APC ISSUE PAPERS

THE CASE FOR "OPEN ACCESS" COMMUNICATIONS INFRASTRUCTURE IN AFRICA: THE SAT-3/WASC CABLE–A BRIEFING

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1. INTRODUCTION: INFORMATION, COMPETITIVENESS AND CONNECTEDNESS

The possession and control of information offers (at various levels) considerable strategic advantages. This ranges from information that is necessary for survival and which facilitates the attainment of basic needs and freedoms;[1] to more complex combinations of information that can become independent sources of productivity and power (van Dijk 2005).

Information has also been described as a source of competitiveness[2]-with respect to the business world the availability of information is said to change the structure of industries and thereby alter the rules of competition. Information bestows, on those that have access to it, new ways of outperforming their rivals; and it can also create new business opportunities, even within existing business operations (Porter and Millar 1985). Could the "competitive advantages" that emanate from having access and the capacity to use information be applicable to non-business entities of varying geographic scope-and especially to nation states?

Popular opinion, amongst policy and decision-makers, asserts that affordable and accessible information can help nations to improve their global standing by lowering the cost of economic and social activities. It can also enhance their ability to differentiate themselves in the global marketplace by increasing the scope and range of activities. As a result, many developing countries have invested extensively in infrastructure and advanced technologies.[3] If indeed nations are like "…big corporation(s) competing in the global marketplace" (Clinton cited in Krugman 1994:29), it comes as no surprise that in an information-

1 The term "freedom" refers to the ability to live the life one values and has cause to value. It takes into account the ability to attain basic needs and indicators of quality of life, as well as the resources and/or income that a person is able to command. (Sen 1999)

2 Competitiveness is defined as the possession of an advantage over other participants in a venture/field/area that is able to improve the performance of the owner.

3 See Krugman, Paul (1994) "Competitiveness: A Dangerous Obsession" *Foreign Affairs* 73 (2) pp. 28-44 for critique of this opinion.

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TABLE 1: DISTRIBUTION OF INTERNATIONAL BANDWIDTH ACROSS REGIONS

	International bandwidth (Mbps)	% of World	Bits per inhabitant	AFRICA	ASIA	LAC
				Less than other regions [approx]	Less than other regions [approx]	Less than other regions [approx]
	2004		2004	2004	2004	2004
World	4.704.468.8		759.0			
Africa	5,329.4	0.11%	6.4		0.05	0.04
Asia	474,207.3	10.08%	128.3	20.0		0.9
Latin America and Caribbean	80,377.0	1.71%	146.3	22.9	1.1	
Oceania	26,789.6	0.57%	842.0	131.6	6.6	5.8
Europe	2,929,246.0	62.27%	3,643.0	569.2	28.4	24.9
North America	1,188,519.5	25.26%	3,647.9	570.0	28.4	24.9

driven world the extent to which a country is 'networked' or 'connected' to the rest of the world is defined as critical to its development.

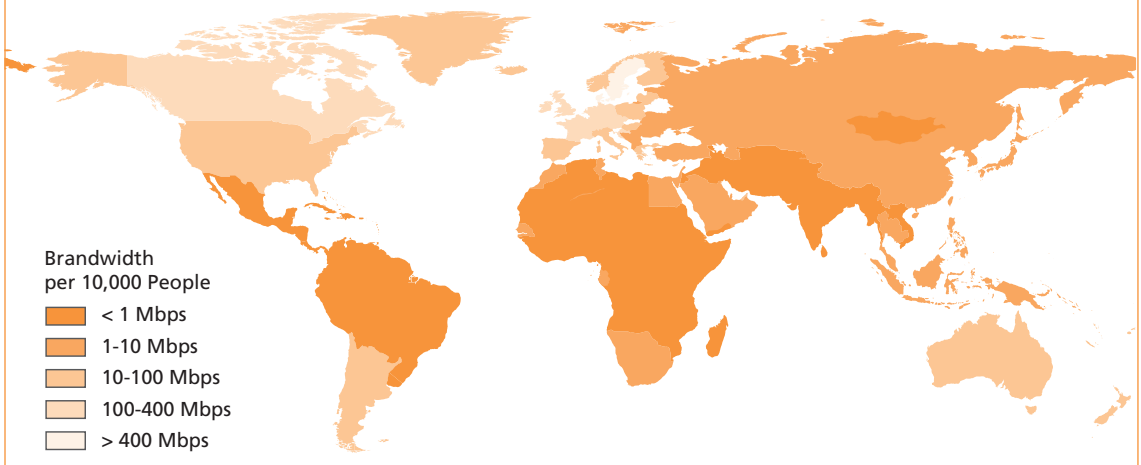
Using comparative levels of communication infrastructure as indicators of levels of "connectedness" (see table 1 and figures 1 and 2), the scale of the infrastructural gap in sub-Saharan Africa and implications for the competitiveness of this region of the world are easily identified.

Table 1 compares the amount of bandwidth (measured in megabits per second–Mb/s) that is available to people living in different regions of the world. It shows that (in 2004) approximately 88% of the total bandwidth available worldwide was located in developed regions of the world. More specific to sub-Saharan Africa, using the indicator "bits per inhabitants," table 1 also shows that a person living in Europe or North America had access to approximately 570 more bits of bandwidth than someone living in Africa. Poor bandwidth availability is again illustrated in figure 1–a map which summarises the amount of international bandwidth available per country adjusted by population. The map shows that the populations of most African countries have access to the least amount of bandwidth worldwide; they are the least "connected" globally.

Low bandwidth is associated with poor telecoms infrastructure. In this sense the poor bandwidth available in sub-Saharan Africa can be partially explained by how under-serviced the region is in terms of international submarine cable infrastructure. The grey lines in figure 2, depicting cable capacity, clearly illustrate the global disparities.

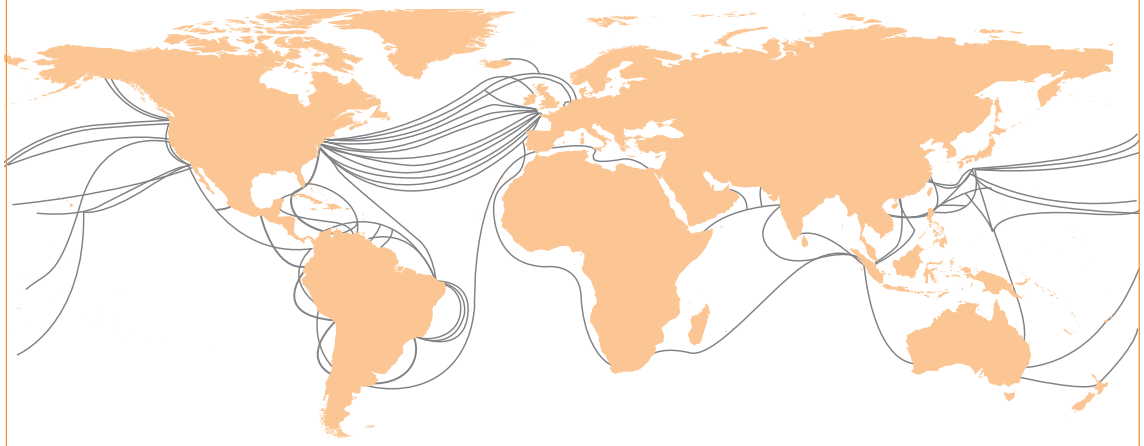
The dearth of international cable infrastructure in sub-Saharan Africa is further compounded by expensive

FIGURE 1: INTERNATIONAL BRANDWIDTH PER CAPITA, 2005



SOURCE: TeleGeography Research

FIGURE 2: UNDERSEA CABLE CAPACITY



SOURCE: TeleGeography Research [telegeography.com/maps]

international satellite coverage and inadequate terrestrial networks between countries in the region, to the extent that communication between African countries is often transited via Europe and/or North America. The result is a situation of prohibitively expensive connectedness.

Strategies for increasing connectivity between countries in sub-Saharan Africa and between the sub-continent and the rest of the world must include the deployment of new communications infrastructure and as importantly, the maximisation of existing infrastructure.

The focus on maximisation is the result of criticism of how existing infrastructure is being utilised. In particular, questions are being asked about the way infrastructure is traditionally built, owned and operated. In sub-Saharan Africa the criticism can be levied at one project: the single grey line in Figure 2, shown originating in Europe (Portugal), and running along the west coast of Africa down to southern Africa and across–via Mauritius (and Reunion)–to the Far East. It represents a pair of optical fibre submarine communication cables known as South Atlantic 3/West Africa Submarine Cable/South Africa Far East (SAT-3/WASC/SAFE).

This briefing focuses solely on the "Africa section" of the submarine cable-South Atlantic 3/West Africa Submarine Cable (SAT-3/WASC). It provides an introduction to the cable, including background information on its development and operation. It also outlines some of the key issues regarding the utilisation of SAT-3 that have been documented in various publications and the mass media.

These issues are then discussed using data from a recently concluded research project by the Association for Progressive Communications (APC) that looked at the impact of the cable in four countries: Angola, Cameroon, Ghana, and Senegal. The research initiated in November 2006 documented and analysed the way SAT-3/WASC has impacted on the telecom markets of these countries and offers lessons that can be learnt from the implementation and management of SAT-3/WASC. The briefing concludes with recommendations (based on the findings of the research project) for maximising the impact of SAT-3/WASC on Africa's connectivity and global competitiveness.

2. GLOBAL SUBMARINE CABLE SYSTEMS: OWNERSHIP STRUCTURES

According to a Telegeography report, when it comes to the transmission of international voice and data between continents "rich countries use fibre, poor countries use satellites." (2001:98) Satellites, although providing much needed connectivity, should however not be defined as substitutes to fibre. Submarine telecommunication cables continue to outpace satellite performance in terms of both total potential capacity and capacity per unit cost; in other words, these cables are less expensive and offer more bandwidth. Voice transmissions via satellite also suffer from noticeable delays and in this respect fibre offers a better quality of voice service.[4]

Technological innovations play a key role in global trends in telecommunication services–including the rapid growth of the internet. These innovations[5] have enabled significant increases in the capacity and reliability of transmission of networks:

> …[M]ore than 100 million simultaneous phone calls can now be handled by a single optical fibre submarine cable[6] spanning thousands of kilometres between continents–a tremendous jump from the first transatlantic telegraph cable which transmitted one single word per minute in 1858. (Fong 2004:806)

Commercialisation has been (and in most cases continues to be) the primary driver behind the expansion of communication networks and this is reflected in the organisational structures that have evolved in the construction and management of submarine cable systems. This trend can be compared to the "early days" when submarine telegraph cables were managed by single entities within the countries that owned and operated the cables, and which received most of the traffic revenue. However telegraph cables were usually confined to national borders. An increase in the demand for international cables–connecting at least two national territories-led to the demise of single-entity ownership structures and the emergence of "committees" that were able to accommodate wider representation of key parties. These "cable management committees" acquired agreement between the participating communications entities, in particular regarding how construction and maintenance costs would be shared and how traffic revenues would be collected and shared.

Because commercialisation is a key determinant behind network expansion, early international cables often concentrated on connecting high traffic point-to-point locations between countries. This meant that countries with low traffic requirements were bypassed. However international cable consortiums offered a way for these countries to participate by allowing them to include their traffic in a larger pool and thereby make cable projects incorporating them viable. Entities could contribute to the construction of the cable and become members of a consortium.

The 1990s saw deregulation of the telecom industry globally and a widening of the types of companies participating in the ownership of international cables. This era also saw the emergence (in the mid 1990s) of non-carrier private cable companies with privately owned and operated cables and a return to more centralised ownership structures.[7] These cables were often built using speculative investment capital and in retrospect, were based on unrealistic forecasts of how much capacity they would be able to sell. The downturn in global financial markets in the late 1990s had a significant and sometimes fatal impact on many of these companies, with infrastructure being sold off where it existed.[8]

4 Yet according to a (2004) NEPAD report "… only 14 of 49 sub-Saharan countries have any fibre connection to each other or to the rest of the world" (cited at http://www.arp.harvard.edu/AfricaHigherEducation/Online.html).

5 Technological innovations that have been of particular relevance include breakthroughs in the area of optical fibres, optical amplification and switching, wavelength-division multiplexing and photonics (Fong 2004).

6 Shorb and Tourgee state that "A single modern submarine cable network is capable of transmitting up to 5.12 terabits or the equivalent of 640 million voice calls simultaneously." (2002:1)

7 This centralised project management structure at times proved to be very efficient in planning and installing cable systems. Fong (2004) provides the example of Global Crossing which was able to build a USD-1billion 21,000 km cable system called Pacific Crossing-1 within two years.

8 See Lynch, Grahame (2005) "The new bandwidth barons: buying binge shifts global fibre assets from American to foreign ownership" *America's Network*.

TABLE 2: OWNERSHIP STRUCTURE OF SUBMARINE CABLE SYSTEMS

TYPE	DESCRIPTION	EXAMPLES	ADVANTAGES	DISADVANTAGES
Consortium	Built by consortium operating through a management committee	SAT-3/WASC/SAFE TAT-14	Owners get capacity at cost; financial stability	Conflict between large and small owners. Owners pay fixed operation and management charges regardless of actual capacity used
Private	Built by start-ups as a speculative venture, usually operating as "carriers" carriers.'[9] In some cases entrepreneurs own the cables in others they only manage them. Capacity is owned outright or on indefeasible right of use (see below) basis by third parties.	FLAG Tyco Transatlantic Hibernia Atlantic	Rapid deployment; simpler management	Responsibility for entire construction and maintenance costs
Co-build	Built by two or more carriers' carrier. Owners manage and market capacity individually	Tellow/AC-2, FLAG/ REACH North Asia Loop	Financial risk is spread; owners get capacity at cost	Owners compete against each other; may introduce too much capacity into the market
Hybrid	Built by one or more carriers but operated and managed by a separate private company	C2C Cable Network, Australia-Japan Cable	Financial risk is spread. Simpler management than traditional consortia	Owners do not receive capacity at cost

SOURCE: Hamilton, Paul and Telegeography (2004) Identifying key regulatory and policy issues to ensure open access to regional backbone infrastructure initiatives in Africa. Report submitted to the Global ICT Policy Division (CITPO), World Bank. p. 16

Reorganisation of the submarine fibre-optic communications business (in the early 2000s) has produced modified ownership structures. There has been increased participation and a return of the dominance of carriers whose core business is the transmission of voice and data traffic. Submarine cables continue to be built by consortia, but some are managed and operated by separate private companies–resulting in what is referred to as a hybrid structure. Table 2 summarises the four types of ownership structures that have been discussed in this section.

The ownership structure adopted determines the type of access other service providers have to the cable–for instance, whether this will be on an open and competitive basis or be closed and monopolistic.

A "closed consortium structure" was adopted for the operation and management of SAT-3/WASC (Axiom 2005). In this model of ownership each member of the consortium contributes towards the upfront capital cost of building the cable and commits to paying for its operational and maintenance costs over its lifespan.

Consortium members pay (or commit to pay) for the entire cable system and its maintenance at the start of the project. This influences how they formulate their business plans and calculate their returns. They determine the configuration of the cable, agree on the funding rules that will cover capital and maintenance costs and also agree on how cable capacity will be allocated. Members of a closed consortium also determine the cost at which capacity on the system will be sold or leased to entities that are non-members. However because the cable has already (in principle) been fully paid for, cash from additional sales or lease to non-members is of relatively low incentive to the consortium, especially when there is potential conflict with a desire to protect their business plans and returns.

The result has been the emergence and propagation of a monopolistic situation and severe criticism of the cable; an outcome far from SAT-3/WASC being considered:

> …[A] shining example in demonstrating the ability of African and global telecommunications companies to work together in harmony towards realizing an important building block in pursuit of the development and improvement of African infrastructure. (Meyer 2001)

9 This refers to a business model in the telecommunications industry in which an operator sells or leases bandwidth on its infrastructure to other operators for reselling to their own customers.

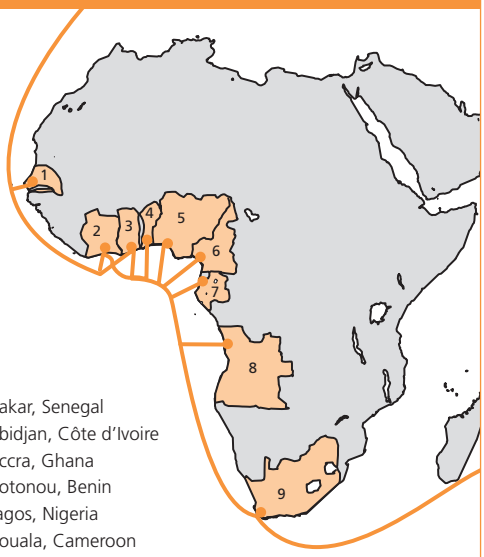
3. SAT-3/WASC

SAT-3/WASC is a 14,350km undersea fibre-optic cable running along the western coast of Africa to the southern part of the continent. When combined with the SAFE submarine cable, it forms part of a larger single network connecting Europe to Asia via western and southern Africa. The SAT3/WASC portion has a design capacity of 120Gb/s (or approximately six-million simultaneous telephone calls) and the SAFE portion a design capacity of 130Gb/s.

SAT3/WASC starts at Sesimbra (Portugal) passes through nine African countries and ends at Melkbosstrand (South Africa). The Africa section of SAT3/WASC (see figure 3) has 9 landing points.[10]

SAT-3/WASC was commissioned in 1999 and entered commercial service in April 2002. Reported[11] amounts invested in SAT3/WASC/SAFE differ and have been stated to be as high as USD 650-million (Jensen 2006; Goldstein 2004). However a shareholders' agreement signed on 17 June 1999[12] cites the cost of the cable as USD 595-million.

FIGURE 3: LANDING POINTS OF THE AFRICA SECTION OF SAT3/WASC



[1] Dakar, Senegal
[2] Abidjan, Côte d'Ivoire
[3] Accra, Ghana
[4] Cotonou, Benin
[5] Lagos, Nigeria
[6] Douala, Cameroon
[7] Libreville, Gabon
[8] Cacuaco, Angola
[9] Melkbosstrand, South Africa

The consortium that owns the submarine cable comprises a mix of African, American, Asian, and European (predominantly telecommunication) companies; in total 36 investors from 35 countries (NITEL 2007; Meyer 2004). How much each company invested and the complete list of who these investors are is hard to ascertain. Analysis of the 1999 shareholders' agreement reveals that the largest investors in the cable are: TCI, a subsidiary of AT&T (12.42%), France Telecom (12.08%),[13] Videsh Sanchar Nigam Limited (VSNL) (8.93%) and Nitel (8.39%). However other sources show different figures. Through their investment individual participants in the consortium own capacity on the cable (calculated in minimum investment unit kilometres (MIU km)).[14] Capacity allocations can therefore be used as a proxy of the level of investment that was made. Table 3 presents allocation figures for some investors.

In June 2003 the capacity of SAT-3/WASC was upgraded to 40Gb/s-a third of its maximum design capacity of 120Gb/s. Yet actual usage of the cable at this time was estimated to constitute less than 3% of its design capacity. (Goldstein 2004) While unverified reports attribute savings of USD 400-million per annum to the SAT-3/WASC cable,[15] such utilisation figures question the efficacy of the investment that went into constructing the cable-for example South Africa and Nigeria are reported to have contributed nearly USD 85-million and

10 The diagram (Figure 3) only shows landing points on the African continent and therefore excludes Sesimbra, Portugal.

11 Information about the cable is difficult to attain and verify as the agreement governing its development, operation and management is deemed "commercially confidential." The figures presented in this document are therefore subject to confirmation (but, where possible, information has been collated and corroborated from multiple sources).

12 See *Fibre for Africa* story: "SAT3 Consortium Contract Emerges" for summary and analysis of this agreement. Available online at http://fibreforafrica.net/main.shtml?x=5039398&als%5BMYALIAS6%5D=SAT3%20consortium%20contract%20emerges&als%5Bselect%5D=4887798.

13 France Telecom is reported to have invested USD 96-million in SAT3/WASC/SAFE; incorporating the needs of subsidiaries: Sonatel in Senegal, Côte d'Ivoire Telecom and Mauritius Telecom.

14 BalancingAct's (2006) analysis of the 1999 shareholder's agreement states that capacity was calculated in a distance-related measure; it therefore lays the basis for charging using "distance-related tariffs."

15 This refers to the savings members of the cable consortium operators enjoy by not routing their international traffic through US and European satellites. (Dhliwayo 2005)

USD 50-million respectively. (Goldstein 2004) However demand for capacity is very much on the increase and the recent upgrade of the cable to 120Gb/s in 2007, which most African members of the consortium participated in, is beginning to raise concerns about the likelihood of capacity on the cable running out. The question is therefore not one of whether demand for capacity exists but rather, at what cost?

3.1 Sale of capacity on SAT3/WASC

The sale of SAT3/WASC capacity in each country with a landing station is administered by the investment party from that country. After the construction of the cable, other licensed operators are able to buy the right to use a dedicated amount of capacity through an indefeasible right of use (IRU) contract.

While this provides exclusive and irrevocable right to use the capacity (usually for the life period of the cable system), the capacity purchased is also "unreturnable" and comes with an obligation to pay a proportion of the operating cost of the cable and a similar proportion of the costs of maintaining it (including any repair costs should the cable be damaged). An IRU does not confer the right to control or manage the cable (this is reserved for cable owners/members of the consortium) and the unit price for IRU capacity is usually higher than the unit price for club members.

There is also the option to lease capacity from the club members–International Private Leased Circuit (IPLC)-for shorter terms and at higher cost than IRUs. Unsurprisingly, consortium members control the availability and prices of IRUs and leases, with capacity often being limited.

An analysis of the 1999 shareholders' agreement states that the cable system is run by a management committee that makes all decisions, except for those reserved for the purchasing committee.[16] The consortium also has three operational sub-committees: finance and commercial; operations and maintenance; and delivery and restoration. The agreement further states that each consortium member is exclusively responsible for the operation and maintenance of its segments of the cable, which might explain why the sale of SAT3/WASC capacity in each country with a landing station is administered by the investment party from that country. Furthermore:

> Parties using the cable pay an annual charge to landing station owners ***[cable station right of use –ROU]*** described as being for covering operation and maintenance of the landing station. Landing station operators (described as "terminal parties") are obliged to provide connections to the terrestrial systems in their country (something many did rather slowly). Significantly these terms and conditions should not contradict the regulation in place in the countries concerned. (Balancing Act 2006)

These arrangements for selling capacity are not in themselves out of the ordinary and are comparable to what pertains to cable infrastructure elsewhere that is managed under a closed consortium basis. However in this context SAT-3/WASC has helped to entrench already existing monopolies and has arguably retarded development efforts.

At the time of its conception, most of the African participants in SAT-3/WASC were monopoly incumbents operating in pre-liberalised telecommunications markets. These incumbents were sole providers of international services. In most cases their monopolistic positions were (and still are in cases) enshrined in the legal framework of the country.

By the time of the commissioning of the cable and up to now, African telecom markets have been undergoing various levels of liberalisation. There are now more operators and service providers in each country needing access to the capacity offered by the cable and they have been frustrated by the monopolistic position taken by SAT-3/WASC consortium members, who have little incentive to increase traffic on the cable. The situation is further compounded when the drive towards regional integration as a means of facilitating the development of the sub-continent is considered. As SAT-3/WASC is currently the only international submarine fibre optic cable servicing sub-Saharan Africa, members of the consortium are not only the gatekeepers of reliable (and potentially affordable) connectivity to their country, but also to neighbouring coastal countries that are not connected to the cable and those that are landlocked.

16 The Purchasing Committee is "a sub-committee of MOU signatories that oversaw the building of the system and was given powers to run the capital project of building the system." (BalancingAct 2006)

TABLE 3: INVESTORS IN SAT3/WASC/SAFE

GEOGRAPHIC REGION	NO. OF INVESTORS [Meyer 2004]	INVESTORS [Various]	ALLOCATED[?] [Private]	% OF TOTAL
Africa:	12	Angola Telecom	805,270	3%
		Camtel	538,604	2%
		Cote d'Ivoire Telecom		
		Ghana Telecom	805,270	3%
		Maroc Telecom		
		Mauritius Telecom	805,270	3%
		Nitel	1,723,111	7%
		OPT Benin	805,270	3%
		OPT Gabon	538,604	2%
		Sonatel		
		Telecom Namibia		
		Telkom South Africa	4,738,603	20%
America:	4	[1]TCI [AT&T Corp]		
		MCI Worldcom International	805,270	3%
		Sprint Communications Co		
		Teleglobe	1,326,103	6%
Asia:	8	China Telecom		
		Chunghwa Telecom Ltd Co		
		Communications Authority of Thailand		
		Korea Telecom		
		Reach		
		Singapore Telecommunications		
		Telekom Malaysia Berhad	2,263,603	10%
		VSL	2,263,603	10%
Europe:	12	Communications Global Network Services (BT)		
		Belgacom SA		
		Cable & Wireless Global Network	1,326,103	6%
		Cyprus Telecommunications Authority		
		Deutsche Telekom AG		
		France Telecom	2,738,603	12%
		KPN Royal Dutch Telecom		
		Marconi	183,047	1%
		Portugal Telecom		
		Swisscom Ltd.		
		Telecom Italia SpA		
		Telefonica de Espana		
		[2]Concert	1,638,602	7%
		[3]Global One Communications		
Total[s]:	36		23,304,936	

Notes:

1. At that time a subsidiary of AT&T
2. At the time Concert was a joint venture between BT and AT&T
3. At the time Global One Communications was a joint venture between Deutsche Telekom, France Telecom and Sprint. It was acquired (in its totality) by France Telecom in Jan 2000

The "reinforced "monopoly" enjoyed by the consortium member strengthens its position in the telecoms market and when coupled with ***weak*** national terrestrial networks–which further worsens the cost of connectivity in the country[17]-constitutes a major impediment to the development of the telecoms and related industries.

3.2 The case for "open access" to SAT-3/WASC

Some stakeholders and commentators have argued that the key to unlocking the potential of SAT-3/WASC lies in the creation of an "open access" environment in countries where consortium members operate. Governments and their agencies are limited in what they can ask of the companies operating within the consortium and are wary of the potentially harmful impact interference of a business contractual agreement can have on current and future prospects of investment in their respective countries. At the same time the 1999 agreement states that:

> No signatory can sell, transfer or dispose of any rights or obligations in relation to the fibre without the permission of the Management Committee. Furthermore (24.2) parties are bound to the terms of the agreement and these terms supersede those that any corporate entity might take to itself within their national jurisdictions. (Balancing Act 2006)

However signatories to the SAT-3/WASC contract must also work within the laws and regulations of the countries in which they operate. The call for open access presents an opportunity for governments and their agencies to create opportunities for ***fair*** and ***low-cost*** access to SAT-3/WASC by establishing and maintaining an environment in which:[18]

- All legitimate current and future operators have access to capacity without undue distortion (fair competition)
- Access to facilities is unconstrained and at a fair price
- Mechanisms to secure low prices to end-users are put in place; and
- In the case of submarine cable infrastructure, landlocked countries are not disadvantaged.

APC's study was limited in scope to the areas that open access seeks to address-namely access and cost. Its thesis is that an "open" environment can be created in relation to SAT-3/WASC by dismantling the monopolies that signatories enjoy in three areas:

- Cable infrastructure-as owners of the only submarine fibre cable in sub-Saharan Africa
- International gateway–which ensures that consortium members are (often) the only operators that can legally bring international traffic into and take it out of the country
- Landing stations–which enable consortium members to charge high access and inter-connection charges to use the facility.

17 An *ITWeb* article using the example of South Africa provides evidence of how expensive charges can be for national backhaul transmission in comparison to internal connectivity: "On a two-year contract, a link between Johannesburg and London, which includes national backhaul access, costs R1.7-million, while the national backhaul from the landing station to Johannesburg costs R1.8-million." See Senne, D. (2007) "SAT3 hopes dashed" IT Web, 24 May 2007. Available online at www.itweb.co.za

18 As defined in Spintrack AB. (2005) *Open Access Models: Options for Improving the Backbone Access in Developing Countries (with a Focus on Sub-Saharan Africa)*. World Bank, Information for Development Program (infoDev)

4. APC COUNTRY CASE-STUDY RESEARCH

4.1 Methodology

A case study approach was adopted for the APC study. This was felt to be an appropriate approach in examining the issues relating to SAT-3/WASC in the context in which they occur.[19] The approach looked to facilitate an understanding of the unique factors and circumstances prevailing in each country that influenced access to and the cost of SAT-3/WASC capacity.

The study was conducted by a team of researchers that were largely resident in each of the countries under investigation. At least two researchers worked on each country study. Key activities during the research comprised the analysis of documents and reports, collation of pre-defined performance indicators using a standardised template specifically developed for the research and a series of face-to-face interviews with a cross-section of relevant stakeholder groups including telecom operators–fixed-line, mobile and internet service providers (ISPs)-government representatives, regulators and civil society.[20]

Specific areas covered by the case studies are as follows:

- Description of the country's telecom market. This included a brief description of the SAT-3/WASC consortium member and changes in the country's telecom environment (regulation, number of players etc.) prior to and after the commissioning of SAT-3/WASC.
- Performance indicators assessing the success of the country's utilisation of SAT-3/WASC. This included capacity utilisation, cost of services, subscription and usage figures. Where relevant, these indicators were compared with alternative infrastructure such as satellite.
- Analysis of access. This included documenting (where data were available) who has access to the cable and how this access is decided. The case studies also focused on identifying barriers to access that exist in each country, including regulatory (licensing), legal, financial (in terms of cost of access) and political barriers.
- Overview of the state of the national backhaul infrastructure. This analysis was conducted as a proxy for assessing "external" limitations to the performance of the SAT-3/WASC cable by measuring the ability of the country to utilise the cable irrespective of the barriers that are the result of the consortium member.

4.2 Findings

This section synthesises information contained in the individual country study reports[21] and highlights some of the issues and trends that are common to all countries. It is divided into two parts: the first part (4.3.1) summarises the status of the telecoms market in each of the countries. It provides information on the "legally permissible levels of competition" that exist in a cross-section of telecom markets in each country. Legally permissible levels of competition refers to sectors of the market in which, according to the country's laws and regulations, more than one operator can offer services. However what is permissible does not always equate to what pertains in the market. Section 4.3.1 therefore also discusses actual numbers of companies that are operational in these sectors and identifies the ownership status of these operators, in particular the national fixed-line operator/s in the country.

The second part (4.3.2) looks at the performance of the telecommunications sector of each case country. Particular emphasis is placed on cost of bandwidth since the commissioning of SAT-3/WASC and on the impact increases in the availability of bandwidth has had on the price of international calls and internet services.

19 See Eisenhardt, Katheleen M. (2002) "Building Theories from Case Study Research" in Huberman, Michael and Miles, Matthew B. *The Qualitative Researcher's Companion*. Sage Publications Inc

20 For reasons of confidentiality the names of interviewees have not been published in this document.

21 Country case study reports will be made available on the APC webpage (www.apc.org).

4.2.1 Level of competition in telecom markets

The SAT-3/WASC signatories that are operational in the countries studied as part of this research operate in monopolistic or "biased" duopolistic markets (see Table 4).

While a review of the telecom regulation and laws of countries such as Angola and Senegal give the impression that their telecom markets are (for the most part) fully liberalised, in reality this is not the case. For example, Angola is cited as having four licensed fixed-line operators; these are Angola Telecom, MS Telecom, Mundo Startel and Wezacom. However at the time of this research, only two-Angola Telecom and MS Telecom-were operational. Furthermore, both operators are state-owned entities. MS Telecom is a subsidiary of Sonangol-the Government-owned oil parastatal, and Angola Telecom is the 100% government-owned incumbent.

TABLE 4: LIBERALISATION OF TELECOM MARKETS

ANGOLA (2004)	Local services	C	Angola Telecom	SO	National teleco operators	5
	Long distance (domestic)	C	MS Telecom	SO	Cellular mobile operators	2
	Long distance (international)	C	Mundo Startel	FP	Internet service providers	4
	Wireless local loop	C	Wezacom	FP	VSAT operators	na
	Data	C				
	VSAT	na				
	Leased lines	C				
	Mobile	P				
	Cable TV	P				
	Internet services	C				
	International gateways	C				
CAMEROON (2004)	Local services	M	CAMTEL	SO	National teleco operators	1
	Long distance (domestic)	M			Cellular mobile operators	2
	Long distance (international)	M			Internet service providers	na
	Wireless local loop	C			VSAT operators	na
	Data	C				
	VSAT	P				
	Leased lines	na				
	Mobile	C				
	Cable TV	C				
	Internet services	C				
	International gateways	na				
GHANA (2006)	Local services	P	Ghana Telecom	SO	National teleco operators	2
	Long distance (domestic)	P	WESTEL	SO	Cellular mobile operators	4
	Long distance (international)	P			Internet service providers	29
	Wireless local loop	P			VSAT operators	57
	Data	C				
	VSAT	C				
	Leased lines	C				
	Mobile	P				
	Cable TV	C				
	Internet services	C				
	International gateways	P				
SENEGAL (2004)	Local services	C	SONATEL	PP	National teleco operators	1
	Long distance (domestic)	C			Cellular mobile operators	2
	Long distance (international)	C			Internet service providers	13
	Wireless local loop	C			VSAT operators	na
	Data	C				
	VSAT	C				
	Leased lines	C				
	Mobile	C				
	Cable TV	na				
	Internet services	C				
	International gateways	C				

Notes:
Table 1.1 reflects what is legally permissible in each country and may not represent what actually pertains in the market
M - Monopoly; P - Partial competition; C - Full competition; na - Not available
SO - State-owned; PP - Partially privatised; FP - Fully privatised

SOURCE: ITU World Telecommunication Regulatory Database and websites of relevant national telecom regulators and/or ministry of communications.

By having two state-financed telecoms entities which have shareholdings in all of the major sectors of the market[22], the Angolan telecom market can be described as a "biased" duopoly–government is literally in competition with itself (although Angola telecom remains the dominant operator).

A similar situation (i.e. a "biased" duopoly with a dominant incumbent) also exists in Ghana. There are two national fixed-line telecom operators in Ghana-Ghana Telecom and Western Telesystems (Westel).At the time of this research both were100% government owned.[23] However Ghana Telecom dominates the fixed-line telecom market: by mid-2007 Westel only had approximately 3,000 fixed lines (all located in Accra) compared to Ghana Telecom's 370,000 lines nationwide.

By comparison to the market for fixed lines, the mobile market in Ghana is significantly more liberalised. There are currently four mobile operators in Ghana: Scancom (which is owned by MTN and operates under the brand name Areeba), Ghana Telecom Mobile (owned by Ghana Telecom and operating under the brand name Onetouch), Mobitel (owned by Millicom Ghana and operating under the brand name Tigo) and Kasapa Telecom (a subsidiary of Hutchison Telecommunications International and operator of the only code division multiple access (CDMA) cellular network in the country under the brand name Kasapa). Notwithstanding the number of active companies there is a limit to how competitive the mobile market actually is. Scancom and Ghana Telecom Mobile control a significant proportion of the market and are estimated to carry 88% of the total mobile network traffic in Ghana.[24]

If the fixed-line markets in Angola and Ghana operate as "biased" duopolies, those of Cameroon and Senegal operate as monopolies, even though on paper these markets can operate under full (Senegal) and/or partial (Cameroon) competition (see Table 4).

In Cameroon the market for fixed lines operates under the monopoly of Cameroon Telecommunications Corporation (Camtel). Although the government has made repeated attempts to privatise the company, its most recent effort (in November 2003) led to a reinforcement of Camtel's monopoly position. This came about as a result of a provisional concession Camtel signed with the government to manage the fixed network and services for a two-year period (renewable for a further two years). Camtel was required to connect 40,000 new lines and increase the number of public payphones throughout the country. The contract gave Camtel up to four years of exclusivity on the provision of fixed-line services in order to achieve these growth targets.

In addition to being the only national fixed-line operator, Camtel also provides data and satellite services and calling cards. Its subsidiary, Camnet, provides internet and broadband services and in 2006 it created a new mobile telephone company called Cameroon Mobile Telecommunications Corporation (CMT) to compete with the country's two (more established) mobile operators, MTN and Orange.[25] The research was unable to confirm the number of ISPs and VSAT operators in the country. However, some level of competition is thought to exist in these markets. Cameroon has a large number of grey-market VSAT and voice over internet protocol (VoIP) operators (see section 4.3.2), which have emerged to fill the demand that Camtel's poor network has been unable to fill. Their emergence has also been facilitated by Camtel's inability to enforce its monopoly in the market for international services.

The national fixed-line operator in Senegal is the Senegalese National Telecom Company (Sonatel), which has been partially privatised (France-Telecom has a majority shareholding). While the International Telecommunication Union (ITU) reports that competition is permissible in all sectors of the Senegalese telecom market, in reality this is not yet the case. Sonatel's monopoly in the fixed-line market ended in 2004; but at the time of this research a second national operator licence had yet to be awarded. There are two mobile operators in Senegal-Sonatel's mobile arm (which operates under the brand name Alize) and Sentel-a subsidiary of Millicom International Cellular (MIC)

22 Angola Telecom operates as a fixed-line operator and ISP. Angola Telecom also owns Angosat, which provides the national backbone with space rented from Intelsat; Movicel, which is a mobile operator using CDMA technology (and that also offers data services); and TV Cabo, which provides cable TV services and is also an ISP. MS Telecom is a fixed-line operator and ISP and owns 25% share in Angola's leading GSM operator, Unitel.

23 In a press statement on October 30, 2007 the Ministry of Communications, Republic of Ghana announced that Celtel International, a subsidiary of Kuwaiti company Zain (formerly named MTC) had purchased 75% of the shares of Westel. The Government of Ghana, through the Ghana National Petroleum Corporation, holds the remaining 25% (http://www.moc.gov.gh/modules.php?op=modload&name=News&file=article&sid=235).

24 "Ghana's leading mobile operators in trouble." *afrol News*, 16 October 2007 [online] http://www.afrol.com/articles/26945 Accessed 4 December 2007.

25 However, as at the time of this research Cameroon Mobile Telecommunications Corporation was yet to launch its service.

(operating under the brand name Tigo). Contrary to what is legally permissible, the international gateway market in Senegal is not yet competitive and Sonatel is the only company that offers connectivity to international bandwidth. As a result, even its competitor in the mobile market, Sentel, must route all international calls from its mobile network through Sonatel. In a similar manner, all ISPs are obliged to pass their international traffic through Sonatel. The research was unable to confirm the number of ISPs and VSAT operators in the country. However, a 2004 Spintrack report is quoted as stating that at the time of their report–and due to the monopoly enjoyed by Sonatel on the provision of satellite and international services-no VSAT licences had been issued in Senegal.

Global experience of telecom reform has shown that in many instances the liberalisation of markets and the emergence of real competition, as multiple operators provide services to consumers, improves the efficiency of markets; much more so than the mere privatisation of the incumbent operator. On the one hand, with the exception of Sonatel, none of the other signatories to SAT-3/WASC studied as part of this research were privatised. These 100% government-owned entities often constitute a conflict of interest in the markets that they operate in and (usually) dominate, impeding sector reforms and constituting operational bottlenecks. On the other hand, and perhaps more significantly, with the exception of Ghana Telecom, all other SAT-3/WASC signatories studied in this research are ***legally*** the sole providers of international connectivity in their countries.

This scenario, in most cases, constitutes a "reinforced monopoly" –state-owned operators who are sole providers of international connectivity in un-competitive markets face little incentive to offer ***fair*** access and prices to other operators and consumers. The impact this has had on the performance of telecom markets in the case countries is discussed in the following section.

4.2.2 Performance of telecom markets

All of the countries studied have experienced increases in international bandwidth capacity available in the country. They have experienced decreases in the cost of international bandwidth both on SAT-3/WASC and from its "alternative", satellite (see table 5). The cost of internet access to consumers has also decreased over time. This has also been the case regarding the cost of international calls.

4.2.2.1 Bandwidth capacity and utilisation

At the commissioning of SAT3/WASC Angola Telecom was allocated a total capacity of 805,270 MIU km,[26] and an assigned capacity of 62,675 MIU km. The operator has since used up its original allocation and was at the time of this research in the process of upgrading its capacity. Likewise Cameroon Telecom (Camtel), whose success in marketing SAT3/WASC has been very limited,[27] has nonetheless increased its allocation on the cable. In December 2006, Camtel bought additional MIU km to stock up its capacity by about 30% and in March 2007 stated that it was using 60% of its allocated capacity. In Cameroon Camtel is by far the biggest user of SAT-3/WASC capacity (this is the case for the incumbents in all the other countries studied). It is estimated to use approximately 50% of Cameroon's allocated capacity on SAT3/WASC, which corresponds to more than 80% of all used capacity. The bulk of the remaining capacity is used by only a handful of large companies that are connected directly to the cable.[28]

Of the countries studied, Senegal has witnessed the greatest increase in bandwidth. This has increased from 42Mb/s in May 2002 (the year in which SAT-3/WASC was commissioned) to 1.24Gb/s in the five years until 2007. Between the launching of SAT-3/WASC and November 2004, bandwidth in Senegal was upgraded on more than 11 occasions. The last upgrade (prior to this research) was in October 2006, which brought the country's capacity up to the 1.24Gb/s. Senegal's bandwidth capacity is available (through Sonatel) to neighbouring countries including Gambia, Guinea Bissau, Mali and Mauritania.

26 Capacity is allocated to the consortium members in MIU kilometres–MIU km, where MIU stands for minimum investment units. When a consortium member wants to implement a link to another member country, a defined number of MIU km are deducted from its balance. Additional capacity can be obtained on demand by consortium members out of a pool of spare capacity from other members.

27 To date only a small number of retail customers are buying SAT-3 bandwidth from Camtel, the first wholesale customers only gained access to the facility in 2005.

28 These include MTN (GSM mobile operator), Orange (GSM mobile operator), Sonel (the national power utility), Pecten (a Cameroon-based oil company), Schlumberger (diversified technology company) and SITA (Societe Internationale de Telecommunications Aeronautiques).

TABLE 5: PERFORMANCE OVERVIEW OF TELECOM MARKETS

	ANGOLA		CAMEROON		GHANA		SENEGAL		
Name of Operator	Angola Telecom		Cameroon Telecom		Ghana Telecom		Société Nationale des Télécommunications		
Fixed line monopoly?	No[1]		Yes		No[1]		Yes		
International gateway monopoly	Yes		No		No		Yes		
SAT3 only submarine cable?	Yes		Yes		Yes		No		
Amount invested (USD mil)	24		20		24		24		
Percentage shareholding [2]	4%		3%		4%		4%		
Capacity allocated (MIU*Km)	805.270		'confidential'		805.270		na		
International bandwidth [Mbps]	na as at 2002		9 as at 2002		4 as at 2002		60 as at 2002		
	na as at 2006		310 as at 2006		40 as at 2006		1024 as at 2006		
Year sale of SAT3 capacity	2002		2002/2005		2002		2002		
Cost of access - SAT3 [E1/monthUSD]	25.000,00 as at 2003		up to 22400.00 as at 2003		12.000,00 as at 2003		na as at 2003		
	14.400,00 as at 2006[3]		4.400,00 as at 2006[4]		up to 12,000.00 as at 2006 [5]		7.468,00 as at 2006 [6]		
Cost of Satellite [1Mb/month USD] [7]	na	as at 2003	9.000,00	as at 2003	15.000,00	as at 2001	na	as at 2003	
	up to 12,000	as at 2006	3.700,00	as at 2006	5.500,00	as at 2006	na	as at 2006	
Operator's Dial-up Charges [USD] [8] - monthly	Corporate	Residential	Corporate	Residential	Corporate	Residential	Corporate	Residential	
	82,97	11,52			na	na	17,76	17,76	Connection
	33,69	4,68	308,41	79,44	na	na	11,96	11,96	Subscription
Operator's ADSL Charges [USD] - monthly	ADSL	ADSL Plus	ADSL	ADSL PRO	B4U	B4U [12]	Royalty-Line	Royalty-ISP	Download speed
	136,49	142,99 [10]	560,75	560,75 [11]		155,55			256
	166,58	203,16 [10]	934,58	[11]	274,81		47,83	34,24 [13]	512
			1.308,41	[11]	321,47	181,48	246,57	214,43 [13]	1024
							300,13	223,61 [13]	2048

NOTES:

1. Fixed line operators are however government owned entities
2. Calculations based on cost of US$650 million
3. Price is per mbps per month duplex to Portugal
4. Price some organisations have been able to negotiate per month for an E1 link (2Mb/s full duplex). Advertised price by Camtel in 2003 was US$12,500 (reduced to US$7,500 since 2006)
5. Price of E1 per month to Europe and America for GISPA (Ghana ISP Association) members. Price to non-GISPA is $8000/month and to non-ISPs is $12000/month
6. Comprised of approximately US$1,402 settlement fee and US$6,066 monthly cost for 2048Kbps line
7. Average Satellite Price (1 Mbit) – duplex. Not fully comparable with SAT3 due to different service characteristics
8. Monthly estimates based on annual contract. Actual full costs to users will be substantially more once phone line costs are included.
9. Corporate: Refers to RNIS product (Internet via ISDN). Made up of 50,000FCFA expense account; 15,500FCFA modem hire and 100,000 router hire.
10. Residential: Refers to RTC product (internet via switched telephone network with throughput of 56kbps). Made up of 25,000FCFA expense account and 17,500FCFA for 50 hours usage. 500FCFA for each additional hour.
11. Prices quoted are highest of two options - product termed "Kz". Price includes installation. 1 Angolan Kwanza = 0.01337 USD
12. 535FCFA = 1USD conversion rate. Includes one time installation fee of 100,000FCFA. The low-end 128/64 package is the most commonly used one. The top three packages (256/128; 512/256; 1024/512) are virtually exclusively used by the corporate sector
13. Ghana Telecom's Broadband4U prices (B4U). Includes US$93 installation fee for all products (1USD = 9,639.83GHC). All options listed are for dynamic Ips (rather than static). 1024/256Kbps option listed under Residential is for Schools only
14. Price includes a one-off installation price of 11,500 FCFA ($US 22) for ADSL 512, and 103,000 FCFA ($US 193) for ADSL 1024 and 2048

With respect to capacity utilisation, the one exception in the case studies was Ghana. The SAT-3/WASC cable provides Ghana with a total allocated capacity of 805,270 MIU km and an assigned capacity of 66,875 MIU km. This research estimated the country's utilisation to be about 10-15% (6 STM1s)[29] of the cable's capacity into the country.[30] However sources interviewed during the course of this research projected that utilisation would increase to 15 STM1s by 2011.

4.2.2.2 Cost of international bandwidth (wholesale)

The cost of international bandwidth has also decreased-although not to levels anticipated by the market (given the potential of SAT-3/WASC). In Angola, the incumbent's (Angola Telecom) monopoly on the international gateway and the resulting lack of competition meant that there was little to no incentive to reduce international bandwidth prices. Unsurprisingly, Angola Telecom kept the prices for SAT-3/WASC bandwidth high and only recently reviewed them downwards, predominantly as a result of political rather than market pressure. In the years immediately following the commissioning of the cable the costs of SAT-3/WASC bandwidth were often the same as or more expensive than satellite bandwidth.

Since SAT-3/WASC came into service Angola Telecom has reduced the cost of wholesale bandwidth on the fibre twice, once in June 2005 and again in October 2006. The initial price for this bandwidth appears to have been around USD 20,000 per Mb/s per month duplex to Portugal. The first reduction of 20% took it down to around USD 16,000, and the subsequent reduction of 10% down to USD 14,400. International satellite prices have also come down in two stages in Angola (at the same time as those of SAT-3/WASC) with a first reduction of 10% followed by a further reduction of 5%. Satellite prices vary between USD 4,000-5,000 duplex, but still appear to be cheaper than fibre in some instances. Discussions with operators have established that the prices being charged are between USD 3,500 and USD 12,000 per Mb/s per month depending on volumes used.

Ghana Telecom implements a differential pricing mechanism with respect to access to SAT-3/WASC capacity. The price prospective buyers pay differs according to the type of licence they hold and whether or not they are members of the Ghana ISP Association (GISPA). Registered members of GISPA pay USD 4,010 for a bi-directional (full duplex) 2Mb/s link (E1) connection, while non-GISPA ISPs are charged USD 8,000 for the same capacity. The costs are even higher for buyers that are not ISPs, who pay USD 12,000 for the same E1 connection-which is the price Ghana Telecom used to charge all wholesale buyers when the cable was first commissioned five years ago. Our research was unable to ascertain the cost basis (if one exists) behind this pricing difference and assumes that it has been largely in response to successful lobbying on the part of GISPA. The research also found that the average price for an "equivalent" satellite connection (of 1 Mb/s duplex) in Ghana during 2007 was approximately USD 5,500. This represents a significant reduction from the amount that would have been paid in 2001, which is estimated to have been approximately USD 15,000.

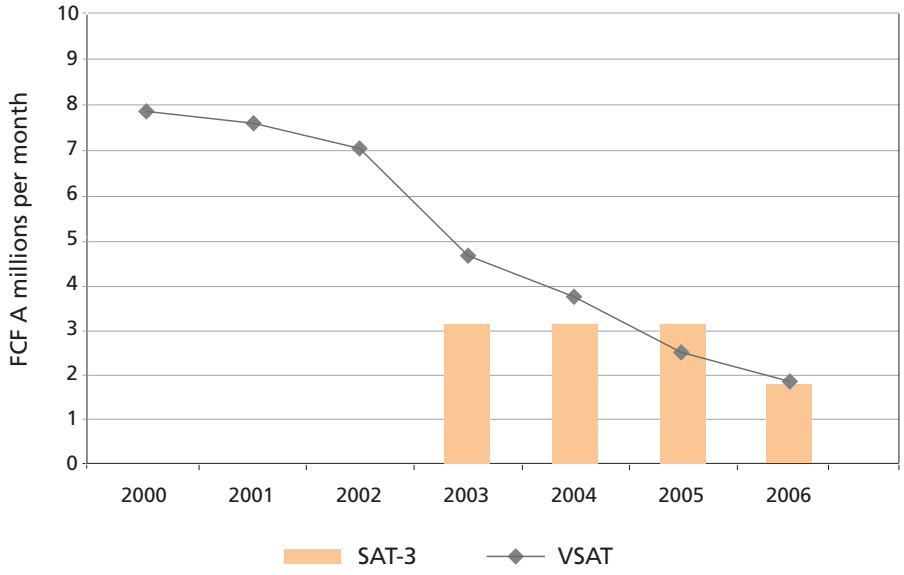
Research findings on Cameroon show a clear correlation between increased availability and reductions in the price of wholesale bandwidth on SAT-3/WASC and the cost of satellite bandwidth (see figure 4). Prior to the arrival of SAT-3/WASC in 2002 satellite was the only way of getting international bandwidth into the country. Despite competition between various international providers in the very small aperture terminal (VSAT) sector in Cameroon, prices remained high-around FCFA8-million to FCFA9-million (approximately USD 11,500) per month for a 1Mb/s downlink and 512Kb/s uplink. Even though Camtel did not connect the first wholesale customers to SAT-3/WASC until 2005, in 2003 it began to advertise E1 links for FCFA7-million (around USD 12,500). VSAT providers reacted to this by reducing their prices by approximately 35% to around FCFA5-million.[31] The providers were able to maintain a price margin above Camtel's SAT-3/WASC pricing until 2005. However, once Camtel connected its first wholesale fibre customers, the price for dedicated VSAT bandwidth fell below Camtel's "equivalent" SAT-3/WASC pricing for the first time. Camtel responded to this (in 2006) by reducing its price

29 Synchronous Transport Module. See: http://en.wikipedia.org/wiki/STM-1

30 There is an inland fibre connection to the SAT-3 landing point in Ghana with three nodes in the greater Accra area: Cantonments Node has 63 E1s, Accra-North Node has 42 E1s and one 34 Mb/s tributary and High Street (Cable Station) Node has 126 E1s.

31 Note that Camtel's FCFA7-million for SAT3/WASC bandwidth compares favourably to VSAT prices, considering that it provides twice the downlink bandwidth and four times the uplink bandwidth and is a better quality product with higher reliability and lower latency than satellite.

FIGURE 4: PRICE OF WHOLESALE BANDWIDTH, SAT-3/WASC VS. VSAT, 2000 – 2006



Note 1: Fibre and VSAT bandwidth prices are not fully comparable due to different service characteristics.
Note 2: Part of the reason for the declining VSAT cost is that the USD lost around 25% of its value against the FCFA between 2002 and 2004.

SOURCE: Interviews with major ISPs with access to SAT-3 bandwidth.

for an E1 by more than 40% to FCFA4-million/month. Furthermore as some ISPs gained more bargaining power through organic growth as well as mergers and acquisitions discounts of up to 40% on this list price have been achieved, with some companies paying as "little" as FCFA 2.4-million (USD 4,400) per month for a SAT-3/WASC E1. In response the VSAT providers are now offering 1Mb/s downlink for as little as FCFA 1.1-million per month (approximately USD 2,000).

While Senegal was identified as the country with the most improvement in bandwidth availability, data for both fibre and satellite wholesale bandwidth prices were difficult to obtain and verify with the operator Sonatel. The following extract from the country report highlights the extent of the problem faced during the data collection process:

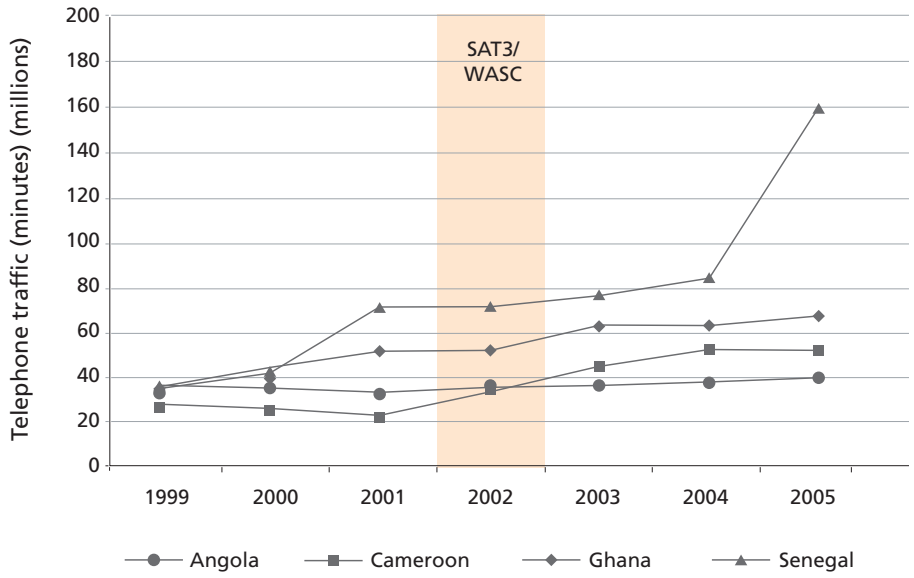
> Attempts at scheduling interviews and discussions with several officials also proved difficult, if not impossible. It took over two months to meet the first Sonatel official for an interview. Most of the questions posed during the interview especially those related to earnings, expenses and SAT-3/WASC-related figures, were not answered. Other requests for data were also not forthcoming. (Senegal case study report)

4.2.2.3 Cost of international calls for consumers (retail)

The extent to which decreases in the cost of international calls and increases in international call and data traffic can be directly attributed to SAT-3/WASC is open to contention. The markets for international and internet services in each of the countries have, at the same time as the commissioning of SAT-3/WASC, also experienced increases in the number of (legal and grey market) operators providing services and the ensuing competition has had a positive impact on reducing prices. This in turn may have had some impact on international outgoing traffic from these countries.

Figure 5 shows the trend in international outgoing fixed-line telephonic traffic in the countries studied. It highlights an upwards trend in the number of minutes of international calls that were being made by the population of each country on its fixed-line network. While all the other countries appear to have witnessed gradual increases in traffic since the commissioning of SAT-3/WASC, Senegal registered a dramatic increase post-2004.

FIGURE 5: INTERNATIONAL OUTGOING FIXED-TELEPHONE TRAFIC



Note 1: 2004 data not available for Ghana so prior year's figure (62 million) is used.

SOURCE: ITU (2007) World Telecommunications Indicators Database

Prior to 2002, tariffs to international destinations in Senegal were between USD 0.74 and USD 1.3 per minute depending on the destinations. This has fallen to USD 0.24 per minute to all the destinations during off-peak hours and USD 0.20 per minute between 6 pm and 11 pm and between 7 am and 8 am. Calls cost as little as USD 0.10 per minute during "night hours" (from 11 pm to 7 am).

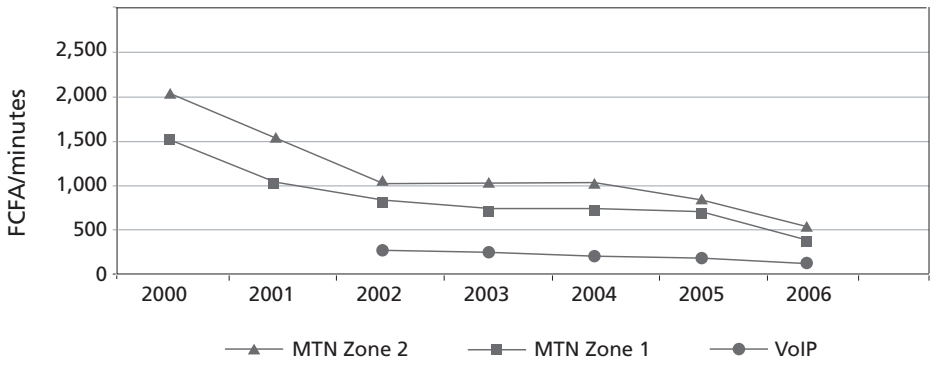
The pattern of tariff reductions on international communication by Sonatel since 2002 is as follows:

- May 2002: 12% tariff reduction on phone calls outside of Africa
- April 2003: further 15% tariff reduction during peak periods
- June 2004: 33% tariff reduction and implementation of a single tariff irrespective of destination
- May 2005: 11% tariff reduction per minute during peak time, 6% reduction during off-peak peak periods and 37% reduction on calls made between 11 pm and 8 am
- May 2006: 18% price reduction on international calls and harmonisation of times (i.e. no longer categorising calling times into peak and off-peak).

The implementation of a single tariff irrespective of destination coincides with the peak in traffic shown in figure 5 and can be considered a stimulus for increases in outgoing international traffic. SAT-3/WASC, together with the use of VoIP (made possible due to increased availability of higher quality bandwidth), have been key factors in lowering tariffs on international communications.

A similar downward trend in the price of international communications was reported in Cameroon (see figure 6). Here the observed impact of SAT-3/WASC on international tariffs is twofold. Firstly, the commissioning of the cable coincided with a temporary halt in the downward trend of international call tariffs. International tariffs had halved between 2000 and 2002, but remained virtually flat in the following three years to 2004/2005. It is possible that Camtel, facing a dwindling or (at best) stagnant customer base countered falling revenues by raising tariffs or at least keeping them constant. It was able to do this due to the higher quality of international connections that became available using SAT-3/WASC capacity compared to satellite. Renewed downward pressure on international tariffs only came in 2005 when the mobile operators gained access to Camtel's SAT-3/WASC bandwidth.

FIGURE 6: INTERNATIONAL CALL RATES IN CAMEROON



Note 1: MTN Zone 1 = France and USA, Zone 2 = rest of world.
Note 2: In 2006 MTN introduced a special rate of FCFA 200 per minute to other MTN networks in Africa.

SOURCE: MTN and various VoIP service providers in Cameroon.

Secondly, SAT-3/WASC enabled the larger scale introduction of VoIP services in concert with the introduction of wireless broadband services. Prior to this, the use of VoIP in Cameroon was very limited due to the insufficient quality of dial-up and satellite links used for connectivity by ISPs and cyber-cafés. In 2002, international VoIP calls to most destinations were offered for around FCFA 250 per minute, which was about a quarter of the price for conventional calls on the fixed-line and mobile networks to the most popular destinations. VoIP rates have declined steadily to as low as FCFA 100 per minute in 2006 (including Camtel's own calling card service), at which time calls on both fixed and mobile networks cost between FCFA 300 and FCFA 400 to the most popular destinations.

In Angola, international rates in 1998 were reported to be around USD 2.96 a minute. By 2003, Angola Telecom international calling rates had fallen to between USD 1.10-2.50 a minute and by the first quarter of 2007 these rates were around USD 0.90 a minute for more popular calling destinations. International calls are even cheaper via Angola's thriving grey market which operates through the country's cyber-cafés or using 'leaky' private automatic branch exchanges (PABXs). International calls to main destinations through this channel are between USD 0.25-0.31 a minute. The cost of international calls in Ghana has witnessed a similar decline, although a historical account was not collated for this case country. In 2001, a call to the US cost USD 1.50 per minute; this had reduced to approximately USD 0.50 per minute by 2006.

4.2.2.4 Cost of internet services for consumers (retail)

Decreases in the cost of internet services since the commissioning of SAT-3/WASC was observed in all the case countries studied. In addition, an increase in the adoption of wireless and broadband connections to the internet was also observed by the research. However, both these trends have not been at anticipated levels, particularly in light of the potential offered by fast and high-quality SAT-3/WASC bandwidth.

The research found that a significant proportion of the Angolan market has gone over to either wireless or digital subscriber line (DSL) broadband connections, but that prices do not appear to have come down. This is despite reductions in the wholesale price of both national and international bandwidth (see discussion in section 4.3.2.2). Angola Telecom currently offers two tariff plans for its asymmetric digital subscriber line (ADSL) service, ADSL and ADSL Plus, which vary according to contention ratios and download limits. The ADSL service costs USD 99 for a 256Kb/s download speed and USD 149 for a 512Kb/s download speed. The equivalent on ADSL Plus costs USD 150 and USD 250 respectively.

By way of comparison, Angola Telecom's cable TV subsidiary TV Cabo offers three broadband tariffs: residential, professional and mega. Prices vary between USD 100 and USD 320 per month. Prices offered for mobile data services by Angola Telecom's mobile operator,

Movicel, vary depending on whether the subscriber is a pre- or post-paid customer. Three download speeds are offered: 150Kb/s (costing USD 112/month), 300Kb/s (USD 173/month) and 1Mb/s (USD 254/month). The latter is currently only available in the capital Luanda.

Price decreases were also recorded for dial-up, wireless and ADSL products in Cameroon. Camnet launched ADSL at the end of 2005 with speeds ranging from 128/64Kb/s to 1024/512Kb/s-the low-end 128/64Kb/s package is the most commonly used one. The high-speed packages were found to be virtually exclusively used by the corporate sector. Camtel's ADSL product attracts a one-time installation fee, which is typically around FCFA 100,000 (USD 187) and the modem is rented (i.e. it remains the property of the service provider). The 128/64Kb/s package–the most popular one-costs FCFA 49,000 (USD 92) per month. Tariffs for dial-up packages have also reduced over time. These have decreased twice: once in 2002 the year SAT-3/WASC was commissioned, and again in 2006 after SAT-3/WASC bandwidth had become available on the wholesale market. However, the relevance of dial-up as an Internet access method is now decreasing quickly as wireless options and ADSL are increasingly becoming available. Many residential households have also terminated their dial-up subscriptions when internet access became available at the workplace.

In Ghana internet dial-up costs in 2006 ranged from USD 25 to USD 35 per month. The average installation cost for broadband was USD 120, with monthly subscription fees of approximately USD 65 per month. Broadband prices however vary across operators and are difficult to compare. Ghana Telecom's Broadband4U charges are the lowest in the country. Monthly charges for Broadband4U products vary from USD 66 for a residential customer with download/upload speeds of 256/64Kb/s to USD 290 for business customers with speeds of 1024/256Kb/s. All Broadband4U products attract an additional (one-time) installation fee of USD 99.

In Senegal, Sonatel has offered a number of tariff reductions over the years, especially with its ADSL service offering. The cost of its ADSL 256 product was reduced by 15% in February 2003 to USD 87. Further price reductions were experienced in May 2003, with the introduction of ADSL 512Kb/s and a tariff reduction of 48.7% on ADSL 256Kb/s. April 2004 saw another drop of 39% and a further 50% on the cost of a range of ADSL products 256-1024Kb/s. There were other promotions in October 2004 and more recently in May 2005 during which the following reductions occurred:

- Drop by 54% on ADSL 256Kb/s and 512Kb/s and tariff reduction of 49% on ADSL 1024Kb/s
- Monthly subscription for 256Kb/s and 512Kb/s lines fell by 22% and 60% respectively
- Drop by 74% on the monthly subscription for ADSL 1024Kb/s
- Introduction of ADSL 2048Kb/s: customers subscribing to 1024Kb/s can benefit from 2048Kb/s while paying less than 44.70% of their invoice
- Price tariff of 512Kb/s made equivalent to cost of 256Kb/s.

In May 2006, price discounts of 30% by Sonatel and 20% by Sentel internet (Senegal's second mobile operator) were made for 1024Kb/s and 2048Kb/s. This particular price reduction is credited with raising the subscription rate of ADSL subscribers in the country to 20,000 from 18,000 (the subscription figure in December 2005).

The ability to connect to SAT-3/WASC via Senegal's Sonatel has also had an impact on internet access costs in neighbouring Mali. Ikatel, Mali's second mobile operator (and a subsidiary of Sonatel) launched its ADSL services in September 2006. ADSL 128Kb/s costs USD 43 per month–this in comparison to Sonatel's USD 38 per month ADSL 518Kb/s (twice as much capacity) that can be obtained in Senegal.

Although a wider range of broadband speeds are available in Senegal and costs and prices of bandwidth and internet access are comparatively lower than other case study countries (and sub-Sahara Africa countries in general), the performance of Sonatel in utilising its SAT-3/WASC capacity is still criticised in Senegal. Respondents to our research noted that after four to five years of Sonatel's ADSL services in Senegal, the price of connectivity could and should be more affordable and the number of subscribers higher. Sonatel's pricing of its ADSL products was compared to France Telecom's offering in France (respondents viewed this as a comparison of tariffs of "the same company") which indicated that the cost of Sonatel's 1Mb/s product is 240% more than what France Telecom charges in France (and this price excludes the cost of initial installation of USD 193).

4.3 Discussion of Findings

The section above (section 4.2) has outlined some of the key findings relating to the ownership structure of the telecom markets of the countries studied by this research and has provided examples of the performance of these markets since the commissioning of SAT-3/WASC. Particular emphasis was on the markets for international and internet services. The findings show that while cost and prices have in general decreased, these reductions have not been commensurate with the potential offered by SAT-3/WASC. This potential is the focus of the next section, which discusses how increasing access to SAT-3/WASC bandwidth and reductions in cost of access and prices to consumers can improve international connectivity in the case countries. This section also identifies barriers to improving connectivity.

4.3.1 Increase in bandwidth capacity and reduction in cost of access

Unsurprisingly, the amount of bandwidth capacity available in each of the case countries was found to have increased over time and each signatory was found to have upgraded its capacity on the cable. These increases in capacity have been accompanied by decreases in the cost of access. For example, in 2003 the advertised monthly cost in Cameroon (by Camtel) for an E1 link was USD 12,500; by 2006 some organisations had been able to negotiate this cost to USD 4,400 per month. It is anticipated that reductions in the cost of access to SAT-3/WASC capacity will lead to decreases in the price of broadband products to consumers. This is analysed in section 4.4.4 below.

Table 6 below presents international bandwidth statistics from the ITU 2007 database on telecom and ICT indicators. Only SAT-3/WASC/SAFE signatory countries with complete data sets for the years indicated are presented in the table (these are the three years prior to the commissioning of the cable and four years after it became operational). The table also presents the compounded average growth rate (CAGR) in international bandwidth for the periods pre- and post- the commissioning of the cable.

TABLE 6: INTERNATIONAL INTERNET BANDWIDTH (MB/S)

INTERNATIONAL INTERNET BANDWIDTH (MBPS)										
	1999	2000	2001	2002	2003	2004	2005	2006	CAGR-PRE	CAGR-POST
CASE STUDY COUNTRIES										
Angola	1,1	1,1	2,0	7,0	7,0	7,0	68,0	191,0	59,19%	93,73%
Senegal	4,1	36,0	48,0	79,0	310,0	465,0	775,0	1240,0	110,03%	73,44%
SAT3/WASC/SAFE SIGNATORIES										
Benin	0,1	2,0	2,0	2,1	47,0	47,0	45,0	47,0	100,48%	86,20%
Cape Verde	0,5	1,0	2,0	3,0	8,0	10,0	14,0	24,0	55,74%	51,57%
Gabon	0,5	0,5	0,5	8,0	45,0	155,0	200,0	200,0	99,01%	90,37%
Mauritius	6,1	6,0	10,0	34,0	63,0	71,0	153,0	192,0	53,46%	41,37%
> 100MB SUB-SAHARAN AFRICA COUNTRIES										
Kenya	2,5	10,5	26,0	26,0	26,0	34,0	113,4	758,6	79,58%	96,34%
Burkina Faso	1,0	1,0	2,0	8,0	12,0	64,0	72,0	215,0	68,18%	93,14%
Uganda	0,8	1,7	5,1	7,7	10,0	60,5	60,5	133,0	77,83%	76,80%
Mali	3,0	3,0	3,0	6,0	6,0	18,0	26,0	310,0	18,92%	120,11%
Zambia	0,3	2,1	2,1	5,1	12,0	22,0	22,0	128,0	110,66%	90,37%
Togo	1,0	1,0	6,0	12,0	14,3	14,3	14,3	100,1	86,12%	52,84%

SOURCE: ITU World Telecommunication/ICT Indicators 2007 Database

Two comments can be made based on the data presented in the table above. First, the rate at which SAT-3/WASC countries have been able to utilise the capacity they have access to differs. ITU quotes Senegal's capacity as 1240Mb/s in 2006, significantly more than any other SAT-3/WASC signatory for which data was available. This may be due to a variety of factors, including the state of the national terrestrial backhaul infrastructure (as exemplified by Angola), inefficient marketing of bandwidth (as shown by Cameroon), affordability and demand. It should also be noted (from CAGR figures) that Senegal has been consistently increasing its bandwidth in the periods prior to and post SAT-3/WASC. Other signatory countries record significant sudden increases in bandwidth as a result of connectivity to the cable.

Second, there are countries that are not signatories to SAT-3/WASC that have, nonetheless, been able to significantly improve the international bandwidth available to their population. In the case of countries like Kenya and Uganda, this has been to levels much higher than what pertains in signatory countries. However the role SAT-3/WASC can play on the continent is highlighted by Burkina Faso, Mali and Togo. These three countries have been able to significantly increase their international bandwidth capacity. Mali is connected to SAT-3/WASC via Senegal, while Togo is connected via Benin. A fibre-optic cable network linking Niger, Burkina Faso and Benin is also planned, which would provide Niger with access to SAT-3/WASC.

4.3.2 Exertion of barriers in supplying access to cable capacity

While the research found evidence of reductions in cost of access, there was little evidence to show that the process of gaining access to SAT-3/WASC capacity through consortium members was becoming easier. Suspicions are raised in the case of Cameroon where Camtel – the consortium member-is by far the biggest user of SAT-3/WASC capacity in the country, using 50% of the allocated capacity (which corresponds to more than 80% of all used capacity in Cameroon).

Various reasons can be suggested to explain this situation-where the incumbent appears to be the main beneficiary of SAT-3/WASC at the exclusion of other players in the market. Firstly, the smallest unit of bandwidth sold by SAT-3/WASC is a full E1, and the prices at which this is offered is unaffordable for a wide variety of service providers. Second, the poor state of national terrestrial backbones limits the areas where access to the cable is available. At the time SAT-3/WASC was commissioned in 2002, Camtel's national backhaul infrastructure was insufficient to effectively distribute fibre bandwidth beyond Douala, where the landing station is located.

A similar situation pertains in Angola. At the commencement of SAT-3/WASC's operation, there was no fibre within the capital Luanda where a large part of international bandwidth demand is to be found. At the time of this research, nearly five years after the opening of the SAT-3/WASC landing station, the only piece of operational fibre in the Angolan national backbone plan is a route from the southernmost city in the country, Namibe, to Lubango and onwards towards the Namibian border. Communications between most locations in Angola occur via microwave links, and mostly via satellite–and these are additional costs to the price paid for bandwidth. When providing price information for services in Angola, it is therefore often necessary to make the distinction between prices obtainable in the capital and locations outside the capital.

The Angola case study offers the example of communications costs for the Lobito office of a government environmental organisation-Instituto de Investigação Marinha– in 2005:

> The system was installed by SISTEC, and is linked to a telephone installed by Angola Telecom. The installation cost of the email and internet system was USD 6,400, and the monthly subscription is approximately USD 350 and USD 1,000, depending on the number of telephone calls and time spent online. (Angola Case Study Report)

In addition, for those of its offices where there is not a microwave or fibre link, the organisation was quoted between USD 487,50 and USD 1387,50 a month on the basis of a 12-month contract for a VSAT service to connect it to Luanda.

A third reason offered for the imbalance in access to the SAT-3/WASC cable is that consortium members have been accused of using delay tactics in connecting service providers they consider to be competitors. For example, in Cameroon, ISPs were initially seen more as competitors than wholesale customers or partners. Even when they were able to get connected to the cable, some found that they were not given the capacity they requested and had to embark on further negotiations with Camtel to have their application for access completed as agreed.

4.3.3 Increase in the quality and range of products

The research also found an improvement in the quality and range of products offered in the market. Where fibre was available, it was often adopted by service providers and at times at the expense of competing sources of bandwidth (i.e. satellite). However some countries have had more success in the adoption of broadband products than others. For instance the availability of the products is mostly limited by the geographic spread of the national terrestrial network, and is therefore often restricted to key urban areas.

4.3.4 Decrease in the prices of products

Data from Senegal illustrates the recurring relationship observed by the research between increases in available bandwidth capacity and the price of products. Figure 4 presents an example of this relationship using a specific broadband product (ADSL 256) offered by Sonatel. It shows that increases in capacity were accompanied by decreases in the price of the product-to the extent that the product has been 'discontinued' and replaced by a higher speed/quality offering, ADSL 512Kb/s.

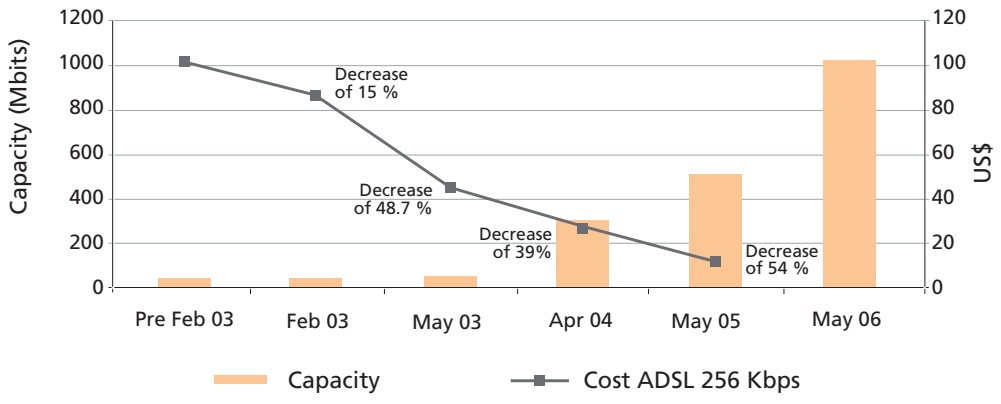
The decrease in prices is welcomed by consumers and is generating (in some circumstances) fierce competition at this level of the market. For example, despite its monopoly position in Cameroon, Camtel (through its ownership of SAT-3/WASC) has helped to drive down the retail price of internet services. Wireless internet services only became available in Cameroon in 2002, the year SAT-3/WASC arrived in the country. Using the example of 64Kb/s product,[32] the research found that the retail price for 64Kb/s shared wireless bandwidth has always remained below the comparable VSAT wholesale price.

Shared bandwidth wireless internet access was introduced (in 2002) at a retail price (FCFA 400,000 per month) that was far below the wholesale price for comparable VSAT bandwidth (FCFA 800,000 per month). This triggered a steep price decline for the VSAT product, which in turn caused the price for the shared wireless product to decline much faster in percentage terms than the price for dedicated wireless bandwidth. The price for shared VSAT wholesale bandwidth appears to have reached its lowest at about FCFA 200,000 per month, where it has stayed since 2004, while the comparable wireless retail product continued its price decline to reach FCFA 45,000 per month in 2006– a mere 20% of the VSAT price. The current retail price for 64Kb/s dedicated wireless bandwidth is only 30% above that of the shared bandwidth VSAT product (around FCFA 275,000 per month). The wireless bandwidth, however, offers up to ten times the bandwidth of the VSAT product and is superior in terms of quality and reliability.

However this is only good news for consumers to an extent, as these decreases in price may be masking non-competitive behaviour by the consortium member in the country. Such concerns are raised in light of the fact that

32 Most customers are still subscribing to lower-cost services with more dial-up-like speeds of 64Kb/s or 128Kb/s since current pricing of real broadband packages is out of reach for the majority of customers.

FIGURE 7: RELATIONSHIP BETWEEN CAPACITY UPGRADE AND COST OF ADSL (256KB/S)



the cheapest provider of "last-mile" end-consumer level products and services is often the consortium member (or its subsidiary). On occasion–as is the case in Ghana-what the consortium member charges is considerably cheaper than prices of the next alternative service provider (as illustrated in Figure 8).

In conclusion, two forms of competition can be seen emerging in the case study countries as a result of SAT-3/WASC. In the "access market" the research found some level of competition from VSAT operators. However where available, resellers of bandwidth would migrate to using fibre bandwidth rather than satellite. The research also found evidence of competition in the "products market," specifically in the form of VoIP and a buoyant "grey market" in international services reported in all countries studied.

FIGURE 8: DIFFERENCE IN PRICING OF BROADBAND PRODUCT IN THE GHANAIAN MARKET

BROADBAND PRICES (PER MONTH)
- Download/Upload speeds (kbps)
Unit: US dollars

512/128 KBPS	GHANA TELECOM	INTERNET GHANA	AFRICA ONLINE*
Installation	99	240	600
Subscription	192	225	> 395

* Price for dedicated packages with speeds from 32 kbps also an additional cost of USD 1, 100 for customer premise equipment.

5. IMPLICATIONS AND RECOMMENDATIONS

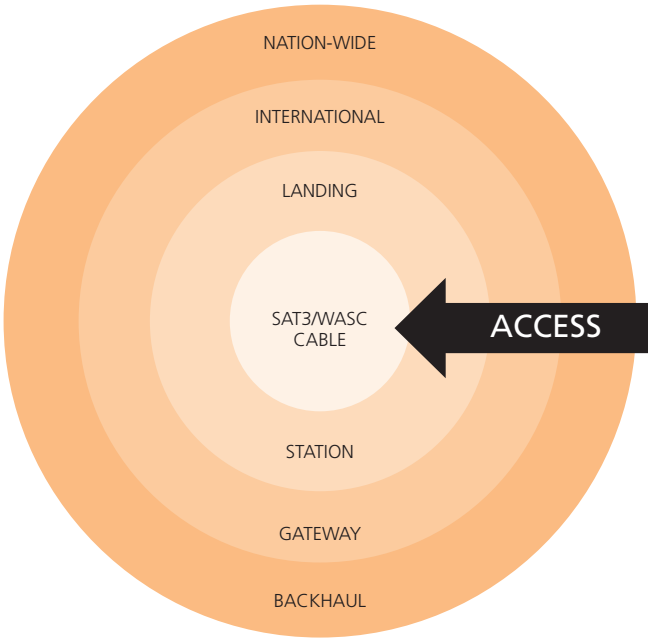
This research set out to study the effect ownership of SAT-3/WASC has had on the communications market of four member countries, Angola, Cameroon, Ghana, and Senegal. The study was limited in scope to the areas that Open Access seeks to address-namely access and cost; with particular focus on the impact of SAT-3/WASC on the competitiveness of the markets for international and internet services in each country. The research found evidence of increased competition in these markets and largely positive effects of the cable in terms of bandwidth capacity. The research also found that the countries were not making the most of the potential of having access to high-speed, high-capacity bandwidth infrastructure.

A key impediment to realising this potential is the "reinforced monopolies" that are enjoyed by the SAT-3/WASC signatories. This is illustrated in the diagram below (figure 9), which represents the varying levels of monopolistic barriers that exist in most SAT-3/WASC countries in sub-Saharan Africa and which by their very nature inhibit access. The diagram portrays monopoly of the SAT-3/WASC landing station and international gateway licences and the ownership of the national backhaul network as concentric circles around the SAT-3/WASC cable. Those wishing to "access" the bandwidth provided by the cable directly must navigate through these barriers.

These circles are represented using solid and broken lines. Solid lines represent pure monopolies. For example at the time of this research SAT-3/WASC was for the majority of countries the only submarine fibre-optic cable providing connectivity in sub-Saharan Africa. In such countries it is therefore a monopoly international fibre infrastructure. It is also the case that in the majority (if not all) of the signatory countries, access to the SAT-3/WASC landing station is restricted to only the signatory operator. The research did not find any evidence of co-location at the landing station in the countries studied. This constitutes another monopoly situation.

Even though the ITU World Telecommunication Regulatory Database indicates that the market for international gateways in many sub-Saharan countries is open to full competition this is rarely the case. This research and similar studies on international connectivity on the

FIGURE 9: CONCENTRIC CIRCLES OF MONOPOLISTIC BARRIERS



continent show that incumbent operators are often the ***legal*** sole providers of international connectivity in their countries– as exemplified by Senegal and Angola. But because "grey markets" of international connectivity exist in these countries, the "international gateway" circle is represented by a broken line.

This is also the case for the "nation-wide backhaul" network. On the one hand, the lack of an extensive national backhaul severely limits the utilisation of the international cable and the ability of the various regions of the country as well as neighbouring countries to access its capacity equitably–Angola and Senegal provide two very different examples respectively. Angola is still in the process of rebuilding its terrestrial network after years of civil war, while Senegal is supplying bandwidth to its neighbours. On the other hand, sole ownership of the terrestrial network by the incumbent operator can lead to uncompetitive practices. A comprehensive terrestrial network is an expensive infrastructure to replicate. In the absence of strong regulation it can constitute a de-facto monopoly within an apparently liberalised market.

The multiplicity of roles that the SAT-3/WASC signatory plays when it has sole ownership of the landing station dominates the international gateway market (or is the legal sole provider of international connectivity in the country) and also owns the national terrestrial backhaul network, unsurprisingly results in severe conflicts of interests. Examples of such conflicts were uncovered by this research with respect to competition. Its findings show that competition is limited in the "access market." With monopoly over the undersea cable, landing station and international gateway, the SAT-3/WASC signatory dictates the bandwidth capacity of a country, the cost of bandwidth to other operators and can also influence (by granting, denying or delaying access) the activities of operators in the market who are also often its competitors. The SAT-3/WASC signatory was also found to influence competition in the "products market." This is because the signatory has a significant impact on the price of products in market as the market leader in international and internet services.

Any intervention by governments or relevant regulatory authorities in opening up access to SAT-3/WASC must be directed at the "concentric circles" in the diagram representing the signatory's influence in the telecom markets of each of the countries. Such multi-dimensional measures must take all spheres of influence into consideration to be effective. For example, providing access to SAT-3/WASC landing stations without also addressing international gateway provision and the state of equitable access to the terrestrial national backhaul network is unlikely to have a significant impact on the way in which SAT-3/WASC is utilised for the country's benefit.

With respect to the monopoly position of SAT-3/WASC in the sub-Saharan region, this report recommends

measures that will ultimately result in the deployment of competing submarine infrastructure. At least three new fibre optic submarine cables along the west coast of Africa are at different stages of completion and proposal.[33] It is anticipated that competition in the form of another cable would promote a more market-oriented approach to SAT-3/WASC.

With respect to SAT-3/WASC landing stations, this report echoes the call made by studies to promote competition by allowing other authorised operators (i.e. those that are able to carry international traffic into and out of the country) access to these facilities and co-locating their equipment at such sites. As discussed in section 3.1, the copy of the 1999 SAT-3/WASC/SAFE Shareholders Agreement that has been analysed by interest groups, states that capacity on the cable can only be sold via the consortium member in each country with a landing station. Whether this is the case could not be ascertained by this research. However, opening up access to the landing stations would increase the ease with which other consortium members could sell their capacity directly to interested operators in member countries. Such a move is likely to facilitate business negotiations (and perhaps competition) between members and also between interested non-member operators and the consortium.

Although most SAT-3/WASC member countries legally permit competition in the international gateway market liberalisation of this market segment has to be made a reality. In documenting the existence and in some cases buoyancy of "grey markets" in the provision of international and internet services this research has highlighted the importance of VoIP in the countries studied. This is an area where legality needs to be addressed by the regulatory authorities and governments so as to better capitalise on the potential it presents in increasing access to the population.

This research also highlighted an increase in the deployment and adoption of wireless products and services. In combination with an extensive deployment of national terrestrial backhaul networks from the landing points of SAT-3/WASC, wireless technologies–provided by a myriad of operators-are likely to play a key role in "last mile" connectivity. Supporting wireless operators is key to realising the potential of SAT-3/WASC.

In general, appropriate measures should be taken to create an environment in which new technologies can be adopted and where service providers are able to obtain a fair price for bandwidth in order to satisfy the demands of their customers. This report therefore calls for studies on the appropriate costing of SAT-3/WASC bandwidth in each member country and based on this the implementation of appropriate mechanisms to regulate prices.

Lastly, with respect to nationwide terrestrial (fibre) backbone infrastructure, the research found that these were generally underdeveloped. Urban areas were significantly better connected than rural areas. Weak terrestrial infrastructure was seen to have implications for the cost of access to backbone networks, particularly when multiple networks are required to achieve nationwide coverage. In response, this report calls for the prioritisation of terrestrial infrastructural development with national and rural access receiving as much attention as regional connectivity (as the shown by the case of Burkina Faso, Mali, and Togo– see Section 4.4.1).

33 These include the submarine cable being laid by Nigeria's second national operator Globacom (Glo-1); South Africa's proposed Infraco cable; Maroc Telecom's West Africa cable etc.

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THE CASE FOR "OPEN ACCESS" COMMUNICATIONS INFRASTRUCTURE IN AFRICA: THE SAT-3/WASC CABLE–A BRIEFING

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