



Diploma Thesis for Michel Hagnauer

Task Description:	Martin Waldburger, Prof. Dr. Burkhard Stiller
Topic:	Sea Cage Gateway - Fish Farming Supported by Mobile Grids
Start Date:	June 1, 2006
End Date:	December 1, 2006
Supervisor:	Martin Waldburger, Prof. Dr. Burkhard Stiller (University of Zürich) Frode Flægstad (Telenor R&D)
Location:	Department of Informatics (IFI), diploma students' room
Support:	Mobile Dynamic Virtual Organizations (MDVOs); adaptive workflows; mobile grid services; Akogrimo project-related information

1. Introduction and Motivation

Grid systems have evolved over time from traditional grid computing to service grids. Grid computing focuses on high performance computing, based on the concepts of cluster-building and resource sharing, by which grid systems are able to solve data- and computationally intensive tasks. Service grids include additionally virtualized, application field-specific services, providing for geographically and organizationally distributed service provisioning in a virtual organization (VO). Evolution of grid systems has not stopped at that stage, but leads currently toward knowledge grids [1]. In knowledge grids, adaptive workflows are of major interest [2]. A complete view on the current status of a virtual organization with respect to executed processes and services is gained by a service aggregator.

This type of grid systems is characterized by its focus on knowledge-intensive tasks which are modeled by adaptive business processes. Accordingly, high performance computing services may still be available and helpful, but they are not regarded anymore as a central concern. However, knowledge grids require functional extensions in other areas, specifically in commercialization and mobility support. A platform as the one to be developed within the European project Akogrimo [3] will support pervasive access to knowledge by means of offering mobile grid services in Mobile Dynamic Virtual Organizations (MDVO) [4], that help its possibly dynamically changing organizational members to solve complex problems in specific application domains with a clear economic orientation.

Commercial service provision in MDVOs is best applied if the following characteristics are prevailing [5]: In a mobile grid, multiple legally independent entities are able to join and leave an operational VO, which includes both, service users as well as service providers, and what turns a static VO into a Dynamic Virtual Organization (DVO). The main reason for this dynamic element with respect to organizational composition is found in mobility, which embraces user,

terminal, as well as session mobility. Mobile grid resources challenge the VO in the areas of session management (*e.g.* session transfers to another device), user- and device-related context management and thus also adaptive business process enactment.

Norway's aquaculture industry – the country's third largest after oil and gas – covering an ample value network with many different, locally dispersed stake holders, that have to deal with non-trivial problems, is assumed to be a well-suited candidate to implement and exploit the concept of commercial service provisioning in an MDVO. Telenor R&D, located in Trondheim, Norway, furthermore maintains a number of collaborations with local industrial and research partners in the fish farming domain, so that considerable know-how in the area has already been established.

2. Description of Work

This work forms an integral part of the respective efforts on a fish farming scenario, called Sea Cage Gateway (SCG). At the current stage, the SCG scenario and the according problems focus on the sea cages themselves where fish is raised. Ongoing work deals for example with detection of misplaced cages. In general, SCG is currently more concerned with questions in the area of wireless sensor networks than mobile grid issues. Information flows accordingly are mostly unidirectional, containing metered data about cages and status of the fishes living in them. Emphasis is put on automation with as little human interaction as possible and needed.

Automation as a design goal appears to be reasonable, both intuitively seen as well as from an economic viewpoint. This is particularly relevant for high-wage countries and when taking the fact into account that fish farming platforms are regulated to be re-located off shore. In a mobile grid, information flows are intended to be bidirectional, so that the potentially mobile or nomadic grid service users not only request and consume services, but also offer services, thus becoming grid service providers as well. Equipping sites with sensors that deliver status information to a management central, called Sea Cage Gateway, thus provides an important step towards mobile grid-supported fish farming.

Accordingly, the primary target of this thesis consists in the integration of the full mobile grid perspective into the SCG scenario, driving thus the full potential of an MDVO established among fish farming-related actors.

3. Thesis Goals

The main objective of this thesis is found in designing and playing through an at most complete case in fish farming which integrates involved actors in an MDVO, resulting in an evaluation of this case with regard to a qualification whether it is able to support the full spectrum of mobile grid and MDVO potentials in this specific domain. This case has to satisfy the following requirements:

- Primarily, it shall identify product-enabling areas so that mobile grid technology would be seen as the main driver for new and innovative products and services. Product-supporting areas can be investigated too, which however is assessed second-rate.
- It has to depict clearly the values added by choosing mobile grids over alternative approaches. This work thus shall answer explicitly the question why and for what purpose a mobile grid is beneficial and the preferred option.
- Time- as well as resource-wise it needs to focus on a potential solution that relies on realistic assumptions so that a demonstrator on site would be feasible to be implemented within a time frame of 2 to 3 years, maximum.
- The case shall be set up in an as concrete and complete form as possible. For instance, this includes investigations in typical activities on fish farming sites as well as management tasks to be fulfilled or realistic assumptions about economic value creation and resource

consumption. An adequate level of domain-specific knowledge, thus, shall be acquired in order to draw a case that integrates the complete set of relevant aspects to be considered in fish farming. Modeling this case shall make use of a well-accepted method, such as a widely used business modeling framework.

4. Activities

Based on the description of work the following activities - some in parallel - are recommended:

- Introduction to fields of interest and provide a motivation for your work. Focus is to be set on mobile grids in a commercial environment. This includes also an outline of used concepts and terms.
- Give an overview of state-of-the-art with respect to related work in the areas of:
 - Mobile grids and Mobile Dynamic Virtual Organizations. Sharpen your view on cooperation and role models that offer a conceptual tool to reflect business flows in inter-domain service provisioning. Alternative concepts rivaling with (mobile) grids need to be analyzed as well.
 - Fish farming. Familiarize with the peculiarities of the application domain, both in general as well as considering specific aspects for Norway. Document ongoing and upcoming efforts and trends in the fish farming-related value chain steps in the aquaculture industry by focusing on the respective stake holders' needs.
 - Business modeling frameworks. Gain an embracing overview of best practices for business modeling so that you have the necessary tools and methods at hand to design and formalize your concept appropriately.
- Out of the motivation and the analysis of related work, derive requirements allowing you to identify actors and roles in the context of the Sea Cage Gateway scenario that would profit from building an MDVO.
- Based on the results of a requirements match, extend the existing SCG scenario towards full-fledged mobile grid support. Identify and characterize relevant business activities in the MDVO. Model the case by applying the chosen method. Exercise through different variations of the case, by means of changing parameters. Document your results.
- Evaluate your work by clearly depicting reached and missed objectives as well as advantages and drawbacks of the chosen approach. Put the discussion focus the overall applicability of the MDVO concept to fish farming.

5. General Notes

- Provide a proposed schedule for your steps within the first two weeks of your work. Clarify details with your supervisor and finalize the schedule of tasks, basically in a bi-weekly fashion. Prepare an intermediate report and a short internal presentation after half time (date to be set) and discuss this with your supervisor. At the thesis' end a final public presentation has to be given.
- The final written report will document all work undertaken and remember that this report must be self-contained. Major technical basics are to be included and detailed knowledge obtained during the work must be documented. Assumptions, design decisions, configuration choices, and results are part of the report as well as implementation details and usage information. Correct bibliographic references and a list of papers, recommendations, and descriptions used must be added, including those ones given below.
- Establish weekly meetings with the supervisor to report on progress and problems.
- Students involved are required to read and answer e-mails related to this project at least twice a week.

- The sheet on hints for diploma/semester thesis work is required to be known.

6. Formal Results

Besides an oral presentation of your work in exactly 20 min plus 10 min for questions and answers during the public presentation, the following written documents are part of your work and need to be handed in to the supervisor in time:

- A report in a soft cover binding, printed double-sided, and in 3 copies (in English, preferred): It covers the problem to be solved, the discussion of the design choices, a set of arguments on the final design choice, a list of solved and open issues, a table of content and figures (including tables), a valid list of bibliographic references, and optional appendices as required. A critical consideration of the task, the work, and the result will conclude the report. The official acknowledgement section is mandatory, a personal one optional, however recommended, as usually a number of people took part in the process of finalizing the thesis. The text processing shall be done in FrameMaker (preferred).
- A documentation of the implemented/configured system, covering the systems view point, an implementation description, a use and installation manual, a documentation of all program and data structures developed or utilized. All of this may be part of the report below, however, in case it will not be included, it must exist in a separate document.
- A dedicated CD has to be produced: (1) a collection of all program sources, software components, protocol implementations utilized, hardware/product documentation in PDF, related work papers in PDF or full HTML pages, and a directory description; (2) the written thesis (report) in source files, figures in source file and gif or eps, and a full printable PS as well as PDF file, the set of slides for the final presentation in PowerPoint, and all further material used, if available in electronic form, such as all existing and documented test scenarios, testing plans, and test results.
- A German (or English, in case of a German report) summary of maximum 2 pages, which will enable a quick and clear survey of this work's tasks and results. This summary will be part of the bound report, and is included after the front page and before any other text will follow. It includes four short sections on: 1. Introduction, 2. Aims and Goals, 3. Results, and 4. Further Work.
- The complete set of copies of the report, the CD, and the talk must be completed and handed in to the supervisor in time before the diploma thesis will change into "submitted" status.

7. References

The following list of references addresses key points. Further paper, scenario, and document research is a must:

- [1] M. Waldburger, B. Stiller: *Toward the Mobile Grid: Service Provisioning in a Mobile Dynamic Virtual Organization*; University of Zurich, IFI Technical Report 2005.07, <ftp://ftp.ifi.unizh.ch/pub/techreports/TR-2005/ifi-2005.07.pdf>, August 2005.
- [2] M. Deluigi: *Impact of Mobile Dynamic Virtual Organizations on AAA-supported Adaptive Workflows*; University of Zurich, IFI Semester Thesis, July 2005.
- [3] Akgogrimo: *Access to Knowledge Through the Grid in a Mobile World*; <http://www.akogrimo.org>, September 2005.
- [4] M. Waldburger, C. Morariu, P. Racz, J. Jähnert, S. Wesner, B. Stiller: *Grids in a Mobile World: Akogrimo's Network and Business Views*. IFI Technical Report 2006.05, April 2006, pages 1-12.
- [5] Martin Waldburger, Burkhard Stiller: *Toward the Mobile Grid: Service Provisioning in a Mobile Dynamic Virtual Organization*. IFI Technical Report 2005.07, August 2005, pages 1-12.