PAPER

Global, National and Regional Information Infrastructure†1

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The computer network systems initiated in the United States are forming a gigantic world-wide network. The National Information Infrastructure (NII) is now attracting attention as an area for the nation and expanding throughout the world.

Although Japan had lagged behind other some nations, its information infrastructure has recently begun to initiate a quicker pace of expansion.

The ability to access such a network is vital and should be emphasized in economic and regional development.

1 Introduction

This year, the International Federation for Information and Documentation (FID) celebrates its centenary. Looking back over the last one hundred years, the pace of scientific and technological change has been startling, and it could well be regarded as the age in which industrial society flowered and bore fruit. More recently, however, the distortions of industrial society have become a matter of concern, primarily in the form of global environmental problems facing humanity.

Human perceptions of value are changing. Japan, for example, is currently undergoing a change from the era of seeking material affluence to an era of the spirit—seeking a higher and more relaxed quality of life—another of several such cyclical changes that have affected Japan throughout its long history.

Industry, which supported the drive for material wealth by mass-production and mass-consumption, is undergoing structural changes. It is culture that will support the drive for an enhanced quality of life, and our present culture may well be characterized as an "information culture." Table 1 gives some comparisons between industrial society and the corresponding "information society." An examination of modern Japanese society suggests a clear trend from industrial to information society.

- Society: Saturation with material goods, superimposed on a recession, means that consumption will not readily recover.
- Industry: Almost all enterprises are engaged in a metamorphosis towards a state of lean, high functionality to cope with their new environment, through the process of "Business Process Re-engineering" (BPR)
- Government: To escape from the recession, the establishment of various new industries using new social capital is under consideration.

The coming of the information society was predicted as long ago as the 1960s. Marshall McLuhan predicted in 1964 that

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	Industrial Society	Information Society
Society	Age of material goods, uniform society Development at the expense of nature	Age of mental satisfaction, diverse society Coexistence with nature
Industry	Mass-production and mass-consumption Emphasis on production Hierarchical organization	Flexible production in appropriate volumes and selective consumption Emphasis on added value Flat organization
Government	Centralization Priority on industry	Devolution to local government Priority on welfare and environment

Table 1 Differences between industrial society and information society

Applications	Crisis/Emergency Management Design and Manufacturing Education and Lifelong Learning Electronic Commerce Energy Management Environmental Monitoring Health Care
Services	Electronic Transactions Data Interchange Multimedia Objects Collaboration Support Resource Discovery
Bitways	Satellite Fiber Optic Cable TV Cellular Broadcast

(Source: High Performance Computing and Communication; "Technology for the National Information Infrastructure," Supplement to the President's Fiscal Year 1995 Budget, National Science and Technology Council.)

Table 2 National Information Infrastructure Layers[2]

the "global village" would be brought about by electronic communications. In Japan, too, Professor Umesao presented his information industry thesis in 1963, and predicted the coming of an age of the spirit.

Just as roads, ports, railroads, air transport and other developments were necessary for the industrial society, the prerequisite of an information society is an information infrastructure.

2 Organization of an Information Infrastructure

In the strict sense, the term "information infrastructure" often refers to communications networks themselves. For the development of the information society, however, the content of the services and various support functions provided by communications networks are more important. For example, in the national information infrastructure (NII)[1] proposed by

4th Level	Lifestyles, work styles (Include human activities. Determine the value system of the new society.)
3rd Level	Intellectual activity support systems(Include systems to support human intel lectual activity)
2nd Level	Information processing system(Include computers, TVs, telephones and other information communications equipment and software.)
1st Level	Network systems (Fiber-optic networks, CATV networks, wireless communi cations systems and other communications networks)

(Sources: Tateo Arimoto, "Progress in computer networks and the development of the national information infrastructure (NII)," Networld + Interop 94 Tokyo, and others.)

Table 3 Configuration of information infrastructure

US Vice-President Gore (See Section 4), the wider sense of information infrastructure is used to encompass the items in Table 2, seen as a three-level structure.

In Japan, on the other hand, the information infrastructure is commonly understood to include human activities. For example, as shown in Table 3, the information infrastructure may be considered as having four levels.

3 The Internet and the Global Information Infrastructure (GII)

At the beginning of 1994, US Vice-President Gore proposed the establishment of a global information infrastructure (GII). Currently the only network established on a global scale is the Internet.

The origin of the Internet name is "Inter-net-working", as a generic term for networks connecting other networks together. The term is usually used, however, to refer to the collection of computers connected together to use the Internet protocol and adhering to the policy of the Internet Society, which is an international organization for cooperation in the technical uses of the Internet.

Table 4 shows the history of the worldwide academic network which originated in America, and is now being used also for commercial purposes; this is usually referred to as the Internet.

In America, in the cold-war era of thirty years ago, the development of communications networks able to withstand even a nuclear war was seen as very important. The US defense budget was used to complete the first network, known as "ARPANET."

Thereafter, the National Science Foundation (NSF) provided capital to complete "NSFNET," linking universities all across America for research purposes. In 1990 this network subsumed the role of ARPANET.

In 1991, NREN (the National Research and Education Network) was started. In 1992, NSFNET was upgraded from 1.5Mbps to 45Mbps under NREN. With the increase in speed, traditional text transmission could be* accompanied by

1964	Rand Corporation publishes proposal
1969	ARPANET is started
1986	NSFNET completed
1990	ARPANET finished, absorbed by NSFNET.
1991	NREN is started
1992	NSFNET enhanced to 45Mbps under NREN
1996	Projected NREN completion (620Mbps)

Table 4 Progress of Internet implementation

multimedia data, including images and voice data.

The Internet now links three million computers in 150 countries, and has grown to a giant network accessed by 30 million people across the world. Growth currently continues, with the number of nodes and users increasing exponentially.

One feature of the Internet is that it is much more than just a communications system. There are a large number of news groups on particular themes across the spectrum of politics, economics, science and leisure interests, in which people from all over the world can participate, with access to information from large-scale databases held by the universities, libraries and governments of the world.

For research workers, the Internet provides instant access to required publications from all over the world, and also a means of easy person-to-person communication worldwide. The Internet has made real a world without frontiers, and can quite properly be called a global network

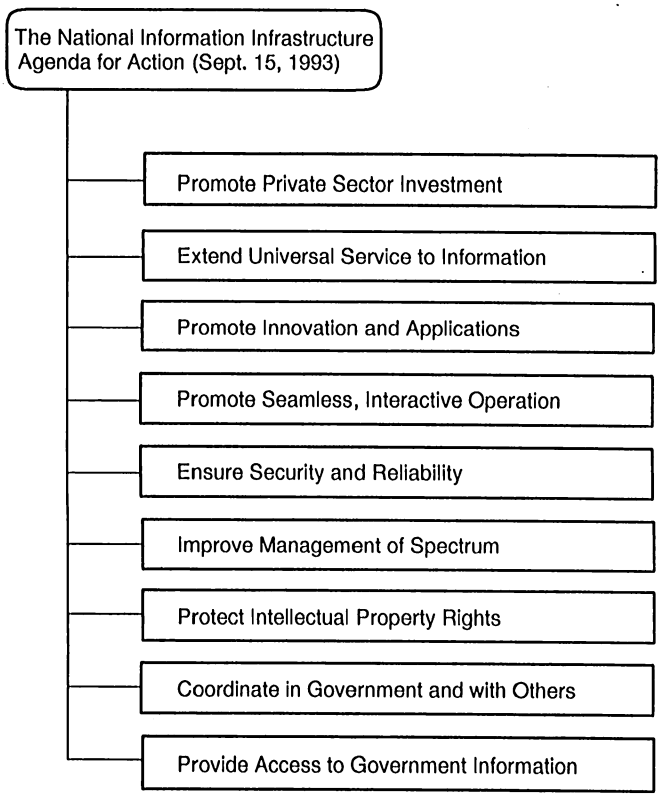
The global information infrastructure proposed by Vice-President Gore means linking together the national information infrastructures of all countries. Bearing in mind the different conditions in different countries, however, implementation will be no easy task.

4 National Information Infrastructure

4.1 Conditions in America

To obtain meaningful insights into the situation within Japan requires, first or all, an overall evaluation of the situation in America, for this will establish how far Japan is lagging in this field.

In America, legislation on high performance computing (HPC) came into force in 1991, and in 1993 Vice-President Gore published the "National Information Infrastructure: Agenda for Action." Its object was to build the foundations for the information society of the 21st century, and it aimed at improvements in aspects of national life such as education, culture and health, and also in the economic strength of American industry. To assist this program, the American government plans to provide between one and two billion dollars year, the economic effect of which is expected to be the creation of some 300 billion dollars of sales per year in new markets by the 21st century and new jobs for



Source: The National Information Infrastructures Agenda for Action," Information Infrastructure Task Force; Sep. 15, 1993.

Table 5 Policy items Under NII Initiatives[1]

300,000 people.

This network system will be able to handle multimedia data including voice, text and images with equal facility, and will integrate the functions of telephones, computers and TVs.

The American NII initiative provides for the nine policy items shown in Table 5.

4.2 Conditions in Japan

There have been advances in computer- and communications networking, a move to open systems, downsizing, and advances in multimedia applications, so that various parts of the technological infrastructure for the advanced information society are in place. Progress towards an information society in Japan, however, is far behind that of America, as shown in Table 6.

In Japan too, there have been a number of attempts to build networks.

(1) NACSIS (National Center for Science Information Systems)

The Ministry of Education began academic information network research in about 1981. In 1986 they established an academic information center (NACSIS), and worked for network expansion. NACSIS is seeking to expand its services and

	The United States	Japan
Sales of personal computers[1]	11,400,000	2,400,000
Diffusion of personal computers[2]	16%	6%
Proportion of personal computers linked by LAN[1]	52%	9%
Computers provided in schools[1]	One for every 19 pupils (1991)	One for every 39 pupils (1992)
Computers provided in government[1]	One for every 3 persons	One for every 10 persons
Number of CD-ROM titles[2]	4,000	1,000
CATV subscribers[2]	57,210,000	1,870,000

[1] MITI Official Bulletin[5]

[2] Telecommunications Council Report[3]

Table 6 Informationalization statistics for Japan and America (1993)

Application	Common Name	Protocols Supported	Operating Body
Academic	TISN	TCP/IP, DECnet	Faculty of Science, University of Tokyo
	WIDE	TCP/IP	WIDE Project
	JOIN	TCP/IP	Japan Organized Internetwork
	BITNETJP	RSC/NJE	Japan BITNET AssociationNACSIS
	SINET	TCP/IP	
	HEPnet-J	TCP/IP or X25, DECnet	High-Energy Physics Laboratory
Commercial	IIJ	TCP/IP, UUCP, etc.	Internet Initiative, Inc.
	SPIN	TCP/IP, UUCP, etc.	Nippon E.S.S.
	InfoWeb	TCP/IP, UUCP, etc.	InfoWeb

(Source: Journal of the Information Processing Society of Japan, Vol. 35, No. 8)

Table 7 Research information networks in Japan[6]

has interconnected with the Science Information Network, SINET, that links many universities and libraries.

(2) NTT

NTT has a long history in information and communications technology. In January 1994, NTT published a report: "NTT's Basic Policy and Current Activities for the Coming Multimedia Age."[7] The current measures referred to include strengthened measures to support multimedia, experiments in the use of a high-speed, high-bandwidth backbone network, experiments in the provision of multimedia services to domestic customers, and low-cost access to optical-fiber networks.

(3) Ministry of Posts and Telecommunications' "Program for the Establishment of High-Performance Info-Communication Infrastructure"[3]

In January 1994 the Ministry of Posts and Telecommunications made an important policy announcement. The Telecommunications Council within the ministry published the above "info-communication infrastructure" program in June 1994. The principal programs within this publication are the provision of optical-fiber and wireless networks, development of advanced applications in public fields using the optical-fiber network, and the revision of legislation to encourage new business. The objective by the year 2010 is to have a multimedia market worth 123 trillion yen and creating 2.4 million new jobs.

(4) MITI (Ministry of International Trade and Industry) "Program for Advanced Information Infrastructure"[8)]

In May 1994, in response to the report from the Information Industry Committee of the Industrial Structure Council and the American NII proposal, a survey of prospects for the high-level information-oriented society and policy program was published.

- Adoption of information orientation in five sectors of public life: education, research, medical care and social welfare, government, and libraries.
- Establishment of centers to provide high quality content and applications.
- Revision of the related legal provisions, improving security and standardization and promoting the activities of the information industry.

(5) Science and Technology Agency "Inter-Ministerial Network"

The science and technology policy committee's discussion group on research information networks debated the immediate policy for research information networks, and published the results of its deliberations in October 1993.

It established a plan called "Inter-Ministerial network," and began a detailed action plan starting operation with a budget of 1.1 billion yen this year.

5 Regional Information Infrastructure (RII)[9)]

RII refers to a regional information network which began from the information specific to local government at the town and village level, including meteorological and crop information, that was conveyed to inhabitants by cable broadcasts. Later, this developed into personal-computer networks.

PC networks center around character based information, and offer two-way communication, readily enabling expansion of the area covered by the network. These advantages were exploited by local government bodies in building local information networks to carry their own independent information services.

Saitama Prefecture is an example of this, using the PC network Nifty-Serve for its own "Country of Sai" service, under which information is provided on prefectural government, consumer issues, medical services, welfare, industry, the usage of public facilities, lectures and special events. Another such example is Oita Prefecture, where interconnection between the Oita University LAN and Oita Prefecture's own PC network (New COARA) is being used to integrate the regional network into a wide area network (WAN).

Although regional networks have been operated with the emphasis on specific local information, the interconnection of PC networks and the Internet means that information can be exchanged at the local,

Regional Network	Abbreviation	Type	No. of Organizations
Tsukuba Interconnection Network	RIC-Tsukuba	A	6
Tohoku Internet	TiA	A	15
Chugoku-Shikoku Internet	CSI	A	27
Tokai Regional Network	TRENDY	A	64
Tohoku Academic Research Network	TOPIC	A	22
Fifth Area Network Community	NCA5	A	*1
Kansai Network Interconnection	WINC	B	68
Kyushu Area Research Network	KARRN	A	47
Osaka Area Academic Network	ORIONS	A	61
Tokyo Area Academic Network	TRAIN	A	45
Hokkaido Area Network	NORTH	A	19

[1] *Member of JPNIC 1993, non-member 1994
Note: Type A are non-profit organizations, type B includes all others.
Source: Journal of the Information Processing Society of Japan Vol.35, No.8

Table 8 Regional networks belonging to JPNIC[6]

prefectural, national and international levels, and this is in the process of effectively eliminating the technical differences between regional networks.

Currently, there are 11 organizations registered with the Japan Network Information Center (JPNIC) for interconnection, as shown in Table 8, and between them they cover the whole of Japan.

In the future, as access to these networks extends to every home, the improvement in the provision of specific local information and the very latest worldwide information will make this kind of information service a major contributor to the advancement of local culture and industry.

6 Network Technology and Developments

Networks, in the author's opinion, will bring about large changes in the concept and disposition of documentation. Multimedia information can be stored in large volumes on inexpensive and lightweight electronic media. For example, an encyclopedia can be held on a few CD-ROMs. On a network, too, stored information can be made available to many users simultaneously, and information from remote locations can be obtained immediately. Recently, using the software concept of "groupware", group projects have been carried out with a number of people sharing information. Thus electronic media have significant advantages.

Research workers around the world are exchanging ideas through the network, and are investigating various technologies related to the network. The Internet in its current state can be seen as the fruit of accumulated research and development over a number of years. Research relating to networks is still active, and various new software packages are being announced.

Here Gopher and WWW/MOSAIC are presented as well-known examples of such software.

(1) Gopher

Gopher is a software product developed by the University of Minnesota to help stu-

dents acquire access to various information without special training.

When the desired information is present on a different computer, the role of Gopher is to reach that computer, access the required information, transfer it, and display it. Using this software, users do not need to know where the information is, or how to access the other computer, but can readily acquire the information themselves.

(2) WWW/MOSAIC

WWW (World-Wide-Web) was developed at CERN, the European center for research into nuclear-particle physics, and is a more advanced multimedia navigation system with database functions that organizes its contents by subject matter based on hypertext technology. It is able to display properly a wide range of multimedia sources and to specify programs to be executed.

MOSAIC, developed at the University of Illinois, is a program for displaying data which has been transferred to a client using WWW. It has an excellent graphical user interface (GUI), and allows information scattered all over the world to be displayed as though on the user's own computer.

Gopher is primarily a text-oriented program, and does not include functions for defining relationships among scattered information. WWW and MOSAIC, which were developed later, allow links to be freely established between any sets of multimedia data, first integrating then displaying information (objects).

Electronic media, however, present various disadvantages. For example, unlike a book, it is not possible to flick through pages of information. Thus there are still many problems to be overcome in the realization of an electronic library. For example, the organization of the media, automatic document indexing, semantic searching, fuzzy specification look-up, and other research topics remain. If we consider electronic media as documentation in the broadest sense, much depends on the quality of the research efforts being made by the organizations represented here.

7 Conclusion

ARPANET and NSFNET, which formed the backbone of the Internet, were originally for the exclusive use of researchers and educators, and they came into existence for—and were used by—a specific set of people. In some quarters this view of the Internet persists. But as the Internet moves on to provide services, both public and commercial, to a wider range of users, many questions arise, as follows:

Will the mutual trust and good faith on which the Internet has been based, despite the cultural differences of many nations, be able to sustain its autonomy? That is, can this huge worldwide network maintain its self-organizing and autonomously controlled functions in the future? Or will complete or partial chaos break out? The network must be open, and this openness must extend both to users and to the providers of networks and services. On the other hand, research is still needed into ways of making computer networks more robust. Moreover, in the move toward a universal service from one aimed at a specific group of users, there are many problems to be solved in the areas of privacy and protection of intellectual property rights.

Since, then, the national information infrastructures will be constructed on the basis of the differing cultures and politics of each country, to build a global information

infrastructure requires that the commonalties and differences be studied very carefully in order to ensure that all the connections work.

For example, in Japan the human network of person-to-person communication works fairly effectively, without using electronic tools, and any computer network should accommodate this pre-existing structure. In commercial organizations, the use of networks to improve business efficiency can be expected to rise rapidly. In government, on the other hand, more investment is urgently needed to provide public services to society at large; this will form the information infrastructure designed to give the Japanese people the quality of life they seek, and will usher in the information culture.

Japan alone can—and must—solve its own special problems, while adopting a cooperative stance internationally. One issue here is the higher charges made for network use in Japan compared with America or Europe.

Rather than computer networks being used as entertainment, the objective here is for them to be used to produce heightened intellectual creativity: efforts must be continued to develop the means and exploit the opportunities of this great potential.

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