



e-IRG Roadmap 2012



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The e-IRG Roadmap 2012 was endorsed by the e-IRG delegates in December 2012.

e-IRG and its mission

The e-Infrastructure Reflection Group (e-IRG) has provided strategic advice and guidance on the development of a European e-Infrastructure for science and research for almost a decade. Members of e-IRG are EU Member States and Associated States. Their governments appoint delegates who participate on a voluntary basis as experts and neutral advisors. e-IRG functions as an open forum for all stakeholders and experts, analyses the future foundations of the European Knowledge Society, and produces white papers, roadmaps and recommendations.

The e-IRG mission is to pave the way towards a general-purpose European e-Infrastructure.

The main e-Infrastructure components and services include networking, high-throughput and high-performance computing, data infrastructures, software/middleware (including authentication and authorisation infrastructures) and virtual research environments that are to be used by international virtual research communities. In the future, these components must constitute a general-purpose digital open space, *an e-Infrastructure commons*, which provides digital tools and collaboration opportunities across the entire of Europe.

Research and innovation are strategic elements for European competitiveness in the world. As today's research is digital and online, the European e-Infrastructures are developing into an interrelated ecosystem that interacts with virtual research communities worldwide. New constituents of the e-Infrastructure ecosystem, such as infrastructures for data and software-related services, are rapidly emerging in projects and informal international collaborations.

The vision for the research e-Infrastructure outlined in this document has been constructed through joint efforts from a large number of experts. The main milestones of the roadmap process have been the meetings of e-IRG delegates, appointed for their knowledge and expertise in the provision of large-scale e-Infrastructure services and the related policy issues. e-IRG meetings aim to reflect on and balance different inputs, including those received from expert consultations, open e-IRG workshops, ESFRI meetings, e-IRG Task Forces on specific issues, and contacts with projects that represent e-Infrastructure users or service providers. The role of the Roadmap in this process is to provide a vision for the future and to motivate continuing efforts to create links between stakeholders, aimed at maximising the socioeconomic value of common research e-Infrastructure.

This Roadmap also describes the first steps in the direction set out in the new e-IRG strategy "e-IRG - Inspiring Future e-Infrastructures in Europe and Beyond" (2012). We hope that the present Roadmap can be used as an instrument by all stakeholders in continuing to pave the way towards a general-purpose European e-Infrastructure.



Gudmund Høst, e-IRG Chair

Executive Summary

The e-IRG Roadmap 2012 outlines a vision for the future of e-Infrastructures in Europe. To meet the challenges of implementing the EU's 2020 Strategy, this vision outlines Europe's need for a single "e-Infrastructure Commons" for knowledge, innovation and science as a living ecosystem that is open and accessible and continuously adapts to the changing requirements of research. This Roadmap presents the principles of the political, technological, and administrative framework needed for such an e-Infrastructure Commons.

To maximise the socioeconomic value of a common research e-Infrastructure, the e-IRG Roadmap 2012 provides policy makers, as well as e-Infrastructure users and providers, insights on the future European e-Infrastructure landscape and European e-Infrastructure coherence.

Important external drivers for e-Infrastructure development include: the need to compete in a global knowledge-based economy; the emergence of new models in research, innovation and learning; the pioneering role of e-Infrastructures for research that has often driven innovation in industry, business and public services; and technology bringing new paradigms for data and information services.

At present there is insufficient cohesion in Europe-wide research and education e-Infrastructures. Users need high quality services that are well managed and above all seamlessly integrated from a users' point of view so that they can get on with their business of science. The integration of e-Infrastructure services requires the full interoperability of the underlying e-Infrastructures. As a living ecosystem, an e-Infrastructure Commons is needed that is flexible and can change dynamically, efficiently and in a future-proof manner.

An e-Infrastructure Commons can only be established through a joint and truly common strategic effort between users and primary strategic actors and suppliers. Hence, many barriers towards realising a European e-Infrastructures Commons 2020 are structural and organisational rather than technical. Organisational models, business models, governance structures, funding models, and legal and regulatory landscapes face fundamental changes in the face of the development of the e-IRG vision: all must be adapted and updated and where necessary, new models have to be put in place.

Strong involvement by users is required in this process of reorganisation. The diversity of user requirements, the need for flexibility in architectural and technological choices, and the specific characteristics of the various e-Infrastructure components will be major challenges when converging governance. To achieve a strategic user pull, e-IRG sees a need for a single e-Infrastructure umbrella forum for strategy setting in Europe that is clearly separated from operational responsibilities.

To further facilitate the needed pan-European cooperation and coordination of e-Infrastructures, all parties should be involved in the various e-Infrastructure components and operate and organise themselves according to three organisationally distinct core functions:

- *Community building and high-level strategy* requires a single organisation with a central role for user communities with a particular emphasis on involving large, advanced and well-organised user communities at a European level and beyond.

- *Service provisioning* requires a flexible open and competitive approach to national, European and global service provisioning with advanced collaboration among public and commercial service providers.
- *Major innovation projects* should be implemented through the best consortia including e-Infrastructure suppliers, industry, users, and academia with a dedicated management structure.

A clear distinction between the funding for service provisioning and innovation will be necessary, where service provisioning is “paid by the users”, and major innovation projects will be justifiably (co-) funded by public R&D funds according to the Horizon 2020 principles. All governance should reflect the European dimension of e-Infrastructures and the global scale of research and education, while respecting national level decisions.

Acknowledgements and background

The e-IRG delegates

Listed on the e-IRG website (www.e-irg.eu) under “Members”

The e-IRG Roadmap Editorial Board

Gudmund Høst
Leif Laaksonen
Ivan Maric
Norbert Meyer
Kees Neggers
Dana Petcu

ESFRI-appointed expert

Bjørn Henrichsen

Other notable contributors

Sverker Holmgren
Frank van Iersel

e-IRGSP3 contributors

Dieter Kranzlmüller
Rossend Llurba
Christian Straube

Roadmap editors

Anton Frank
Marie Sandberg

1 Introduction

With this Roadmap 2012, e-IRG presents a vision of the future of e-Infrastructures in Europe. An advanced e-Infrastructure Commons will be necessary to implement the Innovation Union¹ and the Digital Agenda², two essential flagships of the EU's 2020 Strategy³. e-Infrastructure is used to refer to an environment to share research and educational resources (e.g. network, computers, storage, software, data) so that these resources can easily be accessed and used by academia, researchers and scientists as required. The *value* to the users of any infrastructure is not *in* the infrastructure itself, but in the "*leverage*" it provides on (*new*) *competitive "core activities"* of the users, which make it difficult to create sustainable business models for the exploitation of infrastructures. *Commons*⁴ is used as resource management principle by which a resource is shared within a community.⁵ This Roadmap 2012 presents the principles of the political, technological, and administrative framework for an easy and cost-effective shared use of distributed electronic resources across Europe: the e-Infrastructure Commons.

Key for implementing the Innovation Union is the Framework Programme Horizon 2020⁶ spanning a timeframe of 6 years from 2014 to 2020 and marking a significant transition to new ways of research funding in response to changes in scientific fields. The ERA strategy⁷ (European Research Area) is also at the heart of the Innovation Union, maximising the return on investment in research, and increasing the efficiency, effectiveness, and excellence of the European public research system. ERA has to ensure that Europe has world-class *research infrastructures* (including e-Infrastructures) that are also accessible to all researchers in Europe and beyond.

Due to the fundamental role of IT services in today's research, e-Infrastructures are essential in facilitating the realisation of the vision and potential of the ERA. A Europe-wide, high-quality and ever innovating system of e-Infrastructures will be needed, accessible to all researchers throughout Europe and supplying integrated e-Services according to the different requirements of the various user communities.

Meeting this challenge requires strong investment in innovation of e-Infrastructures, improvements in their coherence, and adaptation of their historical structure and governance systems. Continued development and growth is essential to respond to the increasingly demanding requirements of the users, in both scale and flexibility.

The role of the e-IRG Roadmap 2012 in this process is to provide a vision for the future and to motivate all stakeholders to undertake a concerted action to maximise the socioeconomic value of a common research and education e-Infrastructure. It aims to provide national and international policy makers, as well as e-Infrastructure users and providers, valuable insights into the future European e-Infrastructure landscape and European e-infrastructure coherence.

This roadmap will do this in three consecutive steps:

1. Describe the changing world: new social and technological developments, new research paradigms, such as those caused by the data deluge, and the resulting new user requirements;
2. Present a vision on the required European e-Infrastructures Commons in 2020;
3. Address the consequences: Reorganise for 2020.

This vision builds upon the work of others and on the emerging consensus represented in a number of recent external publications like "Riding the Wave", the final report of the High Level Expert Group on Scientific Data⁸, the GRDI2020 report⁹, "Knowledge without Borders", the report of the GÉANT Expert Group¹⁰ (GEG) and publications of the e-IRG itself such as the White Paper 2011, the Roadmap 2010 and the reactions of e-IRG on the GÉG-Report¹¹ and on the Digital Agenda¹².

1 http://ec.europa.eu/research/innovation-union/pdf/innovation-union-communication_en.pdf

2 http://ec.europa.eu/information_society/digital-agenda/documents/digital-agenda-communication-en.pdf

3 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:2020:fin:en:pdf>

4 'Commons' originates from an English tradition of sharing the pasture grounds in a village.

5 Brett Frischman, Infrastructure, the Social Value of Shared Resources, Oxford University Press, 2012.

6 <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0808:FIN:en:PDF>

7 http://ec.europa.eu/research/era/pdf/era-communication/era-communication_en.pdf

8 <http://cordis.europa.eu/fp7/ict/e-infrastructure/.../hlg-sdi-report.pdf>

9 www.grdi2020.eu

10 <http://cordis.europa.eu/fp7/ict/e-infrastructure/docs/geg-report.pdf>

11 <http://www.e-irg.eu/publications.html>

12 http://www.e-irg.eu/images/stories/digital_agenda_a5_final.pdf

2 The Changing World

2.1 The need for integrated services and interoperable e-Infrastructures

Apart from many existing national, regional, or topical infrastructures, three Europe-wide research e-Infrastructures have been established to date: the European high-speed GÉANT¹³ network interconnecting all European National Research and Education Networks (NRENs), the PRACE infrastructure comprising the largest supercomputers in Europe, and a European Grid Infrastructure (EGI) coordinating the existing National Grid Infrastructures in Europe. Today, complementary infrastructures are emerging, focusing on data, e.g. EUDAT and OpenAIRE, and software. The existing e-Infrastructures represent today's approach¹⁴. They were established separately to focus the effort on the specific characteristics and challenges of each of their respective domains.

However, users in science and higher education are increasingly interested in integrated services focused on their own problems, and much less in who delivers these services. Ultimately, users want to be presented with user-friendly access to all e-infrastructure services they might need. Information and communication technology based resources and services are not, by definition, the users' core business, so neither are e-Infrastructures. To be efficient, users need to concentrate on their core business, using coherent e-services that should be sufficiently simple to use and not costly to manage. Users do not want to be confronted with problems, arising from the incoherent delivery of today's e-Services.

Interoperable e-Infrastructures offer potential economies of scale, e.g., by grids and clouds, or open up the opportunity to cost effectively address a much wider range of research challenges than distinct ones. Common or cooperating e-Infrastructures enhance the opportunities for joint research and worldwide cooperation, e.g., by open networking, international grids or clouds and by offering common data services, as outlined by the recent High Level Expert Group reports "Riding the Wave" and "Knowledge without Borders".

Therefore from the users' point of view there should only be "one" set of integrated e-Infrastructure services supplied in a seamless manner by an interoperable set of underlying e-Infrastructures. The current Internet shows how this works for networking: a common user interface and access mechanism to functionally common services provided by a huge variety of physical networks and inhomogeneous network management domains. Also grid computing and cloud based-services for computing and data services are moving in this direction. The challenge now is to provide this user experience for the full set of needed infrastructure components.

Current roadblocks and issues on the road to more effective integration span all areas of operation and include:

- Insufficient coordination, collaboration, and integration of existing e-Infrastructures at the right level, including those provided by commercial service providers, foiling the goal of a seamless user experience.
- Legal issues, for instance different legal statuses of e-Infrastructure's leading to different access policies for e-Infrastructures, and different data privacy policies and traditions in countries and research fields.
- Hurdles to access and usage of e-Infrastructures; new non-discriminatory access models and flexible usage policies to the e-Infrastructures are needed to allow a larger number of researchers to have access to the e-Infrastructure (e-Infrastructure as a research utility service).
- Lack of "Visibility" of services: currently users get no seamless offering of integrated e-Infrastructure services, but high awareness by users of borders, interfaces, and technologies of the individual components.
- Lack of business models based on secure and sustainable funding streams for the use and innovation of e-Infrastructures.

In addition, new e-Infrastructure components and services will be added to the existing ones. The next upcoming e-Infrastructure component may be large-scale storage facilities for data-oriented services and services for accessing, handling, and analysing large datasets of many types. Fully exploiting the potential of these data services will require close and effective integration with networking and computational resources. Failure to do this will result in costly duplication or ineffective services unable to meet users' requirements. When establishing these additional resources and services the experiences with other e-Infrastructure components should be taken into account right from the start. In particular, a proliferation of coordinating entities needs to be avoided.

2.2 New social and technological developments and user requirements in science

Not the resources themselves must be pan-European, but rather the services to the user that will draw on a combination of various resources across Europe. This will create the capability to bring researchers from across Europe together in international, virtual teams and organisations. Therefore, a living e-Infrastructure ecosystem is needed that is flexible and can change dynamically, efficiently and in a future-proof manner.¹⁵ In various recent visions¹⁶ on the future of existing and emerging e-Infrastructures, the key external drivers that will determine the future, are similar for all the e-Infrastructure components. However, the impact on these components can be different, when acknowledging their special characteristics, functionality, and history.

The important external drivers for e-Infrastructure development include:

- The need to compete in a global knowledge-based economy. If the ERA and the EHEA are to be a key enabler of a knowledge-based economy then these must be supported by a common e-Infrastructure ecosystem.

¹⁵ e-IRG White Paper 2011. (p. 9)

¹⁶ E.g. Riding the Wave, the GRDI-Report, and Chapter 2, 'The borderless World' in the GEG-Report.

¹³ The term GÉANT may be used in three different meanings: "GÉANT network" refers to the pan-European network backbone, "GÉANT project" designates the GN3 project. The GEG uses the name GÉANT2020 in a much wider meaning as a GEANT2020 European Communications Commons

¹⁴ Existing funding mechanisms and user involvements in today's e-Infrastructures and the needs for change have been extensively discussed in Chapter 1 of e-IRG White Paper 2011 (p. 11,12)

- The emergence of new models in research, innovation, and learning, e.g., the increase of multidisciplinary research; the disciplinary and geographical extension of the user groups; the emergence of e-Science, driven by e-Infrastructures and the need for a trustworthy environment.
- The pioneering role of e-Infrastructures for research and higher education that has often driven innovation in industry, business and public services. In its response to the EU's Digital Agenda, e-IRG has already highlighted this pioneering role of the research and higher education community as a traditional early adopter and as developer of new information and communication technology components and services¹⁷.
- Technology bringing new paradigms for data and information services, e.g., ubiquity of data; greening of ICT, etc.

In its response to the GEG-Report, e-IRG¹⁸ has endorsed the views and recommendations of the GEG and, in particular, emphasised the importance of the further integration of all e-Infrastructure components and of strengthening the role of users in developing and financing of e-Infrastructure components and services.

3 A vision towards a European e-Infrastructure Commons 2020

The vision presented here assumes that research and innovation are strategic elements for European competitiveness in the world. As today's research is digital and online, e-IRG believes that in 2020, the European e-Infrastructure components and services will have developed into an interrelated living ecosystem of networking and high-throughput/high-performance computing and data components supporting virtual research communities worldwide. In its earlier publications, e-IRG already strongly supported the concept of a single communications commons, offering end-to-end connectivity, and offering a broad functionality in services.

e-IRG's vision for 2020 is that Europe needs a single "e-Infrastructure Commons" for knowledge, innovation and science, as a living ecosystem, which is open and accessible and continuously adapts to the changing requirements of research.

The internal drivers that will lead to this interrelated living ecosystem of 2020 are complementary developments in the different e-Infrastructure components and will result from the various strategic visions now available. In 2020, the leading edge users of data and their service providers will have met the challenge set in "Riding the Wave" to develop an international framework for how different companies, institutes, universities, governments and individuals would interact with their data systems, a so-called Collaborative Data Infrastructure¹⁹ (see Fig. 1). Further work should lead to the implementation of the central concepts of a digital science ecosystem, including necessary "associated tools"²⁰: in 2020, the digital science ecosystems should have services as well as tools - services to help find tools, discover data, integrate data sets or manage the scientific workflow.

The compelling vision outlined in "Riding the Wave" as already accelerated the strategic plans of the existing e-infrastructure components to work towards this vision.

¹⁷ http://www.e-irg.eu/images/stories/digital_agenda_a5_final.pdf

¹⁸ http://www.e-irg.eu/images/stories/e-irgs_reaction_geg_a5.pdf

¹⁹ Riding the Wave p. 5

²⁰ GDRI 2020 Vision p 3,4

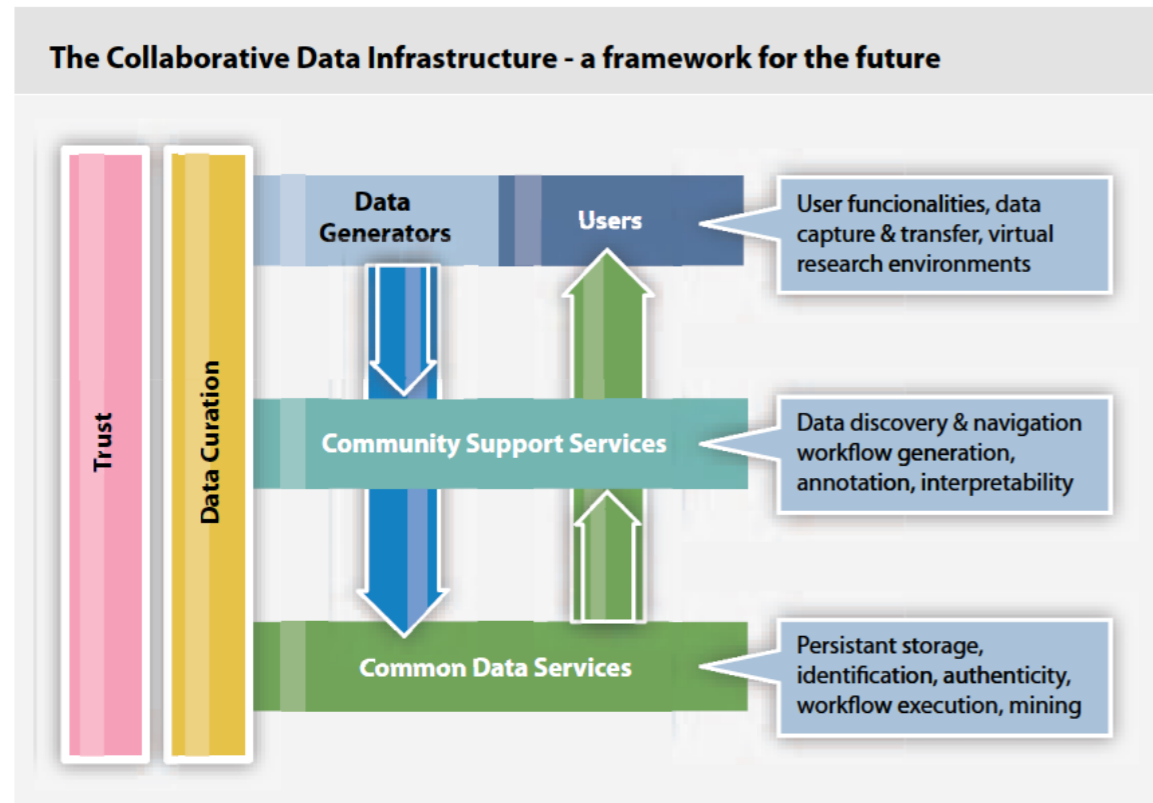


Fig. 1: The Collaborative Data Infrastructure as envisaged in “Riding the Wave”

Services, both current and new ones, will be open and accessible to all users, irrespective of their location and status. In 2020, the concept of the Commons as a “Collaboration platform” will be expanded to cover the full functional capabilities and capacities of all e-Infrastructure components and services. The e-Infrastructure Commons will be rooted in the values of equality, solidarity, and freedom, all of which are held in high regard by Europeans.

Breaking through the limitations of today’s separate e-Infrastructure components, services and governance an “e-Infrastructure Commons” should have liberated scientists from the often complex and distracting business of “computing”. They need services that are coherent, managed and above all integrated so that they can get on with the business of science. However, we must be careful to not become constrained and stifle innovation in the development, provision and use of these services. The idea that there will be just “one way” of supplying or using any service through an “efficient” mandated or “voluntary” monopoly, has to be avoided. It is important that e-Infrastructure providers are encouraged to be open and competitive and above all not “institutionalised”. Providing e-Infrastructures will never be a “solved problem” and there is not just one way to provide it. Allowing e-Infrastructures to evolve is important: open competition, collaboration, but also technological bypassing and new distribution concepts of service belong to the 2020 vision as well.

An e-Infrastructure Commons can only be established through a joint and truly common strategic effort between users and primary strategic actors and suppliers. A common effort in setting a strategic direction is a starting point for this vision, not a remote output.

Striving for a common strategic vision should not, a priori, be taken as a threat or barrier to the continuing innovation and ambition of any of the individual (existing) services. Today’s (and

possibly tomorrow’s) e-Infrastructures have evolved along different functional, geographic, and type-of-user dimensions, and many of these differences will remain. However, the main principles for dealing with access, governance and finance are common, and the recommendations on how to deal with them presented in the e-IRG White Paper 2011, and in the GEG report, will be equally applicable individually and for the total e-Infrastructure ecosystem. Successfully addressing these challenges will naturally drive increasing coherence where required, as each e-Infrastructure is serving the same research and higher education communities.

To meet the above ambitions, e-Infrastructures must develop towards a truly open and global digital ecosystem. Institutional and geographic borders are increasingly artificial in the “virtual” world of e-Infrastructures. Procedures, and regulations designed for the previous era are not necessarily those best suited for 2020. Organisational models, business models, governance structures, funding models, and regulatory landscapes all face fundamental changes in the face of the development of the vision outlined here: all must be adapted and updated and, where necessary, new models have to be put in place.

Through collaborative organisational structures, a European e-Infrastructure Commons for research demand will be more efficiently aggregated than could be achieved by national players going to the market individually. From a technology perspective, they feature multi-vendor, multi-domain open environments that are not normally available from commercial providers.

In the 2020 vision, providers have the freedom to innovate and users enjoy the freedom of choice of the services they need and have equal access to commercial services. As a consequence, there is a need to be a very clear about, and to offer very real value propositions for, each of the e-Infrastructure service providers vis-a-vis the users. Innovation needs to remain a public interest supported by public funding, which should be open for competition, based on quality only.

The innovative drive of leading edge research users and leading edge service providers will also enable Europe to educate, train, nurture, and keep innovative talents in Europe.

In the 2020 vision of the e-IRG, the user base will be extended to support the whole innovation chain, and possibly other public sectors. In its Roadmap 2010, e-IRG has already stated the importance of participation of private research in the use of research networks. In the research arena, user communities are increasingly heterogeneous, often comprising academia, public, and private research institutes, corporations, and non-profit organisations cooperating in public-private partnerships. This trend is reinforced by the move to open innovation. The services provided by PRACE and EGI are needed in an increasing number of research disciplines; a similar trend is visible in new service areas such as data.

A necessary consequence of the vision on the future of European research and innovation is that the e-Infrastructure’s user base needs to be expanded to meet the challenges set in Horizon 2020. An analysis of options to expand the user base of e-Infrastructure services is needed, provided that the mission of an open continuously innovating ecosystem for the special needs of the research and higher education community will not be threatened by such an expansion and that the necessary funding principles will be adapted accordingly (i.e. the innovation research funding should lead the way, but not subsidise the costs, for education, and vice versa).

4 The consequence: Reorganise for Change

Many if not all barriers to realising the vision towards a European e-Infrastructures Commons 2020 are structural and organisational rather than technical. In its White Paper 2011 e-IRG - like others as well²¹ - has identified organisational aspects and common issues on governance, funding and legal matters that need to be addressed for their vision to be realised.

Major changes in governance are urgently needed, and e-IRG has gratefully recognised that the principles that the GEG has recommended for networking in the future are fully in line with the proposed approach for governance and funding in e-IRG's own White Paper 2011.²² Strong involvement by users is required in the process of reorganisation, starting with today's high end users, and in close cooperation with the leading edge research infrastructures in ESFRI.

These principles, to reorganise for change, are fully applicable to all components of the European e-Infrastructures Commons 2020, servicing the same user communities with seamlessly integrated e-Services. Following these principles is also the right way to overcome the current separateness of the existing e-Infrastructure components and to facilitate the emergence of new ones, e.g. for supplying leading edge data management services or cloud services. Urgent action is required because, having no alternative, users have already had to take initiatives themselves, leading to many specific solutions for the same general problem. If we are not careful, we will soon end up with increasing superficial diversification, expensively and unnecessarily duplicating functionality rather than integrating e-Service provisioning. Users want a single and easy to use interface to all e-Infrastructure services they need.

The rapid implementation of a European e-Infrastructure Commons can only be realised effectively by timely inclusion of the users in e-Infrastructure governance while acknowledging their need for a complete portfolio of e-Infrastructure services and not just for network services, grid services, HPC services or data services. Without a coherent and mature approach to e-Infrastructure governance, the views of the GEG for 2020 cannot be fully realised.

The diversity of user requirements in the various sciences and projects, the need for flexibility in architectural and technological choices, and the specific functional characteristics of the various e-Infrastructure components will certainly be major challenges when converging e-Infrastructure governance. e-IRG believes this challenge can be met by applying overall organisational principles for each of the e-Infrastructures components²³. These principles address the three organisationally distinct core functions:

1. **Community building, high-level strategy and coordination in Europe:** a single organisation with a central role for user communities especially involving large, advanced and well-organised user communities at a European level and beyond.
2. **Service provision:** flexible, open, and competitive approach to national, European, and global service provision; with advanced collaboration among the interested public and commercial service providers.

3. **Innovation:** Implementation of major innovation projects through the best consortia including e-Infrastructure suppliers, industry, users and academia with a dedicated management structure comprising the partners per project.

The position of user communities in e-Infrastructure governance will have to be strengthened on four levels:

1. On the **strategic level** user communities will have to organise themselves to drive the long-term strategy.
2. On the **service provision level** user communities will have to learn to use their joint purchasing power in a competitive market.
3. On the **innovation level** advanced users of international e-Infrastructures should support the specification and real-life testing of new e-Infrastructure developments, for their mutual benefit. LHC and eVLBI are already good examples of this approach.
4. On the **standardisation level** user communities should contribute to the process of setting and implementing the international standards necessary to achieve the transition from the current e-Infrastructure service portfolio to the international, service-oriented, e-Infrastructure portfolio recommended in this paper.

A complex ecosystem for e-Infrastructure services calls for governance structures that are transparent, streamlined, accountable, and responsive. This implies creating European level bodies with clear, carefully defined and non-overlapping mandates along the three core functions enumerated above: community building and high-level strategy, service provisioning, and innovation. Governance should reflect the European dimension of e-Infrastructures and the global scale of today's and tomorrow's researcher user base, while respecting that national level decisions still have an important role in all activities. It is not necessary for all countries and national providers to participate in all fora and projects at every level. All pan-European organisations like DANTE, TERENA, EGI.eu and PRACE AISBL, as well as emerging data infrastructures, should re-think their role in reference to the three core functions stated - strategy setting, service provisioning, and innovation - and should reposition themselves accordingly for participation in the foreseen e-Infrastructure Commons 2020.

To achieve a strategic user pull, e-IRG sees a need for a single e-Infrastructure umbrella forum for strategy setting in Europe, with sufficient user participation for community building, high-level strategy and coordination for the entire e-Infrastructure. This umbrella-forum should be clearly separated from operational responsibilities. The current experiences in networking and grid computing provide useful input in setting up this overall strategic framework. TERENA and DANTE are now actively following up on the GEG recommendations to broaden their strategic and coordinating function in the direction indicated by the GEG. EGI.eu is also working actively towards a sustainable future structure.

Besides a common strategy and coordination function, a competitive service provisioning approach and a pluralistic approach to innovation are required. A clear distinction between the funding for service provisioning and innovation will be necessary, where service provisioning is "paid by the users", and innovation will be justifiably (co-)funded by public R&D-funds according to the Horizon 2020 principles. The latter can drive novel service propositions that are not yet offered on the commercial market. Of course due care is needed to ensure that users have enough budget to pay for the services they require, for instance by including these as part of Horizon 2020 or national research grants. It also is clear that a healthy ecosystem requires closer collaboration between e-Infrastructure users and providers in developing and deploying new services.

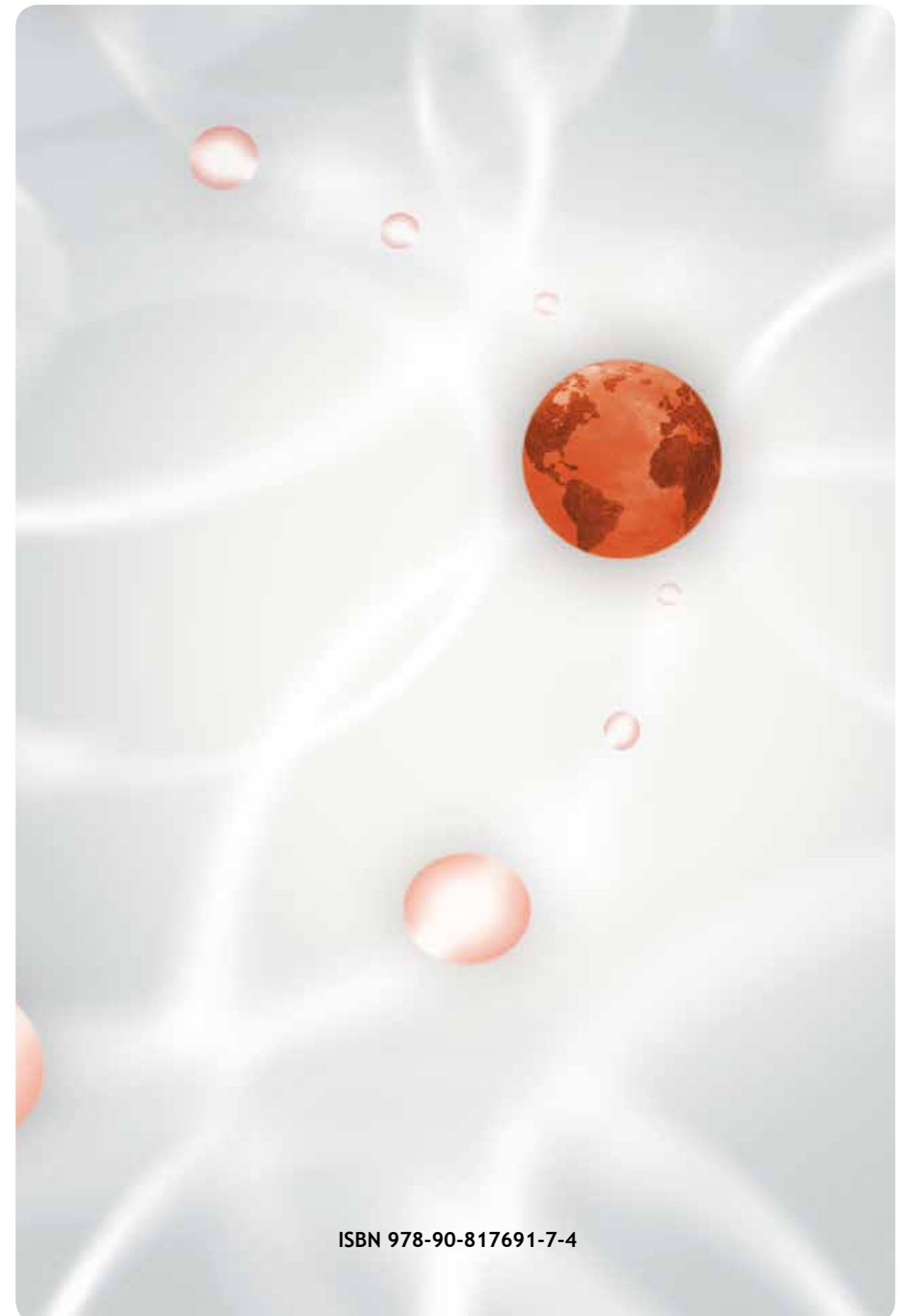
²¹ Like the GEG, the GDRI 2020 consortium, the High Level Expert Group for Scientific data, e.a.

²² e-IRG's reaction to the GEG report p 13

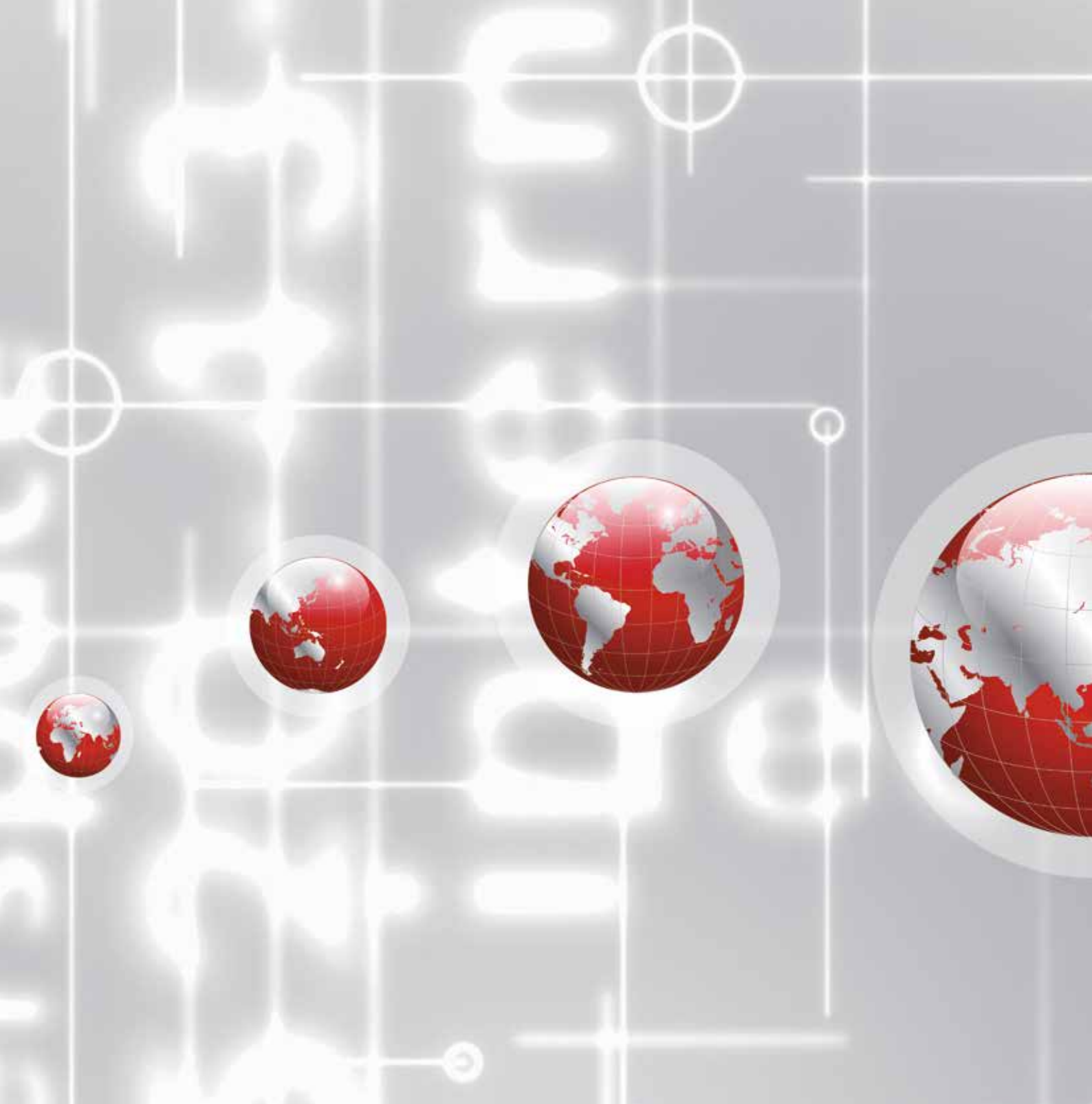
²³ This structure is in accordance with the structure proposed by the GEG for future networking in Europe

Public funding for innovation should be reserved for innovation only. There is a clear need to address the digital divide that exists between countries, regions and users in Europe. Yet at the same time, it is vital that service provision and enhanced innovation drive novel commercial offerings, by building on what the most advanced users/providers in Europe have developed. These different goals are best served by separate funding arrangements whereby, for instance, the Structural Funds should play a more prominent role in helping to address the digital divide. Equally, when funding of services moves to the users, future innovations projects should earmark sufficient budget to pay for the required e-Infrastructure services. This will then automatically give the research user base a stronger voice in keeping the service provisioning in line with their advanced needs and this will also strengthen the e-Infrastructure ecosystem.

All existing and newly emerging organisations involved in e-Infrastructure components should operate and organise themselves according to the three distinct core functions: community building and high-level strategy, service provisioning, and innovation. Equally they must participate in the drive for user and innovation led high-level strategy right from the start.



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e-IRG secretariat
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