Digital Networks and the Internet: The Arab World's Link to the Information Superhighway

Jamal J. Al Menayes*

* Ph. D., The University of Wisconsin - Madison, U.S.A., 1990.
Asst. Professor, The Dept. of Mass Communication, Kuwait University.

Abstract

In this paper I attempt to provide a working definition of the basic components of the much touted Information Superhighway. First, I define the concept of "information" in the context of a superhighway. Second, I discuss the nature of information systems and information technology that make up the superhighway. Third, I attempt to offer a detailed exploration of the characteristics of digital information and digital networks. And, finally, I provide an examination of the Internet as it stands in the Arab World today and its potential uses and applications.

Introduction

In the 1960's renowned media theorist Marshall McLuhan introduced the term "global village" to underscore the role played by mass media in shortening geographical distances between countries and cultures. He argued that the nations and people of the world are looking more alike all the time because they are living in a media created global village, a village made possible by the technology that allows the free flow of information across national borders. Three decades later U.S. vice president Al Gore coined the term "information superhighway' to refer to a collection of high speed global data-exchange networks, also known as the Internet. He argued that the United States and indeed the developed world would not be able to function in the 21st century without dependable and efficient ways to exchange information globally.

Yet the phrase Information Superhighway is problematic. Through continued use it has become a cliche, widely quoted but poorly understood. When Vinton Cerf, president of the Internet Society, says that the "highway is currently more of a dirt road in the backyard with a lot of ruts in it," it is clear he is describing the muddled state of the infrastructure today. The main components, telephone lines, communication satellites and computers, are familiar to most people, but what is not familiar is how these components fit together, and what sorts of information they carry when they are operating in conjunction with one another.

In this paper I will attempt to provide a working definition of the basic components of this so-called Information Superhighway. First, I will try to define the concept of "Information" as it is employed in the context of a superhighway. Second, I will discuss the nature of information systems and information technology that make the Superhighway a viable metaphor. Third, I will offer a detailed exploration of the characteristics of digital information and digital networks which constitute the heart and soul of the Information Superhighway. Finally, I will provide an examination of the Internet as it stands in the world today, and furnish a specific case study of the way networks are structured in some countries in the Arab World and their potential uses and applications.

Information: a definition

Any attempt at defining information runs into immediate difficulties. Since the idea of information is meaningful in relation to someone informed, to the reduction of ignorance and of uncertainty, it is ironic that the term information is itself ambiguous and used in different ways.[1]

Faced with this variety of meanings, one can at least take a practical approach. I can examine the literature and see whether one or more distinctive uses of the term information seem helpful for our purposes. The definitions may not be fully satisfactory, the boundaries between these uses may be blurred, and such approach may not satisfy anyone determined to establish the one correct meaning of information. But if the primary useful concepts can be identified, sorted, characterized, and labeled, then some progress might be made. Using this approach I identify three principal uses of the word information:

1. Information-as-process. What someone knows is changed when he or she is informed. In this sense, information is "the action of informing..; communication of the knowledge or 'news' of some fact or occurrence; the action of telling or fact of being told of something."[2]

2. Information-as-knowledge. Information is also used to denote that which is imparted in information as process: the "knowledge communicated concerning some particular fact, subject or event; that which one is appraised or told; intelligence, news."[3] The notion of information as that which reduces uncertainty could be viewed as a special case of information-as-knowledge. Sometimes information increases uncertainty.

3. Information-as-thing. The term information is also used to refer to objects, such as data and documents, that are considered information because they are regarded as being informative, as "having the quality of imparting knowledge or communicating information; instructive."[4]

The key characteristic of knowledge, and therefore, of information -as-knowledge, is that it is intangible. One cannot touch it or measure it in any direct way. Knowledge, belief, and opinion are personal, subjective, and conceptual. Therefore, to communicate them, they have to be expressed, described, or represented in some physical way, as a mark, signal text, or communication. Any such expression, description, or representation would be information-as-thing. Bearing in mind that information-as-thing is the one and only form of infomation with which information systems can deal directly, I now turn my attention to some aspects of information in information systems.

Information Systems

Information systems used by human beings are open systems. In other words, the provision and use of open systems are not isolated from the rest of the world. Indeed, as will become clear, they are deeply imbedded and heavily influenced by their social and technical contexts.

An information system used by human beings is also likely to be a

complex system, or, in the terminology of systems theory, a large system. A library, for example, may not be very big physically or organizationally. The concept of a library as a set of books that might at some point in time be inspected by one or more people is quite simple. However, the variety of stages, steps, and interactions that can be involved in learning from materials in a library can be quite complex. By complexity we do not simply mean the amount of technical engineering detail, but rather the diversity of elements and relationships involved including the social, economic, political, and cognitive activities.

Types of Information Systems

Just as the word information is used in a variety of ways, so also the term system is freely and loosely applied. Almost any arrangement is liable to be called a system. What, then, are we to make of the phrase information systems? From the perspective of the person informed, a distinction can be made between three sorts of information receiving situations.[5]

1. Communication, in which information is conveyed, intentionally and more or less directly, to the receiver, as in a conversation, a letter or a lecture, constitues one class of information-receiving situations.

2. Retrieval-based information services, wherein collected and stored information-as-thing is sought and retrieved by the user, represent another sort of information-receiving situation. A retrieval situation is more complex than a communication situation

3. Observation. Information can also be received by other means such as obseving an event, conducting an experiment, or contemplating any evidence that has not been communicated or retrieved. This thrid class is referred to as observation.

Our focus in this paper is on retrieval-based digital information systems rather than observation or communication because retrieval-based information systems are at the heart of what is today referred to as the Information Superhighway. The next section will present a theoretical discussion of the type of information technology which makes the information Superhighway a reality.

The Nature of Digital Information

Many professionals and academics who sit in offices surrounded by mountains of books, manuscripts and reports might question the notion that

electronics has become the increasingly dominant medium of communication. To be sure, paper has not lost its place as a vehicle for communications[6], but the text and images we find on the page increasingly are getting there through electronic processes. More and more we shall have the option to read information from a computer display screen or have it printed out on paper.

In addition, electronic mass communications media that involve no printing or paper at all are growing at a much faster rate than are print media. Recent studies in the United States and Japan indicate a growth rate for electronic communication many times that for traditional print. Figure (1) shows the number of words of communication to which the typical American is exposed during an average day. The electronically delivered message has been growing at a compounded annual rate of over 8%, doubling every 10 years, whereas the print-delivered component has remained stagnant, with no growth at all.[7] Given this data it is difficult to argue against the notion that the so-called information age will be dominated by digital electronics for the storage and transmission of speech, text, and images.

The first applications of electronic technology (starting with the telegraph) were "analog" in nature; that is, the recording or transmission medium stored the sound waves of speech or music directly. Edison's phonograph was a good example. It simply transformed sound traveling

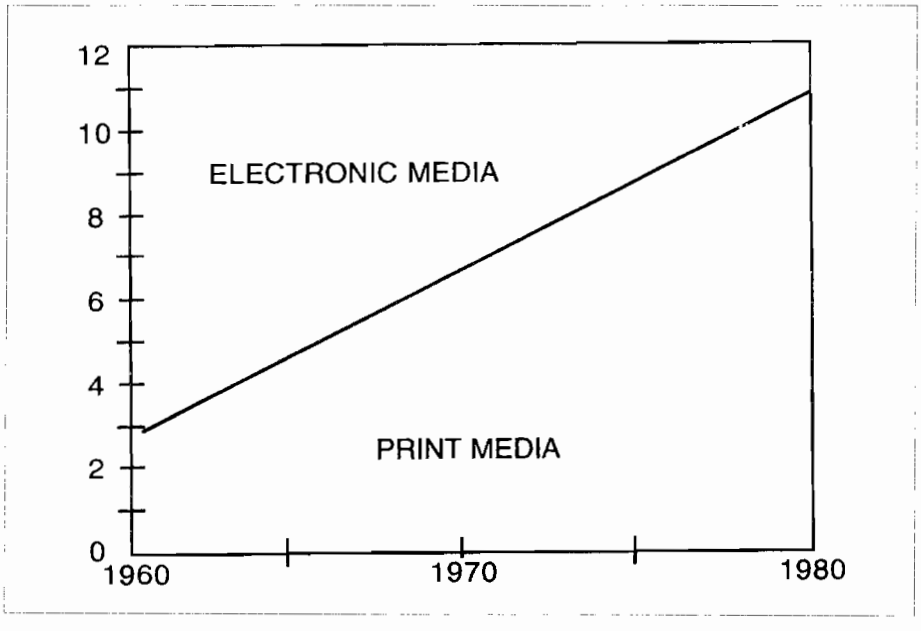


Figure (1) The increasing flow of electronic communication. (From Nueman and Pool 1986)

through a diaphragm into physical vibrations that moved a needle back and forth directly on a rotating wax cylinder. When the wax cylinder was played back on the needle, the diaphragm vibrated as before, reproducing an identifiable resemblance of the original sound.[8] The telephone, radio, television, and magnetic tape use similar electronic analog techniques for audio and video transmission. But audio and video signals can also be stored digitally, as a series of coded magnetic or optical pulses that can in turn be decoded and used to reproduce the original audio or video waveform. For our purposes here, the central question is why digital electronics (as compared to analog electronics) have become increasingly dominant.

Digital communications are preferred over analog ones because they are easily processed by digital computers. This is fundamental, because it brings the phenomenon of electronic intelligence into the processing and storage of information. Analog media are by their nature passive. An analog record player can reproduce recorded signals accurately, but the technology has no way of "knowing" what it is reproducing. Digital storage is different, in that the sounds images are transformed into digital codes. The codes, of course, can be recoded and redisplayed as reproduced sounds and images, just as with analog technologies, but with one major difference. The codes serve as lables. Computer-based digital technologies routinely read and interpret these lables and can actively process and manipulate the information as it passes through the system. They can, for example, save copies, forward, reformat, enhance, correct errors, summarize, abbreviate, or encrypt messages, sounds and images as instructed by the software of the system or directly by the user. Analog communications, for the most part, can be reproduced only as recorded.[9, 10]

The phenomenon of a digital medium "knowing" what information it is processing has proved to be a critical factor in the integration of new media networks. The older analog telephone system, for example, required a switchboard operator or an expensive and maintenance-extensive physical switch to connect the two parties to a conversation. When the two parties are connected, no one else could use the line, and special messages had to be sent to signal to the system when they had hung up. In digital communications each message or packet of data is labeled and flows through a common channel at tremendously high speeds, then being received and stored only by the electronic receiver on the system to which it is addressed. Such systems are more efficient, more reliable, and less expensive.

Digital communication allow greater fidelity. Both analog and digital media have the properties of noise, interference and recording errors, but digital technologies can detect and correct errors. Digital processing also allows for compression of communications to improve efficiency. Standard

telephone lines, for example, normally allow the transmission of only voice-grade audio. Video images require over 1,000 times the capacity or "bandwidth" of ordinary pairs of copper telephone wire, but with compression techniques, simplified video images can be sent over standard telephone lines.

Most important, digital technologies allow for new forms of interaction between the user and the medium.[11] Digital disk and memory technologies allow the user to access any part of the stored information instantaneously, instead of forcing the user to follow a predetermined linear path.

The important point is that the addition of "intelligence" to the communication process through digital electronics allows for a revolutionary shift in the relationship between media and their human users. The old media (newspapers, magazines, books, radio, non-interactive television) were passive, unknowing vehicles between human users. Increasingly with the new media, however, the medium itself is aware of what messages are passing through and indeed is cognizant of how the user is responding.

The Nature of Digital Networks

A network is a collection of interconnected, individually controlled computers, together with the hardware and software used to connect them. A network allows users to share data and peripheral devices such as storage media, to exchange electronic mail and so on. Networks vary in terms of size and subsequently the geographical area they cover. A local area network (LAN) usually includes a group of computers connected for the purpose of sharing resources. It is typically housed in a small area such as a single building or section of a building. A wide area network (WAN) has a large number of computers and computer networks connected to each other using long distance communications methods, such as telephone lines and satellites.

The nature of networks is connectedness and flexibility. The more evenly spaced and the more frequent the interconnections, the more convenient and flexible the communication between any two points. The nature of networks has provided the stimulus for rather extensive research and theorizing in policy[12], economics[13] and engineering[14] A few key concepts from these various literature will provide some guidance for this inquiry.

One such concept is the idea of "network externalities." The idea is simply that because the value of a network is communication or exchange of some kind, the more people or places on the network, the more valuable the network is at the margin to the next person who considers connection to the net. If there are two competing and equivalent networks, and one has

more subscribers, there is likely to be tipping phenomenon as more and more individuals chose the larger network, dropping the smaller one, and thus generating pressure for the smaller network to either connect to the larger one or dissolve. Or, in the language of economists, because there are steadily increasing returns to scale (one universal network is cheaper than two competing and redundant networks), a regulated monopoly or "common carrier" is more efficient and better serves the public interest.[15] Thus, the logic of digital communication is interconnection or "internetworking".

Digital Communications and the Internet

The Internet is a world wide interconnected group of computer networks. The Internet evolved in part from the connection of supercomputer sites across the United States. The National Science Foundation (NSF), a U.S. government agency that promotes science, wanted to get the most out of their supercomputers. Connecting the sites to each other made the supercomputers more efficient. Scientists, researchers and engineers could then access the supercomputers from their own labs and offices. The high-speed networks that connect the NSF supercomputers now form the backbone of the Internet. The backbone consists of high capacity links, microwaves, lasers, fiber optics, and satellite, connecting networks, computer sites, and people all over the world.

Historically the Internet evolved from the ARPANET, a project started by the U. S. Department of Defense (DOD) in 1969, both as an experiment in reliable networking and to link together DOD and military research contractors, including many universities doing military-funded research. ARPA stands for Advanced Research Projects Agency, the branch of defense in charge of handing out grant money.

The reliable networking part involved **dynamic routing**[16]. If one of the network links became disturbed by enemy attack, the traffic on it could automatically be routed to other links. The ARPANET was widely successful, and every university in the U.S. wanted to use it. The eventual increase in size and complexity resulted in the break up of ARPANET into several other networks, like MILNET and CSNET. When IP (Internal Protocol) was introduced, all the smaller networks were able to work together in what is now the Internet.

Today the Internet is a web of different, intercommunicating networks funded by both commercial and government organizations. The Internet has also spread all over the world to connect networks in many countries, including France, Germany, Japan, Russia, the United Kingdom, Australia

and Kuwait. In May 1994 there were more than 2,217,000 host computers connected to the Internet.[17] Each host computer connects thousands of individual users. There were 78 countries connected to the Internet, and 146 countries could exchange electronic mail.[18]

The Internet continues to grow at a rapid rate. Every 30 minutes a new network number is registered with Inter NIC Registration Services or one of the delegated registries located around the world (see figure 2 for growth rates in the U.S.A.). Although the majority of networks are registered to organizations located within the United States, the number of networks being registered to organizations outside the United States is growing more rapidly. It is expected that sometime during 1995 a crossover will occur, and the majority of registered networks will be outside the United States.[19]

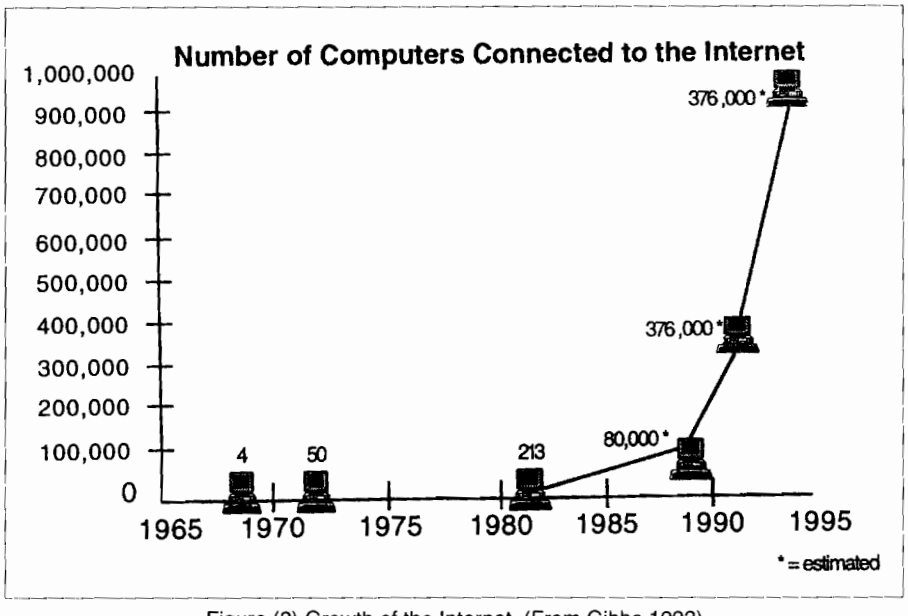


Figure (2) Growth of the Internet. (From Gibbs 1993)

The Internet as a whole is not owned or administered by any single entity. The various subnetworks have owners who recognize that having connections to other networks either enhances their mission (if they are public institutions as in the case of universities) or makes their services more desirable (if they are commercial enterprises). Internet standards, such as protocols and technologies, are ratified by the Internet Architecture Board (IAB). Promotion and support for the Internet concept is handled by the Internet Society, a volunteer organization located in the United States.

The benefits of access to the Internet are far too many to discuss in a paper of this scope. Here are some of the main Internet activities.

1. Library Catalogs. Internet users can browse through library catalogs of such institutions as Harvard University, Yale University, Stanford University, Oxford University, and Cambridge University just to name a few.
2. Electronic Mail. The Internet enables users to communicate with each other almost instantaneously through electronic mail.
3. File Transfer. Files can be found everywhere on the Internet. The ability to pull down a file to get data or run a program is vital for those engaged in research and development work, for example. In this category are resources such as weather and oceanographic data file and satellite pictures.
4. Run Programs on Other Computers. The ability to reach out from one's computer in order to run a program on another computer is quite useful. A user can run software his or her own computer cannot run (due to processor type, memory limitations, and so on).
5. Search for Files and Databases. Several systems on the Internet enable users to search thousands of computers for files and databases around the world.
6. Discussion Groups. Because the Internet is used by millions of people, it is a natural place to make contact and exchange views with those who share similar interests.

Computer Networks and the Internet in the Arab World

1. North Africa

Being a relatively new communication technology in these parts, the Internet is still not widely adopted in the Arab World. However, there are several institutions that have taken a leading role in the implementation and development of this technology in this part of the world. RITNET, for example, is one of the few regional networks that cover the Middle-East. Located in Cairo, Egypt, the network is maintained by The Regional Information Technology and Software Engineering Center (RITSEC). Its mission is to:

> ".. support and help develop the information technology and software industry in the Arab region in order to become a world class industry leader able to compete at the international level and a catalyst for accelerating socio-economic development."[20]

The Center is a joint project between the United Nations Development

Program (UNDP) and the Arab Fund for Economic and Social Development (AFESD). The center was launched in January 1992, and is currently hosted by the Egyptian Cabinet Information and Decision Support Center (IDSC). Among its services is the provision of information about the region, new products, software, computing and networking. RITNET is fully connected to the global Internet providing such services as electronic mail, teleconferencing, FTP (File Transfer Protocol), Archie, WIAS, World Wide Web, Mosiac, just to name a few.

Another leading effort in the adoption of digital networking in the Arab World exists in Tunisia. The Regional Institute for Informatics and Telecommunications (IRSIT) has the ambitious mission of:

"contributing to the preservation and appreciation of our cultural heritage faced with the transformation of economic, scientific and cultural structures entailed by developments in the field of infomatics."[21]

To fulfill this stated goal the institute has carried out several tasks, among which mention may be made of the following:

1) Organizing and developing works of Arabization in the field of informatics and promoting the use of the Arabic language in informatics; 2) participating in the development of informatics and its uses in all direct-impact sectors, such as education, communication, information and industry; 3) promoting the infoimatics industry and telecommunications and associated technologies through the development of Arabized computer products and the setting up of Arab and African firms concerned with informatics; 4) acting as a repository for the collection, transcription and selection of information to be placed in specific data-banks, which shall be made available by means of data transmission networks; and 5) conducting expert operations for the evaluation and standardization of new hardware and software products.[22]

IRSIT comptuer facilities are composed mainly of a mini computer (VAX 6310), and a LAN with 70 nodes. All are connected to major world networks like BITNET, EUNET, NSFNET and the Internet. The physical and logical connections to these networks are done through a link with the **Institut National de Recherche en Informatique et Automatique** (INRIA) in France.[23]

The institute was created by the Tunisian government in 1987 as a commercial and industrial public organization. IRSIT is a non-profit organization whereby all the profits that it generates are reinvested back in the institute and are used in strengthening its research and development capabilities.

II. The Middle-East and the Gulf Region

Despite the abundance of capital and a relatively modern communication infrastructure, the Gulf region is still lagging in the adoption of the Internet or any of its offshoots. It is quite surprising, but to the best of this author's knowledge no Arab Internet connections exist in the Middle-East and the Gulf region outside of Kuwait and Jordan. Kuwait has taken a leading role in the Gulf in the adoption of digital data networks and the Internet. All academic institutions of higher learning in Kuwait are connected to the Global Internet including Kuwait University, The Institute of Applied Studies, and the Kuwait Institute for Scientific Research (KISR). In fact, Internet services are available to private citizens and household users through the Ministry of Telecommunications and Kuwait Electronic Messaging Service (KEMS). For a monthly fee anyone with a telephone line could get a personal account on the Internet including the graphic browser known as Mosaic.

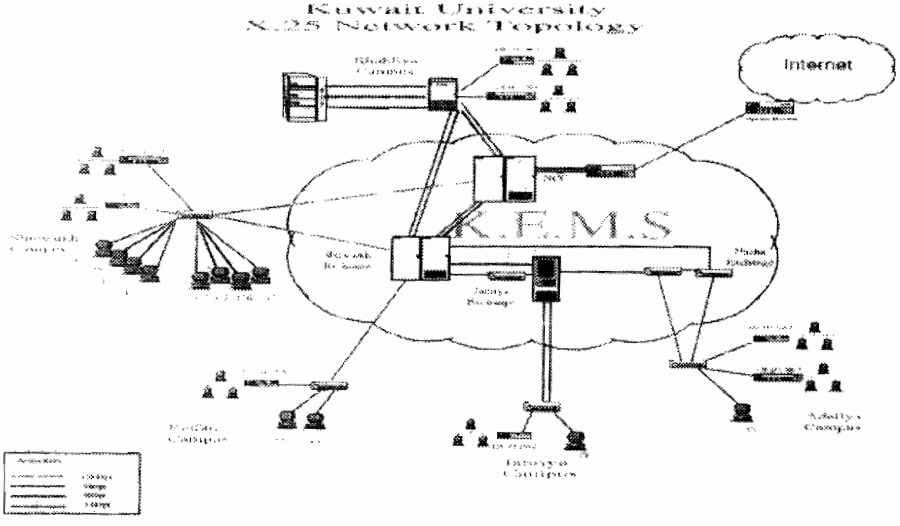
But the most avid user of the Internet in Kuwait is the faculty and staff of Kuwait University.[24] It all started in the late 1980's when Kuwait University embarked on an ambitious plan to have its five campuses connected through a high-speed computer network. This plan was suddenly interrupted by the Iraqi invasion of Kuwait in the summer of 1990. In 1992 Kuwait University vigorously resumed its plan to connect its campuses.

Kuwait University computer network is connected to the global Internet through a VAX-9000 mainframe computer and a host of computer Networks scattered over its five campuses. The interconnection of these five campuses presents a communication configuration of a Metropolitan Area Network (MAN) proportions. The MAN architecture is a relatively new concept designed to provide an efficient, reliable and cost effective network on a large scale. Several factors enter into the choice of a network configuration, chief among them are cost, data transfer rate, room for future expansion, maintenance and reliability. At present the best alternative for data communications is Fiber Optics which can provide the bandwidth, and ease of maintenance requirements for such a network.

Using Wide Area Network (WAN) media and technology in the form of leased telephone lines, Kuwait University Computing Services (KUCS) is able to provide adequate working communications links between all five campuses. These campuses are linked together through an X.25 Public Data Network (PDN) which is run and managed by Kuwait Electronic Messaging Services (KEMS). These links are currently operating at 64 Kbps (Kilo bits per second). Access to the Internet is provided through a satellite link which connects the X.25 PDN to the SPRINT network in

Washington D.C.[25]

All five campuses have their own Local Area Network backbones. All workstations, terminals and LANs which are directly or indirectly connected to a backbone can access the VAX-9000 mainframe and the Internet. Figure (3) shows an overview of the existing campus network. Work in progress includes Fiber Optic backbones in all five campuses with all campuses interconnected in turn by a Fiber Optic metropolitan network. This is aimed at achieving higher data transfer rates within and between campuses for video-conferencing, multimedia data communications and also for the massive amounts of data which can be generated by modern research and analysis methods.



According to faculty members accounts, the benefits of campus connection to the Internet are quite astounding. To some, the Internet has facilitated conducting joint scientific projects with researchers in European and U. S. universities. To others, many of whom have completed their advanced degrees in the United States and Europe, it is an excellent tool for keeping in touch with former classmates and faculty advisors. To students and faculty alike access to the global Internet means immediate access to the wealth of information located in many research libraries and databases around the world. This author is currently working on a world wide cooperative project with researchers from seventy countries, all without leaving the office, thanks to the Internet.

Conclusion

As we approach the close of the final decade of the 20th century, we stand on the threshold of what appears to be a new generation of communications technologies. We have the opportunity to design a new electronic and optical network that will blur the distinction between mass and interpersonal communications and between one-way and two-way communications. We invent new terms like "Information Superhighway" because in our experiences it has been the nature of information to be the sole domain of the few, the elite, and the privileged. Now, thanks to digital technology, information on any topic can be accessed by almost anyone with rudimentary knowledge of computers.

These new technological developments are most often characterized as an explosion or proliferation of new media. The term "media" is plural, and indeed most reviews of the field have proceeded listwise through the growing array of electronic devices, identifying the special properties of each: direct-broadcast satellites, personal computers, digital, high-definition, and interactive television, videotext and teletext, electronic mail and high-speed computer networks.[26] The irony is that, in the end, the new media will be one - a single, high-capacity, digital network of networks that will bridge what we now know as the separate domains of computing, telephony, broadcasting, motion pictures and publishing.[27]

In this paper I have tried to bring some definitional clarity to this new terrain in communication technology, one which is likely to have an everlasting impact on the lives of nations and individuals toward the close of this century. As of yet, this technology is not widely spread, let alone well understood, in the Arab world. Several factors, including levels of economic development, cultural illiteracy and government natural inclination toward control of information flow, have contributed to the slow adoption of this technology in this part of the world. Some exceptions do exist, however. This includes several institutions in the State of Kuwait, paticularly Kuwait University, which has taken a leading role in the adoption and implementation of an ambitious scheme to have its campus fully connected to the global high-speed communication network known as the Internet. The other adopters of this technology in the Arab World exist largely in North Africa. It is hoped that this paper will be one of many efforts to carefully examine this new media technology and explore its potential advantages to countries in this important part of the world.

REFERENCES

1. Braman, S. (1989). **Defining Information**. Telecommunications Policy 3:233-42.
2. **Oxford English Dictionary** (1989): Oxford University Pres 7:944.
3. Ibid. 7:944.

4. Ibid.
5. Buckland, M. (1991). **Information and Information Systems**. NY: Praeger.
6. Strassnan, P. (1985). **Information Payoff**. New York: Free Press.
7. Pool, I., I. Hiroshi, T. Nozomu and R. Hurwitz (1984). **Communication Flows: A Census in the United States and Japan**. Amsterdam: Elsevier/North Holland.
8. Read, O. and W. Wlech (1976). **From Tin Foil to Stereo**. Indianapolis: Sams.
9. Dordick, H. (1986). **Understanding Telecommunications**. New York: McGraw-Hill.
10. Techo, R. (1980). **Data Communications**. New York: Plenum.
11. Lippman, A. (1986). **Fifth Generation Television**. Cambridge, MA: MIT Media Lab.
12. Pool (1983). **Technologies of Freedom**. Cambridge, MA: Harvard University Press.
13. Wenders, J. (1987). **The Economics of Telecommunications**. Cambridge, MA: Ballinger.
14. Techo, R. (1980), op. cit. pp. 62-70.
15. Wenders, J. (1987), Op. Cit. pp. 94-55.
16. During the Gulf War in 1991, the U.S. military had major problems in trying to destroy the Iraqi command network. It turned out that the Iraqi military were using commercially available network routers with standard internet routing and recovery technology. In other words, this technology is reliable.
17. A host computer is a multi-user computer, such as a minicomputer or a mainframe, that serves as a central processing unit for a number of terminals.
18. **Internet World,** September, 1994. pp. 54-58.
19. Ibid.
20. RITNER Gopher service accessed through the Internet, May, 1995.
21. IRSIT Gopher service accessed through the Internet, May, 1995.
22. Information obtained through electronic mail from IRSIT operators.
23. Ibid.
24. According to a source at KEMS, Kuwait University generates 60% of the traffic going through the Kuwait gateway to the Internet making it by far the heaviest user in Kuwait. In addition, Kuwait University system operators report that the number of individual users has increased threefold in the past year alone. Many attribute the increase to the media publicity the Internet has been getting lately.
25. KUCS Windows, September 1994, vol. 94.02 .
26. Dizard, W. (1989) . **The Coming Information Age : An Overview of Technology, Economics, and Politics**, 3rd ed. New York: Longman.
27. Egan, B. (1991). **Information Superhighways: The Economics of Advanced Public Communications Networks**. Boston: Artech House.

* * *