Sponsored by IEEE Computer Society
Technical Committee on Parallel Processing

Workshop on Next Generation Systems

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Workshop Description

This workshop provides a forum for an overview, project presentations, and discussion of the research fostered and funded by the NSF Next Generation Software (NGS) Program. The program was announced in October of 1998, and supports research in two broad technical thrusts: One is in developing Technology for Performance Engineered Systems (TPES) for the Design, Management and Control (Runtime support) of Computing Systems. The other thrust (Complex Application Development Support Systems - CADSS) seeks to create new systems' software technology, including enhanced compiler capabilities, and tools for the development, runtime support and dynamic composition of complex applications executing on complex computing platforms (such platforms referred to as Computational Grids, can include assemblies of embedded systems, as well as high end platforms - Grids-in-a-Box). The program has had thus far three calls for proposals (in FY99, FY01 and FY02) and has funded till now 37 projects, ranging in duration from 2-4years. The majority of the projects supported in the program involve multidisciplinary research, spanning several sub-areas in computer sciences. In addition the program puts emphasis in driving and validating the CS advances with end-user applications.

The TPES component supports development of systematic methodologies and tools for analysis and prediction of the performance of applications, of hardware platforms, and of system software. The approach fostered in the program to consider the computing system viewed in terms of an architectural framework consisting of the applications, the system software and the underlying hardware. Key elements of the methodology fostered by the NGS program, include development of multi-level and multi-modal methods and tools for describing the application software, the system software, and the system hardware. Such models and tools encompass modeling and simulation of components at multiple levels of detail and abstraction, as well as incorporation of performance measurements. Additional key capability will be the ability of combining these multi-level/multimodal methods and tools into "performance frameworks" (in a "plug-and-play" fashion) as needed for understanding, analysis, and prediction of behavior and performance of individual components or layers as well as the system as a whole. Thus the methodology fostered by the NGS program enables component-level and system-level performance analysis and prediction.

The CADSS component of the program fosters new research in two key technology areas: new compiling technology and new application composition technology, which will enable applications to effectively execute under dynamic runtime resource availability as is manifested in complex and heterogeneous Grid computing environments. In the new compiling system technology advocated here, part of the compiler gets embedded in the runtime, and a tight interaction will be enabled between the compiler and the underlying system resource managers as well as measurements, and performance descriptors of the applications and the underlying hardware and software systems. This kind of new compiling system (the Runtime Compiling Systems – RCS) will have the ability to adaptively optimize the mapping of applications on the underlying dynamic platform assembly. New programming models might be needed to aid the RCS in such tasks. In addition the program advocates the need for new technology for knowledge-based, compiler-invoked application components' dynamic assembly, and fosters research along these directions. NGS also supports research for the integration of these technologies into application support environments, and demonstration of the technologies on important production-class applications.

The presentations in this workshop provide a sample of the kind of research projects advancing technology along the directions envisioned in the NGS program.

Workshop Organizer

Frederica Darema, CISE/NSF

Scheduled Workshop Program

Workshop Introduction

F. Darema

Presentations: In order of publication in proceedings. Subject to change on site.

Toward a Framework for Preparing and Executing Adaptive Grid Programs
K. Kennedy, M. Mazina, J. Mellor-Crummey, K. Cooper, L. Torczon, F. Berman, A. Chien, H. Dail, and O. Sievert, D. Angulo, I. Foster, R. Aydt, D. Reed, D. Gannon, L. Johnsson, C. Kesselman, J. Dongarra, S. Vadhiyar, and R. Wolski

Is OpenMP for Grids?
R. Eigenmann, J. Hoeflinger, R. Kuhn, D. Padua, A. Basumallik, S. Min, and J. Zhu

SmartApps: An Application Centric Approach to High Performance Computing: Compiler-Assisted Software and Hardware Support for Reduction Operations
F. Dang, M. Garzarán, M. Prvulovic, Y. Zhang, A. Jula, H. Yu, N. Amato, L. Rauchwerger, and J. Torrellas

Model-Based Control of Adaptive Applications: An Overview
V. Adve, A. Akinsanmi, J. Browne, D. Buaklee, G. Deng, V. Lam, T. Morgan, J. Rice, G. Rodin, P. Teller, G. Tracy, M. Vernon, and S. Wright

Overview: An Integrated Framework for Performance Engineering and Resource-Aware Compilation
W. Sanders, C. Polychronopoulos, T. Huang, T. Courtney, D. Daly, D. Deavours, and S. Derisavi

S^4W: Globally Optimized Design of Wireless Communications Systems
A. Verstak, J. He, L. Watson, N. Ramakrishnan, C. Shaffer, T. Rappaport, C. Anderson, K. Bae, J. Jiang, and W. Tranter

Addressing Fundamental Bottlenecks in Link-Time and Dynamic Optimization
C. Lattner, S. Shekhar, A. Shukla, and V. Adve

Concept-Based Component Libraries and Optimizing Compilers
S. Schupp, D. Gregor, B. Osman, D. Musser, J. Siek, L. Lee, and A. Lumsdaine

A Parallel-Object Programming Model for PetaFLOPS Machines and Blue Gene/Cyclops
G. Zheng, A. Singla, J. Unger, and L. Kalé

Next Generation System Software for Future High-End Computing Systems
G. Gao, K. Theobald, Z. Hu, H. Wu, J. Lu, K. Pingali, P. Stodghill, T. Sterling, R. Stevens, and M. Hereld

Pragma: An Infrastructure for Runtime Management of Grid Applications
M. Parashar and S. Hariri

Designing Energy-Efficient Software
A. Sivasubramaniam, M. Kandemir, N. Vijaykrishnan, and M. Irwin

Multi-Level Modeling of Software on Hardware in Concurrent Computation
J. Paul, A. Suppé, H. Adams, and D. Thomas