Models for the Development of Regional Telecommunications Networks

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Models for the Development of Regional Telecommunications Networks in Africa[1]

1.0 Introduction

The development of telecommunications in Africa began during the colonial era.[2] Telecommunications was a means to maintain control over the colonial possession,[3] 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.[4] Establishment of widespread service was therefore inconceivable. Intra-African telecommunications was precluded by the colonial economic structure which destroyed all pre-existing 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, 1994a; 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 individual need. This paper seeks to find the most appropriate model/s for developing regional telecommunications networks. The essential question addressed will be: Is regional cooperation the most appropriate model for the developing sustainable regional telecommunications networks? In assessing the suitability of regional cooperation to regional network development, this chapter will provide 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 a discussion of each model, the future of regional telecommunications networks will be discussed. The conclusion will seek to provide broad recommendations concerning the possible use of all three models.

Finally, other applications of the regional cooperation model in telecommunications will be broadly evaluated.

2.0 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 seen as essential to establishing trade and government cooperation between African nations. Regional networks were also seen as a method for re-defining the communication structure that had been established during the colonial period. The regional cooperation approach for the of development that evolved during the sixties was applied to the desire for intra-African telecommunication links; this spawned the most ambitious African telecommunications project to date, i.e., the Pan-African Telecommunications Network.

2.1 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.[5] 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, attention was directed toward establishing direct intra-African telecommunications links.

In 1962, there were only 15 HF radio systems operating between African countries. There was one UHF radio system operating in East Africa (Kenya, Tanzania and Uganda); and there were 13 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 pre-investment

surveys. Two consultant teams began a preliminary study of 38 African countries, which was completed in 1969.

In 1969, the UNDP granted $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 km of transmission arteries and 18 international switching centers (ITU, 1974). Routes were selected that could serve as national backbones connecting major population centers in one country and 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 pre-investment 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 $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 continent-wide project, began in 1975 with the UNDP/ITU project RAF/73/023: Implementation of Panaftel Network Phase I (1972-1982). The major goals of this phase were: installation of transmission systems and switching centers; organization of traffic routing and circuit forecasting; specification of radio-relay systems; and 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 sub-regional structure, the Committee hoped to achieve better coordination and easier ratification of tariff structures and routing matrices. Subsequently, sub-regional coordinating committees were established for the North African, Western, Central and Southern and Eastern African sub-regions.[6]

By 1983, Panaftel had progressed significantly; a considerable portion of the network was in use and 39 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 (1983-1986). The major goals of this phase were: tender evaluation, acceptance testing, and traffic management and routing training.

By 1987, the size of the network was more than twice the original

specifications: there were 35,000 km of microwave relay links; 8,000 km of submarine links; 43 international switching centers; and 41 of the member countries had at least one satellite earth station.[7] 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 non-operational links; and 3) to improve mechanisms for operation, modernization and sustained development of the network.

By the late eighties, Panaftel's progress slowed considerably. This was caused by economic, political and operational difficulties. Emphasis shifted from implementation to improving the operation of 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 sub-regional 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. The problems were primarily due to maintenance and operational difficulties.[8]
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 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.[9] In 1989, the future plans for Panaftel were as follows: 1) to tap the potential of fiber optic links; 2) to improve coordination between African PTTs; 3) to help establish a uniform tariff structure; and 4) to 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 km of radio relay links, 8,000 km of submarine cable, 39 international switching centers, and 42 of the 45 member countries had international satellite stations. In 1990, 29 links or approximately 4,000 km of links remained to be installed (ITU, 1991; Riverson, 1991).

2.2 Panaftel Problems

Many of the problems encountered during the implementation of Panaftel were identical to the perennial problems faced by African PTTs; these included: the lack of skilled personnel, inadequate funding, and poor organization. There were also significant environmental impediments; they included: 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 well-defined maintenance 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 14 countries. The NPIMs concentrated on preventative 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 communication. 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 communication. 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% to 1975 telephone forecasts for Panaftel. The ITU also estimated that there would be a yearly increase of 20% until 1980, and a yearly increase of 15% after 1980. These forecasts were justified on the basis of perceived "latent demand" (Okundi, 1979). The actual demand for intra-African communications has never reached the optimistic levels assumed by the ITU's pre-investment studies. In 1992, only 14 % of Africa's international telecommunications traffic was intra-regional (ITU, 1994b).[10]

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 Demba, 1985), and signaling problems were still present as late as 1990 (Girmaw, 1990). In the Southern African sub-region, 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 sub-regions. 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, e.g., the Central African sub-region. Furthermore, Panaftel's political origins made it completely reliant upon 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, i.e., between Kenya and Uganda.

2.3 Current Status of Panaftel[11]

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

- the relatively low revenue from existing links could not justify continued investment; and
- the UNDP felt that political inertia in those regions in which links were still missing -- specifically, the Central African sub-region-- 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 sub-regional 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 Communications Decade for Africa (Second UNTACDA) (Conference, 1993).[12] Attempts to establish connectivity between Central African countries have continued, e.g., 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-1990's, links were deteriorating and much of the system was being exclusively used as backbones for domestic networks. Certain sub-regions within the overall system are currently sustainable -- primarily in the Northern and the Southern African sub-region(e.g., see tables 1 & 2, Appendix).[13] The stability of the links in the Northern and Southern sub-regions is correlated to numerous factors, e.g., the level of trade; the cost of intra-African calls between countries in these sub-regions; cultural/linguistic similarity; etc. 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 3, Appendix); since diverting resources into these links would be an unsound policy -- considering other more pressing telecommunications needs.[14]

2.4 An Assessment

Although Panaftel grew from the initial specifications of 20,000 km of communications links and 19 international switching centers to a network of more than 47,000 km of links and 39 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 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 explicate the economic inviability of much of the network (see Table 3, Appendix). The future of these links and many others like them is questionable. Although certain sub-regions are more stable than others, Panaftel has not become a sustainable continent-wide regional telecommunications network

3.0 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 the network.

Despite the apparent inefficacy of this model, it continues to be employed African telecommunications carriers in the development of regional networks-- e.g. Kagera Basin Project. However, if African nations desire to establish sustainable regional telecommunications networks, a new model must be adopted. There are at least three possible models: Appropriate Environment Model, Regional Satellite Model and 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.

3.1 The Appropriate Environment Model[15]

The Appropriate Environment Model (AEM) 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. Communication capacity is merely an enabling factor; the effective utilization of this capacity is contingent upon numerous factors -- such as appropriate tariff structures, trade, travel, national telecommunication penetration, etc. 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 upon 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 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. National telecommunications penetration levels is 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 (see table 5,

Appendix), 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.[16] Also, the overall efficiency of African telecommunications providers must be improved, e.g., by reducing the number of employees per line[17] and improving billing systems and bill collection.[18] 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 Senergal 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, i.e., the exorbitant tariffs on international calls (Paltridge, 1994). The networks within the Northern and Southern sub-

regions, which are sustainable, have the lowest charges on intra-African calls; conversely, those sub-regions with the lowest level of intra-African communications have the highest charges for intra-African calls, i.e., the Western and Central African sub-regions (see table 4, Appendix). 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 telecommunications providers will have to adopt tariffs that promote intra-African communication, i.e., 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, Kellerman (1990) has shown that telecommunications traffic is most directly correlated to trade. In 1993, only 8.1 % 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 which 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% and Kenya accounted for 33% of Ethiopia's total

intra-African trade (IMF, 1994); in this same year, Ethiopia had the greatest volume of communications with these two countries, i.e., .9 million minutes of calls to Djibouti and .8 million minutes of calls to Kenya (ITU, 1994b). African nations will have to increase the level of intra-African trade, if they are to create the appropriate environment for regional networks. In stimulating intra-African trade, African nations will have to adopt policies that enable the free flow of economic factors, i.e., money, people and information.[19] For example, the 1994 explusion of African expatriates from Gabon will likely lower telecommunications tariff between Gbaon and nieghboring African countries. They will also have to adopt policies that surmount other obstacles to further economic integration, e.g., lack of convertible currency and unequal levels of development (UNCTAD, 1993). These policies will stimulate demand for regional communications, and regional network will follow.

The AEM seeks to establish the milieu necessary to stimulate demand for regional telecommunications capacity. Once the appropriate environment has been established, 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.

3.2 Other Models

Although certain aspects of the Appropriate Environment Model (AEM) are surfacing in the debate on regional network development (ITU, 1994a), this model is not the only one available. The AEM is optimized for regional telecommunications networks that are terrestrial systems; 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; can offer different services; and can carry different types of traffic.

3.3 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).

3.3.1 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, 1979).

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.[20] This study examined: engineering concerns; 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, 1993a). The organization became operational in November, 1993, with its headquarters in Abidjan, Ivory Coast.

RASCOM's specifications call for a two satellite system. The cost of the satellite segments was estimated at $250 million each and the cost of ground segments for the fifty countries was estimated at $800 million (Rzepecki, 1990). RASCOM is cooperatively owned with each country purchasing minimum initial investment shares of $50,000 (Jipguep, 1993a). As of March, 1994, 35 countries had signed the Operational Convention and 30 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, i.e., the Non-Signatory Shareholder Agreement (African Communications, 1994).[21]

After becoming operational, RASCOM's first initiative was to pool the transponder space leased from Intelsat by member nations. RASCOM has also

begun providing commercial services; for example, in 1994, RASCOM began leasing transponder space to the South African broadcasting company ORICOM (African Communications, 1994).

Despite numerous obstacles, in early 1995, RASCOM began preparation for the launch of its first satellite. RASCOM officials stated that the first satellite would be launched in 1997, and would be a co-operative venture with another organization.[22] RASCOM does not expect any difficulty in raising the $250 million needed to launch the satellite; however, we should adopt a wait and see position on this issue.

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, e.g., RASCOM plans to offer TV, video conferencing and data transmission services on a commercial basis. It could also offer mobile services, location identification service and remote sensing applications. A regional satellite system also offers African countries new options for addressing the dismal level of telecommunications in rural areas, e.g., 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.[23]

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% of African international telecommunications traffic is intra-Africa (ITU, 1994b). 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 RASCOM's overall viability, since they will offer a superior alternative on the most lucrative intra-African trunk routes, e.g., between the Ivory Coast and Nigeria.[24]

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 & Faguy, 1986); 2) there are almost four times as many television sets as telephones in Africa (ITU, 1994b); 3) and the ARABSAT and Eutelsat satellite systems have demonstrated the feasibility and profitability of distributing of TV via a regional satellite (Bloch, 1992). An environment that is congenial to television transmission via satellite will have to be created, if this service is to succeed. For example, African governments will have to create an enabling environment for transmitting TV via satellite. The high demand for TV transmission over Eutelsat has been correlated to the liberalization of television broadcasting in Europe (Bloch, 1992).

3.4 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. This model has already been employed with the SE-ME-WE2 (South East Asia-Middle East-Western Europe) fiber optic cable,[25] and has been proposed for an ASEAN regional network.[26] 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,[27] Alcatel's Pan-African Project[28] 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.

3.4.1 Africa One

Africa One is the most ambitious of the fiber optic proposals. AT&T estimates that it will require over 35,000 miles of fiber-optic cable and have an estimated cost of 1.9 billion dollars (AT&T, 1995). AT&T proposes that Africa One will have 41 landing points in Africa and will also connect to Italy and Saudi Arabia. The fiber will have a transmission capacity of 2.5 gigabit-per-second. AT&T has a three tier plan for the development Africa One:

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.

AT&T proposes that 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. 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;[29] however, in May, 1995, RASCOM seemed to have re-evaluated this position and stated that it would work with AT&T on Africa One -- although the exact nature of this relationship was nort disclosed.

AT&T is targeting a broad range of potential investors and funding institutions: African PTT's, private investors, multinational end-users, international carriers, and multilateral and bilateral funding agencies (AT&T, 1994). African telecommunications providers will have the option of either purchasing capacity or equity in the network.[30] Major multinational end-users, will be able to purchase capacity outright or may make long-term commitments in return for guaranteed pricing.[31] Private investors will be able to buy equity

or hold debt. International carriers will be able to purchase capacity on the network.

AT&T provides a myriad of arguments concerning the benefits and economic viability of Africa One. AT&T has argued that Africa One will complement other regional projects, i.e., RASCOM and Panaftel, and will significantly increase intra-African capacity. AT&T 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.

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 40 countries will be connected to its GUFON; further, AT&T estimates that by the year 2000, 100 countries will be connected to the GUFON. AT&T 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 telecommunication traffic patterns, i.e., 86% of Africa's international telecommunications traffic is destined for countries outside the region (ITU, 1994b). Further, AT&T envisions the transmission of significant global traffic through Africa One through the aggregation of global traffic at inter-regional gateways. The aggregation of intra-African traffic and the transmission of global traffic combined with the other revenue sources discussed above 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

support. AT&T 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.

4.0 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. This will be caused by: 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, e.g., AT&T.

The Appropriate Environment Model (AEM) is likely to become the dominant model at the sub-regional level. Several factors will precipitate the shift to this model at the sub-regional level. First, the dimise 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 re-defined 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, 1994). In

the future, African telecommunications providers will likely look to employ new technologies to expand domestic networks.[32]

The restructuring of the African telecommunications sector will also lead African telecommunications providers to emphasize economic viability of international links over political justifications. Thus, if African governments desire to establish regional connectivity because of the associated externalities, then 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 sub-region, which has the healthiest Panaftel links (ITU, 1994), has been able to establish appropriate traffic structures[33] and has significantly out-paced other regions in investing in national networks (ITU, 1994).

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

a. The level of network expansion within, and the amount international telecommunications traffic originating from, land-locked

countries, since this will determine the amount of revenue that will be generated by integrating land-locked countries into one of the fiber-plans.

b. The ability to overcome the coordination problems inherent in this model. For example, the dominance of the organization by large and powerful signatories -- such a Nigeria -- may impede coordination.

c. The establishment of a significant market for Direct Broadcast Satellite (DBS) in Africa. This will be a difficult task, since DBS will raise numerous questions about national identity and cultural imperialism.

Further, RASCOM raises another issue, namely, whether its 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 above, and that VSAT capabilities are already offered by Intelsat, 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.

5.0 Conclusion

The African desire to establish regional connectivity and the climate of regional cooperation that pervaded the debate over African development in the 1960's combined to create the most ambitious telecommunications project to date, i.e., the Pan-African Telecommunications Network. Despite its ambitious goals, Panaftel has not become a sustainable, integrated continent-wide 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, sub-regional 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, sub-regional 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 1970's. 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 political reasoning or some other motivation. Panaftel demonstrates the folly within the "If you build it, they will come" approach to network development. 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, global traffic transmitted over the network. 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. 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 -- e.g., 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 re-evaluate its position toward Africa One (as 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 meta-model for African development. This can be seen in the continued attempts to establish economic communities and trade blocs throughout Africa, e.g., the ECOWAS, SADC, PTA, etc. However, the fact that it 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[34] will be difficult to establish and sustain, because of the political difficulties that are likely to arise, e.g., the selection of the facility's location and the distribution of benefits such as employment.

An appropriate form of regional cooperation in telecommunications is the adoption of common standards. The adoption of 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, 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, 1993b). Other forms of cooperation are probably also feasible, e.g., 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).

Appendix

Table 1. Telecommunications Traffic, Tunisian Panaftel Links to North Africa, 1990

Destination Country	Minutes x 1000
Algeria	1500.00
Morocco	1550.00
Libya	2500.00
Egypt	700.00

Source: ITU, 1991

Table 2: Telecommunications Traffic, Zimbabwean Panaftel Links to Southern African Countries, 1990

Destination Country	Minutes x 1000
South Africa	15265.00
Botswana*	1988.00
Malawi*	693.00
Zambia	1110.0

* Routed through South Africa

Source: ITU, 1991

Table 3: Selected Panaftel Thin Routes, 1990

Originating Country	Destinations Country	Minutes x 1000, 1990
Burkino Faso	Gabon	10.00
Kenya	Nigeria	2
Benin	Ghana	9.5
Cote d'Ivorie	Ethiopia	21.00
Chad	Benin	2.4
Chad	Malawi	1.9
Tunisia	Cote-D'Ivorie	11

Sources: ITU, 1991

Table 4: Average Cost of 3 min. intra-African Call for Selected Countries

Country	Sub-region	Within Sub-region	Outside Sub-region	Comparable N. 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

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Berkeley, 1986

1. I would like to gives thanks to all those who freely provided information, insight, criticism and guidance for this study. First and foremost, I must thank my wife Sasha Thomas- Nuruddin for the many hours sacrificed to reading and re- reading this work. I would like to thank Dr. Martin Elton, NYU; Kevin Holmes CITI/CTR; Dr. Raymond Akwule, Afcom International and George Mason University; and Dr. Eli Noam, CITI and Columbia Business School for their comments and guidance. Finally, I would like to thank all the individuals who freely provided information and resources: Ms. Zeina Afif, AFCOM.; Les Breiner, CIDA; Mr. Brown, ITU, Ethiopia Field Office; Mr. LeClerc, CIDA; Carlos Cordeiro, Ph.D. Stanford University; and Mr. Michael Minges, ITU/BDT.

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

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

4. 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 & Akorli, this volume).

5. The African plan Sub-Committee 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 assess the needs of newly independent African nations.

6. This sub-regional structure was also congruent with regional grouping that had developed in Africa, e.g., the Economic Community of West African States 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 organization would be able to assist in the implementation of Panaftel. Recent studies have suggested that the multitude of telecommunications organization in Africa may have hindered, rather than assisted, telecommunications development on the continent

(ITU, 1994a; ITU, 1994b).

7. During this period, Panaftel also benefited from the initiation of the United Nations Transport and Communications Decade for Africa (1978-1988). UNTACDA provided additional resources to Panaftel.

8. 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 franco-phone and Anglo-West Africa in Sy Demba (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.)

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

10. This data excludes communication with South Africa.

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

12. This project has an estimated cost of 5.35 million -- $1.25 million was provided by Ethiopia and $4.30 million has been contributed by the EEC (Conference, 1993).

13. 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 ITU.

14. 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 $30.8 billion investment (ITU, 1994a). Obviously, the accuracy of this estimate will depend on the cost per line and the type of technology deployed.

15. 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 this document; thus, this document does not make a clear distinction

between these two or any other models for regional network development in Africa (ITU, 1994a).

16. The African telecommunications sector has the highest average rate of return in the world. Africa's average annual return is 26 %, while the world average is 16%(ITU, 1994b). However, these profits are rarely re-invested into the telecommunications network. In 1992, on average only 36% of the profits that are generated by the PTT's was re-invested into the telecommunication network (ITU, 1994b).

17. In 1992, Sub-Saharan Africa had an average of 58 employees per 1000 main telephone lines. The next closest regions in the world were the Arab States and Russia with 19 employees per 1000 dels , then Asia-Pacific region with 17 employees per 1000 dels (ITU, 1994b). 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, 1994b), and lowers the possibility for telecommunications expansion.

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

19. A recent study have correlated the free flow of economic factors to trade between nations, and the ability to form economic communities, trade blocs, etc. (OECD, 1993).

20. $1.5 million in funding was provided by African Development Bank, the UNDP, the ITU, the OAU, the governments of Italy and the Federal Republic of Germany (ITU, 1990).

21. 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 non-signatory members ranged between 20% and 49% 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 will be finalized at a meeting of the RASCOM signatories in Accra, Ghana in May, 1995. (Personal Communications)

22. In early 1995, RASCOM Management declined to disclose the name of their satellite partner.

23. Nigeria wanted the headquarters to be located in Lagos, Nigeria. However, the organization decided to establish its headquarters in Abidjan, Ivory Coast. (Jipgeup, 1993; AFCOM, 1994; Conference,1993). Nigeria has since rejoined RASCOM (Personal Communications).

24. In reference to the optical fiber plans for the continent, specifically AT&T's Africa One proposal, RASCOM asserts that these plans compliment their own objectives, and will not endanger the RASCOM's viability (Personal Communications).

25. This is an 18,000 kilometer fiber-optic network that stretches from Singapore, through the east coast of Africa, to Middle East and France. This system was built by AT&T's Submarine systems division for a consortium of over 50 telecommunications companies.

26. In 1998, the Association of South-East Asian Nations (ASEAN) agreed on a plan the ASEAN Optical Fiber Cable Network (AOFSCN)(Mohammed & Supaat, 1992). The ability in transmit non-ASEAN traffic may become a key revenue stream for this network.

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

28. Alcatel's Pan-African project focuses exclusively on West Africa; it has 19 landing points from Cape Town to Casablanca. The project has an estimated cost of $ 600 million. Alcatel hopes to solicit 50 % of the necessary financing from European, Asian and South American investors. It proposes that remaining half will be contributed by African countries -- it estimated that the average cost per country will not exceed $18 million (Ayre, 1994).

29. Personal Communications.

30. 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 AT&T Submarine Systems, Inc. testified before a "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 US through the bilateral aid agencies -- such as the Agency for International Development (AT&T, 1995).

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

32. Of course, African nations must be cautious in their selection of technology and must be certain that the technology selected appropriately satisfies African needs.

33. 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. This eliminates the need for settlement of payments (ITU, 1994a). This model may also provide an incentive to lower international tariffs, since this would theoretical increase the amount of traffic that flows over the international link and translate into increased revenue for the national telecommunications provider.

34. This application of the Regional Cooperation Model is advocated in OAU, Draft Protocol on transport and communications Article 10 (Rev. 2) item h.