2015 ECI Runtime Systems Workshop

Dates: March 11 - 13, 2015
Location: Rockville Hilton, Rockville, MD

This workshop will establish the foundations of a future research program on runtime systems extreme scale computers. This planned forum will be the second in a series of Exascale Computing Initiative (ECI) workshops, that will determine the research agenda and eventual deployment plans for the ECI software environment. This is a joint ASC and ASCR sponsored workshop.

Early investigations of runtime system software having been conducted by multiple institutions and teams under the previous DARPA UHPC Program, the DOE ASCR X-STACK Program, NNSA ASC projects and several other federally funded efforts.

These runtime systems programs explored various approaches to express, manage and automate various aspects of parallelism, locality, communication, and scheduling. The research efforts included dynamic and adaptive methods for managing complexity and enabling more opportunities for exploiting parallelism.

There is sufficient experience and insight available to develop a research agenda for extreme scale computers. A community forum is needed at this time to establish the key concepts, metrics, requirements, and strategies to be pursued under a new in-depth ECI-chartered program of sufficient duration and funding to ensure the delivery of multiple high quality, comprehensive, usable, and robust runtime system software packages.

Workshop Goals

The goal of this workshop is to establish the foundations of a future research program in extreme scale runtime systems, including determining the characteristics of future runtime systems and a plan that could eventually result in high quality runtime system software packages.

Future runtime system software must achieve significant improvements in efficiency and scalability in the context of user productivity, performance portability, and operational uncertainty due to asynchrony. There is the potential to enable a new generation of dynamic adaptive resource management and task scheduling mechanisms for dramatic improvements in extreme scale computations.

Toward this goal, the objectives of this workshop are to:

1. Propose, discuss, and determine the required characteristics of future extreme scale runtime systems
2. Identify research questions that need to be resolved within the context of current experience and knowledge,
3. Devise metric, measures, benchmarks, and means for testing and evaluation for prototypes of runtime systems,
4. Discuss a research and development roadmap that will result in one or more high quality runtime system software packages that could be deployed in the 2023 timeframe, on extreme scale systems.

Discussion of previous research experiences is required to define the scope, goals and objectives, conceptual vision, technical strategies and potential program organization and plans for future runtime systems research projects.

Workshop Outcomes

1. **Research Agenda**

   Define the intended impact of a future runtime software program to the DOE mission-critical applications. Identify what are the primary research questions to be answered. Determine the success metrics. Define strategy for sustaining multiple concepts/approaches within the scope of an overall vision.

2. **Driving Applications and Workflows**

   Define a set of specific workflows that is both challenged by today's limited methods and exhibits the necessary time-varying operational properties (e.g., irregular, multi-scalar, multi-physics, dynamic), including storage and network data access patterns (steaming, block, random packets) that will be used to determine new runtime system characteristics.

3. **Interrelationships of Runtime with OS and Programming Interfaces/Models**

   Establish the basic requirements of future runtime systems in terms of their relationships with the underlying hardware-oriented operating system and separately with the programming interfaces and compilation strategies. Explore the nature of programming models that will employ runtime systems for management of dynamic adaptive execution to guide co-design of programming and runtime methods.

4. **Metrics of Evaluation, Optimization, and Comparative Analysis**

   Define rigorous means and metrics that are required to assess progress of future runtime systems towards goals and performance sensitivities to parameters. Describe performance models to be employed.

5. **Time-line of program accomplishments and decision points**

   A straw-man example of what an effective research agenda would look like in terms of accomplishments, useful intermediate research results and demonstration development, and application advances through increased scaling and efficiency.