Leland Initiative:
Africa Global Information Infrastructure Gateway Project
(Project No. 698-0565)

Best Practices for Policy Accommodation, Technology Transfer, and End-User Applications of the Internet in the Developing World

Prepared for:

United States Agency for International Development
Africa Bureau, Office of Sustainable Development

Prepared by:

Jeff Bland
Zoey Breslar
Jim Esselman
Dana Ireland
United States Agency for International Development
Policy and Program Coordination Bureau
Center for Development Information and Evaluation
Research and Reference Services Project
operated by the Academy for Education Development

September 1996

TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

The Leland Initiative, also known as the African Gateway to the Global Information Infrastructure (GII) Project, is a five-year, $15 million, interagency initiative designed to assist up to 20 African nations in connecting to the Internet and other electronic technologies in order to promote sustainable development activities.

Coordinated by the U.S. Agency for International Development (USAID), the Leland Initiative's activities fall under three major components, known as strategic objectives (SOs). These strategic objectives are to:

1. promote policy reforms that will encourage the development of telematics technology and reduce barriers to open connectivity;
2. strengthen local telecommunications infrastructure to ensure the availability of reliable, accessible, and cost-effective services for accessing information; and
3. achieve the broad-based use by both the public and private sectors of information and global information technologies needed to meet the challenges of sustainable development.

Recognizing the importance of building on lessons learned, USAID has developed this paper to capture the best practices of prior and current information technology (IT) activities. The paper reviews issues and obstacles in each of the three Leland strategic objectives areas, examines potential solutions, and presents summaries of some of the activities conducted by other groups involved with telematics in the developing world.

Numerous studies indicate that investment in telecommunications technologies yields impressive results in terms of economic growth and development. The Internet also holds the potential for contributing to advances in the health, education, democracy, and environment sectors.

The principal impediment to implementing Internet applications in Africa is the currently undeveloped state of telecommunications on the continent. Phone lines are scarce (there are more phone lines in Manhattan than in all of Africa), and even where they are available, they are generally of poor quality and priced beyond the means of most citizens. Another impediment is the small size of "content markets," which are service areas, such as business phone and fax lines, automated phone services, and on-line entertainment, that would drive the growth of Internet.

Despite these and other constraints, Internet inroads are being made in Africa. At the end of 1995, only seven countries had full access to Internet services. By July 1996, this number had risen to over 15.

1.2 TELECOMMUNICATIONS POLICY

Government policies can profoundly affect the course of a country's use of information technologies (IT) by establishing either a positive, encouraging environment that nurtures growth and development, or a restrictive, rigid environment that impedes development. National policy issues that must be addressed to foster the development of IT applications fall under three main categories: policies governing the telecommunications industry, policies affecting the use and content of electronic information, and policies designed to encourage IT promotion and technical training.

For the most part, countries with policies that have encouraged modernization, growth, and diversity in their telecommunications industry are experiencing greater economic development. The telecommunications industry in Africa and other parts of the developing world generally have been dominated by state-owned monopolies which tend to be inefficient and provide poor quality service. One obvious solution is to turn over operation of telecommunications services to the private sector.

Privatization and liberalization, two separate but related processes, are the most widely used procedures for restructuring state-owned telecommunications industries. Many countries use these processes in order to encourage expansion and improvement of their telecommunications networks and services. Although privatization and liberalization are designed to open up the telecommunications industry, the government must provide some regulatory oversight to ensure fair and open practices.

Governmental control of taxation and tariffs provides a powerful tool for encouraging the development of Internet-related markets. Unfortunately, many developing countries heavily tax IT equipment and services, using them as cash cows for government funds. While this raises much-needed revenue in the short-term, high taxes and tariffs work in the long-term to discourage consumer demand and telecommunications industry expansion. Appropriate tax levels and incentives can alleviate these problems. In addition, maintaining open and fair access to telecommunications markets also will encourage development of a country's industry.

There is a danger in developing countries that common disparities in class and wealth will be reflected in the creation of information "haves" and "have-nots," since poor infrastructure and high costs often make the Internet available only to the wealthy. In order to bring the benefits of Internet access to as many citizens as possible, national governments may need to concentrate on supporting rural/remote connectivity schemes or plans to partially subsidize service for poorer citizens.

The long-term sustainability and profitability of a privately-owned, well-regulated telecommunications industry will only be successful to the extent that there is robust demand for the services (i.e., electronic information in its various formats) made available by the infrastructure. For supply and demand to operate effectively, the government needs to address

intellectual property issues and Internet security issues, while at the same time punishing security breaches and enforcing copyright infringements.

To the governments of some developing countries, information technology in general--and the Internet in particular--has been perceived as a threat to social order and national security. Concerns about online pornography, computer hacking, and other seedy activities are certainly legitimate and will need to be handled as the Internet becomes more ubiquitous and integral to developing countries' economies and societies. Nonetheless, overly restrictive regulations can have a negative effect on electronic commerce, media use of the Internet, and even its use as a medium of conversation between acquaintances.

To oversee, implement, and enforce regulations regarding electronic information ownership and standards, a central regulatory body should be established. The authority should be as independent as possible from both the companies it oversees and the government itself in order to maintain impartiality and to resist political pressures.

The government can play an important role in advocating and encouraging a broad, well-trained IT user base. Some of the policy instruments available to meet this objective include establishing awareness programs, developing national workshops, providing technical training, organizing fora for IT networking, and integrating information technologies into government operations.

1.3 TELECOMMUNICATIONS INFRASTRUCTURE

Essentially, the Internet can be described as a network of computer networks. Any computer on the network can communicate with any other on the network. Internet connectivity can be examined at three levels: international, intranational, and local. International connectivity refers to the high-capacity connections which allow Internet service to be distributed within a country. Intranational connectivity refers to the means used for Internet transmission from one or more entry points to various regions within a country, where it can be more efficiently distributed to individual organizations or Internet service providers. Local level access entails bringing Internet connections to individual homes, businesses, schools, organizations, and any other interested end users.

The absence of widespread, high-quality phone lines in Africa means that Internet service cannot be brought cheaply and quickly upon demand to most homes and small businesses, as is currently the case in the United States. On the other hand, this lack of infrastructure provides an opportunity for "leapfrogging" the copper wire technology of the past for more advanced transmission systems that can be built from the ground up. Recent advances in telematics have led to a wide range of options for offering cheaper, faster, and full-fledged Internet service.

In most cases, Internet access must be brought to a country through an international gateway before the citizens of that country can expect regional and local connectivity. Existing copper cable lines can provide access but with poor quality. New options for Internet access at the international level include the use of leased lines, satellites, or fiber-optic cable.

As developing countries establish international connections to the Internet, a strong intranational infrastructure will become essential for widespread dissemination of information technologies, particularly in rural areas. Approaches for expanding this level of Internet access include: linking existing public and/or private networks; using wireless technology, especially in remote or mountainous areas; and using low earth-orbiting satellites that allow for cheap, although intermittent, connections.

Connections at the local level, or the "last mile," are often the most difficult to establish in developing countries due to poor telephone infrastructure, particularly in rural areas. Approaches to dealing with constraints at the local level include: making the most of existing telephone lines through the use of store and send technologies that minimize on-line connection time; using local area networks that can allow an entire organization to access the Internet through a shared connection; or, using wireless technology.

A country's Internet infrastructure requires continual maintenance to ensure proper functioning. Computers can be protected from common natural and human hazards by using clean, climate-controlled, secure environments whenever possible and by maintaining proper energy sources through the use of surge protectors and back-up power supplies.

Networking systems at all levels require a wide assortment of supporting telematics equipment. Unfortunately, this equipment is neither widely available nor affordable in the developing world. Approaches to this issue include: in the short term, importing necessary equipment from abroad, in which case government policies play an important role in determining availability and cost; seeking equipment discounts or donations; obtaining available free software through the Internet; or, in the long term, fostering the growth of local telematics industries if they exist or encouraging the creation of such industries if they do not exist.

Internet maintenance requires personnel skilled in managing data flow and servicing complex hardware. However, since networking is so new and rare in most of Africa, trained technicians are few, and technician training institutes fewer. For the long-term, mechanisms to make technician training self-sufficient within each country must be put in place. A nation's university system is one place where personnel to staff networks might be recruited since students should have some knowledge of computers and feel comfortable with them. Another approach is to conduct on-the-job training for employees who will eventually maintain an organization's network. The Internet itself provides tremendous resources for information on computer networking.

1.4 END-USER ISSUES

As with any technology, the Internet will benefit a society only to the extent that its citizens and institutions have access to it, understand how to use it, and harness its power to improve job performance. Unfortunately, for most in the developing world the means to access the Internet are unavailable or unaffordable, the skills needed to utilize it effectively are underdeveloped or

nonexistent, and an appreciation of how it can be used to advance society has yet to be grasped by all but a minority of visionaries.

Connecting to the Internet is predicated upon familiarity with the Internet and knowing how to obtain the service. More concerted efforts will have to be made to educate developing country institutions about the Internet, thus assisting them to make effective decisions regarding their use--or non-use--of the Internet.

Given the relative level of income in developing countries, telecottages, or public access points, can provide Internet use without a tremendous initial investment in hardware. Telecottages can be strategically placed to bring the Internet to populations in remote areas, simultaneously furthering the goal of universal access. The media also can play a crucial role in raising public awareness of the Internet.

An end-user strategy for information use and dissemination is critical to gaining maximum benefit from the Internet. Ideally, information strategies should be formulated before connecting to the Internet. Information technologies and information-based services are relatively new to Africa, so institutional strategies for obtaining, disseminating, and managing information will often be absent.

Organizations must confront a number of obstacles when integrating complex information technologies into the workplace. First and foremost, they must acquire the necessary equipment, which can be scarce and expensive in developing countries. Second, they must have staff who are trained in using the technologies and this training is also often in short supply. Finally, organizations must be able to deal with problems that might--and surely will--arise with the equipment and programs.

1.5 CROSS-CUTTING ISSUES

Numerous agencies and organizations have developed initiatives and projects over the last few years to encourage the development of information technologies, particularly the Internet, in Africa. However, information coordination between these networking projects is poor. Some solutions to this problem include: establishing a national repository of information on IT projects; improving communication fora among donors and partners, particularly through use of the Internet; and, conducting regular conferences on IT.

Whenever and wherever a new technology is introduced, cultural factors inevitably affect the success and manner of its use. Language, content, social and gender roles, and cultural preservation and relevance will determine the Internet's reception by every society.

2.0 INTRODUCTION

2.1 THE LELAND INITIATIVE

In 1995, the U.S. Congress approved the Leland Initiative, a five-year, $15 million, interagency initiative designed to assist up to 20 African nations in connecting to the Internet and other electronic technologies that Africans can use to promote sustainable development activities. Also known as the African Gateway to the Global Information Infrastructure (GII) Project, the Leland Initiative was named in honor of Mickey Leland, a former member of the U.S. Congress who was killed in a plane accident over Africa. Mr. Leland had done extensive work in African affairs while a member of the U.S. Congress and was a strong advocate of U.S. support for Africa.

Coordinated by the U.S. Agency for International Development (USAID), the Leland Initiative's activities contain three strategic objectives (SOs):

1. SO 1, carried out by the U.S. Department of State, is to promote policy reform to permit the introduction of telematics technology and reduce barriers to open connectivity.
2. SO 2, implemented by the National Aeronautics and Space Administration (NASA), is to ensure the local availability of reliable, accessible, and cost-effective services for accessing information.
3. SO 3, carried out by USAID, is to achieve a broad-based use of information and global information technologies by the public and private sector to meet the challenges of achieving sustainable development.

Numerous groups, including other donors, non-governmental organizations (NGOs) and private voluntary organizations (PVOs), as well as private sector groups, have already undertaken the initial introduction of telematics technology in Africa and other parts of the developing world. Recognizing the importance of building on lessons learned, USAID has developed this paper to capture the best practices of prior and current information technology (IT) activities.

The paper reviews issues and obstacles encountered in each of the three Leland strategic objective areas, and examines potential solutions.

2.2 INTERNET FOR AFRICAN DEVELOPMENT

The developed world is experiencing explosive growth in Internet-related technologies as individuals, governments, corporations, and other organizations realize the vast potential benefits offered by the Internet. Whether for personal fulfillment on an individual level, a more responsive bureaucracy at the public level, or greater productivity and profitability at the commercial level, the Internet must surely represent one of the pivotal technologies--such as the telephone or the automobile--that can and probably will change the way society works.

Given the fact that most of sub-Saharan Africa remains underdeveloped, it might seem to many that promotion of the Internet on the continent is premature. However, numerous studies indicate that investment in telecommunications technology yields impressive returns in terms of economic growth and development (Parker 1992, 156). The Internet can provide the remote, "unconnected" countries of Africa with newfound abilities to participate in global trade and production, gain better access to information, achieve and maintain international competitiveness, enable more efficient public administration and management, and make possible environmentally-friendly development (Nagy 1995, 12).

The potential for Internet contributions to growth and sustainable development in the developing world exists not only in the economic sector, but also in the health, education, democracy, and environment sectors. The following list, based on Internet experience to date in the developed world, cites a few of the potential applications:

2.2.1 Health/Population/Nutrition

Telemedicine. Doctors in the field can use the Internet to collaborate with experts worldwide, thereby gaining instant access to advice when it is most needed.

Disease Control. Widespread availability of the Internet provides a means for effective, timely tracking of disease outbreaks.

Public Health. The Internet can be used to provide cost-effective dissemination of public health information in an appealing, eye-catching format that should provide greater impact than newsprint or radio alone.

Logistics. Computerization of inventory management, particularly through the Internet, will lead to improvements in shipment of food, medicine and other provisions. For example, stocks of supplies in the field can be monitored on an up-to-the minute basis. Supplies can be shipped in accurate amounts at the proper time, leading to fewer shortages and less waste.

2.2.2 Education

Distance Learning. Like telemedicine, distance learning involves drawing upon experts in cyberspace, where physical proximity becomes irrelevant. For example, African university computer science students could "sit in" on a lecture at a university in another country. While this may have seemed like science fiction just five years ago, ever more effective and cheaper videoconferencing equipment, combined with a robust Internet connection, makes such an arrangement increasingly possible worldwide.

Computer Literacy. Once the infrastructure is in place, the Internet can be tapped with relatively inexpensive computer equipment. What is considered second-hand equipment in much of the developed world could be used to access the Internet in Africa. Donations of this

equipment, along with the prospect of cheap "Internet boxes," offers a real opportunity for introducing millions of African school children to the computer age.

2.2.3 Democracy and Governance

Citizen Access to Government. The Internet can improve citizens' access to government documents, services, and officials. It also allows the public to participate in the democratic process by providing a forum to express opinions and preferences.

More Efficient Bureaucracy. For the same reasons that Vice President Gore's "Reinventing Government" initiative emphasizes information technology, the Internet can improve the efficiency and responsiveness of local, regional, and national governments in Africa.

Greater Freedom of Information. Tele-connected societies are theoretically more democratic. Attempts to quantify telecommunication's impact on democracy have argued that totalitarian regimes are untenable where telephone densities are greater than 20 per 100 inhabitants (Hegener 1996, 5).

2.2.4 Economic Growth

Financial Markets Information. The Internet is an ideal medium for instantaneous transmission of financial market information. It can be used to wire stock exchanges to others in the region and worldwide.

Business and the Internet:
Internet "Free Zones"

Economic free zones have encouraged export growth in many developing countries for years. With robust Internet connectivity, a developing country could encourage export earning through telecommunications free zones as well. In a recent paper, Robert Schware and Susan Hume pointed out that the countries of the Eastern Caribbean could take advantage of low labor costs, a newly-updated telecommunications infrastructure, and an open investment policy to deliver various offshore processing for foreign companies.

One such office-park style free zone, using an earth satellite link to North America, is already in operation in Grenada. The operation created over 200 new positions to process 100,000 Federal Express waybills, which arrive as data images, every day. It is estimated that Federal Express' needs in this area alone could ultimately create over 2,000 jobs (Schware 1994, 1-4).

Worldwide Marketing of Goods and Services. The Internet--particularly its World Wide Web component--can be used to reach a mass market of tens of millions in a graphic, visually-appealing way. The Web may be particularly suited to the tourism industry, which can attract Web surfers with high-quality multimedia presentations of popular destinations.

Increased Productivity. No matter what the industry or service, almost every economic activity benefits from being connected to the rest of the world--or simply the rest of the office--and the up-to-date information the Internet has to offer. "Intranets"--local area networks (LANs) based on the Internet--provide a means to offer basic services such as inter-office e-mail and database sharing, while at the same time providing full Internet access.

2.2.5 Environment/Natural Resources Management

Environmentally-Friendly Technology. Widespread use of the Internet could encourage services industries that are relatively benign to the environment.

Satellite Imaging Technology. Through satellite imaging technology, where snapshots of regional conditions can be instantaneously transmitted to anyone on the Internet, local researchers can track climatic and environmental conditions on a real-time basis.

Access to Research and Researchers Worldwide. Through the Internet, local universities, government agencies, NGOs and PVOs, and donor organizations are able to tap into a tremendous storehouse of research on environmental problems and solutions.

2.3 CURRENT STATE OF TELECOMMUNICATIONS IN AFRICA

The principal impediment to implementing many of the applications described above is the currently abysmal state of telecommunications in Africa. As South Africa's Deputy President Thabo Mbeki pointed out during a G-7 conference in February 1995, there are more telephone connections in Manhattan alone than all of sub-Saharan Africa (Holderness 1996, 4). Of the 49 countries that have less than one percent phone coverage, 35 are in Africa (Panos Institute 1995, 3).

As would be expected, if telephone availability in Africa is poor, then access to the Internet is practically nonexistent. As of 1995, only seven African countries had direct, full-access Internet links, with a few others making plans for full connectivity (Adam 1996, 1), although this number had risen to over 15 by July 1996. As is the case with telephones, even where full Internet access is available, it is priced beyond the means of most citizens, even assuming they own the computers needed to access the Internet.

Perhaps most importantly, very little exists in the way of "content markets" to drive private telecommunications development. In the United States, Europe, and most of the developed world, already-high demand for business phones and fax lines, various automated phone services (such as tele-banking), and on-line entertainment services (most notably cable TV) ensure that there will be a demand for high-tech Internet and World Wide Web services. Accordingly, private companies can reasonably expect a payoff for the considerable capital investment required for widespread Internet access. Given the paucity of demand for such services in most of Africa, encouraging private sector Internet development becomes much more problematic.

2.4 NATIONAL INFORMATION INFRASTRUCTURE PLANNING

Despite various constraints, from poor telecommunications infrastructure to low levels of economic development, African countries are beginning to connect to the Internet in greater numbers. Although the private sector will be the major engine that drives the growth of this technology, governments have an important role to play in advancing the development of viable National Information Infrastructure (NII) plans that give their "citizens access to a broad range of information and information services" (Information Infrastructure Task Force 1994, 40).

A NII plan serves as the basis for the development of Internet technologies at a country level. Plans will be different for each country, but they should cover government information and telecommunications policies, infrastructure design, and awareness and training schemes, among other issues (Walker 1995, 16). The Information Infrastructure Task Force (IITF) of the United States serves as a model for the type of coordination that can be arranged at the national level to help guide a country's approach to working with the Internet. The IITF includes representatives from federal agencies and research bodies who examine technical, legal, regulatory and other aspects of information infrastructure development. An advisory council including representatives from industry, labor, academia, public interest groups, and local governments ensures that the IITF receives input from a cross-section of the country (Walker 1995, 16). Developing countries may want to consider similar arrangements to provide an accommodating framework for the approaching Internet age.

3.0 POLICY ENVIRONMENT

3.1 POLICY'S ROLE IN INTERNET DISSEMINATION AND USE

Government policies can profoundly affect the course of a country's use of information technologies (IT) by establishing either a positive, encouraging environment that nurtures growth and development, or a restrictive, rigid environment that impedes it. This chapter examines some of the policy issues that must be addressed in order to foster the development of IT applications. These issues fall under three main categories: policies governing the telecommunications industry ownership and regulation; policies governing the ownership and regulation of electronic information; and policies designed to encourage IT promotion and technical training.

Telecommunications industry ownership and regulation policies include those affecting:

1. privatization and liberalization of telecommunications infrastructure;
2. telecommunications industry regulation;
3. taxation and tariffs;
4. openness of markets; and
5. universal access to telecommunications services.

Policies relating to ownership and regulation of electronic information include those governing:

1. intellectual property rights;
2. on-line security and confidentiality;
3. censorship; and
4. regulatory authority.

Promotion and technical training policies include those designed to promote:

1. awareness programs;
2. national workshops;
3. technical training;
4. fora for IT networking; and
5. government procurement.

3.2 TELECOMMUNICATIONS INDUSTRY OWNERSHIP AND REGULATION

Economic growth and development are increasingly dependent upon global and domestic information flows, which in turn depend upon sound telecommunications systems. In general, countries with policies that have encouraged modernization, growth, and diversity in their telecommunications industry are experiencing greater economic development. Accordingly, developing countries should consider their telecommunications systems not just as public utilities but rather as tools critical for social and economic improvement (Lerner 1991, 280).

Approaches: Telecommunications Industry Ownership and Regulation

Privatization and Liberalization. The telecommunications industry in Africa and other parts of the developing world generally have been dominated by state-owned monopolies. These institutions tend to be inefficient and provide poor quality service; thus, they are ill-equipped to bring the Internet effectively into their countries. One solution to this problem is to transfer operation of telecommunications services to the private sector.

The Power of Privatization:
St. Kitts-Nevis Telecommunications System

"In 1985, our telecommunications system was government-owned and about as bad as you can imagine," said Prime Minister Denzil Douglas of the Caribbean nation of St. Kitts-Nevis. "Now our system is privatized. The rates to the consumer are a bit higher, but we have a very advanced fiber-optic system, and 60 percent of our schools have access to the Internet. Unless a country can provide a modern system, I would advise them to take it out of the state's hands and put it into the private sector" (Fleming 1996, 1, 7).

Privatization and liberalization, two separate but related processes, are the most widely used procedures for restructuring state-owned telecommunications industries (Adam 1993, 6). Many countries use these processes in order to encourage expansion and improvement of their telecommunications networks and provide needed new services. The processes may be implemented in a number of ways; thus, they should be designed specifically to meet the individual needs of each country (Lerner 1991, 281).

Privatization refers to the process that transfers to the private sector some or all operations, management, and/or ownership of state-owned facilities. The degree of transfer can fall anywhere from minor loosening of bureaucratic restraints on existing telecommunications departments to the complete private ownership and operation of telecommunications facilities.

Liberalization refers to the political and regulatory changes that accompany privatization. These changes help ensure that privately-owned corporations operate efficiently for the public good. Liberalization provides the framework for replacing often-rigid state telecommunications regulation with reliance on competitive market forces. Liberalization encourages competition and provides opportunities for new innovative facilities and services of the in market segments such as cellular radio-telephone, private satellite business networks, and other value-added services such as electronic mail and database services. In developing countries with limited financial resources, these facilities and services can be made possible by liberalization, which may spur private parties to finance and operate separate networks or to interconnect private computer facilities to the existing public network.

Telecommunications Industry Regulation. Although privatization and liberalization are designed to bring more freedom to the operation of the telecommunications industry, the government must provide some regulatory oversight to ensure fair and open practices.

Literature suggests that governments may need to perform the roles of:

1. awarding and regulating franchises;
2. specifying appropriate technical standards; and
3. ensuring access to all systems.

Other regulatory responsibilities, outlined by the International Telecommunication Union (ITU), include:

1. defining the distinction between public and private services;
2. interpreting the law and reconciling policy objectives;
3. ensuring fair competition for new entrants;
4. ensuring efficient procedures for interconnecting new and existing service providers;
5. monitoring reasonable pricing-to-cost ratios and relating this to quality of service;
6. authorizing and assuring the transparency of subsidies when they are necessary; and
7. establishing well-defined, transparent dispute resolution procedures (McCormick 1993, 149).

Decisions regarding the policies above can have far-reaching economic and political implications; therefore, responsibility for administering and enforcing regulations should reside with an independent agency or agencies. In many developing countries that take the road to privatization, these agencies--unnecessary in monopolistic, state-owned telecommunications structures--will have to be created from the ground up. It is better that the government have at least some regulatory structure in place before privatizing its monopolies; otherwise, uncertainty over the rules under which the company will operate may diminish the price investors are willing to pay--or suffocate interest in the transaction entirely (Berenson 1991, 403).

Taxation and Tariffs. Governmental control of taxation and tariffs gives it a powerful tool for encouraging the development of Internet-related markets. Unfortunately, many developing countries heavily tax IT equipment and services, using them as cash cows for government funds. While this raises much-needed revenue in the short-term, high taxes and tariffs work in the long-term to discourage consumer demand and telecommunications industry expansion. Zambia, for example, currently levies a 15 percent duty on computer hardware and a 20 percent duty on software imported into the country, thereby making computer equipment even more unaffordable in an already poor country.

In addition to dampening widespread usage of IT technologies, high tariffs can also hinder the development of local Internet Service Providers (ISPs), which need to make large purchases of sophisticated equipment to start operations. Overly high consumer taxes on IT equipment and services can hinder the computerization of both organizations and homes by resulting in higher prices. At the same time, high producer taxes can hinder the development of local IT industries

by either cutting into profit margins, leaving fewer funds for reinvestment, or by making expected profit margins low enough to retard investment and new business start-ups in the IT sector.

In addition to eschewing growth-retarding tax and tariff structures, government policies can proactively encourage IT development. Such policies can include providing tax incentives and investment-stimulating depreciation schemes that can assist in promoting IT network diffusion. Possible measures range from accelerated depreciation for investment in network hardware and software to tax breaks for firms investing in IT training (Organization for Economic Cooperation and Development 1992, 64). Other measures include tax waivers for new IT ventures, access to targeted credit (perhaps at concessional rates), and tax deferral for newly-privatized IT companies to ameliorate their transition to stand-alone profitability (Hotvedt 1987, 58-59).

Openness of Markets. Maintaining barriers against potential new entrants into communications markets will inhibit infrastructure deployment. Moreover, these barriers will retard the introduction of new information and telecommunications services that require competitive access to underlying networks in order to flourish. By ensuring fair and open access to facilities and networks, thus promoting competition, governments can dramatically increase the availability of information services to consumers (Information Infrastructure Task Force 1994, 9-10).

Regardless of the regulatory model adopted, regulations should clarify the respective rights and obligations of incumbent operators and new entrants. New market entrants need assurance that incumbent operators will not be allowed to use their dominant market positions to hinder the evolution of successful competition (Information Infrastructure Task Force 1994, 14). For this reason, clearly delineated anti-trust laws are crucial to free competition.

Universal Access to Telecommunications Services. The social disparities common in developing countries threaten to create similar classes of information "haves" and "have-nots," since poor infrastructure and high costs often make the Internet available only to the wealthy. In order to bring the benefits of Internet access to as many citizens as possible, governments may need to support rural/remote connectivity schemes or plans to partially subsidize service for poorer citizens. Particularly in the case of rural connectivity, which may require the construction of entirely new infrastructure, government may need to fund some infrastructure construction itself, provide incentives to private organizations, or allow at least partial foreign ownership of such ventures (Parker 1992, 162).

Given the relatively high cost of gaining access to the Internet, governments may want to consider establishing or supporting community access points or telecottages to help ensure equitable access throughout society. These centers should be equipped to allow those who cannot afford the equipment for Internet access to make use of information services. This type of service might be viable as a private sector undertaking. Fees could be charged for various levels of services, from a basic e-mail account to World Wide Web access. Public access to at least e-mail services could be provided through the national telecommunications provider or other public offices.

3.3 OWNERSHIP AND REGULATION OF ELECTRONIC INFORMATION

The long-term sustainability and profitability of a privately-owned, well-regulated telecommunications industry will only be successful to the extent that there is robust demand for the services (i.e., electronic information in its various formats) made available by the infrastructure (Stern 1995, 4.1). For supply and demand forces to operate effectively, the government must protect suppliers' interests in receiving payment for content and consumers' interests in being able to transmit information with confidentiality and conduct monetary transactions securely. Therefore, it is critical that the legal system protect intellectual property issues and address Internet security issues, while at the same time punishing security breaches and enforcing copyright infringements.

In addition to providing an environment conducive to value-added information flows over the Internet, government policies can also have a societal role to play in regulating the content of electronic information; such policies can be designed to curb the availability of "indecent" information or restrict the flow of information considered vital to national security, for example. While many legal issues surrounding the Internet are still in a nascent stage, policymakers should be aware that these issues are bound to arise and would be better addressed in a preemptive, proactive manner.

Approaches: Ownership and Regulation of Electronic Information

Intellectual Property Rights. Intellectual property issues have grown in importance as more nations connect to the Global Information Infrastructure (GII). The Internet gives users the ability to easily download research materials, full-text journals and books, and computer software. Since much of this material is meant to be available only for a fee, there must be sufficient oversight to ensure that this information is not "pirated," or downloaded illegally without payment.

Since content providers will be reluctant to make available information for which they are not being paid, a government's failure to enforce intellectual property rights will eventually hamper electronic commerce and dissemination of information over the Internet within that country. At the same time, confusion over the definition of copyrighted material--as well as confusion over the extent to which they are obligated to police their databases for infractions--may make in-country Internet content providers more reluctant and slower to disseminate electronic information (Kirsh 1994, 1-3).

On-line Security and Confidentiality. While the Internet's open, unregulated, and diffuse nature makes it an unparalleled tool for communications and commerce, the same traits also make it quite vulnerable to unwanted outside intrusion. Such abuses include illegal acquisition of credit card numbers, misrepresentation through fake e-mail addresses, Internet business scams, and on-line libel. Other practices that may have legitimate goals, but which are also ripe for abuse, include workplace and government monitoring of Internet transactions and collection of personal data on individual users by organizations.

Quality and technical standards--such as interconnection standards, service quality standards, allocation of radio spectrum, and privacy standards--all play a crucial role in protecting society and strengthening markets' confidence in the Internet for routine use. Regulations must provide legal standards to uphold quality standards and avoid confidentiality breaches (Talero 1996, 3.5).

Censorship. To the governments of some developing countries, information technology in general--and the Internet in particular--has been perceived as a threat to social order and national security. China, Vietnam, and Singapore have already announced their intentions to control information that can flow into their borders over the information superhighway. Since material available on the Internet remains uncontrolled by a central authority, each of these governments has taken unilateral measures to limit what is available there (Panos Institute 1995, 17).

Concerns about online pornography, computer hacking, and other seedy activities are certainly legitimate and will need to be dealt with as the Internet becomes more ubiquitous and integral to developing countries' economies and societies. Nonetheless, overly restrictive regulations governing access to the Internet and the kinds of information available can have a negative effect on electronic commerce, media use of the Internet, and even its use as a medium of conversation between acquaintances. Furthermore, concerns over legal liability for information transmitted or received by their customers may stifle the growth and innovation of ISPs (Farber 1994, 1-2).

Regulatory Authority. To oversee, implement, and enforce regulations regarding electronic information ownership and standards, a national regulatory body should be established. To maintain impartiality and to resist political pressures, the authority should be as independent as possible from both the interests it oversees and the government itself (Ghobash 1996, 40).

3.4 PROMOTION AND TECHNICAL TRAINING

The government can play an important role in advocating and encouraging a broad, well-trained IT user base. Some of the policy instruments available to meet this objective include establishing awareness programs, developing national workshops, providing technical training, organizing fora for IT networking, and integrating information technologies into government operations.

Approaches: Promotion and Technical Training

Awareness Programs. Governments can provide information on new information technologies to individuals and firms. Some governments are developing programs designed specifically to increase IT awareness among small- and medium-sized enterprises. These programs include developing written and visual material on the types of computer networks available, providing rosters of possible vendors, and developing training programs (Organisation for Economic Cooperation and Development 1992, 59).

National Workshops. National workshops should be attended by representatives of all the stakeholders involved but limited to those who are experienced in the various aspects of communication for development (Woods 1996, 2-3). National workshops should define the

nation's development communication policy and create a formal action plan that outlines the government steps required to make the policy operational. Workshops should also address coordinating the activities of donors to avoid duplication of efforts and to ensure that all inputs to communication for development are in line with the national policy.

For example, workshops held in Mali and Guinea Bissau analyzed existing media channels and structures and produced a series of recommendations to improve their potential for IT development purposes. Both workshops also recommended upgrading the status of the profession of communication for development, as well as specialist training ranging from communication skills training for field workers to higher level academic training for communication planners and managers (Woods 1996, 4).

Technical Training. In many developing countries there are few indigenous informatics professionals. Many such professionals are needed to maintain IT infrastructure, to foster the development of national telecommunications industries, and to exploit new development opportunities (Talero 1996, 3.4). Training programs are costly and must be considered within the entire governmental training/retraining/education program. From data and trends examined by the OECD, IT network skills will be increasingly needed. Hence, the examination and matching of skills, needs, and training programs is a crucial part of the infrastructure required for IT development (Organisation for Economic Cooperation and Development 1992, 60).

One of the more effective training methodologies is assembling representatives from government, academia, and the private sector to develop curricula for on-the-job training and scholastic education. Brazil undertook this type of partnership in developing science parks with the goal of increasing its share of the global software market. These science parks emphasize the creation of new technology businesses in a particular sector (computer software, for example), essentially acting as business incubators. The parks can be owned by government, academia, the private sector, or a consortium of any combination of the three (Talero 1996, 3.4, 5).

Fora for IT Networking. A move towards broader IT networking requires agreement between key network participants (those responsible for building the network, those responsible for maintaining it, and the end-users who will utilize the network) and between participants and the government on standards and protocols, implementation timetables, financing schemes, and so forth. Government can play a role in this process by setting up fora where potential participants in these networks can meet to discuss such issues. Policymakers can also help by removing existing regulatory constraints that overly restrict firms' ability to pool resources and cooperate (Organisation for Economic Cooperation and Development 1992, 60).

Government Procurement. Governments themselves constitute large enterprises with a multitude of offices and employees, many of whom would benefit from information technologies. An OECD Information Technology Policy Forum held in 1990 confirmed that in several regions government procurement of IT was designed to create and spread the use of new IT systems and networks. For example, the French government launched a pilot program to automate administration of governmental and related services such as hospitals and libraries to bring

together government and industry to upgrade IT network skills. This type of policy intervention is a low-cost means of expanding information dissemination and networking ability (Organisation for Economic Cooperation and Development 1992, 61).

4.0 TELECOMMUNICATIONS INFRASTRUCTURE

4.1 OVERVIEW OF INTERNET-RELATED TECHNOLOGY

The Internet can essentially be described as a "network of networks." The architecture upon which the Internet is based, the Transmission Control Protocol/Internet Protocol (TCP/IP), allows for computers and networks of various types to communicate with each other. Because these computers are using the same "language" to communicate, they all become part of a seamless "virtual network" (Jensen 1995, 4).

For the purposes of this study, Internet connectivity will be examined at three levels: international, intranational, and local. International connectivity refers to the high-capacity connections that allow Internet service to be distributed within a country. Even if a nation has the most advanced telephone network available, it is of little use if this system remains unconnected to the rest of the world.

Intranational connectivity refers to the means used for Internet transmission from one or more entry points to various regions within a country, where it can be more efficiently distributed to individual organizations or Internet Service Providers. Intranational networks thereby bridge the gap between the few high-level, international Internet connections and the numerous, less-robust connections required for widespread Internet dissemination.

Local level access entails bringing Internet connections to individual homes, businesses, schools, organizations, and any other interested end users. Local connectivity is often referred to as the "last mile" of Internet service. Very often in the developed world, the same simple copper lines that provide telephone service also serve as local access points to the Internet. The lack of widespread phone service in Africa, however, will often dictate alternative approaches.

This chapter will examine the physical infrastructure over which data can travel. After examining various approaches to bringing Internet connections to a country, issues surrounding the operation and maintenance of a network and telematic equipment will be explored. In addition, human resources issues and other technical aspects of Internet service will be discussed.

4.2 INTERNET CONNECTIVITY OPTIONS

The poor state of Africa’s telecommunications infrastructure is both a blessing and a curse. On the one hand, the absence of widespread, high-quality phone lines means that Internet service cannot be cheaply and quickly brought into most homes and small businesses upon demand, as is currently the case in the United States. On the other hand, this lack of infrastructure provides an opportunity for "leapfrogging" the copper wire technology of the past for more advanced transmission systems that can be built from the ground up.

New technologies are increasingly blurring the lines between national, regional, and local telecommunications infrastructures. In some cases, full and direct access to the Internet can be achieved while entirely bypassing an international Internet gateway that may or may not exist within a country. For example, organizations that employ many individuals, such as universities, NGOs/PVOs, donor organizations, and multinational corporations, can increasingly afford full access to the Internet through satellite hook-up. Other schemes allow for basic Internet connectivity and the ability to use e-mail through "store-and-forward" systems, which will be detailed later.

4.2.1 International Access

In most cases, Internet access must be brought to a country through an international gateway before the citizens of that country can expect regional and local connectivity. Using a roadway analogy, Internet connectivity at the international level would be equivalent to an interstate highway. Much as an Interstate provides high volume, high-speed transit to connect various state and local highway systems, main Internet connections link together the various national networks that already exist. In the past, the price of admission to the global telecommunications network meant laying expensive, unwieldy copper wire across vast distances, often underwater. Fortunately, a number of other options now exist in addition to copper wire.

Approaches: International Access

Leased Lines. Leasing existing high-capacity lines has been the most conventional way to access the Internet at the country level. The main drawback to this approach is its high cost, with even low-capacity lines often costing thousands of dollars per month (Hegener 1996, 4). As a result of technology advancements, leased copper lines are little-used today for international telecommunications access in Africa. Most traffic now travels by satellite or high-capacity fiber-optic cable (Hegener 1996, 10).

Satellites. The use of satellites is one way to circumvent the logistical problems associated with laying fiber-optic or copper wire. Geostationary satellites, which travel in an orbit constantly fixed over a particular point on Earth, can provide Internet transmissions to ground receiver nations anywhere under the satellite's "footprint"--the area on Earth within an unobstructed line-of-sight to the satellite (Hegener 1996, 9).

With this system, a local Internet node would communicate with a remote Internet node via a dedicated satellite connection, thereby providing a full range of services, including World Wide Web. The main drawback to this approach is cost. Since this arrangement requires construction and staffing of a ground receiver station, as well as leasing a satellite connection, this option has an initial per-country cost between $250,000-$500,000, as well as monthly operating costs over $10,000 (Azhar 1996, 51-52).

Fiber-Optic Cable. Fiber-optic cable, with its tremendous data capacity, constitutes the high-end, high-cost approach to international Internet access. Many African countries can hardly

afford financing this infrastructure independently. However, sharing the initial cost of laying the cable and associated hardware--as well as continuing to share the cost of maintaining the system--could make fiber-optic plausible for Africa.

Fiber-optic cable is being used successfully in other regions of the developing world, such as the Caribbean (Wittering 1994, 69-73) and Eastern Europe (Lopota 1995, 1-5). Indeed, work on bringing fiber optic to Africa has begun in earnest as well (see Africa ONE box).

Fiber-Optic Connectivity:
Africa ONE

Africa ONE represents an ambitious plan to construct a fiber optic network around the entire African continent. AT&T plans to spend over $2.5 billion over the life of the project. Construction begins in 1997 and is scheduled for completion in 1999.

Africa ONE will span over 39,000 kilometers and will be mainly submerged underwater, thereby shielding it from many environmental hazards that can cripple terrestrial systems. It will incorporate many state-of-the-art features, such as Wavelength Division Multiplexing, a means of transmitting several spectra of light on a single fiber, thereby providing a great deal of capacity. The network will connect directly to coastal Africa countries and perhaps indirectly to interior nations through satellite, existing cable, and/or other wireless technologies. Africa ONE will have fiber-optic links to several European Mediterranean nations, including Italy, Portugal, Spain, and Greece. It will also link to other overseas networks through existing intercontinental cables.

Current plans have Africa ONE owned by Africans and operated as an independent corporation. The capital funds will be raised through term financing, equity, and other capital financing if necessary. This debt will be amortized by leasing line capacity to interested African telecom carriers. The network will not only cater to Internet service providers, but also to television and telephone providers. As envisioned, Africa ONE should provide an extremely fast, flexible, and reliable means of telecommunications services of all types for Africa (AT&T 1996).

4.2.2 Intranational Infrastructure

In countries where telephones are ubiquitous and long-distance calling is commonplace, the issue of intranational networking is a minor one since extremely robust telecommunications trunks are already in place. In most African countries, however, there is little demand for central telecommunications trunks, as there are few telephones to interconnect within the nation. As developing countries establish international connections to the Internet, a strong intranational infrastructure will become more essential for widespread dissemination of information technologies, particularly in rural areas.

Approaches: Intranational Infrastructure

Terrestrial Cable. Wire-based data trunks have been in place for years to provide telephone access within developing countries. While copper-based trunks have the advantage of already being in widespread use even in developing countries, they generally offer very low bandwidth and are subject to interference, leading to errors in data transmission. Trunk routes all over the world are being upgraded to fiber-optic, which offers a tremendous increase in bandwidth and reliability compared to copper lines. The process, however, is expensive and will take years to complete the upgrades.

In the interim, X.25 networks can bridge the gap between low-bandwidth, low-quality phone trunks and high-cost fiber-optic trunks. X.25 networks are publicly-accessible data networks that link to the global Packet Switched Data Network (PSDN). Using X.25 can be expensive for international Internet access since fees are assessed according to the quantity of data that is sent and received. However, data charges are somewhat lower for intranational connections. Taking into consideration the fact that X.25 connections are more reliable and less prone to interference than many national trunklines for voice-grade transmission, X.25 networks--at least at the intranational level--can serve as "an effective tool for low cost telematics" (Jensen 1995, 10).

Linking Existing Networks. One cost-effective option for expanding intranational networks is simply to interconnect existing networks. For example, connecting the networks of public institutions, such as universities, that are the most telematically advanced provides regional access for further Internet connections (Kritsky 1995, 1-6; Cannata 1991, 22-23; Shkarupin 1995b, 1-7). If it exists, extra line capacity in the networks can be leased to other organizations or ISPs, thereby raising funds for network expansion and continuing operation expenses.

Another strategy is to link the existing networks of private firms and international agencies to form a larger, publicly-accessible network. The newly interconnected organizations would continue to use the network as before, but with additional capacity that could be leased or donated to interested parties (Azhar 1996, 53).

Wireless. The use of airwaves to transmit data is becoming an increasingly popular option for regional networking as the technology improves and prices fall. Radio-based networking options, such as microwave transmission, are especially useful in remote or mountainous regions, where the cost of laying cable would be prohibitively high.

The newest wireless technologies are both reliable and fast. Atmospheric interference can be overcome using packet technology through which receiving stations automatically register what packets of data are received during transmission and re-request any data that was not received. Wireless systems' range can extend up to 50 kilometers and carry up to 64 kilobytes per second at a cost of less than $3,000 (Jensen 1995, 7). On the downside, while wireless backbones obviate the need for laying wire, they do require relay stations to extend their range beyond that of one transmitter alone. To establish and maintain these stations, additional upfront and recurring expenses must be met.

4.2.3 Local Infrastructure

For most Internet users in the developed world, connecting to the Internet merely requires making a call to a local Internet Service Provider over an ordinary phone line that is connected to a modem and computer. Unfortunately, phones are still uncommon in much of the developing world, especially in sub-Saharan Africa. Even where phone lines do exist, their quality is often too poor to support viable Internet connections. Assuming that most homes and small organizations in Africa will not have Internet-ready telephone service in the near future, alternatives to conventional telephone service must be explored.

Approaches: Local Infrastructure

Existing Lines. One solution to providing Internet access where phone connections are poor is to make the most of what is already there. Store-and-forward systems entail storing together a number of e-mail messages or any other binary information and sending them out over ordinary telephone lines or to low-earth orbiting (LEO) satellites in one delivery to a remote Internet node.

Low-Earth Orbiting Satellites:
VITASAT

For years Volunteers in Technical Assistance (VITA) has been using a number of advanced technologies to facilitate development projects in telecommunications-poor countries. In conjunction with terrestrial packet radio systems (VITAPAC) and store and forward e-mail messaging systems (VITANET), VITA uses a low-earth orbiting satellite (LEO) system, called VITASAT, to provide communications connectivity to even the most remote areas of the globe.

VITASAT operated with two LEO satellites from 1984 to 1995, when it added an additional, higher-capability satellite to the network. These satellites collect data as their orbits bring them over ground stations in Africa and South America. As they orbit over Internet-connected ground stations elsewhere, they then download this same data to those stations for transmission over the Internet. In this way, VITASAT can deliver data to anywhere in the world in 90 minutes.

VITASAT is currently in the process of developing more flexible and mobile ground stations for use in remote underdeveloped areas. The new system is simple and requires little equipment (a laptop computer, a portable antenna, and special software). Furthermore, this setup is projected to cost just $3,500, with monthly on-line charges of about $50 per month for up to 100 kilobytes of data transfer. For researchers in remote areas, this system would truly be a cost-effective way to access the Internet (Volunteers in Technical Assistance 1996: 1-3).

Store-and-forward technology makes Internet access affordable and efficient by using telephone lines only as long as necessary. The time actually spent composing e-mails and documents is thereby separated from time spent online, considerably reducing actual connect time and phone charges (See VITASAT box).

By utilizing "Internet Access Points," store-and-forward can be an affordable alternative for those who do not even have telephone service. These access points are simply central locations where individuals can drop off a letter or document in electronic format or where users can sit and type out a message to be sent at a later date. Such a system is currently being used extensively by the Toolnet Foundation (*www.toolnet.org*), which is devoted to bringing information technologies to the developing world.

Using the right modem can also make a difference over poor telephone lines. Spending a few hundred dollars on a quality high-speed modem with error correction may allow acceptable Internet service on a poor phone line where lesser quality modems might fail. Even if the modem is capable of a higher transfer rate than the phone line to which it is connected, it can always take advantage of a higher speed line should the phone line be upgraded or should the modem be later used on a different, better line.

Local Area Networks. Perhaps more than any other solution, the use of local area networks (LANs) provides a cost-effective means for bringing full Internet access to large numbers of users. While a LAN's primary purpose is to interconnect office coworkers within the same building, it can also be used to connect those same people to the Internet. Any situation in which a number of coworkers occupy the same building or cluster of buildings--such as is often the case with offices for government agencies, universities, and corporate headquarters--is well-suited for a LAN configuration, if only for interoffice e-mail.

Once a LAN is in place, all LAN users can access the Internet by simply adding a router to the LAN, using a dedicated line to access the Internet directly or via an Internet Service Provider (Jensen 1995, 11). Since the LAN's interface to the Internet will most likely be more sophisticated and robust than that available to individual subscribers, LAN-based Internet services will be more comprehensive and speedier.

Alternatively, an entirely new regional backbone can be constructed, connecting existing and/or new LANs to that backbone. This approach might be more appropriate to national level educational, governmental, and scientific research initiatives, where the fiscal resources of national government can cover the relatively high costs of backbone construction (Azhar 1996, 51).

Wireless. Just as cellular systems are used to transmit telephone calls, so too can wireless technology provide data transmission for any site within a transmitter's range. This technology has been dropping in price lately, and for many applications--particularly in urban areas, where potential users are highly concentrated in one area--wireless technology is actually a cheaper option than laying copper lines.

One such technology, called "wireless local loop," or WiLL, is being used to provide phone service to large numbers of people in a number of countries, ranging from large-scale service in Spain (800,000 people) to service in remote areas of Sri Lanka and Colombia (Gifford 1995, 35-37). In addition to lower costs, other advantages of wireless technology include faster

deployment, greater mobility, and usefulness as a disaster recovery system when other telecommunications infrastructures are damaged. The use of wireless also has a security advantage over local-loop analog cables, which are sometimes stolen for the copper they contain (Jensen 1995, 7).

4.3 AVAILABILITY/QUALITY/COST OF TELEMATICS EQUIPMENT

Networking systems at all levels require a wide assortment of supporting telematics equipment. Depending on the mode(s) of transmission, this equipment can include satellite receiving stations, microwave transmitters, digital switches, internet protocol (IP) routers, and network servers, as well as the computer workstations used to interface with the Internet.

Having the best fiber optic system available is of little use unless the support hardware is widely available, relatively affordable, and capable of handling anticipated volumes of data traffic. Unfortunately, telematics equipment is in general neither widely available nor affordable in the developing world, where "people are lucky to have typewriters, let alone computers" (Holderness 1996, 2).

Approaches: Availability/Quality/Cost of Telematics Equipment

Importation. Absent local computer/electronics industries, the only short-term solution for most African countries is to import needed equipment. In this case, government policy plays a large role in determining both the availability and cost of the equipment. As discussed in the policy environment chapter, where government policy prohibits the importation of telecommunications equipment or where tariffs on computer equipment are relatively high, efforts should be made to persuade lawmakers of the benefits that wider use of advanced telecommunications systems can yield for all industries, including potential telecommunications industries (Parker 1992, 158-159).

Local Industries. A long-term approach to solving hardware availability is to foster the growth of local telematics industries if they exist or to encourage the creation of such industries if they do not exist. The advantages of this approach are quick access to computers or parts when needed, development of in-country expertise, lower prices (depending on tariff levels, level of competition, etc.), and self-reliance. Internal production would be better suited to peripheral computer components, such as modems, than more complex machinery such as routers. University departments can sometimes provide the technical expertise and equipment needed to build working prototypes of such equipment. This has been the case in Indonesia, where the Institute of Technology Bandung designed and built working prototypes of high-speed packet radio systems, packet radio modems, and associated controller cards for PCs using the system (Purbo 1993a, 1-10).

Another approach to developing local telecommunications industry is for local industry to enter into joint ventures with established foreign telecommunications equipment manufacturers. Both parties benefit--the foreign manufacturer gains a market foothold, and local industry gains vital

experience in developing and/or producing telecom equipment. The recent sale of satellite networks to India by a subsidiary of GTE Spacenet hinged in part upon a joint venture that will manufacture receiving station equipment locally (Parker 1992, 158-159).

Discounts/Donations. There is strength in numbers, especially when it comes to purchasing power. Organizations should jointly purchase computer equipment if quantity discounts can be obtained from vendors. Public organizations, especially educational institutions, also need to be aware of the special discounts vendors sometimes offer to their types of organizations (Jensen 1995, 4.3.4).

Availability of donated computer equipment should also be explored. Numerous non-profit organizations distribute computer equipment donated by corporations and individuals to organizations such as schools and non-profit organizations. Since many of the short-term network applications envisaged for Africa do not require state-of-the-art hardware, second-hand machines from the developed world could meet telematic needs in Africa.

Free Software. Much of the software needed to access and support the Internet and its applications is available free of charge (freeware) or for a small fee (shareware). Netscape, for example, has made its Navigator browser available for free to educational and charitable non-profit institutions. Even low-level methods of accessing the Internet, such as store-and-forward, can be used to fetch computer programs in remote databases (Hegener 1996, 3). Whenever possible, institutions should take advantage of these programs, especially since they usually can be downloaded from Internet sites, a definite advantage if there are no local computer stores.

Compatible Hardware. Whenever possible, computer purchases should consist of compatible hardware, preferably from the same manufacturer and of the same chip class. This allows for the substitution of defective components in one machine with functional components from another. This is especially true for critical components such as routers and servers, where hardware failure might impact many users and could result in lost time and money.

4.4 NETWORK MAINTENANCE: PHYSICAL INFRASTRUCTURE

To better understand the complexities of maintaining the Internet's infrastructure, we will again refer to a roadway analogy. Much as streets, highways, and interstates require a range of devices--such as stoplights, streetlights, cloverleafs, and bridges--to move traffic from point A to point B, so the Internet require a variety of supporting hardware to route data from one computer to another. Likewise, as roadways require regular maintenance to perform at peak, provisions also must be made to maintain international, intranational, and local-level Internet infrastructures for efficient and speedy performance.

4.4.1 Protecting Computer Equipment

A very real concern with situating computer equipment in a developing country is the ability to protect the equipment from natural--as well as human--threats. Computer equipment of all types is sensitive to the harsh extremes of weather. It is therefore imperative that electronics be housed in dust-free, controlled-climate environments. Generally, this means housing computers in air-conditioned areas. In some underdeveloped regions, these conditions may often be impossible to provide.

Approaches: Protecting Computer Equipment

Centralized Locations. One simple solution to environmental and security problems is to centralize computer equipment as much as possible. Providing a single, air-conditioned, secure, dust-free room for an organization's dozen computers is much simpler than providing air conditioning and security for the same computers spread out all over a building. It is more desirable, of course, to decentralize computers whenever possible (thus serving human needs rather than the computers' needs), but keeping the computers in safe, working order must be of paramount importance.

Appropriate Equipment. Some computers are more susceptible than others to environmental hazards, especially overheating. Care should be taken to purchase durable computers that can stand up to environmental extremes. If overheating is a foreseeable problem, then extra heat sinks or cooling fans should be installed in the computers as a preemptive measure. While more advanced computer models that offer features such as multimedia capability are certainly desirable for taking full advantage of the Internet, buyers should also note that more bells and whistles mean more components that can fail.

4.4.2 Reliable Power Sources

Computer networking requires a stable, uninterrupted supply of power. Obviously, frequent power outages or power surges could hinder effective use. For applications where important data is routinely transmitted (such as electronic financial data exchange and scientific research) frequent power outages would be unacceptable--or even disastrous.

Power outages and related problems are common in Africa. Disruptions in electricity can cause frustration to users, but electrical surges can actually ruin computer equipment. In Nigeria, one such surge even melted a would-be networker's computer modem! (Inyang 1996, 2) In response to unreliable power sources, a few simple precautions can be taken.

Approaches: Reliable Power Sources

Surge Protectors. Sporadic electricity supply can be smoothed out through the use of surge protectors. The investment in such equipment is relatively small when compared to the cost of replacing entire computer systems ruined by electrical surges. Metal oxide varistors (MOVs) can

be installed on electric and telephone lines to provide effective surge resistance. At the user level, commercial surge protectors, such as the type available at office supply stores, offer protection as well (Raymond 1993, 9-12).

Back-up Power Supplies. Power failures can result from many things, including lighting strikes, equipment failure, or scheduled brownouts. Critical network components, such as networks operations centers and servers providing access to many users, can be protected from power outages through dedicated backup systems. Individuals or smaller organizations can benefit from a simple backup system using a bank of ordinary car batteries. In this system, one or more computers receive electricity from batteries that are trickle charged when power is available. Such a system is particularly feasible for areas where outages occur on a regular basis (Jensen 1995, 42).

4.5 NETWORK MAINTENANCE: HUMAN AND ORGANIZATIONAL INFRASTRUCTURE

It is a popular notion that the Internet is a system that runs itself, with no one in charge. This may appear to be true from an end user's perspective; in fact, keeping the Internet in working order requires a great deal of constant human intervention at all levels. In addition to networking hardware, Internet connections and networks require a number of personnel to oversee and manage data flow, as well as a number of institutions to regulate and control domain names, create standard protocols, and so forth. Since networking hardware can be extremely complex and fragile, service personnel are needed to perform maintenance and make repairs when necessary. A progress report from the Capacity Building for Electronic Communication in Africa project (CABECA) mirrors other studies when it states that "skill development ranging from sensitizing to advanced system design for local situation is the most critical in the overall [Internet] infrastructure building." (CABECA 1995, 2)

4.5.1 Internet Service Providers

It is untenable for most individuals to connect directly to the Internet. Instead, intermediaries known as Internet Service Providers (ISPs), offer centralized access to the Internet to a relatively large number of customers, thereby achieving efficiencies of scale unavailable to individuals or to small businesses. Widespread Internet access is highly dependent upon ISPs, just as individuals rely on the local supermarket or retail store, rather than a wholesaler, as a place to purchase food or merchandise.

Approaches: Internet Service Providers

Associations. One option for starting up an ISP industry is to create associations designed to provide access to groups, such as universities, with definite Internet access needs. This access initially can be funded and operated by user organizations pooling their resources--funds, equipment, and people--to share costs. Once a "critical mass" of users is generated, the service can be offered to other users interested in Internet access. At some point, fees can be assessed

Creating an ISP Industry:
The VIP Freenet

Telecom costs in the U.S. Virgin Islands have been so high as to inhibit the growth of a service provider industry for the Internet, which has been available there since 1994. Combined with the high cost of transport, equipment, and qualified personnel, high connection charges meant that the costs of setting up and maintaining a local internet service provider would result in fees too high for most users.

The USVI.NET, also referred to as the Freenet, was created in response to this problem. The network used donated computer equipment to start operations and enlisted sponsors to pay for line leasing fees in exchange for advertising. By doing so, Freenet was able to provide Internet service free of charge to local users, who would then encourage their affiliated organizations to join the service.

In this way, a "critical mass" of subscribers to the service was created. By mid-1995, over 1,000 users subscribed to the Freenet, leading to word-of-mouth promotion of the service by satisfied users. The Freenet is now being used for tourism promotion and for government communication (the governor has a FreeNet account), in addition to providing Internet access to those who could not otherwise afford it. By using these creative means to bring in and maintain revenue, the FreeNet maintains sustainability (deBlanc 1995, 1-13).

and the service could eventually become a self-sustaining, commercial enterprise. An example of such an association is the VIP Freenet (See VIP Freenet box).

Small-Scale Enterprise Support. Local Internet Service Providers are the kinds of businesses that would be good candidates for small-scale enterprise support. USAID and other donors have done extensive work in this area. Support for ISPs could come in the form of targeted credit programs, training courses and workshops on the fundamentals of running a business, information on how to raise capital funds, and so forth.

Even more directed assistance could come in the form of workshops for individuals and organizations interested in starting an ISP business. These workshops could feature presentations from existing Africa-based ISPs, resource packets containing information on the procedures, skills, and equipment necessary to become an ISP, and representatives from companies that provide equipment and services to ISPs.

4.5.2 Repair/Service Facilities

As anyone who has dealt with computers can attest, they can often break down or function improperly. Since computers and networks are complex machines, they usually depend upon specialized technicians to service them. These technicians require a great deal of initial training as well as ongoing training to keep up with the rapid developments in computer technology.

However, since networking is so new and rare in most of Africa, there is neither a significant number of trained technicians nor an adequate number of training institutes. At the very least, an adequate number of technicians must be in place to service networks and computers as they become more prevalent. For the long-term, mechanisms must be put in place to make technician training self-sufficient within each country.

Approaches: Repair/Service Facilities

Small-Scale Enterprise Support. Computer hardware and software servicing and repair is the type of work that lends itself well to small- and medium-scale enterprises (SMEs). Computers are generally an everyday tool for businesses and organizations that have them, so most users will not want to be without their computer for too long should a problem occur. Accordingly, robust demand should exist for neighborhood repair shops from which an NGO or local business can receive relatively prompt and convenient service (as opposed to sending the computer away and enduring subsequent delays). Likewise, if ISPs do not have adequate internal technical support staff, it is crucial that they be able to receive relatively prompt assistance from an outside organization; otherwise, lengthy disruptions in Internet access for their customers could result should equipment failure occur.

USAID and other international development organizations have made SME development a key part of their economic development efforts. Their experience should be harnessed to encourage the development of computer-servicing SMEs. Support could come in the form of credit assistance, technical assistance for training personnel, and seminars on forming computer service businesses. These strategies would be well-suited to encouraging local ISP industries as well.

4.5.3 Network Support

Building a network, particularly if it spans an entire country, is only half the battle. A computer network is very complex, requiring a number of switching stations and a plethora of communications electronics to manage the flow of data. Accordingly, the network's physical infrastructure requires an organizational and human infrastructure to maintain its operation.

Network management in developing countries can be problematic for a number of reasons, many of which are financial in nature. Perhaps even more daunting impediments, however, are a lack of technical know-how at both the individual and organizational levels. An entity or group of entities must assume responsibility for managing computer networks; furthermore, these organizations must be able to staff themselves with all types of professionals and technicians who know how to manage, operate, and repair the networks' hardware and software. Unfortunately, such organizations and individuals are often in short supply in developing countries, particularly Africa.

Approaches: Network Support

University Students/Local Specialists. One readily available resource for network personnel is a nation's university system. More than most, university students should have some knowledge of computers and feel comfortable with them. If a university does not already offer appropriate computer science courses, they should be added. Furthermore, universities are often the first beneficiaries of network access and may often have individuals who are already somewhat familiar with computer networking. One interesting solution to lack of technical know-how is to incorporate network building activities into university students' course projects, thus serving two purposes at once (Purbo 1993b, 9).

Another approach is to conduct on-the-job training for employees who will eventually maintain an organization's network. These selected employees can work alongside the technical teams that initially set up the network, thereby gaining on-the-job experience for the future, when their jobs will include network maintenance (Shkarupin 1995b, 6).

On-line Resources. The Internet itself provides tremendous resources for information on computer networking. Users can acquire technical expertise and documentation directly from Internet tools such as Requests for Comments (RFC). These can be used by technologically-inclined individuals to train themselves in the many elements of networking technology (Purbo 1993b, 9). Users can also pose questions to large numbers of technically-minded individuals through the countless computer-related discussion groups available on the Internet. And of course, technicians can always use e-mail to ask questions if they know the correct addresses.

Organizational Models. As with any other kind of infrastructure, nationwide computer networks require a high degree of coordination, which in turn means making organizations responsible for overseeing and managing the networks. In general, these tasks fall to two types of organizations, usually known as Network Operations Centers (NOCs) and Network Information Centers (NICs). Fortunately, there are numerous models for organizing and funding national networks to suit all types of network demands and needs (Ozgit 1995; Gajdos 1995; Li 1995; Shkarupin 1995b).

4.6 OTHER ISSUES

4.6.1 Regional Cooperation

Economic underdevelopment hinders the ability of most developing nations to undertake expensive infrastructure construction or improvement on their own. Regional cooperation can give such nations the level of financial resources and technical expertise required for large-scale telecommunications infrastructure projects. By acting as a coalition, groups of countries can combine purchases of computer equipment and services. Such coordinated purchases hold the potential for volume discounts from vendors for equipment and decreased travel expenses for services consultation, thereby decreasing costs for all members. At the same time, coalition members can benefit from the exchange of indigenous technical expertise, sharing international telecommunications links, and agreeing upon regional standards (Jensen 1995, 31-32).

4.6.2 Infrastructure Redundancy

When an existing system is updated, consideration should be given to keeping the older link for backup and redundancy purposes (American University of Beirut, Personal Computing and Network Services Department 1994, 6). It can also be cost-effective to recycle the obsolete telematics equipment being replaced in urban areas by putting it into service in rural and remote areas, where telecommunications infrastructure improvements generally progress more slowly and where the equipment may be better than what presently exists (or does not).

4.6.3 Appropriate Technology

Notions of "best" technologies must be tempered by financial considerations and by the need for universal access. For any given level of finance, tradeoffs must be made between providing Internet access for as many users as possible and providing the best quality of Internet access for existing users.

Furthermore, the choice of network technology should be sustainable. It is useless to build a state-of-the-art network if it cannot be maintained or if it goes unused. On the other hand, present IT needs and demands must be weighed against projected future IT needs. While the choice of technology must take into account financial considerations and the realistic information needs of society, future demands must be also be carefully considered so that the new infrastructure is not quickly outmoded (Lopota 1995, 2).

5.0 END-USER ISSUES

5.1 MAXIMIZING INFORMATION AS A TOOL FOR DEVELOPMENT

As with any other technology, the Internet will benefit a society only to the extent to which citizens and institutions have access to it, understand how to use it, and harness its power to improve job performance. Unfortunately, for most in the developing world the means to access the Internet are unavailable or unaffordable, the skills needed to utilize it effectively are underdeveloped or nonexistent, and an appreciation of how it can be used to advance society has yet to be grasped by all but a minority of visionaries.

The Internet Bringing People Together:
One Man's Vision

In Benin, West Africa, Father Nzamujo is the Director of Songhai, a self-supporting training center that specializes in training young people in rural agricultural extension techniques and appropriate technology. The Center is made up of 80 farms where students are continually experimenting with new agricultural strains and products.

Father Nzamujo believes in innovation and would like to combine his rural agricultural background with his computer science profession to include on-line agricultural research and development opportunities for the students. He knows that rural agriculturalists can learn from one another by sharing experiences--regardless of one's physical location.

He believes that the Internet can bring together people who may never have had the opportunities before. In his opinion, rural and urban Internet access and adoption is the only hope for Africa to move into the current century. He believes the Internet is the virtual alternative to the African village. In the past, the passing of wisdom from the village elders to the youth was an oral tradition; in the present, communication tradition may include a personal computer, modem, and cyberspace.

5.2 INFORMATION AWARENESS

The Internet is useful only to the degree to which its users are aware of the power it offers. The World Wide Web has become a part of everyday life for many in the developed world, where many have exposure to computers in the workplace and where advertisements for ISPs are increasingly common. Computer technology, the Internet, and the idea of information as a societal tool are much less familiar to most denizens of the Third World.

On a societal level, Internet dissemination can be aided by initiatives designed to inform targeted audiences about what it is, what its uses are, and how to get it. At the micro level, organizations will benefit from having a strategy for incorporating information technologies into the workplace.

5.2.1 Public Awareness of the Internet

Connecting to the Internet is predicated upon first knowing about the Internet and then knowing how to obtain the service. Though the Internet is known at least by name in most cities of the world, it is unknown in many rural areas in developing countries. In these areas, more concerted efforts will have to be made to educate institutions about the Internet if effective decisions are to be made regarding use (or non-use) of the technology. Considering the paucity of ISPs in African countries, local organizations would also benefit from focused assistance in locating the ones that do exist.

Approaches: Public Awareness of the Internet

Getting Connected. The first step in promoting public awareness of the Internet is having the technologies available at a reasonable cost. If the Internet is inaccessible, it is useless to promote it to the population.

Telecottages. Given the relative level of income in developing countries, telecottages can provide Internet use without a tremendous initial investment in hardware. These facilities could not only provide the public with hardware and connectivity, but training as well, enabling the participation of a broader cross-section of the population. Even though some users may have heard about the Internet, hands-on use of the technology will excite them further. Furthermore, telecottages can be strategically placed to bring the Internet to the masses in remote areas, simultaneously furthering the goal of universal access.

Media Involvement. The media can play a crucial role in raising public awareness of the Internet. For example, newspapers could start periodic columns on the Internet, relating the latest Internet news and developments and offering practical tips to Internet users--such columns are already common in American newspapers. This would serve the dual purpose of assisting current Internet users and attracting the interest of non-users. The same thing could be done with television, although cost concerns and production complexities would make it less feasible.

5.2.2 Institutional Strategies for Information Use/Dissemination

An end-user strategy for information use and dissemination is critical to getting maximum benefit from the Internet. Ideally, information strategies should be formulated before connecting to the Internet. Information technologies and information-based services are relatively new to Africa, so institutional strategies for obtaining, disseminating, and managing information will often be absent.

Approaches: Institutional Strategies for Information Use/Dissemination

Develop an Information Strategy. Organizations' information needs and uses are as varied as the organizations themselves, so there are no set models for what shape these strategies should take--each organization must decide this for itself. An organization's information strategy should, however, address the following types of questions:

1. What are the organization's information needs? Types of information can include e-mail (both internal and external), data, and full-text research reports, among others.
2. How often will the Internet be used? Will it be an everyday tool for e-mail and research, or will it be a resource only occasionally used?
3. How many individuals in the organization will use the Internet?
4. Will Internet use be restricted, either in terms of time spent or types of sites that can be accessed?
5. Will information of a sensitive nature be transmitted? Are there security concerns with making information available over the Internet?
6. Will the organization want to "advertise" itself on the Internet? Will it want to make internal publications and/or data available to others via the Internet?

Asking such questions helps an organization to make decisions regarding Internet service. First and foremost, an assessment of information needs should help an organization decide whether it even needs the Internet. A comprehensive information strategy should also help determine whether Internet access will be institutionally universal, whether unlimited (versus hourly-charged) service would be more economical, and what level of sophistication will be required in the computer hardware used to access the Internet. For many, the possibility of staff using the Internet for non-work related purposes is a real concern--one that could be great enough to outweigh making the Internet available. Spelling out specific guidelines on acceptable use of the Internet at the workplace should help quell misuse (or at least lessen confusion over what constitutes misuse).

Appoint a Full-Time Information Coordinator. Once an information strategy is in place, larger organizations can benefit from having someone to coordinate it. Knowledge of the right places to go for information, the "tricks of the trade" in terms of searching for information, and amassing a portfolio of valuable resources of information usually comes from experience. Placing the responsibility for gaining this type of expertise in one position ensures that the coordinator will have the time and resources needed to master these skills. Centralizing responsibility also ensures that the coordinator can identify the most promising techniques, skills, and resources and pass along these to coworkers or provide training on their use. Furthermore, having an information coordinator helps ensure that an organization's information strategies will be implemented in an organized, efficient manner, without employees replicating work or pursuing unfruitful information collection strategies.

5.3 SUCCESSFUL ADOPTION OF INTERNET TECHNOLOGIES

Organizations must confront a number of obstacles when integrating complex information technologies into the workplace. First and foremost, they must acquire the necessary equipment, which can be scarce and expensive in developing countries. Second, they must have staff who are trained in using the technologies--this training is also often in short supply. Finally,

The Key to the Internet:
People are Central to the Global Information Infrastructure

At the International Telecommunication Union Development Conference in March 1994, Vice President Al Gore delivered a speech that called for international collaboration to create a global information infrastructure (GII). The following excerpt highlights the guiding principles for the GII:

> *An equally important part of universal access is teaching consumers how to use communications effectively. That means developing easy-to-use applications for a variety of contexts, and teaching people how to use them. The most sophisticated and cost-efficient networks will be completely useless if users are unable to understand how to access and take full advantage of their offerings* (Gore 1994, 6).

organizations must be able to deal with problems that might (and surely will) arise with the equipment and programs. Again, availability of such services, either within the organization or from an outside firm, is often lacking.

5.3.1 Availability of Computer Equipment/Software

In order to take advantage of services provided by the Internet, organizations need to install the proper equipment. At a minimum, this includes a computer and a modem. The necessary quality of this equipment will vary with the desired level of Internet services. For example, access to the World Wide Web's features of sound and images demands more powerful and faster computers and modems, while basic e-mail service requires less sophisticated machines.

Many developing country organizations already use computer technology relatively well. For example, 71 percent of the institutions interviewed by the Leland Initiative assessment team in Benin had a medium to high level of capacity in the telecommunications/computer area. However, for most organizations--especially those in the non-governmental, non-profit areas--the cost of appropriate computer equipment is a large constraint. Other charges associated with establishing a connection to the Internet make the issue of cost that much tougher. First-year connection costs for Internet access (including costs of computer, modem, telephone line and service charges, communications software, service provider charges, training, and maintenance) have been estimated from $1,500 to $9,200, depending on local prices for the equipment (Management Sciences for Health 1996, 5).

Approaches: Availability of Computer Equipment/Software

Donations. If an organization cannot afford to purchase the necessary equipment, they may be able to find donated equipment. Many organizations in developed countries and some in developing countries, looking to upgrade their equipment, may donate used, but still valuable, equipment to those with less means. For example, a computer magazine in South Africa has published a list of non-profit, development organizations in the country looking for donated equipment. Donors can contact recipients directly or use the magazine staff as conduits for the transfer of used equipment. A list of groups that coordinate the exchange of used computer equipment worldwide can be found on a University of Iowa Web page (*www.uiowa.edu:80/~intlinet/links/computer.htm)*. This list includes three groups that work exclusively with Africa-based organizations.

Telecottages. As discussed earlier, telecottages can play an important role in introducing the Internet to those who might not otherwise experience the technology. In addition, telecottages can serve as working centers where users can accomplish a limited amount of work. For some individuals and organizations, the approach of leasing a machine and Internet access on-site at a telecottage might prove to be more cost-effective and rational than buying computer equipment that would be dedicated to Internet access alone.

5.3.2 Computer Skills and Training

Once an organization secures the proper equipment and establishes a connection to Internet services, it will need to develop or enhance the skills of its staff in using this new technology. The level of expertise needed to function adequately with the new technology will depend upon the level of service the organization chooses. E-mail is probably the easiest Internet application to understand and use. File transfer, gopher, and WWW applications will require more time to learn and apply in a useful manner.

For organizations whose staffs already use computers for word processing or other basic functions, the transition should not be too difficult. Since computers can be intimidating to those who have never used them, organizations whose staffs have had little exposure to computers will face greater difficulties.

Approaches: Computer Skills and Training

In-House Training. More sophisticated groups may be able to provide the necessary training for their staffs within the organization, especially if they have champions of the new technology--people who are eager to make use of the new applications and share their enthusiasm with the rest of the group. Indeed, this is a critical factor for most organizations looking to integrate the Internet into their work.

Outside Training. Organizations with little computer experience will have to seek training from outside groups, such as Internet Service Providers, hardware/software suppliers, telecottages, or

other organizations that specialize in computer training. A local-level answer to the problem could be to create an "Internet Club"--an organization dedicated to hooking up schools, exchanging ideas, demonstrating the Internet, and teaching the Internet to students, teachers, and administrators (Kritsky 1995, 5-6).

5.3.3 Availability of Computer Servicing

Computers and peripherals are prone to failure, especially when they are located in non-ideal environments. Dust, moisture, temperature extremes, and other environmental factors like lightning can all cause delicate electronic components to break down, and computers in Africa will in general be exposed to more of these harsh elements. In addition to hardware malfunctions, software glitches are also common with everyday computer use. Human error or flaws in programs can lead to computer crashes, complete erasure of data in hard-drives, or improper installation of software applications. Sometimes computers simply fail to work for no reason readily discernible to an average user.

For these reasons, the availability of computer servicing personnel is of the utmost importance. In much of the developed world, where computers have become essential tools for business (and increasingly the home), large widespread computer service industries have arisen for both hardware and software. If the expertise to repair hardware or software flaws does not exist in-house, then help is usually just a phone call (or e-mail) away. Since computers are new to most of Africa, such service personnel and businesses are relatively scarce.

Approaches: Availability of Computer Servicing

Use of Laptop Computers. Modern laptop computers are just as capable as their desktop cousins in terms of navigating the Internet. Every feature available in desktops, including modems, CD-roms, large hard drives, and color monitors, is also available on laptop computers. Laptops, however, are less bulky and less heavy than desktops. Their increasingly diminutive size makes them relatively easier to ship away for repair if local facilities are unavailable. A laptop with all accessories can be shipped in a padded mailer for a reasonable price. Doing the same with a desktop could prove untenable, especially if the monitor must be shipped as well. Furthermore, laptops can be used for field work, which would prove beneficial to the types of work many NGOs are doing in Africa. The main drawback to using laptops is their significantly higher cost compared to a desktop with the same capabilities.

University Computer Science Departments. For many African countries, universities represent an important resource for computer expertise. This expertise can be offered to organizations for a fee, generating experience and money for the computer science department while at the same time providing a valuable service for local organizations. In Zambia, for example, Evelyn Hone College's computer science department generated revenue of about $5,000 from January to July 1992 alone by offering consultancies, workshops, and training courses (Corr 1995, 278). Such an arrangement is likely more viable for software support than hardware repair.

Vendor Support. As with any expensive purchase, the availability of vendor support for equipment should be thoroughly considered before buying. Some of the basic questions that should be asked include:

1. What is the computer's warranty? What is covered and for how long?
2. Is repair work done locally or must the computer be shipped away?
3. What is the computer's reliability track record (probably best confirmed independently)?
4. Does the vendor offer a "loaner" in the event of computer breakdown?
5. Does the vendor offer on-site repair?

The basic premise here is "let the buyer beware." While most computers today are of good quality, there will generally be some sacrifice of reliability for a cheaper computer or a new, untested brand. In much of Africa, where repair facilities are few and far between, superior vendor service and/or a solid reputation for brand reliability may well be worth paying a little more upfront. This is especially true if the purchase consists of many identical computers from the same vendor.

Planning Computer Purchases. Today's personal computer market is characterized by a large number of choices, in terms of processor architecture (Intel-based vs Motorola-based), operating system (UNIX, DOS, Windows, and Apple), and makes (IBM, Apple, Compaq, Hewlett-Packard, and Dell to name a few). As a result, every computer contains hardware and software that is often quite different from that used by another computer, even though that computer may use the same operating software or processor or is manufactured by the same company.

Planning computer purchases to optimize standardization of hardware and software makes maintenance easier (Cannata 1991, 23). If computers are standardized within an organization or across a network, then spare parts can be taken from unused computers to repair others; alternatively, while it is being repaired, a malfunctioning computer can simply be replaced with a working computer. The same principle applies to software. With the redundancy built into a network of computers using identical software packages, one computer's crash need not stop the show.

6.0 CROSS-CUTTING ISSUES

6.1 DONOR COORDINATION

Over the past few years, numerous agencies and organizations have developed initiatives and projects to encourage the development of information technologies, particularly the Internet, in Africa. At the recent INET '96 Conference in Montreal, however, African participants noted a lack of coordination among networking projects in Africa. Many steps are being duplicated because of poor national, regional, and international coordination; there is a lack of qualitative information on who is doing what, resulting in a number of projects running in the same institutions or towns without knowledge of each other (Adam 1996a, 1-4).

Approaches: Donor Coordination

National Information Repository. African participants at the Inet '96 Conference proposed establishing national repositories of information as a means for improving coordination of networking projects (Adam 1996a, 4). This task could be managed by a national information infrastructure task force similar to the one established by the United States and discussed in the introduction of this paper.

Use the Internet. Donors can use the very tools they are trying to promote in Africa to communicate with each other about the various projects they support. Many international donors provide information about their activities through their own WWW homepages. This is an excellent way to share their experiences with each other and the public; however, formal channels of communication through virtual working groups (using electronic mail, for example) would allow for closer collaboration.

Conferences. Regular conferences or workshops regarding the use of information technologies in Africa would provide a forum for face-to-face discussion of issues and experiences. The 1995 Symposium on African Telematics (Addis Ababa, Ethiopia) and the 1996 G-7 Information Society and Development Conference (South Africa) both brought together a wide range of parties interested in the advancement of IT in Africa.

6.2 CULTURAL CONSTRAINTS

When introducing a new technology of any kind, there are inevitably cultural factors that affect the success and manner of its use. Language, content, social and gender roles, and cultural preservation and relevance will determine the Internet's reception in any given society.

Approaches: Cultural Constraints

Language and Content. For many non-English speaking peoples, the Internet seems inaccessible. However, translation software exists, as does software that monitors content. These

programs can be used by those institutions and governments who would otherwise prohibit this technology for fear of its inappropriate use. These kinds of restrictions on freedom of information must be addressed on the macro scale at policy levels, and most likely will impact all forms of media.

Social and Gender Roles. Information access and usage vary in societies, based on factors such as social status and gender. Often, literacy rates are a reflection of these cultural dynamics, and although development has been working toward greater equality between the genders and social classes, some sensitivities still exist that will affect the use of the Internet. Further development of human resources, as well as respect for cultural constraints, will form the basis of an effective approach to introducing these new technologies.

Cultural Preservation and Relevance. It is important to be aware of the implications of providing a Western technology and perhaps imposing an ideology. Therefore, giving ownership and manipulation rights and abilities to recipient populations is very important in making the technology a sustainable and applicable one in any society.

7.0 BIBLIOGRAPHY

AT&T. "Africa One Overview." (May, 1996). [Online]. Available HTTP: http://www.att.com/features/0596/africa.html [1996, June].

Adam, Lishan. "Africa on the Line?" *Ceres*, no. 158 (March/April, 1996). [Online]. Available HTTP: http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/DOdirect/DOengB04.html [1996, April].

Adam, Peter S. "Privatization in the Telecommunications Industry." *Economic Reform Today*. Vol. 3, no. 2 (1993): p.6-14.

American Association for the Advancement of Science. *Electronic Networking in Africa: Advancing Science and Technology for Development*. Nairobi, Kenya: AAAS, 1992.

American University of Beirut, Personal Computing and Networking Services. "Internet Challenges and Future Plans." (January, 1994). [Online]. Available HTTP: http://www.hiof.no/aub/services/computer-center/pcns/ncp3.html [1996, May].

Azhar, Zafar. "Building the African Internet: Developing Regional Networks in Africa." *Africa Communications*. Vol. 7, no. 2 (Mar./Apr., 1996): p. 51-52.

Balit, Silvia and Jean-Pierre IIboudo. "Towards National Communication-for-Development Policies in Africa." *SD Dimensions*. (March 31, 1996). [Online]. Available HTTP: http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/CDdirect/CDan0001.htm [May 1996].

Barzdins, Guntis, and John Tully. "LATNET: Wireless Internet Access in Latvia." (January, 1996). [Online]. Available HTTP: http://www.latnet.lv/LATNET/RADIOLink/HTMLDocument.html [1996, May].

Berenson, William M. "Developing the Regulatory Footprint for Newly Privatized Telecommunications Providers." *Federal Bar News & Journal*. Vol. 38, no. 7 (September 1991): p. 400-404.

Bery, Suman K. "Economic Policy Reform in Developing Countries: The Role and Management of Political Factors." *World Development*. Vol. 18, no. 8 (August 1990): p.1123-1131.

Brunner, Jake, Tony Villasenor, Jeff Cochrane, et. al. "The Internet in Central Africa: Issues and Opportunities." (February,1996). [Online]. Available HTTP: http://www.naic2.arc.nasa.gov/nsi/survey/REIMP/yaounde.html [1996, June].

Bush, Randy. "FidoNet: Technology, Use, Tools, and History." (1992). [Online]. Available HTTP: http://www.nsrc.org/networks/fidonet/papers/inet92.paper [1996, June].

Cannata, Arleen. "Creating A Wide Area Network in the Developing World." *Computers in Libraries*. Vol. 11, no. 4 (April 1991): p. 22-23.

Capacity Building for Electronic Communication in Africa (CABECA). "CABECA Report." (1995). [Online]. Available HTTP: http://www.idsc.gov.eg/aii/care.html [1996, June].

Chasia, Henry. "Satellites and Developing Countries." London: IEE Discussion Meeting. (October, 1995).

Corr, Patrick H. "Computer Studies Education in Least Developed Countries: A Case Study of Zambia." *Technology and Developing Countries*. (1995): p. 270-280.

Cunningham, John. "Little LEOs Race for Orbit." *Africa Communications*. Vol. 7, no. 2 (March/April, 1996): p. 29-33. [Online]. Available HTTP: http://www.us.net/afcom/ltleos.html [1996, June].

DeBlanc, Peter. "Networking the Caribbean via the V.I.P. Freenet." (April, 1995). [Online]. Available HTTP: http://www.info.isoc.org:80/HMP/PAPER/043/html/paper.html [1996, June].

Economist. "The Mystery of Growth." *The Economist*. (May 25, 1996): p. 15-16.

Economist. "Tele-Haves and Have-Nots." *The Economist*. (May 18th, 1996): p.19-20.

Farber. "Living in the Global Information Infrastructure: Some Concerns." (October, 1994). [Online]. Available HTTP: http://www.aaas.org/SPP/OPEDS/FARBER.HTM [1996, August].

Fleming, John. "Poor Nations Leapfrog to Future Via New Technologies." *Christian Science Monitor*. (May 22, 1996): p.1.

Gajdos, Peter. "The SANET: Further Evolution." (May, 1995). [Online]. Available HTTP: http://www.isoc.org/HMP/PAPER/106/txt/paper.txt 3 [1996, June].

Garton, Andrew, Jagdish Parikh, Suchit Nanda, and Leo Fernandez. "Pan Asia Networking: An Asian Survey." (1995). [Online]. Available HTTP: http://www.idrc.org.sg/closed/survey/title- page-html [1996, May].

Ghobash, Saeed. "The South African White Paper: An Overview." *Africa Communications*. Vol. 7, no. 2 (March/April, 1996): p. 39-41.

Gifford, Joe. "Wireless Local Loop Applications in the Global Environment." *Telecommunications*. Vol. 29, no. 7 (July, 1995): p. 35-43.

Gore, Al. "Remarks by Vice Al Gore to the International Telecommunications Union Development conference in Buenos Aires, Argentina on March 21, 1994." (March, 1994). [Online]. Available HTTP: http://www.usia.gov/topics/gii/goreitu.txt [1996, August].

Hanna, Nagy, Ken Guy, and Erik Arnold. *The Diffusion of Information Technology*. World Bank Discussion Paper, no. 281. Washington, DC: The World Bank. 1995.

Hegener, Michiel. "E-mail from the Bush." (November 1994). [Online]. Available HTTP: http://www.tool.nl/~toolnet/africa.html [1996, May].

_____. "Telecommunications in Africa: Via Internet in Particular." (March, 1996). [Online]. Available HTTP: http://www.tool.nl/~toolnet/africa.html [1996, June].

Heywood, Peter and Stephen Saunders, eds. "!Competition, Si!" *Data Communications*. (September 1991): p. 70-74.

Holderness, Mike. "A Promising Solution Fraught with Peril." Ceres, no.158 (March/April,1996). [Online]. Available HTTP: http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/DOdirect/DOengB01.html [1996, June].

Hotvedt, Alfred, Peter A. Thomas, and Sinan A. Akisik. *The Potential for Privatizing Telecommunications Systems in Africa: The Cases of Cameroon, Cote D'Ivoire, Kenya and Senegal*. Washington, DC: Center for Privatization, 1987.

Information Infrastructure Task Force. "The Global Information Infrastructure: Agenda for Cooperation." (1994). [Online]. Available HTTP: http://www.eff.org/pub/GII_NII/Govt_docs/gii_co-op_iitf.agenda [1996, August].

International Telecommunications Union. *World Telecommunications Development Report*. (1995). [Online]. Available HTTP: http://www.itu.ch/WTDR95/toc.htm [1996, June].

Internet Society. "Facilitating Internetworking in Africa: Proposal by the Internet Society." (January, 1996). [Online]. Available HTTP: http:// www3.undp.org/aif/isocprop.html [1996, May].

Inyang, Samuel. "Stuck in the Ruts on the Information Superhighway." *Ceres*. no. 158 (Mar./Apr., 1996)[Online].AvailableHTTP: http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/DOdirect/DOengB03.html [1996, June].

Jacobsen, Alan. "Wireless Local Loop Technology: Motivations and Alternatives." (October, 1995). [Online]. Available HTTP: http://www.diva.com/wpwll.html [1996, May].

Jensen, Mike. "African Regional Symposium on Telematics for Development." (1995). [Online]. Available HTTP: http://www.idsc.gov.eg/aii/ddpf.html [1996, June].

Johnnides, Christianna. "ITU Releases New Indicators on Telecommunications Development in Africa." *Africa Communications*. Vol. 7, no. 3 (1996): p.29-31.

Kirsh, Ellen M. "Intellectual Property and the National Information Infrastructure." (October, 1994). [Online]. Available HTTP: http://www.aaas.org/spp/opeds/kirsh.htm [1996, August].

Klensin, John C., and Randy Bush. "Expanding International E-mail Connectivity: Another Look." (1993). [Online]. Available HTTP: http:/www.nsrc.org/nsrcgrants/930600.connexions [1996, May].

Kritsky, Sergei. "UNIBEL: Academic and Research Network of Belarus." (May 10, 1995). [Online]. Available HTTP: http://www.info.isoc.org:80/HMP/PAPER/157/txt/paper.txt [1996, June].

Lerch, Irving A. "Research and Academic Networks: The Emerging Tower of Babel." (April 26, 1995). [Online]. Available HTTP: http://www.info.isoc.org/HMP/PAPER/029/html/paper.html [1996, May].

Lerner, N.C. "Telecommunications Privatization and Liberalization in Developing Countries." *Telecommunication Journal*. Vol. 58, no. VI (1991): p. 279-286.

Li, Xing, Jianping Wu, and Youneng Liang. "Connecting China Education Community to the Global Internet: The China Education and Research Network Project." (April, 1995). [Online]. Available HTTP: http://info.isoc.org:80/HMP/PAPER/077/html/paper.html [1996, June].

Lopota, Vitaly, Stanislav Tarasov, and Vladimir Zaborovski, et al. "Bringing Internet to North-west of Russia--Rusnet N/W Project." (May, 1995). [Online]. Available HTTP: http://www.isoc.org/HMP/PAPER/115/txt/paper.txt [1996, June].

Management Sciences for Health. "A Primer for Accessing and Using Electronic Communications Technology." *The Family Planning Manager*. (Supplement). Vol. 5, no. 2 (summer, 1996).

McCormick, Patricia K. "Telecommunications Privatization Issues." *Telecommunications Policy*. (March 1993): p. 145-162.

Mundy, D.H. "A Computer Science Curriculum Appropriate to Less Developed Countries." *Science, Technology & Development*. Vol. 13, no. 1 (April, 1995): p. 63-71.

Neil, Chambliss, Lee W. McKnight, and Richard J. Solomon. "Re-Engineering the Elephant: Organizational Alternatives for Accelerating Internet Access in Africa." (May 16, 1995). [Online]. Available HTTP: http://www3.undp.org/aif/mitrep.html [1996, May].

Organization for Economic Co-Operation and Development. "Information Networks and New Technologies: Opportunities and policy Implications for the 1990s." *Information Computer Communications Policy 30*. Paris: OECD, 1992.

Ozgit, Attila, Kursat Cagiltay, and Erdal Taner. "Turkish Internet (TR-NET): Policies for Organizational Framework and Funding." (April, 1995). [Online]. Available HTTP: http://info.isoc.org:80/HMP/PAPER/102/html/paper.html [1996, May].

Panos Institute. "The Internet and the South: Superhighway or Dirt-Track?" (1995): p 3. [Online] Available HTTP: http://www.oneworld.org/panos/panos_internet_press.html [1996, June].

Parker, Edwin B. "Developing Third World Telecommunications Markets." *The Information Society*. Vol.8, no. 3 (1992): p. 156.

Priest, W. Curtiss, and Kenneth Komoski. "Wireless: To Achieve Universal Service." (October, 1995). [Online]. Available HTTP: http://www.laplaza.org/cn/local/priest.html [1996, June].

Purbo, Onno W. "An Alternative Approach to Build [a] Low Cost TCP/IP-Based Wide Area Network in Indonesia." (July, 1993a). [Online]. Available gopher: gopher.nsrc.org:70/OR72883-107426-/ASIA/ID/reports [1996, June].

_____. "The Building of Information Infrastructure to Sustain the Current Growth in Indonesia." (July, 1993b). [Online]. Available gopher: gopher.nsrc.org:70/OR33496-72883-/ASIA/ID/reports [1996, June].

Ramani, S. "The Global Information Infrastructure (GII): A Developing Country Perspective." (October, 1994). [Online]. Available HTTP: http://www.aaas.org/SPP/OPEDS/RAMANI.HTM [1996, May].

Raymond, Eric S. "Frequently Asked Questions: Tips on How and Where to Buy Hardware for Your UNIX." (June, 1993). [Online]. Available HTTP: http://www.nsrc.org/lowcost_tools/misc_hard_soft/hard_buyers_guide.html [1996, June].

Rischard, Jean-Francois. "Harnessing Information for Development: A Proposal for a World Bank Group Strategy." (March, 1996). [Online]. Available HTTP: http://www.worldbank.org/html/fpd/harnessing/foreward.html [1996, June].

Sadowsky, George. "Network Connectivity for Developing Countries." *Communications of the ACM*. Vol. 36, no. 8 (August, 1993): p. 42-47.

Schware, Robert, and Susan Hume. "The Global Information Industry and the Eastern Caribbean." (July, 1994). [Online]. Available HTTP: http://www.worldbank.org/html/fpd/FPD.Notes/17/Schware17.html [1996, June].

Shkarupin, V., and I. Mafter. "International Science Foundation Telecommunications Program." (May, 1995a). [Online]. Available HTTP: http://www.info.isoc.org:80/HMP/PAPER/160/txt/paper.txt [June 1996].

Shkarupin, V.V., and Y.V. Demchenko. "Kiev Pilot IP Network." (May, 1995b). [Online]. Available HTTP: http://www.isoc.org/HMP/PAPER/161/txt/paper.txt [1996, June].

Sinebare, Musawe. "The National Information Technology Policy of Papua New Guinea." *Science, Technology & Development*. Vol. 11, no. 3 (December, 1993): p. 260-271.

Stern, Richard. *Internet Toolkit for Managers*. (1995). [Online]. Available HTTP: http://www.worldbank.org/html/fpd/toolkit/foreward.htm [1996, April].

Stribos, Harry. "Broadcasting and Communications Infrastructure in Africa." *Africa Communications*. Vol. 7, no. 2 (March/April, 1996): p. 16-18.

Talero, Eduardo, and Philip Gaudette. *Harnessing Information for Development: A Proposal for a World Bank Group Strategy*. (1995). [Online]. Available HTTP: http://www.worldbank.org/html/fpd/harnessing [1996, June].

Volunteers in Technical Assistance. "Overview: VITA Communications Service." (1996). [Online]. Available HTTP: http://www.vita.org/comm/comm.html (1996, May].

Walker, Celine F. "Telematics for Development: A Caribbean Perspective on National Information Infrastructure Planning." *International Forum on Information and Documentation*. Vol. 20, no. 2 (April, 1995): p.14-28.

Wellenius Bjorn and others. *Telecommunications: World Bank Experience and Strategy*. World Bank Discussion Papers, no. 192. Washington, DC: The World Bank. 1993.

White, Wendy, and Bob Barad. *Electronic Communications for International Development*. Washington, DC: National Research Council, 1995.

Woods, Bernand. "A Public Good, a Private Responsibility." (1995). [Online]. Available HTTP: http://www.fao.org/WAICENT/FAOINFO/SUSTDEV/DOdirect/DOengB02.htm (1996, June).

8.0 GLOSSARY OF TERMS

Account
Every user requires an "account" on the network. This refers to the account under which all of network services are charged. An account holder would receive a "login" and "password" to access the network with.

Address
Like a postal address, a "network address" is used to locate another user for the purpose of directing mail.

ASCII
In the transmission of text information, a network uses "ASCII", the American Standard Code for Information Interchange. Most personal computers use ASCII as well, although word processing programs often require special commands in order to save or load ASCII files. ASCII text has no special characters for formatting such as underlined or bold characters, font changes, etc. Network files of ASCII text can be viewed on the screen (as opposed to binary files, which cannot be).

BPS (baud rate)
The baud rate of a modem refers to the maximum rate of transfer of which it is capable. Dividing the baud rate by 10 gives a rough estimate of the number of characters (individual letters or digits) which it can transfer. Thus, a 2400 baud modem is capable of transferring around 240 characters per second, maximum. Two modems can only connect if they can operate at the same baud rate.

Binary
A file containing one or more strings of data bits which are not printable characters. Some binary files may be computer programs or other forms of data that contain no text characters at all. Binary files cannot be displayed on your screen, but can be downloaded for use with appropriate applications on your computer.

Bit
The smallest unit of data used in a computer. 7 or 8 bits are typically used to represent a single character of text. Binary files are not divided into groups of characters; the network treats them as long strings of bits.

Bulletin Board System (BBS)
A "bulletin board system" (or BBS) is a stand-alone computer which can be dialled and accessed by numerous users simultaneously depending on the number of available lines.

Communications
Pertaining to (a) the software that allows you to communicate with a network; (b) the messages or postings created or read on-line.

Compression
Files may be "compressed" before uploading. By compressing a file, its size, and the time to download it, is reduced dramatically. There are numerous programs available which will compress your files. The most popular being ZIP for IBM, and Compact-Pro or Stuff-It for Macintosh. Files can also be compressed into "self-extracting archives", which enables recipients to "decompress" without the same compression program.

Conference
An "electronic conference" provides a many-to-many communication medium, as opposed to the person-to-person nature of electronic mail. All conferences have a particular subject or purpose, and the topics and responses they contain might provide items of news, ideas, questions, or other information in almost any form. Some special-purpose conferences may have restricted access, allowing some users to write messages, some only to read, and some neither.

Cyberspace
A term used in varying ways to describe the place where electronic communications occur. The word "cyberspace" has become synonymous with "networks", or other interactive information transfer methods e.g. virtual reality. Another term often used to describe a similar concept is "matrix". The users of cyberspace belong to a cyberculture.

Database
Information that can be stored, sorted and searched in a variety of ways.

Data bit
The smallest element of data used in a computer. 7 or 8 bits are typically used to represent a single character of text. Binary files are not divided into character groups; the network treats them as long strings of bits.

Dial-up
A connection to a computer made by calling the computer up on a telephone.

Download
"Downloading" refers to the information received from the network and transferred to a personal computer.

E-mail (Electronic mail)
The transfer of messages between you and other users in the network, or by means of gateways to or from users on other networks. E-mail is similar to an ordinary letter; you supply the address of the recipient(s) and the text of the message. It is different in that delivery takes place in minutes or hours rather than days. E-mail provides private communications, whereas electronic conferencing provides public (or in some cases restricted group) communications.

Error correction

Communication between the modems to ensure that the data sent by one end are the same as those received by the other, even in the presence of noise on the line. Typically this is done by adding checksums to the data. If the received data does not match their checksum the receiving modem asks for them to be sent again.

Ethernet
Often referred to as a "local area network", Ethernet enables computers to determine the way in which they need to communicate with each other.

External modems
Most modems are of the "external" type. Unlike internal modems, they are separate from the computer but are linked to it by a data cable. Modems used with Apple Macintosh personal computers are always external.

FidoNet
A network of hosts and hubs active throughout the world. It is a popular form of networking in developing countries where its various software packages can often overcome line noise problems and cost. Most Fido software requires a certain degree of expertise to install and maintain, though Window's based tools for Fido are beginning to appear.

File
A named group of characters or data bits in your computer or on the network. Files in a computer are similar to file folders in a filing cabinet.

FTP
A file transfer protocol that defines how to transfer files from one computer to another.

Gateway
A computer system that transfers data between normally incompatible applications or networks.

Gopher
A menu-based system for exploring Internet resources.

Hardware
Physical electronic devices such as computers, printers, keyboards, modems, or cables. As opposed to software, which is computer programs.

Internal modems
These modems are installed within the computer, with the only external cable being a phone line into the computer.

Internet
Internet is a large and very popular world-wide computer network begun by the Defence Department in the 60's. Internet connects educational institutions, corporations, organizations, and military and

government installations around the globe. Various independent organizations offer access to the Internet to the general public for a nominal fee. Many Internet users partake in reading and contributing to [Usenet], FTP-ing text files and programs, and "telneting" to other Internet sites. Due to its ease of access and relatively low cost, and it size (the largest computer network in the world), connectivity, and infinite amount of information, many network users prefer the Internet over others.

InterNIC
The combined name for the providers of registration, information, and database services to the Internet.

ISDN
Integrated Services Digital Network; a digital telephone service.

Leased line
A permanently connected private telephone line between two locations.

Logon
A user "logs on" to a network by typing their username, and then their secret password.

Logoff
To disconnect from the network. Sometimes referred to as "log out".

Mail
In the world of computer networking, "mail" refers to electronic mail, or e-mail. It may be used as a verb or noun. However, it is more common to say "I'll e-mail it to you", rather than "mail" which may be confused with "snail-mail", referring to the regular postal network via land, sea, or air travel.

Message
The term "message" refers to any message carried on the network, including conference topics and responses, and "letters" sent by electronic mail.

Modem
A device used to connect a computer through the telephone system, to another computer or network of computers. A modem is similar to a telephone in that it can dial a number, answer a call, and hang up; but the "conversations" it carries are strictly computer-to- computer data language. Modems have different maximum speeds, which are indicated by their baud or bps rate. The word "modem" is derived from "MODulator/DEModulator".

Network
Two or more computers interconnected by telephone lines, coaxial cables, satellite links, radio, etc.

Offline
A user is said to be "offline", when they are not actually connected to a network.

Online
A user is said to be "on-line" when they are connected to a network.

Packet switching
A packet switching system or network enables computer data to be transmitted cheaply and efficiently from state to state or country to country. Computer data is broken into individual packets, sent separately through the packet switching network, reassembled and forwarded to its destination. Packet switching networks are available in most countries and are often referred to as X.25 networks.

Service provider
An organization that provides connections to a network.

Shareware
This is one way of distributing software via networks, or on disk. The program's author usually requests a nominal fee be paid if the program is found to be useful. Alternatively, "freeware" requires no additional fee to be paid.

Software
Computer programs; word-processing programs (like WordPerfect or Microsoft Word), spreadsheet programs (like Lotus or Excel), or database programs (like dBase III+, Foxbase, or File Maker) are all software.

Support
Support staff are often provided to assist network subscribers. Support staff are crucial to keeping subscribers on-line and using the network efficiently.

Terminal
A "terminal" is a device which is connected to a computer network and which acts as a point for entry or retrieval of information. Personal computers can be made to act as network terminals, by running terminal emulation programs (such as PROCOMM or ZTerm). Most such programs allow a user to upload information from the PC to the network, and to download information from the network to the PC.

TOOLNET
A Netherlands based network operated by the TOOL Foundation. It uses Fido networking models to link its network "hubs" (known as TAPS) to the main host computer in the Netherlands. All TAPS must poll the Netherlands. As yet there are no regional polling arrangements for TAPS.

Uploading
To transfer a binary or ASCII file from your computer to the network.

Username

Your "username" identifies you on the network, and is normally made up of your surname and first initial, or your organization name. Your username usually serves as your address for electronic mail as well. With your password, your username provides access to your personal account on the network.

USENET
An information cooperative linking around 16,000 computer sites and about 1 million people. Usenet provides a series of news groups analogous to network conferences.

UUCP (Unix-to-Unix copy)
This is the name of a Unix command, but it is now also used to refer to the protocols used by it to transfer files between Unix machines. There are a number of such protocols, and the two machines choose between the ones supported by each.

Virtual community
Communities that exist and continue to grow in the exchanges that occur within computer communications networks. These communities are not defined by race, color or creed. They are borderless and occur without the factor of proximity.

Word processor
A word-processor is a program used to enter or edit text information in personal computers. A word-processor is often used to create a file before it is uploaded to the network and may also be used to process text after it has been downloaded to the PC.