# Nordic Grid Infrastructure Strategy

This document outlines the major elements of a strategy for Nordic Grid Infrastructure for the next 10 years. The document is part of a strategy process running in Q1 2008, and as such a working paper meant as input for the process.

The strategy outlined here asks the questions "Why a Nordic grid infrastructure" and "what will the infrastructure for grid computing in the Nordic countries look like in 10 years", and attempts to answer these questions by describing a scenario for Nordic grid infrastructure in 2017. The strategy considers how national and joint Nordic infrastructure support Nordic e-Science, and considers the need and roles of Nordic infrastructure organizations such as NDGF and NORDUnet.

The scenario includes the overall role of NDGF in a Nordic and international context, the organization and staffing of NDGF, the services offered by NDGF and how NDGF collaborates with other Nordic actors, and the major activities of NDGF.

The remainder of this document falls in two major parts. The first part describes the aims of the strategy – what is it we want the Nordic grid infrastructure to be able to achieve. The second part describes the elements of the 10-year scenario.

The document concludes with a brief discussion of how to execute the 10-years strategy.

## *Why a Nordic Grid Infrastructure*

Recent years have seen a globalization of science, and at the same time an increasing need for scientific computing and storage. These two factors combined leads to a need for a service that facilitates these resources for the science community on a global scale. We call this new science e-Science, and the service that facilitates it is the Grid. E-Science is about global collaboration in key areas of science, and about the next generation of infrastructure that will enable it.

Grid computing allows the establishment of virtual resources for scientific computing and storage based on existing resources, allowing efficient resource sharing. In global scientific collaborations, researchers join together to form virtual organisations. Grid computing allows scientific computing to be joined to match and support the needs of the virtual organizations.

In the second half of 2006, the Nordic Council of Ministers (NCM) formed a e-Science workgroup, charged with producing a Nordic e-Science strategy. The resulting report (*Nordic e-Science – Research, Education, and Sustainable Infrastructure Services*) emphasizes that "In order to meet the expanding need for new grid applications, the Nordic countries will have to provide a grid infrastructure which is sustainable both in terms of technology and capacity".

Through NORDUnet and NDGF, is has been demonstrated that together the Nordic countries can act more forcefully than each country on its own. The Nordic countries are technologically and culturally alike in many ways, enabling efficient collaboration. Working together facilitates efficient resource sharing across the Nordic countries and allows more efficient resource utilization, thus giving individual users access to a larger and more diverse set of resources.

Just as important, by acting as a coherent virtual body, Nordic resources and competences will have increased visibility internationally and be very well equipped to take part in large scale European and international collaborations. By working together, the Nordic countries can both create an infrastructure that enables ambitious Nordic research projects and maximize the impact of Nordic science in the international community.

A strategy for Nordic grid infrastructure will support the e-Science strategy laid out in "Nordic e-Science – Research, Education, and Sustainable Infrastructure Services". By establishing long term sustainable collaborations to maintain and develop Nordic e-Science infrastructure, the report states that "in a 10-year perspective Norden can be viewed as an entity and a role model internationally when it comes to virtual sharing of e-Science resources".

There are many drivers for e-Science infrastructure in the Nordic countries.. Current examples are:

- The Nordic participation in the WLCG with a joint Nordic Tier-1, which is currently expected to run until 2012, and to be followed from 2015 by the Super-LHC project generating 5-10 times more data.
- Plans for Nordic participation in large scale research infrastructures and to have those placed in the Nordic countries – these could includes:
  - ESS
  - MAX IV
  - FAIR
- Hosting of strategic developments in both astrophysics and astronomy with the establishment of large scientific instruments and large scale data sources.

For the endeavours, Nordic researchers need the support of a common Nordic infrastructure in order to support local, Nordic projects and to participate in large scale international projects. For successful projects, this goes beyond hardware – large scale e-Science initiatives call for support, creation of software solutions, customization, project management and reporting, etc. A Nordic strategy for grid computing should ensure the availability of these resources and allow for shared responsibilities. This will also facilitate a clearer organisation for strategic planning and funding.

## *Aims for a Future Nordic Grid Infrastructure*

A Nordic grid infrastructure must support large scale efforts such as the Nordic WLCG Tier-1. Likewise, it must support discipline-specific communities of users sharing resources or collaborating across the Nordic countries. Equally important, a Nordic grid infrastructure must be a platform for Nordic participation in Nordic (and otherwise international) projects. As such, a Nordic grid infrastructure should allow Nordic partners in EU projects to participate with major computational resources, even in projects where no single Nordic country would have sufficient resources. A Nordic infrastructure should also represent Nordic points of view and maximize impact, in the same way as is the case with NORDUnet in the network space.

A Nordic grid infrastructure must support the national grid and HPC strategies of the Nordic countries. The strategy must be closely tied to the strategies of the Nordic National Grid Initiatives (NGI's), and must leverage the resources and strategies of Nordic HPC centres. The goal is to create a platform for Nordic resource sharing, and that this platform is a resource that can be used by NGI's in national initiatives and by both Nordic and national user communities. The Nordic grid infrastructure must be a supplement to the national infrastructures; it is not intended to replace or compete. It is therefore important that the entire community feels ownership of the Nordic grid infrastructure and that it is seen as contributing to the goals of the NGIs and national resources.

A Nordic grid infrastructure should also support the Nordic e-Science strategy and policies. Nordic infrastructure is a key instrument in bringing to life the Nordic e-Science strategy and support Nordic centres of excellence in e-Science. The Nordic grid infrastructure acts as the interface between initiatives under a Nordic strategy and the national resources that ultimately implement the Nordic initiatives.

The Nordic countries have in the past 10 years achieved a very strong position in development of the middleware that support e-Science. Middleware exists to allow resources and data to be shared within a community, to authenticate usage and ensure security, to support science applications, and create virtual resources from physical ones. A tradition for collaboration and a strong base platform has resulted in strong Nordic contributions in this area. It is essential that a Nordic grid infrastructure both take advantage of this, provide a platform for future development, and directly support the development community, maintaining a key Nordic area of excellence.

From a user perspective, a grid infrastructure must support user communities and enable these communities to form virtual organisations (VO's). Such VO's can be created both temporarily for projects and permanently to support discipline-specific communities. A Nordic grid infrastructure must support this approach to use of e-Science resources. As a result, the infrastructure should focus on VO's rather

than individual users. As a Nordic infrastructure, the natural focus will be on Nordic VO's – collaborative efforts and joint projects spanning several countries.

It is important to realize that the VO approach entails more than technically supporting the VO view of resources and applications. A VO is a human network, a community of scientific users with common needs. Such VO's need human support, ranging from assistance in community creation to guidelines for resource management to full project management for larger collaborative efforts. The coordination done by NDGF for the Nordic WLCG Tier-1 is an example of such a service, and should be considered an integral part of a Nordic grid infrastructure.

## Scenario for a future Nordic Grid Infrastructure

In a 10-year perspective Norden can be viewed as an entity and a role model internationally when it comes to virtual sharing of e-Science resources.

The Nordic grid infrastructure is an overlay for national grid infrastructures, leveraging both national grid initiatives and HPC resources. The national resources are autonomous and are founding partners in the Nordic grid infrastructure, and use the Nordic overlay as a platform for collaboration and to support joint efforts. The Nordic grid infrastructure support Nordic initiatives in EU and international projects and creates synergy between the efforts of the Nordic countries. The Nordic infrastructure represents the Nordic point of view in areas where that is beneficial to the Nordic community.

The operations of the Nordic grid infrastructure is integrated with NORDUnet. A close collaboration with NORDUnet provides the grid infrastructure with most of the facilities required for a reliable service entity that major projects can rely upon and trust as a partner in large international efforts. Such services include a joint Nordic operations centre with w/24x7 operations support and advanced technical operations facilities.

Like NORDUnet, the Nordic grid infrastructure has a small staff. The majority of the work is done by national entities and resource centres, and the majority of the staff is where the computational and storage resources are, and close to the users. There is a permanent Nordic staff, doing project coordination and management of e-Science initiatives, 24x7 operations support and expert-level application support, and development of key middleware components. The staff is distributed across the countries, with much of the staff being close to the resource centres and the VOs.

The Nordic grid infrastructure exists to complement national resource entities, and to support the initiatives of the HPC centres and the NGI's of the Nordic countries. The most visible consequence of this is that the Nordic grid infrastructure does not own or control resources (beyond a few glue components). However, the Nordic grid infrastructure operate and coordinate resources for joint Nordic projects and offer grid services on a Nordic level. It also act as interface between national resource owners and major international projects, and likewise between national resource owners and Nordic VO's. As such, the Nordic grid infrastructure is not an HPC centre or provider of resources. Rather, the Nordic grid infrastructure work with Nordic HPC centres to provide a common platform were this is useful for Nordic research communities, and facilitate sharing of resources on a Nordic level. The Nordic grid infrastructure does this through human networking, by offering joint operations support, and by providing key middleware components for creating a virtual storage and computation entity leveraging national entities.

The activities of the Nordic grid infrastructure are distributed all over the Nordic countries, using both staff, computation and storage resources, and expertise located throughout the region. The grid infrastructure in 2017 support 10 major VOs (application area, user communities, projects), examples being High Energy physics, ESS, Astronomy, bioinformatices, environmental sciences, etc. To support these VO's, the Nordic grid infrastructure supports Nordic middleware development communities in five areas (such as grid computation management, distributed storage, authentication and authorization, etc). In key areas the grid infrastructure participate in international efforts and employ software developers to develop software components needed to advance the mission of the Nordic grid infrastructure.