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Collaboration plan with non-European HPC stakeholders

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Author(s):	Andrew Emerson, Giovanni Erbacci, CINECA Georgi Prangov, Nelly Stoyanova, NCSA Ana Bela Dias, NCF
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Authorship	**Written by:**	Andrew Emerson, Giovanni Erbacci, CINECA Georgi Prangov, Nelly Stoyanova, NCSA Ana Bela Dias, NCF
	Contributors:	Lilit Axner, SNIC Claudio Gheller, CINECA Damien Lecarpentier, CSC Ioannis Liabotis, GRNET
	Reviewed by:	Volker Strumpen, JKU Dietmar Erwin, JSC
	Approved by:	MB/TB

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[2] TOP500 list of the world's most powerful supercomputers, http://www.top500.org.
[3] http://www.isgtw.org/feature/taiwanese-step-their-game.

List of Acronyms and Abbreviations

CINECA	Consorzio Interuniversitario, the Italian supercomputing centre
DARPA	Defense Advanced Research Projects Agency
DEISA	Distributed European Infrastructure for Supercomputing Applications. EU project by leading national HPC centres.
EC	European Community
EEF	European e-Infrastracture Furum (EEF)
EESI	European Exascale Software Initiative
ESFRI	European Strategy Forum on Research Infrastructures; created roadmap for pan-European Research Infrastructure.
G8	Group of Eight, Forum for the governments of eight of the world's major economies.
HPC	High Performance Computing; Computing at a high performance level at any given time; often used synonym with Supercomputing
IESP	International Exascale Project
IPCC	Intergovernmental Panel on Climate Change
KTH	Kungliga Tekniska Högskolan (represented in PRACE by SNIC, Sweden)
LLNL	Laurence Livermore National Laboratory, Livermore, California (USA)
MoU	Memorandum of Understanding.
NCF	National Computing Facilities Foundation (Netherlands)
NCSA	National Centre for Supercomputing Applications (Bulgaria)
PRACE	Partnership for Advanced Computing in Europe; Project Acronym
SARA	Stichting Academisch Rekencentrum Amsterdam (Netherlands)
SNIC	Swedish National Infrastructure for Computing (Sweden)
TFlop/s	Tera (= 1012) Floating-point operations (usually in 64-bit, i.e. DP) per second, also TF/s
Tier-0	Denotes the apex of a conceptual pyramid of HPC systems. In this context the Supercomputing Research Infrastructure would host the Tier-0 systems; national or topical HPC centres would constitute Tier-1

Executive Summary

The challenges facing the development and exploitation of HPC can only be addressed in partnership with its stakeholders. The aim of this document is to provide a set of guidelines and recommendations structured in a Collaboration Plan to present to the Council of PRACE AISBL for the purpose of forming concrete collaborations. This deliverable reports two key results:

- a survey and analysis of HPC related activities in the world to identify potential partners;
- a synthesis of the entire collaboration process including the different modes of collaboration and the procedures to adopt once the potential partners have been chosen.

For the first result, the HPC survey, it was found useful to summarise the contact data in a table according to geographical region. An analysis of this data revealed a large number of initiatives in Europe and USA, and very few in other regions such as South America, Africa or India. Clearly, these latter areas can be investigated further, particularly India which given the size of its population, could become a strategic player in HPC. Regions not including the USA and Europe, but with high HPC investments include Russia, S.E. Asia, Japan and especially China, which at the time of writing has the most powerful supercomputer in the world, according to the top500 list. The survey also looked at initiatives with more global scope, such as the IPCC and IESP.

The second result of the work describes in detail all aspects of the collaboration process which can start once potential partners have been identified. The issues discussed include the purposes of the collaboration and incentives, the various modes possible and in particular the *collaboration matrix*, a practical tool for actually establishing the collaboration. These are then assembled into a final Collaboration Plan containing a set of recommendations for forming collaborative partnerships.

The final outcome is a rationalized and coherent strategy for preparing and undertaking collaborations for the PRACE AISBL with other HPC stakeholders.

1 Introduction

The aim of this document is to describe the strategy and the preparation that has been done in order to produce a plan for promoting European and global collaboration for strengthening HPC usage. During the preparation of the document, it has been assumed that the adoption of a PRACE Collaboration Plan is absolutely essential. The issue is not whether to build collaborations with non-European countries, but instead to choose the mechanisms for their fulfilment. International relations have been regarded as a cross-border and transnational process, in which PRACE AISBL is aiming to realize a common European vision for HPC development. In order to do this the strategy described here is organised into three main phases:

1. A survey to identify HPC initiatives and infrastructures throughout the world.
2. A methodology framework for identifying, organising and enabling the collaboration process before making contact with representatives of these initiatives.
3. In the final stage, the selected initiatives and framework, together with concrete recommendation for future steps, will be presented to the Council of PRACE AISBL.

The plan to be presented to the Council of PRACE AISBL includes a set of possible contacts through which synergetic collaborations with international HPC stakeholders could be pursued. This plan needs to be approved by the Council and afterwards PRACE AISBL should endeavour to establish contacts with the stakeholders following the identified goals, principles, modes and techniques in this document and taking into consideration the recommended timeframe for verification and validation of the first collaboration strategic results until the end of the PRACE-1IP project. In sections 2 and 3 we describe how the HPC survey was performed, and give a summary of the results obtained together with an analysis according to geographical region. Section 4 is devoted to a detailed description of the collaborative process and mechanisms to adopt once the partners have been identified. The last section gives the recommendations and procedural guidelines for constructing the first PRACE Collaboration Plan.

Finally, this document includes an Annex which contains the complete set of contact forms collected by project task members used for the HPC survey.

Bearing in mind the diverse nature of collected initiatives and countries it is a quite clear that there is no single solution that can be applied to all HPC initiatives and countries. During the initial adoption of the collaboration framework model, PRACE needs to deploy a personalised approach to every single partner respecting its science and technology achievements and preferences and looking for mutual beneficial results. This document should be the PRACE open platform, the success of which will be measured by the number of newly created collaborations with non-European stakeholders. The intended audience of this document is the Council and the Board of Directors of PRACE AISBL

For the remainder of the project PRACE 1IP WP4 task 4 will continue to work with PRACE AISBL in order to forge further collaborations with the initiatives identified in this document.

2 Survey of World HPC initiatives

Clearly a vital step for identifying collaboration opportunities involves identifying the HPC-related initiatives which are currently present or planned. A number of projects have already provided data about the global HPC situation, one example being the **European Exascale Software Initiative** (EESI), which in 2010 produced a comprehensive report of large-scale HPC enterprises in the U.S, Europe and Asia [1]. Although we have used data from this report, we decided also to perform our own survey, not only to discover initiatives in areas not covered by the EESI report, but also to concentrate more on obtaining the *contact* information needed for forming collaborations. It should be noted that despite the title of this deliverable we decided to include European initiatives in this survey. We did this additional work in order to have a complete vision of the global situation and to allow a better comparison between the various activities, which are in any case often highly interrelated and so a global vision is necessary. In this section we explain how this survey was performed.

2.1 Survey Strategy and definitions

The survey investigates the relevant HPC initiatives in the different geographical regions worldwide.

2.1.1 *Types of HPC Initiatives*

We first had to decide what constituted an "HPC initiative" for the purpose of possible HPC collaboration with PRACE AISBL. The aim of this task is to build collaborations and since these can be formed in many ways and at different levels, we opted for a broad definition, but clearly with the proviso that HPC is essential.

In the survey we looked for the following types of HPC-related activities:

- Infrastructures distributed at a regional, national, or international level, and perhaps with a dedicated network. Grids are common examples of this type of initiative.
- Networks. By this term we mean an association of different organisations with a common goal, but more loosely linked than that of a Grid.
- Policy initiatives for e-Infrastructures, e.g. e-IRG, EEF, etc.
- Entities providing HPC resources through a peer review process, e.g. National Research Councils, NSF, INCITE, etc.
- Projects for software developments for future Exascale supercomputers, e.g. EESI, IESP, etc.
- Projects for new and future hardware and software trends, e.g. STRATOS, etc.
- Scientific or Engineering projects and user communities.
- Computer centres or research centres for scientific disciplines with a significant HPC component.
- Universities or other academic institutions, particularly in developing countries.

For obvious reasons we have, however, excluded computer centres or institutions which are members of PRACE AISBL.

2.1.2 *Geographical Regions*

For classification purposes, the global HPC ecosystem was divided into the following geographical regions:

- Transcontinental (for intercontinental or global collaborations)
- Europe
- USA and Canada
- South America and Mexico
- Russia
- Japan and S. Korea
- China
- Africa
- S.E. Asia and Oceania, but excluding Japan and China (e.g. countries such as Australia, New Zealand, and also Taiwan).

Notice that for Europe special attention is given to projects listed in the ESFRI roadmap which may require access to the PRACE HPC Research Infrastructure (RI), due to their importance for the research development of Europe based on the strategy defined by ERA.

2.2 Collecting the data and contact form

Data for the survey was obtained from a number of sources such as:

- Contacts directly obtained by PRACE partners participating in this task.
- Publicly available documents such as the EESI Investigation Report on Existing HPC Initiatives.
- The top500 list of supercomputers

To avoid duplication of effort, PRACE project partners involved in obtaining contact data were assigned separate geographical regions and asked to collect activity data only from the given regions. In addition, in order to standardise the information collected, project partners were asked to record their activity data according to a template, an example of which is given in Annex I - Contact Form.

3 Analysis of HPC Survey

In this section we summarise the HPC initiatives collected from the survey. First a summary table is reported and then an analysis of the results for different geographical regions is presented.

3.1 Summary Table

A summary of the survey is reported in Table 1 Summary of HPC initiatives grouped by geographical region. Apart from listing brief details of each activity, in this table we have also attempted to classify each entry by "Type", e.g. Infrastructure, Network, Computer or Research Center, Project, Funding body, HPC initiative, etc. This should not be considered a rigid classification - many funded projects are described as "infrastructures" for example - but rather an indication of the nature of the activity. More complete information for each activity, where available, is given in the Annex II. In the following sections we discuss the data according to geographical area.

Short Name	Long Name and/or Short Description	Type	Initiative Level	Countries involved
Worldwide				
IESP	International Exascale Software Project	Initiative	Intercontinental	Various European countries, USA and Japan
IPCC	Intergovernmental Panel on Climate Change. Scientific body for the assessment of climate change.	Network	Global	198 UN members
ITER	International Experimental Fusion Reactor	Research Center	Intercontinental	Many worldwide incl. EU, China, India, Japan, Korea, Russia and USA.
Europe				
BBMRI	European Bio-Banking and Molecular Resources Initiative.	Network	Continental	14 European countries
CASL	Complex and Adaptive Systems Laboratory	Center	National	Ireland
Cy-Tera	HPC facility, serving the needs of the Cyprus Institute.	Project	Regional	Cyprus (+Germany, USA, Jordan)
EEF	European e-Infrastructure Forum. Discussion Forum composed of large, multinational infrastructures (DEISA, PRACE, EGEE, etc.)	Initiative	Continental	Most EU countries.
EESI	European Exascale Software Initiative. Its goal is to address the challenge of the new	Initiative	Continental	Various full and associated partners throughout

Short Name	Long Name and/or Short Description	Type	Initiative Level	Countries involved
	generation of massively parallel systems for providing Petaflop and Exaflop performances.			Europe.
e-INIS	computational, networking and support infrastructure for Ireland	Infrastructure	National	Ireland
ELIXIR	European Infrastructure for Biological Information.	Infrastructure	Continental	About 25 countries across Europe.
e-IRG	The e-Infrastructure Reflection Group was founded to define and recommend best practices for the pan-European electronic infrastructure efforts.	Initiative	Continental	Representatives from all EU countries
EIROforum	Collaboration of eight European intergovernmental scientific research organisations that are responsible for infrastructures and laboratories (e.g. CERN, EMBL, ESA, etc).	Network	Continental	Various, according to participation of institutions involved.
eSSENCE	Essence of e-Science Collaboration of Lund, Uppsala, Umea universities	Project	National	Sweden
EuroBioimaging	European Biomedical Imaging Infrastructure	Network	Continental	More than 20 countries across Europe, incl. Israel
HPC-World	Creation of a roadmap for HPC e-Science infrastructure allocation reviewing, selection and management	Project	Continental	Europe, USA, New Zealand
HP-SEE	High-Performance Computing Infrastructure for South East Europe's Research Communities.	Project	Regional	Europe (south Europe)
INSTRUCT	European Integrated Structural Biology Infrastructure	Network	Continental	17 European countries
IS-ENES	Infrastructure for European Network for Earth System Modelling.	Project	Continental	10 European countries
LinkSCEEM-2	Linking Scientific Computing in Europe and the Eastern Mediterranean-Phase 2	Infrastructure	Regional	Cyprus, Egypt, Jordan, Germany, USA, France, Israel
NDGF	Nordic DataGrid Facility. Infrastructure for Nordic grid countries	Infrastructure	Regional	Scandanavia + Iceland

Short Name	Long Name and/or Short Description	Type	Initiative Level	Countries involved
Vilnius University	Faculty of Mathematics and Computer Science, Vilnius University	Center	National	Lithuania
National Academy of Sciences	United Institute of Informatics Problems, National Academy of Sciences of Belarus	Center	National	Belarus
USA and Canada				
ANL	Argonne National Laboratory	Center	National	USA
DOE's Institute for Advanced Architecture	Sandia Laboratories	Center	National	USA
Exascale Co-Design Center	Initiative funded by the US Department of Energy.	Funding body	National	USA
INCITE	Innovative and Novel Computational Impact on Theory and Experiment (D.O.E)	Funding body	National	USA
LBNL	Lawrence Berkeley National Laboratory	Center	National	USA
NASA	National Aeronautics and Space Administration	Center	National	USA
NCAR	National Center for Atmospheric Research	Center	National	USA
NCSA	National Center for Supercomputing Applications	Center	National	USA
Bluewaters	Supercomputer funded by NSF and Uni. of Illinois, due to open in 2011.	Center	National	USA
OCI	Office of Cyberinfrastructure of the National Science Foundation (NSF)	Center	National	USA
SDSC	San Diego Supercomputing Center	Center	National	USA
TeraGrid	Grid infrastructure involving various US centers and universities.	Infrastructure	National	USA
UHPC	Ubiquitous High Performance Computing	Initiative	National	USA
Compute Canada	Consortium of Canadian research facilities.	Network	National	Canada
CLUMEQ	CLUMEQ is part of the Compute Canada national HPC platform that coordinates the seven regional consortia across Canada	Infrastructure	Regional (Quebec)	Canada
RQCHP	Réseau québécois de calcul de haute performance	Network	Regional (Quebec)	Canada
HPCVL	High Performance	Network	National	Canada

Short Name	Long Name and/or Short Description	Type	Initiative Level	Countries involved
	Computing Virtual Laboratory			
SciNet	SciNet was funded by the National Platform Fund (NPF) of the Canada Foundation for Innovation (CFI) and by the Province of Ontario as well as the University of Toronto Faculties of Arts and Science, Engineering and Medicine	Network	National	Canada
SHARCNET	Shared Hierarchical Academic Research Computing NETwork	Network	Regional (Ontario)	Canada
WestGrid	Western Canada Research Grid. WestGrid operates HPC, visualization and collaboration infrastructure across western Canada	Infrastructure	Regional	Canada
Russia				
e-Arena	National Association of Research and Educational E-infrastructures	Infrastructure	National	Russia
JSCC	Joint SuperComputer Centre of the Russian Academy of Sciences	Computer Center	National	Russia
Moscow State University	Information and Technology Faculty of Computational Mathematics and Cybernetics of Lomonosov Moscow State University	Center	National	Russia
SKIF Aurora	Intel Xeon cluster hosted at South Ural State University	Center	National	Russia
T-platforms	Plays a significant role in the creation of Russian HPC infrastructure.	HPC Vendor	International	Russia
South America and Mexico				
CMM	Center for Mathematical Modeling, University of Chile	Center	National	Chile
COPPE UFRJ HPC	Grid infrastructure for oil production modeling	Infrastructure	National	Brazil
INPE	National Institute for Space Research (hosts Cray XT6 system)	Center	National	Brazil
China				
CNIC	Computer Network Information Center	Infrastructure	National	China

Short Name	Long Name and/or Short Description	Type	Initiative Level	Countries involved
NSCC	National Supercomputing Center in Tianjin	Computer Center	National	China
NSCS	National Supercomputing Centre in Shenzhen	Computer Center	National	China
SCCAS	Supercomputing Center of the Chinese Academy of Sciences	Computer Center	National	China
SSC	Shanghai Supercomputer Center	Computer Center	National	China
Japan and S. Korea				
ITC	Information Technology Center, University of Tokyo	Center	National	Japan
OPL	Open Petascale Libraries project (EADI)	Initiative	International	Japan, UK
NAREGI	The National Research Grid Initiative is the leading Japanese HPC infrastructure project.	Infrastructure	National	Japan
RIKEN	Research Center which will host the next Next-Generation (10 Petaflop) supercomputer.	Center	National	Japan
TITEC	Tokyo Institute of Technology	Center	National	Japan
KISTI	Korea Institute of Science and Technology Information	Center	National	S. Korea
K e-Science	Korean e-Science Grid project	Infrastructure	National	S. Korea
Africa				
Blue Gene for Africa Initiative	Bluegene computer (donated by IBM) installed in Cape Town.	Initiative	Continental	South Africa
Meraka Institute	African Advanced Institute for Information and Communications Technology	Research Center	National	South Africa
CSIR	The Council for Scientific and Industrial Research	Research Council	National	South Africa
S.E. Asia and Oceania				
National Computational Infrastructure	Initiative of the Australian Government	Infrastructure	National	Australia
BlueFern (University of Canterbury)	Hosts the BlueFern BG/L	Research Center	National	New Zealand
NCHC	National Center for High Performance Computing	Center	National	Taiwan
IHPC	Institute of High Performance Computing	Center	National	Singapore
India				
C-DAC	Centre for Development of Advanced Computing	Computer Center	National	India

Short Name	Long Name and/or Short Description	Type	Initiative Level	Countries involved
CRL	Computational Research Laboratories	Center	National	India
IITM	Indian Institute of Tropical Meteorology	Research Center	National	India

Table 1 Summary of HPC initiatives grouped by geographical region.

3.2 Analysis by region

3.2.1 *Worldwide*

There are a number of initiatives with members that span continents or are even global in nature. An important example here is the IPCC (Intergovernmental Panel on Climate Change), a scientific body which attempts to assess and review the scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. Although it does not conduct research itself, climate modeling is a crucial component in this understanding and is a heavy consumer of HPC resources. Other initiatives include fusion research projects (i.e. ITER) and the International Exascale Software Project (IESP) which has Europe, Japan and the USA as members.

3.2.2 *Europe and ESFRI*

For the European region we have, perhaps not surprisingly, the largest number of entries in the summary table. The types of activity are slightly different here as well, when compared to the rest of the world, since many European computer centers are already part of PRACE and thus have not been included. Instead we have many projects or initiatives, often funded within the EU FP7 Programme, and with scientific objectives (e.g. biomedical). Many of these communities are thus likely to be HPC consumers and collaborations could involve PRACE as a resource provider and collaboration partner. In fact, one of the projects, IS-ENES, has been involved and granted computer time under the auspices of a so-called *virtual community* in DEISA2. It can be also expected that some of the projects emerging from the ESFRI Roadmap will also have HPC needs and as such collaboration with PRACE will become important.

3.2.3 *USA and Canada*

As a leading provider and consumer of HPC resources, there are many possibilities for collaboration at all levels with the USA. For some activities in the table, there is already a history of collaboration with European countries. TeraGrid, for example, already has participated in many activities with DEISA2 and HPC-World; for this reason we denote a special subsection to TeraGrid (see the subsection on TeraGrid).

3.2.4 *South America and Mexico*

In this region the main provider of HPC resources is Brazil with its Cray XT6 system ranked at number 29 in the top500 list. We have very little information of other initiatives in this region.

3.2.5 *Russia*

Russia has made notable advances in recent years in HPC, having 11 supercomputers in the top500 list. We don't have much information about other types of projects or initiatives, with the exception of a joint EU-Russia ICT Call objective ICT-2009.10.2 EU-Russia Research and Development cooperation.

3.2.6 *Japan and S. Korea*

Japan is also an active provider and consumer of HPC resources. Besides establishing contacts with computer centers such as those listed in the table, another important collaboration option is through IESP, where Japan is represented by members of the Tokyo Institute of Technology (TITech), University of Tsukuba, RIKEN and University of Tokyo. South Korea is another country which invests heavily in HPC and reputedly plans to install a Petaflop/s system by 2013.

3.2.7 *China*

In recent years China has become an extremely important player in HPC, as evidenced by the fact that it currently tops the top500 list of supercomputers with its **Tianhe-1A** system and also has another cluster (**Nebulae**, at NSCS) in third place in the same edition of the list [2]. It is noteworthy that both of these clusters are GPU-based, a fact that should be considered in the collaboration plan as it implies a significant level of expertise in this type of architecture. But despite the availability of currently the most powerful computers on the planet, we do not have much information on what other sorts of HPC activities are occurring in this country. In fact, with the exception of the CNIC the other entries in the table relate to computer centers. Collaboration with Chinese activities should clearly be pursued, even if linguistic and cultural differences are likely to be challenging. Special attention should be given to Hong-Kong due to initial collaborations with Europe initiated before the integration into China.

3.2.8 *Africa*

Given the low GDP of this continent, particularly of sub-Saharan Africa, it is not surprising that HPC activities are limited. However, there is one very important entry and that is the Blue Gene for Africa Initiative centred on BG/P system donated by IBM and installed at the Centre for High Performance Computing (CHPC) in Cape Town on 7 October 2008.

3.2.9 *S.E. Asia and Oceania*

For this region currently the Summary Table shows entries for Australia and New Zealand, but at the moment there are no data for technologically important countries such as Malaysia. The situation in Taiwan is worth monitoring since it has published details of a 170 Tflops machine expected to be installed by July 2011 [3].

3.2.10 *India*

According to the EESI report India plans to have a Petaflop system by 2013 but currently there appear to be only small or medium-sized computer centres. Other information is very limited and forming collaborations with initiatives in the Indian sub-continent will probably not be straightforward.

3.2.11 *TeraGrid (eXtreme Digital)*

TeraGrid deserves a special mention not only because of the computational infrastructure it provides but also because it has a history of joint initiatives with DEISA including conferences and workshops (e.g. the European-US Joint Summer School held in Catania in 2010) and a link-up of the DEISA and TeraGrid networks which occurred in 2005. Although in the summer of 2011 TeraGrid will be replaced by a new iniative called *eXtreme Digital* (XD), it should be possible to continue the relationship with PRACE. In fact, during contacts at SC10 (November 2010) in New Orleans between members of TeraGrid and the PRACE project, TeraGrid has shown interest in collaborating with PRACE not just in conferences and workshops but also at the level of exchange of resources. This possibility should be further discussed and explored.

4 Collaboration Plan - guiding principles

During the last few decades, social and economic developments combined with dynamic technological innovations have marked High Performance Computing (HPC) as a competitive and fast changing area. Every single player needs to provide at all levels increasing flexibility, better integration and higher added value in order to meet both its users' demands and expectations as well as to satisfy the objectives of its funding agencies. In such a setting, the creation of working rules and procedures as well as collaboration teams has turned out to be an important organizational strategy, not only as an instrument for overcoming many external and internal challenges but also for grasping a wide range of new opportunities.

In this section, the main supportive components are defined as part of the overall conceptual framework for carrying out the PRACE AISBL responsibilities and obligations in a collaborative ecosystem. In particular, this section provides the essential elements that need to be taken into consideration in the process of initiating, establishing and strengthening of all forms of collaborative activities between PRACE AISBL and third parties. This clearly advocates a slightly more strategic approach, especially due to the specific characteristics of HPC, by defining the main purposes and building blocks for pursuing collaborations, followed by the guiding principles for establishing strong and mutually beneficial partnerships. This section also includes a short description of the main tactical instruments and techniques from the point of view of general HPC collaborations, as well as the practical modes and a collaboration matrix for facilitating the design and the forthcoming tuning process of a platform on which PRACE will organize and fulfill its collaborative activities with other organizations.

As one of the main goals of PRACE is to offer high-quality HPC services to users from both academia and industry, this section advocates additional efforts that can lead to a broader and stronger global positioning and partnership of PRACE AISBL with countries and regions outside Europe as well as for reviewing best practices for HPC and possibly exchanging HPC resources. It is extremely important to protect the future collaboration plan from any unrealistic expectations, wrongly set goals and badly-structured formats. To this end, it is essential to examine thoroughly a group of checkpoints that can give beneficial information to some of the most important questions in collaboration processes: What are the scientific and technological advantages and perspectives? What is the impact of engaging in the collaboration on the European HPC community and on industry and society in general? What is the added value of the collaboration for PRACE AISBL and its users from academia and industry?

In addition, the proposed collaboration platform does not pretend to be the perfect solution that suits equally all countries outside Europe and research organizations in Europe or is even applicable to all cases, but it is foreseen as a component of the future PRACE Collaboration Plan. This plan should underpin efficient and effective partnerships by seeking solutions of specific scientific challenges or technological matters, in which the collaboration of multiple stakeholders is crucial. Of course, in the PRACE case, for a collaboration to be successful it is necessary that all parties are engaged. Furthermore, a multistakeholder approach should be systematically built up and strengthened in order to create added value for all parties involved. It is essential that all parties understand well the collaboration and the added value for each party. One example is IESP where the most important HPC organisations in USA, Japan and Europe are combining efforts to analyse the software challenges of future Exascale machines in order to define a common Roadmap for future actions. This is a typical example of a HPC specific collaboration that will bring added value to all partners and eventually even to other HPC stakeholders of countries outside the collaboration.

4.1 Purposes of the collaboration plan

Following an upsurge in formal and informal collaboration mechanisms at global, regional and national levels, the collaboration functions of interest for PRACE may range from policy development and advocacy of best practices for HPC (e.g. for the peer review process for awarding HPC resources, PRACE AISBL organisation development, etc.) to combined operational activities (e.g. evolution of the structure and organisation of the distributed HPC resources, choice of new architectures, etc.), information sharing (e.g. software development, new hardware technologies, etc.) and joint training activities.

While there is no rule which defines a perfect mechanism, a clear recognition has emerged throughout all sectors that individual organisational objectives and achievements are increasingly dependent upon the capacities and capabilities of others. This sense of interdependence is also reflected in attitudinal changes of HPC organisations seeking more globalisation (mainly national or regional) in order to reach optimal return on the investments made.

Though collaboration is still regarded by some as a potential threat to institutional interests under various circumstances, in the case of HPC it is increasingly “a default option” and less an exception to the rule when it comes to policy development, advocacy, operational activities and information sharing. For instance, PRACE AISBL is a good case study of the recognised importance of collaborations at European scale, especially because the investments necessary to cover needs of users regarding different supercomputer architectures are too steep to be taken in charge by a single country.

The first step that should be taken in order to mitigate possible threats and uncertainties in HPC collaborations is to define clear and accurate collaboration aims providing the organizations involved with answers to possible concerns, defining the potential areas for eligible collaborations, timeframe perspectives, implicit boundaries of the partners and added value of the collaborations for all parties. Moreover, the collaboration purposes should be compliant with and underpin the PRACE AISBL purposes and activities defined in article 3 of the PRACE AISBL Statutes.

Once the HPC initiatives and countries have been identified in sections 2 and 3, and taking also into account the partner’s profile, the collaboration’s aims need to be explored, Examples of such collaboration purposes could include:

- Strengthening the operational, technological and scientific capacities;
- Improving the information and communications processes;

- Exploring new strategic opportunities for HPC scientific and technological development;
- Enhancing R&D and innovative capabilities throughout the HPC sector;
- Boosting the HPC ecosystem integration.

In order to achieve the defined collaboration purposes a successful, sustainable collaboration plan must be designed taking into consideration three major factors: usability, impact, and organizational readiness. With close attention to each of these factors, PRACE is positioning itself to harness the power of the collaboration plan in pursuit of real, sound policy objectives. Additionally, due to the speed of evolution of the HPC market, collaborations need also to be flexible and open to contacts with developers, suppliers and vendors.

An operational approach towards the PRACE purposes is to start with a small number of purposes and then gradually add new dimensions to the PRACE collaboration agenda. This is the preferred approach if subsequent analysis of the major factors shows inadequate results.

4.1.1 *Current status and directions*

According to the PRACE AISBL Statutes "preparing any research and development work necessary for the definition and optimization of HPC systems and related services, both directly and through external partnerships or collaborations" is defined as one of the main activities directly linked to the achievement of the PRACE AISBL purposes (art. 3, paragraph 2). Furthermore, a strong implicit role of collaborations can be found in the achievement of the activities described under subparagraph a) and b), art. 3, paragraph 2 of the PRACE AISBL Statutes.

From the organizational point of view, "the relationship to be established with organizations from countries that are not members of the European Community or international organizations" (art. 14, paragraph 5, subparagraph - n) and "the terms and conditions under which agreements may be entered into regarding the long term use of the resources made available by the Association, or collaborations with third countries or groups of countries regarding the Association and its Members, establishments or organizations" (art. 14, paragraph 5, subparagraph – t) need the Council resolutions adopted by a qualified majority of contributions corresponding to the percentage of the total contributions to reach a threshold set by the resulting value of the division of the number of Hosting Members by the number of Hosting Members plus one.

According to the description of the importance of collaborations in the PRACE AISBL Statutes, there is still an open issue regarding the operational execution of collaboration activities as part of the PRACE AISBL processes and procedural model, reaping the full benefits that collaborations can bring. In many aspects PRACE still needs to continue to step up efforts and resources by initiating and/or developing inclusive and well-structured collaboration initiatives, in particular regarding Petascale computing that continues to mature, the software and the science and industry issues it addresses and even to a greater extent towards the next generation of Exascale perspectives and challenges.

4.1.2 *Collaboration in future contexts*

The general collaboration guidelines concern the inter-relationships among the changing dimensions, dynamics of scientific challenges and new forms of collaboration. We have attempted to identify some of the critical changes in the environment in which HPC

organisations such as PRACE AISBL will have to operate and develop over the coming decade and the various innovative practices that will alter many aspects of traditional collaboration practices and structures:

- **Shifting nature of HPC drivers.** Factors that will expose science and technology challenges in the future will be both familiar and unfamiliar to the present HPC ecosystem. Those that will be familiar will include conventional HPC drivers, but their dimensions and impacts will be greater, and their scale in most cases might be much higher;
- **Changing dynamics and dimensions of HPC applications**. The dynamics and dimensions of HPC applications will most likely change in at least three respects: they will be more synchronous, parallel and global;
- **Increasing the number of the stakeholders included**, e.g. industry, governments, and scientific communities will increase substantially over the next decade in at least three ways: i. HPC resources will be increasingly globalised and less divided into "developed" and "developing"; ii. major social, economic and environmental issues will generate the need for new HPC applications and perspectives; iii. large-scale groups of stakeholders will benefit from long-term HPC solutions arising out of major issues such as climate changes and environmental disasters; energy production and sustainability – from nuclear energy to fundamental chemistry of catalysts; health protection and ageing of populations; etc.
- **Broadening of the HPC offer**. HPC will increasingly depend upon economic instruments complementary to conventional technological and scientific inputs. Greater attention will be paid to social and economic needs, and accordingly HPC sites will expand the range of services they provide. The capacity to anticipate and monitor HPC development through specially designed systems will increase significantly.
- **Adopting new standards of accountability**. The interest of the funding agencies in providing funding assistance as one understands it today will increase when compared to the level of interest and expenditure over the past decade. There are many reasons for this, including the pressures for higher and sustainable growth that governments will face in the years to come, the alternative industrial and commercial opportunities that assets such as HPC will provide, etc. These opportunities will raise the emerging calls for appropriate and adequate funding allocation linked with highly appreciated quantitative variables, such as economic and social impact.

4.1.3 *Basic collaboration principles*

For future partnerships, PRACE AISBL should guarantee the achievement of its success and development, as well as promoting the social and economic impact of HPC in Europe, by ensuring that involved parties pursue collaboration efforts which adhere to the following **guiding principles**:

- **Fee free and public sharing of common results** – the intellectual property created in the collaboration must be made available for commercial and academic use by every partner free of charge, e.g. use of open source software, software related industry standards, software interoperability and other publicly available programs as may be agreed to by the collaborating parties;

- **Leveraging of core competencies** - partnerships between involved parties should be developed in the way that core competencies of all parties are valued and leveraged. Although financial contributions may sometimes be very useful, other types of collaboration activities, such as expertise in software development, resource interoperability, joint training events, best practices for peer review, etc., would benefit significantly from access to the expertise, resources, and global, national, and regional networks of the various partnering sites;
- **Needs-driven and predictability** - working together to ensure that all collaboration efforts aim at meeting identified needs and respect the culture, customs, and structures of all partners involved. Needs in specific HPC fields should be determined through professional assessments performed in collaboration with the providers and the user communities. All parties should work together to ensure that their collaboration efforts are clear and do not have unintended consequences. They should be engaged in making their collaboration efforts as flexible as possible in order to redirect them to areas of greater need if required. Involved parties should work together to develop partnerships that are predictable in nature. To this end, long-term partnerships should ideally be developed in which **needs, efforts** and **risks** are identified in advance, and all related relationships and processes are defined in advance for effective partnership implementation. A good balance of the needs and the efforts necessary for achieving these needs is especially important in HPC collaborations when new developments (either in hardware or software) can have important consequences in terms of funding and usage decisions. Risk analysis is also fundamental to avoid wrong decisions that may jeopardize the interests of the HPC users and the success of PRACE AISBL.
- **Relationships with Governments and European Commission (EC)** - working together to engage national and EC authorities as much as possible in their collaboration efforts when appropriate. In the context of these efforts, partners outside Europe should be assured that the proposed relationships respect the organizational policies and operational independence of all parties involved;
- **Building local capacity** - aiming to build local HPC capacity and resources in the context of collaboration efforts. Though this may not be possible in all contexts, all parties should work together to always ensure that their efforts do not undermine their local HPC capacity. They should continue their own HPC capacity development,if necessary by integration into large HPC distributed resources and thus improve the impact of their relationships on the communities involved;
- **Distinction between research and commercial activities** - establishing a clear separation between managing partnerships for open R&D and pre-competitive R&D and those responsible for technology product development/prototyping and production. Special attention needs also to be devoted to any dissemination restrictions of pre-commercial developments. Parties should be aware of these restrictions typical of the HPC domain when engaging into collaborations.
- **Public relations –** working together to ensure that public relations activities accurately reflect the collaboration efforts and respect the communities involved. It is essential that all parties decide on a plan for their communications strategies in advance if possible, taking into consideration each organization's policies, procedures, and communication needs;
- **Reporting, monitoring and evaluation -** working together to ensure public reporting on the collaboration efforts using clear, consistent, and transparent reporting policies. Furthermore, all parties should be engaged in working together with HPC

communities to monitor and evaluate the impact of their collaboration efforts on the involved target groups. They should be responsible for developing and using defined procedures to qualitatively and quantitatively monitor and evaluate their efforts with the aim of being as systematic and impartial as possible for generating best practices to improve future engagement.

4.1.4 *Collaboration modes*

Having fixed the PRACE collaboration purposes and main principles, it is necessary to clarify the potential techniques that should be utilized during the implementation stage keeping in mind factors such as: trade-offs; weighing advantages against the associated challenges (organisational, financial, scientific and technological); and assessing the organizational capabilities, structure, and assets required to manage those challenges.

- **Ad-Hoc collaboration** - it is not based on explicit processes. Collaboration may happen, but it is still dependent on individual initiatives and skills, and its success depends on the relationship and/or affinity among involved persons from the participating parties;
- **Open collaboration** – based on self-organizing processes within the partner organisations that are based on members' initiatives and are open to modifications at any time without being obliged to a top-down assignment. Allowing for organization members to define and choose the processes by themselves is critical to the success of the engagement. For instance, open collaborations and its associated technological developments have a significant impact on HPC;
- **Planned collaboration -** processes in the partner organizations start to be modified by aiming at including basic collaboration instruments. The first attempt to achieve it is by planning for the collaboration itself. Planning comprises formalizing groups, roles and responsibilities (all forms of awareness) and defining the appropriate communication channels among group members. Coordination is another strong aspect at this level;
- **Aware collaboration -** the processes include activities for which all parties are quite aware of their tasks and responsibilities and are actively committed towards them. Regarding awareness, all stakeholders must understand the process in which they are engaged, the main objectives, their roles and responsibilities and how their activities are related with others to perform these objectives. Additionally, processes at this level explicitly consider a shared knowledge repository for storing group outcomes. The participants in the processes must be aware of this repository and know that they must contribute to it by updating their work results.
- **Strategic collaboration -** a strategic relationship allows the partners to concentrate their key resources on their core competency or knowledge in some additional strategic areas while delegating management of the principal risks and some other less favorable tasks to external organizations.This made-to-measure approach is founded on detailed analysis of the specific strengths and needs of the partners in a given area. This approach can lead to various forms of partnership when the partner is seeking to make an alliance to reduce its risks and guarantee success or getting ground in new strategic directions.
- **Moderated collaboration** – development of practical collaboration mechanisms that allow any group members to propose modifications on certain work assignments, but

keep the leading role of so called “author” to select and allow edits from other group members.

PRACE collaborations, due to the specific and complex character of the PRACE organization, may most probably start as ad-hoc and open collaborations between groups of persons interested in developing a specific HPC software, hardware or even organization issue before evolving into more formal collaborations. Instruments that PRACE can implement in order to achieve its predefined purposes include, but are not restricted to, the following: joint projects (including public-private partnerships); stakeholder analysis; definition of a strategy to reach the key objectives and outcomes; networking; training; co-ordination of standardization efforts; resource exchange, etc.

4.2 PRACE opportunities for global and European collaboration

As a truly European organization, PRACE ASIBL has clear pan-European and international goals, including integration of European Tier-0 and Tier-1 resources and stronger engagement in the formulation and roll-out of the international HPC agenda towards to the next generation Exascale machines, applications and services.

4.2.1 *Case studies*

The PRACE project has established several collaborations with other European organisations which can be used as case studies for future collaborations PRACE AISBL will be willing to establish. Among those European collaborations we can refer to and analyse the collaborations with European e-Infrastructure Forum (EEF) and European Exascale Software Initiative (EESI). As case studies EEF and EESI have also the advantage of being very different organisations.

EEF is a policy Forum with focus on the discussion of principles and practices to create synergies for distributed Research Infrastructures. The main goal of EEF is the achievement of seamless interoperation of leading e-Infrastructures serving the European Research Area, focusing on the needs of the user communities that require services which can only be achieved by collaborating Research Infrastructures. The main interest of PRACE in this collaboration is to follow up on the experiences and best practices of other large Research Infrastructure organisations and also finding means of interacting with some of the services offered by these organisations.

EESI on the other hand is an initiative with the goal of building a European vision and roadmap to address the challenge of the new generation of massively parallel systems composed of millions of cores which are expected to provide Exaflop performances in 2020. This initiative addresses also the software challenges presented by present and future Petaflop/s systems. The collaboration with EESI is fundamental for supporting the optimal usage of the present Petascale and future Exascale resources made available by PRACE to researchers of all scientific fields for which HPC is essential. Collaboration with EESI may be seen as a part of PRACE support towards the users of the PRACE Research Infrastructure.

These two collaborations are good examples of possible collaborations for PRACE AISBL and prove that it is advisable for PRACE AISBL to engage in collaborations with a broad range of organisations to benefit from the experiences and practices of these organisations and to foster the usage of HPC by European researchers.

4.2.2 *Steps of the collaboration process*

Before starting the pure collaboration process PRACE AISBL has to define the minimum eligibility criteria that each partnering side should meet. There are several options for this approach including: preparation of PRACE's list of potential partners; engaging into collaborations on a case by case basis; open for collaboration to all countries that have potential interest to became PRACE partners.

At the next stage the steps of the collaboration process need to be defined. An example of a conceptual flow of steps in the collaboration process has been established as follows (see the diagram in

Figure 1).

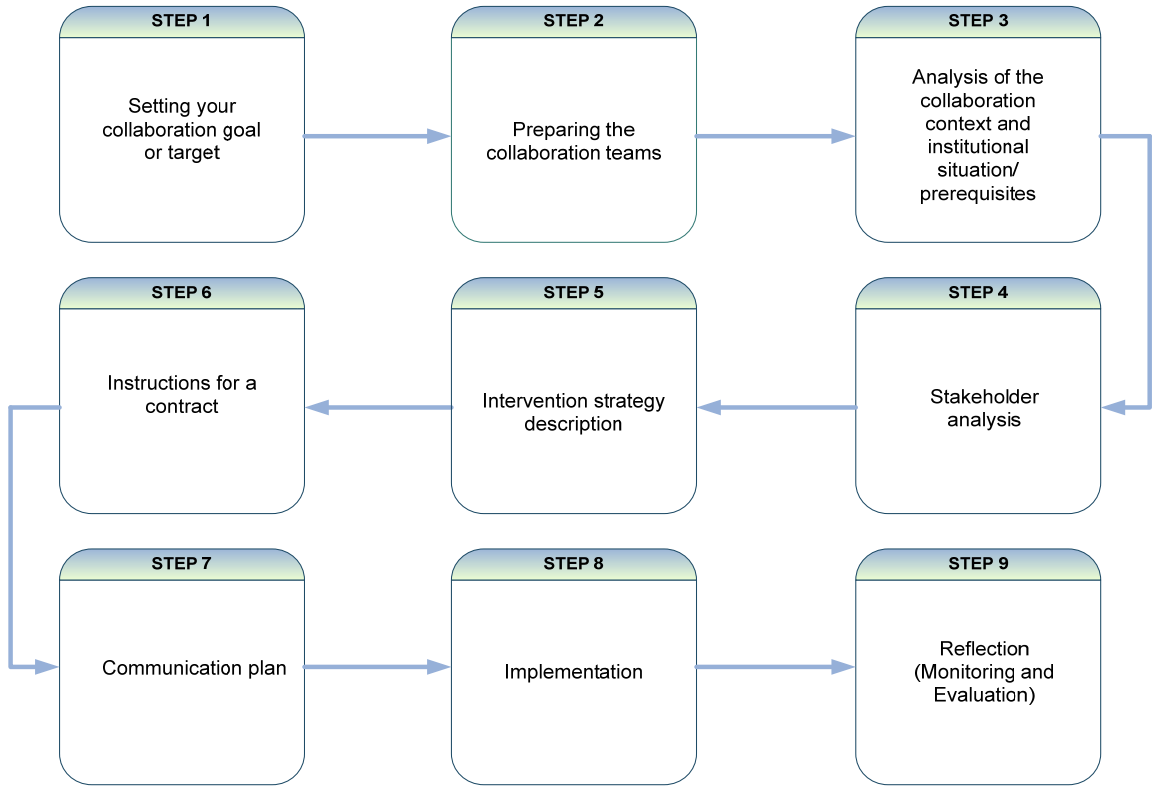

Figure 1: Process for setting up collaborations

Some of these steps are not only of the responsibility of PRACE, but also of the partners engaged in the collaboration. Thus, it is quite essential that the potential partners to be involved in the setting up of the collaboration process enter at the earliest possible step.

In order to strengthen the collaboration process, i.e. define the starting points, refine the operational mechanism and precisely set up the expected results, a collaboration matrix has been developed (see Table 2: Collaboration Matrix).

The Collaboration Matrix is organised around collaboration partners and PRACE AISBL areas of interest for the collaborations. There is no mandatory obligation as to what comes first - potential partner or the PRACE areas for collaboration. Either the collaboration area can be identified first and then the suitable partner, or vice versa. Therefore, the entry points can

be chosen as the collaboration partners or the areas of interest for collaborations as in section 5.

The most important collaboration partners for PRACE AISBL are (see Figure 2: Potential partners for PRACE AISBL collaborations):

- International organizations;
- Other HPC initiatives;
- Governments and European Commission;
- Non-PRACE partners in Europe;
- Scientific, technological and engineering communities;
- Media ecosystem;
- Industry.

The next step is to define in each of the identified areas for collaboration what PRACE AISBL can offer or the possible benefits of partnership with the targeted organizations. It is important to emphasise that the PRACE areas for collaborations are coupled with the PRACE collaboration purposes identified in subsection 4.1.

The PRACE AISBL areas of interest for the collaborations could include:

- Operational technological and scientific capacities;
- Information and communication;
- Strategic HPC development;
- R&D and innovative capabilities;
- HPC ecosystem integration.

After defining the potential partners and the possible areas of interest for setting up collaborations it is possible to analyse the processes for establishing the collaboration (see the Collaboration Matrix for more details) as well as potential outcomes. The Collaboration Matrix analyses for each partner and for each area of interest the main points (topics and elements) the possible collaboration should focus on. The matrix gives a tool for analysing a wide range of possible collaboration activities, i.e. for each type of partner, PRACE AISBL collaborations in all areas of interest are analysed and the main procedures to be approached by the collaboration partners are given.

The topics and elements in each category corresponding to a certain partner's group are indicative and should be examined as a starting point in each collaboration team work. During the analysis period the scope and content of the collaboration topics and elements might be extended in conjunction with the potential partners.

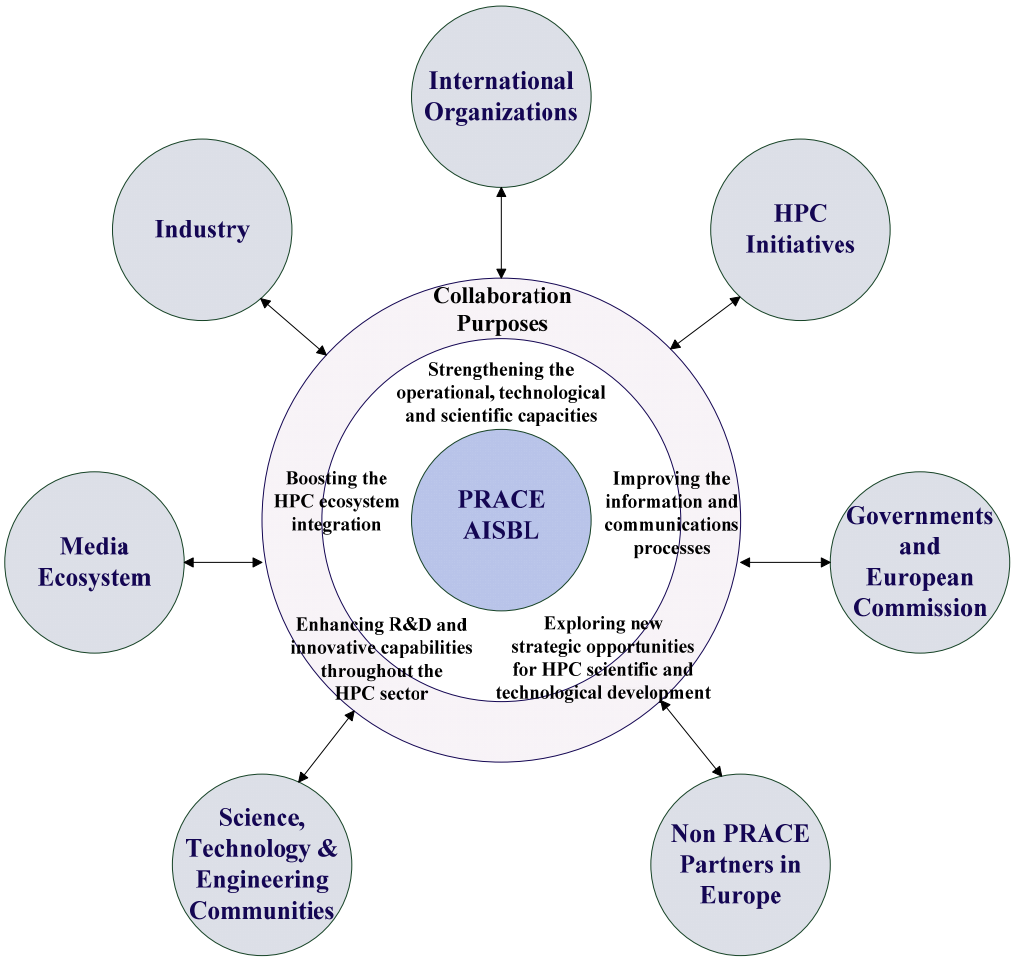

Figure 2: Potential partners for PRACE AISBL collaborations

The Collaboration Matrix provides valuable information for PRACE collaboration teams on drafting the boundaries, identifying the potential partners, shaping the links and the communications tools, defining the resources required and specifying the timelines and the necessary activities. Using the results of the Collaboration Matrix PRACE AISBL will be a step closer to answering the following questions:

- What can PRACE offer potential partners?
- What can potential partners offer PRACE ?
- What are we looking for from potential partners?
- What are the real benefits from the collaboration?

Collaboration Matrix

Areas of interest / Partners	Operational, technological and scientific capacities	Information and communication	Strategic HPC development	R&D and innovative capabilities	HPC ecosystem integration
1. International organizations	- Coordination on a range of common services leading to economies of scale - Conduct cross-comparative assessments	- Establish shared incentives for dissemination of knowledge between organisations - Establish agreed mechanisms for sharing information - Agree structure for distributing costs for knowledge sharing, including data and analysis - Agree on a strategy for structuring frequent communication whilst encouraging key participants to communicate freely on specific issues of concern or interest - Increase participation in established information sharing initiatives for information sharing and strategic planning - Make use of online mechanisms of information sharing	- Identify policy expectations of each party, making the value of activities and outcomes for each organisation explicit - Develop collaborative policy formulation guidelines to reduce concerns over conflicting organisational interests - Conduct mapping of global vulnerabilities to prioritize collaborative policy formulation initiatives - Provide input to policy formulation by facilitating bottom-up information exchange, e.g. through forums, field visits and online networks - Invest in joint strategic planning activities to improve working relationships and develop understanding of common challenges - Conduct regular partner visits to enhance both the partnership and its work - Encourage leaders and key individuals to engage in collaborative processes by developing working	- Establish a dedicated forum for global HPC research and analysis - Use bilateral meetings to gain consensus on which innovation initiatives require support - Agree on responsibilities and division of associated activities and resources relating to innovation to share risk across participating organisations - Share information on adoption of new technologies, ac-counting for potential competitive concerns - Identify common areas of potential for shared innovation and risk management	- Promote awareness and transparency about HPC ecosystem through briefings, online networks, etc. - Seek collaborative input on HPC ecosystem through interagency meetings and workshops - Conduct collective review of global trends in HPC demands - Identify strong networks and HPC alliances that are already formed and target these for joint advocacy initiatives

Areas of interest / Partners	Operational, technological and scientific capacities	Information and communication	Strategic HPC development	R&D and innovative capabilities	HPC ecosystem integration
			relationships with their 'opposite numbers' - Create shared incentives for collaboration and make these explicit within strategic plans - Facilitate staff exchanges between intergovernmental organisations (IGOs) and PRACE AISBL		
2. Other HPC initiatives	- Develop joint understanding of RI and operational procedures - Form working agreements to avoid duplication of efforts - Increase scope of activities in staged increments to build shared knowledge and experience and provide opportunities to disseminate lessons learned	- Create or enhance information sharing	- Conduct reflective workshops at various stages of policy formulation process to enable ongoing input to policy development, 'reality checks' and promote acceptance - Carry out joint assessments and situational analyses - Establish a staff-exchange scheme to promote mutual awareness and understanding of operations and practice to inform strategic planning at all levels	- Establish working groups to identify, prioritise and implement appropriate innovation initiatives	- Facilitate cooperation of all tiers - Hold small-scale, locally driven workshops to facilitate bottom-up transfer of knowledge on HPC ecosystem
3. Governments and European Commission	- Create and facilitate opportunities for key government officers to visit HPC events - Establish collaborative Public Service Delivery initiatives by developing partnerships with government departments. - Provide	- Invest in effective communication mechanisms to promote transfer of knowledge - Disseminate e-newsletters to share information with governments rapidly and efficiently	- Identify supportive government ministers and establish and maintain contact with these individuals - Establish interdepartmental working groups with governments on key policy issues to ensure policy continuity through broader base government support	- Conduct collaborative HPC research together with governments and/or local non-governmental organisations (NGOs) as key partners in all aspects of the research processes - Establish forums to allow information on innovation initiatives to be constructively	- Utilize government contacts to widen scope and reach of HPC ecosystem - Target information campaigns at governments to increase political awareness of existing collaborative initiatives

Areas of interest / Partners	Operational, technological and scientific capacities	Information and communication	Strategic HPC development	R&D and innovative capabilities	HPC ecosystem integration
	awareness campaigns and technical and scientific advisory support.		- Develop guidelines to facilitate HPC coordination - Acknowledge and account for the time-cost of collaboration initiatives within strategic plans - Make explicit how collaboration builds mutual confidence and trust in strategic planning activities	shared with government partners	
4. Non-PRACE partners in Europe	- Develop plans for assistance to new regional partners - Identify value-added and comparative advantage in areas of regional assistance to capitalize on respective expertise	- Share information gathering and communication structures and resources to enhance two-way transfer of knowledge	- Conduct regional forums to secure input from new and existing partners - Facilitate the establishment of long-term partnerships with and between new regional partners	- Identify and gain support for regionally-focused collaborative innovation initiatives	- Hold workshops to identify shared HPC objectives
5. Scientific, technological and engineering communities	- Establish operations-focused engineering and emerging technology forum to identify, priorities and implement appropriate HPC innovations - Initiate or enhance Collaborative Research Support Programs for HPC, developing research activity in European universities - Support research training schemes for local	- Enhance existing information networks to encourage bilateral information flows to improve quality of information - Establish shared objectives with science and engineering community	- Identify and support 'policy champions' in the scientific communities, supporting training courses to develop skills in communicating research, engaging in policy debates, and dealing with the media - Support symposia between policy-makers and scientists to improve dialogue, translation of culture, terminology and practices to facilitate engagement	- Promote awareness of practical constraints through joint conferences in order to adapt innovation adoption processes to HPC organizations -	- Agree priorities for the development of further global research organizations or Intergovernmental Panels to address HPC

Areas of interest / Partners	Operational, technological and scientific capacities	Information and communication	Strategic HPC development	R&D and innovative capabilities	HPC ecosystem integration
	researchers which promote training in innovative qualitative and participatory methodological research tools to redress balance with currently dominant quantitative techniques		- Identify and make use of established 'think tanks' tasked with bridging research and policy - Produce technically-focused guides on impact of HPC to assist the understanding of key issues - Develop multiple points of contact in the scientific, technological and engineering communities, i.e., 'strategic bridging', to improve information flow into planning process		
6. Media Ecosystem	- Evaluate the contribution of media and communications organizations in representing HPC, and actively apply this learning within and across all organizations involved - Identify dispersed networks of HPC actors to integrate with existing online communities supporting operational capacity, e.g. providing financial, technical or informational assistance	- Establish collaborative programs, developing a shared understanding of HPC and media constraints - Encourage managers of existing information sharing sites to offer low bandwidth options - Identify communities with common interests and promote two-way information exchange - Investigate and publicize the existing range of user-friendly, online resources to encourage data and information collecting, processing and dissemination	- Use communications networks to promote HPC awareness - Promote locally-rooted policy positions through online networks to strengthen policy development and support - Develop awareness and, where necessary, provide training to encourage shift from off-line to on-line interaction for traditional policy collaboration structures - Utilize online networks to facilitate and involve 'hard to reach' partners in policy formulation activities - Establish a global alliance of media	- Provide training to increase understanding within media of appropriate innovation requirements, and opportunities to encourage them, e.g. through awards or other publicity - Establish processes to communicate relevant challenges for the online community of technical volunteers	- Initiate regular HPC meetings with media partners to agree principles of coverage and greater understanding of HPC issues - Establish resources for monitoring, cross-referencing and moderation towards partnerships with online HPC groups

Areas of interest / Partners	Operational, technological and scientific capacities	Information and communication	Strategic HPC development	R&D and innovative capabilities	HPC ecosystem integration
			and PRACE actors to provide oversight and partnerships - Harness global intelligence on emerging trends and issues through Wiki-based (or even incentive-based) information sharing sites		
7. Industry	- Develop a range of joint training partnerships - Identify areas of expertise and comparative advantage to maximize input to operations - Agree on types and levels of publicity required by each party - Review previous and existing initiatives to identify recognized strengths and weaknesses towards operational improvement	- Hold discussions to ascertain areas of shared interest - Set up means of two-way information exchange to encourage and facilitate participation of wider corporate sector partnerships, including partners' suppliers - Develop communication strategies in partnership with industry for risk awareness campaigns	- Invest in long-term trust building measures - Establish dedicated forums to discuss success factors and lessons learned following successful collaboration on relief efforts, towards improving collaboration on HPC - Enhance policy collaboration and ensure policy continuity through agreed personnel handover mechanisms - Eliminate barriers, eg, technological, structural, that could exclude local business participation in policy formulation - Promote understanding of partners' business objectives as an organizational requirement - Sustain collaborative relationships through regular dialogue and interaction to ensure collaboration	- Promote assistance from private sector in training and processes for end-user problem identification - Develop real-time systems to manage, through e.g. a resolution committee, collaboration interests with corporate stakeholder needs - Seek input from industry on end user-focused innovation - Identify possible linkages between innovative business solutions and industry support and allocate resources to the establishment of these partnerships	- Develop awareness of HPC issues through training provision to private sector employees and staff exchange programs with HPC organizations - Seek input to HPC strategy, whilst identifying benefits of program to local businesses and community - Support existing industry activities in HPC awareness, possibly through joint training mechanisms

Areas of interest / Partners	Operational, technological and scientific capacities	Information and communication	Strategic HPC development	R&D and innovative capabilities	HPC ecosystem integration
			process is not simply contractual, but rather an inclusive and participatory process - Ensure interests of HPC organizations and companies are being recognized; explore commitments to alleviate private sector concerns of external threats from industry competitors - Establish or enhance channels of communication to handle concerns over contending interests, thereby improving trust and encouraging collaborative efforts		

Table 2: Collaboration Matrix

The collaboration matrix proposed above represents a useful tool for forming relationships with potential partners in different areas of high interest to PRACE. As an important technique the matrix should not be considered as a fixed and static form of predefined topics and elements. Instead, the matrix should be periodically updated and modified in order to provide a reliable, efficient and effective instrument for PRACE in the collaboration process.

An essential stage in the implementation of the collaboration matrix is the identification of risk factors. Operational procedures and controlling issues have been identified as factors that can jeopardize the accurate and quality implementation of the Collaboration Matrix. Further steps to mitigate all identified risks will systematize the PRACE collaboration efforts broadening the internal evaluation and actively facilitating comparison and analysis on a larger scale. This will lead to improvement of knowledge sharing, strengthening of weak-tie relationships, mapping of informal organizational structures, and enhancing the efficiency of team and group activities.

The risk analysis will need to be done taking into account the specific partners involved and the coverage of the partnership. It is possible that a single collaboration will extend over several areas of interest and this will need to be taken into account in the risk analysis. An essential issue is the balance between the collaboration partners.

All these aspects must be considered if we wish to exploit collaborations in order to strengthen the European HPC community in its relations with the global HPC ecosystem. Naturally, PRACE AISBL will need to make sure that the collaborations established will be in agreement with the main purposes defined for the PRACE Association in its Statutes.

4.2.3 *Opportunities and advantages*

Having a clear understanding about the positive effects that successful collaborations can bring to PRACE is a prerequisite for future stronger support and the partners' involvement in the collaboration planning process. Special attention should be paid to the added value of the collaborations with countries outside the EU.

The following opportunities and advantages in the context of HPC development have been identified:

- **Validation by third parties**. The validation of external data, necessary for various analyses which need to be done by PRACE, is a difficult, time-consuming issue and in many cases linked to specific analysis. This means that the team producing the data cannot always devote the needed time to the validation effort, which can quickly become a continuous, tedious process. Having contributions to validation by third parties does not only help to improve the quality and reliability of the data, but also to avoid the unavoidable skew of auto-validation. The main advantages in this area will be to set up the means and procedures for allowing collaboration in the whole chain up to the validation process, and validation by third parties, in particular, since some data will be provided by third parties, these validation procedures will help to improve the quality of the datasets. This can apply to external data necessary for, e.g., monitoring and measuring the social and economic impact of the PRACE organization; software and hardware development used by other organizations, etc.
- **Sharing of ideas and approaches**. Although scientific publications contribute to the spread of new ideas and approaches in the scientific fields dependent on HPC for their development, many details are not obvious from the scientific literature, and need a more personal relationship. In particular, early discussion of new approaches may allow for a faster refinement, and helps to avoid duplication of effort. The willingness to share ideas is not necessarily followed by the actual sharing of the ideas. In fact, these procedures are usually complex, and built with more focus on functionality than usability. Therefore, close contact between potential users and the creators of new ideas is of great importance for their reuse. This is the case for software and hardware developments that need a more personalised approach of creators and potential users as well of new scientific ideas developed by using PRACE resources. PRACE should as much as possible foster and disseminate all types of new ideas, i.e. either to improve the usage of the PRACE resources or obtained by using the PRACE resources.
- **Creation of a critical mass of knowledge and information**. This opens many opportunities for collaboration and creation of a truely critical HPC mass that helps to maintain the good position of PRACE in the international landscape. This should also ease the transfer of scientific results to the market, promoting HPC to companies and public administrations, and the creation of start-ups interested in marketing services based on those results.
- **Contact with other international groups**. The creation of the previous critical HPC mass should also help to convert it as the focal point for other groups at the international level. Coordination with similar efforts, especially in USA, Japan, China, South Korea, India and Brazil, should be taken into consideration on an equal basis.

- **Involvement of industrial and community partners**. It would be beneficial to take advantage of the involvement of industry and community partners in PRACE projects either of purely computational or scientific character, helping them to understand and communicate not only with the projects in which they participate directly, but also with others. In addition, common events where these partners and other interested parties could participate and share know-how with all the involved projects will help to have a broader impact and feedback. Good examples are PRACE symposia, PRACE Industrial Seminars, the PRACE User Forum, training events and Schools open to academia and industry, etc.
- **Joint meetings and global workshops**. In general, the plan is to co-locate the meetings with events attended by persons involved in international projects and other interesting initiatives. These will be sponsored by ongoing projects. This will help dissemination, high quality contributions, the reviewing process, and of course interesting discussions during workshops. These workshops are expected not to be only a place for networking with other relevant international initiatives, but also a showcase for the main results of the projects involved. These types of meetings may also increase the visibility of PRACE AISBL, attract more users and increase the socio-economic and scientific impact of PRACE AISBL.
- **Establishment of joint reference datasets**. Agreement on specific data and parameter sets that can be used for benchmarking and performing reference studies is a well identified target. The establishment of a joint archive of those datasets will be explored by the involved projects. This could represent an important factor for future procurements of PRACE AISBL computer resources.
- **Involvement in global communities with the same interest**. This action should help to understand better the needs and issues of the potential users of the results produced by the involved projects, and obtain feedback about the results. This will be of major interest for future developments of PRACE AISBL in order to provide better services to the users.

Future HPC challenges, including scientific and technological disruptions and emerging opportunities will affect the types of knowledge, organisational capacities and commitments that will be required by research organisations. Of critical importance is HPC development which depends increasingly on collaboration and less upon the ring-fenced multidimensional expertise of any single organisation.

5 Recommendations for the Collaboration Plan

Nowadays a successful and sustainable collaboration strategy must be designed around three major factors: usability (i.e. intuitive, versatile user experience**),** impact (i.e. clear benefits to the HPC users), organizational readiness (i.e. honest assessment of collaboration capacity).

5.1 Recommendations for effective collaboration processes

The following general considerations apply to efforts for creating a successful collaboration:

- Collaboration requires a sufficient commitment by all participants to work together by sharing information, resources, and know-how.
- To be effective, the collaboration often requires trained, professional facilitators in addition to regular staff.
- Facilitators, either ad hoc or present during the whole partnership period, should act as impartial observers, making recommendations for improving collaborative practices.
- Public and private funding sources often fail to understand the time required to create and sustain collaborative efforts and set implementation deadlines that do not provide sufficient planning time.
- Collaboration requires from the very beginning a common vision, goals and language; then the direction and possible outcomes can be fixed from the start, and specialized terminology from different sectors will not hamper the members' ability to understand each other.
- Adequate staff, whether voluntary or paid, is essential. Collaboration involves numerous tasks that cannot be left to chance. At the same time, the staff must contribute their expertise without taking control of the process.
- Collaborative efforts should encourage communication between diverse constituencies and participation by those normally left out of traditional processes, taking into account that multisector collaboration is difficult and complex, requiring time and patience.
- Common courtesy is one of the most essential characteristics of collaboration. This includes the acceptance of others opinions, acknowledging, listening to people, and treating people with respect.
- A clear governance structure with lines of accountability is essential to ensure that the complex collaborative process does not end in confusion.

These recommendations though seeming rather general for most collaborations, have been adapted and recommended for the particular case of collaborations of interest for PRACE AISBL.

In the process of shaping the collaboration framework, PRACE AISBL needs to take into consideration the following prerequisites for successful collaboration:

- Trust reinforcement should be raised to a level that facilitates information sharing and responsibility definition and execution as key factors of all problem-identification and problem-solving activities.

- Partnerships with international and national HPC initiatives are more effective and therefore more desirable than with individuals representing only themselves;
- PRACE should not restrict the geographical coverage of the potential partnerships to countries outside Europe. Collaborations should be chosen according to specific criteria to prevent PRACE from wasting resources on collaborations with limited potential benefits. The following criteria should be taken into consideration:
  - ✓ Duration of collaboration activities;
  - ✓ The process as end result;
  - ✓ The scale of the process;
  - ✓ Creativity;
  - ✓ Flexibility and empowerment;

.

- Time constraints on potential partners, who intend to engage into collaboration activities with PRACE, can be a major barrier to the collaborative process. This should be taken into consideration when planning collaborative actions.
- Communication within participating PRACE organizations is as important as communication between PRACE and its collaboration partners. PRACE should take the responsibility to coordinate the overall collaboration process so that all contributions are effective and coherent.

5.2 Case for actions and next steps

As a permanent pan-European RI providing world-class HPC systems for world-class science PRACE could not allow itself to stay away of the discussions and the following actions that will influence and impact the scope and guidelines for global HPC development reaching sustainable multi-Petascale boundaries and moving towards the Exascale horizon. Having set up the conceptual framework for collaboration activities, PRACE needs to define and start up a handful number of strong and sustainable partnerships.

5.2.1 *Role of PRACE in international Exascale initiatives - G8, EESI and IESP*

There is a clear understanding and recognition that the approaching Exascale threshold can be accelerated by gathering together broad international scientific and engineering efforts and resources. Projects and initiatives such as IESP, EESI and G8[1] are good examples for mobilized international efforts and resources in the exploration of the next Exascale machine(s) and applications.

The examples of IESP, EESI and G8 confirm this report's conclusions for the establishment of partnerships. Approaching both Exascale undertakings by a simple replication of initially defined collaboration patterns should be avoided by taking into account the leading forces behind each one, such as key participants, applicable instruments and techniques as well as

[1]The **Group of Eight** (**G8**, and formerly the **G6** or **Group of Six**) is a forum, created by France in 1975 for the governments of six major economies: France, Germany, Italy, Japan, the United Kingdom, and the United States. In 1976, Canada joined the group (thus creating the G7). In 1997, the group added Russia, thus becoming the G8. In addition, the European Union is represented within the G8, but cannot host or chair.

the expected results. Without considering all these factors it can easily turn into the next "routine talkative setting" leading to unsatisfactory results and in some degree compromising collaboration efforts. This does not exclude some common activities, but underlines the unique characteristics and expected results by each party in the collaboration process.

An example of potential PRACE strong collaboration opportunities with the IESP, EESI and G8 includes the following areas and actions:

- PRACE in support of European presence in IESP:
  - Exchange experience and information on many key performance characteristics of a broad range of Exascale software and organisational issues and challenges;
  - Alignment of the PRACE efforts to the next generation of HPC issues and challenges with efforts in the other non-European countries represented in IESP, including hardware, software and application issues;
  - Organisation of joint HPC events and collaborative participation on international conferences such as ISC and SC;
  - Dissemination of results obtained both by PRACE and IESP.

- PRACE as a facilitator of joint European participation in EESI initiative:
  - Dissemination of information about forthcoming PRACE calls as well as results obtained in the framework of PRACE;
  - Organization of joint HPC events and collaborative participation on international conferences such as ISC and SC;
  - Exchange experience and information on progress in many of the application areas defined and in progress by participants in EESI;
  - Identify the sources of competitiveness for Europe induced by the development of Peta/Exascale solutions and usages as well as the European strengths and weaknesses, in the overall international HPC landscape and competition;
  - Alignment of the efforts of PRACE on application scalability with similar efforts in the USA, Japan and China.
  - Participation in the definition of a European policy and Roadmap for tackling the present and future hardware and software issues of the new Exascale supercomputer systems.

- PRACE as a facilitator of joint European participation under G8 initiatives:
  - Dissemination of information about forthcoming PRACE calls as well as results obtained both by PRACE and G8;
  - Organization of joint HPC events and collaborative participation on international conferences such as ISC and SC;
  - Exchange experience and progress on many of the results obtained by G8 successful applicants to PRACE resources and on the PRACE training events;
  - Provision of technical support to applicants in the preparation of preliminary access proposals to apply for possible G8 calls;

- Provision of expertise, technical and scientific support on international review panels;
- Alignment of the efforts of PRACE on application scalability with efforts in the USA and Japan.

From a pure operational perspective, PRACE AISBL can follow up and strengthen the existing collaborations with IESP, EESI and G8 by initiating a round of discussions with PRACE members participating in these initiatives about future forms of cooperation and coordination.

5.2.2 *Next steps*

With a list of key countries and/or initiatives for potential partnerships obtained from section 2.

Survey of World HPC initiatives, further steps are necessary to transform the proposed collaboration plan platform into future successful PRACE AISBL collaboration partnerships. This plan includes concrete actions and a timeframe:

1. Preparing the collaboration teams for every collaboration partner identified (steps 1 to 6) based on the Collaboration Matrix preferably with the involvement of representatives from industry.

   Indicative Deadline: June 2011.

2. Establishment of contacts with representatives of the identified initiatives and countries and identification of the main interest for collaboration in the following four areas – software, hardware, applications, exchange of information regarding the allocation process, mainly regarding monitoring of the projects' results and analysis of their impact (scientific, social and economic).

   Indicative Deadline: September 2011

3. Analysing the collaboration context and initiatives, institutional situation and prerequisites (from the PRACE AISBL side, this means following its purposes and principles).

   Indicative Deadline: September 2011

4. Providing the Council with a proposal for the PRACE Collaboration Plan, 2012-2015, including:

   a. Resources (budget and funding; human resources needed; technical and physical support);

   b. An operational mechanism for partnerships - collaboration activities description and assignment of roles – following the collaboration types and matrix and eventual formalisation of collaborations through Memorandum of Understanding;

   c. A timeframe for creating and carrying out 5-8 partnerships till 2015.

   Indicative Deadline: October 2011

5. Contacting WP2, task 2.2 Processes for the Research Infrastructure working group in order for a PRACE advisory committee/group to be created as a focal point of PRACE AISBL efforts and relationships with non-European HPC stakeholders.

   Indicative Deadline: October 2011

6. Preparation of the Communication Plan – sharing of information; organization of Trusted Forums and their operations – Industry and Scientific Seminars; Users Forums; Joint Workshops and trainings such as EU-US training.

7. Indicative Deadline: January 2012PRACE Collaboration Plan initial monitoring and assessment - identifying strengths and weaknesses and providing insights for prioritizing future PRACE collaboration efforts.

   Indicative Deadline: June 2012

All the above steps can be initiated within the framework of Task 4.4 of the PRACE-1IP project. Additional support can be provided by Task 4.4 during the discussion and refinement of the proposal for the plan of PRACE collaborations with the BoD of PRACE AISBL. Finally, it is the responsibility of the PRACE AISBL BoD for finalising the PRACE

collaboration plan, for proposing it for approval to the Council of PRACE AISBL and finally for executing the collaboration plan approved by the Council.

6 Conclusions

This document presents a survey of organisations and initiatives of interest for potential PRACE AISBL collaborations including different types of organisations in Europe and worldwide. For obvious reasons institutions of the members of PRACE AISBL were not included in this survey, but the other European initiatives have been added in order to have a complete vision of the global HPC scenario.

The organisations and the initiatives are reported following a geographical distribution, for the sake of simplicity. For each initiative, the description of the main goals, the duration of the activities (when applicable) and a list of contact persons is given. In addition, a classification regarding the type of the organisation is indicated. The organisations/initiatives analysed during the survey have a good geographical distribution and cover most possible points of interest for collaborations of PRACE AISBL. From this information it will be possible to identify suitable partners for potential collaborations.

Different types of possible collaborations from ad-hoc to more structured collaborations are analysed in detail and the methodology for analysing the value and decision of engaging into collaboration is also discussed.

The advantages and the benefits of a collaboration have been explored and include, for example:

- Strengthening the operational, technological and scientific capacities;
- Improving the information and communications processes;
- Exploring new strategic opportunities for HPC scientific and technological development;
- Enhancing R&D and innovative capabilities throughout the HPC sector;
- Boosting the HPC ecosystem integration.

A Collaboration Matrix cross-analysing possible areas of interest for PRACE AISBL collaborations with different types of partners is then presented.

This Collaboration Matrix covers a very wide range of possible collaborations with different types of partners and for each collaboration the necessary processes for establishing the collaboration are indicated.

Finally, the deliverable concludes with a proposal of a Collaboration Plan for establishing collaborations to be presented to the PRACE AISBL Council for approval and for starting the collaboration process. This Collaboration Plan is preceded by a set of possible recommendations for the successful execution of the Collaboration Plan proposed.

Annex

Annex I - Contact Form

Template contact form provided to PRACE staff for collecting contact data of HPC initiatives.

PRACE 1IP WP4 – Task 4.4

Please provide the following information for each of the initiatives you are aware of, involved, collaborate with…

HPC Initiative 1 (name and acronym)

Initiative Level	Involved countries
Local	
National	
European	
International	

Initiative Starting date (approx.):
Initiative End date (approx.)

Keywords: (e.g. HPC, Grid Computing, Distributed Data Services, Remote Visualization… in order to focus what's the initiative for…)

Short description of the Initiative:
……..
……..
……..

Initiative main outcomes (if any):
e.g. "The DEISA initiative sponsored a number of DECI project which are at the leading edge of computational science in the world… bla bla bla…"

Initiative contacts (Max. 3):

Name1	Role/Institution1	e-mail1
Name2	Role/Institution2	e-mail2
Name3	Role/Institution3	e-mail3

Initiative Web Site:

Any other relevant feature of the Initiative:
……

Annex II - contact forms collected by PRACE partners involved in this task (grouped by geographical region)

Worldwide

Intergovernmental Panel on Climate Change (IPCC)

Initiative Level	Involved countries
Local	
National	
European	
International	X

Initiative Starting date (approx.): 1988
Initiative End date (approx.)

Keywords: Climate research; HPC

Short description of the Initiative:
The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change. It was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a clear scientific view on the current state of knowledge in climate change and its potential environmental and socio-economic impacts. The UN General Assembly endorsed the action by WMO and UNEP in jointly establishing the IPCC.

The IPCC is a scientific body. It reviews and assesses the most recent scientific, technical and socio-economic information produced worldwide relevant to the understanding of climate change. It does not conduct any research nor does it monitor climate related data or parameters.

Thousands of scientists from all over the world contribute to the work of the IPCC on a voluntary basis. Review is an essential part of the IPCC process, to ensure an objective and complete assessment of current information. IPCC aims to reflect a range of views and expertise. The Secretariat coordinates all the IPCC work and liaises with Governments. It is supported by WMO and UNEP and hosted at WMO headquarters in Geneva.

The IPCC is an intergovernmental body. It is open to all member countries of the United Nations (UN) and WMO. Currently 194 countries are members of the IPCC. Governments participate in the review process and the plenary Sessions, where main decisions about the IPCC work programme are taken and reports are accepted, adopted and approved. The IPCC Bureau Members, including the Chair, are also elected during the plenary Sessions.

Because of its scientific and intergovernmental nature, the IPCC embodies a unique opportunity to provide rigorous and balanced scientific information to decision makers. By endorsing the IPCC reports, governments acknowledge the authority of their scientific content. The work of the organization is therefore policy-relevant and yet policy-neutral, never policy-prescriptive.

Initiative main outcomes (if any):
Coordination of scientific research on climate change

Initiative contacts (Max. 3): Filippo Giorgi, ICTP- Trieste Italy, giorgi@ictp.it

Initiative Web Site: http://www.ipcc.ch/

Any other relevant feature of the Initiative: Intergovernmental organization

International Thermonuclear Experimental Reactor (ITER)

Initiative Level	Involved countries
Local	
National	
European	
International	X

Initiative Starting date (approx.): 2006 formally
Initiative End date (approx.)

Keywords: Fusion research; HPC

Short description of the Initiative:
ITER is a large-scale scientific experiment that aims to demonstrate that it is possible to produce commercial energy from fusion.
During its operational lifetime, ITER will test key technologies necessary for the next step: the demonstration fusion power plant that will prove that it is possible to capture fusion energy for commercial use.

Initiative main outcomes (if any):
Capturing fusion energy for commercial use.

Initiative contacts (Max. 3):

Osamu Motojima	Director-General	directorgeneral@iter.org
Most European countries have a ITER delegation, and should be easy to ask PRACE partners for contacts		
Members of PRACE SSC and AC are involved in ITER		

Initiative Web Site:
http://www.iter.org/

Any other relevant feature of the Initiative:
High needs of HPC resources

Europe

e-Infrastructure Reflection Group (e-IRG)

Initiative Level	Involved countries
Local	
National	
European	X
International	

Initiative Starting date (approx.): 2003
Initiative End date (approx.) permanent forum

Keywords: e-Infrastructure policy group

Short description of the Initiative:
The main objective of the e-IRG e-Infrastructure initiative is to support the creation of a political, technological and administrative framework for an easy and cost-effective shared use of distributed electronic resources across Europe. Particular attention is directed towards grid computing, storage, and networking.

The e-Infrastructure Reflection Group was founded to define and recommend best practices for the pan-European electronic infrastructure efforts. It consists of official government delegates from all the EU countries. The e-IRG produces white papers, roadmaps and recommendations, and analyses the future foundations of the European Knowledge Society.
Important issues within the e-IRG are currently:

- e-infrastructures in European Commission's Framework Programmes
- a policy for resource sharing
- a registry/repository for European resources
- coordination of new national and EU funding programs
- better links and synergies between Europe and other regions (e.g. USA, Japan) engaged in similar activities

Initiative main outcomes (if any):
e-Infrastructure Roadmaps, Blue Papers, Task Forces on e-Infrastructure related topics

Initiative contacts (Max. 3):

Gudmund Host (chair)	The Research Council of Norway, Norway	gho@forskningsradet.no Norway
Lajos Balint (co-chair)	NIIF/HUNGARNET, Hungary	lajos.balint@niif.hu Hungary

Initiative Web Site:
http://www.e-irg.eu/

Any other relevant feature of the Initiative:
e-IRG is also supported by e-IRG Support Programme (e-IRGSP), a project supported by the EU

European e-Infrastructure Forum (EEF)

Initiative Level	Involved countries
Local	
National	
European	X
International	

Initiative Starting date (approx.): 2010
Initiative End date (approx.)

Keywords: Synergies for distributed Infrastructures

Short description of the Initiative:
The European e-Infrastructure Forum is a forum for the discussion of principles and practices to create synergies for distributed Infrastructures. The goal of the European e-Infrastructure Forum is the achievement of seamless interoperation of leading e-Infrastructures serving the European Research Area. The added value of this forum is that by explaining, sharing and aligning their policies the members can learn from each other and improve the services they offer to their users. As a result, the users will be able to make use of the range of resources offered by Europe's e-Infrastructures with the minimum of technical and administrative barriers. Each e-Infrastructure expects to be able to offer a broader range of facilities to users due to closer interaction of interoperable Infrastructures.
The objectives of the forum are to:

- Share information within the group on status and direction of e-Infrastructures
- Gather input and form common opinion on subjects that will impact the long-term goals, function and effectiveness of Europe's e-Infrastructures
- Present a common view on e-Infrastructures to peer groups elsewhere in the world
- Provide input on the vision and model for Europe's e-Infrastructures
- Be able to offer a clear added-value to key user communities by offering them access to Europe's e-Infrastructures in a coordinated manner and help them devise computing models that make use of the European e-Infrastructures
- Interact with emerging structures to transmit the experience gained from existing production Infrastructures and formulate common user requirements

The membership of the forum is limited to representatives of large-scale, multi-national, multi-disciplinary Infrastructures. New members of the forum will be invited to join subject to agreement by a majority of the existing members. The initial membership is drawn from the following Infrastructures:

- EGEE
- EGI
- DEISA
- PRACE
- Terena
- GEANT

Initiative main outcomes (if any):
Establishment of close links with major European research user communities, funding agencies, standardization and policy bodies relevant for its mission. This forum will offer a way of interacting as a whole with user communities of a multi-national nature that are interested in making use of the Infrastructures.

Initiative contacts (Max. 3):

Thomas Lippert PRACE representative)	FZJ, Germany	th.lippert@fz-juelich.de
Patrick Aerts	NCF/NWO, The Netherlands	p.aerts@nwo.nl

Initiative Web Site: http://www.einfrastructure-forum.eu/

Any other relevant feature of the Initiative:
PRACE is a member of EEF, this collaboration may be used as a reference for future collaborations.

International Exascale Software Project (IESP)

Initiative Level	Involved countries
Local	
National	
European	
International	X

Initiative Starting date (approx.): 2008
Initiative End date (approx.)

Keywords: HPC; Software stack; Exascale computing
Short description of the Initiative:
The guiding purpose of the IESP is to empower ultra-high resolution and data-intensive science and engineering research through the year 2020 by developing a plan for:
(1) a common, high-quality computational environment for petascale/exascale systems;
(2) catalyzing, coordinating, and sustaining the effort of the international open source software community to create that environment as quickly as possible.

Initiative main outcomes (if any):
Production of a technology roadmap for high-end scientific computing with focus on the software stack and building components for future Exascale supercomputing.

Initiative contacts (Max. 3):

Jack Dongarra	University of Tennessee, USA	dongarra@cs.utk.edu
Thomas Lippert	FZJ, Germany	th.lippert@fz-juelich.de
Peter Michielse	NCF, The Netherlands	p.michielse@nwo.nl

Initiative Web Site:
http://www.exascale.org/

Any other relevant feature of the Initiative:
Contacts with software developers and software producers and vendors.

European Exascale Software Initiative (EESI)

Initiative Level	Involved countries
Local	
National	
European	X
International	

Initiative Starting date (approx.): 01/06/2010
Initiative End date (approx.): 31/12/2011

Keywords: HPC, Software development for Petascale

Short description of the Initiative:
The European Exascale Software Initiative (EESI) goal is to build a European vision and roadmap to address the challenge of the new generation of massively parallel systems composed of millions of heterogeneous cores which will provide Petaflop performances in 2010 and Exaflop performances in 2020.
EESI main goals are:

- Investigate how Europe is located, its strengths and weaknesses, in the overall international HPC landscape and competition
- Identify priority actions
- Identify the sources of competitiveness for Europe induced by the development of Peta/Exascale solutions and usages
- Investigate and propose programs in education and training for the next generation of computational scientists
- Identify and stimulate opportunities of worldwide collaborations

Initiative main outcomes (if any):
Roadmap for European Exascale
Initiative contacts (Max. 3):

Jean-Yves Berthou (Project coordinator)	EDF R&D, France	jy.berthou@edf.fr

Initiative Web Site:
http://www.eesi-project.eu/pages/menu/homepage.php

Any other relevant feature of the Initiative:
PRACE project has collaboration with EESI

EIROforum

Initiative Level	Involved countries
Local	
National	
European	X
International	

Initiative Starting date (approx.): 1950s
Initiative End date (approx.)

Keywords: Research infrastructure, HPC needs

Short description of the Initiative:
EIROforum is a collaboration between eight European intergovernmental scientific research organisations that are responsible for infrastructures and laboratories: CERN, EFDA-JET, EMBL, ESA, ESO, ESRF, ILL and European XFEL. It is the mission of EIROforum to combine the resources, facilities and expertise of its member organisations to support European science in reaching its full potential.

Initiative main outcomes (if any):
Fostering collaborations between large research organizations;
Common base for negotiations with EC, national governments, industry, etc.;
Production of documents on science policy.

Initiative contacts (Max. 3):

Michael Watkins	Head of Programme/Head of International Collaborations EFDA-JET, Culham Science Centre, UK	info@eiroforum.org
Name2	Role/Institution2	e-mail2
Name3	Role/Institution3	e-mail3

Initiative Web Site:
http://www.eiroforum.org/

Any other relevant feature of the Initiative:

Includes organizations with HPC needs.

ELIXIR (European Infrastructure for Biological Information)

Initiative Level	Involved countries
Local	
National	
European	*Partners:* United Kingdom, Germany, the Netherlands, France, Spain, Italy, Hungary, Switzerland, Denmark, Sweden, Finland, Iceland *Also involved:* Norway, Estonia, Latvia, Lithuania, Poland, Czech Republic, Slovakia, Austria, Ireland, Belgium, Luxembourg, Portugal, Cyprus, Greece, Israel, Malta, Romania, Slovenia
International	

Initiative Starting date (approx.): 1 November 2007
Initiative End date (approx.) Preparatory phase ends 31 Dec 2011, whereafter Implementation phase begins 1 Jan 2012.

Keywords: Databases, Tools, Data integration, HPC, Grid Computing, Distributed Data Services, Dedicated Network connections, Secure data access.

Short description of the Initiative:
The mission of ELIXIR is to construct and operate a sustainable infrastructure for biological information in Europe to support life science research and its translation to medicine and the environment, the bio-industries and society.

ELIXIR will be a distributed infrastructure arranged as a hub and nodes, with the hub at the European Molecular Biology Laboratory's European Bioinformatics Institute (EMBL-EBI) in Hinxton, UK. As the hub, EMBL-EBI will be responsible for holding the core data collections, administrating ELIXIR and coordinating ELIXIR nodes. Nodes will provide pan-European expertise in one or more of the following areas:

- data resources;
- bio-compute centres;
- specific biological challenges and focus areas;
- infrastructure facilities for integration of biological data, software, tools and services;
- services for the research community, including training and standards development.

Initiative main outcomes (if any):

Since 2008, extensive consultation with stakeholders in academia, industry and funding agencies throughout Europe has identified how ELIXIR can best function to serve Europe's life scientists, operate in partnership with national research strategies and support world-class research. The scope and organisation of ELIXIR has been defined in line with these purposes, also incorporating the context of the other ESFRI biological infrastructures. Work package reports from the preparatory phase, which were produced as part of the consultation process, can be viewed online at the ELIXIR website.

In April 2010 we issued a request for suggestions for prospective ELIXIR nodes. Almost 50 responses from 20 countries were submitted, identifying centres providing data resources, compute capacity, facilities and support services and thereby defining the landscape of potential ELIXIR nodes.

Initiative contacts (Max. 3):

Prof. Janet Thornton	Project coordinator and director EMBL-EBI	thornton@ebi.ac.uk
Dr Andrew Lyall	Project manager	alyall@ebi.ac.uk

Initiative Web Site:
http://www.elixir-europe.org/

Any other relevant feature of the Initiative:
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EuroBioimaging (European Biomedical Imaging Infrastructure)

Initiative Level	Involved countries
Local	
National	
European	Sweden, Norway, Finland, Denmark, Estonia, Germany, Poland, Czech Republic, Hungary, Austria, Switzerland, Belgium, the Netherlands, France, United Kingdom, Ireland, Spain, Portugal, Italy, Greece, Cyprus, Slovenia, Croatia, Israel
International	

Initiative Starting date (approx.): 2008
Initiative End date (approx.) Preparatory phase begins at the end of 2010

Keywords: Imaging, Advanced Microscopy, Databases, Image analysis

Short description of the Initiative:

Euro-Bioimaging is one of four new biomedical sciences projects included in the European Strategy Forum on Research Infrastructures (ESFRI) roadmap update (published in December 2008), Euro-Bioimaging aims to become a European Research Infrastructure (RI) that will address the requirements for biomedical imaging stretching from basic biological imaging to medical imaging.

Euro-BioImaging will address the imaging requirements of both basic and medical imaging communities by creating nodes in many ESFRI member states that will deploy imaging infrastructure in a coordinated and harmonised manner and thus address the fragmentation of such efforts currently present in Europe.

Via the combination of technological and strategic objectives, Euro-BioImaging will provide key elements of successful infrastructures: supporting research, training and innovation in biomedical imaging across Europe.

Initiative main outcomes (if any):

Initiative contacts (Max. 3):

Jan Ellenberg	Scientific Coordinator ALM, EMBL	
Stefan Schönberg	Scientific Coordinator MI, EIBIR	
Antje Keppler	Project Manager, EMBL	keppler@embl.de

Initiative Web Site:
http://www.eurobioimaging.eu/

Any other relevant feature of the Initiative:
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INSTRUCT (European Integrated Structural Biology Infrastructure)

Initiative Level	Involved countries
Local	
National	
European	Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Israel, Italy, the Netherlands, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom
International	

Initiative Starting date (approx.): preparatory phase starting 2008
Initiative End date (approx.)

Keywords: Structural biology, X-ray crystallography, NMR, Structural refinement, Structural calculation

Short description of the Initiative:

INSTRUCT will link the information obtained by the major structural biology methods with state-of-the-art cell biology techniques to provide a dynamic picture of key cellular processes at all scales. Major technology advances, from high throughput methods in protein production, through NMR and X-ray crystallography to electron microscopy mean that major investment in infrastructure is required to maintain European competitiveness. INSTRUCT comprises a dynamic distributed infrastructure of complementary Core, Associate and National Affiliated Centres of excellence open to external user access and driving technical innovation: Core Centres will provide European access of ~20% of total activity to a range of state-of-the-art structural biology technologies and integrative biological approaches and expertise, often offering access to a 'pipeline' of related technologies; Associate Centres will offer specialised technologies or services complementary to that provided by Core Centres and essential to the development of integrative structural biology, for example protein production, mass spectrometry, software development; and National Affiliated Centres are centres of excellence that provide additional opportunities for access to specific structural biology technologies.

INSTRUCT will stimulate the development of innovative technologies by European companies and their effective uptake by both academic and industrial researchers in Europe. European structural biology equipment manufacturers are amongst the foremost in the world. INSTRUCT offers them an opportunity to work with the best researchers in Europe to develop and test the next generation of equipment. The European pharmaceutical industry is already a major user of synchrotron beamlines. INSTRUCT will provide a straightforward route for industry to access all structural biology technologies in order to facilitate a more integrative approach to drug discovery that will enhance the competitiveness of European pharmaceutical and biotechnology industries. INSTRUCT will be ideally placed to act as a forum, drawing together European scientists and other relevant European organisations and activities to develop new approaches, harmonised protocols and standards for data management systems that integrate structural information across technical platforms and across Europe.

Initiative main outcomes (if any):

Initiative contacts (Max. 3):

Prof. David Stuart	University of Oxford	
Dr Claudia Alen Amaro	Scientific project manager	claudia@strubi.ox.ac.uk

Initiative Web Site:
http://www.instruct-fp7.eu/

Any other relevant feature of the Initiative:
……

BBMRI (European Bio-banking and molecular resources)

Initiative Level	Involved countries
Local	
National	
European	Sweden, Austria, the Netherlands, Finland, Germany, United Kingdom, Malta, Hungary, Spain, Italy, Estonia, Ireland, Iceland, Norway
International	

Initiative Starting date (approx.): 2009
Initiative End date (approx.) now in implementation phase

Keywords: Biobanks, patient data, secure data, information management systems.

Short description of the Initiative:
BBMRI will sustainably secure access to biological resources required for health-related research and development intended to improve the prevention, diagnosis and treatment of disease and to promote the health of the citizens of Europe.

A biobank stores, processes, and distributes biological materials and data associated with the material. These biological materials include all types of human biospecimens, such as tissue, cells, blood or DNA. As research data from such samples can be linked with data from medical records, environmental exposure, lifestyle information and other medically relevant information, biobanks are considered invaluable resources for medical research. The samples stored in biobanks are used by researchers for studying genetic and other molecular as well as environmental factors underlying diseases and influencing their outcome. In many cases, scientists need to be able to pool and exchange relevant information held in other similar repositories to reach the statistical power needed or to compare research data generated from different populations. Therefore, interoperability of biobanks facilitating international collaboration is essential.

Initiative main outcomes (if any):

BBMRI builds on existing sample collections, resources, technologies, and expertise that are specifically complemented with innovative components. In particular, BBMRI comprises i) all major population-based and diseaseoriented
biobanks; ii) biomolecular resources, such as collections of antibodies and other affinity binders and a variety of molecular tools to decipher protein interactions and function of bio-molecules, cells and model organisms to study human diseases; iii) bio-computing and sample storage infrastructure, iv) scientific, technical as well as ethical and legal expertise. All resources are integrated into a pan-European distributed hub-and-spokelike infrastructure that is properly embedded into European scientific, ethical, legal, and societal frameworks.

Initiative contacts (Max. 3):

Prof. Kurt Zatloukal	Coordinator	kurt.zatloukal@medunigraz.at
Prof. Eero Vuorio	Executive manager	eero.vuorio@utu.fi

Initiative Web Site:
http://bbmri.eu

Any other relevant feature of the Initiative:
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IS-ENES (Infrastructure for European Network for Earth System Modelling)

Initiative Level	Involved countries
Local	
National	
European	France, Germany, Finland, United Kingdom, Greece, Italy, Sweden, Spain, the Netherlands, Romania
International	

Initiative Starting date (approx.): 1 March 2009
Initiative End date (approx.) 28 February 2013

Keywords: Climate modeling, HPC, Data storage, Distributed Data Services, Visualization

Short description of the Initiative:

IS-ENES, Infra**S**tructure for the **E**uropean **N**etwork for the **E**arth **S**ystem Modelling is an FP7-Project funded by the European Commission under the Capacities Programme, Integrating Activities.

Climate Earth system models are key tools to understanding climate change and its effects on society and are at the basis of the **I**nternational **P**anel on **C**limate **C**hange projections (**IPCC**).

The **E**uropean **N**etwork for **E**arth **S**ystem **M**odelling (**ENES**), through IS-ENES, promotes the development of a common distributed modelling research infrastructure in Europe in order to facilitate the development and exploitation of climate models and better fulfill the societal needs with regards to climate change issues.
IS-ENES gathers 18 partners from 10 European countries and includes the 6 main European Global Climate models. IS-ENES combines expertise in climate Earth system modelling, in computational science, and in studies of climate change impacts.

Initiative main outcomes (if any):

Initiative contacts (Max. 3):

Sylvie Joussaume	Coordinator	sylvie.joussaume@lsce.ipsl.fr
Marie Garcia	Project manager (2011--)	
Mathieu Reboul	Project manager (--2010)	Mathieu.reboul@lsce.ipsl.fr

Initiative Web Site:
http://isenes.enes.org/

Any other relevant feature of the Initiative:
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NDGF (Nordic DataGrid Facility)

Initiative Level	Involved countries
Local	
National	
European	Sweden, Norway, Denmark, Finland, Iceland
International	

Initiative Starting date (approx.): 2006 (2nd version of NDGF)
Initiative End date (approx.) During 2011, NDGF will be transferred to the 3rd version of NDGF

Keywords: Grid computing, Large-scale storage, CERN, Bioinformatics, Distributed data services.

Short description of the Initiative:

The Nordic Data Grid Facility, NDGF, is a collaboration between the Nordic countries (Denmark, Finland, Norway, Sweden). The motivation for NDGF is to ensure that researchers in the Nordic countries can create and participate in computational challenges of scope and size unreachable for the national research groups alone.

NDGF is a *production grid* facility that leverages existing, national computational resources and grid infrastructures. To qualify for support research groups should form a virtual organization, a VO. The VO provides compute resources for sharing and NDGF operates a grid interface for the sharing of these resources

Initiative main outcomes (if any):

The pilot NDGF infrastructure was operational in 2002-2005, and provided distributed storage in addition to the NorduGrid computing resources. It was present in Denmark, Finland, Norway and Sweden, with both storage hardware and dedicated personnel. During this phase, NDGF committed to support ALICE activities in Nordic countries, and, most importantly, to provide a Nordic Tier1 for WLCG. Specifics of this Tier1 are such that it has to be an internationally distributed Facility. Though this was perceived as a very challenging task, Nordic Grid experts demonstrated the possibility of a distributed Tier1 by contributing substantially to ATLAS Data Challenges via NorduGrid since 2002, and by taking part in the LCG Service Challenges in 2005 via joint effort of Swegrid and DCSC. Success of these efforts laid the basis for the next phase of NDGF as a long-term facility, providing computing and data storage services not just to HEP community, but to all the Nordic researchers.

The Nordic Data Grid Facility in its present function as a provider of the Nordic Grid Infrastructure was established in April 2006 by the Nordic Research Councils, after thorough analysis of the pilot NDGF project, requirements of the Nordic e-Science communities, and needs of the NorduGrid collaboration. It came into operation on June 1, 2006, and its initial priority is to live up to the original commitment of establishing the Nordic Tier1, with the traditional focus on storage facilities.

NDGF develops middleware (ARC), distributed storage (dCache) and grid runtime environments for high energy physics, bioinformatics, and additional disciplines. Furthermore, NDGF coordinates operations on the Nordic grid and within EGI.

Initiative contacts (Max. 3):

Michael Gronager	Project director	gronager@ndgf.org
Josva Kleist	Software coordinator	Kleist@ndgf.org

Initiative Web Site:
http://www.ndgf.org/

Any other relevant feature of the Initiative:

Cy-Tera: Computational Infrastructure for Science and Technology in Cyprus

Initiative Level	Involved countries
Local	
National	Cyprus, Germany, USA, Jordan
European	
International	

Initiative Starting date (January 2011):
Initiative End date (December 2015)

Keywords: HPC, data storage, computational services

Short description of the Initiative:
The Cy-Tera project aims at creating a research facility including a high-performance computing (HPC) infrastructure supporting cutting-edge scientific applications, with associated user support and computational science research and training programs. The Cy-Tera facility will be the first HPC facility at multi-Tflops level in Cyprus, serving the needs of the Cyprus Institute (CyI) and its partners for frontier research applications in many fields of great scientific and/or societal importance. It will provide the initial funding for the infrastructure of the Computation-based Science and Technology Research Center (CaSToRC).

Initiative main outcomes (if any):
- Computational infrastructure in the tens of teraflops scale able to offer related services to scientific communities
- Training and educational program
- Research outcomes utilizing the developed computational infrastructure

Initiative contacts (Max. 3):

Dr. Despina Saparilla	Project Manage/CaSToRC	d.saparilla@cyi.ac.cy

Initiative Web Site:
Under development; temporary site:
http://www.linksceem.eu/joomla/index.php?option=com_content&view=article&id=61&Itemid=61

Any other relevant feature of the Initiative:

Swedish e-Science Research Center (SeRC)

Initiative Level	Involved countries
Local	
National	Sweden
European	
International	

Initiative Starting date (approx.): 2010-04-22
Initiative End date (approx.): Persistent

Keywords: HPC, Distributed Data Services, Visualization, Data Storage, Application Enhancements

Short description of the Initiative:
SeRC -- the Swedish e-Science Research Centre -- is formed by the universities in Stockholm and Linköping (KTH, Karolinska Institute, Stockholm University and Linköping Univeristy) around the two largest high-performance computing centres in Sweden (NSC at LiU and PDC at KTH).

SeRC will take a national responsibility in the e-Science area in terms of hosting a majority of the Swedish e-Science infrastructure through PDC and NSC (e.g., almost 80% of the total cores and capacity for academic research in Sweden). To ensure commercialization and non-academic use are dealt with at the highest decision making level, SeRC will have an advisory board that includes experts from the private and public sectors alongside international science and e-Science experts. SeRC will also feature industry representatives taking an active role in the e-Science communities. Thus SeRC, as a Swedish e-Science Research Center, will constitute a leading visionary e-Science node with a national scope and strong international ties. The four partner universities are together committed to strengthening and shaping the emerging e-Science landscape in Sweden and to give research in this field clear priority in their strategic plans.

Initiative main outcomes (if any):
This project will bring together a core of nationally leading IT research teams (tool makers) and leading scientists in selected strategic application areas (tool users) and will focus on three main objectives:

1) Formation of e-Science communities that connect application groups with relevant core e-Science groups and computer experts at PDC and NSC.
2) Research in core e-Science methods such as distributed resources, database technology, numerical analysis, visualization and interaction, mathematical modeling, and parallel algorithms—all focusing on problems critical for several e-Science communities.
3) Much closer collaboration between PDC and NSC, and a substantial increase in advanced support staff, which will turn the centers into comprehensive e-Science enablers.

Initiative contacts (Max. 3):

Dan Henningson	Director/KTH	henning@mech.kth.se
Anders Ynnerman	Co-Director/LiU	andyn@itn.liu.se
Mattias Chevalier	Coordinator/KTH	mattias@mech.kth.se

Initiative Web Site:
http://www.e-science.se/

Any other relevant feature of the Initiative:
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Essence of e-Science, eSSENCE

Initiative Level	Involved countries
Local	
National	Sweden
European	
International	

Initiative Starting date (approx.): Jan 1 2010
Initiative End date (approx.) Persistent

Keywords: HPC, Grid Computing, Distributed Data Services

Short description of the Initiative:
eSSENCE is a research cooperation in e-science set up between Uppsala University, Lund university and Umeå university in Sweden. The program was created as a result of a governmental initiative to promote high-quality research in a range of areas of strategic societal and industrial importance. eSSENCE's vision is to develop Swedish e-science research to the highest international level and create a research environment where the interplay between different e-science competences will open up the field for novel applications, more realistic simulations, and new scientific solutions, models and methods. HPC is an integral part of the activity, and the main part of Swedish grid computing research is within eSSENSE.

Initiative main outcomes (if any):
The outcome of eSSENCE will be an eScience environment where an increased awareness among the different eScience actors in applications, algorithms, tools, infrastructure development and education will lead to a much more efficient interplay between the competences and open up the field for novel applications, more realistic simulations, new scientific solutions and unprecedented excellence in eScience.

Initiative contacts (Max. 3):

Sverker Holmgren	Co-director/Uppsala University	Sverker.Holmgren@it.uu.se
Kersti Hermansson	Co-director/Uppsala University	Kersti.Hermansson@it.uu.se

Initiative Web Site: http://essenceofescience.se/

Any other relevant feature of the Initiative

Linking Scientific Computing in Europe and the Eastern Mediterranean-Phase 2; LinkSCEEM-2

Initiative Level	Involved countries
Local	
National	
European	
International	Cyprus, Egypt, Jordan, Germany, USA, France, Israel

Initiative Starting date: 1/9/2010
Initiative End date: 31/8/2014

Keywords: HPC, e-Infrastructure, Integration of Computational Resources, Distributed Data Services, Virtual Research Community, Networking of Communities

Short description of the Initiative:
The LinkSCEEM-2 project aims at the establishment of a high performance computing (HPC) eco-system in the Eastern Mediterranean region by interlinking and coordinating regional compute, storage and visualization resources to form an integrated e-infrastructure.
The main project objective is to enable scientific research in the region by engaging and supporting research communities with an initial emphasis in the fields of climate research, digital cultural heritage and synchrotron radiation applications. To achieve its mission, the project will link e-resources, provide user support and training, carry out targeted networking activities, and, develop and implement a well-structured HPC resource allocation mechanism.
Three regional HPC centres, namely CaSToRC, BA and NARSS contribute computational resources to the integrated e-infrastructure of LinkSCEEM-2. Additional computational centres from the region may participate through integrating their resources during the course of the project.

Initiative main outcomes (if any):

- An HPC e-infrastructure integrating computational resources from three Eastern Mediterranean HPC centers supplemented by a common resource allocation mechanism, a joint user support helpdesk and an established training program.
- A computational science virtual research community from the Eastern Mediterranean countries.
- Scientific codes for the computational science community of the Eastern Mediterranean including cross-disciplinary, climate modeling, cultural heritage and synchrotron data analysis applications; optimized for the regionally available computational infrastructure.

Initiative contacts (Max. 3):

Dr. Despina Saparilla	Project Manage/CaSToRC	d.saparilla@cyi.ac.cy
Dr. Christos Nicolaou	Scientific Coordinator/CaSToRC	c.nicolaou@cyi.ac.cy

Initiative Web Site:
http://www.linksceem.eu

Any other relevant feature of the Initiative: None
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e-INIS

Initiative Level	Involved countries
Local	
National	e-INIS, (Ireland)
European	
International	

Initiative Starting date (approx.): 2008
Initiative End date (approx.): 2013

Keywords: Large-scale data storage and services, The provision of ICT resources & expertise, Access to improved computational and communications resources

Short description of the Initiative:
The e-INIS initiative is intended to provide Irelands research community with access to world-class computational, networking and support infrastructure. Coordinated by the Dublin Institute for Advanced Studies and including a number of key infrastructure and institutional partners, the project aims to provide researchers from a wide range of disciplines with the best of ICT resources including leading-edge HPC, communications and data storage services. The project is funded by the Higher Education Authority under cycle 4 of the Programme for Research in Third Level Institutions, and consolidates a broad range of expertise form national partners. Building on the proven success of the participating infrastructure providers, e-INIS will consolidate and enhance the offerings available to the community and seek to develop sustainable models for the continued provision of the key facilities that comprise a national research infrastructure.

Initiative main outcomes (if any):
e.g. The initiative has provided network links, storage capacity, human expertise and promotion of computational science.

Initiative contacts (Max. 3):

Keith Rocheford	Dublin Institute of Advanced Studies (DIAS)	rochfordk@cp.dias.ie

Initiative Web Site: http://www.e-inis.ie

HellasHPC - Network of Excellence in High-Performance Computing

Initiative Level	Involved countries
Local	
National	Greece
European	
International	

Initiative Starting date (approx.): 01/06/2010
Initiative End date (approx.) 31/12/2010

Keywords:
HPC, National HPC, Greece, user Communities, National Strategy

Short description of the Initiative:

The goal of HellasHPC is the establishment of a national network of excellence in the domain of supercomputing infrastructures and High-Performance Computing (HPC) in general. The network will bring together scientific teams, researchers, and users of HPC from research and academic institutes from all regions of Greece.
The main activity of the network will be a feasibility study in which we will record and present the current situation in Greece and the requirements of the Greek research community in what concerns HPC infrastructures. The study will also include an overview survey of the current state of the art in HPC together with an estimated cost for the potential procurement, installation and management of a HPC system in Greece.
In parallel with the above activities we will also attempt to liaise with all involved parties and build a community of Greek users with common interests in HPC exploitation, both for research and production purposes. Since many of the partners are already active members of the HellasGrid initiative, we will extend the respective Memorandum of Understanding (HellasGrid MoU) in order to include activities relevant to HPC. Finally, in the context of this network of excellence we plan to organise a number of meetings and workshops with the purpose to bring the community together and identify the critical mass of HPC users in Greece.

Initiative main outcomes (if any):
The main outcomes of the initiative are:

- The project conducted an extensive survey of the existing and potential users of HPC in Greece and identified the potential communities.
- It conducted a state of the art survey in HPC and identified the organizational functionalities as well as the hardware trends for the procurement of and HPC system in Greece.
- It created a Memorandum of Understanding between GRNET and a big number of research and academic institutions in Greece that covers HPC related activities in Greece. The MoU is an extention of the existing HellasGrid MoU that covered grid activities in Greece
- It is in the process of defining a National Strategy for the creation of an HPC center in Greece

Initiative contacts (Max. 3):

Vangelis Floros	Project Coordinator/GRNET	efloros@grnet.gr
Ioannis Liabotis	Project Member/GRNET	iliaboti@grnet.gr
Name3	Role/Institution3	e-mail3

Initiative Web Site:

http://www.hellashpc.gr/

Any other relevant feature of the Initiative:

HP-SEE - High-Performance Computing Infrastructure for South East Europe's Research Communities

Initiative Level	Involved countries
Local	
National	
European	Greece, Bulgaria, Romania,Turkey, Hungary, Serbia, Albania, Bosnia and Herzegovina, Former Yugoslav Republic of Macedonia, Montenegro, Moldova (Republic of), Armenia, Georgia, Azerbaijan
International	

Initiative Starting date (approx.): 01/09/2010
Initiative End date (approx.) 31/08/2011

Keywords: HPC, Regional HPC infrastructure, User communities, Computational Physics, Computational Chemistry, Life Sciences

Short description of the Initiative:
HP-SEE focuses on a number of strategic actions. First, it will link the existing and upcoming HPC facilities in the region in a common infrastructure, and provide operational solutions for it. As a complementary action, the project will establish and maintain the GÉANT link for Caucasus. Second, it will open this HPC infrastructure to a wide range of new user communities, including those of less-resourced countries, fostering collaboration and providing advanced capabilities to researchers, with an emphasis on strategic groups in computational physics, chemistry and life sciences. Finally, it will ensure establishment of national HPC initiatives, and act as a SEE bridge for PRACE. In this context, HP-SEE will aim to attract the local political & financial support for long-term sustainable eInfrastructure.

Initiative main outcomes (if any):
The project has recently started and the results are not visible yet. The main objectives are:

- Empowering multi-disciplinary virtual research communities. HP-SEE will involve and address specific needs of a number of new multi-disciplinary international scientific communities (computational physics, computational chemistry, life sciences, etc.) and thus stimulate the use and expansion of the emerging new regional HPC infrastructure and its services.
- Deploying integrated infrastructure for virtual research communities. HP-SEE will provide and operate the integrated South-East European eInfrastructure and specifically the HPC eInfrastructure for the region. In the project context this focuses on operating the HPC infrastructure and specific end-user services for the benefit of new user communities, and establishing the continuation of the GEANT link to Caucasus.
- Policy development and stimulating regional inclusion in pan-European HPC trends. The inclusion of the new Virtual Research Communities and the setting up of the infrastructure, together with a set of coordinated actions aimed at setting up HPC initiatives in the region, aims to contribute to regional development and ensure that countries in this outermost European region will join the pan-European HPC trends

Initiative contacts (Max. 3):

Ognjen Prnjat	Project Coordinator/GRNET	oprnjat@admin.grnet.gr
Ioannis Liabotis	Project Technical Coordinator/GRNET	iliaboti@grnet.gr
Name3	Role/Institution3	e-mail3

Initiative Web Site: http://www.hp-see.eu

Any other relevant feature of the Initiative:

Grid Ireland

Initiative Level	Involved countries
Local	
National	Grid Ireland
European	
International	

Initiative Starting date (approx.): 2004
Initiative End date (approx.): Unknown

KeywordsGrid Computing, Cert Provision

Short description of the Initiative:
Grid-Ireland is a managed layer above the national academic network layer that provides grid services.

Initiative main outcomes (if any): Provision of Grid gateway systems and Certs to academic community.

Initiative contacts (Max. 3):

Brian Coghlan	TCD	coghlan@cs.tcd.ie

Initiative Web Site: http://www.grid.ie/

Any other relevant feature of the Initiative:

Systems Biology Ireland (SBI)

Initiative Level	Involved countries
Local	
National	Systems Biology Ireland (SBI)
European	
International	

Initiative Starting date (approx.): September 2009
Initiative End date (approx.): unknown

Keywords: Systems Biology, quantitative analysis, predictive modelling

Short description of the Initiative:
Systems Biology Ireland (SBI) is a Science Foundation Ireland CSET (Centre for Science, Engineering and Technology. CSETs are centres of excellence designed to help link scientists and engineers in partnerships across academia and industry to address crucial research questions. SBI is an initiative between University College Dublin (UCD) and the National University of Ireland Galway (NUI,Galway) primarily based on the Belfield campus of UCD.

Its intention is that its research will positively impact on the Irish scientific culture and foster the development of new and existing Irish-based technology companies. It aims to attract industry that could make an important contribution to Ireland and its economy, and expand educational and career opportunities in Ireland in science and engineering.

Initiative main outcomes (if any):
e.g. http://www.ucd.ie/sbi/research/

Initiative contacts (Max. 3):

Professor Walter Kolch	Director/UCD	Walter.Kolch@ucd.ie

Initiative Web Site:

Any other relevant feature of the Initiative:
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Complex and Adaptive Systems Laboratory (CASL))

Initiative Level	Involved countries
Local	University College Dublin, Ireland
National	
European	
International	

Initiative Starting date (approx.): unknown
Initiative End date (approx.): unknown

Keywords: Simulation Science & Extreme Events, Network and Data Analysis, Natural Computing & Optimization, Security & trust.

Short description of the Initiative:
The Complex and Adaptive Systems Laboratory (CASL) is a dynamic interdisciplinary research community advancing scientific knowledge through mathematics and computation. The overarching goal for CASL is to become a globally recognised institute in applied mathematics, computational science and informatics, extracting value from data that will provide insight and innovations to help major national and global challenges through computational modelling and data intensive science."

Initiative main outcomes (if any):
e.g. http://www.ucd.ie/casl/research/
Initiative contacts (Max. 3):

Scott Rickard	CASL Director/University College Dublin (UCD)	Scott.rickard@ucd.ie

Initiative Web Site: http://www.ucd.ie/casl/

Any other relevant feature of the Initiative:

USA and Canada

National Science Foundation (NSF) – Office of Cyberinfrastructure (OCI)

Initiative Level	Involved countries
Local	
National	X
European	
International	

Initiative Starting date (approx.): NSF began in 1950
Initiative End date (approx.)

Keywords: Funding Agency, HPC, Storage systems, grids, clouds, Software suits, Programming, Visualization tools

Short description of the Initiative:

The Office of Cyberinfrastructure coordinates and supports the acquisition, development and provision of state-of-the-art cyberinfrastructure resources, tools and services essential to the conduct of 21st century science and engineering research and education.

OCI supports cyberinfrastructure resources, tools and related services such as supercomputers, high-capacity mass-storage systems, system software suites and programming environments, scalable interactive visualization tools, productivity software libraries and tools, large-scale data repositories and digitized scientific data management systems, networks of various reach and granularity and an array of software tools and services that hide the complexities and heterogeneity of contemporary cyberinfrastructure while seeking to provide ubiquitous access and enhanced usability.

OCI supports the preparation and training of current and future generations of researchers and educators to use cyberinfrastructure to further their research and education goals, while also supporting the scientific and engineering professionals who create and maintain these IT-based resources and systems and who provide essential customer services to the national science and engineering user community.

Initiative main outcomes (if any): Funding of HPC research in all scientific fields for academia and industry (mainly through collaborations with academia)
Initiative contacts (Max. 3):

Rob Pennington	Program Director/Software Infrastructure for Sustained Innovation (SI^2) / Strategic Technologies for Cyberinfrastructure (STCI)	rpenning@nsf.gov

Initiative Web Site: http://www.nsf.gov/dir/index.jsp?org=OCI

Any other relevant feature of the Initiative: Support program for "Catalyzing New International Collaborations". Important relationship for peer review procedures and scientific impact of HPC support for researchers.

Compute Canada

Initiative Level	Involved countries
Local	
National	X
European	
International	

Initiative Starting date (approx.):
Initiative End date (approx.)

Keywords: HPC, Distributed Data Services

Short description of the Initiative:

Compute Canada is leading the creation of a powerful national HPC platform for research. This national platform integrates High Performance Computing (HPC) resources at seven partner consortia across the country to create a dynamic computational resource. Compute Canada integrates high-performance computers, data resources and tools, and academic research facilities around the country. These integrated resources represent close to a petaflop of computing capability and online and long term storage with rapid access and retrieval over Canada's national, provincial and territorial high-performance networks.

Working in collaboration, Compute Canada and the university-based regional HPC consortia provide for overall architecture and planning, software integration, operations and management, and coordination of user support for the national HPC platform. As a national organization, Compute Canada coordinates and promotes the use of HPC in Canadian research and works to ensure that Canadian researchers have the computational facilities and expert services necessary to advance scientific knowledge and innovation.

Compute Canada includes the following 7 regional consortia members:

1 – ACnet (Atlantic Computational Excellence Network)

ACEnet is a consortium of seven academic institutions dedicated to enhancing research collaborations throughout Atlantic Canada via technology. The consortium was awarded its first funds by the Canada Foundation for Innovation in the spring of 2004 and is currently installing resources at its five major universities.

Members:
Memorial University of Newfoundland
Saint Mary's University
St. Francis Xavier University
University of New Brunswick
Dalhousie University
Mount Allison University
University of Prince Edward Island

www.ace-net.ca

Russia and peripheral countries

T-Platforms

Initiative Level	Involved countries
Local	
National	
European	
International	X

Initiative Starting date (approx.): N/A
Initiative End date (approx.) N/A

Keywords: manufacturer, vendor, HPC solutions, services and technology provider

Short description of the Initiative:
Established in 2002, T-Platforms Group is rapidly emerging as one of the leading global HPC companies providing comprehensive supercomputing systems, software and services, with customer installations consistently included on the TOP500 worldwide list of the most powerful supercomputers. Currently, T-Platforms Group consists of T-Platforms, T-Services, T-Massive Computing, and T-Design, with locations in Hannover, Moscow, Kiev and Taipei. It palys a significant role in creating of Russian HPC infrastructure and works in close co-opeartion with the Moscow State University, MSU / MSU Supercomputing Center,
Rusnano, e-Arena.

Initiative main outcomes (if any): N/A

Initiative contacts (Max. 3):

Vsevolod Opanasenko	CEO	vsevolod.opanasenko@t-platforms.ru
Mikhail Kozhevnikov	Commercial Director	mikhail.kozhevnikov@t-platforms.ru
Elena Churakova	Marketing Director	elena.churakova@t-platforms.ru

Initiative Web Site: www.t-platforms.ru

Any other relevant feature of the Initiative:

e-Arena National Association of Research and Educational E-infrastructures "e-ARENA"

Initiative Level	Involved countries
Local	
National	X
European	
International	

Initiative Starting date (approx.): N/A
Initiative End date (approx.) N/A

Keywords: e-infrastructure, academic, Grid, telecommunication

Short description of the Initiative:
e-Arena aims to establishing advanced e- infrastructure that provides an access to HPC resources for research, academy and education in Russia. The main goals are:
• To provide an integrated technical policy in the development of domestic electronic infrastructure for research, science and education;
• To consolidate information and communication resources of research and education community for the implementation of targeted programs aimed at developing the electronic infrastructure of the Russian Federation (RF);
• To support and develop the full participation of Russian research and education community in the international infrastructure projects and initiatives;

Association e-ARENA also consolidates the resources of key research and education telecommunication networks of RF (RUNNet, RASNet, RBNet, as well as FREEnet, RSSI, Radio-MSU, etc.).

Initiative main outcomes (if any):
e.g. "The DEISA initiative sponsored a number of DECI project which are at the leading edge of computational science in the world… bla bla bla…"

Initiative contacts (Max. 3):

Marat Biktimirov	CEO of e-Arena	marat@ras.ru
Name2	Role/Institution2	e-mail2
Name3	Role/Institution3	e-mail3

Initiative Web Site:

Any other relevant feature of the Initiative:
For the time being, Russia is a member of the EGI – InSPIRE project (Integrated Sustainable Pan-European Infrastructure for Researchers in Europe) started on 1 May 2010 and co-funded by the EC for four years, as a collaborative effort involving more than 50 institutions in over 40 countries (http://www.egi.eu/projects/egi-inspire/). Russian membership is represented by the autonomous non-commercial organization National Association of Research and Educational E-Infrastructures "e-Arena"

Moscow State University, MSU / MSU Supercomputing Center

Initiative Level	Involved countries
Local	
National	x
European	
International	

Initiative Starting date (approx.): N/A
Initiative End date (approx.) N/A

Keywords: academic, HPC solutions and services provider
Short description of the Initiative:
The Supercomputing Center of Moscow State University.

Initiative main outcomes (if any):

Initiative contacts (Max. 3):

Prof. Vladimir Voevodin Deputy Director, RCC voevodin@parallel.ru, voevodin@vvv.srcc.msu.ru

Initiative Web Site:

Any other relevant feature of the Initiative:

China

Computer Network Information Center (CNIC), Chinese Academy of Sciences (CAS), Supercomputing Center CAS (SCCAS)

Initiative Level	Involved countries
Local	
National	X
European	
International	

Initiative Starting date (approx.): 1995
Initiative End date (approx.)

Keywords: Supercomputing Center, HPC, Data Center, China Scientific Computing Grid (China ScGrid), Visualization software

Short description of the Initiative:
Founded in 1995, Computer Network Information Center (CNIC, www.cnic.cn) of Chinese Academy of Science (CAS, www.cas.cn) is a public support institution for consistent construction, operation and services of informatization infrastructure of CAS. It is also a pioneer, promoter and participator for informatization of domestic scientific research and scientific research management. Faced with the historical opportunities that have been rarely experienced, CNIC has been striving to become a research, development and application basis for advanced network and application technology, backbone and supporting team for construction, operation and services of informatization, construction and training center of informatization supporting team, promotion center, technology center and exhibition center for scientific research informatization construction of CAS; a window for international technological cooperation and exchange with informatization as basis and a national team for basic resources management and operation of internet.

Initiative main outcomes (if any): In 2009, under the guidance of "11th Five-Year Plan" informatization planning, with the construction of informatization support system as basis and informatization security guarantee system and informatization rule standardization system as pillar, CNIC, based on serving CAS and oriented for national demands and local requests, builds informatization infrastructure in supporting scientific research, provides informatization solutions oriented for services and application and serve the scientific research management activities in the whole Academy and the country by surrounding five links in the whole life cycle including production, transmission, storage, processing and application of data in scientific research.

Initiative contacts (Max. 3):

Xue-bin Chi	Director Supercomputing Center of the Chinese Academy of Sciences; member Academic Committee CNIC	chi@sccas.cn

Initiative Web Site: http://english.cnic.cas.cn/

Any other relevant feature of the Initiative:

Africa

Continental Computational Infrastructure

Initiative Level	Involved countries
Local	
National	South Africa
Continental	Africa
International	

1. Initiative Starting date (approx.): October 2008
Initiative End date (approx.): N/A

Keywords: HPC

Short description of the Initiative:

The Department of Science and Technology and IBM launched the Blue Gene for Africa Initiative in Cape Town in October 2008, giving the country access to supercomputing power not previously seen on the continent.

The BG4A has three interlinking thrusts: infrastructure, promoting collaborative with a major impact on the African continent, and human capital development - building of high-end computing capacity in Africa.

Potential projects which could benefit from this initiative are environmental simulations (water management, climate and atmospheric simulations), plant genomics and agricultural modelling, energy, information analytics and complex systems modelling (such as business systems, risk management, financial models, transportation management and health).

http://www.southafrica.info/about/science/ibm-151008.htm

In September 2009 South Africa got its newest supercomputer, a Sun Microsystems hybrid, which went online in Cape Town, providing the local and regional research community with a powerful tool for tackling problems of climate change, energy security and human health. It is housed at the Centre for High Performance Computing (CHPC), a unit of the Council for Scientific and Industrial Research (CSIR). (http://www.southafrica.info/about/science/sun-290909.htm). The system's hybrid architecture is expected to deliver about 27 teraflops of peak computing power. The supercomputer has been installed in the CHPC's newly refurbished data centre. Green computing interventions have been included in the design and construction of the facility.

Initiative management

The BG4A is hosted by the Centre for High Performance Computing, an initiative of the department, and is managed by the Meraka Institute of the Council for Scientific and Industrial Research (CSIR).

1. Meraka Institute (African Advanced Institute for Information and Communications Technology), http://www.meraka.org.za/index.htm

The Meraka Institute is a large-scale intervention in the information and communications technology space to address challenges in both the developed economy (integrated with the global economy) and the emergent economy (characterised by informal economic activity and poverty).

The institute was launched in May 2005. As a national research, it is managed by the CSIR and supported by the Departments of Communication and of Science and Technology.

The institute aims to facilitate national economic and social development through human capital development; application innovation (realising societal benefits through more applied R&D) and advanced research in selected technology domains relevant to the local context, in cooperation with tertiary education institutions.

The institute leverages the potential of free/libre and open source software (FLOSS) in the local context by supporting its awareness and adoption. In addition, FLOSS is embedded as an underlying philosophy in its research and development programmes.

Meraka Institute initiatives and projects promote the use of ICT for education and training, improved accessibility to information and services, low-cost connectivity and applications of earth observation, and to support people with disabilities. New areas of research and innovation are under development.

2. The Council for Scientific and Industrial Research (CSIR), http://www.csir.co.za/about_us.html, is one of the leading scientific and technology research, development and implementation organisations in Africa. Constituted by an Act of Parliament in 1945 as a science council, the CSIR undertakes directed and multidisciplinary research, technological innovation as well as industrial and scientific development to improve the quality of life of the country's people.

The CSIR is committed to supporting innovation in South Africa to improve national competitiveness in the global economy. Science and technology services and solutions are provided in support of various stakeholders, and opportunities are identified where new technologies can be further developed and exploited in the private and public sectors for commercial and social benefit.

The CSIR's shareholder is the South African Parliament, held in proxy by the Minister of Science and Technology.

The CSIR **was founded on 5 October 1945** (Scientific Research Council Act, Act 33 of 1945) and was constituted as a science council by the Scientific Research Council Act (Act 46 of 1988, as amended by Act 71 of 1990). The organisation is also listed as a public entity in terms of the Public Finance Management Act, Act 1 of 1999, as amended by Act 29 of 1999.
Initiative main outcomes (if any):

The BG4A is for the whole African continent.

Initiative contacts:

Name of the organization	Physical Address:	Postal Address:	Email	Telephone
Council for Scientific and Industrial Research (CSIR)	Meiring Naudé Road; Brummeria; Pretoria; South Africa	PO Box 395; Pretoria 0001; South Africa	callcentre@csir.co.za	Tel + 27 12 841 2911; fax +27 12 349 1153
Meraka Institute (African Advanced Institute for Information and Communications Technology) www.chpc.ac.za	CSIR Site - Building 43 Meiring Naude Road Brummeria Pretoria South Africa	Meraka Institute PO Box 395 Pretoria 0001 South Africa	info@meraka.org.za	Tel + 27 12 841 3028 Fax +27 12 841 4720

Initiative Web Site:

www.chpc.ac.za/about/news/blue-gene.php

S.E. Asia and Oceania

National Computational Infrastructure – Australia

Initiative Level	Involved countries
Local	
National	Australia
European	
International	

Initiative Starting date (approx.): 2007
Initiative End date (approx.): …

Keywords: HPC, Distributed Data Services

Short description of the Initiative:

National Computational Infrastructure (NCI), an initiative of the Australian Government, is hosted by the Australian National University (ANU) and is jointly funded by the Department of Innovation, Industry, Science and Research under its NCRIS (National Collaborative Research Infrastructure Strategy) program and through substantial co-investment by a number of partner organizations, the two most prominent of which are CSIRP (Commonwealth Scientific and Industrial Research Organization) and ANU. The mission of NCI is to provide Australian researchers with world-class high-end computing services.

Initiative main outcomes (if any):

As on of the main outcome can be pointed out a started project - Super Science / EIF Climate HPC Project in 2009. It is a project initiated within the Super Science (Marine and Climate) initiative announced in the 2009 Commonwealth Budget, provides a $50M allocation over three financial years (2009-12) that will:

- commission an internationally significant (petascale) HPC capability and associated data support to serve prioritised climate change, earth system science and national water management research endeavours, and to support world-class research that is of national benefit;
- develop a methodology to identify and support data-intensive or flagship science applications related to other NCRIS and Super Science investments;
- develop and operate a resource allocation system that provides on-demand access to allocated resources where required; and
- construct a new data centre facility that is capable of continuous upgrade for at least a decade.

Initiative contacts (Max. 3):

Professor Lindsay Botten	NCI Director	lindsay.botten@anu.edu.au
Sue Cameron	NCI Executive Officer	sue.cameron@anu.edu.au
Professor Mark S. Wainwright	Chair, NCI Steering Committee	mark.wainwright@unsw.edu.au

Initiative Web Site: http://nci.org.au

Any other relevant feature of the Initiative:

Institute of High Performance Computing (IHPC)

Initiative Level	Singapore
Local	
National	X
European	
International	

Initiative Starting date (approx.): Established in April 1998, IHPC is a Research Institute under the Agency for Science, Technology and Research (A*STAR)

Initiative End date (approx.)

Keywords: HPC and Distributed Data Services

Short description of the Initiative:
IHPC promotes and spearheads scientific advances and technological innovations through computational modelling, simulation and visualisation methodologies and tools. IHPC vision is to provide leadership in high performance computing as a strategic resource for scientific inquiry and industry development.

Initiative main outcomes (if any):

IHPC focuses on performing world-leading scientific research through application of the tools of computational science in the areas of

- solid mechanics,
- fluid dynamics,
- materials science/condensed matter physics,
- chemistry,
- electromagnetics,
- photonics and plasmonics,
- solid-state electronics,
- biophysics, and
- cognitive science.

In addition, IHPC researchers are advancing the field of high performance computing through the development of advanced HPC software and computer architectures, adaptive and collaborative computing, computational geometry, modelling and visualisation, and data-analytics. A new multi-disciplinary area for IHPC is computational cognitive science, which focuses on new and applied approaches to the development of intelligent systems that interact other agents (including humans) in a believable, intuitive, and socially appropriate manner.

Initiative contacts (Max. 3):

For IT and HPC enquiries: help@ihpc.a-star.edu.sg
For R&D collaborations and business opportunities: iddmgr@ihpc.a-star.edu.sg
For general enquiries: ihpc@ihpc.a-star.edu.sg

Initiative Web Site: http://www.ihpc.a-star.edu.sg/index.php

Any other relevant feature of the Initiative: