

scientific applications is of significant importance.

These challenges will be addressed through an integrated program that emphasizes fundamental research and experimental network engineering activities designed to demonstrate the capabilities of ultra high-speed networks under realistic high-end computing scenarios for accelerated scientific discoveries. The integrated experimental network pilots will be supported under the SciDAC program while the fundamental networking research and development will be supported under the MICS program. More information on DOE networking requirements for distributed high-end application can be found in the following workshop reports:

(1) DOE Science Networking Challenges Workshop: Roadmap to 2008: <http://www.es.net/hypertext/welcome/pr/Roadmap/index.html>,

(2) Office of Science High-Performance Networking Planning Workshop, http://doecollaboratory.pnl.gov/meetings/hpnpw/finalreprot/high-impact_science.pdf,

(3) Ultra High-Speed Transport Protocols and Network Provisioning Workshop: <http://www.csm.ornl.gov/gHPN/wk2003>.

A. SciDAC Program: Integrated Experimental Ultra High-Speed Networks

Background

Beyond the scientific computing and computational science research embedded in DOE research programs, SC invests in a portfolio of coordinated research efforts directed at exploiting the emerging capabilities of terascale and petascale computing under the collective title of Scientific Discovery through Advanced Computing (SciDAC). The research projects in the SciDAC portfolio respond to the extraordinary difficulties of realizing sustained peak performance for those scientific applications that require terascale and petascale capabilities to accomplish their research goals. In recognition of these difficulties, the SciDAC research projects are collaborative efforts involving teams of physical scientists, mathematicians, computer scientists, and computational scientists working on major software and algorithm development for problems in the core research programs of SC. Research funded in the SciDAC portfolio must address the interdisciplinary problems inherent in ultra-scale computing, problems that cannot be addressed by a single

investigator or small group of investigators.

This element high performance networks, focuses on using the science applications in the SciDAC portfolio to test and validate the capabilities of ultra high-speed networks. This effort is designed to determine and demonstrate how ultra high-speed networks, high performance middleware, and high-end science applications can be seamlessly integrated to build a new generation network environment for accelerating scientific discoveries. All grant applications submitted under this element must have three distinct but integrated components: the DOE Science UltraNet test and/or the Energy Science Network (ESnet), a set of distributed high-end science SciDAC application prototypes, and a suite of high-performance middleware tools and services to efficiently couple the high-end science applications to the underlying network. In addition, projects in this effort must satisfy the following requirements:

- It must address ultra high-speed network capabilities and at least one or more science applications of national and international significance related to DOE's mission, and must have a high visibility.

- It must involve a distributed high-impact science applications, preferably previously funded SciDAC science applications. A complete description of the SciDAC program at: <http://www.osti.gov/scidac/>.

- High-performance middleware or grid technologies must be employed to couple the selected applications to the underlying high-speed network infrastructures.

- It is expected that projects must use the DOE Science UltraNet Testbed or segment of high-performance networks, such as ESnet with comparable capabilities. Detailed information on the DOE Science UltraNet testbed can be obtained at: <http://www.csm.ornl.gov/ultranet>, and that of ESnet at: <http://www.es.net>.

Specific network capabilities to be demonstrated in these experimental network pilot projects may include but are not limited to the following:

- Petabyte-scale data distribution engineering—ultra high-speed data transfers over very long distances using enhanced TCP and non-TCP protocols, SANs over wide-area networks, network data caching, and dynamic network provisioning network technology for on-demand data transfers, etc. This effort must include appropriate high-impact science applications areas with significant needs for very high-speed data transfers.

- Network monitoring infrastructure—a collection of scalable network monitoring platforms, strategically located at impact science sites and in peering points. This infrastructure must enable national and international researchers to monitor the end-end performance of networks, diagnose faults, and predict network performance at various layers of abstraction including the application layer. The target network environment for this infrastructure should be the DOE UltraNet testbed and/or a segment of the Energy Sciences Network (ESnet) which operates 10 Gbps and above.

- Cyber Security Infrastructure for open science Communities—a comprehensive cyber security infrastructure for a community of scientists that will enable them to collaborate and share distributed resources securely. The target science community must have well-defined shared resources and a collection of appropriate middleware services and policies to share them.

It is recommended that target science applications and tools selected for the above project be selected from current SciDAC projects or projects that are consistent with its vision. A complete list of funded SciDAC projects can be found at: <http://www.osti.gov/scidac/projects>.

B. MICS—Base Program: Ultra High-Speed Network Engineering

The MICS aspect of this solicitation deals with research and development of ultra high-speed network technologies on a longer time horizon. It focuses primarily on deployable network transport protocols, advanced end-to-end network services, network-aware middleware, and end-to-end dynamics provisioning technologies, all of which must operate efficiently at ultra high-speed (10 Gbps and beyond). The specific technologies of current interest include but are not limited to the following:

- Ultra high-speed transport protocols scalable transport protocol—stacks that deliver and sustain multi-Gigabits/second to high-end applications efficiently on dedicated or shared single/multiple ultra high-speed channels. Such protocols could involve the extension of the existing TCP stacks or radical new non-TCP/IP approaches that could interoperate with existing network infrastructures.

- Dynamic provisioning technologies—agile network technologies to provide on-demand optical channels, wavelength scheduling, wavelength sharing, coarse-grain QOS to diverse science