

Next Generation Internet: Implications for Libraries in Knowledge Society

Ching-chih Chen

Professor

Graduate School of Library and Information Science

Simmons College, Boston, MA 02115, USA*

Abstract

In the last decade, the incredibly fast-paced development in digital telecommunications technology has profoundly changed every aspect of our lives. The dramatic and fast increase in the volume of use of Internet, and the quick introduction of innovative Internet-related applications made us realize the urgent need for faster and broader bandwidth communications network. The Next Generation Internet (NGI) initiative proposed by the Clinton administration in October 1996 promised the development of the NGI which will be 100 to 1000 times faster than the fastest Internet of today. With this kind of fast and broadband network available at the beginning of a new millennium, NGI applications are beginning to surface, and surface fast.

This presentation will introduce briefly NGI and NGI applications in general, with specific discussion on the implications of NGI for libraries. Among those potential areas of relevancy to libraries, discussions will concentrate on the development of digital libraries. A vision of global collaborative knowledge-based environment with distributed digital library systems will also be articulated.

Introduction

I am delighted to be in Singapore again after several years of absence. I have loved my experience in the Southeast Asia, therefore when Ms. Julie S. Sabaratnam invited me; I accepted her gracious invitation with great appreciation. As many of you know, in 1989, I brought my second NIT conference (International Conference on New Information Technology) to Singapore with the help of Mr. Lim Hong-too and his staff then at the Nanyang University. In organizing that meeting, I visited Ms. Sabaratnam at the then National Computer Board. I am sure that both of us still vividly remember that pleasant first encounter more than a decade ago.

Since then, how time has passed and passed quickly! But, more dramatically, how technology has changed in this past decade! I recall vividly that in 1989, it was such a novice experience to many when I shared my experience in using interactive videodisc technology as illustrated by my product, *The First Emperor of China*. It was covered everywhere in the news media

* Invited paper presented at the CONSAL 2000, Singapore, 26-28 April 2000

when I talked about how the multimedia technology will change the way we seek, demand, and use information (Figure 1).



Figure 1. Some of the sample media coverage of the Emperor project

Since then, we have experienced a whole array of fast technological advances in multimedia, image, digital electronic publishing, communications, and speech technologies, to name just a few, and the potentials of these new technologies, if used intelligently, are indeed mind-boggling. As concluded in the Executive Summary of the *President's Information Technology Advisory Committee's (PITAC) Report to the President*, entitled *Information Technology Research: Investing in Our Future* (February 1999):

"Information Technology (IT) will be one of the key factors driving progress in the 21st century – it will transform the way we live, learn, work, and play. Advances in computing and communications technology will create a new infrastructure for business, scientific research, and social interaction. This expanding infrastructure will provide us the new tools for communicating throughout the world and for acquiring knowledge and insight from information..."

Today, most people in many countries have their options wide open in terms seeking and retrieving information. Printed sources are still used by very large percentage of world populations, but to those countries with good Internet access, we have seen the dramatic change in information seeking behaviors from those of the past. With the powerful global network available to many of us at considerably low and affordable cost, people have turned to Internet and World Wide Web for all types of information. Yes, the Internet has indeed changed the way we "deal with information" in very big ways. Thus, the theme of this conference, "Stepping into the New Millennium: Challenges for Librarians and Information Professionals" is indeed most timely. With the new trends, there are indeed major issues facing librarianship. If we know how to capitalize the exciting and challenging opportunities ahead of us, we can have a spectacular role in this digital and networked knowledge society. If not, we will have the danger of being sidelined and ignored. As I am talking about this, I cannot help to remember an early study of mine on citizen's information seeking. The study's results were reported as a baseline document for the first White House Conference on Library and Information Services in November 1979, and were the basis for the book, *Information Seeking*, by Chen and Hernon (1982), which has been used widely for information need studies. During that early period more than two decades ago, it was shocking to find that of

the citizens surveyed in six New England states, only 17% of them consulted library – in this case, we referred to public libraries -- in information seeking situations. Only 3% of the 17% mentioned library as the most “useful” information provider. That was the time when Internet and WWW were nowhere to be seen by general public. I cannot help wondering how library is compared now with Internet and WWW as viable and frequently used information sources?

I have been heavily involved in the use of new information technology for library and information related applications in the last three decades. Since February 1998, I have been greatly privileged to serve as a member PITAC, and have learned a great deal from the Committee’s deliberation where the information technologies are leading us to in the next decade. I am not coming here to paint a “gloomy” future of the libraries. Instead, I would like to share with you the excitement of a global collaborative vision with tremendous potential in this digital, distributed, networked and knowledge-centered environment. I 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 libraries for this new 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 librarians.

Internet, the Next Generation Internet (NGI), and IT*2

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. It has emerged 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 organizations for all types of users. It is such a dominating global open system, which has changed the way we work, we function, we learn, and we communicate (Chen, 1998). According to a US Commerce Department report, *The Emerging Digital Economy* (<http://www.ecommerce.gov/emerging.htm>), in the US alone, the IT industry employed 7.4 million workers by 1998, and currently there is a serious shortage of high-tech workers. While in 1994, there were a mere 3 million Internet and WWW users, it has grown to over 300 millions now, it will be more than one billion by the year 2005 (more detailed discussion on this aspect can be found in Chen, 1999). This similar phenomenon must also exist in Singapore and this part of the world. Because of this widespread use of the current Internet, it is not difficult to imagine that it has already reached its extreme capacity. Like a rubber band, it has been stretched to such an extent that it is very fragile. This is the impetus for the development of the Next Generation Internet (NGI).

Since we are all so very familiar with the use of current Internet, I have chosen to speak on the NGI and its implications for libraries.

In mid-March 1998, an exciting NETAMORPHOSIS took place in Washington DC offering a dazzling demonstration of the power and potential of the Next Generation Internet. Before I delve into this topic, please permit me to share with you a short 5-minute video called *Advanced Networking: Connecting to the Future* (March 1998). The video is already two

years old, so we have already begun to witness the delivery of some of the services articulated in the NGI vision.

a) *The NGI Initiatives* (Chen, 1999, p. 56)

On October 10, 1996, President Clinton announced a new “Next Generation Internet” (NGI) Initiative to keep America at the cutting-edge of Internet technology. The \$100 million initiative is a multi-agency effort has the following **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” (US NCO, 1998)

NGI has three specific goals:

- 1) Connecting about 100 government, academic, and industrial research labs, called NGI sites, with end-to-end performance of at least 100 times the speed of the current Internet, and connecting together about ten such sites with a network at least 1,000 times faster. The network fabric for NGI is vBNS for the moment.
- 2) Research and implementation of technologies to support advanced features such as quality of service and security, reliability, robustness, quality of service, etc., and
- 3) The demonstration of advanced applications based on these capabilities. Thus, the NGI will enable revolutionary new applications not only in high-end areas which can accelerate the pace of scientific discovery, but also in areas such as telemedicine, distance learning, digital libraries, etc.

This is a multi-agency initiative that seeks strong partnership with industry, academia, government and the American public. It provides the catalyst for the development of high-performance, secure, reliable networks of the future and holds great future promises.

One of the earliest assigned responsibilities of PITAC in 1998 was to review the implementation of the NGI Program according to the Next Generation Internet Research Act of 1998. The PITAC/NGI Review Sub-Committee completed its first report in April 1999, and the second review is in its finishing stage. As a member of this Sub-Committee, we have asked time and time again for justifications from all agencies. What are the applications that truly require NGI capabilities are frequent and major questions.

b) *The Internet2 Project*

The fast growing use of the Internet as described above, particularly for commercial purposes, has created such a congestion on the Internet that it is clear that Internet's earlier primary users, the academic and research communities can no longer use the current Internet for cutting-edge applications. In order to facilitate and coordinate the development, deployment, operation and technology transfer of advanced, network-based applications and network services; and to further American leadership in research and higher education; 34 research universities got together to start the Internet2 in October 1996. Since then, the Internet2 has grown to more than 150 universities and a host of private company sponsors like 3Com and MCI World Com at the present, with the mission to accelerate the availability of new services and applications on the Internet. Internet2's goals are:

- Enable a new generation of applications
- Recreate a leading edge research and education network capabilities
- Transfer new capabilities to the global production Internet.

Internet2 Backbone is the Abilene Network, which initially deployed a national backbone capable of operating at OC 48 (2.4GB per second) among gigaPoPs, with OC12 (622 Mb/s) or OC3 (155 Mb/s) connection from the Abilene backbone to university gigaPoP or to individual institutions. Even much faster speeds are expected now, with the backbone capacity to OC192 (9.6 Gb/s) and beyond (see <http://www.internet2.edu/abilene>).

This partnership of higher education, government and industry encourages collaborative effort to create the broadband applications, engineering, and network. Thus, it matches well with the Clinton Administration's Next Generation Internet (NGI) Initiative as described earlier. Naturally, since then, most of the wide area and broadband testbed research of NGI have been conducted by the Internet 2 universities, and thus have been funded by the NGI Initiative. It is clear that the NGI and Internet2 are closely related. Yet, 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.

Since 1996, we have seen this Internet2-NGI model has fast become a global model for network and broadband application developments among academic and research communities in many countries of the world.

c) *The IT*2 Initiative (see <http://www.ccic.gov/it2>)*

In addition to the NGI Initiative, in January 1999, the Clinton-Gore administration introduced another initiative known as IT*2 (Information Technology for the Twenty-First Century), in response to the warnings sounded in the preliminary report of PITAC in August 1998. This is a \$366 million dollars of new money for FY 2000 multi-agency federal information technology research and development initiative.

IT*2 supports three kinds of R&D activities:

- 1) Long-term IT research that will lead to fundamental advances in computing and communications, such like those federal government funded projects in the 1960s which has led to today's Internet
- 2) Advanced breakthrough technologies in advanced computing
- 3) Research on the economic and social implications of the Information Revolution, and efforts to help train additional IT workers at our universities.

Yes, the Internet has changed the way we work, we function, we learn, and we communicate. With initiatives like the NGI and IT*2, it is fair to expect that the NGI will continue to do so in even more dramatic ways.

NGI and Implications for Libraries

In the midst of this incredible technological revolution, clearly the trend is to demand for faster, wider global network for more accurate, reliable and secured transfer of large-scale, multi-formatted information. This means that many services and activities that were not possible to offer and carry out due to the lack of network speed and bandwidth can be effectively explored now. In the areas of library and information services, many fiction-like concepts become reachable, more realistic, or even operable now. For example, universal access to information from a borderless global digital library or virtual library with unlimited multimedia resources is a technical reality. This will, for sure, challenge our traditional thinking of collection development. Real-time knowledge acquisition and sharing with experts and remote learning via networked distance education program are being experimented in many parts of the world. Here in Singapore, the National University of Singapore is participating in a multi-million global education project of the Massachusetts Institute of Technology with substantial funding from Microsoft. When a course is being taught at MIT in the evening, it can draw students from the National University of Singapore, some 12 time zones away. If this is the future of distance education, then how are the remote students' information needs be met? This is a good question for academic librarians.

Take the National Library of Medicine (NLM) for another example. In 1998, NLM announced a new, three-phased NGI research program to develop innovative medical projects that demonstrate the application and use of NGI capabilities. These include:

- Quality of service
- Medical data privacy and security
- Nomadic computing
- Network management
- Infrastructure technology for scientific collaboration

Summary of the NLM's Phase-1 NGI projects were available in December 1999. Among the areas covered, the following should give a glimpse on those of potential relevancy to library and information professionals:

- Biomedical Tele-Immersion
- Connectivity, Security, and Performance of an NGI Testbed for Medical Imaging Applications

- Internet Protocol Video Telemedicine and Patient Cardiology Education
- PathMaster: A Web-Accessible Cell Image Database Indexed by Mathematical Descriptors and Supported by Parallel Computation
- Remote, Real-time Simulation for Teaching Human Anatomy and Surgery
- Human Embryology Digital Library and Collaborator Support Tools
- Next Generation Internet (NGI) Implementation to Serve Visible Human
- Networked 3D Virtual Human Anatomy
- Etc.

Clearly, projects related to large-scale digital libraries, high-resolution image databases, networked multimedia knowledge base, intelligent indexing and retrieval, distant education and learning, and the like will have great and direct impact on the way we do our business in libraries and information centers.

It is impossible for me to cover all these topics, I shall choose “digital library” to elaborate slightly on, since it is one of the hottest topics among library circles. Considerable more information can be found in *IT and Global Digital Library Development* edited by Chen (1999).

Digital Library Development

As just mentioned, “digital library” is one of the hottest topics in the library and information field. Many initiatives have been reported in literature (Chen, 1999). They vary greatly in scope, emphasis, and approaches. They range from library digitization and scanning projects at local, state, regional, national and institutional levels, to more formerly organized joint projects of large leading academic and research institutions, such as The Digital Library Federation in the US¹, which was formed by 15 research libraries and the Library of Congress. They range from the more down-to-earth projects to the ambitious national initiatives in R&D activities addressing some difficult problems and issues. Similar diversity of digital library development in other countries in the world can be found.

Regardless of the type of activities, there are many unsolved problems and issues related to digital library activities. These include:

- Definition (Lesk, 1997).
- Roles of digital libraries
- Technology related – infrastructure, quality of service, interoperability, scalability, sustainability, etc.
- Input method and standard – scanning, digitization, OCR
- Data representation
- Organization of digital resources – metadata, indexing,
- Access – indexing and retrieval
- Navigation and search

¹ **The Digital Library Federation** (DLF) was founded in 1995 "to establish the conditions for creating, maintaining, expanding, and preserving a distributed collection of digital materials accessible to scholars, students, and a wider public. The Federation is operating under the umbrella of the Council on Library and Information Resources.

- Content building, “collection management” and organization, preservation
- User interfaces and human-computer interaction
- Multi-lingual problems and issues
- Legal issues related to copyright, privacy, security, etc.
- Economic and social issues, such as information rich vs. information poor, digital divide, etc.
- Collaboration – regional, national and global

Because of the enormity of these unsolved problems and issues, we are far from a true “digital library” that is a challenging extension of today’s analog library. Today’s digital libraries, regardless what types, are poor shadows of the analog libraries in nearly every intellectual respect.

Aside from the typical concerns of librarians, such as those related to content and organization (metadata standards, etc...), other problems and issues will require vigorous interdisciplinary research and exploration. This is why projects such as the multi-agency Digital Libraries Initiatives coordinated by the US National Science Foundation (NSF) since 1995 deserve to have our attention. Currently, similar activities are ongoing in some countries in the world (see Chen, 1999).

US NSF’s Digital Libraries Initiative

Since 1995, several multi-agency initiatives on digital libraries, directed by the Computer and Information Science and Engineering (CISE) Directorate of the NSF have been initiated.

a) Digital Libraries: Phase 1 (DL-1)

The DL-1 is a joint four year \$24 million NSF/DAPA/NASA program begun in 1995 as an interagency program of research and application with the broad goal to advance the methods used to collect, store, organize, and use widely distributed knowledge resources that contain diverse types of information and content stored in a variety of electronic forms. Six projects were supported. They were:

Carnegie Mellon University: Digital Video Libraries

- speech, image and natural language technologies integration

University of Michigan: Intelligent Agent Architectures

- software agents; resource federation; artificial service market economies; educational impact

Stanford University: Uniform Access

- interoperability; protocols & standards; distributed object architectures; interface design for distributed information retrieval

University of California, Santa Barbara: Geographic Information Systems

- spatially-indexed data; content-based retrieval; image-compression; metadata

University of Illinois: Intelligent Search and the Net

- large-scale information retrieval across knowledge domains; semantic search; SGML; user/usage studies

University of California, Berkeley: Media Integration and Access

- new models of “documents”; natural language processing; content-based image retrieval; innovative interface design

b) *Digital Libraries: Phase 2 (DL-2)* <http://www.dli2.nsf.gov/>

The DL-2 is a continuation of the DL-1 program, but the sponsors have increased to include Library of Congress, National Library of Medicine, and National Endowment for the Humanities. These seek to provide leadership in research fundamental to the development of the **next generation** of digital libraries. They have been aiming to:

- Advance the use and usability of globally distributed, networked information resources,
- Encourage new innovative applications,
- Accelerate development, management and accessibility of digital content and collections, and
- Encourage the study of interactions between humans and digital libraries in various social and organizational contexts.

The difference between the emphases of the two programs can be best summarized in the following (Courtesy of Steve Griffin of NSF):

- Research – extend the broad, technology-centered research to new areas and dimension in the DL information lifecycle
- Testbeds – from technology research to that with added emphasis on interoperability and technology integration
- Content/collections – from samples to collection development and management
- Infrastructure – from limited testbed development to operational DLs with usable collections
- Context – from user evaluation to understanding DLs in domain, economic, social, and international context

c) *International Digital Library Project (IDLDP)*

With the changing scales and contexts of interaction and collaboration, NSFNet StarTap has extended its vBNS connections to many countries in the world as show in Figure 2. As we can see that Singapore is one of the few countries in this part of the world which has StarTap connection.

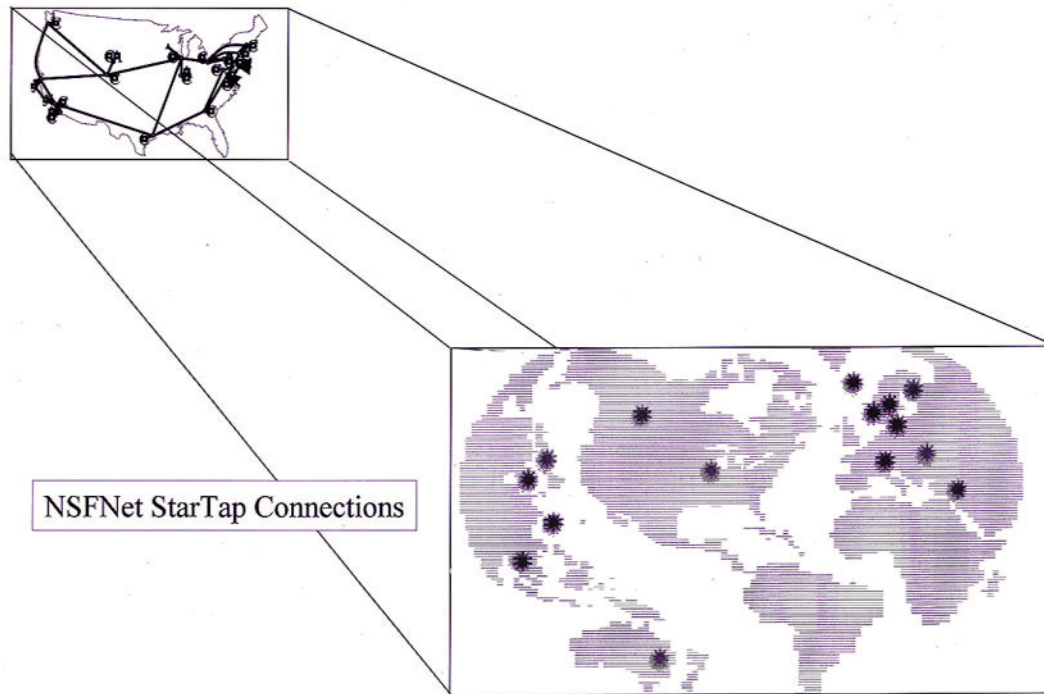


Figure 2. NSF's StarTap connections

In the digital library area, NSF introduced new International Digital Library Program (IDLP) in January 1999. IDLP is intended to contribute to the fundamental knowledge required to create information systems that can operate in multiple languages, formats, media, and social and organizational contexts. In order to operate in a global information environment, research is needed on:

- Interoperable technologies;
- technology for intellectual property protection in a global marketplace, and
- methods and standards for ensuring long-term interoperability among distributed and separately administered databases and knowledge bases.

It is hoped that cooperative research can help avoid duplication of effort, prevent the development of fragmented digital systems, and encourage productive interchange of knowledge and data around the world.

The FY 1999 competition data show that NSF with received more than 50 proposals over 30 countries involved. The formal Program with US/JISC already offered 6 awards for \$5 million over 3 years. The other competitions are still being processed. Clearly, this new IDLP will have significant impact on the advancement of global distributed digital library systems.

CMNet (Chinese Memory Net): US-Sino Collaborative Research Toward a Digital Library in Chinese Studies

I have been advocating the Global Digital Library (GDL) for over a decade, long before we knew the Internet as a common global network (Chen, 1999). The early vision for GDL was that when the high-speed global communications networks are available to connect the distributed “digital” multimedia knowledge bases in different parts of the world, then we can have the GDL with the richest resources on earth, unmatched by any large traditional libraries. Obviously today’s technology is making such connections possible, but problems and issues surrounding digital libraries are too numerous to make such GDL functional as a true digital library even though digital contents are available, which is not yet. To improve the current situation, we need more digital contents, we need more interactions and discussions on common problems, we need more collaborative research across national borders, and we need to share our expertise. Thus, the IDLP has a very significant role to play since it is intended to do just that. It encourages productive interchange of knowledge and data around the world, prevents the development of fragmented digital systems, and creates synergetic collaborative environment for digital information sharing.

When the IDLP solicitation first came out in January 1999, I responded with a proposal called CMNet, hoping to work toward a functional GDL in Chinese studies by achieving it through the US-Sino collaborative research activities. I am delighted that this proposal will be one of the few among the large number of competitive proposals to be funded by NSF. Besides myself as the Project Director, the collaborative partners will initially involve multi-interdisciplinary researchers, faculty, librarians from Tsinghua University and Peking University in Beijing; Jiao-tong University in Shaighai; National Taiwan University, National Tsinghua University, and Academia Sinica in Taiwan, and Cornell University, University of California in Berkeley, and University of Pittsburgh in the US.

Understandably when we are researching into the cross-country, multi-language subject areas, we will face many difficult problems and issues which need to be explored and researched collaboratively. The CMNet researchers have begun to look at the following ones for collaborative research:

- Interoperable multilingual information systems;
- cross-language retrieval systems;
- multiscriptural and multicultural interfaces;
- distributed digital libraries including sound, data, text, image, and video;
- interoperability and scalability technology to permit large world-wide collections;
- metadata techniques and tools;
- digital content development;
- preservation and archiving of digital scholarly information, including technology and procedures for long-term information asset management;
- social aspects of digital libraries and cross-cultural context studies;
- use of digital libraries at all levels of instruction;

- economic and copyright issues: authentication, rights, and fair use; and
- electronic publishing and scholarly communication technology, including collaboratories, online repositories, and new methods of organizing knowledge distribution.

I hope that this project will expand after the initial phase to include more researchers of common interests from other institutions and countries. In addition, this research can also serve as a model for other collaborative research.

Since the project has not even begun, it is too soon to know of the significant results. However, one thing is sure. If we can tackle the essential research topics related to digital libraries with such type of synergetic and interdisciplinary groups, then consensus can eventually evolve to produce workable “standards” and methods. We will then be one step closer to the realization of a real GDL.

Conclusion

In recent years, we have passed several "information jumps" -- from speech to writing to printing, and now to wire and wireless communications. While the current gigantic Internet has offered tremendous opportunities to us, it also has many inherent problems, such as traffic congestion, the lack of bandwidth, quality of services, etc. As NGI develops, current Internet problems will have been addressed and what lies ahead is a real jump for us toward new challenging applications. For the libraries, what lies ahead is a real jump for us toward universal information access via the globally connected distributed information and knowledge systems. Although the concept of the digital “global library”, which I have been advocating for over a decade, is conceptually sound and technologically feasible now, we have still many barriers before a true GDL can be realized. Our continuing efforts need to be concentrated in addressing the problems and issues already identified earlier through collaborative activities, in creating large-scale digital contents for global sharing, and in organizing these digital resources in such a way which can be shared globally and can be retrieved easily, accurately, and securely (Chen, 1998).

Despite of the identified 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 librarians for the 21st century will unquestionably change substantially. Now, it is clear that the 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. We should use this marvelous technology to enable us “to do more by doing less” (Dertouzos, 1997). As the librarians speculate on their work in this new millennium, what we must do is to make sure we can develop a vision for our library's future in this Internet-enabled knowledge 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 (Institute for Information Studies, 1998).

"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" (Institute for Information Studies, 1998). This is a big order!

References

"*Advanced Networking: Connecting to the Future.*" A 5.45-minute video produced by the University Corporation for Advanced Internet Development (an Internet2 group) and the U.S. National Coordination Office for Computing, Information, and Communications for the Netamorphosis - Demonstration of the Next Generation Internet - on March 11-13, 1998 in Washington DC.

Chen, Ching-chih. (1998). "Next Generation Internet and the Academic Library's Role in Knowledge Society," *Proceedings of the International Conferences on New Missions of Academic Libraries in the 21st Century*. Beijing: Peking University, 1998. pp. 2-9.

Chen, Ching-chih. (1999). *IT and Global Digital Library Development*. Newton, MA, USA: MicroUse Information, 1999.

Chen, Ching-chih, (1999) "NII, GII, I2 and NGI, and IT*2 Initiatives: Implications to the Digital Library Development in the US," *in IT and Global Digital Library Development*. Newton, MA, USA: MicroUse Information, 1999. pp. 49-64.

Chen, Ching-chih and Peter Herson. (1992). *Information Seeking*. New York: Neal Schuman, 1982. p. 52.

Dertouzos, Michael. *What Will Be. How the New World of Information Will Change Our Lives*. San Francisco, CA: Harper Edge, 1998.

Information Technology Research: Investing in Our Future. President's Information Technology Advisory Committee's (PITAC) Report to the President. (1999). Washington DC: National Coordination Office for Computing, Information, and Communications, February 1999. p.1.

Institute for Information Studies. *The Emerging Internet*. Queenstown, MD: IIS, 1998. pp. xvi, xix.

Lesk, Michael. *Practical Digital Libraries: Books, Bytes, and Bucks*. San Francisco, CA: Morgan Kaufmann Publishers, 1997.

U.S. National Coordination office for High Performance Computing and Communications. *Technologies for the 21st Century: Computing, Information, and Communications* (Supplement to the President's FY 1998 Budget). Washington DC: NCO, 1998. pp. 3-4.

About the Speaker



Ching-chih Chen, Professor and former Association Dean, Graduate School of Library and Information Science, Simmons College is a sought-after international consultant and speaker. An author and editor of 29 books and more than 150 articles on topics related to new information technology applications and management. She is also the founding Editor-in-Chief of *Microcomputers for Information Management* (1984-1996), and produced the award winning interactive videodisc and multimedia CD entitled *The First Emperor of China*. Since 1987, she has been the Chief Conference Organizer of 11 successful International Conferences on New Information Technology (NIT) in different parts of the world. The 1989 conference was held in Singapore. In the last 10 years, she has been advocating the global digital library concept by linking distributed digital libraries and museums all over the world together via the global network. In February 1997, she was appointed by President Clinton to his *Presidential Information Technology Advisory Committee (PITAC)*, and has also served as a member of PITAC/Subcommittees on the Next Generation Internet, and Information Technology Initiatives, and PITAC's Subgroups on Digital Divide, Digital Libraries, and International Issues. A Fellow of American Association for the Advancement of Science, she has received numerous awards and honors including American Society for Information Science's Outstanding Information Science Teacher (1983), the Library Information Technology Association's LITA/Gaylord Award for Achievement in Library and Information Technology (1990) and LITA/Library Hi Tech Award (1994), the American Library Association's Humphry Award (1996), the Association of Library and Information Science Educators' first National Faculty Award (1997), and many others.