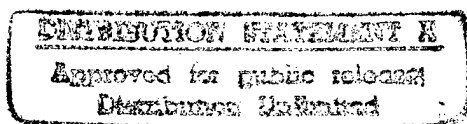


INTRANET APPLICATIONS
AT THE NATIONAL LIBRARY OF MEDICINE

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Summary

The recent launching of the NLM Intranet marks another milestone in NLM's advancing use of Internet technology for internal applications. NLM is participating in the Internet/Intranet revolution now sweeping government and corporate America and elsewhere around the world. Over the last year, NLM has upgraded its major web site, HyperDOC. More than a dozen NLM programs or offices now have their own publicly-accessible home pages. Also, several programs and offices have developed internal web sites for NLM staff use. These include the NLM Intranet, available to all NLM staff, and home pages of the Network Engineering Section and Public Services Division. The Office of Health Information Programs Development has developed a web site for its own use, and also participates in a web site for CENDI (an interagency committee of scientific and technical information agencies, of which NLM is a member).

These NLM web activities illustrate four different levels of Internet/Intranet applications:

- Level 1. Here, the home page is accessible for use by defined NLM staff (e.g., from a specific office, program, or project);
- Level 2: The home page is accessible for use by all NLM staff but not the general public;
- Level 3: The home page is accessible for use by defined (or all) NLM staff and specifically authorized outside persons (e.g., panelists advising a specific program or project); and
- Level 4: The home page is accessible for use by the general public.

Both NLM and NIH have established committees to coordinate web site development and to help assure reasonable consistency and quality among web sites.¹

Despite this progress, Intranet applications--at NLM and elsewhere--are still in the early stages. Organizational development and computer researchers believe that this

¹ The web document "NLM Home Page Responsibilities" details the responsibilities of the document submitter, document management team, system administrator, and editorial committee. The NIH Intranet includes "World Wide Web NIH Guidance" that covers permissible and inappropriate material, linkages, approvals, , security, and the like.

technology can help transform public and private institutions into so-called "continuously renewing" or "self-learning" organizations. For NLM and other government agencies, Intranet can help accomplish various internal communication, reinvention, and organizational development objectives.²

What Is Intranet?

Over the last year or so, the concept of an "Intranet" has moved from a new idea to a buzz word, and is now a hot topic in the computer software community. The term "Intranet" first appeared in the business and computer literature in 1995.³ At that time, Intranet was viewed as the application of Internet software and concepts inside organizations. Internet focused on the external connectivity of an organization, whereas Intranet focused on internal connectivity. The Intranet concept logically flowed from the dramatic increase in Internet use by academic, research, government, and business organizations over the last couple of years. The use of Internet browser software inside organizations allows easy access to a wide range of organizational information, in a variety of formats, and obviates the need for specialized software.

Intranet also can be viewed as an evolution in the use of earlier electronic information technologies (such as e-mail, electronic bulletin boards, and groupware) to share internal expertise and improve organizational and group communications and collaboration. The comparative benefits of groupware versus Intranet are still being debated, but many groupware vendors are now adapting their software to the Intranet.⁴

In 1995, various private companies and educational organizations experimented with Intranet applications. In 1996, Intranet has become big business. Netscape and

² Among other things, the NLM Intranet helps meet internal communication needs as identified by a 1995 NLM Task Force on Internal Communications.

³ See, e.g., Alison L. Sprout, "The Internet Inside Your Company," *Fortune*, Nov. 27, 1995, pp. 161-168; and Thomas A. Stewart, "Getting Real About Brainpower," *Fortune*, *ibid.*, pp. 201-203; Tom Davenport, "Use the Power of the Web," *Information Week*, Jan. 16, 1995. Companies cited as having Intranets at that time included: Sun, DEC, US West, Morgan Stanley, Turner Broadcasting, Cigna, and Hewlett-Packard.

⁴ See, e.g., David Kirkpatrick, "The Internet Saga Continues...IBM and Lotus: Not So Dumb After All," *Fortune*, July 8, 1996, pp. 63-70; Kathleen Gow, "Intranets vs. Notes," *Computerworld*, Feb. 5, 1996; Annmarie Timmins, "Web Moves In On Notes Turf," *Network World*, July 24, 1995; Karen Rodriguez, "Notes vs. The Web," *Interactive Age*, July 3, 1995.

Microsoft, among others, have identified Intranet as a major new market segment and have quickly developed sophisticated product development and marketing strategies.⁵

Over the last several months, Netscape has prepared or commissioned a series of white papers on Intranet and company-specific Intranet profiles. A recent white paper presents the complete "Netscape Intranet Vision and Product Roadmap" that includes:⁶

- information sharing and management, to easily create and publish documents online using hypertext, hyperlinks, multimedia, and the like;
- navigation, to find what you're looking for, instantly, whether internal or external information, reports, articles, and other materials;
- communication and collaboration, such as e-mail, groupware, address book, and phone book functions, among others;
- application access, with seamless access to databases, data warehouses, and legacy applications; and
- directory, security, replication, and management functions.

Microsoft has followed suit with its own Intranet white paper.⁷ The Microsoft Intranet strategy is intended to:⁸

- simplify internal information management and improve internal communications by applying page and link paradigms (navigation and search paradigms pioneered on the Internet make it easier to find, create, and analyze information);
- seamlessly integrate internal corporate networks with the Internet to enhance communication between a business and its customers and partners;
- integrate new products and Internet technologies with existing infrastructure and legacy systems to enable companies to leverage their technology investment and evolve information technology systems smoothly; and
- simplify applications development, deployment, and administration to help companies streamline development life-cycles.

Microsoft has identified numerous specific Intranet applications:⁹

⁵ For current Intranet news, see *The Intranet Journal*, available over the web at <http://www.brill.com/intranet/ijnews.html>.

⁶ Marc Andreessen and The Netscape Product Team, "The Netscape Intranet Vision and Product Roadmap," Netscape Communications Corporation, June 11, 1996, available at http://home.netscape.com/comprod/a...k/white_paper/intranet/vision.html.

⁷ "Microsoft's Intranet Strategy: White Paper," Microsoft Corporation, June 24, 1996, available at <http://www.microsoft.com/intranet/documents/msinswp/intranetTOC.htm>.

⁸ Ibid.

- *Published information*--corporate policies and procedures, customer and product information, human resources information and job listings, instructional materials, research materials and library system access, maps and directions, organizational structures and employee data;
- *Information supporting ad-hoc analysis*--corporate financial information, corporate templates, real time inventory and sales data, scheduling data, research data, sales data;
- *Workgroup collaboration and workflow*--budgeting process, bulletin boards, engineering design and manufacturing, group communications through e-mail, group scheduling including mobile workers, human resources processes, marketing plan, expense report process; and
- *Interactive business processes*--electronic commerce and order tracking, live links between business partner systems, customer support services, help desk services, manufacturing inventory system, selecting health benefits.

The commercial computer software companies see immediate market potential in the Intranet, as an organizing paradigm for the next generation of corporate information systems. The emerging consensus views the "Full Service Intranet" as including directory, e-mail, file, print, and network management services and embedded groupware functions such as calendaring, scheduling, conferencing, database access, task and workflow management, and the like.¹⁰ Improving the effectiveness and efficiency of business processes and streamlining business organizations are among the selling points.

The computer and academic research organizations go further. They now view the Intranet as an entryway into radically new forms of technology-enhanced organizational communications, structure, and process likely to be feasible within a few years to a decade. Intranet, in the view of Larry Smarr (National Center for Supercomputing Applications [NCSA]), is "likely to result in the radical transformation of university, research, and corporate organizations--including organizations like NIH."¹¹ For the next two years, NCSA is giving high priority to work on virtual research teams and institutes. The "Habanero" project is intended to go beyond Java and develop distributed, multimedia, computational resources needed to support Internet/Intranet-based "virtual" research teams. Habanero will upgrade the audio, video, and imaging capabilities of Java/HotJava to include full real-time multimedia collaboration.¹² These advances are

⁹ Ibid.

¹⁰ See, e.g., A.J. Vendeland, Vencorp International, Inc., current reviews dated Oct. 9 and 10, 1996.

¹¹ Larry Smarr, Director, National Center for Supercomputing Applications, University of Illinois at Urbana-Champaign, "Digital Libraries in a Scaleable America: Supercomputers, Java & Habanero," Joseph Leiter Lecture, National Library of Medicine, May 21, 1996.

¹² Java is a programming environment and language that permits the creation of applets that can be embedded in hypertext markup language (HTML) documents located on web sites. The applets can

expected to take organizational information technology several steps closer to the "Star Trek: The Next Generation" level by the turn of the century.

Why Intranet?

The coming Intranet revolution is not just market hype. It responds to a strongly felt need to find ways to transform public and private institutions alike into so-called "learning" or "continuously renewing" organizations. These are organizations with built-in flexibility and capacity to anticipate and respond to changes in the marketplace and larger business environment--whether the "business" is public or private, profit or nonprofit.

The learning organization, as defined by Peter Senge (of the MIT Sloan School of Management), is "an organization that is continually expanding its capacity to create its future. For such an organization, it is not enough merely to survive. 'Survival learning' or what is more often termed 'adaptive learning' is important--indeed it is necessary. But for a learning organization, 'adaptive learning' must be joined by 'generative learning,' learning that enhances our capacity to create."¹³ Intranet can help encourage individual, organizational, and team learning, the development of core competencies, and the building of shared visions of the future(s) an organization and its employees wish to create.

The continuously renewing organization is characterized by Dorothy Leonard-Barton (of the Harvard Business School) as having: "enthusiasm for knowledge...a love of learning is woven throughout the organization;" "drive to stay ahead in knowledge, to surf the waves of technological innovation;" "tight coupling of complementary skill sets...we need boundary spanners...but we also want to retain the separate skill sets to be linked;" "iteration in activities...developing core capabilities is more like growing a garden than like building a brick wall;" "higher-order learning...managers look for organizational metaroutines that will lead the company into the future;" and "leaders who listen and learn...these managers...embody...an enthusiasm for knowledge and an ambition to stay in the forefront, an appreciation of the iterative nature of their jobs, and significant personal skills in managing the interfaces."¹⁴ Again, an Intranet can assist in all of these areas.

John Kao, of the Harvard and Stanford Business Schools, has coined the term "cyberjamming" as the marriage of information technology and organizational creativity. Kao believes that technology can amplify knowledge and literally transform the ability of

include higher quality and complexity audio, video, and imaging than is possible with HTML. Java is a simple, object-oriented, architecture neutral, portable, dynamic language. HotJava is a WWW browser that can retrieve Java applets. See, e.g., Ed Tittel and Mark Gaither, *60 Minute Guide to Java* (Foster City, CA: IDG Books Worldwide, Inc., 1995).

¹³ Peter M. Senge, *The Fifth Discipline: The Art & Practice of The Learning Organization* (New York: Currency Doubleday, 1990), p. 14.

¹⁴ Dorothy Leonard-Barton, *Wellsprings of Knowledge: Building and Sustaining the Source of Innovation* (Boston: Harvard Business School Press, 1995), pp. 261-265.

organizations to develop and compete. "When we add information technology to the mix of creativity and knowledge," says Kao, "we get a particularly potent combination: capabilities to represent, deploy, and track knowledge coupled with technologies to promote collaboration across divergent disciplines and perspectives." "When properly managed," he concluded, "this combination results in creative combustion."¹⁵

Thus the true power of the Intranet concept lies in not just the technology per se but the linkage between the technology and what cutting-edge organizational researchers and practitioners believe to be the keys to institutional survival. In the private commercial sector, Intranet is taking off, with a little help from the software vendors. Netscape lists over 100 major corporations that are implementing full-scale Intranet solutions.¹⁶

In the federal government, Intranet is developing more slowly, but is likely to accelerate soon as the connections to government reinvention are better understood and the use of Internet and World Wide Web sites becomes almost universal among government agencies and programs. Federal initiatives to implement fundamental organizational change and renewal are typically included under the "reinvention" umbrella. Intranet can be properly viewed as an important new vehicle for achieving government reinvention objectives.

Current NLM Intranet Activities

In late 1995, when the Intranet concept first surfaced in the popular press, NLM did not have an Intranet per se. NLM did have an internal gopher server that provided a variety of organizational information for NLM employees. Over the last six months, NLM staff have initiated or participated in several relevant projects.

Upgrade of HyperDOC. The revised and expanded version of NLM's web site, released in March 1996 (and periodically updated), provides a wealth of information. The primary purpose of HyperDOC is to facilitate access to NLM information, databases, and other resources by the biomedical and health care communities and the general public. However, HyperDOC serves a secondary function in making this information more readily accessible to NLM staff as well.

HyperDOC provides periodically updated coverage of NLM news, services, databases, publications, research activities, and grants and contracts. HyperDOC includes information on all of the major NLM organizational units, and many units have their own home page that is linked to the NLM HyperDOC web site. The informational content of these home pages varies considerably, but over time is increasing.

¹⁵ John Kao, *Jamming: The Art and Discipline of Business Creativity* (New York: HarperBusiness, 1996).

¹⁶ Illustrative companies include: Amdahl, Apple, AT&T, Bank of America, Booz Allen and Hamilton, Disney, Houston Chronicle, Kaiser Permanente, Lockheed Martin, Mobil, New York Times, Playboy Enterprises, Shell Oil, Time Warner, Wells Fargo, and Weyerhaeuser.

The family of NLM home pages, with the applicable URLs, includes:

- HyperDoc--<http://www.nlm.nih.gov>;
- Division of Extramural Programs--http://www.nlm.nih.gov/about_nlm/organization/extramural/extramural.html;
- History of Medicine Division--
http://www.nlm.nih.gov/about_nlm/organization/library_operations/history_of_medicine/history_of_medicine.html;
- National Information Center for Health Services Research--
http://www.nlm.nih.gov/about_nlm/organization/library_operations/nichsr/nichsr.html;
- Audiovisual Program Development Branch--http://www.nlm.nih.gov/about_nlm/apdb/index.html;
- Cognitive Science Branch--<http://www.wcgsb.nlm.nih.gov/>;
- Communications Engineering Branch--<http://archive.nlm.nih.gov/>;
- Division of Specialized Information Services--<http://sis.nlm.nih.gov/>;
- HSTAT--<http://text.nlm.nih.gov/>;
- Internet Grateful Med--<http://igm.nlm.nih.gov/>;
- Lister Hill National Center for Biomedical Communications--
<http://lhc.nlm.nih.gov/>;
- MEDLARS Central Computer System--<http://medlars.nlm.nih.gov/>;
- National Center for Biotechnology Information--<http://www.ncbi.nlm.nih.gov/>;
- and
- Online Images from the History of Medicine--<http://www.woli.nlm.nih.gov/databases/olihmn/olihmn.html>.

HyperDOC provides navigational aids for key-word searching of the web site and for locating NLM staff by name, phone number, office location, and e-mail address. Most of the individual home pages also have key word search capability.

HyperDOC is now considered the primary source for NLM fact sheets and various other publications. As of June 1996, all new or revised fact sheets are reviewed and approved for inclusion in HyperDOC. The HyperDOC version is the copy of record.

In sum, HyperDOC and the family of NLM home pages/web sites can help NLM staff, as well as public users, keep up on overall NLM activities and/or locate specific information.

NLM Intranet. NLM recently announced an internal web site known as the NLM Intranet.¹⁷ This home page is intended to serve as an internal resource for NLM staff and, over time, "to become a comprehensive electronic collection of news briefs, reports,

¹⁷ Previously known as IntraWeb.

manuals, and other documents that can be used by staff.” The Intranet is accessible only from NLM staff computers.

The NLM Intranet is under development, and the webmaster is seeking suggestions on possible additions and improvements (via e-mail to wwwnlm@ccmail.nlm.nih.gov).

The NLM Intranet contents are periodically expanded and updated, and currently include:

- *News and Events*--NIH calendar of events, NLM holiday schedule, NLM exhibit schedule, meetings of interest to NLM staff;
- *Staff Services and Resources*--staff library, internal home pages (to be expanded), WWW services, work-related WWW sites of interest to staff (maintained by the Public Services Division), others to be added;
- *NLM's Electronic Filing Cabinet*--policies, reports and memos, NIH manuals, etc.; and
- *Staff Directories*--NLM, NIH, DHHS.

Network Engineering Section Internal Web Site. Since 1994, the Network Engineering Section of the Office of Computer and Communications Systems has been experimenting with its own internal web site. Beta testing resulted in many revisions to the graphics, page layout and design, style, and content of the site. On April 26, 1996, the site was pronounced ready for operational use within NLM.

The site includes many informational and interactive items:

- What's New;
- Requesting Support;
- GroupWise;
- Tips & Hints;
- Customer Services;
- FAQ (Frequently Asked Questions);
- Classes
- Security;
- News & Information;
- Vendor WWW (sites);
- Glossary (of computer and network terms);
- Network Services;
- Windows 95;
- Surfin' the 'Net;
- Who Are We (the Network Engineering Section);
- About This Server; and
- Comments.

This web site provides information and opportunities for NLM users to submit electronic requests for technical and engineering support. Specifically, users can request: new LAN connections, consultation, or support; LAN network outline installation, addition, or change; assistance with LAN problems; LAN services demonstration, training, or documentation; TCP/IP software; and Netscape Navigator software. The site now includes the GroupWise newsletter as well as a listing of training sessions.

Public Services Division Internal Web Site. NLM's Public Services Division (PSD) has an internal staff home page. At present, the home page includes a variety of fact sheets, policy statements, forms, and reports. Eventually, each of the division sections will have its own home page within the PSD web site.

The Technology Assistance Group of the PSD also maintains the "Welcome to Internet Starting Points" available to NLM staff via the NLM Intranet. This comprehensive listing includes Internet web sites in the following categories:

- What's New?--13 web sites;
- NLM Resources--11 sites;
- NIH Resources--8 sites;
- Internet Indexes and Guides--39 sites;
- Computer Vendor Resources--36 sites;
- Other Computer/Internet Resources--35 sites;
- Library Web Servers/Catalogs--17 sites;
- Other Library/Information Science Resources--43 sites;
- Electronic Journal and Virtual Reference Resources--20 sites;
- Government Resources--25 sites;
- Government Resources (Medicine/Health)--21 sites;
- Medicine/Science Organization Resources--27 sites;
- Other Medicine/Science Resources (subject lists)--46 sites;
- Patient/Consumer Health Information Resources--17 sites;
- Medicine/Science/Other Directories--9 sites;
- Internet MEDLINE sources--13 sites;
- Other Useful Resources--17 sites.

The PSD welcomes staff suggestions on additions to the list, but asks that staff review the sites first in order to assure well-informed input.

Office of Health Information Programs Development Internal Web Site. The OHIPD is constructing a web site that, when fully developed, will serve both Intranet and Internet purposes. This developmental site, accessible at present only by OHIPD staff, will have information on each major OHIPD activity areas, such as Planning and Analysis, International Programs, and Outreach. The site can be searched by key word.

The prototype International Programs home page, for example, includes the following:

- Background and Overview;
- Fact Sheet;
- IMPAG Meeting;
- Long Range Planning Panel on International Programs;
- For International Visitors to NLM
- Links to International MEDLARS Centers;
- International MEDLARS Agreements;
- Names and Addresses of MEDLARS Center Technical and Policy Representatives;
- Data on Centers, Online Use, Etc.; and
- International Program Meetings.

The prototype home page for the International Planning Panel includes:

- Panel Members;
- Ad Hoc Consultants;
- Panel Charge;
- Meeting Dates;
- Agenda for First Meeting;
- Briefing Book on the Web;
- Discussion Group for Panel Members; and
- eventually the panel draft report.

The OHIPD web development is evolving towards a four-level approach (mentioned at the outset of this paper) where access to some information would be limited to OHIPD staff (an Intranet function), some information would be accessible to all NLM staff but not outside users (also an Intranet function), some to authorized outside persons (e.g., panelists and consultants), and some information would be accessible to anyone interested (primarily an Internet function but secondarily Intranet).

CENDI Home Page. NLM is a founding member and active participant in an interagency cooperative organization known as CENDI. CENDI includes scientific and technical information (STI) managers from the Departments of Commerce (National Technical Information Service), Energy (Office of Science and Technical Information), Defense (Defense Technical Information Center, National Air Intelligence Center), Health and Human Services (NLM), and the Interior (National Biological Service), and the National Aeronautics and Space Administration.

The DTIC web site is sponsoring a CENDI home page (<http://www.dtic.mil/cendi>). This home page is designed to meet both Internet and Intranet objectives. The main home page is accessible to the general public and includes

information about CENDI's: mission and goals; principals, alternatives, and member agencies; characteristics; history; operations; technology interests and projects and looks to the future. The home page also includes more detailed information on agency programs plus general CENDI announcements and news.

Central to the CENDI mission is the close cooperation among federal agencies with major STI activities. It is important for CENDI agency representatives to exchange information and ideas, share resources, undertake joint projects, and collaboratively explore a range of policy, technical, and operational topics. Accordingly, on behalf of CENDI, DTIC has added Intranet capabilities to the CENDI home page.

The CENDI home page now includes two levels of interactive capability--the CENDI Forum, in which all staff from CENDI agencies are authorized to participate; and the CENDI Director's Forum, which is limited to the principals and alternates from each agency. Both of these forums are password-protected.

The CENDI forums serve as a "collaboratorium" in which participants can access and comment on various documents and draft materials. Each forum provides an easy way to post comments on the forum materials in a common area where anyone with the required password access can read (and further comment, if so desired). The online tutorial for the collaboratorium covers: Reading Articles and Responses; Comment Form; Question Form; Participants; Deleting Unwanted Topics; Downloading Articles; and When Things Go Wrong. The CENDI forums were announced in May; the forums were demonstrated to CENDI members at the October 16, 1996, CENDI meeting held at DTIC.