14

Models for the Development of Regional Telecommunications Networks in Africa

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The development of telecommunications in Africa began during the colonial era.[1] Telecommunications was a means to maintain control over the colonial possession[2] and was primarily limited to communications between the capital and its administrative centers within Africa. The links that were extended out from the administrative capital were primarily used to solidify control.[3] Establishment of widespread service was therefore inconceivable. Intra-African telecommunications was precluded by the colonial economic structure, which destroyed all preexisting intra-African trading systems (Young 1986).

As African nations became independent, some saw telecommunications as a tool for empowerment and development. Yet full realization of the possible benefits of telecommunications was impeded by significant obstacles, such as the lack of indigenous expertise in telecommunications manufacturing and research. During this period, regional cooperation was articulated as a model for African telecommunications development. It was hypothesized that through the pooling of limited resources, African telecommunications carriers could overcome obstacles to telecommunications development. This model continues to dominate debate in Africa (e.g., ITU 1994b; OAU, Draft Protocol).

Although regional cooperation is often presented as a panacea, its ability to satisfy Africa's telecommunications needs must be assessed in terms of each country's individual need. This chapter seeks to find the most appropriate model/s for developing regional telecommunications networks. It addresses the essential question: Is regional cooperation the most appropriate model for developing sustainable regional telecommunications networks? In assessing the suitability of regional cooperation to regional network development, this chapter provides a comprehensive analysis of the Pan-African Telecommunications Network (Panaftel). The experience of Panaftel raises doubts about the use of the regional cooperation model to develop sustainable regional telecommunications networks. It is argued that a new model will have to emerge if sustainable regional telecommunications

networks are to be developed in Africa. Three possible models are examined: the Appropriate Environment Model, the Regional Satellite Model, and the International Aggregation Model. After an explanation of each model, the future of regional telecommunications networks is discussed. The conclusion seeks to provide broad recommendations concerning the possible use of all three models. Finally, other applications of the regional cooperation model in telecommunications are broadly evaluated.

14.1 Panaftel

Since independence, African nations have viewed intra-African telecommunications capacity as essential to their initiatives toward economic, social, and political integration. Regional telecommunications networks have been considered necessary for establishing trade and government cooperation between African nations. Regional networks were also seen as a method for redefining the communications structure that had been established during the colonial period. The regional cooperation approach for the development that evolved during the 1960s was applied to the desire for intra-African telecommunications links; this spawned the most ambitious African telecommunications project to date—the Pan-African Telecommunications Network.

14.1.1 The Historical Development of Panaftel

The Pan-African Telecommunications Network was conceptualized at the first meeting of the Regional Plan Committee (the Committee) for Africa in Dakar, Senegal, in 1962.[4] At this meeting, 115 delegates sought to redefine the communications structure that had been established during the colonial period, in which no attention or resources were directed toward intra-African communications capabilities. As former African colonies achieved independence, they wanted to move toward establishing direct intra-African telecommunications links.

In 1962, there were only fifteen HF radio systems operating between African countries. There was one UHF radio system operating in East Africa (Kenya, Tanzania, and Uganda); and there were thirteen land cable systems carrying about 100 circuits between African countries (Tedros 1987). The Committee delegates envisioned a continental network that would alleviate the need to transmit intra-African communications through non-African transit centers and would facilitate the achievement of African political, economic, and social unity. They saw regional cooperation as the most effective method for establishing this network.

The second meeting of the African Plan Committee occurred in 1967 in Addis Ababa, Ethiopia. Panaftel's structure was further elaborated, and concrete steps were taken toward establishing the network. In 1968, the International Telecommunications Union (ITU) requested funding from the United Nations Development Program (UNDP) for Panaftel's preinvestment surveys. Two consultant teams began a preliminary study of thirty-eight African countries, which was completed in 1969.

In 1969, the UNDP granted U.S.$2 million to the ITU for detailed technical,

economic, and financial studies. These studies concluded that a network combining coaxial cable and microwave radio-relay links would be the best system for Panaftel. These original specifications envisioned a network with 20,000 kilometers of transmission arteries and eighteen international switching centers (ITU 1974). Routes were selected that could serve as national backbones connecting major population centers in one country and providing international links between neighboring countries.

In 1972, the Meeting on the Implementation of the Pan-African Telecommunications Network was held in Addis Ababa, Ethiopia. At this meeting, the preinvestment survey recommendations were accepted. However, the surveys of the West African region were not complete. Another meeting was held in Lome, Togo, in April 1973 to discuss the results of the West African surveys. After the West African region surveys were incorporated, the estimated cost of Panaftel was U.S.$115 million (ITU 1974).

The improvement of intra-African communications links began as early as 1963—primarily through the use of VHF and UHF circuits. However, Panaftel's implementation, as a coordinated and continentwide project, began in 1975 with the UNDP/ITU project RAF/73/023: Implementation of Panaftel Network Phase I (1972–82). The major goals of this phase were: (1) installation of transmission systems and switching centers; (2) organization of traffic routing and circuit forecasting; (3) specification of radio-relay systems; and (4) training of African P&T staff. During this initial implementation phase, it became clear that coordinating Panaftel on a continental basis was unrealistic. By establishing a subregional structure, the Committee hoped to achieve better coordination and easier ratification of tariff structures and routing matrices. Subsequently, subregional coordinating committees were established for the northern, western, central, southern, and eastern African subregions.[5]

By 1983, Panaftel had progressed significantly; a considerable portion of the network was in use, and thirty-nine countries had at least one satellite earth station. The ITU and UNDP began the second phase of Panaftel: RAF/82/060: Implementation of the Panaftel Network Phase II (1983–86). The major goals of this phase were: (1) tender evaluation; (2) acceptance testing; and (3) traffic management and routing training.

By 1987, the size of the network was more than twice the original specifications: there were 35,000 kilometers of microwave relay links; 8,000 kilometers of submarine links; forty-three international switching centers; and forty-one of the member countries had at least one satellite earth station.[6] A third phase—RAF/87/011: Operation and Extension of the Panaftel Network—was initiated in 1988. The major goals of this phase were: (1) to supplement the network with new links; (2) to reactivate nonoperational links; and (3) to improve mechanisms for operation, modernization, and sustained development of the network.

By the late 1980s, Panaftel's progress had slowed considerably. This was caused by economic, political, and operational difficulties. Emphasis shifted from implementation to improving the operation and maximizing the level of traffic transmitted through the network. This shift was necessitated by operational difficulties that undermined Panaftel's overall viability.

In 1989, the status of subregional networks were as follows (ECA 1993):

1. The northern zone was relatively complete.
2. The West African zone represented a problem area for the network, due primarily to maintenance and operational difficulties.[7]
3. The East African zone had a working system. However, political differences between many of the countries hindered the system.
4. The central African zone had the least developed network. The major obstacle appeared to be lack of political will rather than technical difficulties.
5. The southern African region was almost completed.

By 1989, the existing analog transmission and switching systems were gradually being replaced by modern digital equipment.[8] In 1989, the future plans for Panaftel were as follows: (1) tap the potential of fiber-optic links; (2) improve coordination between African PTTs; (3) help establish a uniform tariff structure; and (4) complete the final links in this expansive network (ECA 1993).

As of 1990, when the last full-scale inventory of Panaftel was taken, the system consisted of 39,000 kilometers of radio-relay links, 8,000 kilometers of submarine cable, and forty-three international switching centers. Moreover, forty-two of the forty-five member countries had international satellite stations. In 1990, twenty-nine links or approximately 4,000 kilometers of links remained to be installed (ITU 1991; Riverson 1991).

14.1.2 Panaftel Problems

Many of the problems encountered during the implementation of Panaftel were identical to the perennial problems faced by African PTTs: lack of skilled personnel, inadequate funding, and poor organization. There were also significant environmental impediments: torrential rains, extreme temperatures, and a lack of accessible roads. Theft of equipment also slowed Panaftel's progress (Crecchio 1980).

Maintenance of the network was a major problem. Many of the same environmental impediments that hindered the implementation of the network also impeded its effective maintenance (e.g., torrential rains and the lack of adequate roads). The inability to obtain spare parts and fuel also led to prolonged outages. The most significant maintenance issue was the lack of well-defined maintenance procedures (Crecchio 1980). In fact, the need for such procedures was not articulated until the advanced stages of Panaftel's implementation. In 1980, the ITU initiated UNDP/ITU Project RAF/80/018: Telecommunications Maintenance—Pan-African Network. This project established the National Program for Improved Maintenance (NPIM) in fourteen countries. The NPIMs concentrated on preventive maintenance and establishing a well-defined "fault signaling system" and well-organized maintenance procedures (N'Zengou 1990).

A major challenge in implementing Panaftel was assessing the demand for intra-African communications. As was noted earlier, prior to Panaftel, there was virtually no intra-African telecommunications capacity, and no means by which to forecast the demand for intra-African communications. In 1963, the ITU and UNDP established an HF link between Addis Ababa, Ethiopia, and Abidjan, Ivory

Coast, to assess the demand for intra-African communications. Optimistically, the ITU felt ". . . that the need for telecommunication circuits between African countries was so high that it could not possibly be met with the inherently low capacity HF radio system" (ITU 1974). In assessing the demand for intra-African communications, the ITU applied an input jump of 50 percent to 1975 telephone forecasts for Panaftel. The ITU also estimated that there would be a yearly increase of 20 percent until 1980, and a yearly increase of 15 percent thereafter. These forecasts were justified on the basis of perceived "latent demand" (Okundi 1976). The actual demand for intra-African communications has never reached the optimistic levels assumed by the ITU's preinvestment studies. In 1992, only 14 percent of Africa's international telecommunications traffic was intra-regional (ITU 1994a).[9]

Due to its expansive nature, Panaftel faced numerous coordination problems. For example, it took over a decade for the African countries to standardize signaling systems (Sy 1985), and signaling problems were still present as late as 1990 (Girmaw 1990). In the southern African subregion, many countries were unable to connect through satellite communications because of the use of various incompatible carrier techniques (Dymond 1987). The most serious coordination problems were less technical and more bureaucratic. These difficulties primarily involved establishing appropriate tariff structures and routing matrices.

Political difficulties existed throughout Panaftel's development and either hindered or even precluded its implementation in particular subregions. There was little user demand for intra-African communications; instead, the impetus for the network was political—stemming from perceived economic and political benefits. In regions where there was no political will to establish Panaftel, the network floundered, as in the central African subregion. Furthermore, Panaftel's political origins made it completely reliant upon the maintenance of cordial diplomatic relations. In several instances, cooperation in Panaftel was used as leverage for achieving unrelated political goals. In at least one case, the end of cordial relations led to the disconnection of Panaftel links, namely, between Kenya and Uganda.

14.1.3 The Current Status of Panaftel

As of 1992, international funding for Panaftel[10] was discontinued. The major reasons were:

- The relatively low revenue from existing links could not justify continued investment.
- The UNDP felt that political inertia in those regions in which links were still missing—specifically, the central African subregion—could not be overcome.

Despite the termination of funding, in 1995, the ITU continued to sponsor seminars and training sessions for the African operators of the Panaftel links.

Although Panaftel's funding was discontinued, attempts to establish intra-African communications links have continued on a bilateral and subregional basis. For example, the completion of Ethiopia's Panaftel links to Sudan and Somalia was planned as part of the Second United Nations Transport and Com-

Table 14.1. Telecommunications Traffic: Tunisian Panaftel Links to North Africa, 1990

Destination Country	Minutes x 1,000
Algeria	1,500
Morocco	1,550
Libya	2,500
Egypt	700

Source: ITU, 1991.

munications Decade for Africa (Second UNTACDA) (Conference of African Ministers 1993).[11] Attempts to establish connectivity between central African countries have continued; for example, a project to establish connection between the four countries belonging to the Kagera River Basin Development Organization was initiated in 1992 (ARB 1992).

Despite ongoing attempts to establish intra-African connectivity, the future of Panaftel is in doubt. As of the mid-1990s, links were deteriorating and much of the system was being exclusively used as backbones for domestic networks. Certain subregions within the overall system are currently sustainable—primarily in the northern and the southern African subregion (e.g., see tables 14.1 and 14.2).[12] The stability of the links in the northern and southern subregions is correlated to numerous factors: the level of trade; the cost of intra-African calls between countries in these subregions; cultural/linguistic similarity; and so on. In the future, the level of traffic transmitted over these links is likely to grow. However, the thinnest routes in Panaftel will probably be allowed to deteriorate (see table 14.3), since diverting resources into these links would be an unsound policy—considering other more pressing telecommunications needs.[13]

14.1.4 An Assessment

Although Panaftel grew from the initial specifications of 20,000 kilometers of communications links and nineteen international switching centers to a network of more than 47,000 kilometers of links and thirty-nine international centers, the final assessment of Panaftel should not be based on its size. Instead, an assessment must be based on whether the network is sustainable, since this will determine whether it

Table 14.2. Telecommunications Traffic: Zimbabwean Panaftel Links to Southern African Countries, 1990

Destination Country	Minutes x 1,000
South Africa	15,265
Botswana*	1,988
Malawi*	693
Zambia	1,110

Source: ITU, 1991.

*Routed through South Africa.

Table 14.3. Selected Panaftel Thin Routes, 1990

Originating Country	Destination Country	Minutes × 1,000
Burkino Faso	Gabon	10.00
Kenya	Nigeria	2.00
Benin	Ghana	9.5
Ivory Coast	Ethiopia	21.00
Chad	Benin	2.4
Chad	Malawi	1.9
Tunisia	Ivory Coast	11.00

Source: ITU, 1991.

*Routed through South Africa.

will be able to assist in the advancement of Africa. These same ideas were articulated at the Meeting of the African Traffic Managers (1987); however, these concerns were articulated at the wrong stage of Panaftel's life cycle.

If the revenues generated are insufficient to make the network self-sustaining, then the energy and resources invested have been wasted. A look at the amount of traffic being transmitted over some links explicates the economic inviability of much of the network (see table 14.3). The future of these links and many others like them is questionable. Although certain subregions are more stable than others, Panaftel has not become a sustainable continentwide regional telecommunications network.

14.2 The Need for a New Model

The model employed for Panaftel can be most accurately termed a Multilateral, Large-Scale Regional Cooperation Model. This model is fraught with obstacles and pitfalls. For example, regional networks developed under this model are too dependent on political initiatives. As Panaftel demonstrates, politically motivated networks are not sustainable if and when political will dissipates. Further, the lack of demand for the network beyond political desires means that there is unlikely to be sufficient revenue to sustain it.

Despite the apparent inefficacy of this model, it continues to be employed by African telecommunications carriers in the development of regional networks—for example, the Kagera Basin Project. However, if African nations want to establish sustainable regional telecommunications networks, a new model must be adopted. There are at least three possible models: Appropriate Environment Model, the Regional Satellite Model, and the International Aggregation Model. These models differ in the following ways: the types of technology employed; the types of and method by which connectivity is established; and the potential revenue streams.

14.2.1 The Appropriate Environment Model

The Appropriate Environment Model (AEM)[14] concentrates on establishing the milieu necessary to spawn demand for regional networks. Panaftel clearly

demonstrates that establishing connectivity is insufficient to spur intra-African communications. Communications capacity is merely an enabling factor; the effective utilization of this capacity is contingent on numerous factors, such as appropriate tariff structures, trade, travel, national telecommunications penetration, and so on. The AEM seeks to create the appropriate mix of factors that will stimulate the demand for regional telecommunications networks. This model asserts that since demand for regional networks is contingent on numerous factors, which are external to telecommunications capacity, the best method for developing regional networks is to concentrate on these factors. Further, within model regional telecommunications networks, demand can be induced through the convergence of these other factors. The factors that are central to the AEM are national telecommunications penetration, appropriate tariff and policy structures, and liberal government policies.

Increasing the national telecommunications penetration rates is essential to the AEM. These penetration levels are a key determinant of demand for regional capacity (Checchi 1968). The more individuals that are connected to each national network, the greater the value of each of these networks and the greater the value of connections between these networks. Investing in regional communications capacity without significant growth of national networks will only assure that the regional networks are not sustainable. Thus, resources and energy should be placed in national networks. As national networks develop, the demand for regional communications will increase.

To improve national telecommunications penetration levels, carriers and African governments will have to alleviate many of the obstacles that hinder the expansion of national networks. The poor national penetration levels of African telecommunications networks is partially due to structural problems within the telecommunications sector. First, more of the revenues generated by the telecommunications sector will have to be reinvested in expanding the network.[15] Also, the overall efficiency of African telecommunications providers must be improved, for example, by reducing the number of employees per line[16] and improving billing systems and bill collection.[17] Removing all of these barriers to network expansion is essential to improving national telecommunications penetration and creating the necessary environment for regional telecommunications networks. The restructuring of Africa's telecommunications sector—such as the privatization projects in Senegal and Ghana—will be critical to alleviating these obstacles and can be seen as the first step toward implementing the AEM.

Establishing appropriate tariff structures that enable the use of regional networks is essential within the AEM. If regional networks are to develop, telecommunications providers will have to revise current tariff structures that hinder the use of regional networks, namely, the exorbitant tariffs on international calls (Paltridge 1994). The networks within the northern and southern subregions, which are sustainable, have the lowest charges on intra-African calls; conversely, those subregions with the lowest level of intra-African communications have the highest charges for intra-African calls—the western and central African subregions (see table 14.4). Clearly, there is some correlation between intra-African telecommunications traffic and the cost of intra-African calls. Therefore, in creating the appropriate environment for regional telecommunications networks, African telecommu-

Table 14.4. Average Cost of a Three-Minute Intra-African Call for Selected Countries

Country	Subregion	Within Subregion	Outside Subregion	Comparable North American Price (U.S.–Canada)
Ghana	Western	$10.83	$13.43	$0.90
Benin	Western	$13.72	$22.96	$0.90
Namibia	Southern	$ 3.83	$11.00	$0.90
Zimbabwe	Southern	$ 2.4	$ 7.8	$0.90
Egypt	Northern	$ 3.35	$ 7.5	$0.90
Burundi	Central	$18.90	$15.70	$0.90
Rwanda	Central	$11.10	$11.18	$0.90

Source: ITU, 1994a.

nications providers will have to adopt tariffs that promote intra-African communication, in other words, they will have lower charges for intra-African calls.

The AEM asserts that in order to spur regional network creation, intra-African trade must increase. In reference to G7 countries, Aharon Kellerman (1990) has shown that telecommunications traffic is most directly correlated to trade. In 1993, only 8.1 percent of African trade was intra-African (IMF 1994). The amount of intra-African telecommunications traffic will remain low as long as the level of intra-African trade remains low. Those African nations that have achieved relatively high levels of bilateral trade have also achieved relatively high volumes of bilateral telecommunications traffic. For example, in 1992, Djibouti and Kenya were Ethiopia's two largest African trading partners; Djibouti accounted for 49 percent and Kenya accounted for 33 percent of Ethiopia's total intra-African trade (IMF 1994). In this same year, Ethiopia had the greatest volume of communications with these two countries: 0.9 million minutes of calls to Djibouti and 0.8 million minutes of calls to Kenya (ITU 1994a). African nations will have to increase the level of intra-African trade, if they are to create the appropriate environment for regional networks.

In stimulate intra-African trade, African nations will have to adopt policies that enable the free flow of economic factors, that is, money, people, and information.[18] For example, the 1994 expulsion of African expatriates from Gabon will likely lower the telecommunications tariff between Gabon and neighboring African countries. African nations will also have to adopt policies that surmount other obstacles to further economic integration, such as the lack of convertible currency and unequal levels of development (UNCTAD 1993). These policies will stimulate demand for regional communications, and regional networks will follow.

The AEM emphasizes the need to create a milieu that will stimulate demand for regional telecommunications capacity. Once the appropriate environment has been stabilized, regional networks should be allowed to develop in response to actual demand. If the necessary policies cannot be enacted or the investment in national telecommunications does not increase the demand for regional connectivity, then regional networks should not be developed, since they would be unable to generate sufficient revenues to sustain themselves and would ultimately divert resources from other more pressing national telecommunications needs.

14.2.2 Other Models

Although certain aspects of the Appropriate Environment Model (AEM) are surfacing in the debate on regional network development (ITU 1994b), this model is not the only one available. The AEM is optimized for regional telecommunications networks that are terrestrial systems; that carry only intra-African traffic; and whose primary revenue is generated by basic telecommunications services and data communications. However, none of these attributes is a requirement for viable regional networks. The Regional Satellite Model and the International Aggregation Model offer considerable possibilities for African regional networks. Yet these models are based on different underlying principles: they use different types of technology; they can offer different services; and they can carry different types of traffic.

14.2.3 The Regional Satellite Model

The Regional Satellite Model (RSM) has been utilized throughout the world for regional network development. The European Satellite (Eutelsat) was established in 1983; the Arab Satellite (Arabsat) was established in 1985; and the Asian Satellite (Asiasat) was established in 1990. The use of a regional satellite brings new variables into the process: new revenue sources, new economic considerations, and new coordination concerns. In 1995, African nations were moving forward with efforts to establish a regional satellite under the auspices of the Regional African Satellite Communications Organization (RASCOM).

14.2.3.1 RASCOM

Before Panaftel's implementation began, a dedicated African satellite system was proposed (Okundi 1979). It was hypothesized that Panaftel would not satisfy the demand for intra-African communications and would have to be supplemented by a satellite system. In 1975, the Conference of African Telecommunications Administrations requested a feasibility study for a dedicated African satellite system (Okundi 1976).

Between 1980 and 1984, numerous separate studies were conducted. In 1983, the Inter-Agency Coordination Committee was created to integrate all the previous studies (Akwule 1990). In 1987, the ITU conducted a final feasibility study.[19] This study examined engineering concerns, the financial and economic viability of such a system, staffing and training, and organization and management issues (ITU 1990). After some hesitation on the part of African nations (Hudson 1991), the feasibility study was approved in Abuja, Nigeria, in February 1991. An interim RASCOM organization was created in May 1992 (Jipguep 1993b). The organization became operational in November 1993, with its headquarters in Abidjan, Ivory Coast.

The specifications of RASCOM's call for a two-satellite system. The cost of the satellite segments was estimated at U.S.$250 million each, and the cost of ground segments for the fifty countries was estimated at U.S.$800 million (Rzepecki 1990). The organization is cooperatively owned, with each country

purchasing minimum initial investment shares of U.S.$50,000 (Jipguep 1993b). As of March 1994, thirty-five countries had signed the Operational Convention and thirty countries had purchased their designated investment shares. To attract additional investment, RASCOM will implement a mechanism by which African and non-African investors can buy shares in the organization—the Non-Signatory Shareholder Agreement (Africa Communications 1994).[20]

After becoming operational, RASCOM's first initiative was to pool the transponder space leased from Intelsat by member nations. The organization has also begun providing commercial services; for example, in 1994, RASCOM began leasing transponder space to the South African broadcasting company ORICOM (Africa Communications 1994).

Officials stated that the first satellite would be launched in 1997, and would be a cooperative venture with another organization.[21] As of 1998, RASCOM has not launched any satellites. The organization has experienced delays due to the inability to raise the $250 million needed to launch the satellite. In an effort to raise the capital, RASCOM decided to seek a build, operate, and transfer (BOT) venture with a private sector company that would be willing to finance the RASCOM satellite project. RASCOM issued a request for proposals from various companies, including satellite manufacturers and equipment suppliers. It would be wise to adopt a wait and see position on whether or not RASCOM is able to find a willing BOT partner.

The major benefit of the RSM is the flexibility that a satellite system would provide. It would be a conduit for numerous types of telecommunications traffic; for example, RASCOM plans to offer television, video conferencing, and data transmission services on a commercial basis. It could also offer mobile services, location identification services, and remote sensing applications. A regional satellite system also offers African countries new options for addressing the dismal level of telecommunications in rural areas, such as, the use of VSATs.

Although a regional satellite system would offer numerous benefits, the RSM has many of the same obstacles inherent in the Panaftel model. For example, effective coordination and cooperation between African signatories is essential to RASCOM's success. Problems have already emerged in this regard. For example, during the process of establishing RASCOM as an operational organization, Nigeria withdrew from the organization because of a dispute over the location of the headquarters.[22]

Ultimately, RASCOM's success will hinge on its ability to generate sufficient revenue to justify and sustain it. Intra-African communication is unlikely to be able to generate the necessary revenue, since only 14 percent of African international telecommunications traffic is intra-Africa (ITU 1994a). It is also unlikely that revenues from integrating international traffic from countries in the interior of Africa with one of the fiber-optic proposals will be sufficient to sustain the network. In fact, these optical fiber proposals represent a threat to RASCOM's overall viability, since they will offer a superior alternative on the most lucrative intra-African trunk routes, for example, between the Ivory Coast and Nigeria.[23]

The major opportunity for RASCOM is in the transmission of television, since this is the only service that has the potential revenue necessary for RASCOM's

success. This assertion is based on three observations: (1) the inherent suitability of satellites for point-to-multipoint communications (Podmore and Faguy 1986); (2) there are almost four times as many television sets as telephones in Africa (ITU 1994a); and (3) the Arabsat and Eutelsat satellite systems have demonstrated the feasibility and profitability of distributing of television via a regional satellite (Bloch 1992). If this service is to succeed, African governments will have to create an enabling environment for transmitting television via satellite. The high demand for television transmission over Eutelsat has been correlated to the liberalization of television broadcasting in Europe (Bloch 1992).

14.2.4 The International Aggregation Model

The International Aggregation Model (IAM) is linked to the emergence of international digital networks. The combination of international fiber networks, the digitization of telecommunications traffic, and advances in digital switching and transmission (ATM, SONET, etc.) have resulted in new economies for international telecommunications traffic. The IAM is based on the use of optical fiber to create regional networks that also have the capacity to aggregate international telecommunications traffic. The use of this model in Africa would create a regional network that would not depend exclusively on intra-African telecommunications traffic. This model takes Africa out of isolation and provides a global solution to Africa's desire for regional networks. The model has already been employed with the SEA-ME-WE2 (Southeast Asia, Middle East, Western Europe) fiber-optic cable,[24] and has been proposed for an ASEAN (Association of Southeast Asian Nations) regional network.[25] The extension of this model is related to the existence of SEA-ME-WE2 and other international optical fiber links.

Presently, there are three fiber-optic proposals slated for the continent: FLAG's Africa plan,[26] Alcatel's Pan-African Project,[27] and AT&T's Africa One proposal. For the purpose of this study, the discussion will be limited to AT&T's Africa One proposal.

14.2.4.1 Africa One

Africa One is the most ambitious of the fiber-optic proposals. Its originator, AT&T, estimates that it will require over 35,000 miles of fiber-optic cable and have an estimated cost of U.S.$1.9 billion (AT&T 1995). Moreover, AT&T proposes that Africa One will have forty-one landing points in Africa and will also connect to Italy and Saudi Arabia. The fiber will have a transmission capacity of 2.5 gigabits per second. The development of Africa One by AT&T has a three-tier plan.

1. Laying of an optical fiber ring around the continent.
2. Connecting of interior African countries through alternative means, such as satellite.
3. Providing global and transoceanic connections to the rest of the world.

According to AT&T's proposal, Africa One will be owned and operated by a regional corporation. The staff for the regional corporation will be drawn from the participating African telecommunications providers. Also, AT&T has proposed

that RASCOM be the majority shareholder in the regional corporation. In early 1995, RASCOM stated unequivocally that it would not invest in the network;[28] however, in May 1995, RASCOM seemed to have reevaluated this position and stated that it would work with AT&T on Africa One—although the exact nature of this relationship was not disclosed.

In addition to RASCOM, AT&T is targeting a broad range of potential investors and funding institutions: African PTTs, private investors, multinational end-users, international carriers, and multilateral and bilateral funding agencies (AT&T 1994). African telecommunications providers will have the option of purchasing either capacity or equity in the network.[29] Major multinational end-users will be able to purchase capacity outright or may make long-term commitments in return for guaranteed pricing.[30] Private investors will be able to buy equity or hold debt. International carriers will be able to purchase capacity on the network.

In trying to sell its idea, AT&T has provided a myriad of arguments concerning the benefits and economic viability of Africa One. First, it has argued that Africa One will complement other regional projects such as RASCOM and Panaftel and will significantly increase intra-African capacity. The company also argues that a regional fiber-optic network has several other benefits:

- *Economies of Scale.* Through the use of the same technology, economies of scale can be achieved.
- *Risk Management.* Due to the regional nature, the broad communities of interest, and the economies of scale that can be achieved, risks are reduced.
- *Broad Flexibility.* Due to regional structure, the network will be able to service countries with differing levels of development and telecommunications traffic.

In addition, AT&T foresees numerous potential sources of revenue for the network:

- *Domestic Revenue.* By establishing multiple land points in one country, domestic traffic can be transmitted over the network.
- *Regional Traffic.* Revenues will be generated by intra-African telecommunications traffic.
- *Satellite Connections.* Revenues will be generated by integrating traffic from the interior into Africa One.

However, these potential revenue sources will not be sufficient to justify or sustain the network. The bedrock of Africa One's economic viability is its ability to connect to AT&T's Global Undersea Fiber Optic Network (GUFON). By the end of 1995, AT&T estimates that forty countries will be connected to its GUFON; further, AT&T estimates that by the year 2000, a hundred countries will be connected to the GUFON. The company proposes that Africa One will aggregate outbound African traffic from the region with other regional fiber-optic networks such as SEA-ME-WE2 and SAT2. This proposal is in line with African telecommunications traffic patterns, namely, that 86 percent of Africa's international telecommunications traffic is destined for countries outside the region (ITU 1994a). Further, AT&T envisions the transmission of significant global traffic

through Africa One through the aggregation of global traffic at interregional gateways. The aggregation of intra-African traffic and the transmission of global traffic combined with the other revenue sources discussed earlier make Africa One a viable project from AT&T's perspective.

If the proposal is to move forward, AT&T will have to gain the African nations' support. The company will have to show how the revenue generated from the network will be distributed. For example, although the ability to transmit global traffic through Africa One gives AT&T significant flexibility in traffic routing and provides a potentially significant revenue generator, AT&T's project outline (AT&T 1994) does not indicate how this revenue will be distributed. If AT&T is to gain African support, it will have to address this and other issues that relate to Africa's ability to share in the potential benefits of Africa One.

14.3 The Future of Regional Telecommunications Networks

In the future, Panaftel's model for regional network development is likely to disappear. African telecommunications carriers will be unable to find funding for these types of projects for two primary reasons: the retrenchment of multilateral aid for these types of projects, due to the difficulties encountered by Panaftel; and the inability of African telecommunications providers to compete for funding with international telecommunications providers attempting to establish regional networks in Africa, such as AT&T.

The Appropriate Environment Model (AEM) is likely to become the dominant model at the subregional level. Several factors will precipitate the shift to this model at that level. First, the demise of the multilateral, large-scale model will require that African telecommunications providers desiring to establish regional connectivity adopt another approach. Second, there has been a shift in emphasis from the development of intra-African telecommunications links to development of domestic telecommunications networks. At the end of Panaftel's implementation, the importance of investing in national networks was realized, and Panaftel was redefined to ". . . encompass the entire public telecommunications network down to the subscriber level" (Tedros 1987). This reflects the realization that there is a real telecommunications need at the national level. This emphasis on domestic networks is likely to grow, due to the current restructuring of the African telecommunications sector and the opportunities offered by new technology. Corporatized or privatized telecommunications operators will likely look to increase revenue from the domestic network through investing in its expansion; also, many of the constraints on national network expansion will be lifted once the telecommunications provider is separated from the government (ITU 1994). Further, new telecommunications technologies offer significant opportunities for the expansion of domestic telecommunications. Cellular and VSAT technologies are already being deployed throughout the continent and are aiding the expansion of national telecommunications networks (ITU 1994a). In the future, African telecommunications providers will likely look to employ new technologies to expand domestic networks.[31]

The restructuring of the African telecommunications sector will also lead African telecommunications providers to emphasize the economic viability of international links over political justifications. Thus, if African governments want to establish regional connectivity because of the associated externalities, they will have to adopt the AEM to catalyze regional network development. Finally, the success achieved in those regions that have adopted certain aspects of this model will lead other regions to attempt to implement the principles of the Appropriate Environment Model. For example, the southern African subregion, which has the healthiest Panaftel links (ITU 1994a), has been able to establish appropriate traffic structures[32] and has significantly outpaced other regions in investing in national networks (ITU 1994a).

One should also note that rivalry among countries within the same region to become the international telecommunications hub for that region has also quickened the pace of domestic telecommunications development. For example, Ghana and Nigeria have been making strides to establish regulatory policies that encourage private investment in their national telecommunications industries in an effort to enhance national services in order to become the leader for international call switching within the West African region.

The future of the Regional Satellite Model (RSM) or RASCOM, is extremely questionable. Although plans to establish a dedicated African satellite continue to move forward, the ability of RASCOM to establish a sustainable regional network will depend on numerous factors:

1. The level of network expansion within, and the amount of international telecommunications traffic originating from, landlocked countries, since this will determine the amount of revenue that will be generated by integrating landlocked countries into one of the fiber-plans.
2. The ability to overcome the coordination problems inherent in this model. For example, the dominance of the organization by large and powerful signatories—such as Nigeria—may impede coordination.
3. The establishment of a significant market for a Direct Broadcast Satellite (DBS) in Africa. This will be a difficult task, since DBS will raise troubling questions about national identity and cultural imperialism.

Further, RASCOM raises another issue, namely, whether it is congruent with the current move toward restructuring and separation of the government and the telecommunications provider. The RSM may lead to a conflict of interests: if African telecommunications carriers are eventually privatized and seek to offer intra-African links, this will present competition to RASCOM, which is government-owned. Will African telecommunications regulators attempt to impede projects that compete directly with their own system? Ultimately, considering the issues raised earlier, and that VSAT capabilities are already offered by Intelsat and PanAmSat, the establishment of a dedicated African satellite may not be the most appropriate method for regional network development.

The International Aggregation Model is likely to take hold in Africa as it is doing throughout the world. This model holds numerous benefits for Africa; however, it is unlikely that the current fiber plans will receive much support from

African administrations. It is not clear which plan will prevail, although AT&T has put forward the most comprehensive solution. The most likely scenario is that the plans will continue mainly from international motivations for establishing global fiber systems. African telecommunications carriers will probably jump on board at a later stage.

14.4 Conclusion

The African desire to establish regional connectivity and the climate of regional cooperation that pervaded the debate over African development in the 1960s combined to create the most ambitious telecommunications project to date—the Pan-African Telecommunications Network. Despite its ambitious goals, Panaftel has not become a sustainable, integrated continentwide telecommunications network. Certain links are sustainable and certain regions have advanced further than others in establishing connectivity (e.g., SADC); however, to spur further regional network development, a new model will have to be adopted. The Appropriate Environment Model seeks to establish the necessary milieu in which sustainable networks can develop. The Regional Satellite Model seeks to develop regional networks through a cooperatively owned dedicated African satellite system. The International Aggregation Model employs optical fiber technology for regional network development and incorporates African regional network development into the wider context of global networking.

Although sustainable networks can conceivably be developed with all three models, adopting the AEM would increase the chances of success for both the Regional Satellite Model and the International Aggregation Model. For example, appropriate tariffs for international calls will be essential to the success of both RASCOM and Africa One; and an expansion of national telecommunications networks would increase the traffic transmitted through all African telecommunications systems—national, subregional, or regional; optical fiber, satellite, or microwave. All parties interested in African regional networks (e.g., RASCOM, AT&T, FLAG, African Governments, ITU, etc.) should promote the implementation of the AEM at the national, subregional, and regional levels.

In reference to the RSM, RASCOM should adopt a more flexible stance, rather than bullishly moving forward with plans that originated in the 1970s. It is a different time, in which different technological, economic, and political factors must be taken into account. Development of regional telecommunications networks must be based on the underlying economic viability of the proposed network, not on political reasoning or some other motivation. Panaftel demonstrates the folly within the "If you build it, they will come" approach to network development. Moreover, RASCOM should look at the opportunities offered through other technologies: AT&T's Africa One proposal or one of the other optical fiber plans may hold some opportunities. These plans would increase intra-African capabilities and allow RASCOM to benefit economically from the large amount of extra-African communications, as well as the global traffic transmitted over the net-

work. The question of distribution of revenue must be brought to the table. Furthermore, RASCOM should look to market and increase the penetration of Intelsat's VSAT service; this would also generate revenue for the organization. If the African VSAT market develops and no new technologies supersede VSAT, then RASCOM should consider launching a satellite. But RASCOM must move cautiously; Africa cannot afford another ill-advised attempt at establishing a regional telecommunications network.

Those advocating the IAM will have to continue to make the economic case to African telecommunications carriers and governments, since African support is essential. From the African perspective, AT&T's Africa One proposal may provide significant opportunities; for example, potential revenue, future flexibility, and the transfer of fiber-optic technology to the continent (thereby enabling African telecommunications carriers to learn how to implement and operate fiber-optic systems). If RASCOM opts to reevaluate its position toward Africa One (as it seems to have already begun to do), it should assure that it is a full participant in every aspect of the network, and that Africans take full advantage of all the opportunities and benefits offered by the network.

It is clear that regional cooperation remains a metamodel for African development. This can be seen in the continued attempts to establish economic communities and trade blocs throughout Africa—the ECOWAS, SADC, PTA, and so on. However, the fact that regional cooperation provides opportunities in related areas should not lead to its broad and unqualified application in telecommunications development. Panaftel clearly demonstrates that regional cooperation will not be successful in overcoming all of the obstacles that hinder African telecommunications development. African nations and African telecommunications carriers will have to find appropriate opportunities for cooperation in telecommunications. Certain forms of cooperation are unlikely to be successful. For example, cooperative manufacturing projects[33] will be difficult to establish and sustain because of the political difficulties that are likely to arise, such as the selection of the facility's location and the distribution of benefits like employment.

An appropriate form of regional cooperation in telecommunications is the adoption of common standards. Common standards would increase the ability for regional networks to develop and would create economies of scale within the respective economic communities. This should enable the growth of private manufacturing initiatives. As Mr. Jean Jipguep, deputy secretary-general of the ITU, has stated, " an early agreement on a common standard for mobile communications in Africa would do more to promote investment in this high growth sector than continuing fragmentation and home-grown policies" (Jipguep 1993a). Other forms of cooperation are probably also feasible, such as cooperative training (Crecchio 1980; Riverson 1991) and cooperative purchasing of telecommunications equipment (Hashimoto 1994; Hainebach 1994). Nevertheless, one must question whether these forms of cooperation will be feasible in a more competitive environment in which the government and the telecommunications carriers have been separated and carriers face competition—possibly from other African telecommunications carriers.

Notes

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1. One obvious exception is the development of telecommunications in Ethiopia (see Tsige, this volume).

2. Telecommunications was used to counter threats from both African resistance fighters and other colonial powers (Headrick 1991).

3. For example, in Ghana, during the Ashanti War, the British extended telecommunications capabilities from Accra to Kumasi in order to facilitate the suppression of the uprising (Allotey and Akorli, this volume).

4. The African plan subcommittee was created in 1960 by the Plenary Assembly of the International Telegraph and Telephone Consultative Committee (CCITT) and the International Radio Consultative Committee to address the needs of newly independent African nations.

5. This subregional structure was also congruent with regional grouping that had developed in Africa, for example, the Economic Community of West African States (ECOWAS) and the Southern African Development Coordination Conference (SADCC). During this phase of Panaftel's development, the Pan-African Telecommunications Union was established as the Specialized Agency of the OAU in the field of telecommunications. It was hoped that these organizations would be able to assist in the implementation of Panaftel. Recent studies have suggested that the multitude of telecommunications organizations in Africa may have hindered, rather than assisted, telecommunications development on the continent (ITU 1994a, 1994b).

6. During this period, Panaftel also benefited from the initiation of the United Nations Transport and Communications Decade for Africa (1978–88), which provided additional resources to Panaftel.

7. Although it is not explicitly stated in any material reviewed for this study (with the exception of some discussion of the different telecommunications organizations that originated for Francophone and Anglo-West Africa in Sy (1985)), the differences in language between French- and English-speaking West Africa must have hindered telecommunications traffic. (See Kellerman 1990 for an analysis of the role of language in telecommunications flow.)

8. With the exception of the link between Djibouti and Zaire, all the switching centers installed since 1986 have been digital.

9. These data exclude communication with South Africa.

10. Much of the information for this section is based on personal communications with senior ITU officials.

11. This project has an estimated cost of U.S.$5.35 million—U.S.$1.25 million was provided by Ethiopia and U.S.$4.30 million has been contributed by the European Economic Community (Conference of African Ministers 1993).

12. The countries presented in these tables were selected on the basis of the amount of data available in ITU, 1991. These countries had the most comprehensive data. This is

probably due to a failure by other countries to respond to survey requests issued by the ITU.

13. For example, in 1994, it was estimated that to increase the current average ratio of direct exchange lines (DELs) from 1.6 per 100 to 3.0 per 100 by the year 2000 would require an estimated U.S.$30.8 billion investment (ITU 1994b). Obviously, the accuracy of this estimate will depend on the cost per line and the type of technology deployed.

14. Many aspects of this model are articulated and recommended throughout the African Green Paper; however, it is not presented as a specific model for regional network development. Further, many aspects of the Panaftel model are also recommended in the document, which does not make a clear distinction between these two or any other models for regional network development in Africa (ITU 1994b).

15. The African telecommunications sector has the highest average rate of return in the world. Africa's average annual return is 26 percent, while the world average is 16 percent (ITU 1994a). However, these profits are rarely reinvested in the telecommunications network. In 1992, on average, only 36 percent of the profits that were generated by the PTTs was reinvested in the telecommunications network (ITU 1994a).

16. In 1992, sub-Saharan Africa had an average of 58 employees per 1,000 main telephone lines. The next closest regions in the world were the Arab States and Russia with 19 employees per 1,000 DELs, then the Asia-Pacific region with 17 employees per 1,000 DELs (ITU 1994a). This inefficiency can also be found in the procurement procedures and the lack of competitive tendering. This has the effect of raising the cost per new line, which was the highest of any region in the world (ITU 1994a), and lowering the possibility for telecommunications expansion.

17. A joint UNDP/ITU report showed that for ten surveyed sub-Saharan African countries, an average of only 60 percent of bills were collected, and the state was the main debtor (cited in ITU 1994b).

18. A recent study has correlated the free flow of economic factors to trade between nations and the ability to form economic communities, trade blocs, and so on (OECD 1993).

19. A total of U.S.$1.5 million in funding was provided by the African Development Bank, the UNDP, the ITU, the OAU, and the governments of Italy and the Federal Republic of Germany (ITU 1990).

20. In April 1995, RASCOM began reviewing proposals concerning the precise terms of the Non-Signatory Agreement. At that time, the estimated levels of ownership for nonsignatory members ranged between 20 percent and 49 percent of the satellite system. There was no estimate as to the amount of capital that would be raised through the Non-Signatory Agreement. The precise terms of the agreement were to be finalized at a meeting of the RASCOM signatories in Accra, Ghana, in May 1995 (personal communications).

21. In early 1995, RASCOM management declined to disclose the name of their satellite partner.

22. Nigeria wanted the headquarters to be located in Lagos, Nigeria. However, the organization decided to establish its headquarters in Abidjan, Ivory Coast (Jipguep 1993b; African Communications 1994; Conference of African Ministers 1993). Nigeria has since rejoined RASCOM (personal communications).

23. In reference to the optical fiber plans for the continent, specifically AT&T's Africa One proposal, RASCOM asserts that these plans complement its own objectives and will not endanger RASCOM's viability (personal communications).

24. This is an 18,000-kilometer fiber-optic network that stretches from Singapore, through the east coast of Africa, to the Middle East and France. The system was built by AT&T's Submarine Systems division for a consortium of over fifty telecommunications companies.

25. In 1998, ASEAN agreed on a plan—the ASEAN Optical Fiber Cable Network (AOFSCN) (Mohammed and Supaat 1992). The ability to transmit non-ASEAN traffic may become a key revenue stream for this network.

26. Fiber-optic Link Across the Globe (FLAG) is a partnership between Nynex (United States), Gulf Associates (United States), Dallah Albaraka Group (Saudi Arabia), and Marubeni Corporation (Japan). In 1995, FLAG was pushing a proposal to connect African countries to its 31,000-kilometer fiber-optic link from the United Kingdom to Japan. The FLAG proposal has an estimated cost of U.S.$800 million (Langworth 1994).

27. Alcatel's Pan-African project focuses exclusively on West Africa; it has nineteen landing points from Cape Town to Casablanca. The project has an estimated cost of U.S.$600 million. Alcatel hopes to solicit 50 percent of the necessary financing from European, Asian, and South American investors. It proposes that the remaining half be contributed by African countries—it estimated that the average cost per country will not exceed U.S.$18 million (Ayre 1994).

28. Personal communications.

29. AT&T foresees multilateral and bilateral funding agencies as the most likely source of capital for African telecommunications providers' investment in Africa One. On March 8, 1995, William B. Carter, president of AT&T Submarine Systems, Inc., testified before the Joint Hearing on Trade and Investment in Africa. He argued that Africa One was essential to Africa's development and should be supported by the United States through the bilateral aid agencies, such as the Agency for International Development (AT&T 1995).

30. The long-term economic viability of this strategy has been questioned (Langworth 1994).

31. Of course, African nations must be cautious in their selection of technology and must be certain that their choices appropriately satisfy African needs.

32. The southern African region has adopted a Sender Keeps All tariff structure. Under this model the originating country keeps all tariffs charged to the user, which eliminates the need for settlement of payments (ITU 1994b). This model may also provide an incentive to lower international tariffs, since it would theoretically increase the amount of traffic that flows over the international link and translate into increased revenue for the national telecommunications provider.

33. This application of the Regional Cooperation Model is advocated in OAU, Draft Protocol on Transport and Communications, Article 10 (rev. 2), item h.

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