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# Undersea cables and landing stations around Africa: Policy and regulatory issues

Ewan Sutherland<sup>‡</sup>

## *Abstract*

The availability of undersea cables around Africa has been transformed by a recent surge of investment, ending the monopoly in West Africa and an absence in East Africa. Private investors alone and with governments have funded the laying of cables. Consequently, previous calls for regulated access are no longer appropriate, with the need for more detailed analysis of remaining bottlenecks to ensure affordable prices in telephony and Internet access.

**Keywords:** Africa, Governance, Policy, Regulation, Submarine, Telecommunications.

## *Introduction*

A frequent complaint about telecommunications in Africa concerns the high cost and unaffordability of services, for which one of the principal explanations offered was the expensive wholesale charges for intercontinental and international connections. In East Africa the principal cause was the lack of any undersea cable, obliging operators to use satellites which had limited capacities and high prices. In West Africa, where there has been an undersea cable, though access was controlled by monopoly operators, with a view to extracting rents, rather than to expanding use. Landlocked countries are slowly being connected to their coastal neighbours. High retail charges result in low levels of demand, so that the fixed costs have been borne by a small number of customers, creating a vicious circle of unaffordability and limited demand. This has led to calls for action of various types.

A recent and unanticipated surge in investment has occurred in undersea cables around Africa, so that connectivity and capacity have greatly improved for almost all coastal states, filling a substantial gap in infrastructure and increasing competition. Yet, consumers and governments continue to complain about the high levels of charges for international telephone calls and for access to the Internet, especially when measured

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<http://twitter.com/#!/sutherla> and <http://ssrn.com/author=927092>

in terms of affordability and disposable incomes. This is seen as constraining demand and deepening the digital divide.<sup>1,2</sup>

In the last decade, liberalisation has led to the appearance in almost all African countries of competition amongst mobile network operators (MNOs), greatly increasing the availability and use of telecommunications.<sup>3</sup> It has required the MNOs to make substantial investments in their networks, constructing or leasing “backhaul” connections, from mast and base stations to switching centres, from there to nearby countries and, especially, to the Americas and Europe.

Where liberalisation has included opening the supply of international telecommunications, then competition has driven down prices and driven up demand. Yet many countries retained a monopoly bottleneck on international traffic in order to generate revenues by charging high prices to MNOs and Internet Service Providers (ISPs). In some cases the monopoly was sold as part of a privatisation deal, raising the prices obtained and, allegedly, the bribes extracted.

The high cost of delivering (or “terminating”) voice calls to customers in developing countries has been discussed at length at the International Telecommunication Union (ITU), with objections from some African operators to competitive pressures that would reduce the rates and thus their revenues. This came to a head at the World Telecommunication Standardisation Assembly in 2008 when the ITU Secretary-General forced a vote.<sup>4</sup> He split the member states, with developed countries refusing to accept a proposal for yet higher rates, arguing that markets already provided the incentives for investments and that further liberalisation was essential.<sup>5</sup> Whereas the majority of developing countries wanted to raise the rates for incoming international calls. It is unclear that this has generated any significant additional revenues, with no evidence of any additional funds being provided for network construction.

A label commonly attached to international connectivity within and to Africa is that of “market failure”, on the basis of which are said to be justified either the regulation of

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<sup>1</sup> Fuchs C & E Horak, ‘Africa and the digital divide’, *Telematics and Informatics*, 25, 2, 2008, pp. 99-116.

<sup>2</sup> May JD, ‘Digital and other poverties: Exploring the connection in four East African countries’ *Information Technologies & International Development*, 8, 2, 2012, online. <http://itidjournal.org/itid/article/view/896>

<sup>3</sup> The remaining monopolies are Comoros, Eritrea and Ethiopia from political choice.

<sup>4</sup> A non-binding recommendation on indicative rates for terminating mobile calls was adopted by the ITU and subsequently revised, but the substance had been removed. The issue of network externalities, the premium to be collected to pay for network extension, was placed in another recommendation adopted by the majority vote at WTSA, though a large number of countries stated they would not apply it. An annex was added setting out how such premium might be paid and how to evade commitments made to the WTO, followed by some mathematics on the calculation of network externality premiums. The subsequent WTSA adopted an “opinion” inviting the member states which had reserved their positions on D.156 to reconsider. See:

ITU-T, *Recommendation D.99 Indicative rate for international mobile termination*. Geneva: International Telecommunication Union, 2008. <http://www.itu.int/rec/T-REC-D.99-200804-S>

ITU-T, *Recommendation ITU-T D.156 Network externalities*. Geneva: International Telecommunication Union, 2008. <http://www.itu.int/rec/T-REC-D.156-200810-I>

ITU-T, *Amendment 1 - Practical implementation of Recommendation ITU-T D.156*. Geneva: International Telecommunication Union, 2010. <http://www.itu.int/rec/T-REC-D.156-201005-II!Amd1>

ITU-T, *Recommendation ITU-T D.99 Indicative rate for international mobile termination*. Geneva: International Telecommunication Union, 2012. <http://www.itu.int/rec/T-REC-D.99-201209-I>

ITU-T, *Amendment 2: New Annex B – Determination of the network externality premium*. Geneva: International Telecommunication Union, 2012. <http://www.itu.int/rec/T-REC-D.156-201209-II!Amd2>

ITU-T, *Opinion 1 - Practical application of network externality premium*. Geneva: International Telecommunication Union, 2012. <http://www.itu.int/pub/T-RES-T.1000-2012>

<sup>5</sup> OECD, *Network externality premiums and international telecommunication traffic exchange*.

DSTI/ICCP/CISP(2008)4/FINAL. Paris: Organisation for Economic Cooperation and Development, 2009.

existing operators, in order to reduce wholesale charges, or the state funding of additional networks to fill gaps in the infrastructure. To date there have been no market analyses by national authorities to prove market failure, with the phrase used relatively casually. Sometimes the problem has been the simple absence of a market, one that has yet to come into existence.<sup>6</sup> A second potential failure is the leveraging of market power from control over access to an undersea cable into the markets for international voice telephone calls and International Private Leased Circuits (IPLCs), the point-to-point links used by ISPs, businesses, and national research and education networks (NRENs). The use and potential abuse of this market power arises from political decisions not to admit competitors. The long-standing policy recommendation to address this second problem was to open access to the sole undersea cable as a means to lower prices for international connections.<sup>7,8</sup> The benefits were argued in terms of reducing the price of international telephone calls and lowering the costs of Internet access, which would boost economic growth and reduce the digital divide.<sup>9</sup> However, the enthusiastic laying of new cables requires that recommendation to be revisited.

In Sub-Saharan Africa (SSA) competition in telecommunication markets is seldom measured and less frequently managed by ministries and regulators, despite considerable rhetorical stress on its importance. The essential data needed for the necessary analyses are generally not available, with authorities relying on very basic reporting by operators on their numbers of customers, which may not have been audited and involve significant double counting.<sup>10</sup> Without analysis of accurate data there can be neither a reasoned case for a market intervention nor an impact assessment laying out the costs and benefits of the various options. For example, an insufficiency of competition in retail markets for telephony and Internet access would allow operators to avoid passing on any wholesale savings that they have received from the falling prices of international connections. The underlying problem is not specific to undersea cables, but is a general weakness of the institutions, laws and procedures governing telecommunication markets in SSA.

The positive effects of improving telecommunications for economic growth are well established.<sup>11,12,13</sup> For SSA there is an additional benefit from the large pool of political refugees and economic migrants living in developed countries who have access to competitive telecommunications services, with cheap rates to call home. They remain in contact with their families and communities, who encourage them to send remittances, with telecommunications enabling them to monitor how that money is

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<sup>6</sup> Arndt HW, 'Market failure' and underdevelopment', *World Development*, 16, 2, 1988, pp. 219-229.

<sup>7</sup> Esselaar S, Gillwald A, & E Sutherland, *The regulation of undersea cables & landing stations*. Johannesburg: LINK Centre, 2007.

<sup>8</sup> Jagun A, *The case for "open access" communications infrastructure in Africa: The SAT-3/WASC cable: A briefing*. Melville: Association for Progressive Communications (APC), 2008.

[http://www.apc.org/en/system/files/APC\\_SAT3Briefing\\_20080515.pdf](http://www.apc.org/en/system/files/APC_SAT3Briefing_20080515.pdf)

<sup>9</sup> Sometimes the price is maintained but the download allowance or cap is increased.

<sup>10</sup> Some customers carry more than one phone or more than one SIM card. See Sutherland E, 'Counting customers, subscribers and mobile phone numbers', *info*, 11, 2, 2009, pp. 6-23.

<sup>11</sup> Cronin FJ, Parker EB, Colleran EK, & MA Gold, 'Telecommunications infrastructure and economic growth: An analysis of causality', *Telecommunications Policy*, 15, 6, 1991, pp. 529-535.

<sup>12</sup> Lee SH, Levendis J & L Gutierrez, 'Telecommunications and economic growth: An empirical analysis of sub-Saharan Africa' *Applied Economics*, 44, 4, 2012, pp. 461-469.

<sup>13</sup> Chavula HK, 'Telecommunications development and economic growth in Africa' *Information Technology for Development*, 19, 1, 2013, pp. 5-23.

spent. The World Bank estimates that USD 32 billion was sent to Sub-Saharan Africa in 2013, with considerable economic and personal benefits.<sup>14,15</sup>

This article reviews next the historical background to undersea cables. It then sets out the essential facilities doctrine and measures taken in the liberalization of telecommunications and the regulation of prices. The procedural and implementations issues are then set out. Finally, conclusions are drawn and issues identified for further research.

### *Historical developments*

The traditional approach to the laying of an undersea cable was to form a club of operators that would raise the necessary capital and commit to its long-term maintenance.<sup>16,17,18</sup> The members, invariably the monopoly providers in the nations being served, would then have exclusive rights to use that capacity in their respective markets, to ensure the recovery of their investment. After construction, other operators might, subject to applicable laws, regulations and commercial negotiations, be able to purchase an Indefeasible Right of Use (IRU), a contract transferring to them the exclusive and irrevocable right to use a specified amount of capacity on the cable for its duration, typically 20 to 25 years, but without participation in the management of the cable and at higher prices than those carrying the risks of laying the cable.<sup>19</sup> The next tier comprised operators taking international private leased circuits (IPLCs) for shorter terms at yet higher rates.<sup>20</sup> The club members could control the availability and prices of IRUs and IPLCs, with the available capacities often limited. All access was subject to regulation, usually a simple national monopoly that was only slowly eroded as governments accept liberalisation and opened international gateways to competition, primarily in developed countries.

The first non-club undersea cable was laid in 1989, with PTAT-1 (Private Trans-Atlantic Telecommunications) serving New Jersey, Bermuda, Ireland and the United Kingdom, breaking the monopolies of AT&T and British Telecom.<sup>21</sup> It remained in use only until 2004, when it was no longer viable, given the dramatic reduction in prices on newer and more efficient cables which had very much greater capacities.

The 1990s saw forecasts of very rapid growth in global telecommunications traffic associated with the dot com boom – generating unprecedented levels of investment in undersea cables – but which ended in the crash of 2001.<sup>22,23</sup> The resulting excess

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<sup>14</sup> World Bank, *Migration and remittance flows: Recent trends and outlook, 2013-2016*. Washington DC: World Bank, 2013.

<sup>15</sup> Ultimately, developed countries will seek to reduce or to tax these flows as they have a significant and negative effect on spending and investment in their own economies, given a global total of remittances expected to reach USD 540 billion in 2016.

<sup>16</sup> Mattelart A, *Networking the world 1794-2000*. Minneapolis: University of Minnesota Press, 2000.

<sup>17</sup> Finn B & D Yang, *Communications under the seas: The evolving cable network and its implications*. Cambridge, MA: MIT Press, 2009.

<sup>18</sup> Rowe T, *Connecting the continents: Heart's content and the Atlantic cable*. St John's, Newfoundland: Creative Publishers, 2009.

<sup>19</sup> Subramanian, AS, 'Assessing the rights of IRU holders in uncertain times' *Columbia Law Review*, 103, 2003, pp. 2094-2123.

<sup>20</sup> IPLCs were provided as "half circuits" so that for the Johannesburg to London route, one half was leased from Telkom SA and the other half from British Telecom.

<sup>21</sup> Galbi DA, 'Growth in the "new economy": US bandwidth use and pricing across the 1990s' *Telecommunications Policy*, 26, 1-2, 2001, pp. 139-154.

<sup>22</sup> Callahan G & Garrison R, 'Does Austrian business cycle theory help explain the dot-com boom and bust?' *The Quarterly Journal of Austrian Economics*, 6, 2, 2003, pp. 67-98.

capacity ended in bankruptcies, when traffic failed to materialise and some of the customers went out of or failed to launch their businesses (see Table 1). The net result was a substantial transfer of distressed assets to operators based in India, which had the available money and which could bundle international telecommunications capacity with outsourcing services.

For example, the Fibre-optic Link Around the Globe (FLAG), came into service in 1997 as one of the first privately-owned joint ventures that included non-telecommunication corporations.<sup>24,25</sup> It was marketed as a carrier's carrier, to meet demand from new fixed and mobile network operators, allowing them to purchase capacity as they required, instead of fixed capacities on long-term contracts. While described as global, it bypassed Sub-Saharan Africa, which was seen as having too little demand. FLAG was eventually acquired by the Indian Reliance Group.

**Table 1 Bankruptcies in the undersea cable business**

Operator	Acquiring firm	Description
Global Crossing‡	ST Telemedia (Singapore)	Filed for bankruptcy in January 2002, completed in late 2003. ST Telemedia paid USD 250 million for 61.5% of stock, it is primarily owned by the Singapore Sovereign Wealth Fund, Temasek Holdings. Debt was reduced from USD 11 billion to 200 million. In 2011 Level 3 Communications (NYSE) bought Global Crossing for USD 2 billion.
FLAG Telecom	Reliance (India)	Filed for joint bankruptcy proceedings in Bermuda & USA in April 2002, emerging in October 2002, with debt cut from USD 3 billion to 75 million. In 2003 it was acquired by Anil Ambani's Reliance group for USD 207 million.
Teleglobe	Tata Group (India)	Acquired in 2005 for USD 239 million, following bankruptcy in 2002 and restructuring begun in 2003.
Tyco Global Network	Tata Group (India)	Divested by Tyco International for USD 130 million in 2005. Tyco International CEO was jailed for 8 years and USD 3 billion paid out in a class action brought by investors.
Project Oxygen*	Project closed for lack of funds in August 2000	Planned to be a 275,000 km, USD 14 billion super-Internet connecting every continent, except Antarctica, with 97 landing points in 76 countries. <sup>26</sup>

‡ The collapse of Global Crossing was investigated by the US House of Representatives.<sup>27</sup>

\* Unrelated to a subsequent project of the same name at MIT.

Aside from financial shocks, undersea cables are subject to breakages due to:<sup>28</sup>

- Earthquakes;
- Damage from fishing nets and the anchors of ships; and
- Sabotage and terrorist attacks.

<sup>23</sup> Wheale PR & LH Amin, 'Bursting the dot.com "Bubble": A case study in investor behaviour' *Technology Analysis & Strategic Management*, 15, 1, 2003, pp. 117-136.

<sup>24</sup> Welsh T, Smith R, Azami H & R Chrisner, 'The FLAG cable system', *IEEE Communications Magazine*, 34, 2, 1996, pp. 30-35.

<sup>25</sup> The founding members of FLAG were: NYNEX (now Verizon), Dallah Al Baraka Group from Saudi Arabia, the Asian Investment Fund of Hong Kong, the Telecom Holding Co. of Bangkok, the Marubeni Corp. in Tokyo and Gulf Associates in New York.

<sup>26</sup> Marra WC, 'Applying undersea technologies to Project Oxygen' paper presented at Optical Fiber Communication Conference, 1999, and the International Conference on Integrated Optics and Optical Fiber Communication. OFC/IOOC '99, pp. 234-236. San Diego: IEEE, 1999.

<sup>27</sup> US House of Representatives, *Capacity swaps by Global Crossings and Qwest: Sham transactions designed to boost revenues?*, Washington DC: US Government Printing Office, 2002.

<sup>28</sup> Chang A, 'Why undersea Internet cables are more vulnerable than you think' *Wired*, 2<sup>nd</sup> April 2013. <http://www.wired.com/gadgetlab/2013/04/how-vulnerable-are-undersea-internet-cables/>

The International Cable Protection Committee works to avoid problems from fishing and shipping.<sup>29</sup> The fishing industry counters with claims for damages from gear caught on undersea cables.<sup>30</sup>

Landing stations are at risk from extreme storms and *tsunami*. Such that:

The destruction of an entire landing station, its equipment for interconnecting with the land based networks, and the multiple submarine cables bridgeheads in it could constitute a real danger to the overall network performance of an economy. In addition to this, the repair and reconstruction of an entire station and all its equipment may take much more time and effort than that of repairing a cable.<sup>31</sup>

Where a country has a single cable or a single landing station this limits the resilience of services, though this can be improved by a second cable and a second landing station and by overland links to neighbouring countries. Major enterprises, especially banks, fall back on pre-arranged alternative routes and satellite links, though consumer access to the Internet and even to international telephony can suffer until the repair ship is on station, the cable retrieved and repaired, and the service is finally restored.

One of the most severe incidents was the Hengchun earthquake, off Taiwan, on 26<sup>th</sup> December 2006, which disconnected much of Asia from the rest of the world, since:

The landslide and subsequent turbidity current travelled over 330 km and caused 19 breaking points in seven cable systems. Damages were located in water depths to 4000 m and even undamaged cables were locally mud covered. The cable repair works involved 11 repair vessels and took 49 days.<sup>32</sup>

The loss of services generated considerable publicity throughout East Asia, where broadband had become popular and businesses were increasingly reliant on the Internet. In Hong Kong SAR both the legislature and the regulator expressed concern, and called on operators to ensure greater resilience.<sup>33,34</sup> Whereas, the 2011 earthquake off the coast of Japan had much less effect on network performance, with Japanese operators having the capacity to re-route traffic onto other cables. An additional problem was that repair ships had been damaged by the earthquake and the subsequent *tsunami*.

The new cables serving East Africa have already suffered a number of breaks, both locally and in the cables to which they connect, in order to reach Europe and North America.<sup>35</sup> For example, the anchor of a ship cut the TEAMS cable near the Kenyan coast.<sup>36</sup> A break in the SEA-ME-WE4 cable in the Mediterranean Sea caused problems in East Africa for SEACOM.<sup>37</sup> While these breaks were inevitable and unavoidable, the

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<sup>29</sup> <http://www.iscpc.org/>

<sup>30</sup> Coffen-Smout S & GJ Herbert, 'Submarine cables: A challenge for ocean management' *Marine Policy*, 24, 6, 2000, pp. 441-448.

<sup>31</sup> APEC, *Economic impact of submarine cable disruptions*. Singapore: Asia-Pacific Economic Cooperation, 2012.

<sup>32</sup> *Ibid.*

<sup>33</sup> LegCo, *Report on the disruptions of Internet services due to earthquakes near Taiwan on 26 and 27 December 2006*. LC Paper No. CB(1)1298/06-07(10). Hong Kong, SAR: Legislative Council, 2007.

<http://www.legco.gov.hk/yr06-07/english/panels/itb/papers/itb0417cb1-1298-10-e.pdf>

<sup>34</sup> LegCo, *Enhancing preparedness for telecommunications contingencies*. Hong Kong SAR: Legislative Council, 2008. <http://www.legco.gov.hk/yr07-08/english/panels/itb/papers/itb0414cb1-1200-3-e.pdf>

<sup>35</sup> TechZim, *Archives: Undersea fibre*. Harare: Technology Zimbabwe, 2013.

<http://www.techzim.co.zw/tag/undersea-fibre/>

<sup>36</sup> Mbugua J, 'Kenya: Undersea cable cut disrupts local Internet traffic', *The Star*, 28 February 2012.

<http://allafrica.com/stories/201202281238.html>

<sup>37</sup> Alfrede D, 'Seacom outage affecting SA web', *News 24*, 22 March 2013.

<http://www.news24.com/Technology/News/Seacom-outage-affecting-SA-web-20130322>

loss of service was not, since operators should have switched to the alternate route via West Africa, until repairs were completed. Evidently they had not leased the necessary capacity, presumably to save money, something which should be of concern to consumers, businesses and governments.

An analysis of these issues by Asia-Pacific Economic Cooperation (APEC) pointed to a number of policy failures in the protection of cables, such as countries not being signatories to the UN Convention on the Law of the Sea (UNCLOS) and not being members of ICPC.<sup>38</sup> It also noted the need for adequate provision of repair ships, where operators might economise by having less capacity than countries consider essential to avoid any economic harm from delays in repairing broken cables. Cooperation was considered essential between governments and operators to deliver both protection and resilience, though without imposing obligations that would discourage investment.

While undersea cables last around twenty years, their principal competitor the satellite lasts about ten, with an initially risky launch stage.<sup>39,40</sup> Satellites provide point-to-point communications links within countries, between countries and between continents, together with point to multi-point services for television and broadband Internet access, now using the Ka-band. SSA and especially landlocked countries have historically relied on satellite technologies for international connections and domestic backhaul. While a case has been made for opening access, investment in new satellites has continued with what appears to be a competitive market in the space segment, though there may be bottlenecks at national earth stations through limits on licences (see Table 2).<sup>41</sup>

Internet Service Providers (ISPs) lease dedicated capacity from a network operator either to a point of presence of a global ISP or to one or more of a growing number of Internet eXchange Point (IXP) in order to peer or to exchange traffic.<sup>42</sup> In Europe the model for IXPs is predominantly one of managed non-profit organisations, in contrast to North America which is dominated by commercial IXPs, often primarily data and collocation centres. Both types can extend beyond a single site, some with several locations within a city and a few with very much wider points of presence. One consequence is that:

Obtaining a detailed understanding of the flow of traffic through such an increasingly more densely-connected network poses enormous new challenges.<sup>43</sup>

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<sup>38</sup> APEC, *Economic impact of submarine cable disruptions*. Singapore: Asia-Pacific Economic Cooperation, 2012.

<sup>39</sup> Warf B, 'International competition between satellite and fiber optic carriers: A geographic perspective' *The Professional Geographer*, 58, 1, 2006, pp. 1-11.

<sup>40</sup> Chini P, Giambene G, & S Kota, 'A survey on mobile satellite systems', *International Journal of Satellite Communications*, 28, 1, 2010, pp. 29-57.

<sup>41</sup> IDRC. *Open and closed skies: satellite access in Africa: policy reform and regulatory issues in bridging the digital divide through satellite technologies*. Horsham: DS Air Limited, 2004.

<sup>42</sup> Cardona Restrepo JC & R Stanojevic, 'A history of an internet exchange point', *ACM SIGCOMM Computer Communication Review*, 42, 2, 2012, 58-64.

<sup>43</sup> Chatzis N, Smaragdakis G, & A Feldmann, *On the importance of Internet eXchange Points for today's Internet ecosystem*. arXiv:1307.5264 [cs.NI], 2013. <http://arxiv.org/abs/1307.5264>



**Table 2 Satellite operators in Sub-Saharan Africa**

<i>Company</i>	<i>Satellites</i>	<i>Ownership</i>
Avanti Communications <sup>44</sup>	Hylas 1 & 2 satellites for data connections, IP trunking and broadband.	Listed on London Stock Exchange.
Gateway Communication <sup>45</sup>	Voice, data and IP services.	Owned by PCCW, which is listed on the Hong Kong SAR, Stock Exchange.
Intelsat <sup>46</sup>	Global coverage with more than 50 satellites, providing broadband, direct-to-home TV, GMPCS and point-to-point.	Intelsat SA (Luxembourg).
O3B <sup>47</sup>	IP trunking and mobile backhaul.	O3b Networks Ltd (Jersey) with the following investors: SES, HSBC, Liberty Global, Development Bank of Southern Africa, Satya Capital, Google, North Bridge Venture Partners and Allen & Co.
SES <sup>48</sup>	Digital TV, VSAT, mobile backhaul, VSAT, mobile broadband.	SES SA (Luxembourg) listed on the Luxembourg and Euronext Paris Stock Exchanges.
Thuraya <sup>49</sup>	GMPCS (voice and data).	Registered in UAE, privately owned.

Initially, African ISPs leased an IPLC to a major global centre (e.g., LINX in London), in order to provide their customers with access to the Internet backbone and the content available on it.<sup>50</sup> IXPs began to appear in Sub-Saharan Africa relatively early, largely on the European cooperative model, managed by an association of ISPs. However, problems of market dominance by incumbent operators and of a lack of commercial dynamism have seen some fail to develop and a few to close (see Table 3). SEACOM now offers a commercial multi-centre IXP, bundling connections from East Africa with full Internet connectivity.<sup>51</sup>

A major innovation was the appearance of content delivery networks (CDNs) on the Internet, some of which are operated in-house, by the likes of Google and Microsoft, others by third parties such as Akamai and Limelight, which serve content owners and distributors such as the BBC and Disney.<sup>52,53,54</sup> Their role is to take content from the owners over high capacity connections and to make it available close to consumers on thousands of servers around the world, so that it can be quickly downloaded or webcast. CDNs require high quality and resilient networks and local hosting facilities. The installation of CDN servers tends to lag the development of the retail Internet access market, following where there is sufficient demand, which has meant very slow

<sup>44</sup> <http://www.avantiplc.com/>

<sup>45</sup> <http://www.gatewaycomms.com/>

<sup>46</sup> <http://www.intelsat.com/>

<sup>47</sup> <http://www.o3bnetworks.com/>

<sup>48</sup> <http://www.ses.com/>

<sup>49</sup> <http://www.thuraya.com/>

<sup>50</sup> Giovannetti E, 'Internet upstream connectivity and competition policy: Western Europe and southern Africa' in Kagami M, Tsuji M, & E Giovannetti (eds), *Information technology policy and the digital divide - Lessons for developing countries*. Cheltenham: Edward Elgar, 2004, pp. 35-61.

<sup>51</sup> Wanjiku R, 'SEACOM seeks to take the lead in Africa's IP transit market' *Computer World*, 4 September 2013. <http://news.idg.no/cw/art.cfm?id=2B4BAA26-E1CA-B959-B066857F8E6538F4>

<sup>52</sup> Buyya R, Pathan M & A Vakali, *Content delivery networks*. Berlin: Springer-Verlag, 2008.

<sup>53</sup> Gill P, Arlitt M, Li Z & A Mahanti, 'The flattening Internet topology: Natural evolution, unsightly barnacles or contrived collapse?' in *Passive and active network measurement: Lecture notes in computer science*, 4979. Berlin & Heidelberg: Springer, 2008, pp. 1-10.

<sup>54</sup> Nygren E, Sitaraman RK, & Sun J, 'The Akamai Network: A platform for high-performance Internet applications', *ACM SIGOPS Operating Systems Review*, 44, 3, July 2010.

deployment in Africa.<sup>55</sup> In time, their presence will transfer a significant part of the costs of connectivity and transit from African ISPs and consumers to global content providers and will also offer global platforms for local content and services, including on mobile networks (see Some countries have not yet liberalised international gateway licences or done so only incompletely, with a few seeking to reverse liberalisation, to increase revenues. Arguments for a single gateway have been made under the guise of national security, but the real reasoning seems to be rent seeking, presented as “revenue assurance” by diverting traffic through a bottleneck. Where ISPs and mobile operators can construct or lease their own facilities then prices have fallen, pushing up demand from businesses and consumers, causing the economy to grow.

Figure 1).<sup>56</sup>

**Table 3 IXP in Sub-Saharan Africa<sup>57,58,59</sup>**

Country	City	IXP	Management	Foundation	Traffic	Participants
South Africa	Johannesburg	JINX	ISPA	1996	7.9G	53
South Africa	Cape Town	CINX	ISPA	1996	2.6G	155
Kenya	Nairobi	KIXP	TESPOK	2001	320M	34
DRC	Kinshasa	KINIX	ISPA	2002	-	11
Mozambique	Maputo	MIX	Members	2002	5M	17
Tanzania	Dar es Salaam	TIX	ISPA	2003	47.9M	22
Rwanda	Kigali	TINEX	Members	2003	358M	5
Uganda	Kampala	UIXP	Members	2003	164M	8
Swaziland	Mbabane	SZIXP	Commercial	2004	128k	3
Ghana	Accra	GIX	Members	2005	-	24
Botswana	Gaborone	BINX	Botswana ISPA	2005	-	9
Mauritius	Ebene City	MIXP	Members	2005	-	6
Tanzania	Arusha	AIXP	Members	2006	400k	6
Angola	Luanda	ANG-IXP	Angola ISPA	2006	13M	10
Ivory Coast	Abidjan	CI-IXP	-	2006	4M	5
Zambia	Lusaka	ZIXP	Zambia ISPA	2006	103	13
Nigeria	Lagos	NIXP	Members	2007	-	18
Malawi	Blantyre	MalawIXP	Malawi ISPA	2008	-	36
Kenya	Mombasa	MSIXP	TESPOK	2010	-	8
South Africa	Cape Town	NAPA-CT1	NAP Africa	2012	667M	12
South Africa	Durban	DINX	ISPA	2012	15M	5
South Africa	Johannesburg	NAPA-JB1	NAP Africa	2012	2.98G	29
Congo Rep	Brazzaville	CG-IX	Regulator	2013	20k	6
Burundi	Bujumbura	BurundiX	Members	proposed	-	-
Congo Rep	Pointe Noire	?	?	?	-	-
Sierra Leone	Freetown	SLIXP	?	?	-	-
Zimbabwe	Harare	ZINX	?	?	-	5

Some countries have not yet liberalised international gateway licences or done so only incompletely, with a few seeking to reverse liberalisation, to increase revenues.<sup>60</sup> Arguments for a single gateway have been made under the guise of national security, but the real reasoning seems to be rent seeking, presented as “revenue assurance” by

<sup>55</sup> Johnson DL, Belding EM, & G van Stamm, ‘Network traffic locality in a rural African village’ in Proceedings of the Fifth International Conference on Information and Communication Technologies and Development (ICTD '12). New York: ACM, pp. 268-277.

<sup>56</sup> Yousaf F, Liebsch M, Maeder, A & Schmid S, ‘Mobile CDN enhancements for QoE-improved content delivery in mobile operator networks’ *IEEE Network*, 27, 2, 2013, pp. 14-21.

<sup>57</sup> Packet Clearing House. Internet Exchange Directory.: <https://prefix.pch.net/applications/ixpdir/>

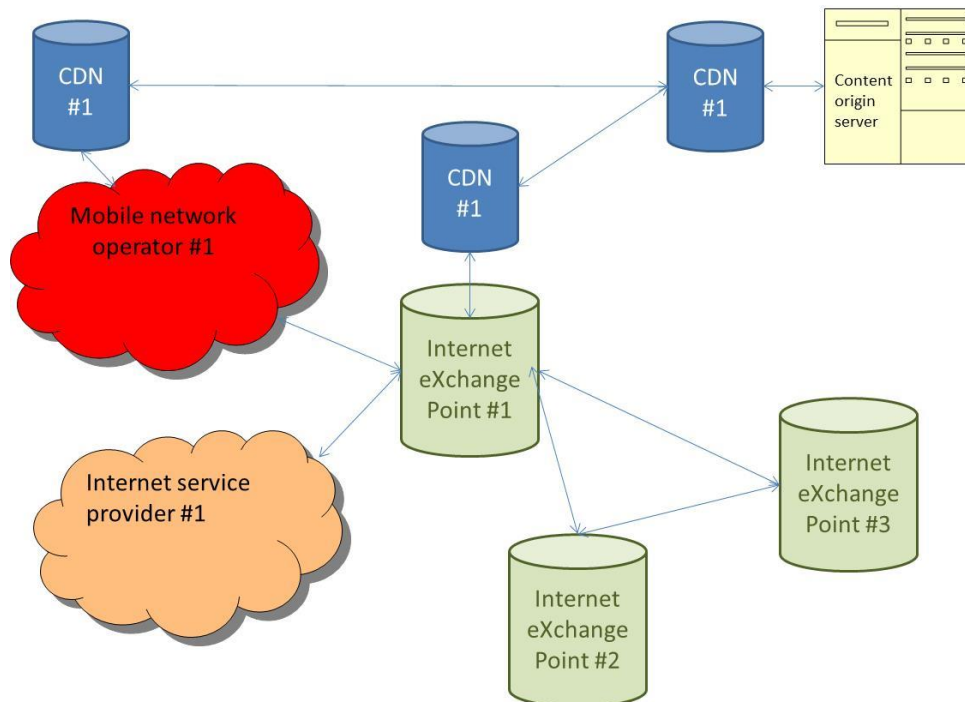
<sup>58</sup> AfriNIC, The Internet numbers registry for Africa. <http://www.afrinic.net/>

<sup>59</sup> AfNOG, The African Network Operators' Group. <http://www.afnog.org/index.php>

<sup>60</sup> Some of this activity is supported by a South Africa firm: Global Voice Group SA, No. 2005/009779/07.

diverting traffic through a bottleneck. Where ISPs and mobile operators can construct or lease their own facilities then prices have fallen, pushing up demand from businesses and consumers, causing the economy to grow.

**Figure 1** Schematic view of Internet traffic



### *African cables*

From 2001 until 2009, the sole undersea cable serving Sub-Saharan Africa was known variously as: South Atlantic 3 (SAT-3), West Africa Submarine Cable (WASC), and South Africa Far East (SAFE). It had been installed by Tyco and Alcatel, stretching some 28,800 kilometres from Portugal to Malaysia, at a cost of USD 600 million, jointly owned by a large consortium of operators from around the world (see Table 4). Some countries passed by the cable were excluded from the club and thus had no spur or landing station, because of the perceived lack of traffic (e.g., Guinea, Liberia, and Sierra Leone). Namibia was a special case, investing in the cable, but using the landing stations of Telkom South Africa. A dedicated repair vessel with a crew of fifty, was on standby should a break occur.<sup>61</sup> The only other cable of this period was Atlantis-II, from Portugal to Brasil, landing at Senegal and the Cape Verde Islands.

The investors in SAT-3 included national incumbent operators in each of the countries where the cable landed, plus northern hemisphere operators able to originate to and terminate telephone calls from Africa, together with exchanging Internet traffic with the rest of the world. The effects of the exclusive control over landing rights in SSA was to eliminate any incentive for the operators to increase traffic, provided they could generate enough revenue from their control over a critical bottleneck. Incumbent operators avoided selling capacity at wholesale prices to other African operators which might resell to third parties. A significant part of the capacity of SAT-3 was unused, held in reserve for cable breaks in the Mediterranean Sea, when traffic between Europe and Asia would be diverted around the Cape of Good Hope.

<sup>61</sup> It was destroyed by a fire while off the coast of Namibia.

**Table 4 Landing stations for SAT3-WASC-SAFE**

<i>Country</i>	<i>Landing station</i>	<i>Investors</i>
Senegal	Dakar	Sonatel
Ivory Coast	Abidjan	Côte d'Ivoire Telecom
Ghana	Accra	Ghana Telecom
Benin	Cotonou	OPT Benin
Nigeria	Lagos	NITEL
Cameroon	Douala	Camtel
Gabon	Libreville	OPT Gabon
Angola	Cacuaco	Angola Telecom
South Africa	Melkbosstrand	Telkom SA
South Africa	Mtunzini	Telkom SA
Réunion	Saint Paul	Orange (France Telecom)
Mauritius	Baie du Jacotét	Mauritius Telecom & Telkom Communications International
India	Cochin	Tata Communications (formerly VSNL)
Malaysia	Penang	Telekom Malaysia
Portugal	Sesimbra	Portugal Telecom
Spain	Alta Vista, Canary Is.	Telefonica de Espana
USA	-	Verizon (formerly MCI)
France	-	Orange (formerly France Telecom)
Namibia	-	Telecom Namibia

The recent surge of investment in cable systems around Africa is shown in Table 5.<sup>62</sup> Of these, two are privately owned cables, Main One and Glo-1, funded by Nigerian entrepreneurs. Further private cables were announced, but not yet constructed and several plans have been abandoned. These were from new firms, based in South Africa, which had no track record in large-scale telecommunications investments and operations, but with impressive plans for cable systems. It was surprising that such large amounts of capital could become available for such speculative ventures, especially given the historically inaccurate forecasts for the growth of traffic. The proposed cables could have added enormous and clearly excessive capacity, though SACS offers an alternative route to the USA via Brasil, bypassing Europe. Given such exuberant commercial investment it is difficult to justify governments investing their limited capital, at least on the major routes, where policies of encouragement and liberalisation seem to be sufficient to achieve any economic and social goals. An obvious concern would be excessive additional capacity, which would make it difficult for investors to recover their costs, with the risk to other operators, of very cheap capacity becoming available as the result of bankruptcy.

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<sup>62</sup> There was a proposal for a network around Africa in the mid-1990s, but this venture came to nought. See Marra WC & J Schesser, 'Africa ONE: The Africa optical network' *IEEE Communications Magazine*, 34, 2, 1996, pp. 50-57.

**Table 5 Undersea cables serving Sub-Saharan Africa**<sup>63,64,65,66</sup>

<i>Cable system</i>	<i>Cost (USD Millions)</i>	<i>Capacity (Tbps)</i>	<i>Completion date</i>
Atlantis-II	370	0.16	Q1 2000
SAT-3	600	0.34	Q2 2002
Seacom	650	1.28	Q3 2009
TEAMs	130	1.28	Q3 2009
LION	-	0.02	Q3 2009
EASSy	265	4.72	Q3 2010
Main One	240	1.92	Q2 2010
Glo-1	800	2.50	Q3 2010
WACS	600	5.12	Q3 2011
LION-2	-	0.02	Q2 2012
SEAS	35	0.02	Q2 2012
ACE	700	5.12	Q2 2012
WASACE	n/a	40.0	defunct
SAex	500	12.8	defunct
BRICS	1,200-1,500	12.8	defunct
SACS	278	40.0	2015*

Access to undersea cables on the western seaboard has improved enormously, with only Guinea Bissau not connected, while Ghana and Nigeria each have three cables, in addition to SAT-3 (see Table 6). However, some countries are relatively vulnerable to breakages through having only one undersea cable: Guinea, Sierra Leone, Liberia, Togo, Benin, Cameroon and São Tomé. While the ACE cable presently runs from France to São Tomé, there are plans to add Angola, Namibia and South Africa, where interconnection to other cables would significantly improve resilience.

East Africa had no cables between the landing stations at Djibouti and South Africa, a problem which is now solved, with one even for troubled Somalia (see Table 7). The TEAMS cable runs only from Kenya to the Persian Gulf (see Table 8), but with EASSy and SEACOM gives Kenya potentially robust and competitive connectivity, if used properly by the operators.

<sup>63</sup> Song S, African Undersea Cables, 2014. <http://manypossibilities.net/african-undersea-cables/>

<sup>64</sup> The various cables can be found at:

ACE Africa Coast to Europe [http://www.ace-submarinecable.com/ace/default/EN/all/ace\\_en/](http://www.ace-submarinecable.com/ace/default/EN/all/ace_en/)

BRICS Cable: <http://www.bricscable.com/>

EASSy East Africa Submarine System <http://www.eassy.org/>

SAex was proposed by eFive Telecoms Ltd <http://www.efive.co.za/> [broken link]

Glo <http://www.gloworld.com/>

LION <http://www.lion-submarinesystem.com/>

MainOne <http://www.mainonecable.com/>

SAT-3 [http://www.safe-sat3.co.za/homepage/SAT3\\_WASC\\_SAFE\\_Home.asp](http://www.safe-sat3.co.za/homepage/SAT3_WASC_SAFE_Home.asp)

SEACOM <http://seacom.mu/>

TEAMS The East African Marine system Limited: <http://www.teams.co.ke/>

WASACE was to have connected Angola, Nigeria and South Africa by 2014.

WACS West Africa Cable System <http://wacscable.com/>

Details of SEAS can be found at EUAITF, 'The EU-Africa ITF supports the Seychelles Submarine Cable project', EU-Africa Infrastructure Trust Fund, 2011.

<http://www.eu-africa-infrastructure-tf.net/attachments/Publications/itf-flyer-seychelles.pdf>

<sup>65</sup> Chan T, 'Being Africa's comms hub', *Commsday Magazine* 15-20 April 2013.

<http://issuu.com/commsdaymagazine/docs/cdmagapril13>

<sup>66</sup> SAex was announced as serving Melkbosstrand, Mtunzini, East London and Port Elizabeth in South Africa, plus the British Overseas Territory of St Helena, Angola and Brazil.

**Table 6 Cable landing stations in West Africa**

Country	City	Main One	Glo-1	WACS	ACE
		2010	2010	2011	2012
Cape Verde	Palmarejo			√	√
Dakar	Senegal	√			√
Gambia	Banjul		√		√
Guinea	Conakry				√
Sierra Leone	Freetown				√
Liberia	Monrovia				√
Ivory Coast	Abidjan	√			
Ghana	Accra	√	√	√	
Togo	Lome				√
Benin	Cotonou				√
Nigeria	Lagos	√	√		
Cameroon	Douala			√	√
São Tomé	São Tomé				√
Rep Congo	Pointe Noir			√	
DRC	Muanda			√	
Angola	Luanda			√	
Namibia	Swakopmund			√	
South Africa	Yzerfontein			√	
South Africa	Melkbosstrand				

\*

**Table 7 Cable landing stations in East Africa**

Country	City	TEAMS	SEACOM	LION	EaSSy	SEAS	BRICS
		2009	2009	2009	2010	2012	2014*
Djibouti	Djibouti				√		
Somalia	Mogadishu				√		
Kenya	Mombasa	√	√	√	√		
Tanzania	Dar es Salaam		√		√	√	
Seychelles	Beau Vallon					√	
Comoros	Moroni		√				
Mayotte	Kaweni			√			
Mauritius	Terre Rouge			√			√
Réunion	St Paul			√			
Madagascar	Tamatave			√			
Madagascar	Toliara		√		√		
Mozambique	Maputo		√		√		
South Africa	Mtunzini		√		√		
South Africa	Melkbosstrand						√

The East African Business Summit in November 2002 was the origin of the East Africa Submarine System (EASSy), the first of several plans to fill a conspicuous gap in the undersea cable map.<sup>67</sup> Business leaders adopted a manifesto for a submarine cable, to be led by private operators including:

- Telkom Kenya;
- Tanzania Telecommunications Company;
- Uganda Telecom;
- MTN Uganda; and
- Zanzibar Telecom.

<sup>67</sup> <http://www.eassy.org/>

Initially it was to be a non-club model, with “open access” at all landing stations, but some governments and operators considered this less commercially attractive than a traditional club.<sup>68</sup> A special purpose vehicle (SPV), WIOCC, was created to represent a group of smaller operators in EASSy, backed by development financial institutions.<sup>69</sup> This was to enable the negotiation of better terms for capacity on behalf of its member companies and to allow them to compete with other members of the consortium. While the prospective partners disagreed about the business model for EASSy, others went ahead with the SEACOM and TEAMS cables with backing from the Kenyan government. A further complication was the proposal for Regional Communications Infrastructure Program (RCIP), a set of terrestrial cables to connect landlocked countries to EASSy.<sup>70</sup>

**Table 8 Ownership of TEAMS (Kenya) Ltd**

Owner	%
Government of Kenya (Ministry of Finance)	20
Safaricom Ltd	20
Telkom Kenya Ltd	20
Kenya Data Networks Ltd	10
Econet/Essar Telecom Ltd	10
Wananchi Group	5
Jamii Telecom Ltd	3.75
Broadband Access/AccessKenya Ltd	1.25
Africa Fibrenet (Uganda) Ltd	1.25
InHand Ltd	1.25
iQuip Ltd	1.25
Flashcom Ltd	1.25

Cisco, a leading equipment manufacturer, publishes a Visual Network Index (VNI) which presently predicts global Internet traffic will reach an annual “run rate” of 1.4 Zettabytes in 2017, up from 523 Exabytes in 2012.<sup>71,72</sup> A large part of the growth is from video, which in SSA is expected mostly to be digital television, though today video is only 6 per cent of its network traffic, but with evidence of the creation of video on demand (VOD) services in a few countries.<sup>73</sup> Demographic growth and increased availability are forecast to generate a compound annual growth rate (CAGR) of over 20 per cent in “Middle East and Africa”, with a 13-fold increase in mobile Internet speeds to 3 Mbps by 2017.

Land-locked countries must obtain transit through another country to reach an undersea cable, resulting in a number of regional initiatives. For example, Ethiopia laid a fibre optic cable through Sudan at the end of 2005, allowing a connection to the landing station at Port Sudan, ending its dependence on satellite. On a larger scale, the World Bank has helped to fund RCIP and a fibre optic network as part of a project to interconnect electricity grids in South-East Africa. China has supported cable to Chad,

<sup>68</sup> Further information on this disagreement is available from NGOs at: <http://www.FibreForAfrica.net/>

<sup>69</sup> World Bank, *Eastern African Submarine Cable System (EASSy)*, Washington DC: World Bank, 2013. <http://go.worldbank.org/PUMBYTYGK0>

<sup>70</sup> World Bank, *Regional Communications Infrastructure Program*, Washington DC: World Bank, 2012. <http://go.worldbank.org/TXCNGATE00>

<sup>71</sup> Cisco, *Visual Networking Index (VNI)*, 2013.

[http://www.cisco.com/en/US/netsol/ns827/networking\\_solutions\\_solution\\_category.html](http://www.cisco.com/en/US/netsol/ns827/networking_solutions_solution_category.html)

<sup>72</sup> A Zettabyte in 10<sup>21</sup> while an Exabyte is 10<sup>18</sup>.

<sup>73</sup> Sandvine, *Netflix and YouTube account for 50% of all North American fixed network data*. Waterloo, ON: Sandvine, 11 November 2013. <https://www.sandvine.com/pr/2013/11/11/sandvine-report-netflix-and-youtube-account-for-50-of-all-north-american-fixed-network-data.html>

along a gap pipeline, and to Uganda, along the Kenyan railway. Liquid Telecom, part of the privately-owned Econet Group, has its own optical fibre cables serving Kenya, Uganda, Rwanda, DRC, Zambia, Zimbabwe and Lesotho with links to undersea cables at Mombasa, Mtunzini and Melkbosstrand, plus plans to extend north to Egypt. Consequently, the picture now looks relatively healthy for land-locked countries. Indeed, a feasibility study for national research and education networks found that the availability of optical fibre networks was no longer the significant bottleneck, that lay with the ability of institutions to make use of such networks.<sup>74</sup>

The small island developing states (SIDS) around Africa struggled for many years to find the capital for landing stations and spurs needed to join the major undersea cables. Portugal and France ensured there were connections to the Cape Verde Islands and Réunion, while Mauritius justified its investment in terms of supporting its growing ICT sector. The LION (Lower Indian Ocean Network) and SEAS cables have connected Mayotte and the Seychelles, while WACS has a spur to São Tomé. The SEAS cable to Seychelles cost around USD 35 million, which with a population of 84,000 is a substantial USD 416 per capita, even against a GDP per capita of around USD 25,000 (PPP).<sup>75</sup> The “dividend” from the government investment in SEAS will take the form of free Internet access for schools, hospitals and social services.

While competition has grown and been proven successful in Internet access and, especially, in mobile telephony, the regimes for access to undersea cables have often seen only limited reforms. In some countries this is now a bottleneck to the more complete development of affordable Internet access and international telephony, though where it has been used, liberalisation seems to be the most effective remedy. It remains unclear why there was such a high level of interest in undersea cables from entrepreneurs, though it seems investors may have more realistic expectations given the failure of some ambitious projects to materialise.

The other cables landing in Kenya are SEACOM (see Table 9) and the more complex structure of EaSSy (see Table 10), in which WIOCC combines international financial institutions and African operators.

**Table 9 The ownership structure of SEACOM<sup>76</sup>**

<i>Investor</i>	<i>Country</i>	<i>%</i>	<i>Notes</i>
Industrial Promotion Services <sup>77</sup>	Kenya	26.56	Aga Khan Fund for Economic Development <sup>78</sup>
Remgro Limited <sup>79</sup>	South Africa	25.00	Replaced Venfin Ltd
Convergence Partners <sup>80</sup>	South Africa	12.50	Andile Ncaba is Chairman and Founding Partner
Shanduka Group <sup>81</sup>	South Africa	12.50	A leading African black owned and managed investment holding company <sup>82</sup>
Herakles Telecom LLC	USA	23.44	Investment fund with no web site

<sup>74</sup> Pehrson B, *Feasibility study on the AfricaConnect initiative*. Stockholm: Project FEAST, 2010.

<http://www.feast-project.org/>

<sup>75</sup> Whereas the spur to São Tomé cost USD 15 million.

<sup>76</sup> <http://www.seacom.mu/about-us/ownership-structure>

<sup>77</sup> [http://www.akdn.org/akfed\\_ips.asp](http://www.akdn.org/akfed_ips.asp)

<sup>78</sup> An arm of the Aga Khan Fund for Economic Development

<sup>79</sup> <http://www.remgro.com/>

<sup>80</sup> <http://www.convergencepartners.co.za/>

<sup>81</sup> <http://www.shanduka.co.za/>

<sup>82</sup> Until recently Cyril Ramaphosa was Chairman.



**Table 10 The ownership structure of EaSSy<sup>83</sup>**

<i>Direct shareholders</i>		<i>WIOCC shareholders</i>	
MTN International Group	British Telecom, UK	Botswana Telecommunications Corporation	Telkom Kenya Orange
Sudatel, Sudan	Etisalat, UAE	Dalkom, Somalia	Telecommunication De Mozambique
SPV2 (Vodacom & Telkom) South Africa	Zambia Telecom, Zambia	Djibouti Telecom	TelOne Zimbabwe
Telma, Madagascar	Saudi Telecom, Saudi Arabia	Gilat Satcom Nigeria Limited	U-COM Burundi
Neotel, South Africa	Comores Telecom, Union of Comoros	Seychelles Cable System Company	Uganda Telecom
Botswana Telecom, Botswana	Bharti Airtel, India	Lesotho Telecommunications Authority	Zantel
France Telecom, France	TTCL, Tanzania	Libyan Post, Telecom & IT Company	IFIs
Mauritius Telecom, Mauritius		Onatel Burundi	

### *Regulating access to undersea cables*

A major factor in the high costs of telecommunications has been the national monopolies for voice and data transmission exercised by incumbent operators over:

- Undersea cables;
- Landing stations; and
- International gateways.<sup>84</sup>

These were originally granted to operators because it was held to be a natural monopoly and that direct provision by the state was the most efficient option. It was also seen as a “cash cow” to be used to fund the construction of the national network, though frequently funds were diverted for other purposes, some of which are corrupt.

Where there is a single cable the policy choice is between liberalisation, to encourage more cables, and legally binding access to the existing cable for ISPs and MNOs. The approaches that can be taken to regulating access to monopoly cables and facilities include:

- Enactment of a specific statutory provision;
- Application of general competition law; and
- Application of telecommunications regulations.

These are not mutually exclusive, rather they can be combined in ways appropriate for a national setting, subject always to having a solid legal basis and having overcome the political and administrative objections. The policy objective would be to offer non-discriminatory access to facilities for all operators and ISPs, with a view to enabling fair competition in retail markets.

To be effective any regulation opening access to submarine cables is likely to have to be coupled with measures to ensure the provision of domestic connectivity. Competing

<sup>83</sup> <http://www.eassy.org/ownership.html>

<sup>84</sup> Rather than connect at the seashore, most operators provide an international gateway at centre of the capital city.

operators and service providers need to be able to construct, or to lease from third parties, the links from their place of business to the international gateway or to the cable landing station. This may require the regulation of:

- Domestic leased lines;
- The provision of spectrum for microwave point-to-point links;
- The right to dig trenches to lay cables; and
- Access to roof space on the landing station for antennae.

Additionally, other undersea cables may need to interconnect. It may also be necessary to ensure that operators can purchase a leased line supplied by the incumbent operator or a rival from the international gateway or the cable landing station and then interconnect to their own networks. One of the necessary measures may be to allow rivals to install their own equipment in the cable landing station, such collocation is notoriously difficult, with problems that might seem trivial becoming major obstacles. It is necessary to identify and, potentially, to regulate a wide range of prices for floor space, roof space (for microwave antennae), electricity and back-up power supplies, with access for staff from all operators while maintaining security.

The doctrine of an “essential facility” is derived from antitrust law in the United States of America.<sup>85,86</sup> The original case concerned an association of railroads denying access to traffic from competing railroad companies seeking to use a bridge over the Mississippi River. It was considered too expensive for rivals to build an alternative bridge, with no convenient site for tens of miles, permitting the owners of the bridge to control the prices charged and to determine the priority given to different trains and wagons. On appeal the US Supreme Court upheld the right to regulate traffic across the bridge.

The test of being “essential” is not easily passed since it requires the inability to duplicate the input. The “facility” cannot be something that gives only a small or a short term advantage it has to be of substantial and long term benefit. Alternative facilities would have to be such poor substitutes that they would not allow rivals to compete effectively.

In the case of an undersea cable landing station there are alternatives. Theoretically it would be possible to purchase dedicated access to a cable landing station in a neighbouring country or to use an international satellite link. However, in many countries these options may not be permitted in law or may be so obviously inferior in quality or so much more expensive that they would not be equivalent. For example, satellite links have limited capacity compared to fibre optic cables, are expensive and have delays in transmission.

The incumbent operator in the neighbouring country may also operate an essential facility and thus be able to charge similarly high rates to its domestic operators, indeed it might well collude with the home country operator by setting a high price, not wishing its own domestic rivals to follow the example of going to another country. Moreover, obtaining a leased line to the point of interconnection in a neighbouring African country may be extremely expensive, not always reliable, and has usually only been possible from the incumbent operators that control the gateways.

The argument for essential facilities has been greatly weakened by the recent enthusiasm for laying cables around Africa, with several countries now having

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<sup>85</sup> Soma JT, Forkner DA, & Jumps BP, ‘The essential facilities doctrine in the deregulated telecommunications industry’, *Berkeley Technology Law Journal*, 13, 2, 1998, pp. 565-614.

<sup>86</sup> Gans JS, ‘Regulating private infrastructure investment: Optimal pricing for access to essential facilities’ *Journal of Regulatory Economics*, 20, 2, 2001, pp. 167-189.

competing cables landed on their shores. An incumbent operator can plausibly, even convincingly, argue that rivals should lay their own cable. Regional fibre networks have improved considerably and these can provide routes to landing stations in other countries. Nonetheless, a solitary undersea cable landing station could be argued to be an essential facility, if it could be shown to be very difficult to duplicate. It would then be possible to require the operator to provide access, with obligations in terms of the quality and price of those facilities, based on the forced disclosure of its costs, terms and conditions.

In other parts of the world the driver for regulating access to the undersea cables has been to support growth of telecommunications markets and to increase the competitiveness of the country compared to its economic rivals or, simply, to catch up. A specific aim has been to increase participation in the market with additional players. The measures taken have been to enhance competition and to ensure greater choice and more competitive prices for businesses and consumers. For example, in Singapore, where there is a shortage of space for additional cable landing stations, the justification was that:

Access to SingTel's submarine cable landing stations is an essential input for many telecoms services. Unnecessary access restrictions limit operators' competitive scope to provide international telecoms services.<sup>87</sup>

The mechanism used was that the Infocomm Development Authority (iDA) modified the Reference Interconnection Offer (RIO) of SingTel to include the provision of access to its cable landing station on specified terms and prices. The powers of the iDA arise from the Telecommunications Competition Code, which in turn is based on statute.<sup>88,89</sup>

For much of Africa the designation of undersea cables as an essential facility is either too late, with the arrival of several recent cables, or too problematic, given the legal and technical complexities. It is easier and more efficient to issue international gateway licences to all players and to encourage the use of regional fibre networks. Nonetheless, it will be important to monitor prices, to help determine whether further interventions are necessary.

In South Africa, Telkom SA was the *de jure* monopoly provider of telecommunications, including all international capacity into and out of South Africa. Despite some liberalisation, Telkom remained overwhelmingly dominant in the provision of fixed telecommunications, a position which it has admitted it abused.<sup>90</sup> Its dominance was recognized in the Electronic Communications Act of 2005, of which Article 43(8) designated submarine cables and satellite earth stations as being essential facilities. They were made subject to regulation using the pro-competitive measures in Article 67(7), including non-discrimination, accounting separation and price controls. However, the regulator never took any action. Fortunately this failure to enforce the law was rescued by the arrival of new operators and new cables in which, strangely, senior political figures were investors.

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<sup>87</sup> iDA, *IDA Deputy Chief Executive Officer and Director-General (Telecoms) Mr Leong Keng Thai*. Singapore: Infocomm Development Authority of, 2005.

<http://www.ida.gov.sg/News%20and%20Events/20050712175459.asp>

<sup>88</sup> iDA, *Telecommunications Competition Code*. Singapore: Infocomm Development Authority of Singapore, 2005. <http://www.ida.gov.sg/Policies%20and%20Regulation/20061010135522.aspx>

<sup>89</sup> iDA, *RIO Agreements with Facilities-Based Operators (FBOs)*. Singapore: Infocomm Development Authority of Singapore, 2012. <http://www.ida.gov.sg/Policies-and-Regulations/Industry-and-Licencees/Interconnection-and-Access/RIO-Agreements-with-FacilitiesBased-Operators-FBOs>

<sup>90</sup> See Competition Commission v Telkom (623/2008) [2009] ZASCA 155 (27 November 2009), Competition Commission and Telkom SA Ltd (11/CR/Feb04) [2012] ZACT (7 August 2012), and Competition Commission and Telkom SA SOC Ltd (016865) [2013] ZACT (18 July 2013).

The high cost of international connections on SAT-3 meant that many ISPs elected to use the alternative of satellite links to Europe and the United States of America. This resulted in download “caps” for retail customers, limiting the amount of Internet data they could use, with heavy charges for additional data. Instead of being 120 milliseconds from Johannesburg to the USA, the satellite route was around 800 milliseconds, causing some applications to fail and many to operate poorly.<sup>91</sup> Slowly ISPs moved to use undersea cables, improving the quality experienced by customers, though often still at high prices.

## *Conclusion*

Undersea cables provide the global backbone for voice telephony and the Internet, consequently they are essential for economic growth and for social development. For many Sub-Saharan African countries they enable the personal connections that ensure continuing southward flows of remittances, while encouraging northward flows of economic migrants and political refugees.

Access to undersea cables is essential for mobile network operators (MNOs) and for Internet Service Providers (ISPs). Misusing control over that access, treating it as a cash cow, a source of monopoly rents, diminishes the capacity of a nation to participate in the global economy and reduces economic growth. Instead, successful policies have focused on ensuring commercial incentives to provide additional undersea and terrestrial fibre optic backbone networks. It has been important to avoid operators leveraging control over an access bottleneck by charging higher prices in domestic markets and engaging in anti-competitive cross-subsidies.

While additional capacity was clearly essential, the recent exuberant investment in undersea cables was unanticipated, given the history of underinvestment. There are two new models, with complex public-private ownership structures and by individual entrepreneurs. The latter appears to be an attempt to compete with the vertical integration of the international mobile operator groups, in order to obtain access to the low wholesale rates for international communications available only at the major global hubs. The involvement of government in cable ownership greatly complicates policy and regulation, which is already often weak, creating the temptation to ensure recovery of investments by raising prices by means of political and regulatory control over international gateways.

While there were indisputably gaps in the market, forecasts for the growth of traffic and the economic returns on meeting that demand have a history of overestimation. It is possible that a significant part of the expected growth of traffic in Africa could fail to appear, at least in the short term. In particular, mobile operators are struggling to justify their investments in upgrading their network infrastructure are only beginning to offer attractive packages for consumers who must also purchase new handsets. This has limited the growth of Internet traffic. Much of that traffic, especially audio and video content, may be placed only once on the servers of content delivery networks located close to customers, perhaps, in partnership with a mobile network operator. This will generate less traffic on undersea cables, from players with considerable bargaining power. It has not been possible to identify any policies and market analyses by governments concerning content delivery networks, yet these are essential for current services and applications, becoming more important for cloud-based services.

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<sup>91</sup> The beach-to-beach latency on SAT-3 for the 12,000 kilometres from South Africa to Portugal was only 60 milliseconds.

The rise of terrorism in Africa causes concern about the security of undersea cables and landing stations.<sup>92</sup> Where countries have only one station or where two or more cables land at the same place, they are vulnerable to attack in shallow waters, on the beach and at the landing station. In addition to improving physical security, governments need to ensure operators have already leased the capacity to re-route traffic through neighbouring countries and to other landing stations, together with the ability to complete repairs promptly.

There has been limited governmental support for Internet eXchange Points (IXPs), often in a somewhat confused manner, with no single agreed approach. Given the presumption that most Internet traffic will originate from mobile network operators, which are increasingly part of multi-national corporations (e.g., Etisalat, Orange and Vodafone), their ability to aggregate and interconnect traffic across the continent or the globe raises concerns for smaller domestic ISPs and the future of IXPs. The IXPs are important for local content and services, including m-health and e-government.

The “market failure” label appears to be little more than a pseudo-economic flag of convenience to cover political interventions. While in the European Union this would be tested against state aid rules or in the USA against strong political opposition and in the courts, in much of Africa it is simply accepted at face value, without a cost-benefit analysis or an impact assessment, sometimes even without discussion or disclosure of market data. Analysis is needed by regulators acting as independent bodies, to determine whether a market is working and to evaluate possible alternative interventions. Governments need to be held to account for their interventions, spending and any distortions of markets.

The objective of regulating access to undersea cables and landing stations would be to enable competition in downstream markets to reduce the costs of international voice and Internet communications, ultimately to sustain national competitiveness and to boost economic growth. It would also help to reduce the digital divide, by making services more affordable, and thus improve social cohesion. In many countries the presence of more than one undersea cable and international terrestrial cables undermines the case for strict price regulation in most countries.

A number of areas require further research. The histories of the Internet eXchange Points in Africa could usefully be recorded and analysed, to see what future they might have and whether there is an African model, one involving mobile network operators. Likewise, the roles of content delivery networks need to be much better understood, in particular to identify any policy and regulatory obstacles to their expansion and any commercial bottlenecks. It is important to recall the warnings about network complexity and opaqueness by Chatzis, Smaragdakis and Feldmann, recognizing that some of this research will not be easy.<sup>93</sup>

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<sup>92</sup> See, for example, Davis J, *Africa and the war on terrorism*. Aldershot: Ashgate, 2007. Keenan J, *The dying Sahara: US imperialism and terror in Africa*. London: Pluto Press, 2013. Dowd C & C Raleigh, ‘The myth of global Islamic terrorism and local conflict in Mali and the Sahel’ *African Affairs*, in print.

<sup>93</sup> Chatzis N, Smaragdakis G, & A Feldmann A, *On the importance of Internet eXchange Points for today’s Internet ecosystem*. ArXiv, 2013 : 1307.5264 [cs.NI]. <http://arxiv.org/abs/1307.5264>