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Project Consortium Information

Partner	Acronym	Contact
Telefónica i+D (Coordinator)	TID	Juan José Hierro Sureda Centre for Excelence for Software Techologies Telefónica i+D Emilio Vargas 6 28043 Madrid SPAIN Email: jhierro@tid.es Tel.: +34 91 337 47 41

1 EXECUTIVE SUMMARY

Now that the Internet has become a commodity for professional and everyday life, businesses and citizens aspire to access ICT-based services in a more seamless, natural fashion. Target sectors range from public health, government and educational services to energy, transport, skills and mass services to individual users.

This demand defines a new global system, in which every electronic medium will support the provision of services. This creates the need for an open, service-oriented approach, with the Internet as its underlying infrastructure and designed to meet the expectations of a service-oriented economy.

Europe aims to play a major role in this shift towards an Internet of Services. The Networked European Software and Services Initiative (NESSI) was launched in September 2005 to support this shared vision, with the mission of developing a strategy for software and services driven by a common European research agenda.

Since then, NESSI is promoted by 22 industrial and academic partners and a community of 500 members from 300 organisations.

NESSI represents a major advance: for the first time ever, industry and academia have joined forces to define a common service-oriented strategy and a target deliverable – NEXOF, the NESSI Open Service Framework.

From its initial vision, NESSI has achieved major results:

- drawing-up of a NESSI Strategic Research Agenda;
- definition of NEXOF: the NESSI Open Service Framework;
- design of the contribution process to gather the widest possible support;
- definition of application scenarios;
- focused workgroups on services, technology or applications

NESSI-Grid contributes to NESSI by defining a vision and strategic research agenda (SRA) for grid infrastructures used in business environments and in particular in NESSI scenarios. While contribution to the

NESSI SRA constitutes the key goal of NESSI-Grid, the project also addresses related matters, such as standards, IPR, research infrastructure, training and dissemination.

NESSI-Grid's main achievements include:

- support the widest and general agreement of the Grid and SOA vision, incorporating views from a wide variety of stakeholders;
- assist the production of a widely supported Strategic Research Agenda (SRA), which would contribute to the Seventh Framework Programme;
- support the development of the Grid and SOA business domains, fostering new opportunities;
- disseminate a Grid research strategy;
- support the co-ordination of research in the Grid and SOA domain. NESSI-Grid's ambition is to serve as a reference point around these technologies and services.
- provide the support structure for the GRID focus of NESSI;
- facilitate liaison with other R+D communities outside of Europe

As NESSI structure and objectives have been continuously evolving, NESSI-GRID evolved in parallel. For instance, while NEXOF did not exist when NESSI-Grid was defined, contribution to NEXOF-RA became one of the main objectives of NESSI-GRID when NEXOF-RA's activities started on February 2008. During these last two years and a half, the technical terminology has evolved as well, and new buzzwords have come out from Enterprise or Business Grids, through Service Oriented Infrastructures to Cloud Computing. All of these terms are covered by the NESSI-GRID SRA scenarios, research challenges and roadmaps.

The NESSI-Grid SRA focuses on opportunities for grids to evolve into major business infrastructures for the more agile and effective delivery of services. The SRA has been developed by the Grid community and details how this evolution can be achieved through a set of research challenges based on business scenarios and current technology trends. The innovative infrastructure is underpinned by the concept of Business Grids.

2 BACKGROUND

2.1 THE NESSI INITIATIVE

2.1.1 Mission

NESSI's mission is to develop a visionary strategy for software and services driven by a common European research agenda, where innovation and business are strengthened by:

- providing Europe's industry and public sector with efficient services and software infrastructures to improve flexibility, interoperability and quality;
- mastering complex software systems and their provision as service-oriented utilities;
- establishing the technological basis, strategies and deployment policies to speed up the dynamics of the services eco-system;
- developing novel technologies, strategies and deployment policies that foster openness, through the increased adoption of open standards and open-source software as well as the provision of open services;
- fostering safety, security and the well-being of citizens by means of new societal applications, enhanced efficiency of industry and administrations, and competitive jobs, hence transforming the European economy into a knowledge-based economy and enabling the European software and IT services industry to attain a stronger global position. NESSI operates in the context of a wide continuum of information and communication technologies, and intends to collaborate closely with other global research initiatives.

2.1.2 Scope

Over the next decade, every electronic device will incorporate interaction capabilities supporting the provision of services to both devices and people within continuously changing scenarios, addressing specific business needs and situations in a continuum which defines a new global system.

This new system is no longer purely computer-based, nor is it focused mainly on exchanging information. On the contrary, ICT will increasingly play a role in dynamically supporting the operations of businesses and the everyday life of citizens in a seamless, natural fashion.

Key properties underlying this evolution include openness, scalability, dynamism, proactiveness, uncoordinated governance and the absence of central control, and limited predictability. This evolution is reflected in the move to distribute solutions not as single software environments but as services – an evolution in which Europe aims to play a major role in order to move towards an Internet of Services.

2.1.3 Target users / sectors in business and society

NESSI's ultimate goal is to enable the next wave of services, by providing a new service framework – the NESSI Open Service Framework (NEXOF). It is aimed at freeing service developers and integrators from constraints linked to identification, security, interoperability, quality, privacy, etc. NESSI's goal is on the one hand to deliver an open-source implementation of NEXOF and on the other hand to foster multiple interoperable implementations of NEXOF – whether proprietary or open-source. Enabling billions of services to interact.

Target sectors range from public health, government and educational services to energy, transport, skills and mass services to individual users. Beyond the transformation of existing domains, NESSI foresees the emergence of new applications born of the exchanges between currently disconnected areas.

Therefore, target users of NEXOF include software and application developers, systems integrators, technology and service providers, as well as private and public end users.

NESSI – enabling the next wave of services for

- ✓ service and software developers
- ✓ system integrators
- ✓ end users
- ✓ private corporations
- ✓ public administrations

2.1.4 Overall benefits for business and society

Service providers, whether SMEs or large organisations, will benefit from a *faster time to market* for new services through service infrastructures offering industrial-grade quality.

For public and private corporate users, the availability of NEXOF-compliant infrastructures will provide a guarantee of current and future interoperability and independence from a single provider with backing from the industrial community as a whole. In other words, *protecting their investments*.

NESSI – enabling the next wave of services to ensure

- ✓ faster time to market
- ✓ protection of mid- and long-term investment
- ✓ independence from a single provider
- ✓increased competitiveness of the European software and services economy

2.1.5 Positioning in a global context

At a general level, the question is not whether the delivery of software is shifting towards a service-oriented model, but rather *how* and *when* this evolution can be brought about so as to guarantee quality of service, ubiquitous operation and continuous availability. The services evolution relies on the Internet as an underlying infrastructure and needs the Future Internet to be in line with the requirements of a service-oriented economy.

New alliances between the traditional IT industry, telecommunication companies, mobile service providers, media corporations, suppliers of consumer electronics and search engine companies will drive the deployment of the Future Internet, to enable

- service platforms and front ends
- virtualized service delivery and real-time multimedia
- technology-independent standards for interoperability
- end-to-end solutions for instant, context-aware, personalized service creation

2.1.6 Contribution to standardization and interoperability issues

In an era of services, interoperability is the major goal – ensuring that services designed by different parties can blend seamlessly to create the environment that best fits user needs. Interoperability is a major reason why the industrial partners of NESSI teamed up; it is the central theme in the definition of NEXOF.

To achieve interoperability, NESSI relies on standards. NESSI's approach is to adopt existing standards and, when needed, adapt them to gear them more closely to their intended use. When, and only when, existing or evolving standards do not fulfil the required needs will NESSI promote a new one. To support this approach, NESSI's standardisation committee – COSTA – is in charge of monitoring the standards and linking to standards organisations as appropriate for the elaboration of NEXOF.

NESSI – enabling the next wave of *interoperable* services through

- ✓ existing standards
- ✓ extended standards

2.1.7 Business scenarios

In NESSI's vision, the service approach coupled with service infrastructures such as NEXOF helps overcome existing limitations linked to incompatible databases, remote access to private information, security and privacy issues that hinder exchange of information. The scenarios of the future take the service level beyond single corporations or administrations and open the door to end user personalization.

2.2 NEXOF

NEXOF, the NESSI Open Service Framework, is an integrated, consistent and coherent set of technologies, methods and tools intended, as quoted by the NESSI mission. Thus, the overall ambition of the NEXOF project is to deliver a coherent and consistent open service framework, ranging from the infrastructure up to the interfaces with the end users, leveraging research in the area of service-based systems to consolidate and trigger innovation in service-oriented economies for the benefit of the whole European Economy. NEXOF will be domain independent and will be accompanied with a sound methodology and tools to be properly instantiated into a broad range of application domains

by a number of end-user communities (including Large, Medium, and Small enterprises) on different technologies.

NEXOF will be composed of:

- A **Reference Model**, which defines the main concepts from both, the technology, business and citizens viewpoints;
- A **Reference Architecture**, to formalise the reference model into open specifications facilitating a precise implementation of the service environment in different domains and technologies;
- A **Reference Implementation**, to make NEXOF happen, serving as the guide for further NEXOF instantiations by different organisations, for different domains and adopting different technological approaches. This is a complex set of methods, tools and technologies released as open source allowing derivative works;
- A **Compliance Test Suite**, to validate each NEXOF instance and the related provided services, not only to be fully operational, but also to be compliant with the Reference Architecture so as to ensure maximum interoperability.

2.3 NEXOF-RA

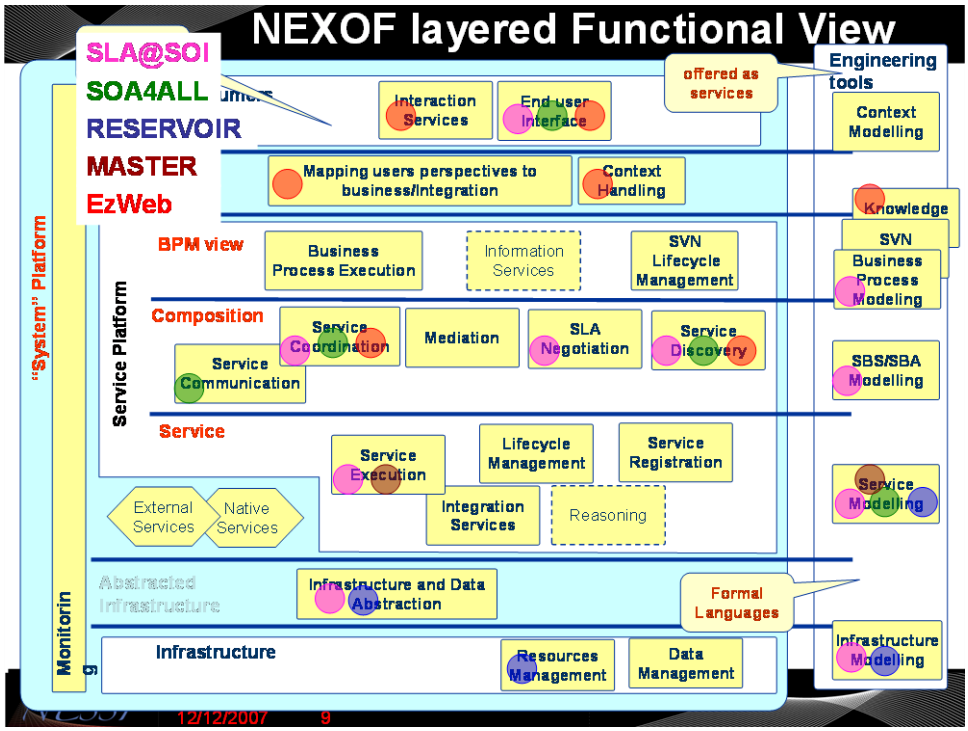
NEXOF-RA (NEXOF Reference Architecture) project is the first step in the process of building NEXOF. NEXOF-RA main results will be the Reference Architecture for NEXOF, a proof of concept to validate this architecture and a roadmap for the adoption of NEXOF as a whole. To build the specifications for the Open Framework Architecture, an open process has been defined to allow the involvement of all relevant initiatives and organizations concerned on building a Reference Architecture for the “Future of Internet”.

The process used for the construction of the NESSI Open Service Framework (NEXOF) Reference Architecture must promote the active involvement of external parties. This is driven by many reasons, which can be summarized as follows:

- inclusion of external parties allows the project to leverage the best-of-breed architectures and technologies, thereby enhancing the quality and applicability of the overall architecture;
- inclusion of the relevant stakeholders enhances the level of adoption of the overall architecture.

This is implemented through a combination of governing and contributing bodies. The governing aspects are handled through the NEXOF Architecture Board, which is the technical decision making authority of the project and includes architects from the key contributing external initiatives. The open contribution aspects are handled through the Open *Construction Cycles* (OCC) of the *Open Architecture Specification Process* (OASP).

Project contribution map: the NEXOF Functional View



The construction process is centred on parallel execution of OCC, each focused on a specific, well defined topic. These topics are made public through successive Invitations to Contribute distributed to the widest community possible.

Any party can participate in the construction cycles, including academic institutions, industry players of all sizes, and individuals. The only requirement is a commitment to contribute in a proactive and constructive fashion. All contributions must be compatible with the inclusion of results in an "open" document with derivative rights. While participation is voluntary and not funded by the NEXOF-RA project, the process is driven, managed and supervised by members of the NEXOF-RA project team, under the technical supervision of the NEXOF-RA Architecture Board.

Each OCC follows a standard pattern:

- During the 2 months following the publication of the Invitation to Contribute, prospective contributors register their interest and formulate a *position paper*. During this period, the Leader for each topic answers questions, reviews registrations and submissions, and verifies interest to build the **Investigation Team** which is the operative body of the next phase.
- During the following 2 ½ months, the Investigation Team formulates a common position based on the consensual convergence of various proposals. This position is then refined by the NEXOF-RA project team for inclusion in the relevant architecture documents.

3 NESSI-GRID ROLE AND ACTIONS

The NESSI-GRID FP6 Support Action supported the activities of the Service-Oriented Infrastructures NESSI Working Group (SOI-NWG) and specific communications and interlinking activities of the NESSI ETP in collaboration with the NESSI bodies (Steering committee, Board, SRA Committee and Strategy & Communication Committee).

The main aim of the SOI-NWG has been developing a specific SRA on Enterprise GRID Infrastructures (now also named Service Oriented Infrastructures or Cloud Infrastructures) and fostering the collaboration of the GRID Community in the elaboration of this SRA. The resulting GRID SRA (version 3) has been contributed to the NESSI SRA and to the NEXOF Reference Architecture in order to identify architecture elements at the Infrastructure Services level

NESSI-GRID has also been in charge of coordinating the ICT FP6 projects Task Group 1 on Grid Architectures. The activities of TG1 have been transferred to the new ICT Service Architectures Working Group.

NESSI-GRID has also developed best practices for attracting the attention of the GRID community and fostering collaboration. The GRID SRA Open collaboration process relying on the Community liaisons coordinator, use of collaborative web based on a wiki tool and mailing list, and intensive presence in GRID-related events, has been successfully completed.

3.1 Advances

From 2006 to 2008, NESSI-Grid supported NESSI's goals and ambitions and contributed to:

- Developing the specific Service-Oriented Infrastructures topics of the NESSI-SRA
- Collaborating with NESSI's communication strategy and developing its own strategy targeted towards the Grid community
- Collaborating with NESSI Interlinking strategy with European policy makers (European Parliament, Member States), international stakeholders, other European ETPs and national NESSI platforms

- Fostering collaboration of the GRID community – through the Service-Oriented Infrastructures NESSI Working group and contributing to the creation of the NESSI Open Source Software Working Group – and coordinating FP6 TG1 on GRID Architectures
- Fostering participation in NEXOF-RA of TG1, SOI-NWG and SOI-related stakeholders

3.2 Summary of NESSI-Grid achievements

- At NESSI-GRID SRA level
  - Delivery of the Grid vision & SRA paving the way from eScience Grids to Business Grids and emerging Enterprise Cloud Technologies;
  - Inclusion of all European stakeholders thanks to a successful Community Involvement Process;
  - Definition of Business Scenarios, Adoption Roadmap and Market and Business Indicators;
  - Assistance to NEXOF-RA on next-generation Infrastructure Services;
  - Extension of NESSI-SRA on Service Oriented Infrastructures topics.
- At NESSI communications level
  - Collaboration with NESSI-Website and newsletters delivery;
  - Participation in GRID and NESSI events – including NESSI's annual General Assemblies and the latest ServiceWave 2008 event.
- At interlinking level
  - Helping NESSI - in co-ordination with NESSI-Soft – to interlink with policy makers (European Parliament, Member States, international bodies, …) research and other ETPs (Future Internet, Inter-ICT Platform Group, etc.) to achieve NESSI objectives and help defining NESSI strategy.;
  - Delivering the report on how to improve innovation in Europe.
- At community level
  - Collaboration with NEXOF-RA by taking GRID SRA as input and launching the Open Collaboration Process;
  - Coordinating the FP6 ICT collaboration Task Group 1 on Grid Architectures;
  - Support the Service Oriented Infrastructures NESSI Working Group with more than 5,000 accesses to its website;

- Contribution to create the new Open Source Software NESSI Working Group;
- Developing the Open Alliance concept as a collaboration instrument to integrate reference implementations of specific NEXOF-RA topics.

These achievements are described in detail in the next chapter.

4 NESSI-GRID'S ACHIEVEMENTS – A DETAILED VIEW

4.1 Presentation

The Networked European Software and Services Initiative (NESSI) aims to create a Strategic Research Agenda (SRA) for European research in services and their foundations, and to implement its recommendations. NESSI-Grid contributes to that activity by defining a vision and SRA for grid infrastructures used in business environments and in particular in NESSI scenarii. While contribution to the NESSI SRA constitutes the key goal of NESSI-Grid, the project also addresses related matters, such as standards, IPR, research infrastructure, training, etc.

NESSI-Grid's main achievements include:

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As NESSI structure and objectives have been continuously evolving, NESSI-GRID evolved in parallel. For instance, while NEXOF did not exist when NESSI-Grid was defined, contribution to NEXOF-RA became one of the main objectives of NESSI-GRID when NEXOF-RA's activities started on February 2008.

4.2 Participant List

The NESSI-Grid Consortium has been structured around the support of a number of European Entities that expressed interest on the Grid technology. This strong interest from European stakeholders from many different business perspectives is driven by a core of Entities, most of whom have been part of this NESSI-Grid proposal.

Telefonica I+D (TID) took the role of coordinator for the Support Action (SSA). The 9 other partners include:

- Atos Origin (Spain)
- British Telecom (UK)
- IBM (Belgium)
- SAP AG (Germany)
- Nokia (Finland) (initially represented by Nokia Oyj and, since January 1st 2007 by Nokia Siemens Networks Magyarország Kft, Hungary)
- THALES (France)
- INRIA (France)
- Engineering Ingegneria Informatica (Italy)
- Software AG (Germany), that left the project at month 7 following an internal reorganisation.

This consortium has been chosen to cover all of the skills and experience needed for this SSA.

4.3 Defining NESSI's vision and strategy on Enterprise Grids

4.3.1 Introduction

Evolving Service-Oriented Economies (SOE) brings new requirements for businesses and services, which will need to react more quickly to changing circumstances. This means that businesses must adopt more flexible service-oriented business processes and be able to develop collaborative relationships. This is only possible if high-level business requirements are transformed into lower level ICT requirements with a high level of automation, so that ultimately the ICT environment can automatically cater for changing business needs.

The Grid SRA[1][2] has been developed through a structured and open community process managed by NESSI-Grid. Special emphasis is placed on the opportunities for Grids to evolve into major business infrastructures for the delivery of services, detailing and prioritizing a set of business scenarios. The vision centres on the shift towards a Service Oriented Economy based on the concept of Business Grid, which is defined as an adaptive service-oriented utility infrastructure for business applications. The SRA explains how this evolution could be achieved through a set of research challenges based on a multi-perspective approach with reference to societal trends, constraints, business scenarios and technology trends.

The methodology of the SRA is based on three steps. First, a set of main business scenarios has been analysed for the identification of the main requirements that a business grid must fulfil to satisfy current and future business needs. Second, the state of the art has been evaluated to understand whether these requirements can be met with current technology. Third, a gap analysis has been conducted in order to develop key research challenges.

The SRA targets a broad spectrum of stakeholders, particularly enterprises, researchers and policy-makers. Industry stakeholders are offered a vision for future IT infrastructures, their related business scenarios, the state of the art for these scenarios, as well as the specific business impact of future research. Researchers are provided with guidance for industry-focused research topics. Policy-makers will gain an understanding of possible areas of influence and expected market impact.

NESSI-GRID SRA has been integrated in the overall NESSI-SRA and it is available at the NESSI Website. Annex I includes the “NESSI-GRID SRA White-paper” with a more detailed overview of the SRA.

4.3.2 Business Grids

The vision set out in this project is the vision of ***Business Grids as the adaptive service-oriented utility infrastructure for business applications***.

They will become the general ICT backbone in future economies, thus achieving a profound economic impact. The adoption of Business Grids is expected to happen in three steps: first as the ICT backbone within enterprises, second as a basis for hosting scenarios and ultimately as the general ICT-infrastructure for service-oriented economies. In this way, Business Grids will eventually support the emergence of new types of application.

The Service Oriented Knowledge Utility (SOKU) paradigm identifies a flexible, powerful, and cost-efficient way of building, operating and evolving IT intensive solutions for use by business, science and society. Applying the SOKU paradigm to Business Grids means that they offer infrastructure resources to higher levels based on the following main principles:

- **Service-oriented**: dynamic allocation & assembly of resources via infrastructure services
- **Knowledge-assisted**: translating high-level business requirements to infrastructure requirements & infrastructure capabilities vice versa
- **Utility**: immediately available, dependable usage, predictable

Business Grids will span several ICT layers so that they can participate in the execution of the business models for the applications they support. The aim is to provide transparent accounting and addressing issues such as auditing, billing, and linkage of resource consumption to business goals. At the infrastructure level, an adaptive service-oriented utility infrastructure will enable the dynamic, on-demand allocation and assembly of resources needed to support service components.

4.3.3 Business Scenarios

The core business scenarios and associated business requirements cover short-term perspectives (basic enterprise, hierarchical enterprise, hosting) as well as mid- to long-term prospects (extended enterprise, merger & acquisition, virtual organizations, dynamic outsourcing, value chains and mega services). Community feedback indicates that Enterprise, Hierarchical Enterprise and Hosting are the most relevant scenarios, though even the lowest ranking (Mergers & Acquisitions) are viewed to be pertinent. In addition, Business Grids also apply to arbitrary compound scenarios which can be combined from the basic ones.

Each scenario has been analyzed in terms of **nine assessment categories**, which are functional & commercial, and 8 non-functional categroeis, namely Dependability, Security, Performance, Interoperability, Manageability, Governance, Flexibility, and Sustainability.

Each scenario has been further characterized by the expected business impact that Business Grids will have.

4.3.4 Technology Trends

The Research Agenda has identified five Technology Trends that will have a significant impact on future business IT systems and specifically on Business Grids: Storage & Data Management; Processor Technology; Network Connectivity; Mobile Devices; and Sustainability. A number of initiatives are tackling issues, such as the increasing amounts of data generated by businesses and research projects, rapidly growing needs and costs for storage and challenges surrounding data management. Societal concerns also surround increasing energy consumption. More research, targeted ICT policies, and coordinated engagement with standard development organizations (SDOs) are needed to support these endeavours, bearing in mind the specific drivers, needs and practices of the business and scientific communities concerned.

The SRA evaluates a number of key research fields: Data Grids; Database Replication; Multi-tier Systems; Application Development; Performance Engineering; Cost & Revenue Management; Autonomic Computing; Virtualization; Security; Interoperability; Manageability, Flexibility & Reconfiguration within the framework of Scientific Grids, Enterprise Grids, Virtual Machine-based Grids, and Mobile Grids. Specific requirements can be matched to top-level challenges and priorities for research, which will ultimately bring benefits to EU's business community.

4.3.5 Research Challenges

The research challenges are derived from the nine business scenarios & the five technology trends. Roughly 50 challenges have been formulated and described in detail. They comprise all the 9 assessment categories and cover the set of related requirements, related SotA areas and trends, a description of the current status, the envisioned status, and the actual gap. Furthermore, each challenge is characterized in terms of priority, complexity and expected time-lines**. Four functional & commercial requirements** have been identified and comprise Data Management; Applications Development; Network connectivity; and Accounting & SLAs. In addition to the **nine non-functional requirements**, which are Dependability; Security; Performance; Interoperability; Manageability; Governance; Flexibility; In addition to the categories introduced above additional challenges have been identified which address Mastering Complex Systems, or are of **Overarching** nature.

The extensive set of research challenges identified would be best tackled in combination rather than in isolation, as several of them are inter-dependent and some partly overlap. Joint research programmes would therefore be beneficial

to tackle not only top-level but also a number of inter-related challenges more effectively. An assessment of all the challenges has enabled the identification of the following **three key challenges**:

KC 1: New system architectures that harmonize service architectures (SOA) and infrastructure architectures (SOI), advance the structure of multi-tier, federated and Internet scale architectures, support all kinds of business models, applications and emerging hardware environments and provide transparent and integrated access for all relevant stakeholders (architects, engineers, operators, customers, …).

KC 2: Advanced system lifecycle approaches including engineering, deployment, composition, provisioning, management and decommissioning phases that support transparent knowledge tracking, feedback loops, prediction and simulation, allow for a clear separation of concerns between different stakeholders (business vs. IT, developers, providers, customers, …) and support the full variety of business scenarios (from traditional data centres to complex service value networks) while adhering to overarching sustainability requirements.

KC 3: Advanced infrastructure technologies in terms of hardware (energy efficient, flexible allocation, virtualization …), middleware (new multi-tier system design, flexible storage systems, harmonized virtualization on all layers) and related programming models (parallel programming, multi-core) that meet the required flexibility of the networked economy.

4.3.6 Conclusions

The development of a major business infrastructure designed for future service-oriented economies represents a shift towards the functional view of data transformation services based on the assumption that innovation in businesses and public services drive the evolution of these services down to the technology level. The community-driven NESSI-Grid SRA exemplifies the general Grid vision in a concrete context based on real business needs, drivers, and challenges.

The Research Challenges for Business Grids within the future SOE detail and prioritize specific requirements that focus on real concerns for the commercial sector. The overall aim is to ensure that the infrastructure is developed in compliance with real requirements, standards and ICT policies through industry-research collaborations. The expected impact of Business Grids as a service-oriented infrastructure is to bring tangible benefits for European enterprises in the evolving IT and business landscape.

4.4 DISSEMINATING ACTIVITIES and NESSI-Grid

4.4.1 NESSI's strategy to communication & dissemination

The NESSI ETP operates through a number of working groups, open to all members and committees which serve a main coordination role in one key area of NESSI.

The communication activities of NESSI are defined and managed by the NESSI Strategy & Communication Committee (NESSI S&CC). The S&CC elaborates a yearly strategy and communication plan that describes the different target audiences that NESSI wants to focus on, the main message to be delivered to each target audience and the tools to reach out, including events, online and printed communication supports, active mailings and other activities.

The table below, extracted from the latest version of the NESSI S&C plan details the target audiences and messages. It also highlights the role of Grids within this overall strategy.

	Raising Awareness	Position a Solution	Generate Active Interest
EU Parliament / Politicians	NESSI exists	NESSI provides benefits to all (scenarios) NESSI supports future growth NESSI provides a mechanism for innovation & fast deployment (NEXOF) NESSI provides a mechanism for structuring collaboration (NESSI research structure)	Generate ✓financial support ✓regulatory framework support
National Politicians	NESSI exists	NESSI provides benefits to all (scenarios) NESSI supports future growth	Generate ✓financial support ✓link to national R&D

		Linking NESSI to national policies can benefit all (+ how) NESSI provides a mechanism for innovation & fast deployment (NEXOF) NESSI provides a mechanism for structuring collaboration (NESSI research structure)	programmes
EU Commission – DGs beyond ICT	NESSI exists	NESSI supports EU policies (+ which ones and how) NESSI's main focus is to provide new solutions to application areas (+ which ones and how)	Generate ✓financial support ✓regulatory framework support ✓work programme content support
ICT Industry	NESSI delivering an Open Service Framework NESSI's research structure	NESSI provides an implementation of a service backbone Disseminate NEXOF opportunity and evolution Delivery of NEXOF Open Source / support for other NEXOF implementations Disseminate Business Grids vision / Business services vision	Contribute to NEXOF Adopt NESSI Advertise the NESSI Strategic & Compliant projects
Academia	NESSI delivering an Open Service Framework /	NESSI defines research needs key to the future of IT and	Focus on the NESSI proposed research

	NESSI's research structure	that require collaboration NESSI has a research structure Disseminate NEXOF opportunity and evolution Advertise the S-Cube Network of Excellence	directions. Collaborate to adapt the education curricula to industrial future needs Advertise the NESSI Strategic & Compliant projects
SME	NESSI exists NESSI delivering an Open Service Framework	NESSI provides a landscape for service plug-in / faster service deployment SMEs supported to contribute to NEXOF	Develop / propose / use services within a NESSI reference implementation Participate to NEXOF development Join the NESSI SME Working Group
Open Source Community	NESSI exists NESSI delivering an Open Source implementation of NEXOF	NESSI framework is an opportunity for open source contributions Disseminate NEXOF opportunity and evolution	Join the NESSI OSS Working Group
Standards Organisations	NESSI exists NESSI has the COSTA committee	NESSI framework requires existing / enhanced / new standards	Link NESSI to selected standards organisations
(Business) User Community	NESSI exists Specific areas benefit from services	NESSI is an opportunity to increase the level of security and quality across the enterprise while also increasing the flexibility and level of information	Adopt NEXOF implementations within the enterprise IT architectures, to modernise legacy systems, to enlarge the

		exchange NEXOF is a tool to protect user investments when deploying innovative solutions	services offered to employees and customers Join the specific NESSI Working Groups Create new NESSI Working Groups Adopt Disseminate the use cases from NESSI Strategic Projects / S-Cube
Citizens	NESSI exists	NESSI enables solutions that can impact every day life (future scenarios / removing barriers between vertical domains)	Adopt NESSI enabled services as a “guarantee” for security, dependability, privacy and trust
Financial Community	NESSI exists	NESSI is a key actor in enabling new business models NESSI will impact user scenarios	Ensure support from this community at a EU level (through the EIB and similar actors) and for SMEs through targeted venture capital events. Educate the financial community.
Technology Platforms – IST (Artemis, eMobility, EPoSS, ISI, NEM)	NESSI involved in Future Internet collaboration NESSI supporting common Future Internet event	NESSI a key actor in software and services NESSI’s interest in collaboration to activate user scenarios that involve all platforms	From the common Future Internet vision, define a common view of key services and infrastructure elements and of

			which infrastructure levels are addressed by which platforms Support the ServiceWave annual event
Technology platforms – non IST	NESSI exists	Service models key to existing and new businesses (using scenarios)	Validate scenarios on NESSI test beds Understand and evaluate full potential of service models Ensure that all security, safety and distribution models well addressed by NEXOF
NESSI platform	NESSI is moving – and needs active contributions NEXOF is the mechanism to contribute	NEXOF moving forward New research opportunities (NEXOF / FP7 Calls / National calls)	Ensure that all NESSI members are “involved” Ensure that all NESSI Working Groups understand / communicate beyond their own activities Ensure collaboration between NSPs Support visibility of active NESSI Working Groups
NESSI Strategic Projects NESSI Compliant Projects	NEXOF is the mechanism to contribute	NEXOF calls for contribution NEXOF architectural boards	Ensure collaboration between NSPs Ensure synchronisation with NEXOF

4.4.2 NESSI-Grid’s relation to NESSI

In this overall plan, NESSI-Grid played a key role in

- contributing to the dissemination of NESSI's evolution to the Grid community
- contributing Grid related advances to the NESSI community

To avoid any confusion, NESSI defined early on that any Support Action like NESSI-Grid would always communicate in relation to NESSI, and the NESSI-Grid logo was designed to clearly mark this relationship.

This also means that contrary to Support Actions that start from scratch in terms of reaching out to an audience, NESSI-Grid benefited from the larger outreach of NESSI.

This was especially visible through

- NESSI-Grid's news relayed in the general NESSI newsletter, a quarterly information news of 8 to 12 pages that is emailed to 1,200 contacts and distributed in printed form at NESSI events
- NESSI-Grid's online visibility through a specific page on the NESSI Web site at www.nessi-europe.eu – itself linked to the SOI-NWG Wiki web site
- NESSI-Grid announcements displayed both in the general and specific news sections of the NESSI Web site
- Grid related sessions organised at each NESSI event: NESSI General Assembly 2006, 2007 and ServiceWave 2008. In addition, major sessions were organised at events such as IST 2006, ICT 2008, OGF23, EGEE conferences etc.
- The distribution of the NESSI-Grid SRA at ServiceWave 2008 where it was included in the USB key distributed to each of the 250 participants

4.4.3 NESSI-Grid's contribution to NESSI

NESSI-Grid played a major role in NESSI and provided a structured community process that in turn created a channel of communication.

On the one hand, the community process provided an organised method and a visible result to entice contributions. On the other hand, it provided an organised community to which NESSI could expand its communication activities.

Through its extensive use of a dedicated Web site (www.soi-nwg.org), NESSI-Grid created an operational model for a NESSI Working Group that will be further analysed and used to disseminate towards the other NWGs. It is clear that being able to support financially an editor was a major catalyst to support the level of activities – however, even without the level of financial support, the mechanism in itself was very well implemented and the communication activities were all oriented towards supporting this mechanism.

This experience will be analysed and used to create a best practice approach for existing and new NESSI Working Groups.

4.5 INTERLINKING ACTIVITIES

One of the objectives of NESSI-GRID was to maximise the impact of the SRA. Therefore, one dedicated work package was created to interlink with policy-decision makers. The main purpose of this two-way communication was:

- To transmit the importance of NESSI objectives and research priorities, in order to get them included in the research policies.
- To have feedback to help defining NESSI strategy
- To establish synergies with other actors like European technology platforms and NESSI counterparts overseas.

The NESSI-GRID project shared these activities with Support Action NESSI-SOFT, with a separation of roles clearly defined. NESSI-SOFT approached SME and academia stakeholders, NESSI-GRID interlinked with the European Commission, the European Parliament, Member States initiatives, other ETPs and other counterparts overseas. It also generated recommendations to improve European Innovation.

The next sections provide an overview of the interlinking activities carried out by NESSI-GRID and a summary of the lessons learned.

4.5.1 European Community, European Parliament and Member States Initiatives

European Community, European Parliament and Member States decisions play an important role in the definition of research policies and strategies. NESSI-GRID aim has been to establish a fluid communication with those entities in order to help the implementation of NESSI objectives and vision.

NESSI Interlinking objectives with EC and EP have been almost totally achieved. There is a **significant increase of NESSI awareness at high level**. NESSI informed these target communities about its strategic lines, exposed the SRA and received recommendations for their development and relation with national research actors. In addition, through the collaboration of NEXOF RA, the applicability of NESSI principles and approach on different vertical sectors was disseminated.

Due to the evolution of NESSI's perspective on the Future of Internet, a significant effort was devoted to this objective, involving EC contacts related with this topic, and widening the relationship to other EC units not tackled before, with direct access of the NESSI working groups to these new EC contacts. Communication with the EC is now very fluid, with joint participation in many meetings and events. **There is a clear perception by the EC of NESSI as a reference actor for Software and Services** and, in support of this statement, NESSI has been consulted to provide position papers on a Software Strategy for Europe as well as contributions through SRA volumes towards the elaboration of the FP7 Work Programme and Future of Internet vision.

Approach to the European Parliament was more difficult and we started seeing some interest thanks to the Future of Internet Initiative.

A Joint Mirror Group of representatives from different member states was established as a task force to find synergies among national research initiatives and try to align them with the European ones related to NESSI objectives. Although activities of this group did not progress as expected, NESSI has indirect contact to the National policy makers thanks to the National Technology Platforms. These NTP (INES, NOSSI, NESSI-Slovenia, NESSI Poland, NESSI Bulgaria) were created in part thanks to the support of interlinking activities and have fluid communication with the corresponding National Agencies. Links have also been established to national programmes such as, for instance, the Jacquard Dutch initiative on software and services.

4.5.2 European Technology platforms

NESSI-GRID supported contacts with representatives of other ETPs in order to find synergies among them and define common objectives to avoid overlap and collaborate to European research.

Interest generated by the Future of Internet initiative led to the creation of common task forces to work in the common objectives. Joint meetings with the respective national mirror groups (Inter-ICT Platform Group) and the EC served to receive recommendations from the administration entities as well as to recommend actions to them to promote ETP activities. Another good example is the collaboration of the ETPs in the organisation of the ServiceWave 2008 event.

4.5.3 International Cooperation

NESSI has **increased its awareness overseas and is now a European Reference for Software and Services** mainly in the Asian area. Collaboration with international projects and initiatives like ECHOGRID, EU CHINA Grid, ICSOC, FASSBINDER, NiHao, OW2, ASPIRE and EU-CHINA INFSO served this goal, as well as participation to international events and meetings with

policy makers like the Japan Science and Technology Agency (JST) and the 863 (the science and technology Ministry of P.R China). Main interested countries were China, Japan and South Korea.

4.5.4 Improvement of European Innovation

Another result of interlinking activities is the generation of a set of recommendations, approved by the NESSI Steering Committee to improve the conditions of innovation in Europe. These recommendations are reflected in two NESSI position papers (Consultation on the Green Paper of the European Commission on "The European Research Area new perspectives" and "A European Software Strategy") that are used as a basis for NESSI contributions to the EC and the Future of Internet vision. The second position paper was made public and is available from the NESSI Web site.

4.5.5 Lessons learned and recommendations

Based on the experiences gathered during the interlinking activities, this section details lessons learned and recommendations.

Lessons learned

1. Create awareness as soon as possible to get interest from your targets

   At the beginning NESSI was hardly known by the intended target audience and therefore some of them did not demonstrate much interest. Creating a documented awareness (what is NESSI, what is NESSI's aim, what is NESSI's role, who are NESSI's members) is the prerequisite first step, after which collaboration is easier. Organisation of big events, like the NESSI General Assemblies and more recently ServiceWave, where keynote speakers where invited (if possible target members) are efficient in reaching out. In addition, having the support of the EC to NESSI activities raised the interest of many stakeholders to collaborate.

2. Consider the amount of time needed to identify a limited set of new relevant contacts

   It is very difficult at the beginning to know and get all the relevant contacts that will open the doors to access to key decision makers. This is a long term task and should be taken into account in the initial action plan.

3. Difficulty to trace interlinking activities, due to the fact that many of them are done by high-level people

4. Focus the effort according to the context. e.g. linking with members of the parliament is more efficient when they have to prepare decisions such as launching JTIs or ETPs.
5. Creation of a task force with National Initiatives improved efficiency, since its members had common objectives and worked to achieve them and to take advantage of synergies.
6. The National Initiatives are a good ambassador of NESSI to the National Agencies, since they are in close contact. Coordination Actions are a good instrument to foster the creation of this type of Initiatives that are proven to be very useful.
7. To create effective collaboration between the ETPs, identify a single and strong common topic of interest. The Future of Internet acted as a catalyser for the ETPs to move from the intention to collaborate to effective collaboration.

Recommendations

1. To organise big events to create awareness and invite key members of the target audience. Take the opportunity to create new contacts
2. To consider in the planning the time span needed to get the right set of contacts.
3. To use the NESSI Working groups to deepen the relationship with many units of the EC, in addition to the contacts established by the NESSI Board or Steering Committee
4. To retain and expand current contacts regarding International cooperation to deepen collaboration.
5. To enforce International cooperation with America.
6. To use the Future of Internet Initiative to approach the European Parliament, in direct relation with the different activities of the European Parliament in areas of relevance to NESSI.
7. To create task forces with people/entities that show interest on working to achieve specific objectives. Do not try to work will all representatives on all topics.
8. To focus the effort according to the context.
9. To take advantage of National Technology Platforms to link with National Agencies.

4.6 *FOSTERING COLLABORATION*

4.6.1 The SOI-NWG

NESSI-Grid supported the activities of the Service Oriented Infrastructure WG which is focused on research topics around the lower level infrastructure component services run on. With this component services can be composed and orchestrated to support processes which will be ultimately delivered to the user through a user/service adaptive interaction layer.

The Service Oriented Infrastructure WG, as stated in its manifesto, is focused on the new generation of ITC infrastructures that will support development and execution of component services and their provision as utilities. It will focus on designing a detailed research agenda on the following areas:

- Service abstraction and virtualisation.
- Inherently Stable and Safe Architectures
- Decision Support and Automation tools for IT Service Management
- Technology bases for wide scale computing utility.

The NESSI Working Group on Service Oriented Infrastructure has sought to work together with other NESSI working groups. This collaboration has been especially important with the Service Engineering WG and the Semantic and Web 2.0 User/Service Adaptive Interaction WG for the development of a complete end-to-end service model and architecture. Collaboration is also foreseen with the Trust, Security and Dependability WG in order to establish how security features have to be implemented at the Service Oriented Infrastructure layer.

4.6.2 Fostering contributions to NEXOF-RA Open Process

Contribution to NEXOF-RA was set as a new and high priority goal for SOI-NWG. NEXOF-RA started in March 2008 and during the first phase of the project the activities were focused on:

- Setting up an Open Process for the contribution of specifications. This process, based on Requests for Proposals Programme, is open to any project or group willing and able to contribute relevant results to the NEXOF Reference Architecture Specification.

- Define the basic architectural principles, base glossary and initial RFP call. This work is organized in the several horizontal and vertical work packages. WP3 holds a very close relationship with the SOI NWG. It is named Advanced Service Aware Infrastructures and is responsible for the input related with Service Oriented Infrastructures.

The SOI NWG has collaborated with NEXOF-RA WP3 through audio conferences and face-to-face meetings and provided input towards the definition of the topics of the first RFP call. The SRA has been used as a key input for the establishment of the priorities of WP3 and the next version on roadmap is expected to be of great relevance for the development of the complete RFP programme.

NEXOF-RA Open Process and opportunities for Grid Projects were presented at OFG 23 (June 2008) and V GRIDS@WORK (October 2008) events.

4.6.3 ICT GRID ARCHITECTURES TECHNICAL WORKING GROUP (TG1)

The NESSI-Grid project was invited to assume leadership of TG1 activities at the concertation meeting held on April 27th ,2007 in Brussels. The Grid Architecture Technical Working Group (TG1) focuses on architectural challenges from the FP5, FP6 and FP7 EU projects, gathering the requirements, from an architectural point of view, and investigating the transition from current Grids to Next Generation Grids.

The soi-nwg.org website contains a specific chapter through which relevant information on Grid Architectures and TG1 activities are shared among the different IST Grid projects. This includes relevant documents, info about meetings, track on decisions, current action plan, etc.

As part of TG1 activities, a whitepaper[1] describing the Grid Architecture adopted in each of the existing IST Grid projects has been produced and submitted to the European Commission FP7 review process.

There was also work towards the definition of a work plan so that both SOI NWG and TG1 can foster contributions to the RFP programme. The proposed mechanism is to leverage TG1 and its community in order to give more visibility to NEXOF-RA RFPs and encourage contributions and feedback. The first open request, issued on September 2008, has collected input on high priority topics that should be addressed by the NEXOF-RA RFP programme and possible

contributions on the RFP topics already issued by NEXOF-RA. These inputs were collected by TG1 and offered as contribution to NEXOF-RA.

"TG1 Whitepaper on Grids Architectures" summarizes TG1 contributions to NEXOF-RA Open Process.[1]

Transition of TG1 activities to the Service Architecture CWG in FP7 was implemented in the last Software & Services Collaboration meeting in September 2008.

4.6.4 OSS NESSI Working Group

The NESSI Open Source WG supports NESSI in defining an overall Open Source strategy targeted to European companies wishing to implement or adopt Open Source, as well as to Open Source development communities wishing to collaborate and participate to NESSI.

Specifically, the NESSI Open Source WG provides other NESSI committees and working groups with all support, help and inputs needed for positioning Open Source as a major channel for the dissemination of NESSI outcomes, ensuring adequate levels of software quality, security, dependability and safety and for the enticement of the Open Source community to actively contribute to NEXOF.

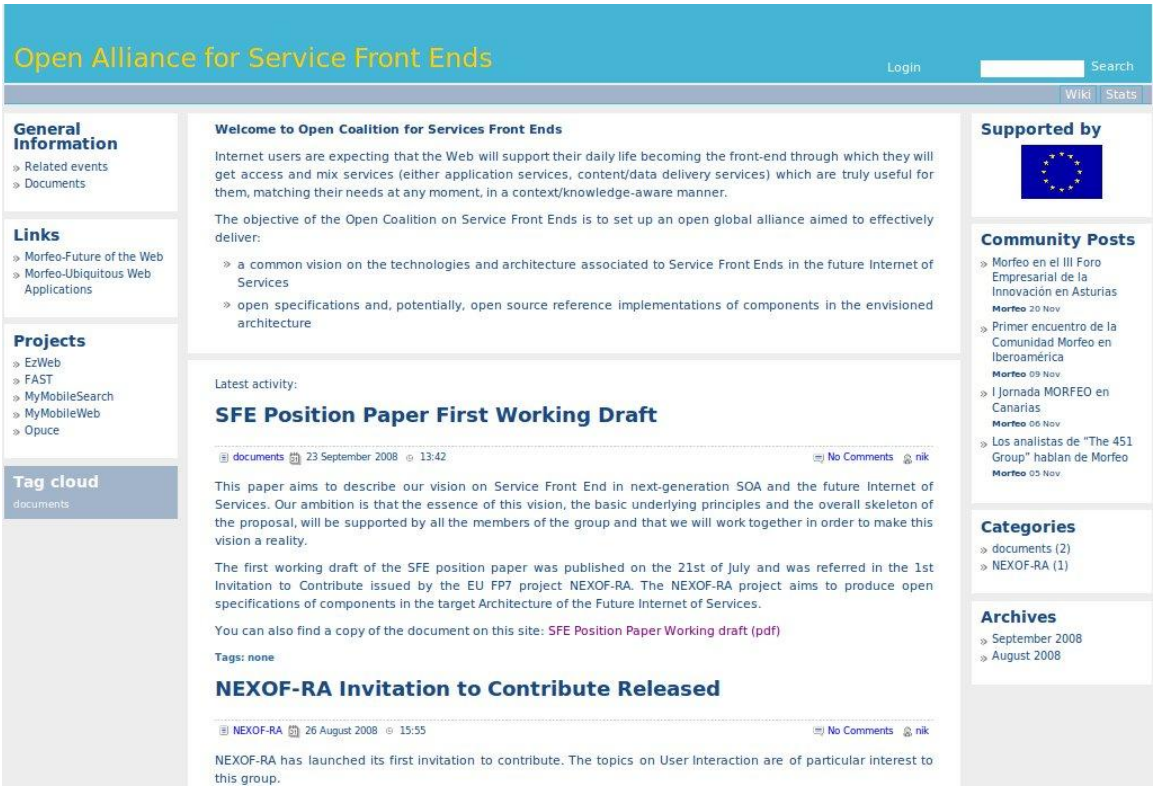
Also, the NESSI Open Source WG promotes integration of Open Source within NESSI platforms and services, ensuring that the resulting integrated systems meet quality and security requirements according to the overall strategy of Open Source usage on the part of the adopter.

During this time NESSI-GRID and SOI NWG members (TID, ATOS, THALES, INRIA, ENG) have actively contributed to the building and running of this working group. One work package is dedicated to delivering NEXOF (WP2 – Delivering NEXOF) and made the link with the work performed in NESSI-Grid. In fact, the NESSI-Grids document "Relationship with Standardization Bodies and Open Source Communities: Action Plan and Recommended Policies for FP7", with the support of OSS-NWG, encourages NESSI to follow a strategy for success consisting in that NESSI actually incubates **Open Alliances** around different chapters/areas of the target NEXOF Reference Architecture. These open alliances will bring together industrial and academic organizations which

share a common vision on the technologies that should be developed in a given chapter of the NEXOF Reference Architecture and together commit to spend resources to:

- support the NEXOF Open Architecture Specification Process that the NEXOF-RA project will drive with respect to specifications in that chapter (as such, may help to constitute the investigation team in related open construction cycles); and
- develop (jointly or not) reference implementation of specifications in that chapter that will be the basis for actual products.

Open Alliance for Service Front-Ends Web Page (http://sfe.morfeo-project.org):



Following this strategy, the first Open Alliance directly linked with the NEXOF Reference Architecture initiative was created on July 2008: "*Open Alliance for Service Front-Ends*" (http://sfe.morfeo-project.org) hosted by the MORFEO Open Source Community. The objective of the Open Coalition on Service Front Ends is to set up an open global alliance aimed to effectively deliver:

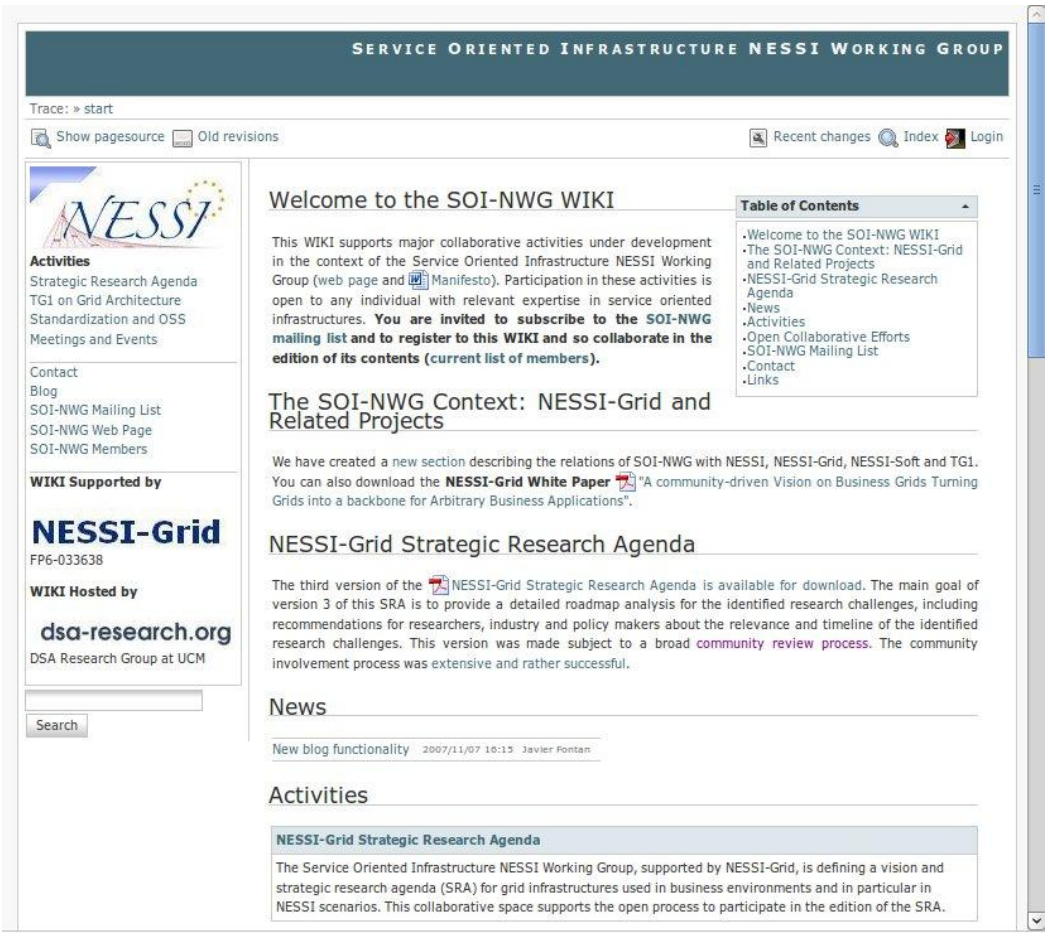
- a common vision on the technologies and architecture associated to Service Front Ends in the future Internet of Services;

- open specifications and, potentially, open source reference implementations of components in the envisioned architecture.

This Open Alliance is initially formed by the projects EzWeb (Spanish funded), FAST (FP7), MyMobileWeb and MyMobileSearch (Spanish funded), and OPUCE (FP6).

4.6.5 The SOI-NWG Website

The SOI-NWG Website main page (http://www.soi-nwg.org)



Collaboration activities have proven to get better chances to succeed when there is a website where all relevant information is gathered and continuously updated, and that website incorporates tools that enable collaborative working

on documents, etc. At NESSI-Grid we have launched a dedicated site associated to the SOI NWG. This website is at:

The SOI NWG website has been structured to foster visibility as well as involvement of the Grid Research Community in the different activities of the SOI NWG, currently mapping to activities of the NESSI-Grid Project. The website is structured in four main chapters:

- NESSI-Grid Strategic Research Agenda
- TG1 activities on Grid Architectures
- Standardization and OSS strategy
- Meetings and events

5 THE WAY FORWARD

5.1 SOI-NWG

Although NESSI-GRID provided key support to SOI-NWG, SOI-NWG does not end with NESSI-Grid. SOI NWG will continue working with the support of NESSI members and partners.

Moreover, there are contacts with NESSI Strategic Projects NEXOF-RA, SLA@SOI and RESERVOIR to capitalize on the collaboration with Virtualization and SLA&QoS ICT WGs. The SOI-NWG website has been offered to support Virtualization and SLA&QoS ICT WGs activities.

5.2 GRID SRA

The NESSI Steering Committee (SC) approved the integration of the GRID SRA into the NESSI-SRA in November 2008. The GRID SRA will be a significant ingredient in the creation of new NESSI Strategic Projects proposals.

Some of the partners involved in NESSI-Grid collaborate in NEXOF-RA and NESSI SRA committee. Feedback from these projects could be integrated in future updates of the SRA.

SRA Elaboration methodology was presented to NESSI SC and NESSI SRA committee. It was recognized as a good practice to be kept in further updates. SRA Elaboration Process is well documented and public.

5.3 Open Alliance

A sub-set of the NESSI partners is analyzing the opportunity of creating an Open Alliance to integrate a reference implementation of some topics GRID

SRA and NEXOF-RA in the same way that the Service Front-ends Open Alliance is evolving.

5.4 Open Source Software NWG

Thanks to the support of NESSI members, this NESSI Working Group was launched in 2008 and has been very active on setting up the NESSI strategy on OSS. Some NESSI-Grid members committed to continue working on this NWG.

5.5 NESSI

The platform has defined its major steps for the coming years. These activities will be supported

a) by the industrial partners

b) through the NESSI Strategic Projects

c) through any contributing project, as defined by the open contribution model

d) through the NESSI-2010 support action

The major steps for NESSI over the coming years are as follows:

a) drawing-up and delivery of NEXOF and management of the open contribution model;

b) investigation of the barriers to adoption in terms of services, at the legal, infrastructure and systemic levels;

c) creation of additional scenarios to validate NEXOF through real-life approaches;

d) actual linkage with user communities, specifically in the areas of e-Government and e-health, with analysis of additional areas such as energy, transport, skills and learning;

e) collaboration with the other ICT ETPs.

More specifically, activities already identified for 2008 and 2009 include:

- the Future Internet Initiative
    - NESSI ETP is working with ICT ETPs eMobility, EPoSS, ISI and NEM to define a common research agenda and proposal for implementation of the Future Internet. A first common vision document has been released in January 2009. The 5 ETPs and, in

a second phase, interested companies will analyse the possibility of creating a JTI as a tool to build critical mass and work on meeting this challenge.

  - NESSI projects are involved in the Future Internet Assembly and cooperate with projects from different technical domains. NESSI will continue to work, as much as possible, in a coordinated way through NEXOF-RA to enhance collaboration in delivering the NESSI Service Open Framework.

- SRA preparation. This will be planned with respect to the outcomes of NEXOF and the emergence of new approaches such as Future Internet Initiatives.
- SRA implementation:
  - collaboration between projects under the NEXOF-RA plan
  - collaboration between FP7-Challenge 1.2 projects and Future Internet Assembly projects
  - gap analysis and new research opportunities to create Strategic Projects for FP7 – Calls 4 and 5
  - execution of NESSI Strategic projects
- ETP organisation and logistics
  - finalise the funding model for 2008 and 2009
  - support the creation of a legal entity which will take over the NESSI Office
  - create a funding model applicable to the new set of NESSI projects that should start in 2010 and 2011
- Adoption Strategy
  - User Strategy implementation
  - Future Internet strategy implementation
  - SMEs involvement in FP7 Calls 4 and 5
  - cooperation with member states and national platforms
  - international cooperation
  - Open Source Community involvement
- Dissemination
  - continue to build up NESSI's image and role
  - create the new ServiceWave service conference held on the first time in December 2008 in collaboration with ETPs eMobility,

EPoSS, ISI and NEM, National TP INES, Networks of Excellence CoreGrid and S-Cube, Support Actions EIFFEL, 4NEM and NESSI 2010, IEEE and ICSOC.

6 AVAILABILITY OF RESULTS AND REFERENCES

[1] All public documents are available on the SOI-NWG website (http://www.soi-nwg.org).

[2] Official NESSI documents are also available at the NESSI Website (http://www.nessi-europe.eu).

[3] NEXOF-RA Project. http://www.nexof-ra.eu

7 CONCLUSION

NESSI-Grid supported NESSI during a period in which:

✓ *The Service Oriented Infrastructures NESSI Working Group has been actively contributing to NESSI vision*

✓ *A new Chapter of the NESSI-SRA has been included covering Service-Oriented Infrastructures topics*

✓ *A successful SRA Open Collaboration Process has been developed with the contributions of more than 90 stakeholders*

✓ *Interlinking and Communications activities have succeeded on NESSI visibility.*

contributing to NESSI

www.nessi-europe.eu

8 LESSONS LEARNED

NESSI-Grid has found some useful lessons learned while developing the Community Collaboration Process on the GRID SRA:

✓ *High risk on finding a lack of collaboration from community was overcome with the hiring of SRA Editor and Community Liaison Coordinator and the Design of an Open Collaboration Process*

✓ *SRA Collaboration process must have very concrete objectives to help the community understand what is required and capture the interest of contributors in collaborating*

✓ *Public acknowledgement and recognition of contributions are key*

✓ *Community process requires active and continuous animation*

✓ *For Interlinking activities define a strategy and focus targets depending on the context*

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ACRONYMS

	The 8 ETPs which have been created in the area of IST are:

ARTEMIS	Embedded Computing Systems
EMobility	Mobile and Wireless Communications
ENIAC	European Nanoelectronics Initiative Advisory Council
EPoSS	European Technology Platform on Smart Systems Integration
EUROP	Robotics
ISI	Integral Satcom Initiative
NEM	Networked and Electronic Media
NESSI	Networked European Software and Services Initiative

	Other important acronyms are

CIP	Competitive and Innovation Programme
CP	Collaborative Project – (also know as a STREP)
CSA	Coordination and supporting activities
DG	Directorate General
DoW	Description of Work
ETP	European Technology Platform
FP6	Sixth Framework Programme of the European Commission
FP7	Seventh Framework Programme of the European Commission
ICT	Information & Communication Technologies
IP	(Large Scale) Integrated Projects
IST	Information Society Technologies
JTI	Joint Technology Initiative
MS	Member States

NESSI SRA	NESSI Strategic Research Agenda
NEXOF	NESSI Open Service Framework
NEXOF–RA	NESSI Open Service Framework Reference Architecture
NoE	Network of Excellence
NP	NESSI Project
NSP	NESSI Strategic Project
NWG	NESSI Working Group
OW2	Open Source Community initiated through the merger of ObjectWeb and OrientWare
PO	Project Officer
SAAS	Software As A Service
SC	Steering Committee (NESSI)
SOA	Service Oriented Architecture
SSA	Special Support Action
STREP	Specific Target Research Project
WP	Work programme
WP	Work Package

A. NESSI-GRID SRA Whitepaper

NESSI-Grid contributing to NESSI

A NESSI-Grid White Paper

A community-driven Vision on Business Grids Turning Grids into a backbone for Arbitrary Business Applications

Foreword

The NESSI-Grid SRA focuses on opportunities for grids to evolve into major business infrastructures for the more agile and effective delivery of services. The SRA has been developed by the community for the community and details how this evolution can be achieved through a set of research challenges based on business scenarios and current technology trends. The innovative infrastructure is underpinned by the concept of Business Grids. This White paper offers a high-level overview on the SRA.

June 2008 **www.nessi-europe.eu**

NESSI – the Networked European Software and Services Initiative – was launched as a European Technology Platform in September 2005. Coordinated by 22 partners, it unites a community of 300 organisations from industry and academia active in Information and Communication Technologies. It plans to deliver NEXOF, the NESSI Open Service Framework.

NESSI-Grid is a support action launched under the FP6 European Commission research programmes which contributes to NESSI. NESSI-Grid started in May 2006 and will end in October 2008.

Table of contents

Introduction

Evolving Service-Oriented Economies (SOE) bring new requirements for businesses and services, which will need to react more quickly to changing circumstances. This means that businesses must adopt more flexible service-oriented business processes and be able to develop collaborative relationships. This is only possible if high-level business requirements are transformed into lower level ICT requirements with a high level of automation, so that ultimately the ICT environment can automatically cater for changing business needs.

The SRA has been developed through a structured and open community process managed by NESSI-Grid. Special emphasis is placed on the opportunities for Grids to evolve into major business infrastructures for the delivery of services, detailing and prioritizing a set of business scenarios. The vision centres on the shift towards a Service Oriented Economy based on the concept of Business Grid, which is defined as an adaptive service-oriented utility infrastructure for business applications. The SRA explains how this evolution could be achieved through a set of research challenges based on a multi-perspective approach with reference to societal trends, constraints, business scenarios and technology trends.

The methodology of the SRA is based on three steps. Firstly, identifying the requirements that a business grid must fulfil to satisfy current and future business needs. Secondly, evaluating the state of the art to understand whether these requirements can be met with current technology. Thirdly, pinpointing the gaps in the state of the art, in order to develop key research challenges.

The SRA is addressed to a broad spectrum of stakeholders, particularly enterprises, researchers and policy-makers. Industry stakeholders are offered a vision for future IT infrastructures, their related business scenarios, the state of the art for these scenarios, as well as the specific business impact of future research. Researchers are provided with guidance for industry-focused research topics. Policy-makers will gain an understanding of possible areas of influence and expected market impact.

Business Grids & the Shift Towards Service Oriented Economies

Business Grids are an adaptive service-oriented utility infrastructure for business applications and will form the general ICT backbone in the future knowledge and service economies.

***Business Grids** as adaptive service-oriented utility infrastructure*

The Service Oriented Knowledge Utility (SOKU) paradigm identifies a flexible, powerful, and cost-efficient way of building, operating and evolving IT intensive solutions for use by business, science and society. Applying the SOKU paradigm to Business Grids means that they offer infrastructure resources to higher levels based on the following main principles:

- **Service-oriented**: dynamic allocation & assembly of resources via infrastructure services
- **Knowledge-assisted**: translating high-level business requirements to infrastructure requirements & infrastructure capabilities vice versa
- **Utility**: immediately available, dependable usage, predictable

Business Grids will span several ICT layers so that they can participate in the execution of the business models for the applications they support. The aim is to provide transparent accounting and addressing issues such as auditing, billing, and linkage of resource consumption to business goals. At the infrastructure level, an adaptive service-oriented utility infrastructure will enable the dynamic, on-demand allocation and assembly of resources needed to support service components.

Business Grids will become the backbone of the ICT infrastructure through the following steps:

1. Business Grids will become the ICT backbone for enterprise solutions.
2. Business Grids will support hosting scenarios for small and medium sized enterprises (SMEs).

Business Grids are the Backbone of ICT infrastructure

As the interworking between administration domains becomes commonly accepted & is supported as part of the infrastructure there will be a shift towards:

3. Business Grids providing the ICT infrastructure to support service-oriented economies (SOE) & ultimately support the emergence of new types of applications.

Business grids denote the specific adaptation of the grid paradigm for the context of business applications. In terms of Foster's definitions, Business Grids follow an open-standard-based approach, key for achieving a utility infrastructure across administrative domains. Business grids also relate to Foster's definition that business applications require non-trivial qualities of service due to their highly networked nature, that is, their co-existence with other applications and services.[1]

1. Ian Foster, *What is the Grid? A Three Point Checklist*, July 2002, http://www-fp.mcs.anl.gov/wwwfp.mcs.anl.gov/~foster/Articles/WhatIsTheGrid.pdf

Beneficiaries of Business Grids

Business Grids have the potential to bring benefits to a wide range of organisations and sectors, as summarised below:

- **Commercial enterprises** where the main adoption drivers are improving performance, bringing significant reductions in computing time, the possibility of doing new things, implementing new services, as well as reducing time to market and costs.

Sectors & Main Uses comprise: **Aerospace & Automotive** (collaborative design & modelling); **Architecture** (engineering & construction); **Electronics** (design & testing); **Energy** (oil & gas for exploration); **Financial Services** (stock analysis & risk management); **Life Sciences** (especially pharmaceuticals & biotech firms); **Manufacturing** (inter/intra-team collaborative design, process management); **Media/Entertainment** (digital animation); **Telecommunications** (processing & analysis of large amounts of data); **Transportation** (modelling & simulation)**; Utilities** (improving efficiency & dealing with peaks & valleys in utilization).

- **Academia** and **research** with emphasis on collaborative work and the utilization of resources.
- **Public Sector** as a major user of high power computing.

The main players comprise: middleware, application, hardware, network, content, service, and payment providers; grid systems integrators; users from the private & public sectors; regulatory bodies (standard bodies & policy-makers); identity providers as certification authorities & other influential groups, such as the media and consultants.

Business Scenarios

The core business scenarios and associated business requirements cover short-term perspectives (basic enterprise, hierarchical enterprise, hosting) as well as mid- to long-term prospects (extended enterprise, merger & acquisition, virtual organizations, dynamic outsourcing, value chains and mega services). Community feedback indicates that Enterprise, Hierarchical Enterprise and Hosting are the most relevant scenarios, though even the lowest ranking (Mergers & Acquisitions) are viewed to be pertinent.

Business Grids are envisioned to support the various scenarios, which can be combined to form more complex, compound scenarios, such as Business Applications; Enterprise; Hierarchical Enterprise; Hosting; Extended Enterprise; Dynamic Outsourcing; Mergers & Acquisitions; Virtual Organizations; Value Networks; and Mega Services.

9 Key Requirements

Each scenario has been analyzed in terms of **nine key requirements**, which are functional & commercial, and non-functional: Dependability, Security, Performance; Interoperability; Manageability; Governance; Flexibility; and Sustainability along with the expected business

impact. A sample of the expected impact of Business Grids on the basic Enterprise, Hierarchical Enterprise & Hosting is provided in the tables below.

Basic enterprises are set up as one homogeneous administrative domain. They should provide general purpose infrastructure services within one domain & ultimately act as the ICT backbone for the entire infrastructure. The SRA identifies ways in which the Enterprise can be extended to include mobile devices for access to grid and sharing mobile device resources, bringing new services.

ENTERPRISE	
VISION	**EXPECTED IMPACT**
Service-oriented; knowledge-assisted; utility. Business Grids as an enabler for agile business.	• Providing IT resources as a service to the entire organization. • Significantly improving flexible IT resource usage; transparency on IT resources to foster further industrialization & adoption. • IT provisioning & management as a utility, bringing significant operational savings.

Larger enterprises are usually organized through a hierarchy of departments with individual departments complying with general enterprise policies while potentially deviating from them because of different legislative constraints.

HIERARCHICAL ENTERPRISE	
VISION	**EXPECTED IMPACT**
Harmonized enterprise-wide infrastructure built on hierarchy of departmental grids. Business grids as enabler for efficient, flexible, & transparent IT operation in complex enterprise set-ups. Enabler for implementing changes in the enterprise organizational structure to meet internal & external demands.	• Enabling the sharing of IT resources in a service-oriented way. • Transparently mirroring the organizational structure of different enterprises. • Supporting automated IT provisioning & management on the enterprise level (where possible) & on the department level (where needed).

Hosting environments provide resources and services, usually by pre-allocating them ("static hosting"). Key challenges are associated with creating dynamic hosting scenarios, that is, between several administrative domains.

HOSTING	
VISION	**EXPECTED IMPACT**
Adding transparency & dependability. Supporting highly dynamic hosting scenarios. Significantly impacting hosting scenarios by supporting new hosting business models: software as a service; on-demand computing & enabling short-term relations. Much more flexible interactions between several organizations.	• Automation support for negotiation & set-up of hosting relationships & Service level Agreements (SLAs). • On-demand (or at least near real-time) allocation of resources & services. • Comprehensive management of complete hosting lifecycle from enactment to decommissioning.

Five Technology Trends Impacting on Business IT Systems

The Research Agenda has identified five Technology Trends that will have a significant impact on future business IT systems and specifically on Business Grids: Storage & Data Management; Processor Technology; Network Connectivity; Mobile Devices; and Sustainability. A number of initiatives are tackling issues, such as the increasing amounts of data generated by businesses and research projects, rapidly growing needs and costs for storage and challenges surrounding data management. Societal concerns also surround increasing energy consumption. More research, targeted ICT policies and coordinated engagement with standard development organizations (SDOs) are needed to support these endeavours, bearing in mind the specific drivers, needs and practices of the business and scientific communities concerned.

The SRA evaluates a number of key research fields: Data Grids; Database Replication; Multi-tier Systems; Application Development; Performance Engineering; Cost & Revenue Management; Autonomic Computing; Virtualization; Security; Interoperability; Manageability, Flexibility & Reconfiguration within the framework of Scientific Grids, Enterprise Grids, Virtual Machine-based Grids, and Mobile Grids. Specific requirements can be matched to top-level challenges and priorities for research, which will ultimately bring benefits to EU's business community.

Match Key Research Fields to top-level challenges

A good case in point is the integration of mobile devices and pervasive scenarios involving embedded processing capabilities into the enterprise grid, which could lead to new opportunities for grid access and the creation of new mobile services. While software developers would need support to produce effective, robust applications that hide the complexity, the shift towards an open infrastructure would ultimately make it easy for developers to write and deploy applications and services. This challenge is closely connected with the creation of new skill sets for programming and scripting languages.

1. STORAGE & DATA MANAGEMENT	
Drivers & Needs	**Challenges & Opportunities**
Compliance with Sarbannes-Oxley & Basel-II is driving businesses towards large-scale storage of all relevant financial records, including email. Data volumes in typical businesses are growing at around 50% p.a. with budgets for storage exceeding other IT hardware budgets.	• Clear need for storage & data management systems so that organizations can keep pace with the rapid growth in volume & complexity of usage. • Storage should provide Business Grid applications with the ability to maintain persistent data & retrieve it as and when required.

2. PROCESSOR TECHNOLOGY	
Drivers & Needs	**Challenges & Opportunities**
Multicore processors offer a way to maintain the rate of improvement in available computing power.	• Benefits include processing power with very low latency & also in power dissipation, an increasingly important factor.

3. NETWORK CONNECTIVITY	
Drivers & Needs	**Challenges & Opportunities**
Access networks use different devices and have different features in terms of bandwidth, latency & reliability with important implications for application performance.	• As Business Grids develop, the role of networks to interconnect resources in different locations will become increasingly important.

4. MOBILE DEVICES	
Drivers & Needs	**Challenges & Opportunities**
PDAs, mobile phones, portable media players, sensors, etc are becoming increasingly important constituents of the global networked ICT ecosystem. Mobile phones are increasing computational capacities using multiple approaches to network connectivity.	• Incorporating mobile devices into Business Grid scenarios means that their context (geographic location, connectivity features) has to be taken into account.

5. SUSTAINABILITY	
Drivers & Needs	**Challenges & Opportunities**
Energy efficiency in data centres for business and the environment is the most important issue facing technology providers and their customers today (The Green Grid Consortium). Energy costs are projected to exceed 50% of the total IT budget over the next few years. The security of supply for large data centres could also become an issue in some locations. Demand for computing capacity continues to grow resulting in increased energy requirements for hardware & associated cooling systems. Important implications for operational costs and for sustainability & climate change.	Energy efficiency optimization is an ever important factor affecting the IT infrastructure. Priorities include: • More efficient hardware & data centre architectures. • Integrated management solutions that cater for ambient temperature & energy consumption. The ability to demonstrate high energy efficiency is expected to serve as a driver in the adoption of Business Grids and an advantage over stand-alone deployments. Regulation & legislation are expected to grow in importance.

Specific Research Challenges to Advance the State of the Art

The research challenges are derived from the nine business scenarios & the five technology trends. The thirteen specific challenges each have a set of related challenges and are ranked in terms of priority, complexity and expected time-lines. **Four functional & commercial requirements** have been identified and comprise Data Management; Applications Development; Network connectivity; and Accounting & SLAs. In addition to the **nine non-functional** requirements, which are Dependability; Security; Performance; Interoperability; Manageability; Governance; Flexibility; Mastering Complex Systems, a core set of **Overarching Challenges** have been defined.

The sample of high priority challenges below illustrates how specific research activities could advance the state of the state of the art for both functional and non-functional requirements. Specific examples are given for functional requirements (data management) and non-functional requirements (dependability; security; performance & interoperability).

Electronic data stored in files & databases is the highest value asset for commercial organizations. Businesses therefore require a data management system with a real potential for improvement in performance, reliability, scalability & integration. To date, there has been limited focus in R&D projects on issues surrounding commercial data management systems. Coupled with this, there has not been a sufficient number of targeted efforts to satisfy the required level of reliability for enterprise applications.

Data Management is a good example of why research in this area is a high priority, in order to meet three key functional and commercial requirements in the Enterprise Scenario*:*

1. *Fast provisioning of systems (time to market) & low costs.*
2. *Reliable & secure management of business data.*
3. *Operating IT infrastructures as a business.*

Data Management Systems allowing improved reliability, scalability, integration & performance.

Three **inter-related challenges** for Data Management are scalable data management; low latency geo data management and autonomic data management. All these challenges are high priority with medium-high complexity and achievable in the medium-long term. A summary of the state of the art serves to highlight the impact of research tackling these related challenges.

Current scale-out approaches achieve a scalability of a few tens of sites. Specific research for **scalable data management** would help develop data-base management systems with high scalability for shared data bases, which are the main requirements for Enterprise Grids managing large amounts of data. Additionally, new approaches to data replication are needed to ensure scalability at hundreds of nodes with low replication overheads.

Low latency is another important goal for the future Business Grid. At present, geographically replicated data shows poor performance. Several business scenarios need geographical distribution of data, tolerance of catastrophic failures due to network connectivity problems, & low latency to distant clients. Achieving **Low Latency Geo Data Management** would enable shared & geographically distributed data to change dynamically and ensure low latency for all clients.

Data management systems need to be able to handle heterogeneous underlying resources & apply them effectively to support business processes & applications. **Autonomic Data Management** is needed to ensure that the systems:

- are self-healing; provide high performance independent of the workload with continuous reconfigurations to maximize performance that is, self-optimizing.
- cater for file systems that can accommodate high & variable latency, complex failure modes & cross-organization operation, including VOs.

From a non-functional perspective, key business requirements have been mapped to specific research challenges to illustrate their impact on the future Business Grid. The examples, which focus on high priority research challenges, include dependability; security; performance and interoperability. The tables below outline the specifics and research challenges for each of the four requirements with reference to current state of the art.

DEPENDABILITY	
Requirements for the Business Grid	**Related Research Challenges**
• High-availability of infrastructure resources. • Balancing availability levels with costs. • Autonomic: automatic repair & recovery in the event of error.	Open Challenge: extending self-healing to complex, multi-tier systems typical of the business infrastructure – high priority. Cost-awareness, which is particularly important for Hosting, and mobile dependability are medium level priorities.

SECURITY	
Requirements for the Business Grid	**Related Research Challenges**
• Security Policies on infrastructure level with guarantees for integrity & confidentiality of business data. • End-to-end (infrastructure to user) security demands. • Supporting several levels of security authentication.	Security considerations are a major roadblock for commercial adoption of Grid. Business Grids need to provide security mechanisms for lower level virtual execution environments with granularity & flexibility enabling a reflection of higher-level security zones: business group, business process or organizational entities – high priority. This approach complies with recommendations of ESFORS (EU Security Forum for Web Services) & SOI formulated by NESSI. Enforcement & brokering of security policies are also high priority.

PERFORMANCE	
Requirements for the Business Grid	**Related Research Challenges**
• Prediction & accounting of non-functional behaviour (applications, services, resources). • Massive Enterprise job scheduling with pre-emptive/planned allocation.	Various virtualization technologies exist but do not indicate predictable impact. Scheduling solutions focus on batch-like jobs. Predictions do not cater for dynamic situations. Resource management is largely homogeneous. Top priorities include: • Develop system & models for virtualization technologies enabling impact analysis of different workloads. • Better understanding of the impact of scheduler decisions across layers & for transactional applications.

INTEROPERABILITY	
Requirements for the Business Grid	**Related Research Challenges**
• As grid solutions become more widely adopted, the need for interoperability & standards increases. Interoperability is crucial for organizations connecting grids within their own & other organizations. • Standards-based with effective interoperability.	There are a few standards that cater for specific enterprise needs (ETSI, OGF). There is a need for open standards ensuring interoperability of grid applications at the infrastructure level and middleware level. Top priority: • Engagement with the standardization process, providing conformance test methods, promoting wide adoption.

Requirements for Manageability; Governance; and Flexibility range from catering for flexible changes of the business process & applications to remaining fully functional during incidents and planned maintenance. The challenges surrounding these requirements are main low-medium priority and achievable in the short to medium term. However, resource management in multiple admin domains and dynamic resource allocation & release are high priorities.

Overarching Challenges: Requirements & Impact

Highlight Business Value & reduce complexity

Overarching challenges entail demonstrating the business value irrespective of the specific technology adopted; reducing complexity & the need for an architecture-driven approach to grid. Reducing the complexity of Grid technology is high priority with medium-high complexity and achievable in the medium to long term.

- The ultimate goal is an "invisible" infrastructure so that businesses can focus on their main concerns. The challenge lies in providing a highly automated configuration & management; different levels of abstraction; user-friendly interfaces; a focus on scalability & interoperability without universal standardization. Raising the level of abstraction is connected with Application Development so there is a need for domain specific languages, tools & development environments that hide complexity & simplify the development of business applications for a specific domain. Understanding software lifecycle issues in open service oriented architecture is also important.

Direct contribution to business value is a medium-high priority with medium-high complexity and achievable in the medium to long-term.

- A business Grid should bring benefits that are clearly linked to the business goals of its users, enabling straightforward value assessments. The challenge is to map high-level business goals & technical functionality. Mapping should be flexible to cope with changes in priorities & business models.

Architecture-driven solutions are a medium-high priority but with high complexity and achievable in the medium-long term.

- The main goal is to define common principles, in order to construct & operate grids that support reproducible & interoperable solutions. The challenge is to build a consensus on best practices & standards for building & operating business grids that cater for a variety of scenarios.

The framework should ensure that the service ecosystem is:

- **Well-governed**: policy & rules driven, monitored by SLAs.
- **Well-balanced** between the need of flexible business flows & mandatory technology processes.
- **Well-orchestrated** at the level of complex end-user services.
- **Well-integrated** at the level of software systems powering core & derived services.
- **Well-instrumented** at the level of the technology stacks powering the software systems.
- **Well-supported** at the level of infrastructure.

Three Key Challenges to Achieve the Business Grid Vision

The extensive set of research challenges identified would be best tackled in combination rather than in isolation, as several of them are inter-dependent and some partly overlap. Joint research programmes would therefore be beneficial to tackle not only top-level but also a number of inter-related challenges more effectively. An assessment of all the challenges has enabled the identification of **three key challenges**, that is, **architectures**; **lifecycle management** and **infrastructure technologies**, where significant progress in the state of the art is needed.

THREE KEY CHALLENGES
1. New system architectures • Harmonizing service architectures (SOA) and infrastructure architectures (SOI). • Advancing the structure of multi-tier, federated & internet scale architectures. • Supporting all kinds of business models, applications and emerging hardware environments. • Providing transparent & integrated access for all relevant stakeholders: architects, engineers, operators, customers.
2. Advanced System lifecycle approaches • Engineering, deployment, composition, provisioning, management & decommissioning phases that support transparent knowledge tracking, feedback loops, prediction & simulation. • Enabling a clear separation of concerns between different stakeholders, e.g. business versus IT, developers and customers. • Supporting the full variety of business scenarios, from traditional data centres to complex service value networks, while complying with overarching sustainability requirements.
3. Advanced infrastructure technologies • Hardware: energy efficient, flexible allocation, virtualization. • Middleware: new multi-tier system design, flexible storage systems, harmonized virtualization on all layers. • Related programming models (parallel programming, multi-core) that meet the required flexibility of the networked economy.

Conclusions

The development of a major business infrastructure designed for future service-oriented economies represents a shift towards the functional view of data transformation services based on the assumption that innovation in businesses and public services drive the evolution of these services down to the technology level. The community-driven NESSI-Grid SRA exemplifies the general Grid vision in a concrete context based on real business needs, drivers, and challenges.

The Research Challenges for Business Grids within the future SOE detail and prioritize specific requirements that focus on real concerns for the commercial sector. The overall aim is to ensure that the infrastructure is developed in compliance with real requirements, standards and ICT policies through industry-research collaborations. The expected impact of Business Grids as a service-oriented infrastructure is to bring tangible benefits for European enterprises in the evolving IT & business landscape.