

## Large Scale Networking (LSN)

**LSN Agencies: NSF, NIH, DOE/SC, DARPA, NSA, NASA, AHRQ, NIST, OSD, NOAA, DOE/NNSA**  
**Other Participants: DHS, FCC, USGS**

LSN members coordinate Federal agency high-performance networking R&D in leading-edge networking technologies, services, and enhanced performance including programs in advanced network components, optical network testbeds, security, infrastructure, and middleware; grid and collaboration networking tools and services; and engineering, management, and use of large-scale networks for scientific and applications R&D.

### President's 2006 Request

#### *Strategic Priorities Underlying This Request*

- By 2008, science cooperation and model development in high-energy physics, bioinformatics, weather, astrophysics, and other areas will require near-real-time petabyte and above data transfers. Current technology and the Internet Protocol (IP) will not scale to this level. This need is addressed by 2006 LSN coordination on optical networking testbeds to develop the generalized multi-protocol label switching (GMPLS) protocol, interdomain resource reservation and management, and optical networking protocols and switches.
- Secure interdomain cooperation and collaboration is hindered by lack of a scalable authentication, authorization, and accounting protocol (AAA). In 2006, the LSN agencies will cooperatively develop an AAA interagency testbed with the aim of later expanding the AAA protocols to larger-scale networks. They are also developing security best practices and new technologies such as automated intrusion response.
- Optimizing application performance over networks is severely constrained by lack of visibility into the interior of networks. Joint Engineering Team (JET) members are coordinating implementation of standard measurement boxes and standard protocols allowing end-to-end tuning of application performance.

#### *Highlights of Request*

Promote development and coordination of Optical Networking Testbeds (ONTs): NSF's CHEETAH and DRAGON networks, DOE/SC's UltraScience Net, and coordination with OMNInet, NationalLambda Rail, and regional ONTs. These testbeds are developing GMPLS, agile circuit-switching, and interdomain control plane tools, services, and management (e.g., resource reservation, security). Collaborative activities include:

- **All:** Coordination of network backup during times of stress, outage, or national emergency
- **All:** Coordination on OMB's call for cybersecurity implementation
- **DOE/SC, NSF:** End-to-end agile networking
- **DOE/SC, NSF:** High speed transport protocol
- **DOE/SC, NSF, others:** End-to-end QoS/GMPLS
- **DARPA, NSA, NSF, OSD:** End-to-end network performance measurement
- **DARPA, NSF, FCC:** Programmable wireless networking (ProWin) and networking of sensor systems (NOSS)
- **DHS, DOE/SC, NSF, OSD:** Network security research

#### *Planning and Coordination Supporting Request*

- **Co-funding:** NSF networking research projects (e.g., cyber security, fundamental network research) receive support from DARPA, DHS, DOE/SC, and NSA
- **Workshops:** Follow-up meeting on 2004 JET Roadmap Workshop co-sponsored by DOE/SC, NSF to plan joint activities; LSN ONT Workshop, August 2004 to plan 2005-06 activities; 2005 NSF Cybersecurity Follow-on Workshop; DOE/SC National Collaboratories Workshop to plan 2005-06 programs
- **Coordination by LSN Teams:**
  - **Joint Engineering Team (JET):** DOE/SC, NASA, NIH, NIST, NOAA, NSA, NSF, OSD, USGS, with national labs, universities, and vendors (ANL, ARSC, CAIDA, Cisco, CSC, FIU, Internet2, ISI, IU, Juniper, MAX, NLANR, Qwest, StarLight, UIC, Umd, UNC, UW) – ONTs; engineering research networks (JETnets); security best practices; applications testbeds (IPv6, IPv6 multicast, performance measurement); metrics and monitoring: interdomain, end-to-end, internal network visibility;

- recommendations: 9,000-byte MTU; international coordination
- **Middleware and Grid Infrastructure Coordination (MAGIC) Team: DOE/SC, NIH, NIST, NOAA, NSF, with national labs, universities, and vendors (ANL, Boeing, Cisco, Educause, Fairfield Technology, HP, IBM, Internet2, ISI, LANL, Level3, LBL, Microsoft, PNL, UCAR, UIUC, Umd, UWisc)** – middleware and Grid tools and services; collaboration infrastructure; applications; security, privacy (coordinate certificate authorities); standards development; international coordination
- **Networking Research Team (NRT): DARPA, DOE/SC, NASA, NIST, NSA, NSF** – basic research (technology and systems); prototyping/testing optical networks (dynamic provisioning, GMPLS-based control plane); applications; wireless, nomadic networking (ad hoc, mobile); education and training
- **Information exchange:** Multiagency LSN program manager participation in review panels, informational meetings, principal investigator (PI) meetings; monthly LSN, JET, MAGIC, and NRT meetings; tactical coordination among program managers with common interests; DOE ESSC meetings coordinated with Internet2 Joint Techs Meetings; GMPLS working group coordinating development of inter-domain signaling in agile optical networks

### 2005 and 2006 Activities by Agency

**NSF:** Sponsorship at universities of fundamental networking research (architectures, fundamental design, control and management, innovative technologies, extensible networks, strategic research); networking of sensor systems (network programming, hardware/software, architecture, privacy/security, protocols, and algorithms); programmable wireless networks (dynamic spectrum management, topology discovery, robust/secure architecture, applications development, management); CAREER awards for networking research; network security (intrusion/attack detection and prevention, network forensics, critical systems protection, survivable designs and protocols); infrastructure development (create, test, and harden next-generation systems); optical networking testbeds (DRAGON, CHEETAH, applications development, security, GMPLS, interdomain services, bandwidth on demand)

**NIH:** Testbed projects to demonstrate QoS, security and medical data privacy, nomadic computing, network management, collaboratory infrastructure technology; Biomedical Informatics Research Network (BIRN)

**DOE/SC:** Middleware and network research (on-demand bandwidth, Grid security, transport protocols, control plane signaling [optical networking], guaranteed end-to-end bandwidth); and network testbeds (Grid3 currently operational); UltraScience Net (research and engineering prototype); QoS/MPLS Testbed (ESnet production network)

**DARPA:** Self-aware collective systems (resilient, scalable, self-diagnosing, self-healing collections of assets); cognitive networking (self-aware, self-managing networks)

**NSA:** Wired and wireless location-based services; optical routing and control; quantum communications and quantum key distribution; high-speed information security; pricing models in networking and information assurance

**NASA:** Space communications and networking (backbone networks and ad hoc networking, energy-efficient integrated communications/networking, data and link layer applications); networking for supercomputing support; projects in Grid computing and space communications end in 2005

**NIST:** Complex systems (Web service/global information systems, self-managing systems, wireless protocols for healthcare, IP telephony): trustworthy networking (cryptographic standards and applications, smart card security, quantum communications, next-generation protocol architecture, Internet infrastructure protection); networking for public safety: protocols for public safety communications, indoor localization

**OSD (HPCMPO):** IP end-to-end performance measurement, measurement tools, IPv6 pilots, network security (WAN firewalls and encryption), automated management, IPv6 multicast, and broadband access to Hawaii and Alaska

**NOAA:** Advanced networking infrastructure including distributed Web servers; computer and network security; applications (collaboratories, Grid computing, storm-scale simulations, wireless, remote operation)