A Report on Professor Sushil K. Prasad's Visit
The University of Melbourne, Australia
July-Aug 2006

Professor Sushil K. Prasad of Georgia State University, Atlanta, USA, was funded for a two-month research visit to the University of Melbourne, Australia, during summer 2006 to collaborate with Prof. Buyya on Grid and Mobile Computing research, with Prof. Palaniswami on Sensor Networks, and with NICTA. The outcomes of the visit are as follows:

1. Prof. Prasad gave a series of talks to the Grid Computing group at Univ. of Melbourne on Parallel Algorithms and Data Structures, and on Middlewares. The final talk was on an open NICTA/UMLB colloquium entitled "SyD: A Middleware for Collaborative Applications over Small Heterogeneous Devices and for Distributed Biological Workflows over Web Services."

2. A joint proposal to National Science foundation was submitted entitled "PIRE: US - Australia - Canada Partnership in Developing Middleware Technologies for Enabling Mobile Grid" with Prof. Buyya and Prof. Palani. This also resulted in international collaborations with sensornet group at Oak Ridge National Lab and Acenet group at University of New Brunswick, Canada.

There are good reasons for integrating the handheld devices, such as cell phones and personal digital assistants (PDAs), and the myriad of sensor networks into the current computational and data grid infrastructure: (i) these devices are increasingly getting more capable in processing power, memory, and battery life, (ii) are getting better connected, and (iii) are proliferating. Harnessing their capabilities holds the key to a range of applications from homeland security to e-science. Prof. Prasad has designed and implemented a middleware for handheld and other devices to enable seamless embedded software development and their deployment on a heterogeneous set of devices across multiple networking protocols and data formats. They have also developed and prototyped a preliminary system which allows users to develop and execute simple workflows over actual web services deployed over the Internet, while the workflow is launched and monitored through a mobile PDA.

Prof. Buyya and Palani have developed robust middlewares for distributed computation and workflows over the grid infrastructure, and are developing a middleware for interfacing with sensor networks.
This PIRE project proposed to leverage of these complementary works, and research into developing a mobile grid infrastructure which seamlessly allows (i) employing mobile devices as a window to the global grid, and (ii) extending the global grid to the mobile devices, wherein these devices act as servers for data (stored and sensed) and synergistically collaborate among themselves and with core grid for greatly enhanced utility.

3. Prof. Prasad co-advised a Ph.D. student of Prof. Buyya's lab, Anthony Solisto, on advance grid scheduling techniques, resulting in a joint paper

entitled "GarQ: An Efficient Data Structure for Advance Reservations in Grid Computing" submitted to Intl.Conf. on Parallel Processing (ICPP). A follow up journal submission is planned.

In Grid systems, users may require assurance for completing their jobs on shared resources. Such guarantees can only be provided by reserving resources in advance. However, if many reservation requests arrive at a resource simultaneously, the overhead of providing such service will be significant. An efficient data structure for managing these reservations plays an important role in order to minimize the time complexity for searching available resources, adding new requests, and deleting existing reservations. Several data structures have already been proposed for related scheduling problems, e.g. for admission control in network bandwidth reservation, including Linked Lists and Segment Tree.

In this paper, they first describe suitably modified versions of the Linked List and Segment Tree data structures in capable of dealing with advance reservations in computational Grids. For Segment Tree, this entailed developing a new algorithm for finding a free interval closest to the requested reservation. Next, it describes how these operations can be performed on Calendar Queue, a data structure commonly employed for discrete event simulations. It then proposes a Grid advanced reservation Queue (GarQ), which is a new data structure based on Calendar Queue and Segment Tree, that improves some weaknesses of the aforementioned data structures. We demonstrate the superiority of the proposed structure by conducting a detailed performance evaluation on real workload traces.

4. A project has been started to create a light-weight implementation of gridbus broker to enable it to interface with web services. The students involved are Chad Christopher and Yan Chen from Prasad Lab and Krishna Nandiminti and Srikumar from Prof.Buyya's lab. The main idea was to create a stack of lightweight componentswhere the scheduler was to be replaced by a 'matcher' and calls to the execution framework removed. The entire architecture has been laid out.

5. Some joint initial exploration has been carried out in utilizing SVM techniques developed by Prof. Palani's lab into formulating distributed algorithms for extending lifetime of sensor networks. Also, fleet application of SyD middleware is planned to be leveraged for Prof. Palani's mobile inventory and logistics framework.