The EUAsiaGrid Roadmap

Paths to a sustainable, persistent e-Infrastructure in the Asia-Pacific region

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Abstract: The EUAsiaGrid project has developed a Roadmap towards the establishment of a persistent and sustainable e-Infrastructure for research in the Asia-Pacific region. This paper describes its aims and context, the decisions make in its creation and outlines the proposal for an Asia-Pacific Grid Initiative that will allow partners from different countries in the region to coordinate their national initiatives and align themselves with the emerging infrastructure in the region as well as developments elsewhere in the world.

Introduction

The Asia-Pacific region has benefited from the development of a number of components of a full grid infrastructure driven by the participation of the region in the LHC experiments and the provision of support for this by Academia Sinica in Taiwan. The work conducted in the EC-funded EUAsiaGrid project[1] has provided support for the establishment of additional infrastructure components within the partner countries and for the development of user communities from a wide range of research disciplines. Thanks to EUAsiaGrid, re-

[1] http://www.euasiagrid.eu

searchers in these countries can now sign up to an existing infrastructure through certification authorities in their countries and join a generic virtual organisation, the EUAsia VO, that gives them access to the established EGEE resources in the region.

The current EGEE e-Infrastructure has been developed through a series of projects funded by the European Commission. The EGEE projects have contributed to the development of the basic technologies underpinning grid computing today and have established a worldwide operational e-Infrastructure supporting research applications spanning a wide range of disciplines from high-energy physics to the social sciences. In addition, the Commission funded a number of Coordination and Support Actions that have helped to establish regional grid infrastructures in regions such as South-East Europe (SEE-Grid[2]), the Mediterranean (EUMedGrid[3]), Latin America (EELA[4]), China (EUChinaGrid[5]), India (EUIndiaGrid[6]) and, finally, the Asia-Pacific region through EUAsiaGrid.

Together, these projects have helped to expand the reach of the growing e-Infrastructure for research around the globe to facilitate research collaborations between different parts of the world. As the infrastructures mature and are being used by a growing number of researchers worldwide, the question of sustainability comes to the forefront. In order to make the existing infrastructure persistent and sustainable, the necessary technical, organisational and wider social arrangements need to be put in place to ensure that it can be taken for granted by researchers today and in the future.

In Europe, the EGI Design Study project has developed a blueprint (EGI-DS Consortium 2009) for the establishment of a European Grid Initiative based on National Grid Initiatives within individual states that contribute to a common European infrastructure integrated with the other regions in the world and are coming together in the EGI Council to provide the necessary governance. To provide an operational basis for the EGI at the European level, a new organisation, EGI.eu, has been established under Dutch law. The ar-

[2] http://www.see-grid.eu/

[3] http://www.eumedgrid.eu/

[4] http://www.eu-eela.eu/

[5] http://www.euchinagrid.eu/

[6] http://www.euindiagrid.eu/

rangements put in place in Europe provide an example for other regions that wish to foster a persistent and sustainable e-Infrastructure but it is likely that rather than adopting this model one-to-one, other regions will need to come up with arrangements that reflect their cultural, socio-economic and political context.

It is in the light of this that EUAsiaGrid project has developed a roadmap (EUAsiaGrid Consortium 2010) aiming to inspire the necessary political will and degree of collaboration amongst key stakeholders to drive forward the project of fostering a persistent, sustainable e-Infrastructure for research in the region. Aimed primarily at key decision makers at the national policy level and in senior management in institutions, the first part of the roadmap focuses on an assessment of the potential impact of such an infrastructure. It outlines the benefits that may be realised through increased scientific collaboration, resource sharing and the provision of an infrastructure that can be taken for granted by its users before highlighting the usage of the infrastructure in different research disciplines ranging from high-energy physics as an example of a discipline not only adopting but driving the development of grid technologies to the social sciences that are only beginning to develop models of e-Infrastructure usage that realise their full potential.

The second part provides a blueprint for the technical and organisational structure. While the latter is largely inspired by examples like the European Grid Initiative and the Latin-American Grid Initiative (LGI), it also takes into account the specific characteristics of the Asia-Pacific region such as the immense heterogeneity and the at times difficult political context, both within countries and internationally, hindering the straightforward implementation of a hierarchical model such as those underpinning the EGI and LGI.

In the following sections, we first provide a description of the context and aims of the EUAsiaGrid Roadmap as well as an analysis of the strengths, weaknesses, opportunities and threats in relation to the currently existing e-Infrastructure in the Asia-Pacific region. Finally, we outline the structure of the proposed Asia-Pacifc Grid Initiative (APGI) and first steps towards its establishment.

Aims and Context

The aim of the Roadmap is to foster an e-Infrastructure for research that should be:

- **Persistent and pervasive:** the infrastructure is available at any point in time independent of specific uses. Researchers have access to it regardless of their location and affiliation as long as their use fits a defined set of criteria.
- **Embedded:** the infrastructure is provided for research use in a wide range of disciplines and research areas, it is not an end in itself. Consequently, ongoing community engagement activities will help to ensure that researchers from all disciplines will play a role in shaping its ongoing development.
- **Easy to use:** access to the infrastructure is easy enough for researchers without specific computing skills to start using it. The complexity of using advanced functionality should be proportional to their utility.
- **Managed**: the infrastructure is operated in a way that ensures a consistent and high quality user experience. The necessary coordination is ensured through internationally agreed governance mechanisms.
- **Supported:** education, training and user support are provided. Wherever possible, support will be provided at a local level in local languages and according to local needs. Their quality is en sured through international collaboration and a shared pool of resources such as training material underpins the provision of high-quality support.
- **Scalable:** the infrastructure is constructed in ways that ensure it can serve the needs of today and scale over time to support wider uptake by a larger number of researchers as well as supporting new research applications requiring larger capacities.
- **Homogenous in use:** the inevitable heterogeneity of resources and the technical and organisational arrangements around them are generally hidden from the users to provide ease of use.
- **Federated:** based on subsidiarity principle, what can (best) be done locally is done locally but in a way that local activities benefit from international collaboration and coordination.

- **Sustainable**: funding arrangements are put in place that ensure that the overall infrastructure is maintained even as individual resources become unavailable or as partners join or leave the collaboration.

These *core characteristics* guided the development of the EUAsiaGrid Roadmap and provide the fundamental yardstick by which the success of the Asia-Pacific Grid Initiative will measure the outcomes of its activities.

In order to understand the starting point for the roadmap, we conducted an in-depth analysis of the state of the existing e-Infrastructure in terms of both the technical resources and the social arrangements put in place to support its operation and usage. The overriding theme is that while the support provided by the EUAsiaGrid project has raised the baseline and given researchers access to significant resources, there is still much heterogeneity in the adoption of grid technologies in different countries in the region. While some have comprehensive national programmes, others are currently formulating their policies and programmes and some lack significant buy-in and are dependent on individual institutions taking the initiative. The existence of catch-all provision of key infrastructure services, support, certification services and a VO means that these issues do not pose insurmountable problems but the longer-term sustainability of the infrastructure will depend on wider and more homogeneous adoption.

Table 1 (next page) shows the strengths, weaknesses, opportunities and threats identified in a summary form.

Strengths	The existence of a mature set of core services and operational arrangements across all areas with catch-all arrangements to compensate for heterogeneity at the national level. EUAsiaGrid has established a number of resource centres, ensured that CAs exist in all countries and established the EUAsia VO as a catch-all mechanism allowing researchers to access available resources.
Weaknesses	Lack of funding in many countries leading to a lack of e-Infrastructure re- sources as well as a lack of training and support capacity. Lack of national initiatives as well as international governance and national representation.
Opportunities	The establishment of EGI in Europe and LGI in Latin America are providing a strong template for the creation of a structure underpinning the Asia-Pacific Grid Initiative. In the context of the EGI-InSPIRE proposal, key resource providers in the Asia-Pacific region have formed a Joint Research Unit (JRU) that can form the basis for a growing Asia-Pacific Grid Initiative. The CHAIN proposal, if funded, provides an effective coordination mechanism linking the EGI with regional initiatives and realising economies of scale by combining previously separate efforts.
Threats	The lack of plans to establish national grid initiatives in most countries leads to the provision of resources and operational arrangements being dependent on local resources without any national coordination. Issues of sustainability are often caused by uncertainties about technical development, short-term, project-based funding arrangements and lack of funding and policy support for the formation of sustainable, persistent services.

Table 1: SWOT Analysis of e-Infrastructures

One of the main issues that grid initiatives anywhere in the world face is the transition from project funding to more sustainable models that allow the provisioning of a dependable service. As already mentioned, the levels of funding available for e-Infrastructures in the Asia-Pacific region vary widely and the limited horizon for funding leads of problems such as staff fluctuation or conflicts between the requirements of service provision and research agendas. In addition, in many countries the resources provided are tied to specific subject areas, further compromising the aim of developing a generic, shared infrastructure.

Networking still plays an important role in the region as provision can differ between countries and between different institutions within a country. At the moment, the Asia-Pacific Advanced Network (APAN[7]) and the Trans-Eurasia Information Network (TEIN[8]) provide connectivity within the region and to Europe and the US. The provision of these inter-regional links is driven by the participation of countries in the LHC experiments at CERN. While overall connectivity to Europe and the US exceeds 50Gbits/s, connectivity within the region itself is less well developed. Changing this situation is one of the aims of the TEIN3 project, which will provide a larger number of countries with upgraded link capacities to the regional backbones. The provision of network capacity is gradually improving and international collaboration is also helping to address network disruptions such as in the case of taifun Morak, which took out important international links. In this instance, ASGCnet in Taiwan provided a backup route via its dedicated link to Europe.

At the middleware level, we can observe a degree of pragmatism in many countries with resource provides often supporting multiple middleware stacks to enable collaborations with partners in different parts of the world and with different technological commitments. Many countries have taken part both in EC-funded projects using the g-Lite middleware stack[9] and in the Pacific-Rim Applications and Grid Middleware Assembly (PRAGMA[10]), which focuses on intero-

[7] http://www.apan.net

[8] http://www.tein3.net/

[9] http://glite.web.cern.ch

[10] http://www.pragma-grid.net/

perability with US grids using the Globus Toolkit[11]. In the longer term, it seems likely that the choice of middleware will not be one of selecting between different homogenous solutions rather be one of configuring a number of best-of-breed components together that inter-operate using commonly agreed standards. This is already visible in the approach being taken in Europe with regard to the Unified Middleware Distribution (UMD), which does not propose the development of a new, single middleware stack but rather aims to adopt components from g-Lite, ARC[12] and Unicore[13], three existing stacks developed within different contexts in Europe. Significant experience exists within the region with regard to interoperability, e.g., in Australia where the Australian Research Collaboration Service (ARCS[14]) has provided interoperability with different platforms of international importance through the use of national gateways. Rather than trying to control heterogeneity, ARCS has focused on bringing together different communities and institutions with different commitments. Ultimately, it will be important that while the need for interoperability is crucial for the provision of a shared e-Infrastructure, this infrastructures ultimately exists to serve the needs of researchers and their projects, so a degree of flexibility will be required as no one solution will fit all needs. The more an e-Infrastructure will bend without breaking the more it will be fit to stand the test of time and deliver the expected support for driving forward science.

The provision of resources in the emerging Asia-Pacific e-Infrastructure has made significant progress through support by the EUAsiaGrid project. In contrast to initiatives such as PRAGMA, EUAsiaGrid has aimed from the start to foster the emergence of a persistent and sustainable e-Infrastructure that individual researchers can take for grants and simply use by signing up to a suitable virtual organization such as the EUAsia VO, which acts as a discipline-neutral catch-all VO for the region. A crucial achievement is that resources now exist in all the partner countries and the necessary human resources are being developed to sustain and expand these in-

[11] http://www.globus.org/

[12] http://www.nordugrid.org/arc/

[13] http://www.unicore.eu/

[14] http://www.arcs.org.au/

vestments. Each country has a user interface (UI) machine through which researchers can access the resources provided by the EUAsiaGrid VO and other VOs. Local certification authorities with supporting registration authorities exist to provide end-user and server certificates to establish a trust infrastructure under the governance of the Asia-Pacific Grid Policy Management Authority MA[15]). While the provision of an increased number of resources to meet future requirements is dependent on the provision of funds from national agencies, the support through EUAsiaGrid has helped to ensure that the baseline functionality and key services are readily available. Through the help of its training workpackage, the provision of training and support is being extended into the individual partner countries so they can become more independent from the catch-all provision of training and support. This is a key factor in ensuring scalability and sustainability.

Towards an Asia-Pacific Grid Initiative

In the short term, it is not possible to develop fully-fledged national grid infrastructures and an incorporated international organization such as EGI.eu in Europe. This is partly due to the lack of investment in e-Infrastructure in the region but also because problems exist with the lack of a political mandate at the national level for representation of countries through a single organisation. At the wider policy level, the lack of coordination within the region and the political problems that exist make it impossible to adopt the model provided by the EGI in a straightforward way.

Instead, the EUAsiaGrid Roadmap provides a proposal for the development of the Asia-Pacific Grid Initiative through a sequence of steps starting with the creation of the APGI Union, a lose federation of individual institutions and Joint Research Units (JRUs) based on a set of *standard operating principles and procedures*.

[15] http://www.apgridpma.org/

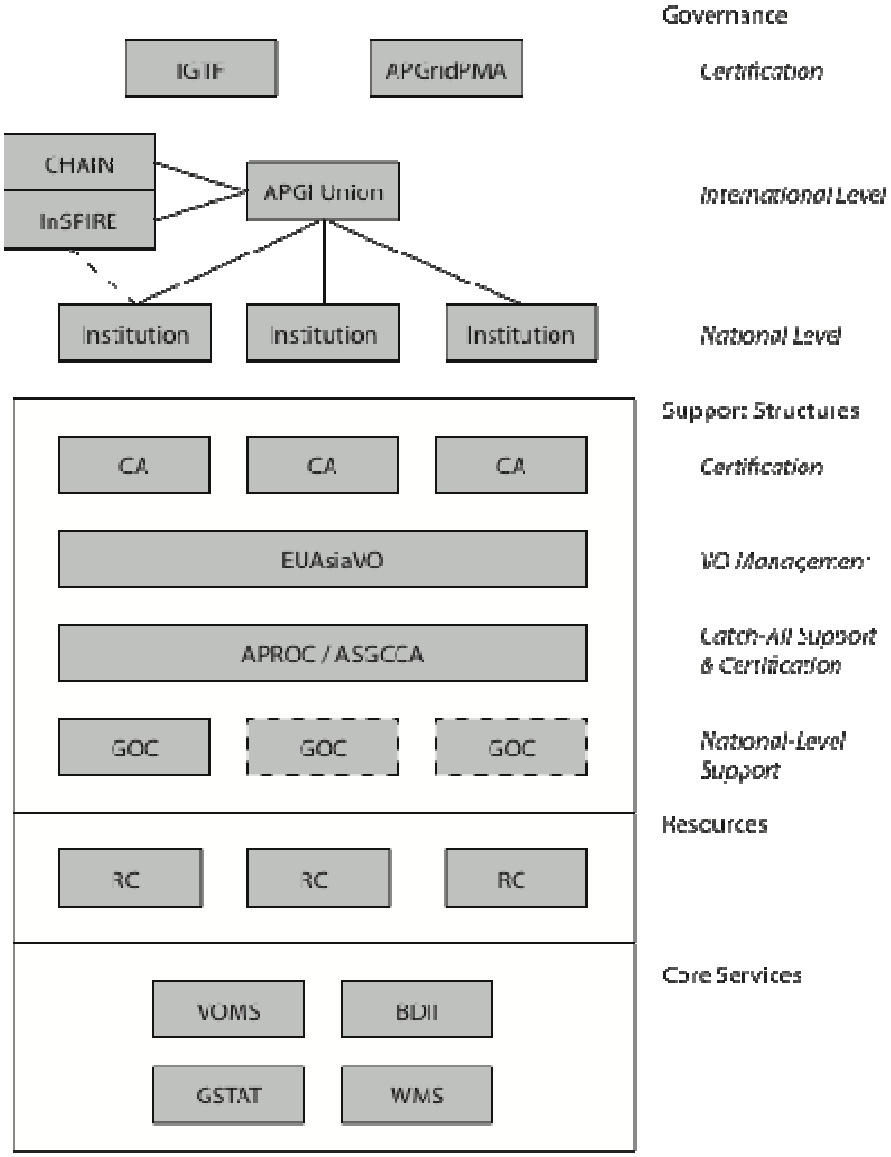

Figure 1: Organisational and Technical Structure of the APGI Union

Figure 1 illustrates the structure of this proposed Union, which is based not on national representation but the participation of individual institutions as contributors to a shared infrastructure. The structure builds on the existing strengths identified in the SWOT analysis such as the availability of core services and the provision of key

support services through the Asia-Pacific Regional Operations Centre (APROC[16]) and APGridPMA as well as the increased breadth of resources that are now available under the EUAsia VO. An important influence on the formation of the APGI Union will be the JRUs that are underpinning the participation of partners from the region in the EGi-InSPIRE and CHAIN proposals. These two projects will play an important role in the further development of a worldwide persistent and sustainable e-Infrastructure and the participation of key partners in the region, in particular, of Academia Sinica Grid Computing, will ensure that these efforts are well coordinated.

A crucial aspect of the usefulness of the structure of the APGI Union is that it does not fundamentally differ from the EGI model and that it will allow a gradual migration towards a model based on national representation. It is not currently possible to give a timeframe for this transition but experiences made in Europe show that the transition of a number of key players can lead to an 'avalanche effect' that will eventually lead to the universal adoption of the principles of national representation through NGIs and the establishment of a coordinating organisation similar to EGI.eu.

The standard operating principles and procedures for the APGI Union have been developed to allow the APGI Union to function as a regional grid initiative and to participate in international collaborations that will oversee the transition from the existing EGEE infrastructure to a persistent and sustainable infrastructure under the EGI and similar initiatives such as the LGI in Latin-America. Their formulation was based on experiences made in the context of PRAGMA and of APAN as well as a critical assessment of the current state of adoption and the formulation of governance structures in the region.

Conclusions

This paper has outlined the aims and context of the EUAsiaGrid Roadmap and the structure of the proposed Asia-Pacific Grid Initative, its initial form as the APGI Union based on contributions by

[16] http://aproc.twgrid.org/

individual institutions as well as the transition towards the full EGI/NGI model. We have described the reasons why we believe that an immediate and straightforward adoption of the model of national representation is unlikely to be successful and our motivation for proposing a model based on a gradual transition stating from an interim solution.

The funding of the EGI-InSPIRE and CHAIN projects by the commission will provide an important impetus for the establishment of the APGI Union and its gradual transformation into a regional grid initiative fully integrated with worldwide activities, supported by improved network and resource provision and legitimised through increasing evidence of impact on substantive scientific research. Ultimately, the success of this initiative will depend on the willingness of governments to provide the necessary policy frameworks and the funding necessary to develop and sustain national grid initiatives. We believe the EUAsiaGrid Roadmap has given policy makers the necessary evidence to inform and justify a decision to invest in the creation of the APGI and the infrastructure it support.

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