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New Communications Technologies for Development: Challenges for Africa

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The importance of expanding and upgrading telecommunications in developing countries has been a major telecommunications theme throughout the 1980s and 1990s. Nowhere are the needs greater or the problems more daunting than in Africa.

Access to telecommunications in most of Africa is extremely limited. For a population of about 570 million, there are only 3.5 million exchange lines. The poorest countries have less than one telephone for every 2,000 inhabitants and virtually no reliable communications in rural and isolated areas (Hudson 1990a). Of the approximately 151,000 villages in Africa, 121,000—or 80 percent—have no telephone service although the population of the continent is at least 70 percent rural (Jipguep 1990). Teledensities (number of telephone lines per 100 population) range from 0.1 to 8.9. At least thirty countries have less than 1 line per 100 inhabitants.

Of course these averages do not reflect actual access to telecommunications for most Africans. Telecommunications facilities are concentrated in urban areas, although typically 80 percent or more of the population live in rural areas. Thus the majority of Africans have no access to telephone service.[1] Table 15.1 shows that many countries have less than 1 line per 1,000 people in areas outside the largest city.[2]

Internet access in Africa is also extremely limited. As of mid-1994, at least twenty African countries had no Internet access. Only South Africa had full Internet connectivity. The other countries had electronic mail access only, typically at a major university (*NSF Network News* 1994).

To meet the very modest goal of 1 telephone per 100 inhabitants by the end of the century, the existing 5 million lines will have to be increased by another 4 million, requiring an investment estimated at U.S.$6 billion (Westendoerpf and Odeh 1990).

Table 15.1. African Teledensity: Urban and Rural Areas (1992)

Country	Teledensity: National	Percentage of Population in Largest City	Teledensity: Largest City	Teledensity: Rest of Country
Algeria	3.7	12.1	6.0	3.54
Angola	0.5	16.9	2.2	0.18
Benin	0.3	4.4	4.3	0.21
Burkina Faso	0.2	4.6	3.0	0.23
Burundi	0.2	4.6	4.5	0.03
Cameroon	0.4	6.7	3.3	0.25
Chad	0.1	12.9	0.5	0.01
Djibouti	1.4	75.0	2.0	0.29
Egypt	3.9	17.2	8.1	3.94
Ethiopia	0.3	3.7	4.6	0.25
Ghana	0.3	7.3	2.2	0.30
Ivory Coast	0.7	17.7	3.0	0.21
Madagascar	0.3	5.8	2.9	0.29
Malawi	0.3	3.6	4.3	0.21
Mali	0.13	7.8	1.2	0.11
Mauritania	0.3	22.0	1.2	0.11
Morocco	2.5	12.8	5.9	2.13
Mozambique	0.4	10.1	2.7	0.09
Namibia	4.0	9.6	20.5	2.23
Niger	0.1	7.6	1.2	0.05
Nigeria	0.3	6.6	1.4	0.19
Senegal	0.8	20.1	2.8	0.28
Sierra Leone	0.3	16.7	1.8	0.05
Somalia	0.2	11.5	1.7	0.04
South Africa	8.9	6.4	44.6	7.42
Sudan	0.2	7.7	0.7	0.22
Swaziland	1.9	6.5	10.9	1.35
Tanzania	0.3	6.3	2.0	0.20
Togo	0.4	19.1	1.8	0.08
Tunisia	4.5	20.0	6.8	4.03
Uganda	0.2	4.0	1.6	0.10
Zambia	0.9	12.2	2.5	0.71
Zimbabwe	1.2	11.4	5.2	0.71

Source: World Telecommunications Development Report, Geneva: ITU, 1994.

Not only is the amount of infrastructure in Africa limited, but the quality of service is also poor in many regions. Local call completion rates are less than 30 percent compared with more than 70 percent for industrialized countries (Saunders, Warford, and Wellenius 1994). The World Bank estimates that the average network expansion rate in Africa is under 7 percent per year, whereas the economic requirement is not less than 12 percent. Sub-Saharan Africa has invested only 0.3 percent of gross domestic product (GDP) in telecommunications, while Europe, which is near saturation, has invested 0.7 percent of GDP and Latin America 0.6 percent (Lomax 1990). Clearly, management of the telecommunications sector must be improved if increased investment is to be obtained and utilized effectively to meet these growth targets.

15.2 Telecommunications in the Development Process

Telecommunications is a "missing link" in much of the developing world, as the Maitland Commission noted (International Commission 1984).[3] The telecommunications link is not simply a connection between people but a link in the chain of the development process itself. There is now considerable evidence that telecommunications contributes to socioeconomic development. Projects and studies conducted in the 1980s and 1990s have shown that telecommunications can facilitate many development activities, including agriculture, industry, shipping, education, and health and social services (see, e.g., Saunders, Warford, and Wellenius 1994; Hudson 1984; and International Commission 1984). These studies have been augmented by recent research on rural telecommunications in the United States (cf. Parker and Hudson 1992; Parker et al. 1989).

In an increasingly time-conscious world, distance represents time. In economies that depend heavily upon agriculture or the extraction of resources (lumber and minerals), distance from urban markets has traditionally been alleviated only by the installation of improved transportation facilities, typically roads. Yet transportation links leave industries without the access to the information that is becoming increasingly important for the production and marketing of their commodities.

Another disadvantage faced by many developing countries is economic specialization. As they strive to diversify their economies, timely access to information on market opportunities and modern production and management techniques becomes even more critical. As developing countries join the global market by attracting multinational corporations, establishing joint ventures, and developing service industries, they soon recognize the need for a reliable and modern telecommunications network.

Telecommunications is also vital to the emerging information sectors in developing regions. The great distances between the major research institutes and development centers, as well as the vagaries of postal services and expense of airfares, mean that experts are isolated from each other and from the people they are trying to help. For example, the National Research Council points out that sharing information is vital for Africa if Africans are to contribute to finding solutions to their own development problems:

> Economic development in Africa will depend heavily on the development of the information sector. Countries will need the ability to communicate efficiently with local and overseas markets to determine where they may have comparative advantages for supplying their products to consumers or to purchase essential imports, based on current prices and services. Many of the economic development problems facing African countries have scientific and technological components that will require solutions to be developed in Africa by African scientists. . . . Lack of information is a critical constraint. (National Research Council 1990)

In sum, the ability to communicate instantaneously can facilitate the development process by increasing the following:

- Efficiency, that is, the ratio of output to cost.
- Effectiveness, or the extent to which development goals are achieved.
- Equity, that is, the distribution of development benefits throughout the society.

15.3 New Technologies and Services

Telecommunications technology has changed dramatically in the past decade. Perhaps the most telling evidence of change is the cover of the Maitland Commission report itself, which shows two rotary dial telephones. This is not to say that digital switching did not exist by 1984, but that it was not considered necessary or perhaps even appropriate for developing regions. A second indicator is that the commission specifically identified only telephone service, and proposed access "in due course [to] the other services telecommunications can provide." Today, many of those services could be available as soon as telecommunications service is provided.

Recent innovations in telecommunications and other information technologies have resulted in new equipment and services that are particularly suitable for the applications of developing countries. The following sections describe examples of these technologies and services.

15.3.1 Satellite Communications

Satellites have been considered an ideal technology for Africa because of the continent's limited infrastructure, vast distances, and widely scattered population. African countries were among the major early beneficiaries of the Intelsat system, which linked African capitals to each other and to the rest of the world. A regional satellite could extend these benefits by linking towns and villages into national networks and distributing broadcasting services.

15.3.1.1 Thin-Route Satellite Earth Stations for Voice and Data

The advent of small low-cost earth stations, such as those used for rural telephony with domestic satellites or the VISTA terminals used with Intelsat satellites, bring voice and data communications to isolated regions such as deserts, jungles, mountainous areas, and offshore islands. These earth stations may be installed in any community or project site without the need for expensive terrestrial links to the national network. They may serve the surrounding territory through line-of-site radio links. Earth stations designed for mobile communications such as Inmarsat's suitcase terminals could also be used for communications with refugee camps and to coordinate emergency relief activities (Hudson 1990a).

15.3.1.2 Data Broadcasting

The flow of information within the developing world has been hampered by the cost of distribution and by the lack of access to telecommunications facilities in rural areas. Very small aperture terminals (VSATs) now make it possible for news service information to be disseminated to virtually any location. News service copy is transmitted by satellite from a hub earth station that may be shared with other data, voice, and video customers. These "micro earth stations" may be powered using photovoltaics or portable generators (Parker 1987). Reuters uses this VSAT technology for news service feeds to Latin America. In Asia, the World Broadcast Service based in Hong Kong uplinks news service feeds to Intelsat's

Indian Ocean satellite, which covers 80 percent of the world's population, including much of Africa.

15.3.1.3 VSATs for Interactive Data Communications

Microcomputers or terminals linked to mainframes via interactive VSAT technology can be used to collect and update information from the field. A VSAT network called NICNET operated by the Indian government's National Informatics Center (NIC) now links 160 locations and will be expanded in the next stage to more than 500 (Blair 1988). Similar systems may be used for electronic banking, whether linking teller machines to computers or remote bank branches to headquarters—and for other interactive applications such as reservation systems, weather and pipeline monitoring, and other field data collection. Most recently, VSATs are being employed for Internet services. From the VSAT hub, an Internet Service Provider located in African can link into a major Internet backbone in the United States via satellite.

15.3.1.4 Regional Geostationary Satellites

Until 1995, the only geostationary satellite system providing voice and data communications for Africa was the Intelsat system. Intelsat has linked African capitals to each other and to the rest of the world for more than two decades. Some countries such as Algeria, Sudan, and Nigeria have also leased Intelsat capacity for domestic communications, typically linking their provincial capitals. However, the Intelsat system is designed for heavy-route trunking rather than thin-route services. There have been many attempts to obtain a regional satellite system for Africa that would be specifically designed to meet needs for rural telecommunications and broadcasting services. The ITU, the Organization for African Unity (OAU), and other organizations sponsored the RASCOM (Regional African Satellite Communications) project to examine the feasibility of a regional African satellite. Yet the difficulties of working out ownership, management, and financing have stymied regional proposals such as RASCOM. However, other satellite capacity for Africa has become available. In 1995, PanAmSat launched its PAS-3 Atlantic Ocean Satellite, which offers coverage over Africa as well as connectivity between Europe and the United States. In the same year, PanAmSat also launched its PAS-4 Indian Ocean Satellite, which includes dedicated high-powered Ku band-spot beams over Southern Africa to support the region's first direct-to-home satellite television platform. Other global geostationary satellite systems may follow to compete with Intelsat. Meanwhile, the commercial viability of other regional satellites for either multipurpose use or specialized broadcasting applications is being evaluated by several entities. And Intelsat itself modifyied its footprints to accommodate developing country requirements.

15.3.1.5 Microsatellites

Very small satellites that provide limited but very inexpensive message communications are known as microsatellites. SatelLife of Cambridge, Massachusetts, operates two microsatellites, Healthnet I and Healthnet II, with sixteen stations licensed in Africa. These satellites provide store-and-forward data communications; when the satellite passes overhead, data can be transmitted and received by very cheap

earth stations linked to personal computers. Field reports from the Gambia cited improved efficiency of collecting epidemiological data from vaccine trials using Healthnet instead of having a person from the Ministry of Health travel 500 kilometers every week to pick up the data. Similarly, in Cameroon, Healthnet is used for logistics coordination, administration, and communication, instead of someone traveling from province to province (SatelLife News 1994b).

15.3.1.6 Low Earth Orbiting Satellites

Another satellite option is likely to be low earth orbiting (LEO) systems designed for personal and mobile communications. Such systems could also be used for fixed communications in rural areas. Several global satellite systems have been proposed using LEO satellites. Frequencies were allocated for LEO systems at the ITU World Administrative Radio Conference in 1993. Low earth orbiting satellites are intended to be used for mobile communications from small handheld terminals. Proponents of LEO systems have stated that this technology could be used to provide communications in isolated regions such as much of rural Africa. While the availability of handheld units for ubiquitous communications is appealing, price estimates for this service in the range of U.S.$3 per minute are far beyond the means of most African users. Even if prices were to drop considerably, LEO communication would not be affordable for rural Africans. Major rural economic interests might use this service, for example, to provide telephone service for tourists in game parks, to reach remote mining sites and plantations, and so on.

15.3.2 New Radio Technologies

Advances in radio technology such as cellular radio and rural radio subscriber systems offer affordable means of serving rural communities. A recent news magazine article on the communications revolution showed a Masai warrior talking on a cellular phone.

Radio technologies also make it possible to reach villages without laying cable or stringing copper wire. A radio network may extend to clinics, development offices, and villages from a backbone microwave system, as is done in Zimbabwe and Rwanda (see chapter 7). Radio may also link surrounding villages to satellite earth stations, an approach used in Peru.

15.3.3 Digital Compression

With voice compression technology, digitized voice signals can now be "compressed" so that several voice signals can share a single 64-kilobit channel. Sixteen-kilobit voice has proved viable for telephony; some vendors have also introduced 8-kilobit voice with adequate quality for basic telephony. The advantage of the compression is that the cost per voice circuit can be significantly reduced if up to eight voice transmissions can share a single channel.

In video compression technology, digitized video can be sampled and compressed so that video signals require as few as 64 kilobits instead of the typical 1.5 to 2 megabits. The quality of the compressed picture has improved and the price

of video codecs (coders/decoders) has dropped considerably in the past couple of years, with the result that video conferencing may be a viable alternative in Africa where travel between capitals is both expensive and time-consuming.

15.3.4 Conferencing and Messaging

A thin-route service with considerable promise for development applications is audio teleconferencing. Several sites can be linked together through a bridge at a switching point or by assigning a common frequency on a satellite audio channel. Electronic mail or communication via computer is a means of exchanging information immediately. Personal computer users worldwide may now interact using various electronic mail networks. Messages may be sent from one computer to another by communication through a host computer that is equipped with communications and message-processing software including "mailboxes" for subscribers. These services are cheaper than voice communications and overcome the time zone differences that hinder real-time communications. Users may dial into local nodes of packet-switched networks to reduce transmission costs. Specialized electronic mail networks have been established for users in developing countries (International Development Research Centre 1989).

Another application of computer communications is computer conferencing, that is, interaction of many users through a central host computer. Each conference member may share ideas with the others and respond to their comments. Participants may log on at their convenience, thus avoiding the need for scheduling to accommodate individual schedules and time zone differences.

15.3.5 Transmitting Hard Copies

Another technology with widespread development applications is the facsimile or fax machine, which enables any type of hard copy including print, graphics, handwritten messages, and the like to be transmitted over a telephone line. Also, "fax boards" may now be installed in personal computers to allow a message created on a personal computer to be sent directly to a facsimile machine.

15.3.6 Personal Computers

Information in the form of databases, full text of journals, video images, and other graphics may now be stored on compact discs and retrieved with a relatively inexpensive reader attached to a personal computer. The advantages of CD-ROMs (compact disc, read-only memory) include vast storage potential, low cost, durability, and ease of use. In addition, CD-ROMs can be used on a standalone basis, without the need for on-line access to databases. Of course, the discs must be frequently updated to keep information current. University and other research libraries in many African countries have rapidly adopted CD-ROMs because of the vast amount of information from journals and other sources that can be accessed.

The enhanced graphics capabilities of personal computers now make it possible to use desktop publishing systems to produce newsletters and other printed materials without typesetting. These features may be particularly valuable in countries

where newspapers, texts, and development materials in local languages may be scarce and costly to produce. Development agencies may now produce their own materials in-house. Storefront desktop publishers may enable many small users to share the desktop publishing equipment and software. Desktop publishing may be combined with telecommunications, such as facsimile, for example, so publications may be inexpensively produced and distributed.

15.3.7 Photovoltaics

Photovoltaics are also important for the future of African telecommunications. Harnessing sunlight is an ideal solution for generating power in a continent where power grids are overtaxed in cities and often nonexistent in rural areas. Solar-powered rural call offices, repeaters, and satellite terminals are being introduced, but more affordable and appropriate designs are needed.

Electrification is an important component of any development strategy. A priest who had founded a cooperative in Rwanda that assembled solar panels explained to the author: "Development begins in the head." The package he had developed included a power supply for two lights and a radio for a small house, so that the family could read and listen to the radio after dark (Hudson 1991a).

15.4 Using New Technologies for African Development

15.4.1 Applications and Benefits

The new technologies offer many opportunities to overcome the barriers of distance that make information acquisition and dissemination so difficult in many developing regions. The following sections describe some examples.

15.4.1.1 Benefits for Commerce

A Nairobi industrial spare parts firm expanded 35 percent after the installation of additional telephone lines (Saunders, Warford, and Wellenius 1994). Farmers in the Nile delta are able to obtain better prices for their produce by contacting buyers in Alexandria directly by telephone rather than dealing through local middlemen (Hudson, unpublished research). National parks not only protect the environment but generate significant foreign exchange from tourism in many parts of Africa. Game wardens and park rangers use two-way radios to combat poaching and assist visitors.

Computers combined with telecommunications enable organizations to conduct business from virtually any location. Banks may transfer funds internationally using the SWIFT network (Hudson and York 1988). Airlines may book reservations from ticket offices, airports, and travel agencies. Brokers and traders may buy and sell coffee, soybeans, copper, petroleum, and the like, electronically. With reliable telecommunications links, these activities need not be limited to cities. Agricultural cooperatives may use computer terminals to find where to get the best prices for their crops. Tourist lodges in scenic areas may book reservations.

15.4.1.2 Logistics

Field reports from the Gambia cited improved efficiency of collecting epidemiological data from vaccine trials using Healthnet instead of having a person from the Ministry of Health travel 500 kilometers every week to pick up the data. Similarly, in Cameroon, Healthnet is used for logistics coordination, administration, and communication, instead of someone traveling from province to province (*SatelLife News* 1994b).

Unfortunately, limited access means that the benefits of improved telecommunications too often remain hypothetical. Studies by the ITU, World Bank, and other agencies have documented the benefits of telecommunications in rural and urban activities that could be obtained if reliable telecommunications were available. For example, Ugandan cotton and coffee cooperatives could eliminate unnecessary trips by managers and improve logistics if telecommunications linked the cooperatives with each other and their processing and marketing operations. It was estimated that these cost savings would offset the expense of the telecommunications investment in one to four years, depending on the technology selected for the network (Saunders, Warford, and Wellenius, 1994, pp. 185–186).

15.4.1.3 Electronic Messaging and Meetings

Facsimile transmission and electronic mail may be particularly viable alternatives to sending hard copies of correspondence and documents through the mail, where service may be slow or unreliable. Managers and researchers located in different cities may exchange information quickly. These technologies can also be used to link project staff in the field with each other and with headquarters.

Travel in Africa is both very expensive and very time-consuming. Officials may require two to three days to travel within the African continent because of inconvenient flight schedules and the limited frequency of interregional flights. Airfares are also high because of lack of competition on most routes. However, managers, development experts, or project staff may now stay in touch electronically rather than having to travel for face-to-face meetings. Audio conferencing allows participants at several sites to participate in the same meeting, while computer conferencing allows for group members to interact at their convenience by reading and contributing to a discussion stored on a host computer. Video conferencing may also be a viable option for linking major African capitals or research centers.

These electronic meetings do not offer the richness of face-to-face interaction, but they may be particularly important as a substitute for traveling to meetings where transportation costs severely strain limited travel budgets.

Researchers have also hypothesized that reducing isolation can help to reduce personnel turnover. While causal data are difficult to obtain, it appears that communication is at least an important factor. For example, better communications is cited as one of several factors encouraging reversal of the medical brain drain in Navrongo, Ghana (*SatelLife News* 1994a).

15.4.1.4 Training

Audio conferencing may be used to update field staff without bringing them to the cities for training. For example, in Peru the Rural Communication Services Project

linked seven rural communities, three via satellite, and four via VHF radio and then via satellite to the national network. More than 650 audio teleconferences concerning agriculture, education, and health were carried out during the project (Mayo et al. 1987).

The ITU has piloted training courses on telecommunications that use computer conferencing and facsimile to supplement written materials.

15.4.1.5 Distance Education

Audio conferencing has been used in other parts of the world to link isolated students who are studying by correspondence. For example, the University of the South Pacific uses a satellite-based audio conferencing network to provide tutorials to correspondence students scattered in ten island nations of the South Pacific. The University of the West Indies (UWI) also offers instruction to students at extension centers throughout the Caribbean using a combination of satellite and terrestrial audio links (Hudson 1990a).

In many parts of Africa, there are well-established correspondence courses, which were typically developed to help students complete their high school education and teachers to attain certification. However, dropout rates are high. The experience at USP and UWI indicates that regular tutorials can reduce dropout rates by providing advice and feedback for students and by creating a sense of community with other correspondence students. Reliable telecommunications links in Africa would enable students to participate in audio or computer conferences from local community centers. Several distance learning projects which use satellite technology to educate students living in remote rural areas have taken off in South Africa. For example, the Africa Growth Network offers interactive educational courses to over 2,000 remote sites throughout the country on the PanAmSat satellite.

15.4.1.6 Research

Computer terminals or personal computers with modems linked to the telecommunications network can provide access to databases anywhere in the world. Agricultural researchers, for example, may access the Food and Agriculture Organization (FAO) databases in Rome. Health researchers may search the database of the National Library of Medicine in Bethesda, Maryland. Others may search specialized development databases such as those for agriculture and energy in India and for development project management in Malaysia.

Costs may be reduced further if these searches can be localized. Databases may be downloaded onto computers within the country, with updates transmitted at regular intervals using telecommunications. The search then becomes local, without the cost of connect time.

Databases in CD-ROM format are also proliferating rapidly. Several universities and research centers in Africa now search databases locally using CD-ROM drives attached to personal computers (National Research Council 1990). Many bibliographic databases contain detailed abstracts. Some CD-ROM materials now include full text, an important consideration where books and journals are expensive and difficult to obtain.

15.4.1.7 Dissemination of Information

Information for use in publications may be transmitted from the field and from regional centers to desktop publishing locations via telecommunications networks. For example, development workers and reporters in the field could send in reports by facsimile; these materials would then be edited and published in newsletters in the city. Posters and notices could be faxed to the rural communities. Newsletters could be faxed either directly to the communities or to regional centers for duplication and dispatch to schools, clinics, or government offices in their territory. Information obtained from various sources such as news services, databases, and teleconferences could also be disseminated to development workers throughout the country or region via facsimile.

These technologies can also help to foster democracy. In Rwanda, before the massacres of 1994, fledgling political parties used fax machines to organize rallies and sent audiocassettes and videotapes of the president's speeches around the country so that people would know what their leaders were saying. Reporters used newly installed rural telephones to file stories.

15.4.2 New and Changing Demands for Services

The proliferation of technologies and services has several implications for African telecommunications planning. First, there are likely to be new and changing demands for telecommunications services. It is not unrealistic to expect that project managers will want to communicate from laptop computers in the field, rural businesses will want to send messages by facsimile, and environmental agencies will want to monitor data on rainfall, soil erosion, and livestock collected in rural locations.

15.4.2.1 Voice and Data

While basic voice communication is still the first priority, many African users now have requirements for data communications as well, particularly facsimile and relatively low-speed data communications. Thus transmission channels must be reliable enough to handle data and voice traffic.

15.4.2.2 Urban and Rural

The availability of relatively low-cost radio and satellite technologies for serving rural areas makes it possible to reach even the most remote locations and to base priorities for service on need rather than proximity to the terrestrial network. But these links also need to be highly reliable if rural users are to take advantage of the applications of facsimile and data communications just described.

15.4.3 Responding to Demand for New Services

The new technologies now available are likely to create demand for new services such as packet-data networks and teleconferencing networks. African telecommunications managers must be able to respond to these demands both by providing

the technical facilities and by setting realistic tariffs if users are to take advantage of the information-sharing potential now possible via telecommunications.

15.5 Bottlenecks and Bypass

15.5.1 The PTT Bottleneck

Today more than 95 percent of Africa's population has no access to reliable telecommunications, despite the availability of VSATs and other relatively low-cost technologies (VHF, UHF, rural subscriber microwave systems, cellular radio, and the like). Given the demand, the reduction in costs, and the potential benefits, why is the diffusion rate so low? There are many reasons, but a major problem is that in most cases the telecommunications administration (PTT) acts as a gatekeeper or bottleneck that prevents customers from obtaining equipment and services. Thus the government-operated utility model that was adopted to protect the public interest now acts as a constraint to retard growth of the telecommunications sector and, as a result, the economy as a whole.

Some examples illustrate the result of the bottleneck. First, the number of television sets has greatly exceeded the number of telephones in many African countries. This imbalance is generally not the result of government priorities but of either lack of awareness of the role of telecommunications, lack of coordinated planning in delivery of services, or unwillingness to give up political and economic control.

Data from forty countries show that on average there are four times as many television sets as telephone lines in Africa (see table 15.2). However, the range is even more striking. Sudan, for example, has 29.8 times as many television sets as telephone lines; Nigeria and Liberia have more than ten times as many television sets as telephone lines, while the Ivory Coast has 8.9 and Uganda has 6.9. Countries where there are approximately the same number of television sets as telephone lines are typically among the poorest, with very limited access to either.[4]

Similarly, personal computers are becoming more widely available than telephone lines in many development agencies, businesses, and universities in Africa. The reduction in cost and increase in computing power of personal computers have been accompanied by advances in telecommunications that should make affordable voice and data communications available virtually anywhere. Yet access to computers is by way of a competitive marketplace, whereas telecommunications services are provided in most countries through access to a single national network. While a personal computer is a standalone technology (despite the fact that it can be linked to other computers through a network), a telephone set and a satellite terminal are useless by themselves—they require a network. Thus, users cannot meet the need for telecommunications alone by buying a telephone set, a cellular phone, or a VSAT. They must be able to connect to a network, and the PTT controls access to the only network. If the PTT is not responsive to consumer needs, as is often the case, frustrated consumers remain without service. These same consumers can usually buy standalone technologies such as computers and videocassette recorders (VCRs) on the open market.

Table 15.2. Ratio of Television Sets to Telephone Lines in Selected African Countries (1992)

Country	Telephone Lines per 100	TV Sets per 100	Ratio of TV Sets/Tel. Lines
Algeria	3.7	3.0	0.8
Angola	0.5	0.6	1.3
Benin	0.3	0.5	1.5
Burkino Faso	0.2	0.5	2.5
Burundi	0.2	0.1	0.4
Cameroon	0.4	2.3	5.4
Central African Republic	0.2	0.4	2.4
Chad	0.1	0.1	1.7
Congo	0.8	0.6	0.8
Djibouti	1.4	5.2	3.6
Egypt	3.9	10.8	2.7
Equatorial Guinea	0.4	0.7	2.1
Ethiopia	0.3	0.2	0.9
Gabon	1.9	3.8	2.0
Ghana	0.3	1.5	5.0
Guinea	0.2	0.7	3.7
Ivory Coast	0.7	6.0	8.9
Lesotho	0.6	0.6	1.0
Liberia	0.2	1.8	10.8
Madagascar	0.3	2.1	7.1
Mali	0.1	0.1	0.9
Mauritania	0.3	1.7	5.4
Morocco	2.5	7.4	3.0
Mozambique	0.4	0.3	0.7
Namibia	4.0	2.6	0.7
Niger	0.1	0.5	3.8
Nigeria	0.3	3.0	10.6
Senegal	0.8	3.6	4.8
Sierra Leone	0.3	1.0	3.2
Somalia	0.2	1.7	10.4
South Africa	8.9	10.3	1.2
Sudan	0.2	7.2	29.8
Swaziland	1.9	2.0	1.0
Tanzania	0.3	0.2	0.5
Togo	0.4	1.1	2.6
Tunisia	4.5	8.0	1.8
Uganda	0.2	1.0	6.9
Zaire	0.1	0.1	1.2
Zambia	0.9	3.1	3.5
Zimbabwe	1.2	3.1	2.5
Unweighted Average	**1.1**	**2.5**	**4.0**

Source: World Telecommunications Development Report. Geneva: ITU, 1994.

Another bottleneck was pointed out in an article in the Harare *Sunday Herald* during the 1989 Africom Development Conference sponsored by the International Telecommunications Union. Under the headline "Telephone Blues," the article reported that the Zimbabwe Postmaster General had announced that the freeze on

telephone installations imposed in 1989 would continue because there were no available telephone instruments. He confirmed that there were telephone lines available in certain areas, but no telephone sets, and that the department had applied to the government for a foreign exchange allocation to source the sets. The article stated that there were 70,000 applicants waiting for telephones ("Telephone Blues" 1990).

While it is unusual to have extra lines in most parts of Africa, the situation in Harare pointed out that some bottlenecks could be overcome simply by opening up the market, in this case for terminal equipment. Africans could probably obtain reconditioned rotary dial telephone sets for next to nothing from countries that have switched to tone dialing.

It should be noted that several African countries are opening up their markets for terminal equipment. However, this equipment is generally imported from overseas and must be paid for with hard currency. Some African countries do produce telephone sets, so it would be possible to establish a market in which they could sell sets in other African countries directly to users rather than to the PTTs.

15.5.2 Bypass: The Users' Response

When users are unable to obtain the capacity they need, or to afford to use available services, they look for alternative solutions. In the old days, they turned to high-frequency (HF) radio. There are still numerous private HF radio networks today in many parts of Africa, and although HF is frustrating in its signal quality and varying reliability, the price is right. If the users own their radios, they can use them whenever they want without paying a carrier. Now, satellites offer a more reliable bypass option.

The Flying Doctor Service operated by the African Medical and Relief Foundation (AMREF) in Kenya, Tanzania, Malawi, and other countries continues to use its own dedicated radio networks rather than the public telephone system because of the high cost and low reliability of the telephone service. As noted earlier, another nonprofit development organization has gone even further and launched its own satellite for medical communications in the developing world. SatelLife's microsatellite, launched in July 1991, provides store-and-forward data communications to small terminals in developing countries. SatelLife was founded by the International Physicians for the Prevention of Nuclear War to reflect their belief that the greatest threat to our common humanity is the gap that exists between health conditions in the developing world and those in industrialized countries.

Why did physicians feel compelled to raise funds for their own satellite? Because, despite modern technology, telecommunications facilities in the poorest regions were either unavailable or unaffordable. "The need in Africa for electronic mail not dependent on traditional communications infrastructures is desperate: In Zambia, international calls are billed at US$6 per minute. In Kenya, a fax costs $7.70 per page outgoing. In Tanzania . . . the minimal cost of a telex [is] a little more than US$25" (Clements 1991). African researchers have been able to use the satellite for free for the first three years and have gained access to medical libraries and other sources of expertise (*SatelLife News* 1993).

These applications may seem rather inconsequential in terms of usage and revenues lost to carriers. But in other parts of the world, commercial users such as banks, brokerages, news services, and oil companies are turning to bypass on a much bigger scale. In most cases, users would rather not have to develop expertise in telecommunications and set up their own networks. Physicians, educators, and bankers simply are looking for affordable and reliable service. They would invariably rather deal with the carriers and leave the technical details to them. But out of frustration, and sometimes desperation, they have turned to setting up their own networks.

15.6 Restructuring the Telecommunications Sector

Since telecommunications is critical to Africa's social and economic development, well-managed telecommunications networks are vitally important. As noted by David Lomax (1990), improved management will be needed not only to improve service quality but to manage the huge investments required to expand the networks. Increasingly, as computers and facsimile machines proliferate, African networks will be required to carry not only voice but facsimile and data communications traffic as well.

Several African countries have begun to reorganize their telecommunications sector. Nigeria has separated its domestic telecommunications from the post office and brought it together with external communications under a new organization, NITEL (Nigerian Telecommunications Ltd.), which operates as a limited liability company with the Nigerian government as majority shareholder (see chapter 9). The company has increased its rates dramatically and also instituted management practices such as aggressive bill collection and downsizing the workforce. Both of the procedures have increased revenues but have been unpopular among users, some of whom claim that service quality has not improved commensurate with local rates.

In 1985, Senegal established the National Society for Telecommunications (SONATEL), which extended the jurisdiction of the former international carrier (TELESENEGAL) to include domestic communications and did so by taking over domestic services formerly operated by the Office of Posts and Telecommunications (OPT). The state is the sole shareholder of SONATEL, which operates as a national company. It has introduced modern management techniques including bonuses and incentives for employees based on merit, as well as improved planning, engineering, and commercial services.

In 1975, Zambia turned its General Post Office (GPO) into a parastatal organization, the Post and Telecommunications Corporation (PTC). In 1987, Zambia made a further move to establish the independence of telecommunications from the government by transforming the state-controlled and state-funded PTC into a limited liability company as part of the Zambia Industrial and Mining Corporation (ZIMCO). Under ZIMCO, the government's investments will have strict limitations, and the company is to operate without subsidies (Akwule 1990).

In the late 1990s, several major countries moved toward a postprivatization of

their telecom operations: South Africa, Ivory Coast, Ghana, Egypt, Moracco, and Tunisia. These are all indicators of the movement toward greater autonomy of the telecommunications sector in developing countries by setting up an entity with independent management, commercial goals, and foreign investment. In the short run, this approach is likely to lead to greater efficiency simply because the entity has an incentive to generate surplus revenues if it is allowed to retain and reinvest its own profits. However, if the government remains the majority shareholder, the government does have a stake in the operation of the company. This role may make it possible for the government to establish other goals as well, such as subsidized service for rural areas or introduction of new services. On the other hand, it also places the government in a potential conflict of interest between the goals of the company—to operate commercially—and the goals of the state. It is not clear how these conflicts would be resolved.

As the experience in some industrialized countries such as the United States, Canada, and the United Kingdom has shown, a private monopoly eventually reaches the point where it has few incentives to serve the public interest or to hold down costs. If competition is not to be introduced, a system of incentives that encourages efficiency but requires that certain public policy and service goals be met is required. There do not appear to be models of incentive regulation or other comparable mechanisms in Africa as yet.

15.7 Financing Options

While investment in developing world telecommunications has increased dramatically in the decade since the Maitland report was written, Africa still lags in attracting investment despite the immense unmet demand. The major reason for this continued underinvestment is the perceived high level of risk. Political instability in the form of coups and civil wars continues to plague numerous countries, while corruption at high levels is endemic in many regimes.

Yet Africa is not a single monolith; there are many bright spots. The end of apartheid in South Africa is the most visible reform, but there have been other significant advances such as the independence of Namibia and the reconstruction of the Ugandan economy. South Africa may become a regional economic engine; however, conditions on the continent continue to vary greatly in terms of political stability, economic organization, and existing infrastructure.

Another reason for underinvestment is the reluctance of many African governments to restructure the telecommunications sector. While there is a move toward corporatization, so that telecommunications can be run as an autonomous government entity, many governments appear to want to maintain control over the sector and the revenues it generates. Yet, as noted earlier, some have adopted the approach of allowing the private sector to provide new services such as cellular systems and value-added networks. This strategy may eventually serve as a transition to general privatization.

Another method of harnessing private initiative while maintaining public-sector control is to license telephones to private agents. For example, in Rwanda, kiosks

that sell newspapers and soft drinks also offer telephone and sometimes fax services. The kiosk owner gets a percentage of the revenue, protects the telephone from vandals, and typically stays open much longer than the post office, where other pay phones are located.

Financing for telecommunications in Africa typically involves a mixture of World Bank and other development bank loans, bilateral aid, often in the form of tied aid requiring installation of equipment from the donor country, and vendor financing. Models introduced in other regions such as build-operate-yransfer (BOT) (e.g., in Thailand and Indonesia) and obligations to invest as part of franchise agreements (Philippines) may also be used as incentives in Africa if national political and economic risks can be minimized.

The most recent trend for financing telecommunications in Africa, particularly for the PTTs, is through privatization. Many major national telecommunications operators in Africa, from Nigeria to Uganda, have been privatized or are planning to be privatized. The most likely financing partner for the African PTTs are national telecommunications operators in Europe. However, Texas-based SBC and Telekom Malaysia have also participated with privatizations throughout Africa. Although most PTTs stand to gain capital infusions by being privatized, African countries also run the risk of losing control of one of their most valuable national assets.

15.8 The Role of the International Telecommunication Union: Beyond Technical Assistance

Through its Technical Cooperation Department, the International Telecommunication Union (ITU) has carried out telecommunications projects approved by the United Nations Development Program (UNDP) and the developing countries involved. As such, it has been largely a subcontractor for the UNDP (Codding and Rutkowski 1982). The Maitland Commission recommended the creation of a Centre for Telecommunications Development to take a more proactive role in responding to the needs of developing countries and to provide a vehicle for participation by the private sector. In 1989, the ITU's Advisory Group on Telecommunications Policy noted in its report *The Changing Telecommunication Environment* that "Developing countries require advice with greater emphasis on economical, financial, managerial and regulatory issues both to stimulate expansion of basic telephone service and to respond to the new telecommunications environment. They turn to ITU as the most appropriate organization for providing such advice" (Advisory Group 1989).

A new structure to respond to developing country needs was approved by the ITU Plenipotentiary Conference in 1990. A Bureau for Technical Cooperation was approved, to take over and expand upon the functions of the Technical Cooperation Department. (The Plenipotentiary extended the life of the Center for Telecommunications Development for two years, but the functions of the center have been folded into the bureau.)

What should be the role of the ITU in providing assistance to Africa? Clearly,

there is a continuing need for training, both technical and managerial, and assistance in preparing technical plans. These have been the traditional roles of the ITU, through training courses and seminars and provision of on-site experts to work with the staff of developing countries.

A second role may be as a regional coordinator. Through RASCOM, the ITU helped African nations to integrate the overlapping and conflicting activities of several regional organizations, coordinated activities designed to gather data on the continent's telecommunications requirements, and examined various options for obtaining satellite services for domestic and regional use. A third role could be to provide a wider range of advisory and consulting services to assist African countries in dealing with the complex policy issues they face in deciding how to restructure the telecommunications sector, introduce new services, consider privatization and competition, revise tariffs, monitor service quality, and other activities.

Does the ITU have a further role to play? Perhaps it is now up to the countries themselves either to establish their own autonomous regional satellite organization or to use the data from the RASCOM studies to plan for their own national or regional communications networks, to develop strategies to entice carriers and equipment suppliers, and to obtain the necessary financing (see Hudson 1991b).

15.9 Implications for African Telecommunications Planning

15.9.1 Integrating Planning across Sectors

In order for new communications technologies to serve development goals, communications planning in Africa must be integrated with national planning. If a country intends to open up new areas for settlement or resource development, telecommunications facilities will be required. If a country intends to diversify its economy, it will need to ensure that adequate infrastructure is in place. It may also need to upgrade the skills of its workforce, perhaps by using instructional technologies.

Lack of coordination between communications and other sectors results in wasted resources and lost opportunities. Some countries have been unable to attract new industries because they lack the necessary telecommunications infrastructure. Too often, telecommunications planning is done in isolation without information about government development priorities or new economic activities.

New technologies allow telecommunications planners to respond to changing needs by installing radio or satellite links, for example, to serve new customers or development projects. Yet planners often do not take advantage of this new technical flexibility by authorizing modifications to existing network plans. They may also hinder development even if the equipment is in place if they enforce unrealistic technical standards or adopt tariffs that make it virtually impossible for potential customers to take advantage of the newly installed facilities.

In sum, the following is needed for coordinated communications planning to occur:

- Telecommunications administrations must be informed about national priorities and development plans.
- National planners must be made aware of the importance of telecommunications infrastructure to national development.
- Resources for extension and improvement of facilities must be allocated to the communications sector, and resources for training and utilization of facilities must be included in the sector budgets.
- Potential users must be made aware of the services available and how they could benefit from them.

15.9.2 User Involvement

Users are rarely heard from when the telecommunications plans for developing countries are being prepared. Yet the users are the most important element of any plan; without an understanding of their needs and constraints, telecommunications services may be inappropriately designed or priced. Why are users such as business managers, development agency officials, and researchers so often unrepresented? They may not have the technical expertise usually expected in planning activities, or they may be unaware of how and when to get involved.

In a sense, telecommunications planners have to act like extension agents to get out and meet with users, learn about their needs, and help them to translate their requirements into facilities and services. This is a new role for telecommunications carriers worldwide. Yet it is a particularly important function in developing countries where resources for new facilities are limited and failure to meet user needs can hinder economic development as well as limit the carriers' projected revenues.

15.10 Conclusion

The goal of using telecommunications to contribute to national development requires an active government policy to ensure that telecommunications plans and services are designed to meet national goals. It also requires flexibility and innovation in services, equipment, and pricing to respond to user needs.

The important fact for African policy makers to keep in mind is that the telecommunications network is more than simply a financial asset and a source of revenue. It is a vital strategic resource for their nations and for the continent. By meeting the challenges posed by new and converging technologies, telecommunications planners can maximize the benefits of telecommunications for African development.

Notes

1. Even in South Africa, which has the highest teledensity on the continent, telephone access in black townships, including those in urban areas, is extremely limited.

2. Data on urban versus rural areas are not available for some of the poorest countries, which tend to have extremely low telephone densities.

3. The author was a special adviser to the Maitland Commission and drafted sections of the report on the role of telecommunications in socioeconomic development.

4. South Africa is an exception, with approximately 1.2 times as many television sets as telephone lines, according to ITU data.

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