Project Summary
Next-Generation Servers for Optimization as an Internet Resource

Large-scale optimization has been a subject of investigation for over 50 years, but the challenge of making it useful in practice has continued to the present day. Initially the greatest difficulties were posed by solution *computation* and model *representation,* but the primary impediment to broader use of optimization models and methods today is one of *communication.* Increasing numbers of optimization "solvers" are implemented increasingly well, but prospective users are unaware of them or do not see the potential benefit that would justify obtaining and installing them. Modeling systems tend to be slow to support new solvers, moreover, especially ones that address new problem types.

The ability to send optimization problems over the Internet, for submission to a solver at some remote site, is now providing an increasingly practical way of addressing communication problems in large-scale optimization. A remote optimization "server" can accommodate numerous problem types and can provide varied solvers for problems of each type, giving modelers much more of a choice than they could hope to have locally. Previous work under the auspices of the Optimization Technology Center of Northwestern University and Argonne National Laboratory studied and experimented with the concept of an optimization server through the creation of the NEOS Server, which makes nearly 50 solvers available through a broad variety of network interfaces. Still, the current NEOS Server only begins to address the communication difficulties of large-scale optimization with respect to solver choice, scheduling, benchmarking, and connection to modeling languages. Because the Server has evolved along with the Web and the Internet, moreover, it is limited to some degree by early design decisions.

Intellectual merit. The planned research is motivated by a vision of a next-generation NEOS Server that addresses outstanding challenges of communication in large-scale optimization. This work will address design as well as implementation issues posed by standardizing problem representations, automating problem analysis and solver choice, working with new web-service standards, scheduling computational resources, benchmarking solvers, and verification of results — all in the context of the special requirements of large-scale computational optimization.

Research in these areas is timely, being motivated by new standards for web services and by the recent success of the NEOS Server itself, and will build on the considerable expertise in optimization servers already available at the Optimization Technology Center.

Broader impact. The NEOS project has been a major activity of the Optimization Technology Center since the Center's founding in 1994. Its continuing goal is to make optimization a part of the worldwide software infrastructure that supports science and commerce. To this end, the NEOS Guide (`www.mcs.anl.gov/otc/Guide`) includes on-line examples of optimization problems, listings of test problem collections, and surveys of publications and software. The complementary NEOS Server (`www-neos.mcs.anl.gov`) provides remote access to solvers and hence is the focus of the proposed research.

The ready availability of optimization tools has widespread benefits, both directly to practitioners, and indirectly by improving the quality of research and education in optimization techniques. Excerpts of comments from a wide variety of users testify to the NEOS Server's value in helping potential users of all kinds. The Server's variety of solvers and interfaces also tend to ensure that it is addressing a broad base of needs.