Project Title: Pan-American Telemedicine Network (PATN)

Estimated Start Date:

Estimated End Date:

Government Coop. Agencies:

Implementing Agency: Energy Life Sarl, ITU & HUG

Beneficiary Countries: Latin-America

ITU Project Manager:

SUMMARY OF CONTRIBUTIONS

A) Project Budget

Description	**USD**
Phase I	3,102,000
Phase II	2,662,000
Total:	**5,764,000**

Brief Description:

The project will establish Telemedicine centers/nodes in Latin American countries[1] equipped with medical and video conferencing equipment, real-time management of medical records, satellite or broadband connection and adapted telemedicine software systems in specialty/reference centers and primary health centers to enable continuous medical education and tele-consultation. The project is comprised of two phases – (i) Creation of national telemedicine networks; and (ii) Linking Pan American Telemedicine Network to a Grid enabled environment.

For the	**Signature**	**Date**	**Name/Title**
ITU:	______________	___/___/_____	Mr Brahima Sanou, Director of BDT
Partner:	______________	___/___/_____	

[1] The project will focus on the following countries: Bolivia, Colombia, Ecuador, Peru and Venezuela.

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1 Background & Context

Telemedicine tools enable the communication and sharing of medical information in electronic form thus facilitating access to remote expertise. A physician located far from a reference center can consult colleagues remotely in order to resolve a difficult case, follow a continuous education course over the Internet, or access medical information from digital libraries or knowledge bases. These same tools can also be used to facilitate exchanges between centers of medical expertise and health institutions within countries and across borders[2].

Telemedicine has evolved to become an important field of medicine and healthcare overall, involving everything from simple patient care to actual performance of operations at a distance, tele-monitoring, tele-proctoring, and other significant educational activities[3].

The continuing education of healthcare professionals and access to specialized advice are keys to improve the quality, efficiency and accessibility of health system. In developing countries, these activities are generally limited to the capitals, and delocalized professionals do not have access to such opportunities, or even to didactic material adapted to their needs. This limits the interest of such professionals to remain active in the periphery, where they are most needed to implement effective prevention strategies and frontline healthcare.

The Pan-American Latin-American Network (PATN) project is designed to address these needs and is comprised of two phases – (i) Creation of national telemedicine networks; and (ii) Linking Pan American Telemedicine Network to a Grid enabled environment. For the **1st phase**, ITU, in partnership with the Geneva University Hospitals (HUG), aims to create telemedicine networks in Latin American countries. This project will build on more than over ten years of accumulated experience and know-how of the HUG, gained through the RAFT network (Reseau en Afrique Francophone pour la Telemedicine) that have been developed since 2001 in Africa (See RAFT Network section), to enable the deployment of telemedicine services and tools along with IT enabled diagnostic devices to the regional and district hospitals across Latin America. All systems are designed to operate over low-bandwidth connectivity.

The **2nd phase** of the project has two main aims. First is to deploy in Latin America the Grid platform, an integrated e-Health Grid based application that offers Diagnose Support System (DSS) and data federation to support collaborative co-working and shared computing power for automated analysis. Second is to demonstrate innovation in the region by improving the quality and possibilities of clinical screening and better diagnostics.

The project has the ambition to transfer this e-Health platform to Latin America and demonstrate its feasibility and impact to support local preventive health practices to reduce mortality in the rural regions and contribute to reduce the digital divide by bringing Grid facilities to healthcare professionals in Latin America.

[2] Assessment of Internet-based tele-medicine in Africa (the RAFT project), C O Bagayoko and all. Computerized Medical Imaging and Graphics 30 (2006) 407–416

[3] Telemedicine for Trauma, Emergencies and Disaster Management, Rifat Latifi (Editor), Ronald K. Poropatich, George J. Hadeed (Contributing Editors). Artech House 2011

Phase I: Creation of national telemedicine networks

2 The RAFT Network[4]

The Geneva University Hospitals have developed a telemedicine network in Africa (the RAFT, Réseau en Afrique Francophone pour la Télémédecine), first in Mali, then in Mauritania, Morocco, Cameroon, and, since 2004, in Burkina-Faso, Senegal, Tunisia, Ivory Coast, Madagascar, Niger, Burundi, Congo-Brazzaville, Algeria, Chad, Benin, and Guinea.

The core activity of the RAFT is the webcasting of interactive courses targeted to physicians and other care professionals, the topics being proposed by the partners of the network. Courses are webcast every week, freely available, and followed by hundreds of professionals who can interact directly with the teacher. 70% of these courses are now produced and webcast by experts in Africa.

A bandwidth of 30 kbits/s, is sufficient, and enables the participation from remote hospitals or even cybercafés.

Other activities of the RAFT network include medical tele-expertise, tele-ultrasonography, and collaborative development of educational on-line material.

The RAFT network is currently organized and run by more than 40 national coordinators throughout Africa, and by a coordination team based in Geneva. In each of the partner countries, the RAFT activities are supervised by the focal point, a medical authority (usually a university professor) that links the project to the national governmental bodies (ministry of health, ministry of education). A local medical coordinator (a junior physician) and a technical coordinator take care of the day-to-day operations, including communication with the care professionals, identification of training needs, technical training and support of the various sites within the country.

Key partnerships include the Université Numérique Francophone Mondiale (UNFM) and the World Health Organization (WHO). The RAFT is recognized as an official WHO collaborating centre for eHealth and Telemedicine.

The current priority is the large-scale deployment of these telemedicine tools along with IT-enabled diagnostic devices such as portable echography, to the regional and district hospitals in Africa. These infrastructures could also be used to facilitate public health activities including the collection and communication of surveillance and healthcare indicators to the ministries.

The usefulness of these tools to support isolated care professionals has been demonstrated, as well as the sustainability of the implementation in large hospitals who can integrate the recurring connection costs in their operational budgets. Given the high costs of satellite connections (about 500 USD per month), which are the only options in remote areas, it has been evaluated that sustainability can currently be achieved down to the district-level hospitals who usually serve populations of 50’000 to 200’000, and operate as the first level of reference for dispensaries and rural hospitals.

For example, in the district hospital in Bankass, Mali, 120 kilometres away from the regional hospital, a general practitioner is performing an obstetrical ultrasound examination under the supervision of

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[4] http://raft.hcuge.ch

an expert, 800 kilometres away in the capital, Bamako. Thanks to this new diagnostic ability and with the confirmation of the remote expert that the symptoms are not too serious, the patient will be treated locally in the district hospital and will not be evacuated. Such tools not only empower isolated physicians, but also increase the value of remote Healthcare facilities perceived by local populations.

In parallel, the network is extending to other linguistic areas: educational sessions have been produced in English since October 2008, and are available to hospitals in English-speaking Africa and the Middle East. Since 2011, the project is being implemented in Latin America, on the Altiplano in Bolivia.

2.1 The Altiplano Project

In 2011, the funding provided by "Piaget", a private Swiss company, has allowed the purchase of telemedicine equipment to 5 hospitals in the region of the Altiplano (Cordillera de los Andes, 3800 meters on average above sea level) in the region of La Paz and Lake Titicaca in Bolivia. University Hospital "Hospital de Clinicas" in La Paz serves as a national reference site. Four health centers (Patacamaya, Tiquina, Copacabana and on the "Island of the Sun" on Lake Titicaca) were particularly connected and equipped, in order to cover the activities of the tele-ultrasound.

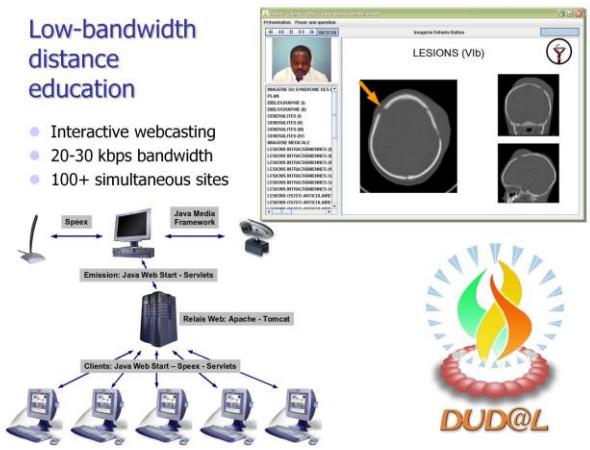
An on-site visit allowed verifying the correct operation of the system, identifying new needs, especially in the field of electrocardiography (ECG), dermatology, and the need for continuous training in the use of ultrasound.

Activities in 2012 strengthen the existing network, extending it to the south of the Bolivian Altiplano, deploying four more centers (H. Bracamonte, H. Uyuni, Kolcha-k, Llica) in the region of Uyuni and help to develop a national strategy for the use of the telemedicine tools.

In 2012, the project foresees the continuation of funding for the Internet connections to different centers installed in 2011 and the implementation of the module for electrocardiography (ECG) in three hospitals (Patacamaya, Copacabana and Tiquina).

2.2 Dudal: the RAFT's low-bandwidth distance education tool

Dudal is the distance education environment created for the RAFT, specifically developed and tuned in order to function over low-bandwidth connection (25 kilobits/second), thus enabling remote users to participate, even from a cybercafé in a small town. Emitting a course does not require any additional bandwidth, thanks to the use of a relay station which distributes the information to the other clients. This ability to let anyone be an emitter as well as a receiver has been identified as one of the keys to the success of the network in Africa.



This application is open to anyone and everybody can follow the course, ask questions to the teacher via instant messaging.

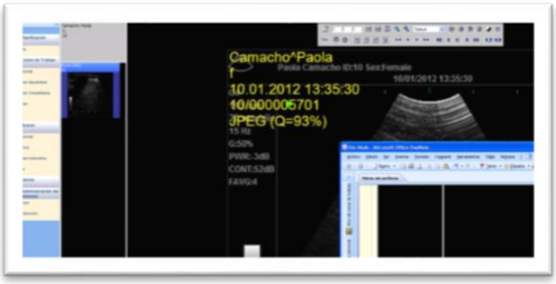
The training for a webcast in a course takes 2 days during one or two hours per day. The focal point should coordinate with general coordinator the schedule of the training sessions.

The focal points are in charge of identifying the needs, experts and coordinate webcasting of the courses with the general coordinator.

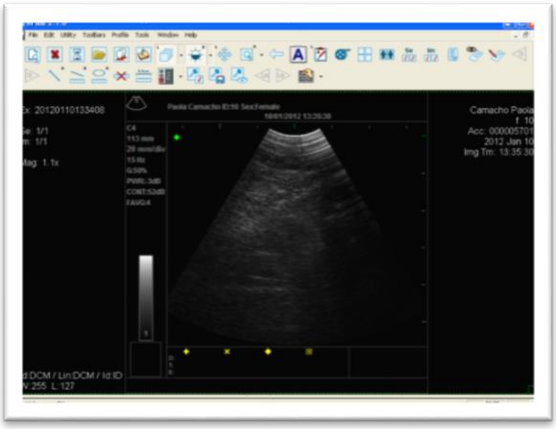
2.3 Teleconsultation via virtual communities of experts

The goal of this service is to improve the decision-making capabilities of physicians, and help them decide if a patient with an acute abdominal pain or obstetrical problems can be taken care of locally or needs to be transferred. Such decision is often crucial, as the risk and cost of transfer to regional or nation hospitals are high.

So far, the main application for teleconsultation is ultrasonography, in particular in the domain of obstetrics and gynecology.



The ultrasound images are taken using a portable device (the Voyager), through an application installed on the computer of the health center, in DICOM format. These images are then transmitted via satellite connection to the reference health center, where they are stocked on the server, using the RadOffice web application. The satellite connection is reliable but takes some minutes to complete the transfer, depending on the size of the images that are being sent. RadOffice is a RIS/PACS application that the network is using and it serves to send and receive the images made by members. It also serves to do and to send medical reports after the process of examination.



Once the images are placed on the server by a requesting member, specialists receive a notification that a medical advice is being requested. In the reference health center a specialist can read the images using the PACS viewer and send the report.

Finally, the system sends a notification to the requesting member that his case was analyzed and the report containing a clinical impression is available.

The experiences of RAFT show that health care professionals get trained for two weeks with a radiologist in a university hospital and become skilled enough to perform quality examination in their remote hospitals. Images are then sent to specialists for review and confirmation of the diagnosis.

The workflow is as follows:

- Patients at each site can be admitted for examination and a patient record is then created.
- The patient’s name figures on the working list of RIS/PACS – RadOffice and in the ultrasound Voyager (Worklist) : RIS/PACS RAdOffice Worklist, Voyager Worklist

- The radiologists at the Hospital de Clinicas can do the diagnostics either by using the PACS web viewer.
- Finally, a report is created with the diagnosis and is linked to the patient's record, and it is accessible by the members of the network.

3 Project objectives

The first objective of this project is to establish telemedicine centers/nodes in Latin American countries to enable tele-consultation assistance and continuous medical education by implementing national telemedicine networks in the region.

The second objective is to evaluate the impact of such networks for the improvement of healthcare processes (reference, counter-reference, decision-making capabilities, continuity of care) and public health activities (quality of data collection, measurement of indicators, efficiency of care).

4 Expected results

4.1 Phase I - National Telemedicine networks created

- Enhanced diagnostic and therapeutic decisions (Without having to move the patient or the specialist), improved the logistics of care and the planning of medical evacuations through remote support to care professionals.
- Remote Access to distance continuing education adapted to the needs of care professionals, thus improving their motivation while staying active where they are most needed.
- Enhanced coordination of public health activities through more complete and timely information to decision makers. Connected care centers can easily and timely transmit their activity and epidemiological indicators to the Ministry of Health, thus improving epidemiological surveillance and facilitating healthcare planning.
- Improved cooperation and knowledge sharing between Latin America medical universities and hospitals benefiting from similarities in context, culture and language.

5 Main activities

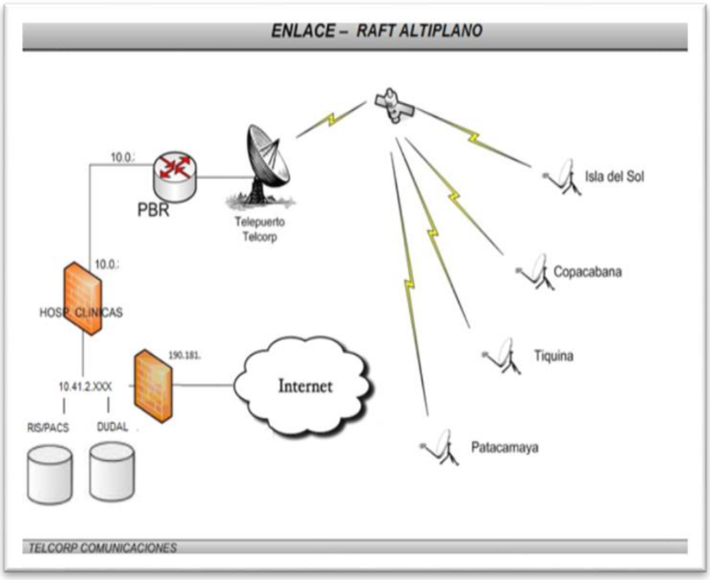
5.1 Phase I - (2 years): Creation of national telemedicine networks

- Replicate in 5-6 countries in Latin America the Telemedicine network model implemented by HUG in Bolivia at the "Altiplano 2012 Project" as is described in the RAFT network Section. The model will be adapted to fit each country context and specificities. See deployment strategy below.
- Provide Webcasting of interactive training by leading medical professionals to university students and young professionals in remote areas in implementing countries (Capacity building activities).
- Provide Tele-consultations using an integrated system capable of managing patients, storing and forwarding medical records and images and providing second opinion to remote patients. The system will comply with international standards in medical imaging and Electronic Medical Records (EMR) facilitating interoperability and exchanging of patient information.
- Deployment of low cost portable m-Health tools in remote location to empower Health centers workers posted at primary Health Units to access remotely doctors/specialists for decision support.

- Preparation of annual dissemination plan, periodical reports and impact analysis (economic, cultural and social).

6 Deployment strategy

The deployment strategy usually starts with the connection and the equipment of university hospital in the capital, then moving to provincial and regional hospitals. Sustainability in these large hospitals (i.e., essentially the financing of the internet connection) is usually achieved in 2 to 3 years, by taking the financing of the recurring costs via the hospital direction and/or the ministry. Given the low-bandwidth requirements of the system, care professionals can also participate in the activities of the network from cybercafés in more remote areas.



Deployment of new telemedicine units in district hospitals is an ongoing process. Ultrasound machines are deployed along with the telemedicine equipment: these ultrasound devices have become sufficiently affordable (around 6000 euros per unit) to be distributed in small hospitals, as these can significantly improve the diagnosis and decision-making performance for isolated physicians, and particularly help to decide if a patient can be taken care of at the local level or requires an often risky and expensive transfer to a regional or nation hospital.

Each telemedicine station contains:

- A mobile ultrasound machine enabling triage of abdominal and obstetrical images;
- A laptop and a webcam (telemedicine hardware);
- Installation and implementation of infrastructure
- Two years of connection fees, assuming that the deployment contact will require the receiving hospital to guarantee the financing of these connection costs after the two first years of operation
- Training activities in using the telemedicine station and basic training in triage ultrasonography, that both are organized by the national coordination teams. Support will be provided at the national level by the existing teams as well as centrally, from Geneva.

7 Work plan

WorkPlan	Year 1												Year 2											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1. Project Coordination and Management																								

2. Latin America Clinical and ICT Landscape evaluation																								
3. Deployment of Telemedicine Services																								
6. Dissemination and Training activities																								
7. Sustainability and International collaboration																								

8 Budget

Overall project coordination for 2 years	
Description	**Price (USD)**
Project Manager (ITU)	300,000
Project Coordinator (HUG)	300,000
Mobilize stakeholders and resources at global and country levels, costs include PR, advocacy, travel, etc.	50,000
Development and dissemination of lessons learned, costs include writing up, editing and printing results, dissemination, organization of and attendance at global and regional conferences and workshops, etc.	50,000
Total	**700,000**

Cost per country for 2 years	
For a focal point: University hospitals, independent infrastructure	
Description	**Price (USD)**
RIS / PACS Server (Equipment and supplies)	15,000
RIS/PACS Licenses	40,000
Connecting to the Network for Telemedicine (Connectivity 1 Mbps) (24 months)	24,000
Computers and supplies	5,000
Satellite Kit	3,000
Installation and deployment	6,000
Project Management	60,000
Training and Education	12,000
Network Maintenance	24,000
Travels	5,000
Evaluation	20,000
Total (USD)	**214,000**
Telemedicine Network Solution for peripheral health care centers and Hospitals x5	
Description	**Price (USD)**
Portable ultrasound equipment (Dicom)	8,000
Laptop Computer + Webcam + programs	2,000
Connecting to the Telemedicine Network (Connectivity) (24 months)	12,000
Satellite Kit	3,000
Installation and deployment	4,000
Project Management	-
Training and Education	8,000
Network Maintenance	-
Travel	5,000
Total/ peripheral health care center (USD)	**42,000**
Total for 5 peripheral health care centers per country	**210,000**

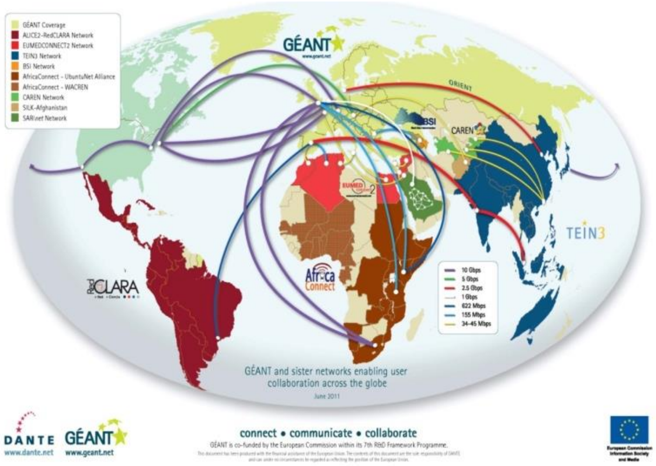
Total/country	**424,000**
Total for 5 countries	**2,120,000**

Project cost for Phase I for 2 years	**2,820,000**
Overhead	**282,000**
Total cost	**3,102,000**

Phase II: Linking PATN to a Grid enabled environment

1 Grid Computing

For about 10 years of the global grid communities working on e-Science, the possibility of use of their results, open the option to explore synergies with development work within the mandate of ITU in the context of Hyderabad Action Plan. The outcome might benefit world communities in different areas including, emergency telecommunications, climate change, and e-applications and services such as e-government, e-education, e-health, e -agriculture, e-commerce, etc.



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. 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.

The concept of "Grid computing" has started in the mid-1990s at Argonne National Laboratory and the University of Chicago, referring to a proposed distributed computing infrastructure for advanced science and engineering.

Major efforts, huge resources and funding have been put into research & development of core grid computing technologies, grid infrastructures and grid applications in a variety of science fields including healthcare and life science. Grid infrastructure was expanding steadily from local, regional to international scale. For instance, since the early 1990s, the EU has invested more than €500 million in the development of e-Health tools and systems.

1.1 e-Health Infrastructures

e-Health Infrastructures include today high-capacity and high-performance communication networks (GÉANT), cloud and grid-empowered resource sharing infrastructures and supercomputing facilities, combined with scientific application software, data repositories and services.

Grid computing refers to the coordinated resource sharing. It can be divided into three layers. The bottom layer is the grid network infrastructure, e. g. GEANT, or IPv6 support network. The middle layer may contain basic grid middleware for basic grid functions and high level grid middleware for other functionalities. The middleware provides functions of security, resource/execution management, and information service and data management. Typical grid middleware's are Globus, and gLite. The application layer covers a variety of grid applications ranging from particle physics to current data-intensive, computing and/or knowledge-intensive applications in healthcare.

A worldwide effort in grid research and development on grid and healthcare applications was observed in EU, USA and Asia. The EC Framework Programme (FP5) started in 1998 – 2002 launched with 58 M€ of funding to support over 20 grid projects in the areas of grid infrastructure, middleware development and grid applications, with Mammogrid, GEMSS and BIOGRID projects on healthcare and bioinformatics. In EC FP6 (2002-2006), a funding of 125 M€ were invested in grid research and development and a further 200 M€ on grid deployment (research infrastructure). The UK e-Science programme started at the end of 2000 invested almost 200 M€ in grid projects until 2004, with eDiaMonND and CLEF projects on healthcare applications. The USA initiated the BioMedical Informatics Research Network (BIRN) project at the end of 2001 with aim of fostering large-scale collaboration in biomedical science, with initial funding of 20 M€ in 2001 and further 20 M€ in 2004. Japan started a five year BioGrid project in 2002, with 5 M€ per year.

On grid infrastructures the EU's Enabling Grid for e-Science (EGEE) and the USA's TeraGrid projects are the top two. The EGEE project is the largest grid infrastructure project in Europe with 32 M€ funding for the initial two years starting in April 2004. The project aimed to develop a service grid infrastructure in Europe available to scientists 24 hours-a-day. It is successor of the EU Data-Grid (EDG) project which costs 10 M€ of EU funding. Two pilot applications for the EGEE are the Large Hadron Collider Computing Grid and Biomedical Grids to cope with the flood of bioinformatics and healthcare data. The TeraGrid project was launched by the national Science Foundation USA in August 2011 and since the 60 M€ of funding has been invested in an effort to build and deploy the world's largest and most comprehensive distributed infrastructure for open scientific research. In 2004 the TeraGrid has connected nine distributed supercomputing sites in USA and has formed 20 teraflops of computing power.

Health-e-Child project, and FP6 ICT for Health Integrated project, started in 2006 with 12 M€ in funding and the goal of developing a Grid-powered platform for clinical diagnosis support and research in peadiatrics, based on the vertical integration of biomedical data and knowledge. The Health-e-Child platform based on the EGEE gLite grid middleware has undergone security assessment and has been released in production since December 2008 securely and anonymously hosting the health records of patients enrolled in the project.

The initiative of developing a Global Imaging Laboratory based on a Grid/Cloud computing to help develop drugs for Alzheimer's disease, involves four EC-funded projects under the FP7 programme with almost 10 M€: neuGRID (2008-11), outGRID (2009-12), DECIDE (2010-12), and N4U (2011-15). The neuGRID Consortium has built the core of the infrastructure (computational nodes, connectivity, middleware, and a set of core applications for image processing). The DECIDE consortium has implemented onto neuGRID a popular tool for the detection of a diagnostic marker for Alzheimer's disease based on PET imaging (gridSPM). The outGRID Consortium has promoted the interchange of technical information of neuGRID with LONI and CBRAIN partners. N4U will develop the user-facing services of neuGRID and a managing structure that will make it sustainable and profitable.

The global efforts on grid and grid applications on healthcare have created a new specialist area called HealthGrid, which is the integration of grid computing and healthcare. The impact of grid computing on healthcare will touch almost every aspect of healthcare, from diagnosis, treatment, primary/acute care and social services. It will have a great and profound impact on future personalized healthcare.

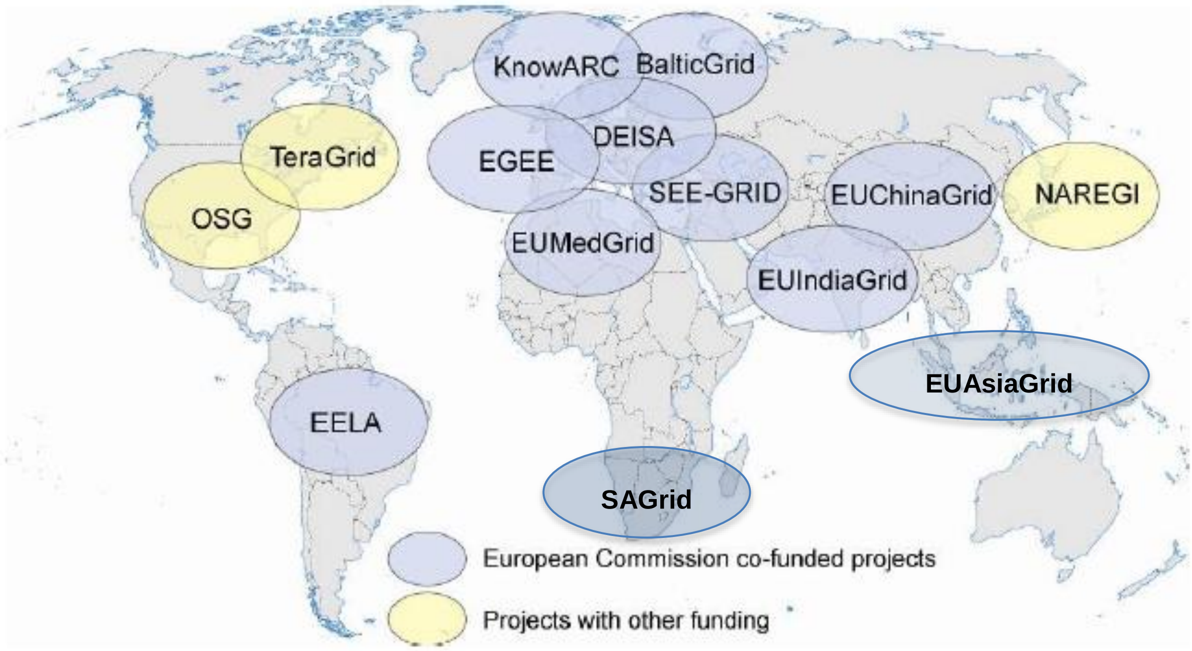
1.2 *Regional e-Infrastructures*

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.

1.2.1 Europe

Network: GEANT Network.

Grid Computing: Under FP7, the e-Infrastructures activity is part of the Research Infrastructures programme. It focuses on the further development and evolution of 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.



EGEE (Enabling Grids for E-SciencE): aims of building on recent advances in Grid technology and developing a service Grid infrastructure.

DEISA: Distributed European Infrastructure for Supercomputing Applications.

EGI: The European Grid Infrastructure enables access to computing resources from all fields of science. Currently there are 10 disciplines and 36 scientific areas that are being supported, Life science among them.

1.2.2 [North America]

Network: 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[5], National LambdaRail (NLR) and the NASA Integrated Services Network (NISN).

Grid Computing: 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

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[5] 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.

cyber-infrastructure that brings together community resources and enables effective computational resource sharing at the academic and research campuses.

TeraGrid → XSEDE: is the most advanced, powerful, and robust collection of integrated advanced digital resources and services in the world.

ExTENCI: The Extending Science Through Enhanced National CyberInfrastructure (ExTENCI) 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 users.

1.2.3 Latin America

Network: The ALICE (America Latina Interconectada Con Europa) project was set up in 2003 to develop the RedCLARA network, (Latin American Cooperation of Advanced Networks) which provides IP research network infrastructure within the Latin American region and towards Europe.

Grid Computing: EELA Project: e-Science grid facility for Europe and Latin America aimed at building a high capacity, production quality, scalable Grid to answer the needs of a wide spectrum of applications. At present GISELA Project (Grid Initiatives for e-Science virtual communities in Europe and Latin America) is implementing the Latin American Grid Initiative (LGI) sustainability model, providing Virtual Research Communities (VRCs) with the e-Infrastructure and Application-related Services.

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.

1.2.4 Mediterranean and Middle East

Network: EUMEDCONNECT: is a pioneering initiative to establish and operate an IP-based network in the Mediterranean region with a direct link to GÉANT, allows approximately 2 million users across North Africa and the Middle East to collaborate with their peers at more than 4000 research and education establishments in Europe.

ASREN: Arab States Research and Education Network is the association of the Arab region National Research and Education Networks (NRENs).

Grid Computing: EUMEGRID is supporting the development of a Grid infrastructure in the Mediterranean area and promoted the porting of new applications on the Grid platform. Several applications have been deployed spanning different fields of interest: High Energy Physics, Biology and Biomedicine, Hydrology, Archaeology, Seismology and Volcanology.

1.2.5 South-East Europe

Network: The SEEREN (South-East European Research and Education Networking initiatives) project has established the SEE segment of the GÉANT network. Currently, the SEE-LIGHT project is working towards establishing a dark fibre backbone that will interconnect most NRENs in the region.

Grid Computing: SEE-GRID is focusing to the establishment of collaborative models for use of computing and data resources across various domains. 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.

SEEGRID participates in the creation of GATE application for PET Scanners.

1.2.6 Sub-Saharan Africa

Network: The UbuntuNet Alliance is the NRENs in Africa, primarily in East and Southern Africa. The Alliance aims to interconnect African NRENs to each other and connect them to other regional RENs.

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.

Grid Computing: Apart of the dissemination activities the Sub-Saharan region of Africa is involved more and more in distributed computing initiatives. 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.

South Africa is the only country in the Sub-Saharan region with a dedicated activity to coordinate distributed computing. The South African National Grid (SAGRID, 2010) consisted of a federation of seven institutes taking part in Grid operations and belonging to the SAGrid JRU[6].

1.2.7 Asia Pacific

Network: The third generation of the Trans-Eurasia Information Network (TEIN3) provides a dedicated high-capacity Internet network for research and education communities across Asia-Pacific. 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 the world.

The Asia Pacific Advanced Network (APAN) 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.

Grid Computing: EUAsiaGrid project contributes 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.

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.

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.

EUIndiaGrid Is committed to create a common grid infrastructure for European and Indian researchers. Researchers will be able to join forces in the field of High Energy Physics with organizations such as CERN, in addition to Atmospheric & Earth Sciences, Biology and material Science, the four main application areas of EU-IndiaGrid.

NAREGUI (Japan), 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.

[6] 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.

2 Grid Applications for e-Health

HealthGrid is an innovative use of emerging information technology to support access to rapid, cost effective and high quality healthcare. Based on the grid technologies, the vision of Healthgrid is to create an environment where information at the five levels (molecule, cell, tissue/organ, individual/patient, population/public health) can be associated to provide individualized healthcare. It can be used to improve individualized healthcare and to support an epidemiological study. For individualized healthcare, the HealthGrid can facilitate access to relevant information from a patient regardless of where he/she has been, or where he/she is now using computer-aided tools for specific data patient for the detection and diagnosis of a disease to support medical decision making and defining the most appropriate therapy and treatment from diagnosis.

In particular the areas of healthcare provision and research that can be beneficially affected by Grid technology include:

- Medical imaging and image processing
- Modeling the human body for therapy planning
- Pharmaceutical Research and Development
- Epidemiological studies
- Genomic research and treatment development

In all these areas, Grid technology can either significantly reduce the cost or time to produce results and evidence, or even provide resources that are able to deliver services that cannot be economically delivered using conventional networked information systems.

2.1 Medical Imaging and image processing

Medical diagnosis and intervention increasingly relies upon images, coming from: x-ray (increasingly digital, though still overwhelmingly film-based), ultrasound, MRI, CT, PET scans etc. This trend will increase as high bandwidth systems for picture archiving and communications are installed in large numbers of hospitals (currently, primarily in large teaching hospitals). More than patient data, the medical images by far represent the major amount of information collected for medical data. However, medical images are not sufficient by themselves as they may need to be interpreted and analyzed in the context of the patient's medical record (that is the metadata associated with the images). Finally, medical data are used in diagnosis, continuing care, and therapy planning.

2.1.1 Medical data storage and archiving

Medical images represent enormous amounts of data: a single image can range from a few MB to 1 GB or more. The legal aspects concerning medical data archiving vary from country to country.

Grids provide support for distributed mass storage of data. Medical data should always be considered as sensitive in general and identifying data should remain strictly confidential. Encryption (and thus anonymization) of data on disk and during network transmission is therefore mandatory.

2.1.2 Image processing

Medical image analysis algorithms have been developed to assist clinicians to handle the amount of data by providing reliable and reproducible assistance to diagnosis and therapy. Indeed, the manual processing of 3D images is very fastidious and often error prone. Moreover, 3D medical image interpretation requires mental reconstruction on the part of the physician and is subject to large inter-operator variations. Grid technologies will enable image processing communities to share common datasets for algorithm comparison and validation. They will offer an access to large processing power suited to processing full datasets in reasonable time, compatible with the needs for experiencing new algorithms. They will also ease the sharing of algorithms developed by different research groups thus encouraging comparative studies.

2.2 Modeling the human body for therapy planning

Beyond medical data acquisition and analysis, modeling of the human body enables specific medical treatments. The key distinguishing factor compared with image processing or image reconstruction in the same applications arena is the use of computational methods for predictive purposes – providing physically accurate information that is not included in medical images themselves. Given the complexity and the computing cost of most human body models, Grid technologies are a good candidate to face computation challenges arising in this area.

2.2.1 Numerical simulations of the human body

With the development of Grids and large medical databases, one can expect the development of more specific or even individualized models. These models could be built from specific patient data and target specific pathologies or functions. Many areas of development in numerical human modeling are already at the stage that they can be used by medical researchers as tools for investigation into cause of medical problems and treatment procedures. Research into cardio-vascular disease in particular is an area where HPC simulation software is widely used, for example to improve understanding of processes leading to illness or to failure of implants such as artificial heart-valves or stents. The interest of the Grid approach is to provide services to medical or clinical users, removing any need for them to have to handle the details of the computing systems or simulation methods. Grid technologies are also required to provide high-bandwidth to large collections of coarse-grained, distributed, non-textual, multidimensional time-varying resources.

2.2.2 Therapy planning

Many human body models have been developed for therapy planning. Examples of numerical simulation used by health practitioners include radio-surgery/radio-therapy planning, electromagnetic source localization, reconstructive maxillo-facial surgery, etc.

Grid can be used to provide access to appropriate computational services and deliver these to medical users. The major challenges will be to ensure that services can be delivered into the user's workplace in an appropriate, ergonomic manner and that security, policy and legal constraints related to the use of patient data are fulfilled.

2.3 Pharmaceutical Research and Development

The Pharmaceutical R&D enterprise presents unique challenges for Information Technologists and Computer Scientists. The diversity and complexity of the information required to arrive at well-founded decisions based on both scientific and business criteria is remarkable and well-recognized in the industry.

Grid technology holds out the promise of more effective means to manage information and enhance knowledge-based processes in just the sort of environment that is well established in Pharma R&D.

2.4 Epidemiological studies

Conventional epidemiology requires extensive collections of data concerning populations, health and disease patterns, as well as environmental factors such as diet, climate and social conditions. A study may focus on a particular region or a particular outbreak, or it may take as its theme the epidemiology of a condition across a wide area. The range of data required will, therefore, vary with the type of study. Ethical issues may also arise if data collected in the first place in the course of individual health care is to be used for research.

The analysis of aggregated data requires the construction of complex models and the use of sophisticated statistical tools. This has necessitated collaboration between physicians and statisticians, and the rise of epidemiology as a discipline. The technology to allow federation of databases stored locally in hospitals has existed for some time. It is possible for these databases to be queried for epidemiological purposes while preserving patient anonymity. Such distributed queries may be managed and supervised by the hospitals with primary responsibility for the data, ensuring compliance with ethical and legal regulatory frameworks.

Grids overcome the problems of the mere integration of databases. They can enforce the interoperability of tools and analysis services and they may also enforce common standards and semantic clarity about database content and tool input/output. Indeed, the Grid-based federation of retrieval systems provides a significant alternative to federation of databases.

2.5 Genomic medicine grid

The full realization of the Genomic Medicine concept, in which genomics and proteomics are used to empower health care, requires the integration of knowledge from worlds traditionally apart, specially biology and medicine. To effectively harness the wealth of information available in research centers and care facilities, a new framework of computer methods and tools must be in place, bridging medical and bio informatics. In such approach, all levels of information (from the molecule to the population, through the cell, the tissue, the organ and the patient) and the most appropriate techniques and methods would be used, some coming from bioinformatics, and others from medical informatics or even public health or epidemiological informatics.

3 Phase II Vision

Phase II of this project aims to investigate the feasibility of developing a Latin American database of images, using emerging Grids technologies, so that the implementation of a set of important healthcare applications of this database can be enabled and the potential of the Grids can be harnessed to support co-working between healthcare professionals across the Latin-American countries. Applications will include:

1) epidemiological studies;
2) advanced image processing;
3) educational programmes and;
4) tele-diagnosis.

This is the first such project in the Latin American Region and its novelty lies in its ability to provide new geographical, cultural and statistical environments in which clinical records and images from different diseases can be studied. This project will provide the environment in which the multiple dimensions of medical records and images from different health centers can be investigated, since it will provide samples of data, which historically have not been easily attainable across the region.

4 Project Objectives

The first objective of phase II is to link national Telemedicine networks to a Grid enabled environment to enhance the exploitation of available ICT health care resources through a distributed clinical information systems and databases.

The second objective is to contribute to the knowledge base of Grid technology in Latin America through the development of grid-based methods to manage and share images and related data. The work will draw heavily on existing network development in Latin America, for example, the GISELA project.

5 Expected Results

5.1 2nd Phase - Pan American Telemedicine Network established

- Enhanced exploitation of available ICT resources for health care in the Latin American region through distributed clinical information systems and databases enabled by Grid technologies.
- Improved delivery of patient care through the use of more advanced e-health services through the use of Grid technology capabilities.
- Improved cooperation and knowledge sharing between Latin America medical universities and hospitals benefiting from similarities in context, culture and language.
- Improved access to a Pan-American federated image database system, based on Grid technologies and Federated-Database technologies that will allow rapid deployment of software packages to operate on locally stored information.
- Improved intelligent systems for the monitoring of health status for early illness detection and medical intervention.
- Improved data distributed (potentially heterogeneous) across Latin-America will be presented through customized interfaces to medical practitioners as a single logical database, enabling regional study, by integrating multiple databases into a federation.

6 Main Activities

6.1 2nd Phase (2 years): Linking Pan American Telemedicine Network to a Grid enabled environment

The aim in this phase is to use Grid technology to open the possibility of implementing a set of e-health applications supported by a distributed clinical information systems and databases in the Latin American region, and to deploy services like acquisition and processing of medical images, data storage, archiving and retrieval, data mining (in particular for epidemiological studies). The 2nd Phase will:

- Provide broadband connectivity between national Telemedicine Reference Centers implemented in countries of Phase I and specialized health centers in Europe with the support of high-speed networks provided by the National Research and Education Networks (NRENs) deployed in Latin America and GÉANT network in Europe.
- Provide healthcare professionals new ways to diagnose and treat patients by implementing an ultrasound-based diagnostics imaging database, using federated database technologies that will provide improved access to distributed data and will allow rapid deployment of applications packages to operate on locally stored information (for example computer aided diagnostic and quality control applications). Clinicians can gain access to relevant healthcare data regardless of where it is stored.
- Conduct epidemiology studies for different pathologies in a geographically distributed database[7] across the Latin American countries based on ultrasound-based diagnostic imaging techniques.
- Support integrated video, voice and data system technology for its use in:
    a. e-Clinic (tele-diagnosis, tele-consulting, tele-radiology and tele-pathology),
    b. e-Imaging (video-conferencing to support multidisciplinary meetings and diagnosis),
    c. e-Learning (tele-instruction and tele-education),
- Explore the provision of Grid-enabled Telemedicine services such as those provided by "GISELA[8]" Project.

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[7] Distribution of data across multiple sites is a trend in many emerging internet applications. The advantage is each site can process its own data with some degree of autonomy and users can be provided with a single global view of the data.

[8] GISELA: Grid Initiatives for e-Science virtual communities in Europe and Latin America.

7 Work plan

WorkPlan	Year 1												Year 2											
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1. Project Coordination and Management																								
2. Latin America Clinical and ICT Landscape evaluation																								
4. Integration to Grid enable environment																								
5. Broadband connectivity assessment																								
6. Dissemination and Training activities																								
7. Sustainability and International collaboration																								

8 Budget

Project Budget	
Description	US$
Infrastructure ass'mt Study in Latin America	300,000
Infrastructure Deployment (5 countries)	1,700,000
Total	**2,000,000**

Technical coordinator (2y) Region	120,000
Mission Costs	100,000
Needs Ass'mt Study	100,000
Cap. Bldg Wkshops	100,000
Total	**420,000**

Total (5 countries)	2,420,000
Overhead	242,000
Total	**2,662,000**

9 Risk assessment

- Lack of appropriate infrastructure and dedicated personnel at the national level. (Medium) Feasibility studies will be performed and national commitments obtained prior to project initiation at the national level.
- Overlap with existing telemedicine initiatives driven by academia and private sector. (High) Collaboration and synergy opportunities will be explored with partners in Latin America prior to the project to avoid overlap and maximize the use of existing resources and knowledge.
- Resistance to change from clinicians to integrate new ICT technologies and working methods. (High) Training programs aligned with user friendly applications/interfaces and other strategies to build confidence will be implemented.
- Confidentiality of clinical records to be assured through appropriate systems.

10 Sustainability

- The Project is modulated in 2 consecutive and independent phases which ensures that results are achieved even if the 2nd Phase is not implemented.
- Sustainability is also highly dependent on national commitments in terms of provision of allocating resources, appropriate funds after the end of the project to ensure connectivity.
- Collaboration with other international initiatives will be sought to ensure sustainability.

11 Project management

Project Steering Committee PSC: Convened and chaired by the Project Managers (PM), the Project Steering Committee (PSC) is composed of one representative per partner. The PSC is the supervisory board of the project, taking decisions related to the general management of the project. The PSC meets every 2 months through conference calls.

In general, the major official decisions related to the execution of the project will be taken by the PSC and executed by country focal points.

The major tasks of the PSC are:

- To set up collaboration agreements
- To review and approve the overall project planning, progress and achievements
- To define and review communication and IP usage strategies
- To define, setup and review the quality strategy
- To review project risks
- To define, setup and to approve guidelines for the management
- To review and approve the financial situation of the project
- To review and approve progress reports
- To act as a platform for end user and medical advisory for the project
- To act as final instance in conflict resolution
- To define and to monitor the adherence to ethical guidelines

PSC decisions will be taken on a consensus basis. Whenever consensus cannot be reached the agreement will be reached on a proportional vote basis, being the vote of each partner weighted by its percentage of the total project cost.

Project managers PM: A project manager will guide and manage the overall direction of the project.

Project Coordinators PC: Two technical and medical project coordinators PC will be assigned to oversee and coordinate the implementation of the project and to run the day-to-day activities. Both coordinators will report to their respective PM.

The PC will assume the following tasks:

- Promotes the establishment and maintenance of effective partnerships between stakeholders.
- Advise on both technical and medical issues.
- Manage daily activities and help resolving daily problems.
- Manage meetings of steering committee.
- Prepare periodic progress reports.

At the country level, the project management is based on a decentralized model involving national coordination teams in each of the participating countries. Typically, a team is made of at least three collaborators:

1. **The focal point:** a recognized medical authority with good contacts with the government (ministry of health, ministry of higher education, ministry of communication), the focal point is in charge of overseeing the operation at the national level and make sure that they are well integrated with the national e-health strategies;
2. **The medical coordinator:** a physician, who is in charge of training, supporting and interacting with local care professionals, points out education needs and reveals opportunities
3. **The technical coordinator** is in charge of the technical aspects of the deployment and the daily operations of the telemedicine tools.

This team is in charge of coordinating the activities at the national level, organizing training sessions for new participating healthcare facilities, and supervises the deployment of technical infrastructures.

12 Beneficiary countries

The project benefits Latin-American countries and initially focus on the following countries:

- Bolivia
- Ecuador
- Colombia
- Peru
- Venezuela

13 Partners – Roles and Responsibilities

Telecommunication Development Sector (BDT), International Telecommunication Union (ITU)

ITU/BDT has the mandate to support the ITU membership in improving access to ICT applications and services, especially in underserved and rural areas, achieving trust and confidence in the use of ICTs, the Internet and next-generation networks, promoting fair and equitable access to critical Internet resources. The activities in the broad area of ICT Applications includes promoting and implementing e-Services especially e-Health.

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Role:

Leveraging its membership and wide scope of activities and expertise that cover infrastructure deployment, policies, regulations, and standards development that support the sustainable provision of ICT services, ITU is uniquely positioned to play a pivotal role in mobilizing different ICT/telecom partners to deploy required Telemedicine infrastructure and services, secure high-level commitment from all ICT stakeholders and provide overall project management/coordination and any technical support required.

Geneva University Hospitals, Division of eHealth and Telemedicine

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Role:

Leveraging on its 10-year experience in deploying such activities, HUG will provide technical and medical expertise for the setup and organization of the telemedicine activities, for capacity building and for the evaluation of impact.

14 Other potential partners at country level

14.1 Ecuador

CITIC - Centro Internacional de Investigación Científica en Telecomunicaciones, Tecnologías de la Información y las Comunicaciones.
Contact person: Dra. Zoila Ramos, Director CITIC

14.2 Colombia

Tele-Informatics Research Group (GITUN) of the Universidad “Nacional de Colombia
Contact Person: Mauro Calderon Florez, Scientific Director of GITUN.

14.3 Peru

Facultad de Ciencias y Filosofia,"Universidad Peruana Cayetano Heredia" (UPCH)
Contact person: Dr. Juvenal Castromonte, Deputy Dean, Facultad de Ciencias y Filosofia.

14.4 Venezuela

Center Of Simulations Models, ULA, Merida
Contact Person: Prof. Herbert R. Hoeger, Director of the Center for Simulation Models

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