



e-IRG Recommendations 2003-2011

The following recommendations have been adopted by the e-IRG during the period 2003-2011. Please refer to the original documents for a contextualised understanding of the scope and nature of each recommendation.

www.e-irg.eu

e-IRG secretariat
c/o Netherlands National Computer Facilities Foundation (NCF)
P.O. Box 93575
NL-2509 AN The Hague, The Netherlands
Phone: +31 (0)70 344 0526
secretariat@e-irg.eu

Visiting address
Anna van Saksenlaan 51
NL-2593 HW The Hague
The Netherlands

e-IRG
e-Infrastructure
Reflection Group

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e-IRG Recommendations 2011 by Stakeholder (based on White Paper 2011)

Recommendations to Governments

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).

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.

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.

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.

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NL-2509 AN The Hague, The Netherlands
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secretariat@e-irg.eu

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- 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.

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.

Recommendations to the European Commission

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.
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- Rigorously investigate the causes of the digital divide between European researchers and combat this with the appropriate instruments.

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 AAs.

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.

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.

e-Infrastructures Services

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

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- 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.

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.

Recommendations to e-Infrastructure Providers

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.

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.

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 AAs.
- Accelerate the continued integration of different identity technologies, through supporting active collaboration between the IGTF, GÉ-ANT and relevant European and international working groups.

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 centers at optimum locations in terms of the balance between green energy and energy efficiency.

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.

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.

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.

Recommendations to Users and Scientific Communities

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 utilize 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.

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.

Recommendations to ESFRI

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.

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.

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.

e-Infrastructures Services

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

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.

Recommendations Blue Paper 2010:

Networking

- Recognise new Research Infrastructures (RI) as ‘innovation engines’ in research network evolution, and encourage them to engage with this role by defining, testing and using new networking services.
- The e-IRG encourages RI to participate in networking coordination bodies to secure an on-going exchange of information on the development of advanced networking services.
- Encourage advanced users and research network providers to ensure that national and European authorities support appropriate governance and financial models.

Authentication, Authorisation and Accounting

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

Grid, Cloud and Virtualisation

- Promote collaboration among grid and cloud infrastructure providers and users to raise awareness of the range of available technologies and how to best use them.
- Encourage RIs to inform NGIs and EGI.eu of their technical requirements and provide feedback on existing and future services, with a focus on requirements and services rather than technologies.
- Support organisational models that encourage the RI community to engage with the management structures of the NGIs, EGI, and related activities such as EMI and IGE.

High Performance Computing

- Improve understanding of the specific requirements of the research community (the ‘science case’), and the broader economic needs in terms of driving future requirements for the largest HPC systems.
- Support the development of a balanced HPC ecosystem that integrates resources at a range of scales matched to user requirements.
- Promote specific enabling activities, such as scalable software development and user training, to ensure efficient usage of HPC resources.

Remote Access and Remote Instrumentation

- Encourage RI and sensor networks to connect to the wider networked world using standard interfaces, either directly, or indirectly, through the existing e-Infrastructure.
- Formalise the responsibility of European RI to support remote users.
- Champion the user- and broader societal perspective for development and deployment of new RI and sensor networks.

Data infrastructures and persistent storage

- Identify and promote common (long-term) data-related services across different RI.
- Encourage, through policy and facilitation, community practices and standards that assist researchers in exploiting multiple data resources, within and across disciplines.
- Raise awareness of the responsibilities set by the Toronto statement, INSPIRE directive, and similar initiatives.

Virtual Research Communities and collaboration

- Build VRCs by fully exploiting the benefits of the ERA and integrating a stimulating mixture of the involved organisational entities. Multidisciplinary and/or Public Private Partnership VRCs are recommended.
- Ensure VRC developments are incremental and application- and challenge-led.
- Exploit the educational and innovation potential of VRC tools developed and deployed by research communities.

Recommendations: e-IRG Roadmap 2010

- To reach the “ideal e-Infrastructure” model presented above, and to enable maximal socio-economic benefits, e-IRG proposes a number of concrete, near-term actions. These e-IRG recommendations are listed below in order of impact and urgency, starting with the highest priority:

Infrastructure as a Service (IaaS)

- The adoption of an Infrastructure as a Service (IaaS) model should be strongly stimulated and supported with the aim of increasing the sustainability of e-Infrastructure and to identify and provide innovative solutions which could find a larger use in society

Commodity computing

- Since commodity computing to run scientific applications is the most common “first e-Infrastructure contact point” for new users and user communities, e-IRG recommends strengthening and clarifying the roles of the National Grid Initiatives and the European Grid Initiative.
- e-IRG recognises the importance of transparency and compatibility of the organisational and financial models as key factors in maximising the benefits of broad commoditisation of computing services for all scientific users.
- e-IRG also recommends that organisational structures and incentives are put in place that ensure that all the actors in the commodity computing domain will have an interest in – when technically appropriate – bringing new users and user communities into contact with other components of the e-Infrastructure.

Standards and interoperability

- e-IRG recommends continuing¹ interoperability benchmarking through global standardisation. In addition to making it easy to benchmark in terms of suitability, dependability and cost-effectiveness in different application domains, this will ensure long-term interoperability of different implementation technologies used for providing e-Infrastructure services and create a marketplace for commercial offerings.

¹ As stated, for example, in the 2006 report of the e-IRG Task Force on Sustainable e-Infrastructures.

High Performance Computing

- e-IRG recommends establishing organisational structures and processes that ensure that European know-how related to exascale computing can be rapidly accessed. This requires design of optimal support structures that ensure all European expert communities can freely and efficiently share information, about both specific solutions and general best practices.
- International efforts, such as IESP, should be followed.

Sustainable data management infrastructure

- e-IRG recommends that sufficient EU and national resources are reserved for preparatory work to create a blueprint for enabling data-intensive research. e-IRG also recommends that established e-Infrastructure initiatives appoint a representative to liaise with this new initiative. e-IRG will commit its expertise, contacts to policy makers, and data management experts to support this initiative.

Networking

- e-IRG supports Pan-European efforts focusing on the impact of new research networking technologies and policies on the innovation potential of e-Infrastructure, and the impact of cost and policy differences in the member states on commercial deployment. More efforts should be targeted towards ensuring that new networking technologies are taken into use as rapidly and broadly as possible.

Commercial uptake

- e-IRG recommends gathering information about successful commercial uptake of e-Infrastructure - related innovations to identify policy, funding and other mechanisms that would support seamless transition of proven e-Infrastructure collaboration models into broader use in society.

New user communities

- e-IRG recommends that the member states, European Commission and the sustainable e-Infrastructure initiatives propose and provide resources for mechanisms that will:
 - Accelerate the adoption of sustainable e-Infrastructure services by new user communities
 - Complement the competitive “call for projects” approach with a faster mechanism to target resources to popular e-Infrastructure services.
 - Identify partners and collaborative processes to support the organisational development of new user communities.

International collaboration

- e-IRG recommends that funding agencies and host organisations ensure that policies related to funding and human resources are flexible enough that – when such opportunities present themselves – European e-Infrastructure experts will be able to accept visible leadership roles in global groups without sacrificing their career development within the European Research Area. This will maximise the positive, global impact of European e-Infrastructure investments in the global arena.

This empowering of individual European experts should be matched with policy-level actions to align procedures, to maximise information exchange, and strengthen cooperation on international matters.

e-IRG recommendations and decisions for the 2009 Czech presidency (e-IRG White paper 2009)

Global Collaboration

- The e-IRG acknowledges the global nature of science, research and education and recognises the strategic importance of global collaboration between worldwide parties involved in e- Infrastructures as a key element for the global competitiveness of the European e-Infrastructures.
- The e-IRG recommends that global collaboration should move from its ad-hoc character to a more structured and continued mode adequately supported by the EC and national funding agencies; Europe should continue to take a leading role in global collaborations.

Education and Training in the Use of e-Infrastructure

- The e-IRG recommends that the national, regional or European level of investment in e-Infrastructure education should be balanced to the investment that is going into e-Infrastructure provision. This may be achieved by embedding e-Infrastructure education at the undergraduate level, as well as developing curricula at the postgraduate level to improve exploitation of e- Infrastructures.
- The e-IRG recommends the harmonisation of education across the ERA to support student, researcher and worker mobility, mutual recognition of qualifications and equal opportunities. Standards need to be developed for sharing training material and e-Infrastructure between institutions, as well as for student and teacher identification enabling access to e-Infrastructure facilities and resources use.
- The e-IRG recommends the formation of user community support infrastructures in each European country. It especially encourages the collaboration of several countries in order to increase the efficiency of such infrastructures.

Grid and Cloud Computing

- The e-IRG acknowledges the apparent rapid growth of commercial Cloud-like services, providing on-demand virtual computing resources, data storage and software services. The e-IRG recommends that major e-Infrastructure initiatives investigate the integration of commercial and non-commercial infrastructure services and of Grid and Cloud-like technologies especially for achieving the provision of on demand virtual computing and storage resources into existing e- Infrastructures.

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c/o Netherlands National Computer Facilities Foundation (NCF)
P.O. Box 93575
NL-2509 AN The Hague, The Netherlands
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- The e-IRG recommends that the EC and Member States support should not be limited to a single distributed computing technology and infrastructures, promoting an open approach, when aiming to set up sustainable pan-European e-Infrastructure organisations within Grid, Cloud and High Performance Computing.

Security: A “holistic” approach

- The e-IRG strongly encourages the harmonisation of approaches in access management between the NREN and Grid e-Infrastructure providers.
- The e-IRG recommends evaluating whether the well-established CSIRT collaboration platform in the NREN-community could possibly accommodate the needs of other e-Infrastructure components before development of domain-specific structures for analogous tasks.
- The e-IRG recommends the promotion of a coherent framework that will act as a working base for the implementation of unified security services. In particular, the full extent of cross-disciplinary synergies of a coherent model for data security should be studied and exploited.

Service-centric e-Infrastructures through virtualization

- The e-IRG notes the emerging use of virtualisation in ICT service provision, whereby physical resources can be shared by users in a manner which appears to support each user independently, optimizing resource utilization, reliability, energy efficiency and maintenance costs. The e-IRG recommends the investigation of virtualisation in key e-Infrastructure projects.
- The e-IRG recommends that further research on virtualisation concepts is supported, including development of open standards for the integration of tools from different vendors and academia in order to support the emergence of a competitive marketplace in this domain.

Remote Instrumentation

- The e-IRG recognises the benefits of remote instrumentation, especially for large and costly research infrastructures.
- The e-IRG recommends the development of mechanisms enabling fair remote access to state-of-the-art equipment, including the preparation of a sustainable sharing scheme, both for public and private research, and research on standards for integrating remote instrumentation into the current e-Infrastructure (grids, advanced computing and data repositories).

- The e-IRG invites the EC and Member States to strengthen their support for research on remote instrumentation. This should cover technological, economic, policy and security aspects.

Sustainability of the computing-related e-Infrastructure

- The e-IRG notes the importance of the steps undertaken by the EGI and PRACE initiatives to promote sustainability of the computing-related e-Infrastructure, such as the development of policies, business models and funding schemes for the new required structures. The e-IRG recommends that adequate levels of funding should be granted by the EC and Member States for the development of the new structures both on the national and European levels.
- The e-IRG recommends that major e-Infrastructures initiatives such as EGI and PRACE cooperate closely in order to define complementary and interoperable environments for the benefit of European researchers. This environment should ensure that access to resources in Europe is granted through an open and transparent process, based on international standards and interoperable middleware.
- The e-IRG recommends the funding of activities that help national user communities to cooperate with corresponding user communities in other countries, in order to foster the European research activities in using the e-infrastructure.

Recommendations from the e-IRG Education and training task force report, 2008

The ETTF recommend that e-IRG develop policies on the following issues:

Recommendations as to the level of investment necessary in Member States in order to provide education in the use of e-Infrastructure.

Suggestion: The national, regional or European investment in relevant education and training, which is primarily oriented to equipping graduates to use e-Infrastructure well, should be comparable with the investment that is going into e-Infrastructure provision. The recommended strategy for achieving this is to persuade the universities to adapt their curricula in order to prepare their graduates. The significant investment is justified based on the crisis we currently face. Unless there are adequate numbers of people schooled in the creation, use and further development of e-Infrastructure technologies, Europe and its Member States will fail to fully exploit these vital tools for research and innovation. The consequences of this failure will be felt both economically and socially and result in losses in the knowledge economy. Ensuring an increase in the outflow of skilled individuals inevitably involves commitment in the form of funding. That funding should be catalytic in order to encourage the changes in university curricula.

Recommendations to align the development of distributed-computation knowledge and skills.

Suggestion: Academic institutions, particularly universities, should build on proposals for undergraduate and postgraduate courses in digital systems judgment and e-Science formulated at curricula development workshops. Further work on developing and agreeing those curricula should be undertaken by individuals proposing to teach this material and by relevant professional bodies. The goal of this alignment should be mutual recognition and understanding, not uniformity.

Recommendations as to the harmonisation of education in the use of e-Infrastructure.

Suggestion: Professional bodies, e.g. the Royal Society of Chemists and the Institute for Engineering and Technology in the UK, should identify target attainments in the exploitation of e-Infrastructure for their profession and should harmonise these across the ERA in accord with the Bologna framework. The goal of this harmonisation is not uniformity of skills and knowledge. Rather, it is a common framework to support student mobility and mutual recognition of

qualifications, particularly where they are used to appoint staff to positions in the use or operation of critical e-Infrastructure.

Propose standards for student and teacher identification that would enable access to educational grid facilities and authorization/management of the resources used.

Suggestion: A task force, set up by the e-IRG, EGI and GÉANT should build on the eduroam protocols to extend them to cover student use of collaboration facilities and multi-site t-Infrastructure.

Propose standards for sharing training material and t-Infrastructure between institutions.

Suggestion: Those in the EU developing e-Infrastructure courses should build on creative commons for sharing all educational material and the EGI should mediate agreement between NGIs on sharing t-Infrastructure.

Establish a system for agreeing standards that accredit workers who design, build, operate and support e-Infrastructure so that qualifications are recognised across the ERA.

Suggestion: The bodies in Member States that accredit technical skills and knowledge should adapt the proposals developed by the OGF ET-CG working group in order to develop European-wide recognised qualifications.

e-IRG recommendations and decisions for the 2006 Finnish presidency

Authentication and Authorisation

- Encourage forming a seamless AA-infrastructure for e-science applications by systematically taking AA-interopability into account in national funding and policy decisions. Specifically ask relevant proposals to define their relationships with IGTF and TERENA task forces.

Usage policies

- The e-IRG recognises the work of the Joint Security Policy Group (JSPG) in their search for a widely deployable common Grid Acceptable Use Policy (AUP). The EC and the member states are encouraged to direct relevant national or EC projects towards participation in this process (of developing a common Grid AUP) to achieve increased compatibility among infrastructure islands, which may facilitate future convergence. The JSPG is encouraged to manage this process and facilitate the resolution of any outstanding issues.

Education and Training

- The e-IRG recommends that the EC support the launch of an ERA-wide activity to coordinate education and training efforts, with an emphasis on the efficient exploitation of e-Infrastructures by EU citizens. It is recommended that investments in education and training be adjusted in accord with the findings of this coordination activity.

Grid economy - Allocation and accounting

- The e-IRG deems it important that current fragmented efforts (projects, facilities, initiatives) evolve into a rich service-oriented e-infrastructure economy that is both attractive and sustainable and can support a wide variety of applications, services and user communities of all sizes. The e-IRG recommends that member states and the EC promote and actively facilitate sharing of information and best practices related to allocation, accounting and economic models for e-infrastructure resources and services.

HPC in Europe Task Force (HET)

- The e-IRG acknowledges the formation of the HPC in Europe Taskforce (HET) and the important role assigned to it in the ESFRI roadmap. e-IRG invites HET to exchange its views with the e-IRG, especially on the long-term perspective for the policy framework on the European Supercomputer Infrastructure.

Supercomputing

- The e-IRG recommends that the EC and countries represented in the e-IRG institute a policy and funding framework allowing the creation of a number of world-class HPC systems (petascale and beyond) to become available for European research and development.
- The e-IRG strongly encourages the EC to fund the necessary development of software, algorithms and middleware to work towards a tight integration of European HPC systems, national computing infrastructures and existing Grid projects into an integrated European e-Infrastructure service.

Recommendations from the e-IRG Task Force on Sustainable e-Infrastructures, 2006

Recommendation I

- Governments and the Commission should develop policies and mechanisms to encourage increased investment in a more coherent and interoperable way across Europe.

Recommendation II

- The existing e-Infrastructure projects must be superseded by integrated sustainable services at national and European levels.

Recommendation III

- e-Infrastructures must be application-neutral and open to all user communities and resource providers. National funding agencies should be encouraged to fund multi-disciplinary and inclusive infrastructures rather than disciplinary-specific alternatives.

Recommendation IV

- e-Infrastructures must inter-operate and adopt international standard services and protocols in order to qualify for funding.

Recommendation V

- The Commission should, within the seventh Framework Programme, develop a pan-European e- Infrastructure which explicitly encourages the further integration of national e-Infrastructure Initiatives.

Beyond the recommendations made above and to further increase the efficiency and impact of e-Infrastructures the Task Force recommends the following actions:

- To strengthen the integration of industrial efforts and SMEs into sustainable infrastructures in this context, industry has to be seen as both a potential user and a major partner for service provision. Clear policies have to be established for access from industrial research projects in pre-competitive domains, industrial production projects accessing innovative technologies or deploying innovative strategies and industrial production projects with occasional exceptional requirements (critical computing on demand).
- Infrastructures need to remain state of the art; therefore new technologies should be evaluated and introduced continuously. In order to make investments in R&D more

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efficient, the take up of new technology in production infrastructures should be improved by appointing e- Infrastructure providers as stakeholders in relevant R&D efforts.

- To accelerate and expand the adoption of e-Infrastructures attention must be paid to their ease of use. Investing in improving the usability (e.g. by hiding complexity and increasing interoperability) will broaden their user base, adding significant value to the science community and increasing European competitiveness.
- The new opportunities presented by distributed infrastructures requires increased training and an improved skills base for the research community, which also needs to form part of any national or European strategy for e-Infrastructure. This will require further advisory and guidance services that collaborate across Europe.²

² The proposed e-IRG Task Force on Training and Education should look into this and make in due time necessary recommendations to support these activities.

Recommendations from the Luxembourg White Paper 2005:

Towards National Grid Initiatives

- The e-IRG would like to promote the idea of the National Grid Initiatives i.e. a governance model to guide Grid infrastructure deployment and operation at country-level in an application-neutral way.

The e-IRG believes that the adoption of the NGI idea across Europe would be a requirement for the evolution to the next phase of the e-Infrastructures that is expected to be implemented in FP7, and encourages all countries to work on this.

Authentication, Authorization, Accounting policies

- Support the establishment of frameworks able to integrate all the (nation- or community based) AA federations, in the spirit of the achievements of the EUGridPMA with respect to PKI policies and practices, and promote the necessary steps to compatibilize current authorisation practices and systems with these frameworks. The group acknowledges the steps in this direction taken by the GEANT2 AAI and the Cotswolds Group initiative.

Accounting

- During the UK chairmanship the following points should be discussed:
 1. The Legal aspects of accounting such as:
 - Access to accounting data allowed by data privacy laws
 - Arbitration in the event of disagreements on charges between user and resource providers
 2. The interaction of accounting with banking systems
 - How to manage the trust relationships between user, resource provider, metering systems, and financial brokers.

Legal issues in e-Infrastructures

- Legal issues in electronic infrastructures are of vital importance and specific steps should be taken in order to make progress. It is advised that a dialogue between legal and technical experts should be kicked-off preparing an inventory of legal issues that are currently being encountered or foreseen to be relevant taking as a starting point the Luxembourg White Paper. A dialogue could be initiated by means of a workshop, and on the basis thereof when deemed appropriate a more permanent group might be established. A proper analysis and evaluation of the above inventory list would have to follow, on one hand providing priorities

and classifying the issues and on the other hand paving the way for the integration of legal issues in the next generation of e-Infrastructures.

Network developments & grid requirements

- The major conclusion at which both workshops independently arrived was that it is important to realise that R&E networking is very much a multi-domain activity. The e-IRG would like to stress that global connectivity will never mean global network, but rather inter-domain cooperation and attention for interoperability. This must be taken into account for all planning that strives towards global end-to end connectivity for researchers.
- Of course end-to-end connectivity as such and the smooth migration of users to it are still serious challenges that we have to overcome. The solution here will be to generate and agree on the necessary interconnection and middleware/AAA issues. Any notion that a single network will be able to solve this should be avoided, since it may slow down working on the real issues and diverges energy in the wrong direction.
- The e-IRG would like to emphasise that network research is imperative to meeting next generation Grid requirements. Integrating advanced optical technologies while advancing e-science applications and Grid middleware is critical. One shall not assume network technology remains static while research is conducted for advancing grid middleware and applications. Thus e-Science networking requirements should be studied carefully, new technologies and control plane solutions should be investigated and possible integrated in the applications/middleware in order to automate the networking requests.

User Support policies

- Infrastructure planning should include the provision of resources for the co-ordination and delivery of an educational programme covering all aspects of grid usage.
- We recommend that the infrastructure planning includes the provision of resources for the support of application areas, both in the form of support for the first application migration, and with dedicated on-going support for application areas according to their scope and complexity.
- We recommend that the developments of day-to-day support systems for grids be fully supported. It is important that user support system developments are fully documented and discussed at GGF and with other major grid projects. This applies also to the development of information systems for grid users.
- A policy for networking support for grid infrastructures should be agreed and made mandatory for all entities contributing to the operational environment. The implementation of the networking

www.e-irg.eu

e-IRG secretariat
c/o Netherlands National Computer Facilities Foundation (NCF)
P.O. Box 93575
NL-2509 AN The Hague, The Netherlands
Phone: +31 (0)70 344 0526
secretariat@e-irg.eu

Visiting address
Anna van Saksenlaan 51
NL-2593 HW The Hague
The Netherlands

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- support should be interfaced to the overall user support infrastructure.

Towards a European Federated Middleware Institute

- The e-IRG considers that Grid middleware will form a fundamental component of e-Infrastructures across the European Research Area. It is thus of key importance to endorse the principle of establishing a federated Middleware Institute to ensure the development of production quality Grid middleware leveraging EC as well as national efforts across Europe.

Usage policies

- Given that there is still no agreed text for the general AUP, the recommendation from the Den Haag White Paper is still valid:
“The e-IRG notes the timely operation of an EGEE/LCG/OSG group working on a common Acceptable Usage Policy for multidisciplinary Grid infrastructures and it expresses its satisfaction and support for the current draft AUP proposed in this white paper and would like to encourage the group to consolidate it asap. It is felt that such an effort would greatly promote pan-European resource sharing for eScience.”

Storage and data services

- We recommend therefore the establishment of a distributed shared network of European data centres, maintaining digital research data and other digital materials over their entire life-cycle and keeping them for current and future generations of users. This must include processes of digital archiving and preservation but also all the processes needed for good data creation and management, as well as the capacity to add value to the data to generate new sources of information and knowledge.
- We also strongly recommend to co-ordinate the data management software development efforts across Europe and to stimulate P2P and Google-like technologies to be applied in research for data management purposes.

Grid and Industry in the context of the European Research Programmes

- The e-IRG invites representatives of European enterprises and other commercial stakeholders to come forward and identify the expectations and needs from the business community and the contributions they expect to be able to make in return considering the long term goals of the European e-Infrastructures. e-IRG specifically also invites SME's to contribute their views and ideas.
- In the same context the e-IRG wishes to be more proactive in the future in exposing its work to industry and to business.

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e-IRG secretariat

c/o Netherlands National Computer Facilities Foundation (NCF)
P.O. Box 93575
NL-2509 AN The Hague, The Netherlands
Phone: +31 (0)70 344 0526
secretariat@e-irg.eu

Visiting address

Anna van Saksenlaan 51
NL-2593 HW The Hague
The Netherlands

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Recommendations from the Hague White Paper 2004:

ENDORSEMENTS

- The e-IRG encourages work towards a common federation for academia and research institutes that ensures mutual recognition of the strength and validity of their authorization assertions.
- The e-IRG notes the timely operation of an EGEE/LCG/OSG group working on a common Acceptable Usage Policy for multidisciplinary Grid infrastructures and it expresses its satisfaction and support for the current draft AUP proposed in this white paper and would like to encourage the group to consolidate it asap. It is felt that such an effort would greatly promote panEuropean resource sharing for eScience.
- The e-IRG encourages the formation of a forum dedicated to the coordination and exchange of technology and policy for disciplinary grids. The task of the forum is to reduce duplication of efforts, but still recognize and pronounce unique demands from disciplinary user communities.
- The e-IRG stresses the importance of deploying flexibly configurable and reliable end-to-end optical connections for research and education end users (e.g. eScience experiments). This provision should coexist with IProuted services and build upon the European 3 tier hierarchical model consisting of the campus, NRENs and panEuropean GÉANT networks.
- The e-IRG gives high priority to the visibility of European infrastructures at venues such as the annual Supercomputing and Communications Conference organized in the US. The goal is to have an increased and continuous presence at booths, panels, talks, and keynote addresses. e-IRG
- encourages a coordinated European presence at the SC2005. Europe should also focus on creating greater global visibility of corresponding European venues. This could entail merging of some conferences to create critical mass and reach global impact.

Suggestions

- A forum dedicated to the coordination and exchange of technology and policy for disciplinary Grids should be formed. The task of the forum is to minimize duplication of efforts but still recognize and pronounce unique demands from disciplinary user communities. It is also recommended that the e-IRG is given the responsibility to establish this forum.

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e-IRG secretariat
c/o Netherlands National Computer Facilities Foundation (NCF)
P.O. Box 93575
NL-2509 AN The Hague, The Netherlands
Phone: +31 (0)70 344 0526
secretariat@e-irg.eu

Visiting address
Anna van Saksenlaan 51
NL-2593 HW The Hague
The Netherlands

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Recommendations from the Dublin White Paper 2004:

ENDORSEMENTS

Authentication policy development

- The e-IRG notes the timely operation of the EUGridPMA in conjunction with the TACAR CA Repository and it expresses its satisfaction for a European initiative that serves eScience Grid projects.

Authorization policy development

- The e-IRG endorses the principle of the EUGridPMA and TACAR. The e-IRG welcomes this development which positions Europe in the forefront of Grid and eScience interoperability. The e-IRG strongly encourages the EUGridPMA / TACAR to continue their valuable work and recommends that they be supported by the relevant EU / national projects and agencies.

Recommendations from the Athens workshop 2003:

Recommendations

- The European Research Area should clearly be seen to embrace Innovation – articulated in the context of this meeting through the name European Research and Innovation Area (ERIA)
- The strong level of interest in the meeting indicates how e-Infrastructures are vital for the attainment of the vision of e-Europe and ERA.
- It is clear that many countries are joining together into regions and this was presented as a powerful tool for cooperation. An EU-wide infrastructure could grow from these regions.
- e-Infrastructures will only succeed if we solve end-to-end issues at the technical, infrastructural, methodological and social/human levels.
- GEANT is a major achievement and may show the way forward in terms of building production Grids and a real e-Infrastructure throughout Europe.
- Solving the challenges of authorisation, authentication and accounting are key challenges for all Grid projects – this is a major hurdle in the context of building an e-Infrastructure for Europe.
- The trust model has to be developed further in order to share not just bandwidth but also computing resources. Grids must take the lead in helping with this process.
- The next steps for the Grid must be to move to reliable, resilient, and robust production quality middleware.
- We should continue to focus on Open Standards and avoid any vendor lock-in.
- The idea of an Open Middleware Infrastructure Institute for Europe was broadly supported – the rationale behind this being to create the next generation of production quality software from the developments that have taken place to date.
- Key to the general uptake of Grids and the creation of a real e-Infrastructure for Europe will be the transition from e-Science -> e-Business -> e-Society.
- We must identify the next generation of applications – the so called “killer apps” – and improve our promotion of the benefits that e-Infrastructures will bring to their user communities.
- To build e-Infrastructures we need to focus on middleware interoperability and the accompanying policy decisions required to make our software and operating paradigms interoperable in a global context.
- Policy issues – particularly in a local context need to be addressed. Only by addressing the intricacies of local policy issues will be able to make local resources available in Grids.
- We will build e-Infrastructures by focusing on policy issues related to resource sharing in the context of the European Research Area. Such discussions must take place at an intergovernmental level.
- The overall recommendation from this meeting is that an e-Infrastructures Reflection Group, built from National Programme representatives, should be established and perhaps advise the Governmental representatives who sit in existing committees.

- The e-Infrastructures Reflection Group should consider and communicate clear messages on e-Infrastructure Policy issues to both the European Commission and existing e-Infrastructure projects on policy matters.
- A troika of the current presidency of the EU (Greek) and the two following ones (Italy and Ireland) should discuss further what needs to be achieved with regard to moving this debate forward.



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e-IRG secretariat
c/o Netherlands National Computer Facilities Foundation (NCF)
P.O. Box 93575
NL-2509 AN The Hague, The Netherlands
Phone: +31 (0)70 344 0526
secretariat@e-irg.eu

Visiting address
Anna van Saksenlaan 51
NL-2593 HW The Hague
The Netherlands

e-IRG
e-Infrastructure
Reflection Group