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1. Introduction & Background on e-IRG White Paper and Recommendations

The main objective of the e-Infrastructure Reflection Group (e-IRG) 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. The e-IRG 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.

The 7th White Paper has been released in July 2011. It addresses some of the most interesting questions related to new and on-going e-Infrastructure challenges by treating seven topics carefully chosen by the e-IRG delegates. Innovation is the common thread throughout the document and special emphasis has been put on governance of e-Infrastructures. Those topics are e-Infrastructure governance, Future of research networking, Authentication, authorisation and accounting, Energy and green IT, Exascale computing and related software, e-Infrastructure services and Data infrastructures. Each chapter ends with a short set of recommendations that should be taken into consideration by governments, funding agencies, the European Commission, ESFRI, e-Infrastructure providers and user communities.

This document presents the White Paper 2011 recommendations by type of stakeholder preceded by a short description of each topic. Five categories of stakeholders have been defined. Recommendations are often directed to multiple stakeholders.

[Stakeholders are advised also to read through the whole White Paper in order to not miss any recommendations that might be useful for them but not taken up in their category.]

2. White Paper topics

e-Infrastructure Governance

The number and size of e-Infrastructures are growing. Are the governance models currently used sufficient to guarantee their future? Who should be the players in the governance model besides the service providers: the governments, the private sector, the user or a combination of these?

Future of Research Networking

The White Paper 2011 also reflects upon the future role and development of Research networks, which are so well established that we run the risk of forgetting to think about their future. The White Paper highlights this issue and gives recommendations for national and international policy makers.

Authentication, Authorisation, and Accounting

The development of Authentication, Authorisation and Accounting is addressed, calling for new visions to realise the interworking and sustainability of the e-Infrastructure ecosystem.

Energy and Green IT

Efficient energy use, green energy, cheap energy, and energy consumption by ICT are daily topics on many management agendas. But is cheap energy compatible with green energy?

Exascale Computing and Related Software

Supercomputing continues to spearhead innovation as countries and companies strive for the most powerful supercomputer. But can we go from Tera-flops to Peta-flops and can we efficiently use such computing power? Does a software revolution need to take place before supercomputing can make a leap forward?

e-Infrastructures Services

Services are of growing importance, especially from a user's perspective. Which services should be delivered and at what level of quality?

Data Infrastructures

Data infrastructures are discussed, with a few suggestions for the set-up of European data infrastructures.

3. Recommendations by Stakeholder

The White Paper 2011 recommendations are presented by the following stakeholders:

- **Governments:** National governments, especially the ministry that is responsible for e-Infrastructures.
- **EC:** The European Commission, in particular its Directorates-General for Research & Innovation and Information Society & Media.
- **e-Infrastructure Providers:** Entities on the national level that coordinate and operate e-Infrastructures.
- **Users, Scientific Communities:** Users of e-Infrastructures.
- **ESFRI:** The European Strategy Forum on Research Infrastructures, is a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach. The mission of ESFRI is to support a coherent and strategy-led approach to policy-making on research infrastructures in Europe, and to facilitate multilateral initiatives leading to the better use and development of research infrastructures, at EU and international level.



3.1 Recommendations to Governments

3.1.1 e-Infrastructure Governance

- Establish a user-community-centric approach in strategic e-Infrastructure governance. This should include the appropriate funding mechanisms that make a clear distinction between the funding of service provision and the funding of innovation activities.
- Define the long-term financial strategy for e-Infrastructures aimed at a sustainable operation of services in a flexible and open environment that includes offers from commercial service providers.
- Introduce governance models that provide efficient and effective coordination mechanisms at all levels: regional, national, European and - where possible - global while providing the possibility for public and private research and cooperation via public-private partnerships (PPPs).

3.1.2 Future of Research Networking

- Use the planned GN3 foresight study led by TERENA to draft an Innovation Agenda for research networking to be used by all stakeholders.
- Rigorously investigate the causes of the digital divide between European researchers and combat this with the appropriate instruments.

3.1.3 Energy and Green IT

- Promote R&D on Green IT topics and provide more service management procedures.
- Locate data centres at optimum locations in terms of the balance between green energy and energy efficiency.

3.1.4 Exascale Computing and Related Software

- Encourage the development of European hardware technology in order to compete and cooperate with the current leading countries in HPC.
- Dedicate resources to the study of new programming models, algorithms and languages, porting software libraries and software tools to exascale environments, and preferring open source software solutions to leverage existing know-how in a cost-efficient way.



- The partnership between users of exascale computing, industry and computer scientists must be encouraged, and scientists should be given the opportunity to liaise with programming experts.
- Ensure that the value of the scientific case for exascale computing is well understood and appreciated by society at large by means of knowledge dissemination, and engagement with the public, policy makers, and industry.

3.1.5 e-Infrastructures Services

- Promote cooperation with other public sectors in the e-Infrastructure arena, like government and healthcare, to exploit economies of scale and intensify the contribution of research and education e-Infrastructures in facing societal challenges at large.
- Boost innovation by public-private partnership activities through the joint creation of a market for e-Infrastructure resources and services.

3.2 Recommendations to the European Commission

3.2.1 e-Infrastructure Governance

- Establish a user-community-centric approach in strategic e-Infrastructure governance. This should include the appropriate funding mechanisms that make a clear distinction between the funding of service provision and the funding of innovation activities.
- Define the long-term financial strategy for e-Infrastructures aimed at a sustainable operation of services in a flexible and open environment that includes offers from commercial service providers.
- Introduce governance models that provide efficient and effective coordination mechanisms at all levels: regional, national, European and - where possible - global while providing the possibility for public and private research and cooperation via public-private partnerships (PPPs).

3.2.2 Future of Research Networking

- Use the planned GN3 foresight study led by TERENA to draft an Innovation Agenda for research networking to be used by all stakeholders.
- Rigorously investigate the causes of the digital divide between European researchers and combat this with the appropriate instruments.

3.2.3 Authentication, Authorisation, and Accounting

- Require that, wherever possible, future pan-European e-Infrastructure and ESFRI RI projects define their access control policies and mechanisms from the beginning, in accordance with the standards and best practices adopted by the community.
- Draw up a roadmap to book progress for all stakeholders in the unified integrated approaches to replace existing authentication and authorisation infrastructures based on national AAls.

3.2.4 Energy and Green IT

- Promote R&D on Green IT topics and provide more service management procedures.
- Work out and promote Green IT standards at an international level like the Energy Star or the green grid.

3.2.5 Exascale Computing and Related Software

- Encourage the development of European hardware technology in order to compete and cooperate with the current leading countries in HPC.
- Dedicate resources to the study of new programming models, algorithms and languages, porting software libraries and software tools to exascale environments, and preferring open source software solutions to leverage existing know-how in a cost-efficient way.
- The partnership between users of exascale computing, industry and computer scientists must be encouraged, and scientists should be given the opportunity to liaise with programming experts.
- Ensure that the value of the scientific case for exascale computing is well understood and appreciated by society at large by means of knowledge dissemination, and engagement with the public, policy makers, and industry.

3.2.6 e-Infrastructures Services

- Involve the user communities in the definition and exploitation of e-Infrastructure services.
- Promote cooperation with other public sectors in the e-Infrastructure arena, like government and healthcare, to exploit economies of scale and intensify the contribution of research and education e-Infrastructures in facing societal challenges at large.
- Boost innovation by public-private partnership activities through the joint creation of a market for e-Infrastructure resources and services.

3.2.7 Data Infrastructures

- Work out a step-by-step strategy for developing the European data infrastructure gradually, addressing basic issues such as data persistency, accessibility and interoperability first, and leaving complicated issues such as privacy and legal matters (like cross-border exchange of sensitive data) for subsequent stages.
- Involve stakeholders of the data infrastructure including resource providers, existing infrastructures and initiatives and user communities in order to build reliable and robust data services suitable to real needs.

3.3 Recommendations to e-Infrastructure Providers

3.3.1 e-Infrastructure Governance

- Establish a user-community-centric approach in strategic e-Infrastructure governance. This should include the appropriate funding mechanisms that make a clear distinction between the funding of service provision and the funding of innovation activities.
- Define the long-term financial strategy for e-Infrastructures aimed at a sustainable operation of services in a flexible and open environment that includes offers from commercial service providers.
- Address the problems of barriers to cross-border service delivery and quickly remove as many of these as possible.
- Introduce governance models that provide efficient and effective coordination mechanisms at all levels: regional, national, European and - where possible - global while providing the possibility for public and private research and cooperation via public-private partnerships (PPPs).
- Investigate the effectiveness of legal structures, like ERIC, for e-Infrastructures.

3.3.2 Future of Research Networking

- Innovate in network provisioning and network governance to satisfy user demand and stay competitive at the global level.
- Build the networks as a federative and open system, giving flexibility and worldwide connectivity to public and private researchers and with seamless integration with other e-Infrastructure service providers.

3.3.3 Authentication, Authorisation, and Accounting

- Continue to improve national infrastructures and their alignment with agreed standard procedures for identity management, accounting and assurance, with the objective of technical interoperability between all national AAls.
- Accelerate the continued integration of different identity technologies, through supporting active collaboration between the IGTF, GÉANT and relevant European and international working groups.

3.3.4 Energy and Green IT

- Decrease the energy consumption of all e-infrastructure components by providing a different kind of architecture and working out more efficient software management procedures.
- Develop more efficient ways of using the provided energy by increasing the efficiency of the cooling systems and reusing the heat energy for different purposes.
- Analyse the environmental impact of various approaches to energy maintenance.
- Promote R&D on Green IT topics and provide more service management procedures.
- Locate data centres at optimum locations in terms of the balance between green energy and energy efficiency.



3.3.5 Exascale Computing and Related Software

- Identify new grand challenges in science that are able to utilise the exascale platforms.
- The partnership between users of exascale computing, industry and computer scientists must be encouraged, and scientists should be given the opportunity to liaise with programming experts.
- Specialists must create training materials, including robust and easy to use “cook books” for users, especially for those who are not computer scientists.
- Ensure that the value of the scientific case for exascale computing is well understood and appreciated by society at large by means of knowledge dissemination, and engagement with the public, policy makers, and industry.

3.3.6 e-Infrastructures Services

- Involve the user communities in the definition and exploitation of e-Infrastructure services.
- Use virtualisation and SOA when developing and introducing new e-Infrastructure services wherever this is efficient. Apply simplified access, transparent service offerings, customised support, standardisation, improved governance models and sustainable business models in the definition and deployment of e-Infrastructure services.
- Boost innovation by public-private partnership activities through the joint creation of a market for e-Infrastructure resources and services.

3.3.7 Data Infrastructures

- Implement strategy at different levels, including low-level services such as bitstream data storage, exchange in data infrastructures, content-related curation, preservation and data exploitation services, as well as activities aimed at interoperability and data access federation and openness.
- Involve stakeholders of the data infrastructure including resource providers, existing infrastructures and initiatives and user communities in order to build reliable and robust data services suitable to real needs.

3.4 Recommendations to Users and Scientific Communities

3.4.1 Exascale Computing and Related Software

- Dedicate resources to the study of new programming models, algorithms and languages, porting software libraries and software tools to exascale environments, and preferring open source software solutions to leverage existing know-how in a cost-efficient way.
- Identify new grand challenges in science that are able to utilise the exascale platforms.
- Specialists must create training materials, including robust and easy to use “cook books” for users, especially for those who are not computer scientists.
- Ensure that the value of the scientific case for exascale computing is well understood and appreciated by society at large by means of knowledge dissemination, and engagement with the public, policy makers, and industry.

3.4.2 Data Infrastructures

- Involve stakeholders of the data infrastructure including resource providers, existing infrastructures and initiatives and user communities in order to build reliable and robust data services suitable to real needs.



3.5 Recommendations to ESFRI

3.5.1 e-Infrastructure Governance

- Address the problems of barriers to cross-border service delivery and quickly remove as many of these as possible.
- Investigate the effectiveness of legal structures, like ERIC, for e-Infrastructures.

3.5.2 Authentication, Authorisation, and Accounting

- Require that, wherever possible, future pan-European e-Infrastructure and ESFRI RI projects define their access control policies and mechanisms from the beginning, in accordance with the standards and best practices adopted by the community.

3.5.3 Exascale Computing and Related Software

- Ensure that the value of the scientific case for exascale computing is well understood and appreciated by society at large by means of knowledge dissemination, and engagement with the public, policy makers, and industry.

3.5.4 e-Infrastructures Services

- Involve the user communities in the definition and exploitation of e-Infrastructure services.

3.5.5 Data Infrastructures

- Involve stakeholders of the data infrastructure including resource providers, existing infrastructures and initiatives and user communities in order to build reliable and robust data services suitable to real needs.



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