3.1.5 South-East Europe

3.1.5.1 Network technologies

The SEEREN and SEEREN2 (SEEREN2, 2008) (South-East European Research and Education Networking initiatives) projects have established the SEE segment of the pan-European GÉANT network and successfully connected the research and scientific communities in the region. Most of the countries in the region are now part of GÉANT. Currently, the SEE-LIGHT project is working towards establishing a dark fibre backbone that will interconnect most national Research and Education networks in the region.

The dark fibre backbone is funded by Hellenic Plan for the Economic Reconstruction of the Balkans (HiPERB). The topology of available fibres at the study/analysis stage is show in Figure nnnn.

Figure 10: Topology map of the SEE-LIGHT network

The SEELight project tackles the materialization of the South-East European Lambda Network Facility for the regional research, academic and education communities. The network will enable to provide end-to-end network services to meet user demands, to serve as a testbed for development of new networks and services, and to allow the SEE research and education community to participate in international networking activities. The project has been accepted for funding within the Hellenic Plan for the Economic Reconstruction of the Balkans (HiPERB) framework. The construction works are anticipated to last for two years in each beneficiary country, while the network is expected to be provided for a period of 15 years.

3.1.5.2 Grid Technologies

3.1.5.2.1 SEE-GRID (SEE-GRID2)

The SEE-GRID project is focusing to the establishment of collaborative models for use of computing and data resources across various domains all over Europe and worldwide is currently being pursued through several e-infrastructure efforts. In this context, the SEE-GRID regional initiative has recently demonstrated that a geographically-independent, common-pool of computing resources can be of substantial scientific value to a widely distributed, less-resourced region like South-East Europe (SEE).

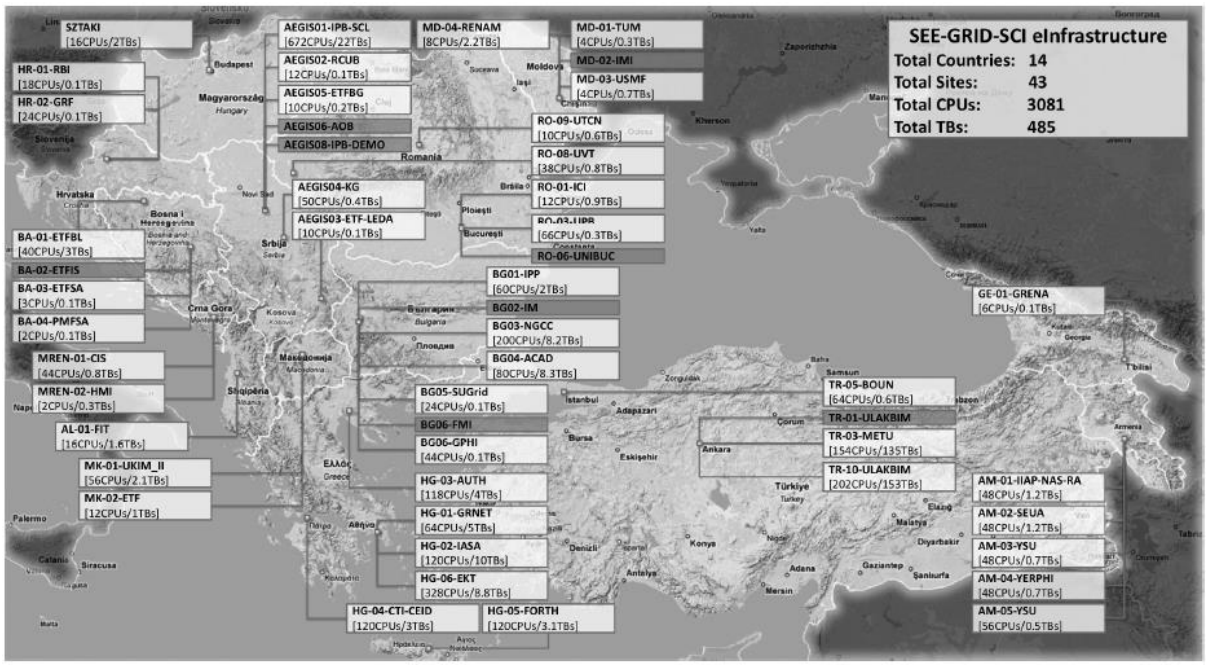

Figure 11: Map of the SEE-GRID-SCI infrastructure.

The SEE-GRID-SCI leverages the SEE e-Infrastructure to enable new scientific collaborations among user communities. It was a 2 year project, co-funded by the European Commission, and starting on 01/05/2008.

SEE-GRID-SCI stimulates widespread e-Infrastructure uptake by new user groups extending over the region, fostering collaboration and providing advanced capabilities to more researchers, with an emphasis on strategic groups in seismology, meteorology and environmental protection. The initiative thus aims to have a catalytic and structuring effect on target user communities that currently do not directly benefit from the available infrastructures. Current dedicated resources for these 3 major VOs are in the order of 2000 CPU cores and 300 TB of storage, spread over more than 40 Grid sites.

In parallel, it aims to enlarge the regional e-Infrastructure to cater for demands of the communities by increasing the computing and storage resources and involving new partner countries in the region.

Finally, SEE-GRID-SCI targets to help mature and stabilize the National Grid Initiatives in the region, allowing them to join the new era of longer-term sustainable Grid infrastructure in Europe.

In longer term, SEE-GRID-SCI aspires to contribute to the stabilization and development of South-East Europe, by easing the digital divide and stimulating e-Infrastructure development and adoption by new user communities, thus enabling collaborative high-quality research across target scientific fields.

3.1.5.3 Applications

Table 6: SEEGRID2 developed applications.

Acronym	Application Name	Scientific Field	Country
SALUTE	Stochastic ALgorithms for Ultra-fast Transport in sEmiconductors	Electronics	Bulgaria
CRYSTAL	Phase-Field Method for 2D Dendritic Growth	Metallurgy	Bulgaria
PBFS (iSGTW article)	Parallel Blood Flow Simulation	Medical Simulation	Serbia
PROPEL	Asteroid PRoper Elements	Astronomy	Serbia
PALESS	Parallel Analog and Logic Electronic Simulation System	Electronics	Serbia
SLEEP	Visual Interactive General Purpose Discrete Event Simulator	Electronics	Serbia
SDA	Kandilli Earthquake Seismic Data Server and Analysis	Earth Science	Turkey
GridAE	A Grid-based Framework for Artificial Evolution Applications	Computer Science	Turkey
G-PIP	Protein-protein Interaction Prediction Application	Bioinformatics	Turkey
GROW	Grid-aware Optimal Data Warehouse Design	Computer Science	FYR of Macedonia
PMT	Parallel Motion Tracker	Computer Science	FYR of Macedonia
GATE	GEANT4 Application for Tomographic Emission	Bioinformatics	Albania
CPFCGM	Calculation of Partial Fluxes with Combined Graph Method	Electrical	Albania
Solar	Solar-4.1	Astrophysics	Albania
OAAforDCPP	Optimal Assets Allocation for Defined Contribution Pension Plans	Business	Bosnia and Herzegovina
SoFAPPGrid	Solving Frequency Assignment Problem with Polarization on the Grid	Computer Science	Bosnia and Herzegovina
PFE for CBIR	Parallel Feature Extraction for Content Based Image Retrieval	Computer Science	Bosnia and Herzegovina
PARF	Parallel Random Forests	Computer Science	Croatia
VEPPAR	Visualisation, Parallel Processing and Rendering	Computer Science	Croatia
EMMIL	B2B E-Marketplace Models Integrated with Logistics	Business	Hungary
FEM2.5D	2.5 Dimensional Frequency Domain Electromagnetic Numerical Modeling	Geophysics	Hungary
Eilenberger	Self-consistent solution of microscopic equations of superconductivity	Physics	Montenegro
PRNNS	Patterns Restoration using Neural Networks Simulation	Computer Science	Moldova
EQUSIM	Earthquakes simulation	Earth Science	Romania
DIOGENES	Distributed Optimal GENEtic algorithm for Grid applications Scheduling	Computer Science	Romania
DRMR	Data Reduction using Multi-dimensional Regression	Aeronautics	Romania

The regional user communities from fields of meteorology, seismology and environmental protection are currently the ones most strongly supported in the current SEE-GRID-SCI project. The current support focus is on: Seismology VO, which has six applications ranging from Seismic Data Service to Earthquake Location Finding, from Numerical Modeling of Mantle Convection to Seismic Risk Assessment; Meteorology VO, with two comprehensive applications, following an innovative approach to weather forecasting.

3.1.6 Sub-Saharan Africa

Figure 12: Definition of Sub-Saharan Africa as used in the statistics of the UN institutions. However Sudan and South Sudan is classified as North Africa by UN.

3.1.6.1 Network Technologies

3.1.6.1.1 UbuntuNet

The UbuntuNet Alliance is non-profit continent-wide of National Research and Education Networks (NRENs) in Africa, primarily in East and Southern Africa. It was established in the latter half of 2005 by five established and emerging NRENs in the region and now has a total of thirteen NREN members. The Alliance aims to interconnect African NRENs (Table 7) to each other and connect them to other regional RENs and to the Internet at high speeds to enable researchers, educators and students collaborate effectively and participate in global research and education networking activities.

Table 7: UbuntuNet Alliance NRENs

Country	NREN
Democratic Republic of Congo (DRC)	Eb@le
Ethiopia	EthERNet
Kenya	KENET
Malawi	MAREN
Mozambique	MoRENet
Namibia	X-net
Rwanda	RwEdNet
Somalia	SomaliREN
South Africa	TENET
Sudan	SUIN
Tanzania	TERNET
Uganda	RENU
Zambia	ZAMREN

Formally, the UbuntuNet Alliance for Research and Education Networking is an Association of Representative Members, these being individuals who have been nominated by African NRENs that have been recognized as bona fide Participating RENs by the UbuntuNet Board. The Alliance, originally incorporated as a non-profit association in Amsterdam, The Netherlands, is now in the process of registering in Malawi, giving it a formal African base. The Alliance will also register in other African countries as and when operational considerations require this.

The UbuntuNet Alliance is driven by a vision of securing high bandwidth connections - gigabits instead of the historical kilobits per second – at affordable prices, that connect African National Research and Education Networks (NRENs) to each other, to other NRENs worldwide, and to the Internet generally.

UbuntuNet Alliance is a partner in the CHAIN[3] (EU FP7) and the CORENA[4] Project (funded by IDRC).

UbuntuNet Alliance posits communication, dissemination and outreach as important tools for its development as well as for the general understanding of academic networking in Africa.

3.1.6.1.2 AfricaConnect

The AfricaConnect project aims to establish a high-capacity Internet network for research and education in Southern and Eastern Africa to provide the region with a gateway to global research collaboration. AfricaConnect builds on the roadmap prepared by the Feasibility Study on the AfricaConnect Initiative (FEAST). The project will last four years and will consist of two phases, the first of which will be to plan and procure the network and is expected to last up to twelve months.

The AfricaConnect project is the collaboration (Table 8) between 15 project partners from Africa and 5 partner from Europe. DFN (Germany), GARR (Italy), FCCN (Portugal), HEAnet (Ireland) and SURFnet (Netherland):

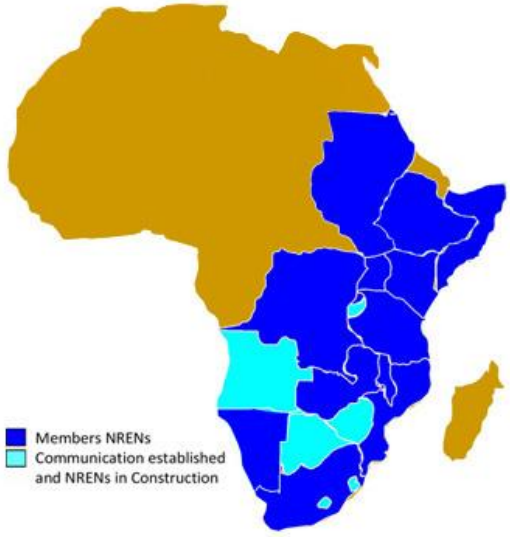

Figure 13: AfricaConnect geographic scope

Table 8: Collaboration partner AfricaConnect.

[3] The CHAIN project aims to coordinate and leverage recent efforts and results with a vision of a harmonized and optimized interaction model for e-Infrastructure and specifically Grid interfaces between Europe and the rest of the world. The project will elaborate a strategy and define the instruments in order to ensure coordination and interoperation of the European Grid Infrastructures with other external e-Infrastructures.

[4] Consolidating Research and Education Networking

NREN Logo	Country	NREN Name & Address
UbuntuNet Alliance	**Malawi**	**UbuntuNet Alliance** HB House, Block C, P.O. Box 2550, Lilongwe Malawi
	Ghana	**Association of African Universities** African Universities House Aviation Road Extension 11 Airport Residential Area P. O. Box AN 5744 Accra-North Accra, Ghana
WACREN	**Ghana**	**West and Central African Research and Education Network (WACREN)** 11 Aviation Road Extension, P O Box 5744, Accra, Ghana
eb@le	**DRC**	**Eb@le** C/O CEDESURK Avenue de la Democratie 44 Kinshasa-Gombe B.P. 14898, Kinshasa 1 Republique Democratique du Congo
EthERNet	**Ethiopia**	**Ethiopian Education and Research Network**
KENET	**Kenya**	**Kenya Education Network** University of Nairobi, The Jomo Kenyatta Memorial Library, P.O. Box 30244 00100, Nairobi, Kenya
MAREN	**Malawi**	**Malawi Research and Education Network** University of Malawi P.O. Box 278, Zomba, Malawi
morenet	**Mozambique**	**Mozambique Research and Education Network** Ministry of Science and Technology of Mozambique 770 Patrice Lumumba Avenue, Maputo, Mozambique.
Rwednet	**Rwanda**	**Rwanda Education & Research Network** c/o Kigali Institute of Science & Technology Avenue de l'Armee P.o.Box: 3900 Kigali, Rwanda

	Somalia	**Somali Research and Education Network** C/o Afralti Complex, Waiyaki Way Westlands, - P. O. Box 35572 -0100, Nairobi, Kenya
	Sudan	**Sudanese Universities Information Network** c/o University of Khartoum - P.O. Box 321/22, 11115, Khartoum, Sudan
	South Africa	**Tertiary Education and Research network of South Africa** House Vincent,Wynberg Mews, 10 Brodie Road,Wynberg 7800, South Africa.
	Tanzania	**Tanzania Education and Research Network** P.O. Box 95062, Dar es Salaam, Tanzania,
	Uganda	**Research and Education Network for Uganda** C/O Directorate for ICT Support Faculty of Computing and IT -Block A, Ground Floor Makerere Universit- P.O.Box 35009 Kampala, Uganda
XNet	**Namibia**	**Xnet Development Alliance Trust**
	Zambia	**Zambia Research and Education Network** Copperbelt University, Jambo Drive, Riverside,- P.O. Box 21692, Kitwe, Zambia

There is also investment in major new submarine cables (Figure 14) linking Sub-Saharan Africa to Europe and India. The first of these, the SEA Cable System built by SEACOM Ltd, was commissioned in July 2009, connecting Mtunzini (South Africa), Maputo (Mozambique), Dar es Salaam (Tanzania) and Mombasa (Kenya) to London.

The second cable to land was TEAMS, led by the government of Kenya and connecting Mombasa to Fujairah, also commissioned during 2009. The third was EASSy cable which landed in the second quarter of 2010. Other cables are being deployed. This rapidly evolving marine optical cable scenario is captured in Figure 1 (courtesy www.manypossibilities.net, a site developed and maintained by Steve Song, Research Fellow, Shuttleworth Foundation, and a Director of the Alliance). In this respect, Ubuntunet has been one of the stakeholders of the FEAST project (FEAST, 2010) (Feasibility Study for African – European Research and Education Network Interconnection) that, between December 2008 and December 2009, has studied the feasibility of connecting African NRENs to the GÉANT network and has documented the relevant issues in the region inhibiting these enabling technologies. In its final study (FEAST final report, 2010), FEAST has identified the opportunities available in Sub-Saharan Africa in terms of new intercontinental submarine cables with abundant capacity and emerging regional and national terrestrial fiber optic backbones.

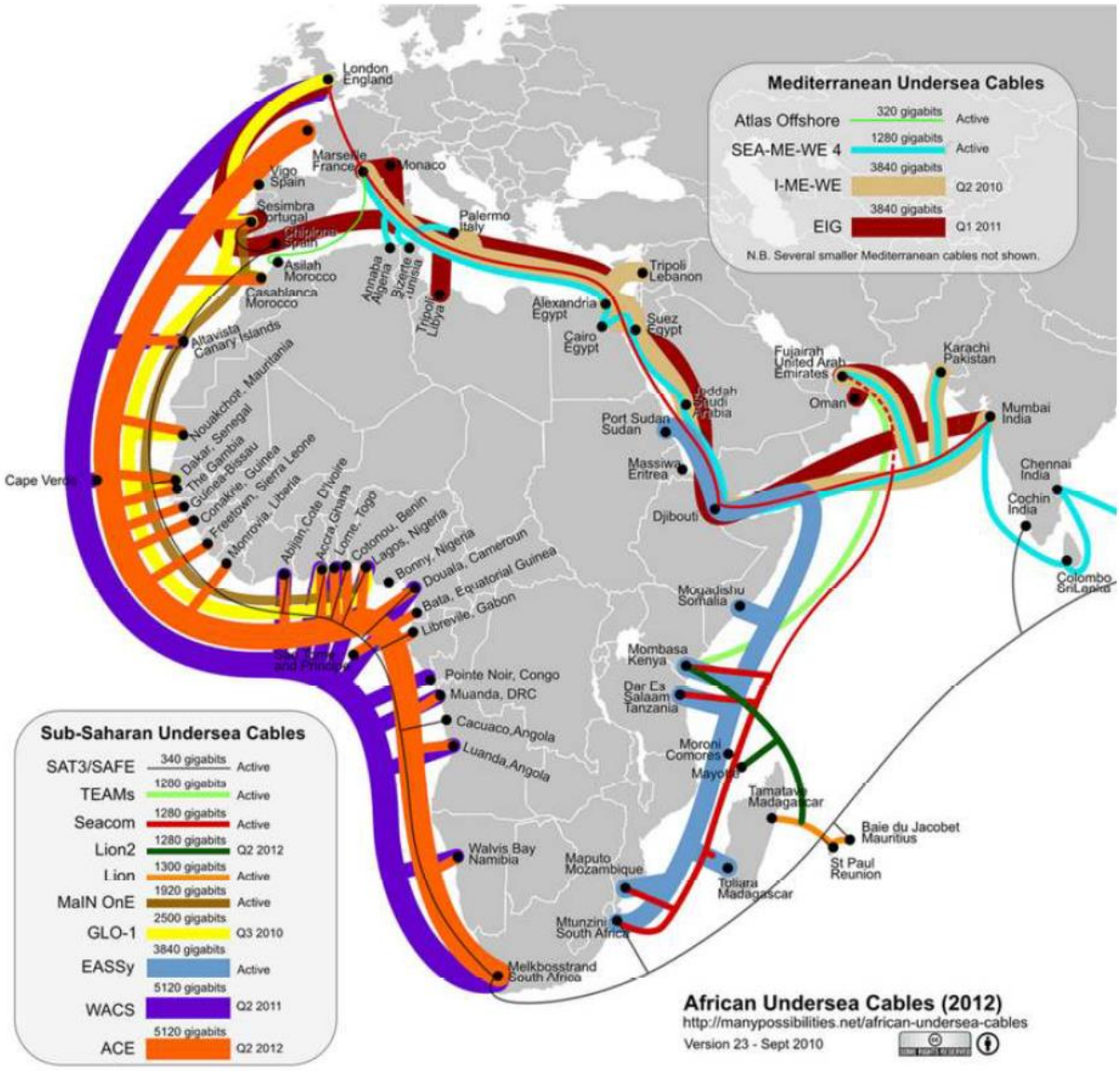

Figure 14: Undersea cable connections to the African continent

3.1.6.2 Grid Technologies

Apart of the dissemination activities of strategic projects, such as IST-Africa (IST-Africa, 2010), EuroAfrica-ICT (EuroAfrica-ICT, 2010), and eI-Africa (eI-Africa, 2010), co-funded by the European Commission in the context of its Sixth and Seventh Framework Programs, the Sub-Saharan region of Africa is involved more and more in distributed computing initiatives. The recent advent of affordable international bandwidth, the reform of national telecoms policies and the subsequent construction of high-bandwidth national research networks in the early part of the first decade of the century has created a positive effect on interest in deploying e-Infrastructures in the region. In particular the Southern African Large Telescope (SALT, 2010) and the Karoo Array Telescope (KAT, 2010) – were great stimuli of the interest in deploying networks and Grids in the region. Data sharing considerations were long a concern, too, for the South African participation to two experiments of the Large Hadron Collider. Two groups of research centers participate to the ALICE and ATLAS experiment at CERN in Switzerland, respectively, and the hub of medical and fundamental nuclear physics research undertaken at the iThemba Laboratories was one of the original drivers for experimenting with a national data and compute grid.

South Africa is the only country in the Sub-Saharan region with a dedicated activity to coordinate distributed computing, which started with two projects centrally funded by Department of Science and Technology. These were the national research and education network (SANREN, 2010) and the Centre for High-Performance Computing (CHPC, 2010), which was inaugurated in 2006. The plan for a high-speed network connecting the country's universities and national laboratories generated interest in the creation of a federated distributed computing infrastructure based on the grid paradigm. The creation of a Joint Research Unit in mid-2008 was the start of this project, which aimed to integrate existing computing clusters and storage distributed in the institutes into a national grid computing platform.

The South African National Grid (SAGRID, 2010) by the start of 2010 consisted of a federation of seven institutes taking part in Grid operations and belonging to the SAGrid JRU[5]:

- Meraka Institute (Cyberinfrastructure Programme, Pretoria);
- University of Cape Town , including the UCT-CERN Research Centre;
- University of the Free State (Bloemfontein);
- University of Pretoria (Pretoria);
- North-West University (Potchefstroom);
- University of Johannesburg (Johannesburg);
- University of the Witwatersrand (Johannesburg);
- iThemba Laboratory for the Accelerator-Based Sciences (Faure);

with open activities under way for further inclusion of other universities in the country.

The development of the national Grid was based in many ways on the experience acquired in Europe. The gLite (gLite, 2010) middleware stack was adopted as standard at all sites, ensuring that the infrastructure would be easily used by Virtual Organizations operating on the EGEE resources. Integration into operational tools such as the Global Grid User Support (GGUS), Grid Operations Database (GOCDB) and monitoring tools such as the Real Time Monitor (RTM) and GSTAT ensure that the operations in South Africa are performed in a compatible manner to that of the other international infrastructures.

Grid computing services and identity management are most often secured and managed with X.509-standard digital certificates issued from a trusted Certificate Authority. A major obstacle in the Sub-Saharan region was the lack of a CA accredited by IGTF. Since there is indeed no region of the IGTF responsible for Sub-Saharan Africa, the nearest Policy Management Authority (PMA) is that responsible for Europe and the Near East: EUGridPMA. A proposal to accredit a new CA for South Africa, the SAGrid CA (SAGrid CA, 2010), was accepted by EUGridPMA in 2009 and full accreditation is expected in early 2011. To avoid delays, the INFN CA (INFN CA, 2010) has assigned Registration Authorities in several South African institutes which are able to issue digital certificates for individuals and services locally.

The Grid infrastructure in South Africa makes of course use of the high-bandwidth SANReN network and aims to integrate the distributed computing resources attached to it providing their users with a powerful platform for collaboration and scientific research. This platform, due to its interoperability and operation as a single unit, can be considered as an extension of international infrastructures elsewhere, and access and usage of it is to a large degree location-independent. Coordinated training and development events both in South Africa and the broader region, undertaken in collaboration with the GILDA t-Infrastructure (Grid INFN Laboratory for Dissemination Activities) have expanded the base of competent site administrators and users, in concert with similar activities undertaken by the EUMEDGRID-Support project (see above). This foundation work is essential in developing the base of applications, technical experts and eventually (and most importantly) users in the region.

[5] SAGrid Joint Research Unit is a federation of institutes, research units, laboratories and other groups which provide computing resources to the users. Sharing resources in an ad-hoc way can lead to abuses and unfair usage, which is why a Joint Research Unit (JRU) has been formed as an expression to collaborate at a technical level and formalize the agreements necessary to share resources in a federated manner.

3.1.6.3 Applications

South Africa stands apart from the rest of the continent with a substantial research infrastructure, including e-Infrastructure. South African participation to the LHC experiments ALICE and ATLAS – both heavily dependent on Grid computing – since 2004 and 2009, respectively, has accelerated usage of distributed computing in the country. The EGEE Virtual Organizations BIOMED and e-NMR have also been enabled on the sites belonging to the SAGrid infrastructure, providing access to researchers in these domains to these applications, while contributing resources from South Africa.

Other domains, notably astronomy, biodiversity and bio-informatics, have also had a long interest in distributed data and computing activities in a Grid paradigm. The recent existence of the national Grid infrastructure described above has greatly accelerated these and with participation to projects such as EPIKH[6] (EPIKH, 2010) this usage is expanding to many other domains. The dedicated application porting schools run by South African and other partners in EPIKH have seen several new applications being ported to the grid, in research domains such as:

- Detector design and simulation;
- Gene sequencing;
- Molecular dynamics;
- Distributed data management for the Southern African Large Telescope;
- Computer science and genetic programming;
- Human language technologies.

Trans-national research and collaboration has traditionally not been very common in the region, resulting in exacerbating the so-called "digital divide" and "brain drain" effects. In recognition of this certain projects have been identified and funded to stimulate these kinds of e-Science activities which would make use of e-Infrastructure in the region. Two of these will be mentioned here: ERINA4Africa (ERINA4Africa, 2010) and the HP/UNESCO project "Piloting Solutions for Reversing Brain Drain into Brain Gain for Africa" (HP/UNESCO, 2009). ERINA4Africa (Exploiting Research Infrastructure PotentiAl for boosting research and innovation in Africa) is an project co-funded by the European Commission under the "Research Infrastructures" program to extend the lessons learned during the ERINA study (ERINA study, 2008)) in Europe, and provide African and European policy makers with an analysis of scenarios for exploiting e- Infrastructures. ERINA4Africa also makes use of the results of the FEAST project. These are applications and research activities identified as having a high chance of success given access to advanced e-Infrastructures, especially high-bandwidth networks and compute Grids. Examples of these, from the FEAST final study, are:

- Collection of DNA from malaria patients at the University College of Medicine in Blantyre, Malawi, to be analysed in collaboration with the University of Liverpool, UK;
- The High-Performance Liquid Chromatography (HPLC) laboratory at Makerere University (Uganda) and Muhimbili University of Health and Allied Sciences (MUHAS) in Dar-es-Salaam (Tanzania), in collaboration with the Karolinska Institute in Stockholm, Sweden.

[6] EPIKH: Exchange Programme to advance e-Infrastructure Know-How.

3.1.7 Asia Pacific

3.1.7.1 Network Technologies

3.1.7.1.1 TEIN3

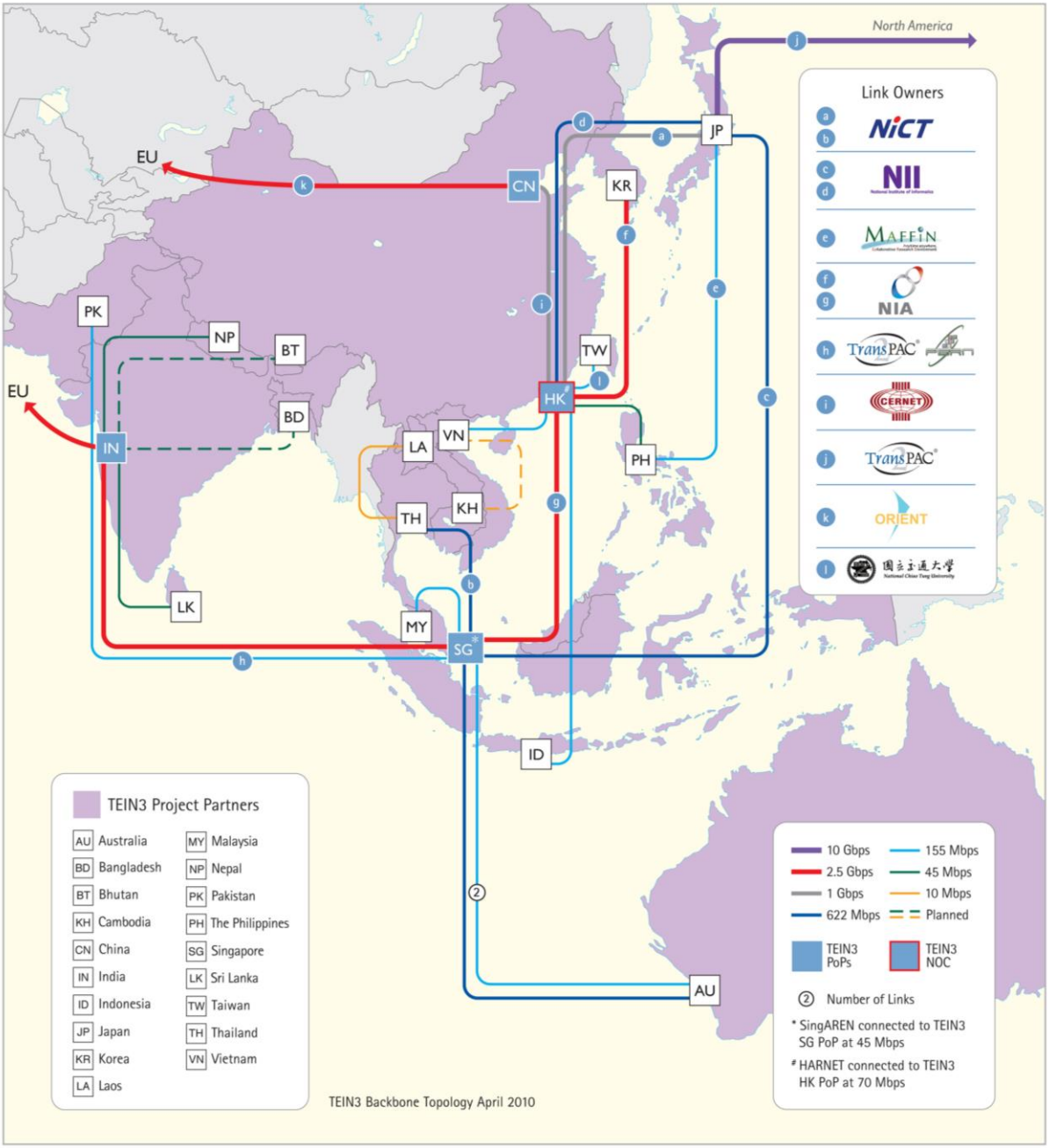

Figure 15: Topology of the TEIN3 Network

The third generation of the Trans-Eurasia Information Network (TEIN3) (Figure 15) provides a dedicated high-capacity Internet network for research and education communities across Asia-Pacific. TEIN3 already connects researchers and academics in China, India, Indonesia, Japan, Korea, Laos, Malaysia, Nepal, Pakistan, the Philippines, Singapore, Sri Lanka, Taiwan, Thailand, Vietnam and Australia. Bangladesh, Bhutan and Cambodia are in the process of getting connected, bringing the total number of partners involved in TEIN3 to 19.

With direct connectivity to Europe's GÉANT network, TEIN3 offers Asia-Pacific a gateway for global collaboration, enabling over 45 million users at more than 8000 research and academic centers to participate in joint projects with their peers in Europe and other parts of the world.

Building on the success of TEIN2, at the end of 2007 the European Commission announced a new financial package for the seamless continuation of the network beyond 2008. The EC is contributing €12m towards the cost of TEIN3. Further substantial funding and link capacity are provided by the Asian partners.

One of the central objectives of the TEIN3 project is to extend the TEIN network to the South Asian sub-region. To this end a feasibility study (SAFS) was undertaken in conjunction with the prospective South Asian partners in Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka.

The TEIN3 network circuit speeds up to 2.5 Gbps. The capacity of most links has been upgraded compared to the predecessor network to meet increased demand from the user community.

The Asia Pacific and European partners od TEIN3 are: Aarnet (Australia), BdREN (Bangladesh), CamRen (Cambodia), CERNET (China), HARNET – JUCC (Hong Knong), ERNET (India), INHERENT (Indonesia), JNG2plus (Japan), Net3 (Japan), Maffin (Japan), Koren (Korea), Lernet (Laos), Myren (Maylasa), NREN (Nepal), PERN (Pakistan), PREGINET (Phillipines, SingREN (Singapore), LEARN (Sri Lanka), ThaiREN (Thailand), TANET (Taiwan), VinaREN (Vietnam). The European partners are: Renater (France), SurfNET (Netherlands), Janet (UK).

3.1.7.1.2 APAN

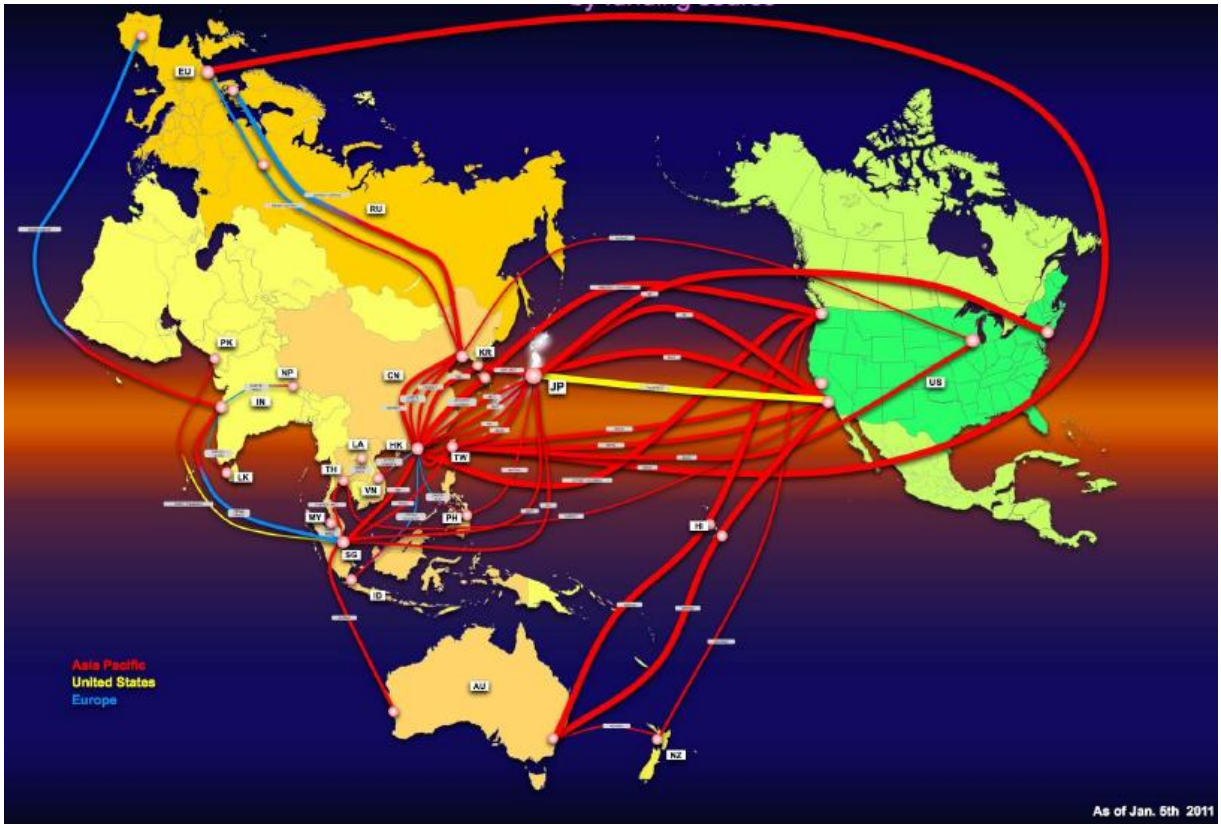

Figure 16: Asia-pacific backbone topology

The Asia Pacific Advanced Network (APAN) (Figure 16) refers to both the organization representing its members, and to the backbone network that connects the research and education networks of its member countries/economies to each other and to other research networks around the world.

International cooperation coordinated through APAN is beginning to address network weaknesses such as bottlenecks and network disruptions such as those caused by the typhoon Morak. In that case, ASGCnet (the Taiwanese Research and Education Network) provided TEIN and APAN with a backup route to Europe during the network outage affecting them.

The recent incorporation of APAN as a legal entity based in Hong Kong will further help to strengthen the organizational arrangements and structures at the policy level to improve network provision in the region. The APAN organization is based on the principle of national representation, with only one Primary Member from each country. Currently, there are 15 Primary Members forming a Council, the highest governing body of APAN. The governance structure of APAN follows the principles of subsidiarity as it allows individual members to operate largely under their own rules according to the policies and funding principles of their countries but benefitting from the international collaboration and coordination provided through APAN. This arrangement aims to overcome the significant differences in the socio-economic and political characteristics of countries in the region.

3.1.7.2 Grid Technologies

3.1.7.2.1 EUAsiaGrid

The EUAsiaGrid project contributes to the aims of the EU Research Infrastructures FP7 Programme to foster collaborative research across geographical, national and disciplinary boundaries by providing support for the development of an e-Infrastructure for research in the Asia-Pacific region. The main objective is to identify and engage scientific communities that can benefit from the use of a grid-based e-Infrastructure by improving or expanding their research efforts through collaborations and new modes of research enabled by state-of-the-art grid technologies. EUAsiaGrid is a support action comprising 17 partners from 12 countries. In the Asia-Pacific region, we have partners from Australia, Indonesia, Malaysia, the Philippines, Singapore, Taiwan, Thailand and Vietnam.

EUAsiaGrid promotes the use of grid technologies developed within Europe, in particular the gLite middleware and works towards a regional policy framework that will lead to the development of an e-Infrastructure in the Asia-Pacific region. The project provides support for scientific communities using grid applications by providing training and further dissemination of knowledge about grid application porting, deployment and usage – through events such as conferences and workshops. It also provides direct support to users and communities to help them integrate grid infrastructure use into their daily routine work. The project also gathers evidence about the adoption of grids and e-Research approaches in the partner countries and uses this for the definition of a technical roadmap and the policy framework

EUAsiaGrid helps to provide resources to meet the computing and storage needs of research communities in the Asia-Pacific region and establishes the infrastructure support that will enable them to collaborate effectively with colleagues in Europe and the wider world.

While a number of countries in the Asia-Pacific region have significant investments in e-Infrastructures for research, the level of funding is still very heterogeneous and only a few countries have National Grid Initiatives (NGIs) that provide the necessary coordination at the national level to leverage the capability of Grids to provide persistent and sustainable e-Infrastructures that can be taken for granted by researchers and that enable them to focus on their substantive research. Until recently, most Grid-related initiatives were based at individual institutions that sought to build up capacity to support specific research projects and application areas. As a consequence, many resource providers ended up trying to support installations with different middleware stacks, stretching their resources. Clearly, a coordinated approach to the development of a persistent and sustainable e-Infrastructure would not only maximize the return on investment by enabling a wider range of researchers to benefit from the resources but would also help resource providers cope with the heterogeneity and continuous evolution of grid technologies.

Through the coordination and support provided by EUAsiaGrid, much needed local capacity has been developed, both in terms of resources available as part of the world-wide EGEE infrastructure and in

terms of the supporting human infrastructure that is needed to carry on their ongoing operation and effective exploitation by researchers. To minimize barriers to access the Grid infrastructure, the EUAsiaGrid project also created and maintained a catch-all, application neutral, Virtual Organisation called EUAsia. Furthermore, several Certification Authorities (CAs) approved by the International Grid Trust Federation (IGTF, 2010) already operate in the region, with the Academia Sinica Grid Computing one (ASGCCA, 2010) serving as a catch-all CA and taking care of users of those countries that do not yet have their national CA. Any researcher from the region interested in trying the Grid for his/her research can get a certificate through a nearby Registration Authority and immediately subscribe to the EUAsia VO. Although application neutral, nodes serving this VO have installed many application packages to be easily available. Also, each partner has set up a user interface to provide local access to the Grid.

The EUAsiaGrid project has ended in June 2010 but the EUAsiaGrid Consortium has agreed to keep open, on a best effort basis, the existing infrastructure and a Memorandum of Understanding is being approved and signed by the following partners:

- Academia Sinica, Taipei, Taiwan;
- Advanced Science and Technology Institute, Quezon Cirty, Phylippines;
- CESNET, Czech Republic;
- Hydro and Agro-Informatics Institute, Bangkok, Thailand;
- Institut de la Francophonie pour l'Informatique, Hanoi, Vietnam;
- Istituto Nazionale di Fisica Nucleare, Italy;
- Institut Teknologi Bandung, Bandung, Indonesia;
- National University of Singapore, Singapore;
- Universiti Putra Malaysia, Selangor, Malaysia.

3.1.7.3 Applications

During the EUAsiGrid project a high number of application-related activities has been started and followed up. Some specific activities requiring a collaborative approach were performed in a form of dedicated "data challenges" within the domains of earthquake mitigation, biomedical studies of dengue fever and social science simulations.

3.1.7.3.1 Application areas:

Bioinformatics and Biomedical Research

- Institut de la Francophonie pour l'Informatique (IFI), Vietnam
  - Pandemic diseases analysis
- Institute of Natural Products Chemistry (INPC), Vietnam
  - Virtual screening for drugs from Vietnamese natural product source
- Institute of Applied Mechanics and Informatics (IAMI)
  - Retinopathy and glaucoma studies
  - GVSS (GAP Virtual Screening Service) Application, related to Dengue fever caused by dengue virus
- Academia Sinica Grid Computing (ASGC), Taiwan
  - Virtual screening for neglected and emerging diseases such as Avian Flu and Dengue Fever
- MIMOS Berhad (MIMOS), Malaysia
- Ateneo de Manila University (AdMU), Philipines
  - In silico screening for anti-dengue drug discovery using Grid Application Platform (GAP)
- National University of Singapore (NUS), Singapore
  - Grid Computing Solutions for Life Science Applications

Computational Chemistry

- National Electronics and Computing Technology Center (NECTEC), Thailand
- Academia Sinica Grid Computing (ASGC), Taiwan

Disaster Mitigation

- Advanced Science and Technology Institute (ASTI), Philippines
    - SPECFEM3D Globe: simulates three-dimensional global and regional seismic wave propagation based upon the spectral-element method (SEM).
- Ateneo de Manila University (AdMU)
- Academia Sinica Grid Computing (ASGC), Taiwan
    - Earthquake Mitigation
    - Carbon Flux

Weather Forecast and Climatology

- Hydro and Agro Informatics Institute (HAII), Thailand
    - Grid for water security: reduce risks or damage from water related disasters.
    - Weather research forecast for Grid (WRF4G)
- Institute Teknologi Bandung (ITB), Indonesia
    - Grid-enabled and improved weather forecast

Trade Modeling and Poverty Alleviation

- Ateneo de Manila University (AdMU), Philippines

Engineering Physics

- Institute Teknologi Bandung (ITB), Indonesia
    - Dynamic operability studies

Digital Culture

- University Putra Malaysia (UPM), Malaysi

Social Science

- Academia Sinica Grid Computing (ASGC)

3.1.7.3.2 EUChinaGrid

EUChinaGrid is an initiative to extend the European GRID infrastructure for e-Science to China. The first aim of EUChinaGRID will be to facilitate scientific data transfer and processing in a first sample of application areas that have already strong collaborations between Europe and China. These pilot applications will immediately profit of the new infrastructure, and will be subsequently regarded as the driving force to test and deploy an effective grid infrastructure between Europe and China.

China has developed both grid middleware and nation-wide e-Infrastructures. The most relevant are:

- CNGrid, the China National Grid Project, is supported by the "High Performance Computer and its Kernel Software" project which, in turn, is a key project belonging to the National High-Tech R&D Program. The CNGrid is a test bed for the new generation of information infrastructure by integrating high performance computing and process transaction capacity. It efficiently supports various applications including scientific research, resource and environment research, advanced manufacturing and information service by sharing resources, collaborating and service mechanism. It also propels the progress of national e-Infrastructure and related industry through technology innovation. It is based on a middleware developed in China named GOS (Wang, 2010);
- ChinaGrid, the China Education and Research Grid, is an important project funded by Chinese Ministry of Education and aims at constructing a public service system. It is also supported by the National High Technology Research and Development Program of China

in the context of the “863 Program”. The goal of ChinaGrid is to integrate heterogeneous mass resources distributed in the China Education and Research Network (CERNET), share those resources in the CERNET environment effectively, avoiding the “resource islands”, provide useful services, and finally form the public platform for research and education in China;

- CROWN Grid is a test-bed to facilitate scientific activities in different disciplines, based on the Globus Toolkit middleware. It was formerly developed at the Beihang University and then became matter of cooperation between UK and China.

3.1.7.3.3 EUIndiaGrid

The Eu-IndiaGrid project is coordinated by INFN (the Italian National Institute of Nuclear Physics) and sees the participation of several premier research institutes in Europe and India:

- Abdus Salam International Centre for Theoretical Physics, ICTP, Italy
- Bhabha Atomic Research Centre, India
- Cambridge University, United Kingdom
- Centre for Development of Advanced Computing, C-DAC, India
- Consortium GARR , The Italian Academic and Research Network, Italy
- Education and Research Network, ERNET, India
- Metaware SpA, Italy
- SAHA Institute of Nuclear Physics, Kolkata, India
- Tata Institute of Fundamental Research, Mumbai and National Centre for Biological Sciences, India
- University of Pune, India
- Variable Energy Cyclotron Centre, VECC, Kolkata, India

The kick-off of the EU-IndiaGrid project, in 2006, happened in coincidence with the announcement of the connection, for the first time, of GÉANT2 and ERNET, the Indian Education Research Network. ERNET is also among the EU-IndiaGrid project partners and within the project has given a significant contribution to connectivity development through its role of Nationwide Academic and Research Network.

Since its kick-off, EU-IndiaGrid has helped to create the conditions for access to a common grid infrastructure for European and Indian researchers. European and Indian universities, academic and research institutes are now able to collaborate on a global level. By supporting collaborative research between the two regions, researchers are able to join forces in the field of High Energy Physics with organisations such as CERN, in addition to Atmospheric & Earth Sciences, Biology and material Science, the four main application areas of EU-IndiaGrid.

Within the context of Euro-India high-level collaboration in research we select here a few case studies as examples of successful applications of grid computing. These Euro-Indian teams have been using the Eu-India grid infrastructure from the very beginning of the project as pilot user communities.

They are now able to fully exploit the power of the EU-IndiaGrid infrastructure and increase in this way their scientific achievements in the area of High Energy Physics, Material Science, Biology.

and Earth and Atmospheric Science. The figures below provide a glimpse of which kind of science is now under investigation on the EU-IndiaGrid infrastructure.

The valuable work performed so far within the EU-IndiaGrid Application workpackage activity has helped scientists coming from other different scientific domains to embrace the grid paradigm for

research activities, changing the way research is made and enabling them to address new computational challenges that would be unreachable without an e- infrastructure. This is indeed the case of a large financial analysis recently performed on the infrastructure by a research group in Athens in collaboration with ICTP. This analysis requires to generate and then analise a huge amount of data (order of ten terabyte of data produced by a few thousands of jobs). Such large computational requirements cannot be satisfied by the institutions involved: they just require an e-infrastructure.

In order to highlight the benefits introduced by the grid paradigm and use the established e-Infrastructure as a dissemination tool, we can report on the success of the Bemuse case study application developed within the EU-IndiaGrid infrastructure. BEMusE, or the Bias-Exchange Metadynamics Submission Environment, is a grid-enabled tool able to fold a 36-residue protein in less than a year of single CPU time: a vast improvement on the hundreds or thousands of CPU years required by other grid-based techniques. Bedazzling researchers with its accuracy and speed, BEMusE captured the poster prize at December's eScience 2007 conference. BEMusE evolved from the Bias-Exchange Metadynamics algorithm, developed by Alessandro Laio and Stefano Piana, which folds proteins with increased accuracy.

The EU-India Grid team immediately realized how much the algorithm would benefit from the grid. A joint working group was then formed both by EU-IndiaGrid research and the scientific team behind the BEM algorithm in order to exploit it on the grid. The porting activity of the BEM algorithm from an HPC platform to the EU-IndiaGrid infrastructure was concluded a few months ago and the results have been extremely promising. The simulations, run on the grid, were able to explore protein conformations at a speed comparable to simulations run on HPC resources using MPI. In the original MPI implementation, all CPUs start at the same time and have the same hardware and similar input files. With the EU-IndiaGrid grid-enabled approach, exchanges are still synchronous, but the CPUs arrive at different times, have different speeds and may be mixed with others that ran for very different intervals: this however seems to enhance the overall performance of the phase exploration in the system. Presently a number of large simulations involving large biological systems of medical importance are under investigation.

3.1.7.3.4 NAREGUI

Center for Grid Research and Development in National Institute of Informatics seeks to advance research and development of grid middleware, grid operation technique and applications. The goal of the activities is to establish an academic information infrastructure for cutting-edge research, such as e-Science, and educational activities.

NAREGI makes fundamental building blocks in the Cyber Science Infrastructure (CSI), and its goal is to provide a large-scale computing environment for widely-distributed, advanced research and education (the Science Grid). NAREGI, the National Research Grid Initiative, was created in 2003 by the Ministry of Education, Culture, Sports, Science and Technology (MEXT). From 2006 through 2007, the research and the development were continued under the "Science Grid NAREGI" Program of the "Development and Application of Advanced High-performance Supercomputer project" being promoted by MEXT. The NAREGI Grid Middleware Ver. 1.0 was released in 2008. NII endeavors to build the Grid infrastructure by continuing software maintenance and user support services.

4 The impact when deployment e-infrastructures

e-Infrastructures include services as diverse as the physical supply of backbone connectivity, single- or multiple- purpose grids, supercomputer infrastructure, data grids and repositories, tools for visualization, simulation, data management, storage, analysis and collection, tools for support in relation to methods os analysis, as well as remote access to research instruments and very large research facilities.

The impact of e-infrastructures on virtual research communities are affected by:

- The regulation and governance of e-infrastructures,
- The integration or separation of e-infrastructures at national and disciplinary levels,
- Different organizational and business models,
- Considerations of research communities needs and practices in the services provides by e-infrastructures.

In the deployment and use of e-infrastructures is expecting a number of inhibitors. At the early stage, cultural differences between developers and end-users may occur. For example developers may aim to work on leading-edge technologies, in contrast to the basic and specific services that user needs. There is also a negative attitude among some users towards computer-enhances research environments, with a reluctance to spend the time and resources currently required to learn to use the new technology.

e-infrastructures my accommodate cultural differences between developers and users but by improving communication channels, such as through conducting routine meetings and telephone conferences, could help establishing a common ground.

5 Strategy

6 Results Framework

7 Management Arrangements

The project will be governed by:

Steering Committee: meeting at least once a year. The Steering Committee will:

(a) Approve the annual action plan as proposed by the Project Manager;

(b) Approve all substantial changes to the annual action plan;

(c) Evaluate and approve periodic (annual) and terminal progress reports established by the Project Manager;

(d) Provide advice and directives concerning the progress of the project.

The Steering Committee will consist of:

- Director of the SU/TCDC
- Director of the Telecommunication Development Bureau (BDT), ITU
- Chief, Business Development Unit, ITU/BDT
- ITU Project Coordinator
- Representative of the UN ICT Task Force
- Representative of the UNDP Bureau for Development Policy
- Policy Adviser, SU/TCDC

All decisions of the Steering Committee will be taken by consensus.

7.1 Project Manager.

7.2 Project Team.

7.3 Accounting

7.4 Monitoring and Evaluation

8 Sustainability

9 Risks

The major risk is that in-country activities may suffer delays due to unforeseen local events and circumstances. This risk will be minimized by closely involving the UNDP and ITU field offices from the onset when the participating countries are confirmed. The availability of scarce expertise at the local level may also delay project activities. This risk will be reduced by judicial choice of collaborating partners from other developing regions that would assist in training selected local experts.

10 Legal Context

(a) Under no circumstances shall the ITU enter into any commitment regarding implementation of the Project before the ITU Telecom Surplus Steering Committee approve the ITU contribution of US$ 1’200’000 to the Project.

(b) Procurement of any goods, works or services in the framework of this Project shall be carried out by the ITU in accordance with its relevant rules and procedures.

(c) Creation of African Coordinating Center (as described under Phase Two of the Project) will be initiated only upon signature of an agreement relating to establishment and status of the African Coordinating Center. The signatories of this agreement will be UNDP SU/TCDC, ITU and the Government of identified host country.

(d) All activities stipulated in the Project Document shall be implemented as stated. However, should there be a need to make changes or modifications to any of the agreed activities determined by the parties concerned, all signatories to the Project Document must concur before such changes are made.

11 Budget

12 Glossary

CBRAIN:	e-Infrastructure located at McGill, Montreal, Canada, and related to neuGRID. It targets computational imaging scientists and offers access to computational grid-based resources for exchange and distributed processing of 3D/4D brain imaging data. (http://cbrain.mcgill.ca)
EGI:	European Grid Infrastructure
e-Infrastructure:	is the term used in ICT that include Connectivity, Grid computing, Supercomputing, Scientific Data, Global virtual Research Communities, Standards, and can include supporting operation centers, service registries, single sign-on, certificate authorities, training and help-desk services. Most importantly, it is the integration of these that defines e-infrastructure.
FP7 neuGRID for you:	denotes the currently ongoing second development wave, kicked off in July 2011 and due to run until December 2014. NB: "neuGRID4you" denotes the infrastructure, "FP7 neuGRID4you" the project.
FP7 neuGRID:	denotes the first development wave, run between 2008 and 2010. NB: "neuGRID" denotes the infrastructure, "FP7 neuGRID" the project.
FP7 outGRID:	support action aimed to kickstart interoperability of neuGRID with related North American e-Infrastructures.
GÉANT:	The GÉANT network provides a range of services, not yet commercially available (currents speeds ranging from 40 to 100 gigabit/s), to scientists across borders on a permanent basis.
GLOBIOS:	a global, user-friendly and easily accessible online platform based on Grid/Cloud/HPC computing offering transparent access to large brain image datasets, image data mining and imaging analysis applications, computational power, training and help. GLOBIOS will have a core made of EU neuGRID, US LONI, and Canadian CBRAIN, and fully compatible nodes in other countries/continents. NB: "GLOBIOS" denotes the infrastructure, "FP7 GLOBIOS" the project.
HPC:	High Performance Computing
ITU-D:	International Telecommunication Unit – Development Sector
ITU-T:	International Telecommunication Unit – Standardization Sector
LONI:	Laboratory of Neuro Imaging, e-Infrastructure located at UCLA, Los Angeles, US, and related to neuGRID. It targets neuroscientists working in the field of Alzheimer's disease and offering access to large brain image datasets and algorithm pipelines. (http://www.LONI.ucla.edu)

neuGRID:	A grid-based e-infrastructure for data archiving/ communication and computationally intensive applications in the medical sciences. The aim of this project is to deploy e-infrastructures to enable European neurosciences community to carry out research required for the pressing study of degenerative brain diseases to build a new user-friendly grid-based research e-infrastructure where the collection/archiving of large amounts of imaging data is paired with computationally intensive data analysis.
NGI:	National Grid Initiatives or Infrastructures (NGIs) are organizations set up by individual countries to coordinate the computing and storage resources that they provide to the European e-Infrastructure (EGI) to meet the needs of their local user communities to collaborate internationally. NGIs are EGI's main stakeholders, together with CERN and EMBL (two European Intergovernmental Research Organizations or EIROs). Each NGI contributes a number of sites to the grid infrastructure. NGIs are responsible for the maintenance and running of the sites they operate.
PRACE:	Partnership for Advanced Computing in Europe (www.prace-project.eu)
The outGRID vision:	deploying and delivering GLOBIOS.
Type 1 countries:	where e-Infrastructures with aim similar to that of neuGRID are already in place. This is the case of the US and Canada, where LONI is operational at UCLA and CBRAIN at McGill. Here, specific solutions have been developed and the challenge is to develop interoperability with neuGRID.
Type 2 countries:	where e-Infrastructures with aim similar to that of neuGRID are not in place, but generic infrastructures exist (such as high bandwidth networks, high performance computing centres, or traditional imaging laboratories) that can be capitalized on to develop neuGRID nodes or neuGRID-interoperable infrastructures. Here, specific technical solutions are lacking, those developed in the context of FP7 neuGRID and FP7 neuGRID4you can be exported "in solido", and interoperability with neuGRID will be straightforward. This is the case of India and China.
Type 3 countries:	where the basic generic infrastructures are lacking. Typically, these countries are devoid of high bandwidth networks, high performance computing centres, and traditional imaging laboratories. These are generally – but not necessarily – low income countries. Here, deploying neuGRID nodes or neuGRID-interoperable infrastructures is unrealistic; professional can at best be educated on the potential of and to use e-Infrastructures developed elsewhere.
WHO:	World Health Organization
EGI-InSPIRE Project	Integrated Sustainable Pan-European Infrastructure for Researchers in Europe.
FP7	

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14 Annex 1: GLOBIOS PROPOSAL

Proposal full title:

DESIGNING A GLOBAL E-INFRASTRUCTURE FOR COMPUTATIONAL BIOMEDICINE

Proposal acronym:

GLOBIOS

Type of funding scheme:

Coordination and support actions (supporting)

Work programme topic addressed:

INFRA-2012-3.3: Coordination actions, conferences and studies supporting policy development, including international cooperation, for e-infrastructures

Name of the coordinating person

Giovanni B. Frisoni

List of participants:

Participant no.	Participant organisation name	Participant Short name	Country
CO1 Coordinator	Provincia Lombardo Veneta Ordine Ospedaliero di San Giovanni di Dio Fatebenefratelli	FBF	Italy
P2	MAAT France	maatG	France
P3	Stichting European Grid Initiative	EGI.eu	The Netherlands
P4	Juelich Supercomputing Centre	JUELICH	Germany
P5	Consortium GARR	GARR	Italy
P6	International Telecommunication Union	ITU	N/A (UN Agency)
P7	World Health Organization	WHO	N/A (UN Agency)
P8	The Regents of the University of California	UCLA	United States of America
P9	Royal Institution for the Advancement of Learning McGill University	MNI	Canada
P10	Johns Hopkins Medical Institutions	JHU	United States of America