UNDERSEA CABLE MARKETS AND THE DEVELOPING WORLD

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Abstract: Large swaths of the developing world, particularly in Africa, are still without fiber optic connectivity. Past efforts to link these regions have had only limited success. How have macroeconomic trends, the growth of the telecommunications industry, and the development of the submarine communications industry progressed in the last decade to make ubiquitous fiber optic connectivity to less-developed countries (LDCs) suddenly more viable?

This paper will examine the state of submarine cable and terrestrial backhaul markets in developing regions, focusing on the struggle of poorer nations to advance their information and communications technology (ICT) infrastructure. Conclusions will be drawn as to the overall developmental trend: is the world moving gradually toward ICT (and international network) equality, or are the disparities today greater than they were in the monopoly era? The article will distill Terabit Consulting's analysis of global undersea markets to predict whether the most beneficial capacity cost reductions will continue to be confined to the wealthiest markets, or whether future patterns in fiber optic deployment will be spread more equitably among the world's community of nations.

1 INTRODUCTION

As of 2007, 32 of the world's 53 poorest nations had no access to international fiber optic connectivity, representing an unserved population of 461 million. However, it appears that wiring these nations to the global grid has now become economically viable and, more importantly, crucial to overall global economic development and stability.

Historically, fiber optic connectivity was not a viable proposition for poorer nations. Their traffic flows were characterized as "long and thin" – too far and too small to justify the construction of multi-million dollar cable systems, and adequately handled by satellite networks. However, since the turn of the century this market scenario has been uprooted by two forces that have had a seismic effect on the developing world: mobile networks and the Internet.

The unprecedented and unanticipated growth of mobile telephony in less-developed countries, which has exceeded (and continues to exceed) virtually all forecasts, demonstrates the latent demand in less-developed markets and has given more urgency to the construction of fiber optic connectivity. In countries where only seven years ago communications were limited to a few thousand (often-unreliable) fixed lines, now millions of mobile subscribers crowd the airwaves.

Mobile networks have finally helped to narrow the gap between rich and poor countries in terms of basic telephony, while laying the foundation for more effective and comprehensive ICT infrastructure. The next logical progression, which will undoubtedly have a more profound impact on LDCs' overall development, is the advancement of the Internet. This has already begun in earnest with the establishment of thousands of Internet cafes and the emergence of significant, rapidly-growing populations of dial-up subscribers. Now wireless technologies show promise in contributing to the rapid development of broadband access networks. Further, Internet service providers are slowly but surely becoming important players in the developing world through the promotion of voice-over-IP (VoIP) telephone service and existing broadband access technologies. But in order for the Internet to achieve its potential in LDCs, next-generation intercontinental fiber optic bandwidth is urgently needed.

Beyond the growth of telecommunications and the Internet, macroeconomic trends now also favor the construction of fiber optic networks in developing regions: for example, the rapid shift of "digital industries" to low-wage nations; greater regional cooperation that has resulted in increased regional traffic flows; increased foreign investment in LDC telecommunications markets; the emergence of pan-regional operators; and the current state of the submarine cable supply markets and financing environment.

Given current levels of mobile and Internet deployment, one thing is already certain: the technologically-inferior satellite infrastructure now serving much of the developing world can no longer accommodate international traffic requirements of most LDCs. Instead, existing demand levels have solidified the economic justification for pervasive fiber optic connectivity in the developing world.

A regional analysis reveals which regions in the developing world have been adequately served by fiber and which have not: South America, for example, benefited from the deployment of multiple undersea systems in recent years. West Africa witnessed the arrival of a technologically-advanced system that has, by most accounts, been limited in its utility because of high prices and a poor terrestrial backhaul network. In

India, the national regulator has gone to great lengths to ensure the fair use of the country's newfound wealth of international capacity. Meanwhile, some regions remain completely cut off from the international fiber optic grid.

LDCs still face significant obstacles in the development of ICT infrastructure. Technology has addressed some of them, but others remain, most related to social investment and infrastructure. How these issues are addressed will determine the extent to which ICT truly flourishes in these nations.

Moreover, when developing international fiber optic connectivity, it is necessary to strike a delicate balance between furnishing adequate incentive for initial parties to invest in new systems and accommodating the needs of other users for access to these advanced facilities at reasonable prices.

Ultimately, Terabit Consulting's analysis of developing markets provides incontrovertible substantiation that fiber optic connectivity is vital to the overall development of LDCs and that all of the fundamentals are now in place to justify the construction of fiber optic connectivity throughout the developing world.

2 MOBILE TELEPHONY IN LDCS: UNLEASHING LATENT DEMAND AND BUILDING A FOUNDATION

The growth of mobile telephony in the developing world has been by all measures explosive: in the world's 53 poorest nations the number of mobile subscribers has gone from 217,000 in 1995 to 7.6 million in 2000, and then, almost beyond belief, to 178.2 million in 2005. Preliminary estimates have put the total for year-end 2006 at over a quarter of a billion. As early as 2000, after only a few years in business, mobile operators had already deployed networks throughout the developing world that exceeded the size of fixed-line networks which had taken decades to construct. And because of a last-mover's advantage, many LDCs boasted mobile telecommunications networks that were technologically superior to their counterparts in the West.

The fact that mobile penetration in the developing world has exceeded (and continues to exceed) virtually all published forecasts is a testament to the high level of latent demand that has been pent-up in poorer nations for years.

Mobile networks, then, have laid the foundation for telecommunications development in LDCs. Unfortunately, tens of millions of mobile subscribers sit on networks that are technologically "stranded" – linked to the international telecommunications infrastructure only through expensive satellite links that often result in astronomical consumer charges for international calls (this being one of the great paradoxes of modern society: the fact that call tariffs in the world's richest countries are only a fraction of those charged in the world's poorest countries).

3 THE NEXT STEP: INTERNET DEPLOYMENT IN THE DEVELOPING WORLD

Riding the coattails of mobile telephony, the Internet has already made significant headway in less-developed countries. In spite of the short-term logistical obstacles that threaten to hinder widespread adoption of the Internet across the developing world (which are discussed later in this paper), the Internet counted an estimated ten million users in the world's 53 poorest nations as of year-end 2006. The most impressive penetration rates have occurred in urban areas. In most LDCs, Internet traffic now exceeds voice traffic; most of Terabit Consulting's country-by-country forecasts call for Internet traffic (and VoIP) to account for almost all international capacity demand within the next five years.

Internet service providers' business models, both large and small, seem finally to be gaining financial credibility throughout the developing world. Capitalizing on what is perceived as growing complacency on the part of mobile operators, as well as perceived indifference on the part of fixed-line operators, Internet service providers are gaining market prominence. Although consumers once held mobile operators in great esteem for bringing service to regions where there previously had been none, as subscriber bases have grown into the millions, mobile operators have been increasingly viewed with skepticism and scorn, based on the perception that prices have remained relatively inflated and service quality has not met expectations. Internet service providers, meanwhile, have leveraged this backlash to penetrate the consumer market with low-cost VoIP offerings and wireless Internet access technologies (in some cases going head-to-head with their fixed-line parent companies).

The poor state of the developing world's fixed-line infrastructure is being overcome by ISPs both through the deployment of wireless technologies such as IEEE 802.11 (Wi-Fi), 802.16 (WiMax), and 802.20 (Mobile-Fi), and through the construction of new greenfield fiber optic and DSL networks initially targeted at business customers. Meanwhile, mobile operators are piquing consumers' interest with rudimentary GPRS service.

On a developmental basis, the widespread penetration of the Internet has become essential to the advancement of education, healthcare, and commerce. Further, the Internet will play an integral role in promoting the international migration of digital industries (discussed in the following section) to LDCs.

4 THE EMERGENCE OF DIGITAL INDUSTRIES IN THE DEVELOPING WORLD

Historically, the world's richest economies have viewed the primary role of the developing world as being first a source of natural resources and, since the 1980s, a source of cheap manufacturing labor. However, LDCs are increasingly benefiting from the emergence of so-called "digital industries" – those industries to which digital transmission and processing is essential, such as information technology and software development, call centers, entertainment, media, pharmaceuticals, and research.

Although they are by no means a universal panacea for the developing world, the digital industries are proving to be a source of strong economic growth for some LDCs. The most obvious beneficiary is India, which has benefited from the West's outsourcing of an increasing variety of information-based professions (coincidentally, as this paper was being written, labor unions at the leading newspaper in Terabit Consulting's hometown complained about the outsourcing of advertising and circulation positions by posting full-page ads in a rival newspaper proclaiming that "It's the Boston Globe, not the Bangalore Globe!"). Outsourcing of digital industries to India was one of the primary justifications of the five new fiber optic systems that were landed on the country's shores between 2002 and 2006.

As wage pressures grow in India, however, a secondary group of LDCs is rapidly positioning itself to capture the country's spillover: in early-2007, for example, the Kenyan government announced that "two major airlines" were planning to shift their call centers from India to Kenya. The Nigerian government has also outlined aggressive plans to increase its share of global outsourcing.

The dearth of low-cost, high-capacity international infrastructure proved to be one of the primary reasons why the outsourcing of information industries lagged the outsourcing of manufacturing jobs by almost two decades. Going forward, international fiber optic bandwidth will be the industries' key enabler.

5 REGIONAL COOPERATION AND INCREASED TRANS-BORDER TRAFFIC FLOWS

The savings achieved by accommodating the increase in trans-border traffic flows between contiguous countries is yet another incentive for the construction of international fiber optic links to LDCs. The promotion of intra-regional commerce by economic organizations such as the Economic Community of West African States (ECOWAS), El Mercado Común del Sur (Mercosur), and the Association of Southeast Asian Nations (ASEAN) has led to increased intra-regional telecommunications traffic flows. In lieu of trans-border fiber optic connectivity, many contiguous nations in the developing world are forced to route their correspondent traffic via nodes in North America or Europe, a proposition that is both technically and economically irrational.

6 FOREIGN INVESTMENT AND PAN-REGIONAL TITANS

A "conditionality" of international financial institutions' assistance to developing nations has consistently been the "liberalization" of telecommunications markets. More often than not, this has resulted in the sell-off of LDCs' most profitable telecommunications markets to foreign investors, typically in the form of mobile licenses. This, in turn, has given rise throughout the developing world to pan-regional telecommunications giants such as Celtel (a subsidiary of the Kuwaiti operator MTC) and Digicel (founded by Irish investors). Other foreign investors such as Millicom of Luxembourg, MTN of South Africa, and Orascom of Egypt have also gained a significant foothold in developing markets. It will be essential that these pan-regional operators have the reliable and cheap international bandwidth that only optical fiber can provide; in fact, some of these operators have announced plans to construct their own systems.

7 THE DEVELOPING WORLD FINALLY BENEFITS FROM SUBMARINE CABLE INVESTMENT TRENDS

A primary reason why much of the developing world was left out of the unprecedented stampede to build undersea cables between 1998 and 2001 was that most investment was speculative and investor-led; financiers concentrated on historically safe routes such as the transatlantic and the transpacific, and were loathe to furnish private funding for systems in the developing world.

Today, however, Terabit Consulting's analysis shows a definitive trend away from "entrepreneurial" investment in undersea cables, down from a high of approximately 50 percent of all investment in the 2001-2002 timeframe to almost zero in the 2006-2007 interval. Today's more conservative financial logic requires that every submarine cable's business plan be linked directly to end-user revenues; as such there are no longer any "speculative" systems but only "carrier" or "consortium" systems.

Carrier- and consortium-based models, with some "hybrid" financial modifications, are the only ones naturally suited to the risky economic terrain of the developing world. All of the LDC projects with which Terabit Consulting has been involved have been spearheaded by telecommunications operators themselves, often with the participation of international

financial institutions such as the International Finance Corporation (World Bank Group) and the European Investment Bank.

8 NULLIFYING THE SATELLITE CAPACITY PROPOSITION

In spite of their relatively low bandwidth, high unit costs, and technological inferiority to fiber, satellite networks adequately accommodated most of the developing world's bandwidth needs until the turn of the century. Voice traffic generated by underdeveloped fixed-line networks accounted for the vast majority of traffic; consequently, traffic channels to the developing world earned the characterization of "long, thin routes." In many developing nations, total international demand was only a few megabits per second: certainly not enough to justify the construction of multi-million dollar, gigabit- and terabit-capable cable systems.

However, telecommunications market dynamics in most developing countries started to change significantly in 2000 and 2001. Mobile penetration began to exceed fixed-line penetration in many countries and growth rates of several hundred percent annually sent the number of mobile subscribers soaring into the millions in many developing markets. The Nigerian market, for example, saw mobile penetration rise from 30,000 in 2000 to close to 30 million in 2006, a one-thousand-fold increase. Simultaneously, millions flocked to the Internet throughout the developing world, resulting in data demand that rivaled voice demand.

As of 2007 there remain few countries where the economic case for fiber optic connectivity is not superior to that of satellite. Terabit's recent analysis performed on behalf of international financial institutions investigating the possibility of fiber connectivity in different regions of sub-Saharan Africa has shown that even in those countries with the lowest UN Human Development Index values, there is already enough actual, manifest demand to warrant the construction of fiber optic connectivity and discontinue use of satellite. This is in spite of the latent demand that has been artificially restrained by the current high cost of satellite capacity. With proposed point-to-point fiber prices as low as one-tenth that of satellite on some fiber routes to the developing world now under construction, the expectation is that well-managed fiber optic connectivity will allow gigabits, if not terabits, of latent demand to finally emerge.

9 REGION-BY-REGION ANALYSES

Terabit Consulting's continued analysis of international telecommunications markets, infrastructure, and capacity demand has revealed both successes and market opportunities throughout the developing world. The following subsections will evaluate the market conditions in West Africa, East Africa, the Middle East, South Asia, Southeast Asia, the South Pacific, Latin America, and the Caribbean.

West Africa

It was not until five years ago that undersea fiber optic connectivity arrived in the less-developed countries of sub-Saharan Africa. Although the first sub-Saharan undersea fiber optic cable system, SAT-2, bypassed the entire west coast of Africa when it entered service in 1993, its 2002 successor, SAT-3, incorporated landing points in Senegal, Ghana, Cote d'Ivoire, Benin, Nigeria, Cameroon, Gabon, and Angola. This latter cable was heralded as a breakthrough for African telecommunications, which had previously subsisted on a piecemeal network of microwave links, coaxial cables, and a scattering of satellite earth stations. SAT-3, it was said, would put the West African region on an equal technological footing with most of the rest of the world, providing an abundance of cheap bandwidth for research, education, healthcare, and commerce.

However, by most accounts the story of SAT-3 is a tale of promises unfulfilled and a cable system that has done little to promote ICT development in West Africa. Five years after its activation, most of the $300-million system's capacity remains in the exclusive use of the three dozen incumbent operators that constructed it, and critics accuse the operators in many countries of setting unfair prices for the sale of capacity to competitors and failing to construct an adequate terrestrial distribution network for the system's capacity. As a result, mobile operators, Internet service providers, competitive fixed-line operators, and multinational corporate customers, which collectively generate the majority of each country's international traffic, have for the most part opted to continue using satellite capacity.

As of 2007 a number of projects aim to either break SAT-3's stranglehold of the West African undersea capacity market or to increase connectivity to markets that were not previously served. They include a Nigeria-to-Europe system proposed by Nigeria's competitive operator Globacom; Project West Africa, proposed by Infinity Worldwide Telecommunications Group of Companies (IWTGC); the West African Festoon System (WAFS), and a handful of others.

East Africa

East Africa forms the longest stretch of coastline in the world which has no international undersea fiber optic connectivity. From Mtunzini, South Africa to Djibouti, a distance of almost 7,000 kilometers (plus the entire 4,800-kilometer coastline of Madagascar), there are no international undersea fiber optic cable landings and an addressable population of over 300 million (including inland nations) must rely on satellite capacity for international connections.

The East African Submarine Cable System (EASSy), which has been under serious consideration for the at least the last three and a half years, was arguably the first credible proposal for undersea connectivity to the region. An accompanying backhaul infrastructure, the East African Backhaul System (EABs), would carry capacity to poorly-served inland nations. However, delays in EASSy's progress and concerns about the pricing of capacity sales to competitive operators have spawned interest in competing systems to serve the Kenyan market, including government proposals such as the East African Marine System (TEAMs) and a joint cable proposal by Kenya Data Networks and FLAG Telecom.

The Middle East

For the most part, LDCs in the Middle East have been adequately served by Europe-to-Asia cables such as the Sea-Me-We cables and FLAG's two systems (FLAG Europe-Asia and Falcon) through the region, as well as by feeder systems in the Persian Gulf.

South Asia

India's international capacity market has undergone a major transformation within the last five years as the result of five new high-capacity intercontinental undersea links. Further, the country has made significant headway in the management of international undersea capacity: in December of 2006 the country's regulator, the Telecom Regulatory Authority of India (TRAI), announced a policy of open access to all international cable landing stations.

The explosive growth of the India's submarine cable market has coincided with the emergence of the country's telecommunications titans in the global market. Reliance Group and Tata Group have positioned themselves as the two largest owners of worldwide undersea cable networks thanks to their purchases of FLAG Telecom and the Tyco Global Network respectively.

As of 2002 India was served by only three undersea fiber optic cable systems: Sea-Me-We-2, FLAG, and Sea-Me-We-3. Collectively the country's capacity was little more than 50 Gbps, or less than 50 bits per second per capita. By year-end 2006, though, the country's international undersea bandwidth had increased to more than 650 Gbps, with a total upgradeable capacity of up to 20 Tbps.

Southeast Asia

Through a combination of undersea initiatives (including those funded by the Association of Southeast Asian Nations) and terrestrial links such as the China-Southeast Asia Cable System and the Greater Mekong Sub-Regional Backbone System, most LDCs in southeast Asia are served by international fiber optic connectivity. However, the levels of international capacity available to some countries are unlikely to accommodate forecasted long-term demand.

The experience of one country that was recently connected for the first time, Papua New Guinea, serves as a possible example of providing connectivity to those LDCs that are truly unable to afford it: in the case of PNG, the decommissioned Pacrim West cable was retrieved, reinstalled, and re-christened as the Australia-Papua New Guinea-2 cable at less than one-fifth the cost of a new system.

The South Pacific

The LDCs of the South Pacific, with their relatively small populations, desperately await the construction of a fiber optic solution for the region. Former American protectorates, in particular, have pinned their hopes on a system that would be partly financed by the United States military in order to link American bases throughout the region.

Latin America

Because none of the countries of Latin America fall into the classification of "very low income," (i.e., among the 53 poorest), and because multinational corporations have been quick to tap consumer markets throughout the region, most countries in the Latin American region have never been starved for bandwidth. In particular, three major ring systems were constructed in 2001 and 2002 providing multiple terabits per second of design capacity between North and South America. Of mainland Latin American countries, Terabit Consulting's analysis revealed that only Suriname and Guyana lack international fiber optic connectivity.

The Caribbean

There remain a number of countries in the Caribbean, most notably Cuba, Haiti, and some eastern Caribbean states, that have yet to be connected to undersea cable networks. However, a number of systems, both proposed and under construction, have aimed to network almost all of these countries. Some of these projects have garnered financial assistance from international financial institutions.

10 FIBER AND ICT IN THE DEVELOPING WORLD: OBSTACLES AND THREATS

Although macroeconomic trends, the growth of the telecommunications industry, and the development of the submarine communications industry all promote the case for constructing additional fiber optic connectivity to LDCs, there are clearly a number of issues that must be addressed in order to ensure successful network development. Most concerns about ICT in less-developed countries focus on the capability of users to take advantage of network connectivity.

At the most basic level, increased Internet deployment will necessitate a more aggressive stance against

illiteracy: according to the United Nations Development Programme, at least 18 countries (14 in Africa, three in Asia, and one in the Middle East) were believed to have adult populations that were majority-illiterate; worldwide, roughly one in five adults is unable to read and write. Nevertheless, significant efforts are being made to reduce this number; in particular, the United Nations Millennium Goal #2 calls for universal primary education by 2015, and the program's 2006 annual report noted that enrollment rates have increased to 86 percent in the developing world (although enrollment in sub-Saharan Africa stands at a mere 64 percent).

Linguistic considerations, and the concentration of content among a handful of languages, form another barrier to Internet development in many LDCs. According to most sources, English-language websites account for between one-half and four-fifths of all Internet content, and the vast preponderance of content (estimated at upwards of 95 percent) is in a limited group of languages consisting of English, other European languages, Chinese, and Japanese. Major linguistic groups, especially those in Africa, are barely represented in the medium.

Consumers' access to reliable sources of electricity is another pressing concern. The limited penetration of electrical networks in the developing world has had an impact on even those telecommunications networks which, at first glance, would seem unlikely to be affected. By way of example, a number of mobile operators in the developing world have told Terabit that network utilization rates fall precipitously on Sundays, not because of natural usage patterns but rather because many users do not have access to electricity in their homes and are only able to charge their mobile handsets at their workplaces. Their batteries are often exhausted before the end of the weekend. Given these logistical pressures posed on a relatively self-sustaining system such as a wireless network, it is clear that much progress needs to be made with respect to penetration and reliability of electrical networks in order to sustain a much more energy-intensive platform such as the Internet. [Some alternative steps have already been taken to address this concern; for example, the One Laptop per Child program (OLPC) envisions the distribution of laptops with batteries that can be charged by hand-cranks.]

Economic barriers arguably form the largest obstacle to Internet deployment in the developing world. With 19.4 percent of the developing world living in extreme poverty and over 75 percent of the population in countries like India, Bangladesh, Haiti, Nicaragua, Cambodia, and at least 20 African countries living on less than $2 per day, Internet deployment can seemingly be classified as no less than a luxury for much of the population in most LDCs. However, the effort to provide information equality between the world's richest and poorest nations is increasingly viewed as a powerful tool in the struggle to combat poverty.

In terms of potential obstacles that are perhaps more readily addressable at the network-operator level, one recurring theme that has arisen with some of the projects in which Terabit Consulting has been involved is the issue of "open access." International licensees are generally reluctant to surrender control of gateways, and some incentive must be provided for large investors to make commitments to cable system financing. However, past systems constructed in LDC markets have proven that a relinquishing of complete control to the incumbent operator can result in a next-generation fiber optic cable system sitting largely unused. Future systems serving the developing world will have to strike a delicate balance between investment incentives and sensible capacity management. To that end, the governments of some LDCs have classified international fiber optic bandwidth as a "national resource," a fitting characterization for a product which will be invaluable to most LDCs' overall economic development.

11 CONCLUSION

In 2002, United Nations Secretary General Kofi Annan said that "the gap between information 'haves' and 'have-nots' is widening, and there is a real danger that the world's poor will be excluded from the emerging knowledge-based global economy." Five years later, some progress has been made but there still remains an enormous amount of work to be done: most notably, the construction of fiber optic connectivity to the 32 extremely poor nations that do not yet have it. Although a number of obstacles must be addressed in order to ensure the long-term viability of ICT development in these LDCs, a close analysis of market fundamentals reveals that there has never been a better time for all involved to ensure the provision of ubiquitous fiber optic connectivity throughout the developing world.