International Exascale Software Project (IESP):

Over the last twenty years, the open source community has increasingly provided the software stacks at the heart of the world's HPC systems. The community has invested millions of dollars and years of effort to build key components from low-level performance counter interfaces like PAPI to the Linux operating system, GNU tools, MPI, math libraries such as PLASMA and PETSc, and new languages like CoArray FORTRAN, UPC, and Fortress. However, while this investment is tremendously valuable, and at the core of all petascale machines, it is poorly coordinated, planned, and often missing key integration technologies. While open source development within a single project, such as MPICH, can be coordinated by a repository gatekeeper and a mailing list discussion, the community has no mechanism for identifying key holes in the software environment, integration areas, or coordination. With the explosion of multicore parallelism and new hardware models and features, such as transactional memory, speculative execution, and GPGPUs, this completely uncoordinated development model will not provided the needed software to support peta/exascale computation on millions of cores. We believe the community must work together to prepare for the challenges of exascale computing and ultimately link together into an International Exascale Software Project.

The plan to create an International Exascale Software Project (IESP) is critically important to the HPC community. The mission should be to provide peta/exascale architectures the highest quality computational environment in support of scientific discovery. To achieve this mission, we plan to build an international partnership that joins industry, the HPC community (CS and Apps), and production HPC facilities to design, coordinate, and integrate software for leadership-class machines. This can be accomplished with a proactive and comprehensive program to assess the short-term, medium-term and long-term needs of applications for peta/exascale systems and to foster development activities that take the best technologies from the research communities into usable, production-quality usable software for developers. Specifically, engagement in the following activities should be started:

- Build international collaborations in the areas of high-performance computing software and applications.
- Development of open source systems software, I/O, data management, visualization, and libraries of all forms targeting tera/peta/exascale computing platforms,
- Research and development of new programming models and tools addressing extreme scale, multicore, heterogeneity and performance,
- Cooperation in large-scale systems deployments for attaching global challenges,
- Joint programs in education and training for the next generation of computational scientists.

- Vendor engagement to coordinate how to deal with scale

The IESP should fall into three major phases: first, building an executive committee, consensus, and planning; second, the focus is on developing early successes; and third in the later years, when new capabilities will be added to make scalable application development easier and more effective.

First Two Years

To have maximum short-term impact, would be seeded to two groups: (1) computer and computational scientists, who can develop their prototype tools and libraries to a level of maturity that would make them easy to partner with vendors and HPC facility staff for further development and integration; and (2) application scientists working on critical applications, who would be funded to explore and adopt new scalable programming models and tools without which the applications cannot achieve peta/exascale performance.

Future Years

In a process beginning in the first two years, the IESP needs to develop a longer-term plan for the inclusion of software capabilities needed over the long term lifetime of the project. This plan may include activities to foster research and development needed to deliver important future capabilities. The goal of this activity will be to reach beyond the nearest milestones to provide new capabilities that can make leading edge systems more broadly usable in the future.