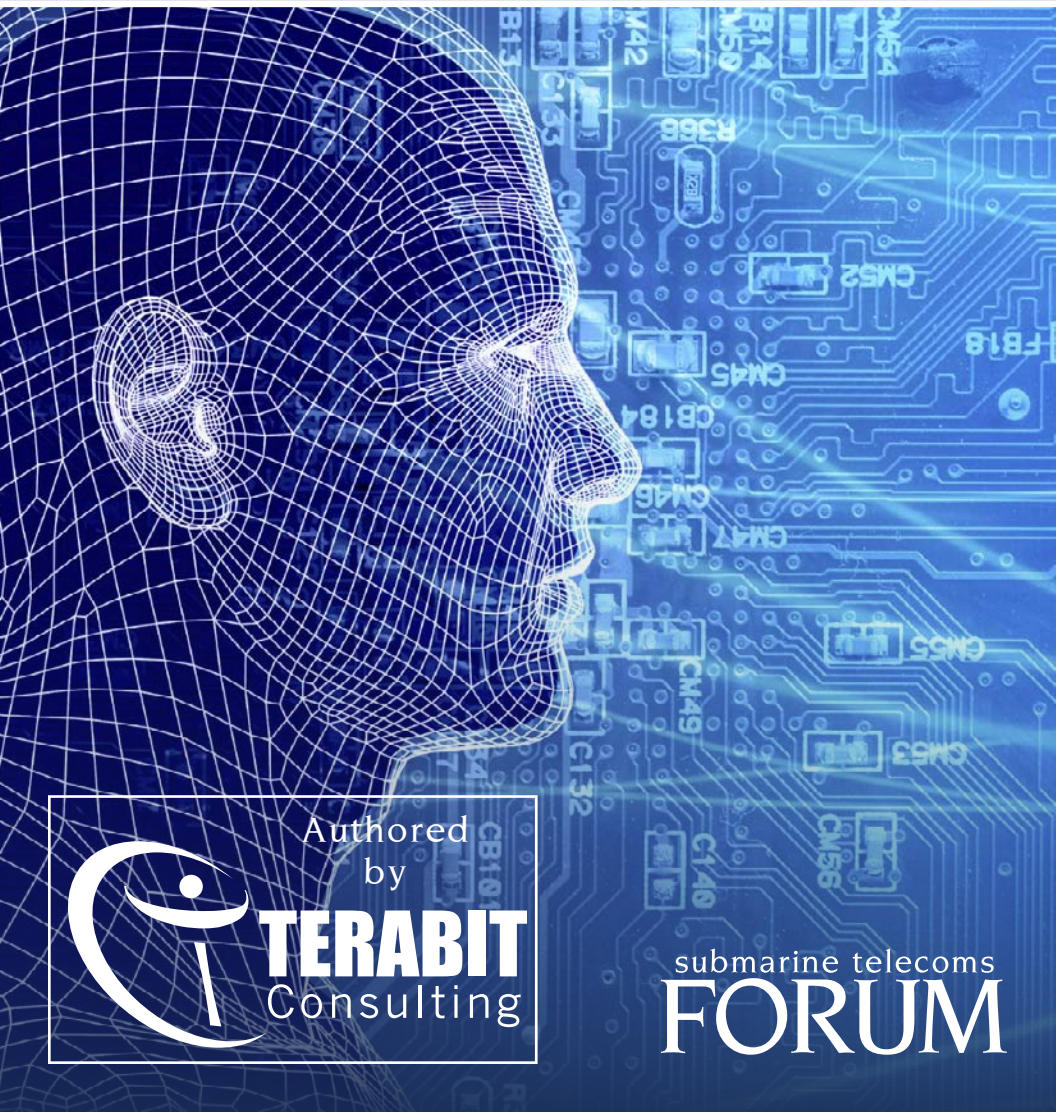
submarine telecoms INDUSTRY REPORT

2013



Authored by TERABIT Consulting

submarine telecoms FORUM

Submarine Cable Industry Report

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1. Foreword

SubOptic is once again pleased to support the Subtelforum Industry Report, now in its second year. It fills a gap in the market place by providing an independent view of the overall industry written by Terabit Consulting, who have insider knowledge of the structure and challenges it faces in the future.

Its views are those of the author and some readers may take issue with some of the conclusions it reaches, but then that is life and not all commentators have the same view of the world, which is why an independent author is essential.

Fortunately with SubOptic 2013 being held next month in Paris, there is an opportunity when the industry comes together, to debate and discuss both the contents of this report and the wider issues of concern to many of us in the community of interest served by our industry.

Some of these are highlighted in this report such as:

- Where will money come from to finance new system build?
- What will the shape of the industry be over the next five years?
- How will the upgrade market impact the turnkey system suppliers?
- The different drivers that will impact the various geographic regions and what are the major challenges to be overcome.
- This is just a short list of the many issues covered by this report, which deserves to be read in detail.

Well done to Subtelforum for continuing this initiative, which I hope will become a regular feature. I look forward to seeing you all in Paris next month, to continue the debate.

Fiona Beck
President of the SubOptic Executive Committee and
President and CEO of Southern Cross Cable Network

2. Introduction

Welcome to the second edition of the Submarine Telecoms Industry Report, which was authored by the submarine industry's leading market analysis firm, Terabit Consulting, with research overseen by Terabit's Director of International Research, Michael Ruddy. It serves as an analytic resource within a trilogy of products beginning with the Submarine Cable Map and including the Submarine Cable Almanac.

The Submarine Telecoms Industry Report features in-depth analysis and prognoses of the submarine cable industry, and serves as an invaluable resource for all who are seeking to understand the health of the submarine industry. It examines both the worldwide and regional submarine cable markets, including issues such as the new-system and upgrade supply environments, ownership, financing, market drivers, and geopolitical/economic events that may impact the market in the future.

In this report, Terabit Consulting identified $28.5 billion in new projects that are currently being actively pursued by their sponsors. Of those, $4.5 billion worth of new projects are either under construction or considered to be in an advanced stage of development and well-positioned for near-term deployment.

While the crystal ball will rarely be completely clear, one fact remains – that our 150+ year old international enterprise continues to be a thriving, exciting and ever-evolving industry.

Our aim is to make this information as timely and available as possible. As always, we feel that an informed industry is a productive industry.

TERABIT Consulting

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The Undersea Cable Report 2013

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The most diligent quantitative and qualitative analysis of the undersea cable market - **1,600 pages** of data, intelligence, and forecasts that can be found nowhere else.

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3. Executive Summary

In 2013 the submarine communications industry marks its 25th year of providing transoceanic fiber optic communications. The first quarter-century has been marked by unimaginable highs and lows, but the industry's performance over the last five years makes clear that it has recovered from its post-dot-com-bubble collapse with a healthy marketplace which, for the foreseeable future, should continue to average at least $2 billion in new investment and 50,000 kilometers annually, together with an increasingly robust upgrade market. More importantly, from the perspective of global economic and human development, the industry's recent and planned investment patterns show a distinct trend toward improving connectivity in developing regions and accomodating the few island and coastal nations that remain without fiber optic connectivity.

Terabit Consulting's examination of investment and demand reveals that much of the industry's future activity will be driven by what Terabit identifies as the "BICS" markets – Brazil, India, China, and Sub-Saharan Africa. Over the last five years, more than $6 billion of the period's $10 billion effectively targeted the latter three markets, and an examination of proposed projects reveals serious plans for an additional $5.5 billion to be invested in the Brazilian market – including two new systems between Brazil and Europe, four between Brazil and the United States, and five between Brazil and Africa.

Terabit Consulting identified 177 new projects, with a total value of $28.5 billion, which are either under construction or proposed. Fifteen new projects either entered service in early-2013 or are scheduled for completion in 2013 (i.e. under construction or in advanced stages of development), for a total value of $1.4 billion. There are an additional 24 projects which Terabit Consulting classified as "high-activity," i.e. considered to be credible projects in an advanced stage of development with a high probability of activation in 2013 or 2014. The total value of these projects is $3.1 billion; consequently, if there are no major construction delays then an average of at least $2 billion worth of new systems will

enter service annually in 2013 and 2014. A total of 95 projects were classified into the "medium-activity" category, for $16.8 billion worth of proposed investment, serving as a strong indicator of future deployment over the mid-term. Finally, the "low-activity" category comprises 43 projects with a combined value of $7.2 billion; although not in advanced planning stages, each of these projects was confirmed by Terabit Consulting to be under consideration by operators or investors, with some showing strong potential based on market conditions.

An analysis of activated undersea capacity reveals that the greatest growth has occured in Sub-Saharan Africa, Latin America, and Asia, led by 71 percent compound annual growth in Sub-Saharan African intercontinental capacity over the last five years, compared to 27 percent in the comparatively mature transatlantic market.

Table 1: Growth in Activated Capacity along Major Undersea Routes, 2007-2012

	CAGR, 2007-2012
Sub-Saharan African Intercontinental	71.2%
North America-South America	54.2%
Pan-East Asian	46.6%
South Asia & Middle East Intercontinental	41.2%
Transpacific	36.2%
Australia & New Zealand Intercontinental	33.1%
Transatlantic	26.9%

Terabit Consulting's regional analyses revealed the unique characteristics of each long-haul submarine cable market.

In the transatlantic, the lack of new deployment over the last ten years would seem to make the market ripe for new investment, but

the financing of new transatlantic cables has proved exceedingly difficult. Nevertheless, there are two serious proposals for new transatlantic connectivity, with each promising low latency between the financial hubs of London and New York.

Investment in the transpacific market will continue to be strongly influenced by the growing bandwidth requirements of China and Japan, but Terabit Consulting also identified an opportunity for a transpacific cable from Russia's eastern coast an even stronger opportunity for single-cable connectivity between the United States and India in order to avoid the risks of passing through Egypt.

Deployment of new undersea connectivity to South America will be driven by Brazil, which accounts for half of the continent's population but five-eighths of its international bandwidth demand. Brazil's economic growth has been strong and more equitable than in other developing markets, resulting in a larger addressable base for telecommunications and Internet services; the 2014 World Cup and 2016 Summer Olympics are expected to result in even greater increases in bandwidth demand; and its Plano Nacional de Banda Larga (PNBL) is both ambitious and credible. Terabit Consulting's evaluation of Brazilian operators indicates that there was a strong case for the planned AMX-1 cable, based on the market shares of America Movil's Brazilian subsidiaries.

The collapse of the Pacific Fibre project, which would have connected the United States, New Zealand, and Australia, revealed the challenges faced by private investors hoping to compete in markets served by a handful of operators that control both the consumer markets and the existing international infrastructure. Nevertheless, other investor-led proposals aim to pick up where Pacific Fibre left off. Terabit Consulting believes that some form of operator participation or commitment will be needed for any of the proposed Australian long-haul projects to succeed.

Most new Sub-Saharan African investment aims to connect the continent to Latin America, with specific interest in linking the Lusophone countries of Angola and Brazil. From the perspective

of the global network, robust connectivity in the South Atlantic is urgently needed but it remains to be seen whether bandwidth demand along the route will be high enough to justify the required investment. Consequently many of the South Atlantic projects have proposed onward links to other continents, hoping to capitalize on the principal of Metcalfe's law.

The market for new undersea capacity to South Asia and the Middle East, which includes the Europe-to-Asia route, is dominated by the expectation that there will be a Sea-Me-We-5, possibly with strong influence from Chinese operators. Terabit Consulting expects that the most successful projects in South Asia and the Middle East will be those that can provide economically and technically viable means of bypassing Egypt.

The Pan-East Asian undersea cable market features three new consortium-led projects that are about to be completed, two of which attracted investment from non-traditional investors in the form of Google and Facebook. Terabit Consulting believes that the new consortium-led projects, in which most major East Asian operators have stakes, were necessitated by the fact that most of East Asia's existing pan-regional bandwidth is controlled by private investors and operators from outside of the region.

Plans for trans-Polar connectivity seem to be afflicted by skepticism on the part of financiers, but from a technological, economic, and geopolitical standpoint, the route has never been more credible. Over the long term it is possible that the three largest political powers present in the Arctic (Canada, Russia, and the United States) will take greater interest in the potential for undersea connectivity (and surveillance) in the region.

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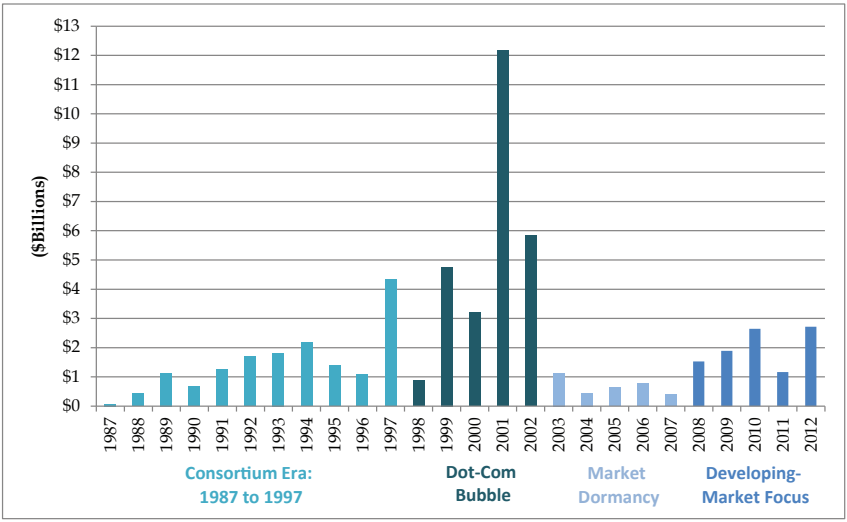
4. Worldwide Market Analysis and Outlook

4.1 Overview of Historical System Investment

As of year-end 2012 there had been $56.3 billion worth of investment in fiber optic submarine systems, comprising 1.25 million kilometers. In the 25 years since the advent of transoceanic fiber optic systems, the market has averaged $2.25 billion worth of investment and 50,000 kilometers of deployment per year.

Figure 1: Investment in New Submarine Fiber Optic Projects, 1987-2012

($Billions by Ready-for-Service Date)



The first transoceanic fiber optic cable, TAT-8, entered service in December of 1988 (although a few regional systems, both experimental and commercial, had been installed prior to that date). For the first ten years of its existence, the submarine fiber optic cable market was relatively predictable, controlled by consortia of operators, including many government-owned monopolies.

On January 1, 1998 the European telecommunications market became fully liberalized. Internet penetration was steadily ramping up, with usage already exceeding 30 percent in three

countries: Iceland, New Zealand, and Sweden. By the following year, the submarine consortia's long-term build-out strategies to accommodate ISDN and Group 4 fax traffic were quickly rendered obsolete. Inspired by the early success of private submarine investment in the transatlantic market, throngs of speculative investors pitched submarine cable build-out plans that ultimately resulted in more than $25 billion worth of new systems being deployed in less than four years.

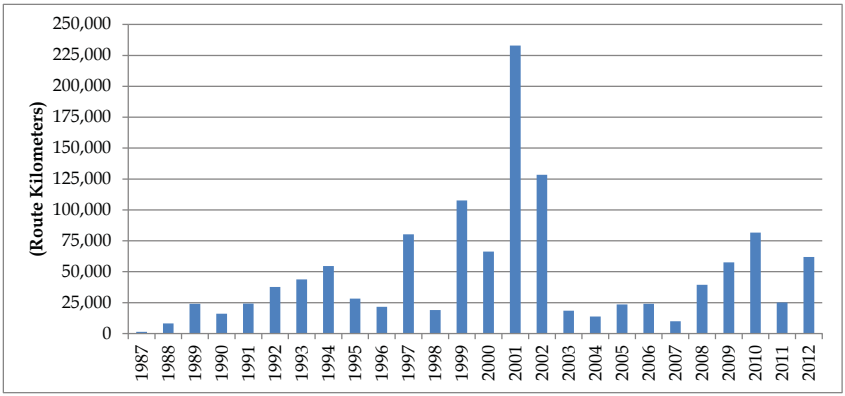
During that period, the price of international bandwidth had spiraled downward, driven by intense competition in many transoceanic markets and unprecedented advancements in dense wavelength division multiplexing (DWDM) technology. By 2002 the majority of the major international wholesale network operators had declared bankruptcy, and deployment of new submarine fiber optic systems came to a virtual standstill.

Between 2003 and 2007, the submarine market struggled to reach levels of $1 billion in new investment annually. Major submarine cable plants were shuttered, and the industry saw its annual production capacity fall to approximately one-third of its all-time high of 200,000 kilometers. At the same time, the submarine cable industry's fleet of installation and repair vessels shrunk in number as ships were converted for use in more profitable endeavors. Wholesale markets for submarine capacity on developed routes remained depressed, and even purchasers of distressed cable assets struggled to remain profitable despite costs bases that were a fraction of original construction outlays.

By 2008, however, the industry appeared to have found a new balance focused on bringing connectivity to underserved routes and regions, with annual investment in new projects returning to normal historical levels and the emergence of an extremely robust market for system upgrades fueled by a shift to 40G and 100G transmission technology.

Figure 2: Deployment of New Submarine Fiber Optic Projects, 1987-2012

(Route Kilometers by Ready-for-Service Date)

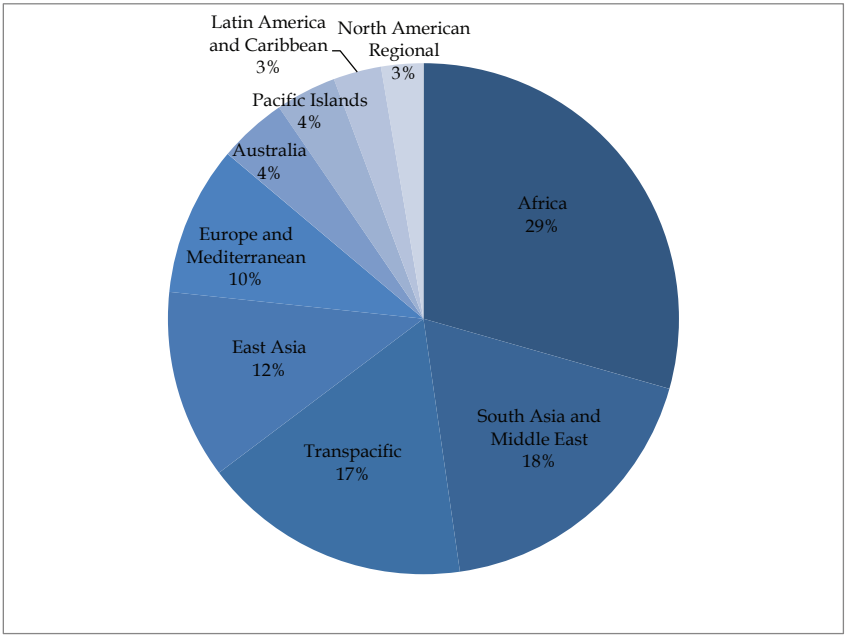


4.2 2008 – 2012 Systems in Review

In the five years between 2008 and 2012, $10 billion worth of new submarine fiber optic systems entered service, for an average of $2 billion and 53,000 kilometers per year, which is in line with overall historical averages.

Geographically, $2.9 billion was invested in new systems in Sub-Saharan Africa, including four new long-haul systems along the continent's western coast and three along its eastern coast. Four new systems connected India and the Middle East to Europe at a cost of $1.7 billion, and three new transpacific systems also entered service at a cost of $1.7 billion. Collectively, more than $6 billion of the period's investment targeted the markets of China, India, and South Africa – three of the five so-called "BRICS" markets.

Figure 3: Investment in New Submarine Fiber Optic Projects by Region, 2008-2012



4.3 Systems Investment in 2013 and Beyond

The analysis identified 177 new projects, with a total value of $28.5 billion, which are either under construction or proposed. Proposed projects were each classified into one of three categories: "high activity," "medium activity," and "low activity" based on various criteria including supply contracts, funding, licenses, carrier commitments, market opportunities, marine surveys, desktop studies, and feasibility studies.

In the most immediate category, 15 new projects have been identified that either entered service in early-2013 or are scheduled for completion in 2013 (i.e., under construction or in advanced stages of development), for a total value of $1.4 billion.

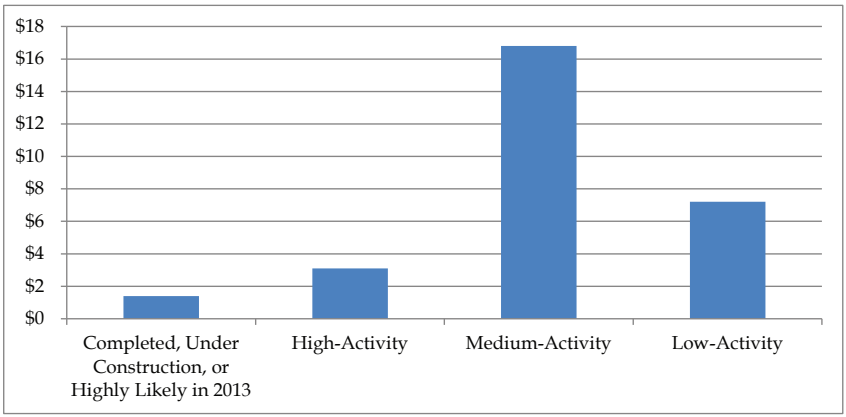
In addition, 24 "high-activity" projects have been identified, which are considered to be credible projects in an advanced stage of

development with a high probability of activation in 2013 or 2014. The total value of these projects is $3.1 billion. Consequently, if there are no major construction delays then an average of at least $2 billion worth of new systems will enter service annually in 2013 and 2014.

A total of 95 projects were classified into the "medium-activity" category, for $16.8 billion worth of proposed investment. Finally, the "low-activity" category comprises 43 projects with a combined value of $7.2 billion.

Figure 4: Projects with 2013 RFS Dates and Proposed Submarine Fiber Optic Projects

($Billions)

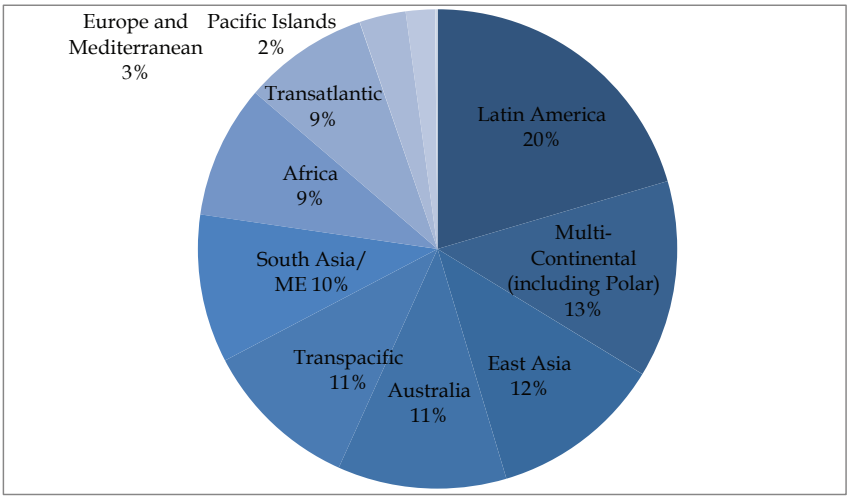


Prior to the most recent round of undersea cable deployment, Terabit Consulting forecasted that most undersea investment would be directed toward two spheres: first, unconnected markets; and second, the so-called "BICS" economies – i.e., each of the BRICS economies with the exception of Russia (which, given its proximity to European hubs and terrestrial connectivity, would require lower levels of investment over the short-term). During the 2008-2012 timeframe, more than $6 billion or 60 percent of investment was directed toward India, China, and South Africa. Not surprisingly, the industry has now turned its focus to Brazil, with two systems planned between Brazil and Europe, four between Brazil and the

United States, and five between Brazil and Africa, for a total of $5.5 billion worth of proposed investment.

When credible proposed investment, i.e., those projects that can be classified as either "high-activity" or "medium-activity," is classified according to geography, it becomes clear that submarine investment is likely to be significantly more diversified among different regions than it had been in the past. Credible proposed investment targeting developing or unconnected markets accounts for more than two-thirds of the total. At the same time, there remains a reasonable amount of credible interest in traditional transoceanic markets that have historically been the cornerstone of the industry. Overall, future investment in new submarine systems appears balanced and sustainable.

Figure 5: Credible ("High-Activity" and "Medium-Activity") Proposed Submarine Fiber Optic Projects by Region, 2013 and Beyond



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5. Supplier Analysis

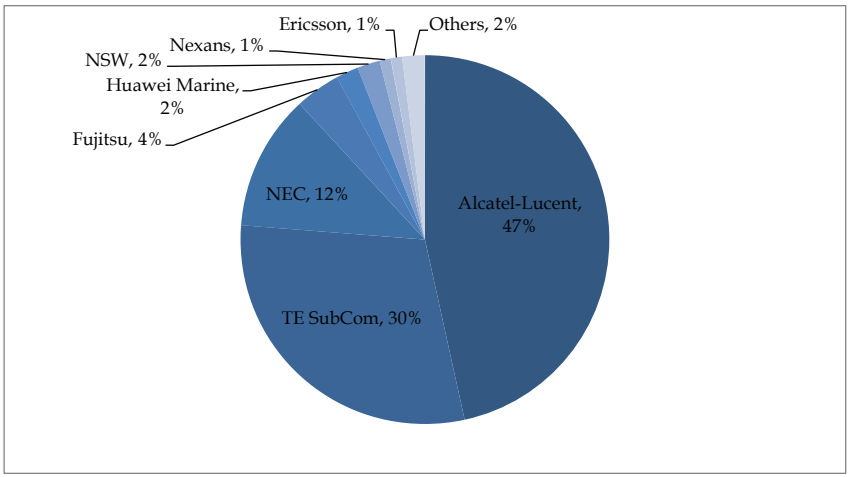
5.1 System Suppliers

The future landscape of submarine system suppliers is perhaps one of the greatest question marks facing the industry. The industry's capital and technological requirements serve as a formidable barrier to entry and have limited the number of suppliers that can viably compete for turnkey system supply contracts.

There is no clear indication that the supply market for new systems has become more competitive over time. Historically, the market for new fiber optic submarine systems was fairly evenly divided along geographical lines between three groups: the predecessors of Alcatel-Lucent, the predecessors of TE SubCom, and the Japanese supply community. The obstacles faced by the likes of KDD-SCS, OCC, and Hitachi Cable had a negative impact on the Japanese supply community, leading to a decline in its market share, although NEC has recently gained strength particularly in the Asia-Pacific region. Meanwhile, among the two other major suppliers, as TE SubCom has remained relatively stable at approximately one-third of the market for new systems, Alcatel-Lucent's market share has approached one-half.

Figure 6: Market Share for Supply of New Systems, 2003-2013

(Primary Contracts Only; Excluding Subcontracts)



Many industry observers were encouraged by the launch of Huawei Marine Networks, a joint venture between Huawei Technologies and Global Marine Systems, in 2008. The company's initial entry into the market was aggressive, and it was accused of "buying market share" by submitting low-cost bids for new projects. Huawei's development of repeater technology positioned it as a viable competitor against the established suppliers, but its dependence on others for the manufacture of fiber optic cable has proven to be a significant challenge. More recently, Huawei Marine Networks has been dealt a setback by the efforts of some American and Australian politicians to blacklist Huawei Technologies.

The three wildcards in the submarine supply landscape are the future strategy of Huawei Marine Networks (including the possibility of partnering with Chinese cable manufacturers); the expected sale of Alcatel-Lucent's submarine networks division and a realignment of the industry's manufacturing assets; and the growth of equipment-only suppliers such as Ciena, Infinera, Mitsubishi, and Xtera, driven by 40G and 100G transmission technologies.

5.2 Upgrade Suppliers

Capacity upgrades have become one of the most dynamic aspects of the submarine cable industry. Beginning in the late 1990's few, if any, systems were equipped to their full design capacity at RFS; instead, owners consciously planned to install additional terminal equipment as market conditions dictated. Any optically amplified system can potentially be upgraded beyond its design capacity, and those installed from 1999 onwards are excellent candidates. Provision of terminal equipment for upgrades does not require investment in repeater design, cable manufacturing, or cableships, and this has resulted in many suppliers beyond those traditionally engaged in provision of submarine cable systems entering the market for terminal equipment upgrades. This dynamic may be uncomfortable for some suppliers, but has brought about striking benefits for system owners.

The upgrade market will arguably be the most consistent source of growth and has been targeted by four equipment suppliers in addition to the traditional submarine system suppliers.

Table 2: Key Upgrade and Redeployment Projects for Equipment Suppliers

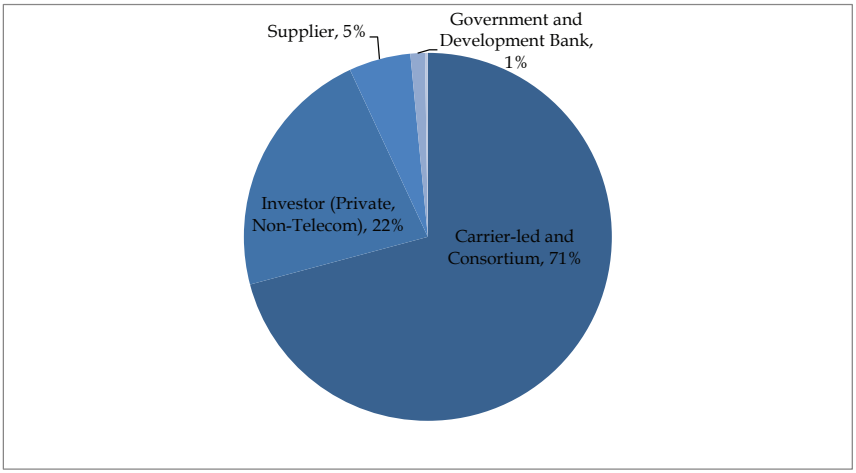
Ciena	Southern Cross Cable Network, TGN Atlantic, Japan-US Cable Network, North Asian Loop, Australia-Japan Cable, FLAG Europe-Asia, FLAG Atlantic-1, Latin American Nautilus, Seacom
Infinera	Pacific Crossing-1, North Asian Loop, Transatlantic cable, MedNautilus, Kodiak-Kenai, Pacnet
Mitsubishi	Asia-America Gateway, TAT-14, I-Me-We, EAC, Japanese domestic
Xtera	EAC/C2C, AC-1, Gulf Bridge International, GlobeNet, Arcos, PAC, SHEFA-2, GOKI, Columbus-2, Columbus-3, Gemini Bermuda, C-BUS, East-West Cable, Tamares Cable

6. Ownership Analysis

6.1 Financing of Current Submarine Systems

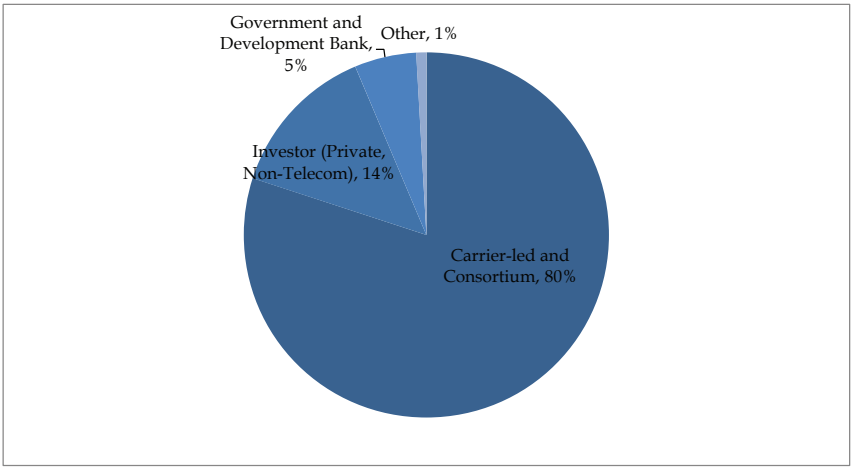
Historically, 71 percent of submarine fiber optic cable investment has been financed by telecommunications carriers on their own, in small groups, or in large consortia. Largely due to the influx of speculative investment during the dot-com bubble, projects led by non-telecom, private investors have accounted for 22 percent of investment. Supplier financing accounted for 5 percent, also largely a legacy of dot-com era financing models.

Figure 7: Financing of New Submarine Fiber Optic Systems, 1987-2012



During the most recent five-year period from the beginning of 2008 to the end of 2012, carrier-led and consortium projects accounted for 80 percent of total investment, with investor-led projects accounting for 14 percent and government- and multilateral development bank (MDB)-financed projects accounting for 5 percent.

Figure 8: Financing of New Submarine Fiber Optic Systems, 2008-2012



The analysis clearly indicates a shift toward a marketplace in which the telecommunications operators undertake most investment in new systems themselves. Opportunities for private, non-telecom investors have decreased significantly while governments and development banks have taken a significantly more active role. Although much of the activity in the latter category has been focused on less-developed markets, government financing has recently been proposed for projects on more developed routes such as the transatlantic.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7. Regional Market Analysis and Capacity Outlook

7.1 Transatlantic

7.1.1 Bandwidth and Capacity

The transatlantic submarine cable market continues to confound market observers with its ongoing drought of investment. The route was the object of more than $10 billion of investment during the 15-year period following the advent of the first transoceanic fiber optic cable, TAT-8, in the late-1980s. More than $7 billion worth of new transatlantic systems entered service between 1998 and 2003, primarily seeking to capitalize on runaway Internet bandwidth demand between Europe and North America. Yet there has been no new direct transatlantic construction for more than ten years, and the traditional consortia of operators that once dominated transatlantic telecommunications have remained publicly silent since 2001.

Two new investor-led projects in the North Atlantic, both with similar competitive strategies based on low latency, missed their planned 2012 ready-for-service dates, but in 2013 their promoters offered news that seemed to reveal divergent trajectories. One project, contracted to an American supplier, reported that it had gained a preliminary commitment from the United States government's export credit agency, while the other project, contracted to a Chinese supplier, was forced to suspend all work amidst claims of "dangerous" anti-Chinese political sentiment and blacklisting efforts in the United States.

Meanwhile, there has been increasing interest in direct transatlantic links between Europe and Latin America, driven by the growth of Brazilian bandwidth demand ahead of the 2014 FIFA World Cup and the 2016 Summer Olympics, as well as demand for connectivity among the research community (there have also been proposals for what would be the first transoceanic projects across the South Atlantic, connecting South America with Africa; those projects are described in the "Sub-Saharan Africa" section).

There also remains a belief among some industry veterans that a consortium-led project may soon materialize in the Atlantic, perhaps proposing a "next-generation" twist to differentiate itself from the traditional TAT cables.

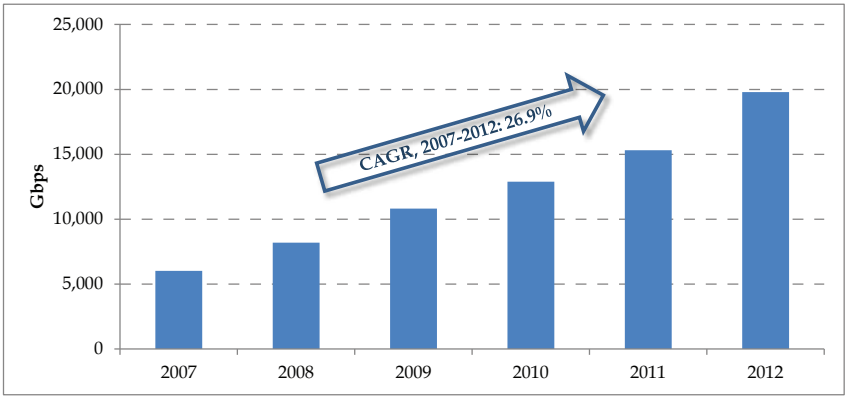
Table 3: Existing Transatlantic Cable Systems

RFS	System	Owner(s)
1999	Atlantic Crossing-1 (AC-1)	Level 3
1999	Columbus-3	International consortium of carriers
2000	Yellow (Level-3)/Atlantic Crossing-2 (AC-2)	Level 3
2000	Atlantis-2	International consortium of carriers
2001	FLAG Atlantic-1 (FA-1)	Reliance Globalcom
2001	Hibernia Atlantic	Hibernia Networks (Columbia Ventures Corp.)
2001	TAT-14	International consortium of carriers
2001	TGN-Atlantic	Tata Communications
2003	Apollo	C&W Worldwide (Vodafone) / Alcatel-Lucent

Between 2002 and 2008, ten transatlantic submarine cables were either entirely or partially removed from service, leaving nine systems offering a total of 15 different cable paths between Europe and the Americas. The seven lit DWDM systems between North America and Europe are owned by six entities: Apollo SCS Ltd. (a joint venture between Cable & Wireless Worldwide and Alcatel-Lucent), Level 3 (formerly Global Crossing, which operates two systems), Hibernia Networks (owned by Columbia Ventures Corporation and Constellation Ventures Partners), Reliance Globalcom, Tata Communications, and the TAT-14 consortium. Consequently, the transatlantic market can be described as an overwhelmingly "wholesale" market, where operators have opted to lease capacity from network operators, as opposed to making direct investment in their own capacity infrastructure.

A number of events have brought about the commoditization of bandwidth between most European and North American endpoints. In the late-1990s, hundreds of fiber pairs were deployed to metropolitan areas on both continents, making point-to-point connectivity both economical and practical, and at the same time retail markets were fully liberalized. Then, more importantly, in the early-2000s the dot-com bubble burst drove many cable operators into bankruptcy, allowing investors to acquire transoceanic networks at pennies on the dollar and unleashing a downward price spiral that saw erosion of up to 75 percent per year and the "dumping" of bandwidth onto the market. In the same decade, new industries emerged offering data center and content delivery services that further streamlined international connectivity for both operators and end-users. By the mid-2000s transatlantic bandwidth had become extremely cheap (sometimes cheaper than its construction cost) and end-to-end services between North America and Europe were efficiently and competitively managed, to the point where even small- and medium-sized enterprises could be characterized as viable bandwidth clientele.

Figure 9: Total Activated Transatlantic Capacity, 2007-2012



As of year-end 2012, lit transatlantic capacity was 19.8 Tbps. The compound annual growth of lit transatlantic capacity was 27 percent over the preceding five years, although actual transatlantic bandwidth demand growth has been slightly higher, at 30 percent.

Determining the total design capacity of existing transatlantic systems is an imprecise task: although 40G and 100G upgrade technologies promise vast design capacity increases in theory, the practical implementation of the technology in ten- to fifteen-year old transoceanic systems, especially those which have undergone multiple repairs, has not shown uniform success. Nevertheless, at least five transatlantic systems claimed to be significantly or fully upgradeable to 40G, yielding a design capacity (based on field demonstrations) of at least 66.8 Tbps and as much as 100 Tbps, with even greater capacities theoretically possible with 100G.

7.1.2 New Systems

The lack of new submarine deployment directly between Europe and the Americas within the last ten years would seem to make the market ripe for new investment, but the financing of new transatlantic systems has proven exceedingly difficult as continued price erosion, increasing upgradeability of existing systems, and the perceived maturity of demand have all combined to frighten away prospective sources of financing. Furthermore, veterans in the project finance sector remain haunted by the meltdown of the transatlantic bandwidth market in the early-2000s.

Most proposed transatlantic projects propose some competitive advantage not available among existing systems. These include lower latencies targeting high-frequency trading (HFT) customers; access to energy-efficient data centers; and direct, cost-efficient connectivity on a historically underserved route (i.e., Europe-to-Latin America).

Two privately-financed projects targeting the traditional North Atlantic route between Europe and North America were announced in September of 2010 and July of 2011, respectively: Hibernia Networks' Project Express and Emerald Networks' Emerald Express. Initially, both projects announced ready-for-service dates in 2012. Hibernia Atlantic selected the Anglo-Chinese joint venture Huawei Marine Networks to supply (and to potentially provide financing for) its new system while Emerald Networks chose the American supplier TE SubCom. Apart from marine survey activity and securing some of the required permits, there was little material progress announced by either of the two projects during most of 2012.

However, in January and February of 2013, important news about both projects began to emerge. Emerald Networks' news was positive, as it indicated that it had received what it described as a "preliminary commitment" from the US government's Export-Import Bank in the form of a "Preliminary Project Letter."

Hibernia Networks' news, on the other hand, appeared dire. The company was reported to have "halted work with Huawei" on the Hibernia Express project due to security concerns expressed by the US government toward Chinese suppliers such as Huawei and ZTE. Hibernia Networks' reported decision followed a 2012 investigation by the US House of Representatives' Permanent Select Committee on Intelligence which the chairman of the committee, Republican Congressman Mike Rogers, summarized by saying that "If I were an American company today…and you are looking at Huawei, I would find another vendor if you care about your intellectual property, if you care about your consumers' privacy, and you care about the national security of the United States of America."

Critics asserted that the 60-page report released by the Intelligence Committee contained no scientific or engineering evidence of security weaknesses unique to ZTE and Huawei, nor did it identify any attempts at espionage; instead, the report based its assertions on what it claimed was the failure of ZTE and Huawei to "provide clear answers to Committee questions…provide supporting documentation…or alleviate Committee concerns." Critics also claimed that the committee's actions, which benefitted American suppliers, could easily be construed as trade protectionism. For its part, the committee said that more detailed information could be found in the classified annex to the report, but "that information cannot be shared publicly without risking US national security."

Beyond the political intrigue surrounding the two North Atlantic projects, there remain fundamental concerns as to whether private investors can succeed in such a well-served market where bandwidth has effectively become a commodity. In fact, throughout 2012 it was rumored that both projects had been shelved. The projects' initial focus on attracting high frequency trading (HFT) companies through latency savings of a few milliseconds was largely debunked as a major potential source of bandwidth demand, as questions also arose regarding the ability to simultaneously market low-latency bandwidth at a premium price to HFT and other mission-critical

clientele while still capturing traditional operator demand at market prices.

Meanwhile, at least three other new systems would provide paths between Europe and Latin America in an attempt to enhance connectivity on a route which offers only one relatively low-capacity alternative to interconnection in the United States (namely, Atlantis-2).

The success of any of the proposed transatlantic projects will depend on commitments or participation from tier-one carriers, as privately- or alternatively-financed cable systems will find it challenging to compete against future consortium-led endeavors.

Table 4: Planned Transatlantic Cable Systems

(Europe to the Americas)

System	Owner(s)
Atlantic Cable System-Europe (ACSea-EUR)	Telebras
Emerald Express	Emerald Networks
Europe Link with Latin America (ELLA)	Research community
Project Express	Hibernia Networks (Columbia Ventures Corp.)
Transatlantic Consortium System / TAT-15	International consortium of carriers
WASACE North (WASACE Phase III)	WASACE Cable Company

7.2 Transpacific

7.2.1 Bandwidth and Capacity

Investment in new transpacific systems has been more consistent than in the Atlantic. New transpacific cables began entering into service less than six years after completion of the last cable from the "dot-com" investment boom. Furthermore, while Internet bandwidth markets on both sides of the North Atlantic quickly matured and settled into growth rates of less than 30 percent, the overall growth of Asian bandwidth demand has been more characteristic of emerging markets.

Table 5: Existing Transpacific Cable Systems

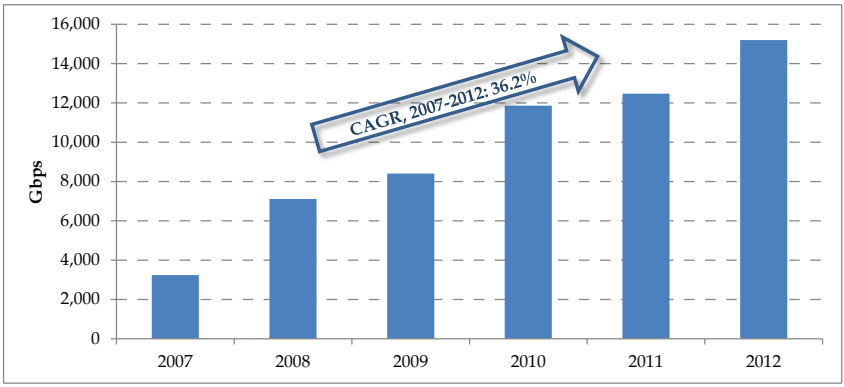
RFS	System	Owner(s)
2000	Pacific Crossing-1 (PC-1)	NTT
2001	China-US Cable Network	International consortium of carriers
2001	Japan-US Cable Network	International consortium of carriers
2002	TGN-Pacific	Tata Communications
2008	Trans Pacific Express (TPE)	International consortium of carriers
2010	Asia-America Gateway (AAG)	International consortium of carriers
2010	Unity / EAC Pacific	Pacnet / Google / Bharti / Global Transit (Time dotCom) / KDDI / Singtel

The transpacific market suffered a shock with the activation of three new systems between 2008 and 2010. Each of the three new systems targeted its own market segment: Trans Pacific Express (TPE) catered to China's transpacific demand; Asia-America Gateway (AAG) was the first cable to connect North America

directly to Southeast Asian markets; and Unity/EAC Pacific, led by Pacnet and Google, positioned itself as a complement to data center infrastructure in the United States and Japan. Between 2008 and 2010 the number of active transpacific systems increased dramatically, from four to seven. Furthermore, the Unity/EAC Pacific project, with more than two-thirds of its capacity controlled by non-operators and wholesalers, opened up the Japan-US wholesale market, which until then had been dominated by TGN Pacific and Pacific Crossing-1. As a result, transpacific prices fell by as much as 50 percent in one year.

As of year-end 2012, activated transpacific capacity was 15.2 Tbps. Using 40G technology, and based on demonstrated upgradeability in the field, the combined design capacity of transpacific systems is at least 60 Tbps. Theoretical upgradeability based on the full potential of 40G and 100G may ultimately reveal itself to be significantly higher, but the length of transpacific spans is expected to pose a significant obstacle to the maximum implementation of wavelengths and higher line rates.

Figure 10: Total Activated Transpacific Capacity, 2007-2012

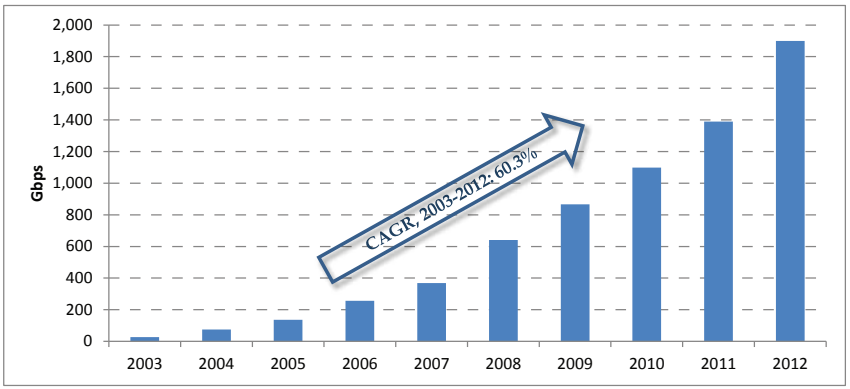


In addition to strong bandwidth growth, the case for new deployment in the transpacific is bolstered by the technical challenges of implementing 40G and 100G upgrades on the route's existing submarine segments, some of which are among the longest cable spans in the world. There is also greater geographical segmentation in the transpacific market, with operators in secondary Southeast Asian markets showing a sustained desire

for additional transpacific connectivity that lands directly on their shores. It should be noted, however, that prohibitive costs may lead some Southeast Asian submarine projects to ultimately opt to land in markets such as Guam, rather than constructing complete transpacific spans.

Over the long term, the primary driver of transpacific and Asian submarine markets will undoubtedly be the growth of Chinese Internet and telecommunications markets. As of 2013, Chinese international bandwidth exceeds 2 Tbps, with 52 percent directed toward the United States. Although international bandwidth demand from China still remains a distant second in the region, behind Japan's which is approximately 3 Tbps, the Chinese market nevertheless shows the strongest prospects for growth in the region, driven by its fixed broadband market which is expected to exceed 200 million subscribers by 2014. The country's fiber-to-the-home market exceeds 25 million and more than 8 million fiber kilometers have been deployed. China's 12th Five-Year Plan calls for broadband speeds to increase to 20 Mbps in urban areas and 4 Mbps in rural areas by 2015.

Figure 11: Chinese International Internet Bandwidth, 2003-2012



7.2.2 New Systems

There have been few formal announcements of proposed transpacific systems between Asia and North America.

Table 6: Planned Transpacific Cable Systems

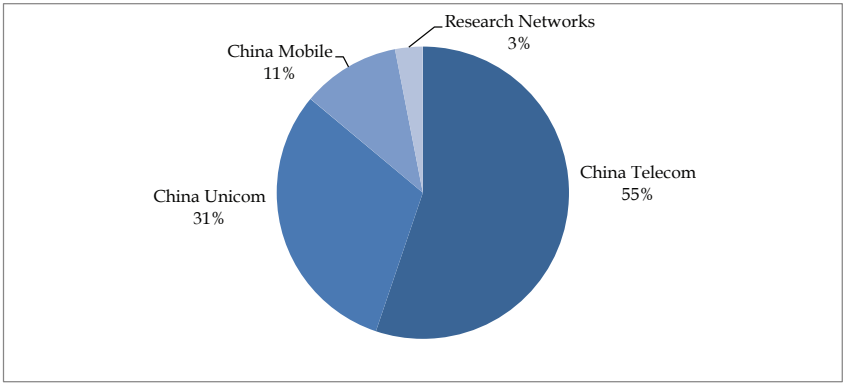
System	Owner(s)
China-US-2	International consortium of carriers
Serantau Cable System (Malaysia-US)	Konsortium Rangkaian Serantau Sdn Bhd
Southeast Asia-US	International consortium of carriers
Trans Pacific Express (TPE) Expansion	International consortium of carriers

Given the tremendous costs involved in constructing a transpacific cable system, the route has historically been a less attractive market for investor-led projects, with operators taking the leading role. It is expected that there will be a continuation of the trend of comparatively smaller transpacific consortia, which during the last round of transpacific deployment consisted of between six and 17 telecommunications and Internet companies.

For the foreseeable future, operators in China and Japan will likely have the strongest influence on future deployment of submarine cables in the North Pacific.

In China, China Telecom and China Unicom have respective shares of 13 and 26 percent in the Trans Pacific Express (TPE) system, but it is unclear how long these shares will accommodate each operator's demand, and both operators are believed to be seriously considering options for additional capacity. China Mobile is also expected to adopt a more aggressive stance with respect to transpacific capacity; the operator has recently begun making investments in Asian regional submarine capacity including the Southeast Asia-Japan Cable (SJC) and Asia-Pacific Gateway (APG), and is constructing its own Global Network Centre in Hong Kong to integrate its data center services and submarine connectivity.

Figure 12: Chinese Operators' Share of China's International Internet Bandwidth, 2013



Japan's 3 Tbps of bandwidth demand remains the largest in the region and for the immediate future the transpacific bandwidth demand of the country's leading operators NTT and KDDI will likely be accommodated by their investments in the PC-1 and Unity systems, respectively. However, the country's third major operator, Softbank Telecom, is expected to emerge as an aggressive investor in submarine bandwidth following its pending mid-2013 acquisition of 70 percent of Sprint Nextel. The acquisition will give Softbank an expanded portfolio of lit submarine cable assets in the Pacific, the Atlantic, and Latin America and is expected to transform Softbank into the world's third-largest mobile operator by revenue, behind only China Telecom and Verizon.

Among the transpacific projects that have been announced to the public, one of the most developed plans is for the Serantau Cable System, which was proposed by the Konsortium Rangkaian Serantau (KRS), a group of 24 Malaysian operators. The 18,500 kilometer system would connect Malaysia and the United States, and would avoid two major submarine cable "choke points" in the Luzon Strait and the waters off Singapore, which are vulnerable to earthquakes and anchor damage, respectively. However, as of 2013 the Malaysian government's financial support, which would likely be a prerequisite in order to move forward, remains uncertain.

Although there don't yet appear to be any credible plans to develop transoceanic connectivity from Russia's pacific coast, Terabit Consulting's internal analysis has identified a relatively strong market opportunity for direct connectivity between the east coast of Russia and either Alaska, Canada, or the US West Coast.

Over the longer term, Terabit Consulting also expects serious operator-led initiatives for single-cable transpacific connectivity between the United States and India, which would address some of the risk posed by concentration of India-bound cables through Egypt (the proposed BRICS cable would also do the same, albeit in the opposite direction).

7.3 North and South America

7.3.1 Bandwidth and Capacity

The North America-South America capacity market is heavily dependent on three privately-owned geographic ring networks: Oi's GlobeNet, Telefonica's SAM-1, and Level 3's South American Crossing (the latter connects to the mainland United States via Level 3's other Latin American cables, Mid-Atlantic Crossing and Pan-American Crossing).

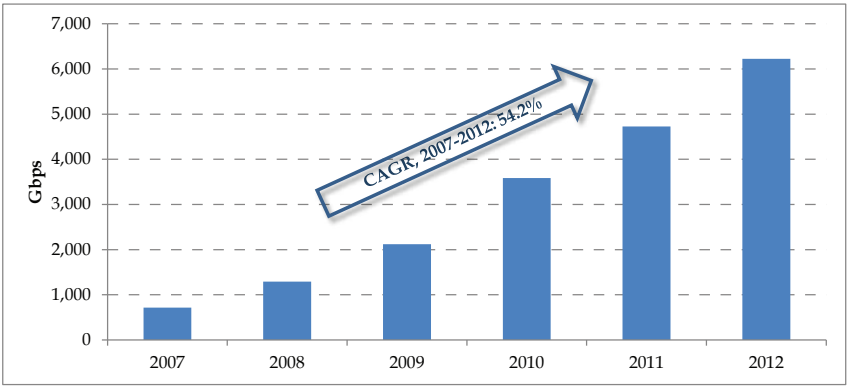
Americas-II is the only other existing link between the United States and Brazil; it was constructed by a consortium of more than a dozen operators in 2000 and has been upgraded to levels well beyond its initially-stated design capacity, although its design capacity is still estimated to be below those of the three geographic ring systems. Connectivity to the northern and western coasts of the continent, meanwhile, is provided by the consortium cables Maya-1 and Pan American, as well as by Columbus Networks' Arcos-1 and CFX-1 systems.

Table 7: Existing US-Brazil Cable Systems

RFS	System	Owner(s)
2000	Americas-II	Consortium
2001	GlobeNet	Oi
2001	SAM-1	Telefonica
2001	South American Crossing (SAC)	Level 3 *(LANautilus (Telecom Italia) fiber pair)*

As of year-end 2012, lit submarine cable capacity between North America and South America was 6.3 Tbps. Growth in activated submarine capacity has been extremely high, with a compound annual growth rate of 54 percent over the last five years.

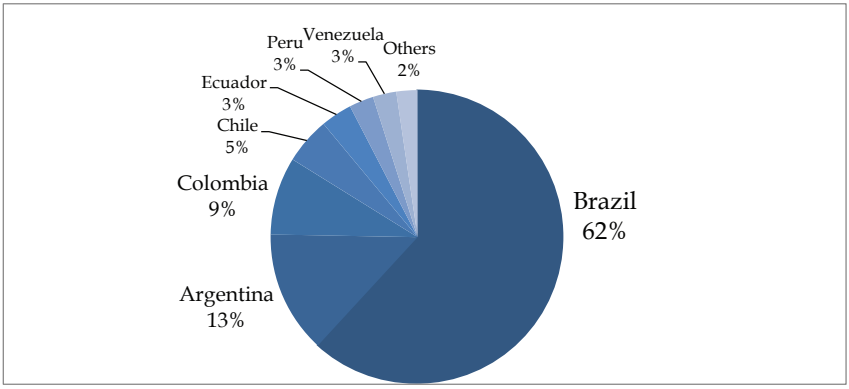
Figure 13: Total Activated North America-South America Capacity, 2007-2012



The dynamics of the Latin American market are unique; the majority of Internet demand is directed to North America (specifically Miami), and bandwidth pricing remains among the highest of any region, ranging from $25 per Mbps for volume IP transit in Brazil to $80 per Mbps in Paraguay. Transport pricing on the North America-South America route is as much as ten times higher than transatlantic pricing. This is due in large part to the relatively tight control over the marketplace exhibited by the three major wholesalers (Level 3, Oi, and Telefonica), as well as unforeseen bandwidth growth in the continent's primary markets, combining to create a "seller's market."

Growth in South American bandwidth demand, though strong in almost all of the region's markets, is driven by Brazil, which accounts for half of the continent's population but five-eighths of its international bandwidth demand. Brazil's economic growth has been strong and more equitable than in other developing markets, resulting in a larger addressable base for telecommunications and Internet services, and the 2014 World Cup and 2016 Summer Olympics are expected to result in even greater increases in bandwidth demand. The country's Plano Nacional de Banda Larga (PNBL), administered by state-owned Telebras, aims to provide 1 Mbps high-speed Internet connections for US$18 per month and has attracted commitments from most major operators.

Figure 14: Share of South American International Bandwidth Demand by Country, 2013



7.3.2 New Systems

Future deployment of submarine connectivity to South America will be driven in large part by the bandwidth requirements of Brazil's major operators. Three of Brazil's four largest telecommunications operators have ownership of significant (terabit-capable) submarine cable assets. The notable exception is America Movil, which owns the country's Claro, Embratel, and Net brand names.

It is therefore unsurprising that the most advanced South American submarine cable project in terms of development, according to sources, is America Movil's AMX-1 cable, which will connect Brazil, Colombia, Puerto Rico, the Dominican Republic, the mainland United States, Mexico, and Guatemala. The project's supplier, Alcatel-Lucent, asserts that the 17,500-kilometer cable will have a trunk design capacity of more than 50 Tbps using 100 Gbps technology.

Table 8: Major Brazilian Operators and Their Submarine Cable Assets, 2013

	Fixed Line Market Share Rank	**Mobile Market Share Rank**	**Fixed Broadband Market Share Rank**	**Submarine Cable Assets**
Oi	1	4	1	**GlobeNet**, Consortium Cables
Telefonica/ Vivo	2	1	3	**SAM-1**, Consortium Cables
Net/ Claro/ Embratel (America Movil)	3	3	2	Consortium Cables
TIM (Telecom Italia)		2		**SAC** (via LANautilus Fiber Pair)
GVT (Vivendi)	4		4	
Telebras	N/A (Established to manage the *Plano Nacional de Banda Larga)*			

In March of 2012 Boston, USA-based Seaborn Networks revealed plans for its Seabras-1 project. Unlike other Latin American cable projects, Seaborn-1 would connect only the United States and Brazil, and notably, the project would pursue a "carrier's carrier" business plan. Selling capacity on the open market in Brazil may prove to be challenging, given the aforementioned dynamics of the country's telecommunications sector. The end-user market is concentrated in the hands of a few operators, three of which (Oi, Telefonica, and Telecom Italia) have their own terabit-capable networks in place between Brazil and the United States, with a fourth (America Movil) expected to

launch its own before the end of the year. A May 2012 announcement that Tata Communications would become an "anchor tenant" on the Seabras-1 system was a significant step forward although Tata is not currently a major player in the region's end-user markets. Nevertheless, Seabras-1's supplier Alcatel-Lucent reported in January of 2013 that it was performing a marine survey and Seaborn said that the 32-Tbps, 100G-capable system was expected to be activated in 2015.

In 2012 Alcatel-Lucent was also awarded the turnkey contract for a third 100G-capable North America-South America submarine project, the comparatively modest Pacific Caribbean Communications System (PCCS), which would span 6,000 kilometers from the United States to Ecuador and Colombia via the Caribbean and Central America.

Table 9: Proposed Latin American Systems

System	Owner(s)
America Movil-1 (AMX1)	America Movil
Atlantic Cable System-US (ACSea-US)	Telebras
BRICS Cable	Imphandze Subtel Services (S. Africa)
Pacific Caribbean Communications System (PCCS)	Consortium
Seabras-1	Seaborn Networks (USA)
Transamericas Broadband Infrastructure (TBI)	Consortium
WASACE Americas	WASACE Cable Worldwide / Aterios Capital

At least four other projects would also provide connectivity between North America and South America, although none had announced supply contracts as of early-2013. They included three projects that would be integrated with larger interregional networks: Telebras'

Atlantic Cable System (ACSea), the BRICS Cable, and WASACE Americas.

ACSea would form part of a hub network connecting Brazil to North America, Europe, and Africa via a series of cables. BRICS, meanwhile, would provide connectivity between the United States, Brazil, South Africa, India, Singapore, China, and Russia. WASACE would comprise intercontinental links from Europe to North America to South America to Africa.

The fourth proposed project that has yet to announce a supply contract, Transamericas Broadband Infrastructure (TBI), would consist of an ambitious consortium-led North America-Latin American geographic ring system along both sides of South America. Among the investors that had reportedly considered participating at one time or another were AT&T, Google, France Telecom, and least a dozen Latin American operators.

7.4 Australia and New Zealand

7.4.1 Bandwidth and Capacity

The international bandwidth market in Australia and New Zealand has shown tremendous growth, with the two countries' combined international bandwidth currently well in excess of 1 Tbps, more than 80 percent of which is directed toward the United States. Between 2011 and 2012, the total volume of data downloaded via Australia's broadband networks grew by 51 percent. Future growth in the countries' international bandwidth demand is expected to be significantly higher than in other developed markets due to aggressive government-led investment in broadband infrastructure. In Australia, the rollout of the $40-billion Australian National Broadband Network (NBN) is well underway, with more than 3.5 million residences and businesses set to be connected to fiber by 2014 and fiber connectivity for more than 90 percent of the population by 2021, ultimately promising 1 Gbps of download bandwidth to the home. Across the Tasman Sea, meanwhile, New Zealand's Ultra-Fast Broadband (UFB) initiative aims to connect 75 percent of the country's population to broadband service with download speeds of at least 100 Mbps by 2020.

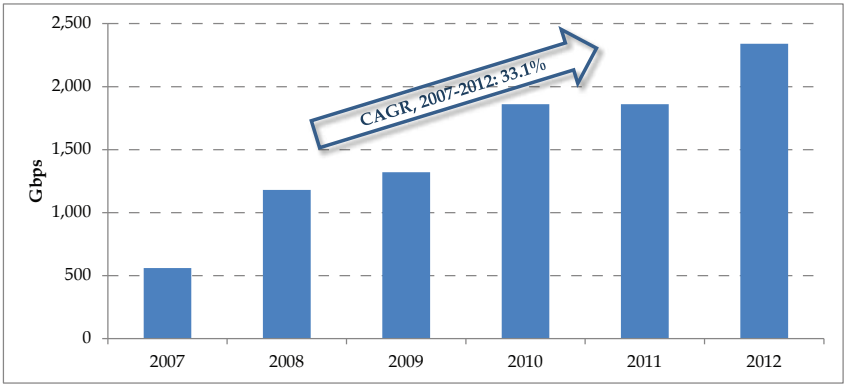
Table 10: Existing Australia/New Zealand Intercontinental Systems

RFS	System	Owner(s)
1997	Jasaurus	International consortium of carriers
1999	Sea-Me-We-3	International consortium of carriers
2001	Southern Cross Cable Network (SCCN)	TNZ / Singtel Optus / Verizon
2002	Australia-Japan Cable (AJC)	International consortium of carriers
2008	Endeavour	Telstra

2009	Pipe Pacific Cable-1 (PPC-1)	TPG Telecom

The lit bandwidth of Australian and New Zealand Pacific cables exceeded 2.3 Tbps as of year-end 2012, although much of the countries' international bandwidth is configured as protected paths on Southern Cross. It should also be noted that Southern Cross alone expects to increase its lit capacity by an additional 1 Tbps in 2013.

Figure 15: Total Activated Capacity between Australia & New Zealand and the United States (including Hawaii and Guam), 2007-2012



With its elevated demand for long-distance bandwidth in the direction of the United States, relatively limited number of intercontinental submarine cables, and bandwidth prices remaining stubbornly high at between $25 and $40 per Mbps for volume purchases, the Australian and New Zealand international bandwidth market would at first glance seem to be an attractive opportunity for submarine cable investors. However, the failure of the proposed Australia-US Pacific Fibre project revealed the pitfalls of trying to compete in an environment where both the retail market and international submarine infrastructure are dominated by a handful of operators.

Table 11: Market Share of Major Operators in Combined Australia & New Zealand Markets, and Their Key Intercontinental Submarine Cable Assets, 2013

	Fixed Line Market Share	Mobile Market Share	Fixed Broadband Market Share	Key Intercontinental Submarine Cable Assets
Telstra	74%	40%	48%	Endeavour & AAG Fiber Pair to US (100%); Australia-Japan Cable (47%)
Optus (Singtel)	9%	27%	14%	Southern Cross (40%)
Vodafone / Vodafone Hutchison		25%	6%	
Telecom New Zealand / AAPT	9%	5%	7%	Southern Cross (50%)
Subtotal, Top 4 Operators	**92%**	**97%**	**75%**	
Other Operators	8%	3%	25%	Pipe Pacific Cable-1 (TPG Telecom)

Four telecom groups, Telstra, Singtel Optus, Telecom New Zealand, and Vodafone/Vodafone Hutchison Australia, control approximately 93 percent of the combined consumer market in Australia and New Zealand. Telstra, Optus, and Telecom New Zealand, which collectively control about 76 percent of the consumer market, each have their own high-capacity systems toward the United States. The presence of TPG Telecom's Pipe Pacific Cable (PPC-1), which connects to Guam, further limits the addressable

market for submarine cable investors looking to connect Australia and New Zealand with the United States.

Consequently, any future investment in submarine infrastructure between Australia and the United States will require the participation of either a major operator or a government investor, in the form of equity or a very large capacity commitment.

7.4.2 New Systems

Perhaps the most serious effort in the last ten years to construct a new cable between Australia and the mainland United States was Pacific Fibre. The project was first announced in early-2010 and development continued in earnest for more than two years; in mid-2010 Asian submarine cable operator Pacnet was identified as a potential investor in the project, and the project was also buoyed by Vodafone's pledge in 2011 to shift its capacity from Southern Cross onto the new cable once it entered service. Total pre-sales on Pacific Fibre, to a base of what was reported to be five "foundation" customers including Vodafone, iiNet, and New Zealand research network REANNZ, were said to amount to $170 million.

By early-2012, however, rumors began circulating that the project was encountering strong resistance in its fundraising efforts. In response, investors Rod Drury, Sam Morgan, Peter Thiel, and Sir Stephen Tindall announced in mid-2012 that they would inject additional capital into the endeavor. Some sources indicated that the project may have also been in a position to attract funding from Chinese investors, but such efforts were ended because of espionage fears expressed by US authorities.

By July of 2012, Mr. Drury revealed that the project had only raised half of its required funding and would be abandoned. Shortly after the project collapsed, one of its co-founders, Lance Wiggs, predicted that one major outcome of Pacific Fibre's failure would be higher bandwidth prices. Mr. Wiggs conceded that the telecommunications markets in Australia and New Zealand were controlled by the same limited number of investors that controlled the submarine infrastructure, and claimed that the Pacific Fibre project was defeated in part by "a well-known game theory scenario from other cable markets, where typically incumbents drop prices just enough to discourage credible threats and then prices remain

static and monopoly rent-taking ensues. Indeed the self-reported historical Southern Cross prices were amusingly static and then plummet arguably around about the same time as various credible threats turn up."

In late-2012, a number of proposals emerged to succeed the original Pacific Fibre endeavor. Kim Dotcom, the founder of the seized file-sharing service Megaupload, indicated that he would revive the Pacific Fibre project as part of his plan to re-launch Megaupload in New Zealand. However, skeptics noted that efforts by the US Department of Justice to extradite Mr. Dotcom from New Zealand in order to stand trial on charges of copyright infringement might prove to be an obstacle if his project were to apply for a submarine cable landing license in the United States.

Also in late-2012, Australian communications minister Stephen Conroy indicated that the Australian government might consider investing in a submarine cable to the United States as part of its National Broadband Network initiative. "If the international market doesn't improve, for $250 million out of a $40 billion budget I'll build a link to the US to bring prices down," he told an Internet conference in New York. Some observers praised the plan as necessary intervention to address what they perceived to be a market failure, but as of 2013 the Australian government had given no indication that it intended to proceed with such an investment.

At approximately the same time, SubPartners, led by the developer of the Pipe Pacific Cable project Bevan Slattery, announced that it would construct two intercontinental cables serving Australia: Asia Pacific Express East (APX-East) to Hawaii and California, and Asia Pacific Express West (APX-West) to Indonesia and Singapore. The company said that it would differentiate itself from other projects by allowing customers to purchase partial fiber pairs or "spectrum ownership" that would allow the customers to benefit from advancements in transmission technology.

In addition to the APX cables, the informal Australia NBN proposal, and the Kim Dotcom plan, several other projects would provide intercontinental connectivity to Australia, primarily via the country's west coast. The proposed Australia-Singapore Submarine Cable (ASSC-1) project between Perth and Singapore was initially proposed in early-2012 and indicated that Telstra had committed

to purchase a fiber pair; however it appeared to be negatively impacted by the Australian government's hostility toward Huawei, which would have participated in the supply of the project through its joint venture Huawei Marine. A similar system proposed by Leighton Holdings, the Australia-Singapore Cable (ASC), was reportedly still on the table even as the company moved to sell off its telecommunications assets. Matrix Cable System's submerged branching units also leave open the possibility of future expansion of that system to Perth.

Elsewhere, sources have indicated that the Pacific Transit Cable, first proposed approximately 12 years ago as a South Pacific link between Australia, New Zealand, and Chile, is once again under consideration, and the proposed Hawaiki cable would connect Australia, New Zealand, and Hawaii with branches to several South Pacific islands.

Table 12: Proposed Australia/New Zealand Intercontinental Systems

System	Owner(s)
Asia Pacific Express East (APX-East)	SubPartners
Asia Pacific Express West (APX-West) (formerly Australia-Indonesia-Singapore Cable)	SubPartners
Australia NBN Cable	Government of Australia
Australia-Singapore Cable (ASC)	Leighton Contractors Telecommunications (Australia-Singapore Cable Ltd.)
Australia-Singapore Submarine Cable (ASSC-1)	ASSC-1 (JPC International)
Hawaiki	Hawaiki Cable / Intelia
Matrix Cable System Australian Expansion	Brantwood International Ltd. / Causeway Bay Investments Ltd.

Pacific Fibre	Originally Pacific Fibre Ltd.; revival proposed by Kim Dotcom
Pacific Transit Cable (PTC)	CTC (Chile)
Southern Cross Cable Network-2 (SCCN-2)	Southern Cross Cables Ltd.

The market opportunity for intercontinental capacity was potentially made more complex by the February 2013 announcement that Telecom New Zealand, Telstra, and Vodafone would cooperate in building a $60 million cable between Australia and New Zealand to be known as Tasman Global Access (TGA). The project's proponents said that the cable would increase each country's access to the other's international submarine cables, but New Zealand operator CallPlus (the parent company of ISP Slingshot) said that it would express concern to regulatory authorities about what it perceived to be the anti-competitive nature of the project.

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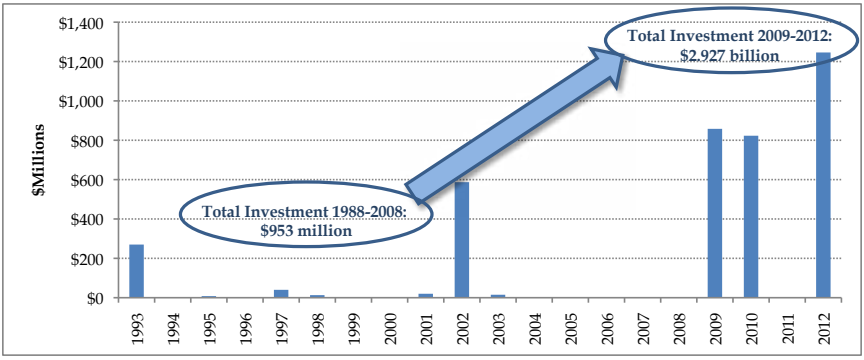
7.5 Sub-Saharan Africa

7.5.1 Bandwidth and Capacity

Until four years ago, Sub-Saharan Africa was the most underserved region in the world with respect to international fiber capacity. East Africa was particularly underserved and reliant exclusively on costly and less-reliable satellite connections; the 6,700-kilometer stretch of coastline between Mtunzini, South Africa and Djibouti had the dubious distinction of being the world's longest expanse of shore without an international submarine cable.

In the mid-2000s, the scenario changed dramatically, driven by three factors. First, the adoption of mobile phone service throughout the continent exceeded all expectations, driving growth in both bandwidth demand and operator revenue. Second, international financial institutions including the World Bank and the African Development Bank, as well as private financiers, increased their lending for telecommunications infrastructure projects in the region, particularly fiber optic networks. At the same time, submarine suppliers began to focus on potential greenfield opportunities in Africa in order to counteract the lack of new investment in transoceanic markets, often proposing attractive prices for potential new African projects in an attempt to stimulate demand.

Figure 16: Investment in New Sub-Saharan African Systems, 1993-2012



The result was a wave of major investment between 2009 and 2012 totaling almost $3 billion that included three intercontinental cables along the east coast (TEAMS, Seacom, and EASSy), four along the west coast (Glo-1, Main One, ACE, and WACS), and additional investment in regional systems (including Adones, LION, LION-2, and the Seychelles-East Africa System).

Table 13: Existing West African Intercontinental Systems

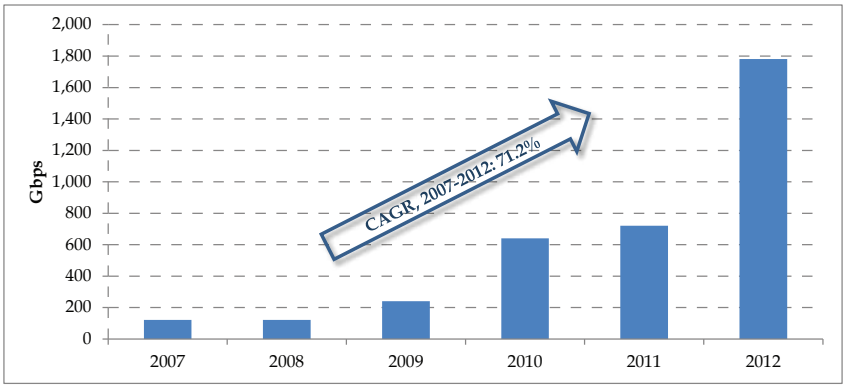
RFS	System	Owners
1993	SAT-2	Consortium
2002	SAT-3/SAFE	Consortium
2010	Glo-1	Globacom
2010	Main One	Main Street Technologies
2012	Africa Coast to Europe (ACE)	Consortium
2012	West Africa Cable System (WACS)	Consortium

Table 14: Existing East African Intercontinental Systems

RFS	System	Owners
2009	East Africa Marine System (TEAMS)	TEAMS Ltd. / Etisalat
2009	Seacom	IPS (Aga Khan Fund) / Remgro / Herakles Telecom / Convergence Partners / Shanduka Group
2010	East African Submarine Cable System (EASSy)	Consortium / West Indian Ocean Cable Company (WIOCC)

The arrival of next-generation submarine systems to the Sub-Saharan African market over the last four years has had a dramatic impact on the continent's international bandwidth, with annual growth in demand exceeding 100 percent in many markets, and total lit capacity in Sub-Saharan African submarine cable systems increasing by 71 percent annually over the last five years.

Figure 17: Total Activated Sub-Saharan African Intercontinental Capacity, 2007-2012



Overall, the majority of next-generation Sub-Saharan African submarine cable projects are either majority- or wholly-funded by telecommunications operators, sometimes in the form of consortium projects such as EASSy and WACS. The carrier-funded projects, dimensioned around operators' own estimated bandwidth requirements, are generally perceived to be less risky than investor-led models predicated on the sale of wholesale capacity to operators.

Consequently, a key issue surrounding the African submarine cable market is whether the wholesale capacity business model, particularly projects led by private non-telecom investors, can survive and flourish. Analysis reveals that the wholesale market is rife with both opportunities and challenges.

On the one hand, the addressable market of African wholesale bandwidth customers is more promising than in many other regions. Sub-Saharan Africa has 49 markets and dozens of operators with international bandwidth demand, none of whom are dominant on a continental basis, and many of whom were until

recently paying inflated satellite capacity prices. In this respect, the continent meets what Terabit Consulting has identified as an optimal scenario for private investment in submarine infrastructure: many of the region's operators lack the resources to make their own investments in intercontinental infrastructure. Opportunity also presents itself to wholesale providers in the form of the continent's persistently high bandwidth prices; some Sub-Saharan African markets still command hundreds of dollars per Mbps for Internet transit bandwidth via Europe.

On the other hand, the African wholesale capacity market faces significant challenges due primarily to the restrained development of the continent's domestic Internet markets. Africa's fixed-broadband deployment is negligible compared to other regions, and mobile Internet usage, still largely 2G in many markets, has not shown the growth rates that initially characterized the uptake of mobile voice and texting services. Perhaps, more importantly, operators' control over the terrestrial segments of the network infrastructure poses an obstacle to the efficient distribution of submarine capacity, beginning with shore-to-city backhaul and international gateways, and throughout domestic transmission and access networks, which in many cases are significantly underdeveloped. In most African countries, domestic infrastructure effectively imposes both an economic and technical bottleneck on international submarine capacity, with exorbitant interconnection and access prices charged by domestic operators for what is often low-bandwidth, unreliable infrastructure.

Regardless of the performance of Africa's wholesale bandwidth market, Terabit Consulting does not forsee an overall bandwidth "glut." The design capabilities of sub-Saharan Africa's submarine cable systems will greatly exceed demand for the foreseeable future, but the dynamics of the African telecommunications market, particularly its historical resistance to both consolidation among operators and transborder market integration, allow it to support multiple submarine cable projects. Most African operators are financially healthy and willing to invest in or purchase submarine cable capacity.

7.5.2 New Systems

Although some existing West Coast systems propose the construction of extensions to South Africa and several smaller projects propose intraregional connectivity, most of the proposed investment in Sub-Saharan African submarine market focuses on the construction of transatlantic systems between Africa and Latin America. Some projects specifically target the linguistic ties between Lusophone countries including Brazil and Angola. Most of the projects position South Atlantic spans as part of larger network build-outs that include connectivity to North America, Europe, or Asia.

For there to be significant South Atlantic demand between Africa and South America, Terabit Consulting believes that there may need to be greater progress in the Southern Hemisphere's Internet content development, Internet routing patterns, political relations, and overall economic development. In the meantime, there is perhaps a more immediate opportunity for single-system (or otherwise seamless) connectivity between Africa and the United States.

Table 15: Proposed Sub-Saharan African Intercontinental Systems

System	Owners
Atlantic Cable System-Africa (ACSea-AFR) (Possible integration of project with SACS)	Telebras / Odebrecht
BRICS Cable	Imphandze Subtel Services (S. Africa)
South Atlantic Cable System (SACS) (formerly Angola-Brazil)	Angola Cables / Telebras
South Atlantic Express (SAEx)	eFive Telecoms
WASACE South	WASACE Cable Worldwide / Aterios Capital

7.6 South Asia & Middle East/Europe-Asia

7.6.1 Bandwidth and Capacity

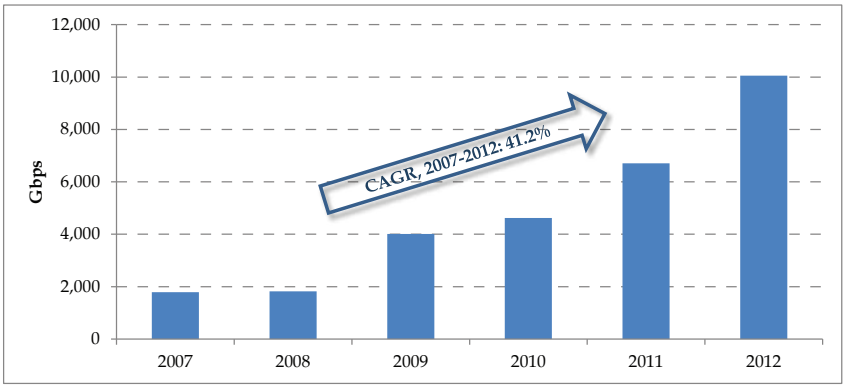
India, with incoming international Internet bandwidth in excess of 1 Tbps as of 2012, is the leading generator of bandwidth demand in South Asia and the Middle East. India's demand far exceeds the combined demand of the regions' next three largest bandwidth markets, which in descending order are Saudi Arabia, the United Arab Emirates and Pakistan. The Indian international bandwidth market is unique for its strong ties to the United States; as of 2013 India is the United States' leading voice correspondent, accounting for more than one out of every four outgoing international calls made in the United States, and the combined, bidirectional international Internet bandwidth (both direct and connecting) between the two countries is itself on track to exceed 2 Tbps in late-2013 or early-2014.

Terabit Consulting's analysis shows that the near-term promise of the Indian telecommunications market will likely be weaker than China and Brazil, due primarily to structural problems in the Indian economy. On the surface, Indian economic statistics appear to be encouraging: in less than ten years, between 2002 and 2010, the Indian middle- and upper-class (characterized as households with incomes in excess of USD$4,000 per year) grew from 13.8 million households to 46.7 million. Extremely impoverished households earning less than $1,000 per year fell from 65.2 million to 41 million. Yet despite the country's income gains, middle- and upper-class households still account for less than 20 percent of the population. The size of the country's so-called "in-between class," classified as having an income of between $1,000 and $4,000 per year per household, remained steady at more than three-fifths of the population; the average household comprises more than five inhabitants so the upper bound of this classification translates to roughly $2.20 per household member per day.

In light of the low income of many of the country's households, mobile voice services are extremely affordable: Indian ARPU is among the lowest in the world at approximately 114 INR (USD$2). However, the industry's long-term challenge will be to ensure widespread penetration of broadband Internet services, which so far have failed to achieve significant penetration outside of the

country's upper class. A primary obstacle is the country's low computer ownership, at less than 10 percent of households. In addition, national broadband initiatives proposed by the Indian government have failed to gain traction. Affordable ADSL packages do exist, but fiber-based broadband services are significantly more expensive than in the rest of the world; the country's largest Internet service provider recently launched a fiber-to-the-home service priced at INR 2,999 (USD$56) per month for the lowest bandwidth of just 1 Mbps. On the mobile side, 3G adoption has been weaker than expected, and its growth has been restrained by widespread consumer complaints about high prices, weak coverage, incompatible handsets, and "bill shock."

Figure 18: Total Activated South Asian Interregional Capacity, 2007-2012



The South Asian and Middle Eastern bandwidth market has recently been dominated by efforts to provide a cost-effective and reliable path to Europe that avoids the bottleneck of cables crossing terrestrially through Egypt. The concern is not new; carriers had expressed concerns about the Egyptian crossing since the 1990s and their fear of catastrophic cable outages were realized multiple times, most notably in 2008 when Sea-Me-We and FLAG cables were cut simultaneously, prompting speculation of a political or military conspiracy. Frustration increased when Egyptian authorities delayed the landing of new cable systems in order to allegedly accommodate surveillance requirements put in place by the Egyptian Office of Military Services and Reconnaissance.

Cable operators' concern was further heightened by the political uncertainty accompanying the Egyptian Revolution of 2011. Simultaneous cable outages in Egypt have resulted in the loss of as much as 80 percent of India's international bandwidth.

Various routings have been constructed or proposed in order to compete against cables passing through Egypt. One of the first submarine alternatives was the SAT-3/SAFE project which in 2002 provided the first Europe-Asia connectivity via South Africa but with greater latency. Fiber optic systems connecting India eastward started to appear at approximately the same time but created an equally-risky chokepoint in the Strait of Malacca. Then in 2011, largely as a result of political uncertainty in Egypt, plans were finalized for multiple terrestrial networks bypassing Egypt to the east including Europe Persia Express Gateway (EPEG), Regional Cable Network (RCN), and Jeddah-Amman-Damascus-Istanbul (JADI Link).

Both RCN and JADI Link pass through Syria and have reportedly been impacted by the country's civil war. EPEG opted for a route through Iran, and in 2013, Gulf Bridge International (GBI) announced a terrestrial link via Iraq. Political risk in each of those countries, as well as embargo restrictions imposed by the US government against American operators considering investments in the region, have prevented any of the terrestrial networks from emerging as a viable solution. At the same time, a wide range of problems with the Egyptian crossing (ranging from economic to technical and political) have made the quest for an economically- and technically-viable "Egyptian bypass" one of the submarine industry's top priorities.

Table 16: Existing South Asian Interregional Systems

RFS	System	Owners
1997	FLAG Europe-Asia (FEA)	Reliance Globalcom
1999	Sea-Me-We-3	Consortium
2002	i2i	Bharti Airtel
2002	SAT-3/SAFE	Consortium

2004	TGN-TIC	Tata Communications
2005	Sea-Me-We-4	Consortium
2006	Falcon	Reliance Globalcom
2009	Seacom / TGN Eurasia	IPS (Aga Khan Fund) / Remgro / Herakles Telecom / Convergence Partners / Shanduka Group / Tata Communications
2010	I-Me-We	Consortium
2011	Europe India Gateway (EIG)	Consortium
2012	Gulf Bridge International (GBI) / MENA	Gulf Bridge International / Orascom Holdings

7.6.2 New Systems

Three proposed interregional projects serving South Asia have been mentioned publicly: Sea-Me-We-5, BRICS Cable, and the Tagare Cable.

Bharti Airtel, China Mobile, China Telecom, France Telecom, Saudi Telecom Company, and Singtel have been identified as the leaders of the new Sea-Me-We-5 consortium, which is reportedly considering options to bypass Egypt. The project would be the first Sea-Me-We endeavor with strong influence from Chinese operators, and would compete against the roughly one dozen international cables already serving India, as well as two other proposed systems: the BRICS cable, which would be the first system to provide a direct link between India and the United States, and the proposed "Tagare Cable." There are also a handful of other proposals for cables between South Asia, the Middle East, and Europe, typically put forward by smaller groups of operators, sometimes as a bargaining tool to improve terms with other existing or planned projects. As of 2013 none of these other projects was reported to have gained any significant traction.

Terabit Consulting expects that the most successful projects in South Asia and the Middle East will be those that can provide economically and technically viable means of bypassing Egypt.

Table 17: Proposed South Asian Interregional Systems

System	Owners
BRICS Cable	Imphandze Subtel Services (S. Africa)
Sea-Me-We-5	Consortium
Tagare Cable	Neil Tagare

7.7 Pan-East Asia

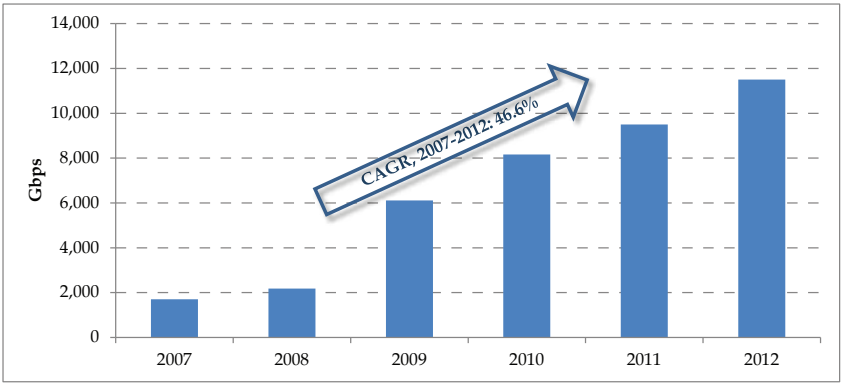
7.7.1 Bandwidth and Capacity

Much of the existing pan-East Asian submarine infrastructure is controlled by either private wholesale investors or operators from outside the region. In the former category, wholesaler Pacnet owns two of the region's largest networks, EAC and C2C, which it markets under a single brand name, EAC-C2C. Among the operators from outside the region with large investments, Reliance Globalcom of India and Telstra of Australia have ownership in the RNAL/FNAL cable system, and Indian operator Tata Communications is a major shareholder in TGN Intra-Asia.

The greatest intrigue surrounding the Pan-East Asian submarine bandwidth market came at the beginning of May, 2012, when Indonesia's largest operator PT Telekomunikasi indicated that it would submit an offer for Pacnet with expected financial closure by mid-year. On May 21st, Pacnet abruptly issued a statement that "effective today," long-time CEO Bill Barney "is no longer serving as chief executive officer and the board of directors thanks him for his service to Pacnet." Just as abruptly, the CEO of PT Telekomunikasi said on June 5th that "we cancel our plan to buy Pacnet because it doesn't bring added value to the company." Thus ended a brief courtship that would have had the potential to significantly alter the Asian telecommunications landscape, with rumors abounding as to the circumstances that shaped the events.

Some observers asserted that there may have been operational concerns unique to Pacnet while others pointed to the negative economic environment that had brought down other transactions such as Reliance Globalcom's proposed $1.5 billion initial public offering of its FLAG Telecom submarine cable unit on the Singapore Exchange, which the company was forced to abandon in July of 2012, stating that it would "await appropriate market conditions to unlock the full value of FLAG Telecom assets."

Figure 19: Total Activated Pan-East Asian Capacity (Trunk Segments), 2007-2012



The design bandwidth of existing submarine infrastructure in the pan-East Asian market is among the highest of any long-haul route in the world, with confirmed trunk design capacities of almost 100 Tbps and the possibility of additional bandwidth with full implementation of 40G and 100G upgrades.

Table 18: Existing Pan-East Asian Systems

RFS	System	Owners
1997	Asia-Pacific Cable Network (APCN)	International Carrier Consortium
2001/ 2002	EAC-C2C	Pacnet
2002	Asia-Pacific Cable Network-2 (APCN-2)	International Carrier Consortium
2002	Reach North Asia Loop (RNAL) / FLAG North Asia Loop (FNAL)	Reliance Globalcom / Telstra / PCCW / Reach
2009	TGN Intra-Asia (TGN-IA)	Tata Communications / PCCW / Globe / EVN

7.7.2 New Systems

Three new consortium-led projects connecting multiple markets in East Asia are expected to soon be completed: Asia-Pacific Gateway, Asia Submarine-cable Express, and the Southeast Asia-Japan Cable. The APG and SJC projects are unique because they are the first submarine cable projects not serving the United States to attract investments from the American Internet giants Facebook and Google, respectively. A fourth project, led by a Hong Kong-based subsidiary of an Australian investment firm, was also reportedly being explored in partnership with Huawei Marine Networks beginning in mid-2012.

The three new carrier- and consortium-led projects will result in a major realignment of the region's submarine bandwidth markets; the majority of the region's largest operators will have equity stakes in their own next-generation, pan-regional submarine infrastructure, thus challenging the wholesale bandwidth models of existing submarine cable owners such as Pacnet, Tata Communications, and Reliance Globalcom.

Table 19: Proposed Pan-East Asian Systems

System	Owners
Asia-Pacific Gateway (APG)	China Mobile / China Telecom / China Unicom / Chunghwa Telecom / Facebook / Global Transit (Time dotCom) / KT / LG Uplus / NTT / StarHub / Viettel / VNPT
Asia Submarine-cable Express (ASE) (includes Cahaya Malaysia)	NTT / Telekom Malaysia / PLDT / StarHub
Quest Pan-Asian Submarine Cable	Quest Investments Ltd.
Southeast Asia-Japan Cable (SJC)	Brunei International Gateway / China Mobile / China Telecom / Chunghwa Telecom / Globe Telecom / Google / KDDI / Singtel / PT Telkom / Telemedia Pacific / TOT

7.8 Polar Route

Long considered outside the realm of practical possibility, the concept of a trans-Polar cable has never been more credible with respect to each of the major considerations: technology, economics, and geopolitics. There are currently two actively-promoted proposals for trans-Polar cables, but as of 2013, potential sources of financing for the projects have reportedly remained sketchy.

There is a strong geopolitical aspect to the trans-Polar projects: overall, cables have been proposed by investors from each of the three largest powers present in the Arctic (Canada, Russia, and the United States), although each has varying degrees of support from their home governments. Given the strategic importance of the Arctic region with regard to petroleum and gas deposits, freshwater, seafood, and transport, it is expected that government support for each prospective project will eventually increase, with the projects allowing for governments to expand their economic and political influence in the region as well as surveillance capabilities.

Table 20: Proposed Polar Systems

System	Owners
Arctic Fibre	Arctic Fibre, Inc.
Russian Optical Trans Arctic Cable System (ROTACS)	Government of Russia / Polarnet Project Ltd.

The Arctic Fibre system, led by Canadian investor Douglas Cunningham, would connect Japan, Alaska, and the United Kingdom via northern Canada, with the possibility of future expansion to China. The project would provide a route between North Asian and European markets, avoiding what company representatives identified as "problematic areas" including the Luzon Strait, the South China Sea, the Suez Canal, and the Mediterranean. A low-latency path of 168 milliseconds would be created between London and Asian destinations including Tokyo, Seoul, and Shanghai. The project would also seek government support to provide connectivity to Arctic communities in Canada and Alaska as well as the proposed Canadian High Arctic Research Station.

ROTACS and its predecessor, Polarnet, have been under consideration since at least 2002, and can be considered as the first serious proposal for Arctic connectivity, having completed route surveys in 2003. The project, connecting England, northern Russia, and Japan, was effectively shelved between 2005 and 2011, but comments from the Russian government in 2011 indicated that the government would lend its support to the project.

Despite the lack of progress in actually constructing any of the systems, Terabit Consulting does believe that a trans-Polar project will eventually succeed, perhaps capitalizing on what Terabit Consulting has identified as potential demand for a submarine cable between Russia's Pacific coast and North America.

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8. Conclusion

In 2013, the submarine communications industry will mark 25 years of transoceanic fiber optic communications. Although the industry's greatest revenues came during the dot-com bubble, its greatest successes from the perspective of global development arguably came during the last five years, as fiber optic connectivity was landed on the shores of less-developed countries that had been dependent exclusively on low-bandwidth satellite connections.

More than 20 nations and territories still remain without fiber connectivity, but financing from a wide variety of sources including governments, multilateral development banks, operators, and other investors seems likely to reduce that number in the near-future. Additional opportunities for undersea investment will also materialize in markets served exclusively by one fiber optic undersea cable, which as of 2013 included Bangladesh, Belize, Republic of the Congo, Democratic Republic of the Congo, Equatorial Guinea, French Guiana, The Gambia, Guinea, Guyana, Liberia, Mauritania, Myanmar, Namibia, Nicaragua, Sierra Leone, Suriname, and some island economies.

Much of the investment in new undersea bandwidth will be driven by what Terabit Consulting has identified as the "BICS" economies – Brazil, India, China, and South Africa, with the latter serving as a cornerstone for continuing Sub-Saharan African investment. There will also be an increased focus on direct destinations that have yet to be connected. Overall, the industry can remain confident that investment in new systems will average at least $2 billion per year, with average annual deployment of at least 50,000 kilometers, and continued growth in demand for system upgrades.

Having achieved a level of stability that some observers feared would never be possible after the dot-com bubble burst, the submarine communications industry can look forward to a healthy marketplace and continued contribution to the planet's economic and human development.

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