

Project Proposal
The HPNumSOA Project: High Performance Numerical Computing on Service-Oriented Architectures

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1. Aim of the Research

To investigate the applicability of Service Oriented Architecture Middleware (SOAM) to high performance numerical computing.

2. Background

Grid systems are extensively used in distributed scientific collaborations. Prominent examples are NEESGrid which is a set of shared resources used by earthquake engineers and the Particle Physics Data Grid which is a collaboration based on sharing data and analysis tools used in the hunt for subatomic particles [1]. However, building applications that run reliably and efficiently on these grid systems is often a difficult task. The basic reason is that these applications consist of a heterogeneous collection of sub-applications that are stitched together to form one large distributed application. The difficulty lies in making all the pieces work together in a consistent and predictable manner [2].

In the early days, grid systems were built with ad hoc collections of software. But the emergence of Web Services has galvanized the Grid systems around Service Oriented Architectures (SOAs) [1].

PlatformTM Computing is one of the pioneers in this field whose interests are in the development of Performance Modelling, Evaluation and Programmability Issues of Parallel Scientific Applications using Service Oriented Grid-Oriented Infrastructures. Their concept of the Virtualized Data Centre which provide virtual distributed environments to facilitate virtualized resources, rapid resource allocation and coordination of resources across the entire spectrum of application types and existing heterogeneous systems using grid platform is gaining traction in enterprise IT as a key strategy for aligning with business objectives in today's competitive environments[3]. For the realization of the same ends, they are interested in developing Service Oriented Middleware (SOAM), which provides a high-level infrastructure for enabling grid services.

3. Investigation Area for This Project

The SOA approach has worked well for financial application of PlatformTM Computing. In this project I will investigate the applicability of this approach to (scientific and engineering) numerical applications.

- Develop programming models that extend shared memory paradigms such as OpenMP to a distributed environment.

- Characterize the scientific applications or libraries that can be ported to run well on a service-oriented communication infrastructures (SOAM), running in a dynamic (EGO) and static environment.
- Investigate the programmability and optimization of such applications including things such as tracing and debugging tools.
- Devise a performance modelling methodology that can predict the performance of such applications, and also be used to make run-time decisions in a dynamic environment. [4]

4. Timescales

The aim of the project is to achieve the following results in three years time:

- Develop programming models that extend shared memory paradigms or characterize the scientific applications or libraries that can be ported to run well on service-oriented communication infrastructures.
- Investigate the programmability and optimization of such applications.
- Case study and testing of the above models based on SOAM and/or other case studies provided by PlatformTM and ANU.
- Completion of the PhD study.

5. References

- [1] D. Gannon, B. Plale, M. Christie, L. Fang, Y. Huang, S. Jensen, G. Kandaswamy, S. Marru, S. L. Pallickara, S. Shirasuna, Y. Simmhan, A. Slominski and Y. Sun, "Service Oriented Architectures for Science Gateways on Grid Systems" in *Proceedings of Service-Oriented Computing - ICSOC 2005, Third International Conference, Amsterdam, The Netherlands, December 12-15, 2005*. pp 21-32.
- [2] L. Baresi, R. Heckel, S. Thone and D. Varro, "Modeling and Validation of Service-Oriented Architectures: Application vs. Style" in proc. *ESEC/FSE'03*, September 1-5, 2003, Helsinki, Finland.
- [3] "Aligning IT in Real Time with the Speed of Changing Business Demands: Using a Grid Platform to Orchestrate your Enterprise IT Resources", White Paper available at: http://www.platform.com/NR/rdonlyres/FED88940-8381-406A-948C-CC676407BB9E/0/EGO_WP2.pdf%20
- [4] "The HPNumSOA Project: High Performance Numerical Computing on Service-Oriented Architectures", Available at: <http://cs.anu.edu.au/people/Peter.Strazdins/projects/HPNumSOA/>