21 世纪

大学图书馆的新使命

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THEME I: Mission and Purpose of Academic Libraries in the 21st Century

NEXT GENERATION INTERNET
AND THE ACADEMIC LIBRARY'S ROLE
IN KNOWLEDGE SOCIETY

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It is indeed a great privilege to take part in this historical event, and I find the theme of this meeting, "New Mission of Academic Libraries in the 21st Century" so incredibly timely and significant.

This is a magic moment —— the 100th anniversary of this great university, which I remember, when I was very little, how I was at awe to hear just the name mentioned. But like all moments it will not last forever. We must make the most of it. This is why I stand before you and hope to explore together with you the exciting and changing time we are in, and how important it is for us to know what to do to prepare our academic libraries for the next century. If we can hold fast to our guiding principles on information access and provision, and know how to use the available technologies effectively, we can make this time of change a moment of dazzling opportunity for all academic librarians.

There is little historical precedent for the swift and dramatic growth of the Internet. In just a few short years, the Internet had evolved from a somewhat esoteric phenomenon to mainstream reality, and from what was a limited scientific communication network developed by the U.S. Government to facilitate cooperation among Federal researchers and the university research community, to a ubiquitous communication and information access tool across all levels of educational institutions, and a popular global open system, which has changed the way we work, we function, we learn, and we communicate. Knowing that many excellent papers at this conference are on academic library network developments via the Internet and innovative use of this generation Internet for better information access and service provision, I have chosen to speak more on the *Next Generation Internet* and the changing role of academic libraries in the digital knowledge society.

As a member of President Clinton's Advisory Committee on High Performance Computing and Communications, Information Technology, and Next Generation Internet, I have been enormously privileged to work with a group of high-power IT leaders on the committee and have kept more up-to-date with the US government's new direction in this area of developments. Let me share with you first a short 5 minute video called "*Advanced Networking: Connecting to the Future*".[1]

[Showing of *Advanced Networking: Connecting to the Future*]

Clearly we can begin to imagine what the future will hold for us for document delivery, for education, for home and schools, etc. We can begin to imagine the vision of the Next Generation Internet.

Next Generation Internet (NGI) Initiative
The NGI Vision

In the 21st century, the Internet will provide a powerful and versatile environment for business, education, culture, and entertainment. "Sight, sound, and even touch will be integrated through powerful computers, displays, and networks. People will use this environment to work, study, bank, shop, entertain, and visit with each other. Whether at the office, at home, or traveling, the environment and its interface will be largely the same. Security, reliability, and privacy will be built in. Customers will be able to choose among different levels of service at varying price points. Benefits of this dramatically different environment will include a more agile economy, improved health care —— particularly in rural areas, less stress on the ecosystem, easy access to life-long and distance learning, a greater choice of places to live and work, and more opportunities to participate in the community, the Nation, and the world"[2].

The NGI Goals

To make this vision possible, President Clinton and Vice President Gore announced on October 10, 1996 the Next Generation Internet (NGI) Initiative, which will accelerate the introduction of new networking services for our businesses, schools, and homes with the following specific goal[3]:

NGI's first goal is to research, develop and experiment with advanced network technologies that will provide dependability, diversity in classes of service, security, and real-time capability for such applications as wide-area distributed computing, teleoperation and remote control of experimental facilities. These activities focus on network growth engineering, end-to-end QoS, and security.

Accompanying the development of advanced network technologies is NGI's second goal, development of the next generation network fabric. This effort will overcome today's speed bumps slowing end-to-end usable connectivity caused by incompatibilities in switches, routers, local area networks, and workstations. Two thrusts within this goal are planned: First, construction of a high-performance distributed laboratory consisting of the 100 NGI sites at universities, Federal research institutions, and other research partners at speeds in excess of 100 times today's Internet. This laboratory will be large enough to provide a full-system, proof-of-concept tested for hardware, software, protocols, security, and network management required by the commercial NGI. Second, developments of ultra-high speed switching and transmission technologies and end-to-end network connectivity at more than one gigabit per second. Such networks will be high-risk, pioneering networks limited to 10 NGI sites at speeds 1000 times faster than today's Internet. The network fabric for NGI is vans for the moment.

These two goals —— experimental research of advanced network technologies and development of the next-generation network fabric —— will provide the basis for terabit per second networks operated by appropriate network management and control providing guaranteed end-to-end QoS.

Finally, Goal 3 to test the advanced capabilities of the first two goals. It will demonstrate a selected number of applications requiring these capabilities over the NGI network(s). Procedures have been established to ensure that selected applications provide robust, realistic complete tests of technologies that can be extended and adapted to other applications. Initial applications are being chosen from the federally focused applications in appropriate technology classes, such as digital libraries, remote operation of medicine, and crisis management[2].

Virtual environments (VEs) will also be developed. These are applications of potentially wide-spread utility in medicine, design, collaboration, and training that demand high bandwidth, low latency communications, and have the potential to exploit vast amounts of computational and storage capabilities. Through the use of virtual worlds tailored for specific educational or training tasks, VEs have the promise of fostering fast and effective learning ... In the academic environment, VEs can engage students and foster faster learning ... Virtual laboratory infrastructures can be easily applied to educational purposes, augmenting science education. Collaborative VEs are expected to help develop social and team communication skills that prepare students for an information-based society and work force.[3]

This multi-agency NGI initiative —— a solid partnership with industry, academia, government and the American public —— provides the catalyst for the development of high-performance, secure, reliable networks of the future and holds great future promises.

Internet2

The NGI initiative is closely related to Internet2, a collaborative effort by more than 100 U.S. research universities to create and sustain a leading edge network capability enabling the creation of the broadband applications, and education. While the goals of the NGI and Internet2 are complementary and interdependent, they are clearly distinct. The NGI initiative is a Federal mission-driven R&D program, while Internet2 focuses on innovation in academic research and education applications. The NGI initiative will create an experimental, wide area, scalable tested to develop mission-critical applications; Internet2 will meet end-to-end performance requirements by developing and deploying advanced network infrastructure. Much of the wide area tested for Internet2 will be provided by the NGI Initiative. Both the NGI initiative and the Internet2 project will develop and test advanced network technologies not supported by today's Internet, primarily through NGI-funded research at Internet2 universities. Continued strong coordination and communication between the Federal and academic communities will be crucial for the success of both programs. [2]

Digital Library Development

At the present time, we do not have a clear "theory" of digital libraries. The term, "digital library," has been used rather loosely. Although simple definitions have been given by many, they are generally not well defined. For example, Lesk called a "digital library" "a collection of information that is both digitized and organized" [4]. This can have so many different interpretations ranging from a digital collection of digitized books, journals, reports, or photo collections to something more complex ones in network-based collaborative knowledge environment. Yet, they all share some common characteristics —— i.e., a digital library can be searched, accessed all over the world, and copied without error. [4] In order to do this, a digital library must have digital CONTENT, and content must be properly stored, organized, so that it can be found or retrieved. This is why so many current "digital library" projects have been heavily involved in making the library collection digital or bringing together available digital files so that information can be accessed and shared via the network.

The "digital library" applications solicited for the NGI initiative will not be concentrating in the baseline efforts for scanning and digitization. Instead, as articulated by the National Science Foundation (NSF)'s Human Centered Systems (HuCS) program, effort will be made to supports university-led research in the development of advanced methods for collecting, storing, and

organizing information in digital form for network access; and advances in multi-agency supported basic research on multimodal interaction with computing systems, including speech, text, image, and multimedia advanced technology. As of today, NSF has already supported 6 major "digital library" projects and the FY 1998 NSF's HuCS R&D areas include the continuing development of knowledge repositories and information agents that sort, analyze, and present massive amount of multimedia and multi-source information; collaborators that provide access to knowledge repositories and facilitate knowledge sharing, group authorship, and control of remote instruments; systems that enable multi-modal human-system interaction including speech, touch, and gesture recognition and synthesis; and virtual reality environments and their use in scientific research, health care, manufacturing, and training [5].

Future Higher Education Institutions

With the potential of NGI, the notion of university campus will take on a very new meaning. We will see more geographically dispersed learning centers come to being, distant-learning and "one-to-one" interaction will be very viable means of education provision, university research will have more global collaboration, and educational services will follow and extend the medical center model. No wonder Peter Drucker and others have predicted that in thirty years the university as we know it will no longer exist. Yet some think that for the short run, however, the Internet will probably augment higher education more than it will transform it, because the Internet is still too new, too costly, and perhaps too threatening to bring about major change any time soon. They argue that regulation, bureaucracy, tradition, and turf will block its more revolutionary potential [6].

Regardless what, it is sure that the Internet will provide "better, faster, cheaper" additions to existing academic structures and traditions, as well as open the playing fields of higher education to private-sector firms, sometimes in cooperation and sometimes in competition with academic institutions [6]. Thus, for academic libraries of the future, the NGI's opportunities for convenient and timely knowledge update and access and for efficient transfer of knowledge are enormous. Undoubtedly, NGI will fundamentally and radically change the way which higher education faces new demands, and academy libraries provide aggressive information services.

Global Digital Library (GDI) and Universal Information Access

In recent years, we have passed several "information jumps" from speech to writing to printing, and now to wire and wireless communications. Now, this gigantic open system —— the Internet —— has offered tremendous opportunities to library professionals, but it also has many inherent problems, such as traffic congestion, the lack of bandwidth, quality of services, etc. As the NGI develops, current Internet problems will have been addressed and what lies ahead is a real jump for us toward universal information access. This means that technologically, anyone, anywhere, could talk, write, confer with, or send multimedia —— textual, audio, and visual —— digital information to anyone else in any part of the world! So, the concept of the digital "Global Library," which I have been advocating in the last decade, is not only conceptually sound but also technologically feasible now. Yet, we still need to pass many hurdles before we can reach this goal because there are still many barriers. Some of the major issues include [7-9]:

- System-centered issues:
  —— Scalability

—— Interoperability —— these issues include system, syntactic, semantic, linguistic, temporal interoperability, as well as integration of diversity of hardware and software.

—— adaptability and durability —— ability to deal with multimedia representation, dynamic information structuring, information identification, legacy systems, deployment of metadata, standards, provenance, etc.

—— support for collaboration

● Collection-centered issues —— structuring, indexing, and metadata provision for collection; gathering, validating, and authorizing data; security and integrity of collection; preservation of collection; etc.

● User-centered issues:

—— legal issues which arise with respect to copyright, intellectual property, privacy and confidentiality, personal and business equity, and security;

—— the differences in culture, especially as reflected in the means for communication;

—— generational gaps;

● developing multilingual, multiscriptural, and multicultural interfaces

—— etc

The Global Digital Library (GDI) Prototype

Currently with the easy and widespread use of the Internet and WWW, there are thousands and thousands of websites available in the cyberspace. In this big mess of digital ocean intermingled with multiple kinds of information —— commercial, entertainment, educational, and others —— there are repositories of digital libraries with knowledge-based contents. Yet, these repositories are certainly of very small minority, and thus precise and quick retrieval of them is not always easy since the current web-based retrieval capability is far from ideal. Even when it is retrievable, each site differs from the other in terms of contents, depth of knowledge presented, style of presentation and user interface. As a result, users are generally confused and perplexed. Thus, one of the key challenges is to develop a digital library structure which can provide a coherent, consistent view of as many of these repositories of the similar nature as possible, and yet, it is still possible to retain the diversity of each site which can be responsive to unique constituencies. The current GDL prototype is such an attempt, which links the repository information of various types of educational institutions —— such as national libraries, national archives, major museums, networks, and research/academic libraries —— together in one single global digital library system with a coherent and consistent interface. In a way, these digital knowledge bases have been filtered out from the big digital ocean, and are placed in a system for easy information access.

Figures 1 and 2 shows how Library of Congress' digital libraries can be easily accessed by entering the GDL system and click on the Library of Congress graphic icon (one of the three national libraries of the U.S.) Similarly, a user can access the digital library of Peking University by choosing China from Asia, and then click on the Peking University's graphic icon, as shown in Figures 3 and 4.

This exercise can show that the depth of contents for each major library in the world differs greatly from strictly directional type of homepage information to the substantial digital library collections such as those of the Library of Congress of the U.S.A. Thus, the need for major libraries to build digital knowledge-based contents is obvious.
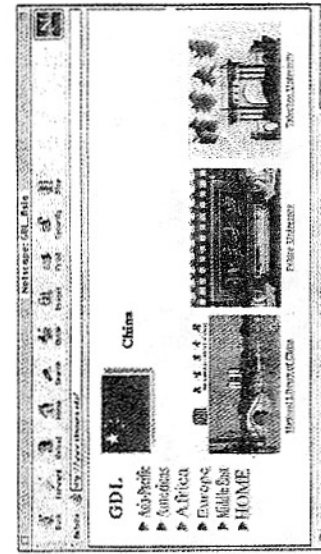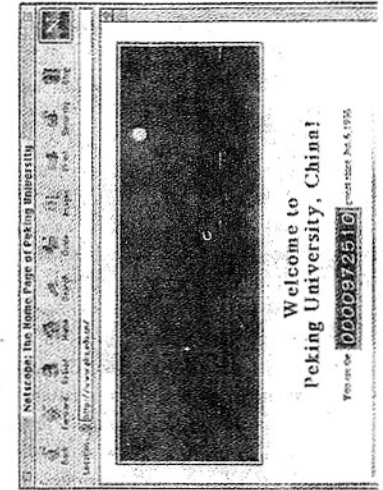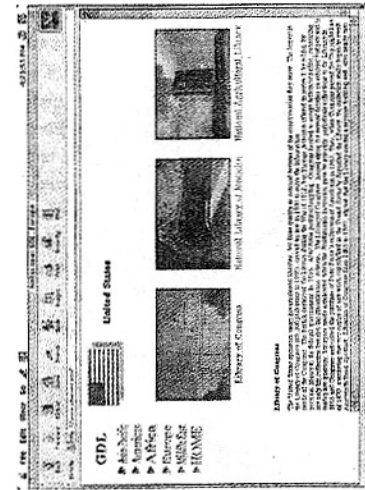

Fig. 3

Fig.4

Fig. 1

Fig. 2

Once the digital contents are available, the global information will practically be at an individual's fingertips, the educational process will be freed to focus on how to access and organize this information, rather than on the acquisition of "facts." Information technology will allow students and teachers, as well as domain experts, to author and publish their own educational materials. Multimedia technologies will yield applications with a whole range of new and more accessible functions, likely to have major impacts on education as well as entertainment. The emerging Information Infrastructure will deliver education content to school, to work, and to the home, for self-directed study, collaboration, and easy access to specific expertise. In conjunction with radical rethinking of the associated curricula, information technology can enable "just-in-time learning," providing critical information when the learner needs it [10].

Educational applications demand ease of use, interfaces that span a wide range of user sophistication, access to distributed collections of information and expertise, ease of authoring new materials, ease of indexing existing collections, (very) low cost network access and management capabilities that must scale, extensive use of sophisticated simulation, visualization, and virtual reality technologies to support training, and so on. They also demand privacy, security, protection of learning infrastructure, and intellectual property protection for authored materials and associated billing and payment systems. Educational applications provide a natural environment in which to test support mechanisms for collaborative problem solving by geographically dispersed students. They could make excellent use of networked, sensory immersing virtual environment[10].

Clearly the GDL can facilitate the transforming potential of "information access" and "information creation," can eliminate the barriers between users and information providers, can promote broad-based access, and can address critical public policy issues —— remember that the educational technology is considerably more than connectivity.

Conclusion

Despite of potential difficulties, barriers, and challenges, one thing is sure that the technologies and the infrastructure are in place now for us to experiment a universal global library. With this, the role of academic librarians for the 21st century will unquestionably change substantially. For the first time ever, lack of proper technology is no longer an obstacle. But, technology is not the end in itself rather the means to an end. We should not suffer from the loss of direction caused by preoccupation with ever-changing technology. As the academic librarians speculate on their work in the next millennium, what we must do is to make sure we can develop a vision for our library's future in this Internet-enabled society, and define its role in facing a new frontier.— But, the greater challenge for us is to understand the evolutionary path and the transitional strategies that will be necessary to guide us from where we are today to any Next Generation Internet-related vision of tomorrow [6].

"What makes this point in human history so interesting is that we are all —— people, organizations, and governments struggling with the vast changes in our processes and procedures that the Internet is bringing about, and will continue to bring about. The challenge is not to predict the end point of the change —— namely, what the Internet-enabled future will be —— but rather to better understand what we must do today and tomorrow, no matter what the Internet becomes or brings about. What people and institutions can do to cope with the changes the Internet will bring, however it emerges" [6]. This is a big order!

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