Large Scale Networking (LSN)

NITRD Agencies: NSF, OSD and DoD Service research organizations, NIH, DARPA, DOE/SC, NSA, NASA, NIST, AHRQ, DOE/NNSA, NOAA
Other Participants: USGS

LSN members coordinate Federal agency networking R&D in leading-edge networking technologies, services, and enhanced performance, including programs in new network architectures, optical network testbeds, network security, infrastructure, middleware, end-to-end performance measurement, and advanced network components; grid and collaboration networking tools and services; and engineering, management, and use of large-scale networks for scientific and applications R&D. The results of this coordinated R&D, once deployed, can help assure that the next generation of the Internet will be scalable, trustworthy, and flexible.

President's 2008 Request

Strategic Priorities Underlying This Request
Large-scale data transfers: Enable near-real-time petabyte and above data transfers, by 2008, to support science cooperation and modeling in high-energy physics, bioinformatics, weather, astrophysics, and other areas, overcoming scalability limitations of current technology and the Internet Protocol (IP)
New architectures: Develop future Internet architectures that are flexible, trustworthy (secure, reliable, ensuring privacy), and able to support pervasive computing using wireless access and optical light paths, networked sensors, and innovative applications (e.g., applications on the fly and large-scale information dissemination)
End-to-end performance measurement: Develop visibility into the interior of networks to enable optimization of application performance over networks; implement standard measurement instrumentation, standard protocols, and cooperation across domain boundaries to allow end-to-end application performance tuning

Highlights of Request
Optical network testbeds (ONTs): Evaluate lessons learned from NSF's CHEETAH and DRAGON networks, DOE/SC's UltraScience Net; and coordination with OMNInet, OptiPuter, Internet2, NationalLambda Rail, and regional ONTs; develop the second generation of GMPLS, QoS, agile circuit-switching, and interdomain control plane protocols, tools, services, and management (e.g., resource reservation, security) – NSF, DARPA, DOE/SC, NASA
Innovative network architectures: Global Environment for Network Investigations (GENI) support of R&D for a large-scale experimental facility for new scalable, flexible, trustworthy, usable Internet architectures; develop facility concepts that allow researchers to encompass in their visions high-impact emerging technologies, such as quantum cryptography – NSF, with DARPA, DOE/SC, NASA, NIST, NSA
Network security research: Provide network security for R&D networks, applications, and infrastructure – NSF, OSD, DARPA, DOE/SC, NIST
End-to-end agile networking, QoS, GMPLS: Develop robust capability and technologies to provide on-demand networking and assured bandwidth for advanced networking applications – NSF, DARPA, DOE/SC, NASA, other agencies
Wireless and sensor networking: Advance capabilities for highly distributed, ubiquitous networking – NSF, DARPA, NIST, other agencies
Large-scale data flows: Develop InfiniBand and single-stream flows over WANs, high-speed data transport protocols – NSF, NRL, DOE/SC, NASA
IPv6 and cyber security implementation: Roll out IPv6 onto research networks and establish DNSSEC prototyping in research networks in response to OMB requirements – All
End-to-end network performance monitoring and measurement: Identify intrusions and bottlenecks and isolate faults – NSF, OSD (HPCMP), DARPA, DOE/SC, NSA, NASA
International coordination: Leverage investments in federated security regimes and optical networking transparency with international partners – NSF, DOE/SC

Planning and Coordination Supporting Request
Federal Plan for Advanced Networking Research and Development: Develop a vision and plan for coordinated, multiagency Federal networking R&D activities in networking architecture, technologies, services, and applications to promote U.S. leadership in next-generation networks – All LSN agencies

Co-funding: NSF networking research projects receive support from DARPA, DOE/SC, NSA

Workshops: Annual government/private sector ONT workshop to provide input into coordinated Federal activities for R&D and promote technology transfer; NSF GENI workshops to coordinate research on new architectures, experimental infrastructure, and control plane technology; academia/industry/government workshop to identify networking R&D needs – Multiple agencies

Coordination by LSN Teams:

– **Joint Engineering Team (JET): DOE/SC, NASA, NIH, NIST, NOAA, NSA, NSF, OSD (HPCMP), USGS, with participation by academic organizations (CAIDA, CENIC, Internet2, ISI, MAX, NLANR, StarLight), national labs (ANL), supercomputing centers (ARSC, MCNC, PSC), universities (FIU, IU, UIC, UMd, UNC, UW), and vendors** – 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; tool sharing and data exchange; 9,000-byte MTU recommendation; international coordination; transit and services cooperation

– **Middleware and Grid Infrastructure Coordination (MAGIC) Team: DOE/SC, NIH, NIST, NOAA, NSF, with participation by academic organizations (EDUCAUSE, Internet2, ISI, UCAR), national labs (ANL, LANL, LBNL, PNL), universities (UIUC, UMd, UNC, UWisc), and vendors** – Middleware and grid tools and services; applications; coordinated certificate authorities for security and privacy; collaboration infrastructure; standards development; international coordination (e.g., federated certificate authorities under Americas Policy Management Authority)

Information exchange: Multiagency LSN participation in review panels, informational meetings, principal investigator (PI) meetings; tactical coordination among program managers with common interests; coordination of JET meetings with DOE ESSC and Internet2 Joint Techs Meetings; GMPLS forum coordinating development of interdomain signaling in agile optical networks

Additional 2007 and 2008 Activities by Agency

NSF: University-based fundamental networking research in broad-area networking topics, including future Internet design, wireless networks, sensor networks, and infrastructure research (create, test, harden next-generation systems); middleware development and dissemination

OSD (HPCMP): IP end-to-end performance measurement, network monitoring tools, IPv6 pilots and IPv6 multicast, network security (IPsec, VPN portals, attack detection tools, filters, encryption), automated management, disaster recovery planning, research network high-speed access to Hawaii and Alaska

NIH: R&D on data and computational grids in support of biomedical research, including Biomedical Informatics Research Network (BIRN) and cancer Biomedical Informatics Grid (caBIG); focus on QoS, security, medical data privacy, network management, and collaboratory infrastructure technologies

DARPA: Network technologies that work in and adapt to extreme conditions; distributed networks leveraged for robust network access control; complex mobile RF networks for actionable situational awareness; and collective technology for dynamic teams of people, software agents, and robots

DOE/SC: Middleware and network research (security, data management, standards-based protocols, advanced reservation and scheduling); Open Science Grid (operational infrastructure for large-scale applications); UltraScience Net (research and engineering prototype); connectivity (ESnet, MANs, collaboration services, trust federations and authentication services)

NSA: Cognitive radio technology (architecture, spectrum management, mesh network testbed), delay-tolerant networking, and Internet performance measurement

NASA: Large-scale data transfers (near-real-time terabyte+ transfers, InfiniBand over WAN); end-to-end performance measurement, agile Lambda switching networking; and end-to-end IPv6 implementation

NIST: Quantum communications; Internet infrastructure protection (Domain Name Service, Internet routing); IPv6 standards and deployment; seamless mobility; modeling of complex systems; public safety communications

AHRQ: Support for networking in activities to improve health data standards and raise the quality and patient safety of hospital and ambulatory care services

DOE/NNSA: Applied research in advanced networking and distance computing

NOAA: Advanced networking infrastructure, including lambda-based networking, IPv6, distributed Web servers; computer and network security; applications (collaboration, grid computing, wireless, remote operation)