

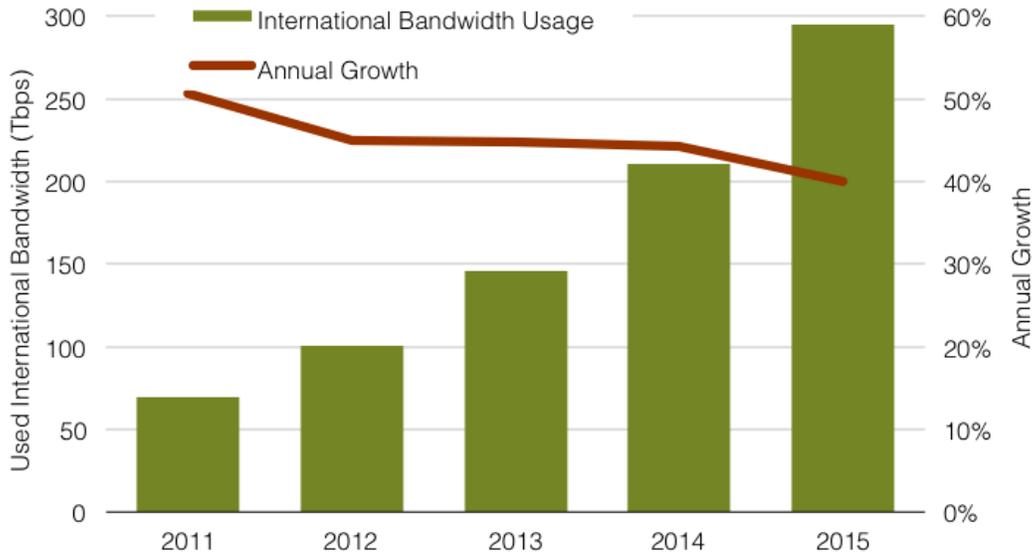
## Executive Summary

The global wholesale bandwidth market is shaped by many factors—some that change the face of the industry and others that contribute a measure of predictability. The industry is perpetually marked by the impetus to keep innovation and cost competitiveness ahead of inevitable price erosion. TeleGeography's *Global Bandwidth Research Service* assesses the state of the global telecom transport network industry and evaluates the factors that shape long-term demand growth and price erosion.

## Supply and Demand

While the pace of global bandwidth demand growth has slowly ebbed, the amount of used bandwidth added worldwide has been staggering. International bandwidth usage doubled in just two years, growing from 146 Tbps in 2013 to 295 Tbps in 2015 (see Figure: Worldwide International Bandwidth Growth, 2011-2015).

**FIGURE 1**  
**Worldwide International Bandwidth Growth, 2011-2015**

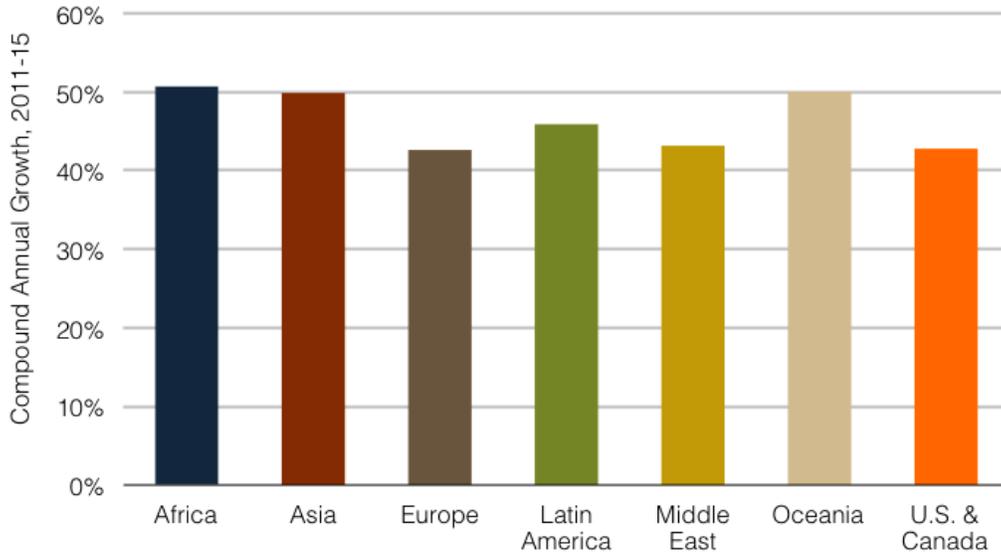


Source: TeleGeography

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Demand growth has been strong across the globe, with no single region experiencing compound annual growth of less than 40 percent over the past five years (see Figure: Used International Bandwidth Growth by Region, 2011-2015). The pace of growth has been strongest on links connected to Africa, Asia, and Oceania, where demand increased at compound annual growth rates of over 50 percent between 2011 and 2015.

**FIGURE 2**  
**Used International Bandwidth Growth by Region, 2011-2015**

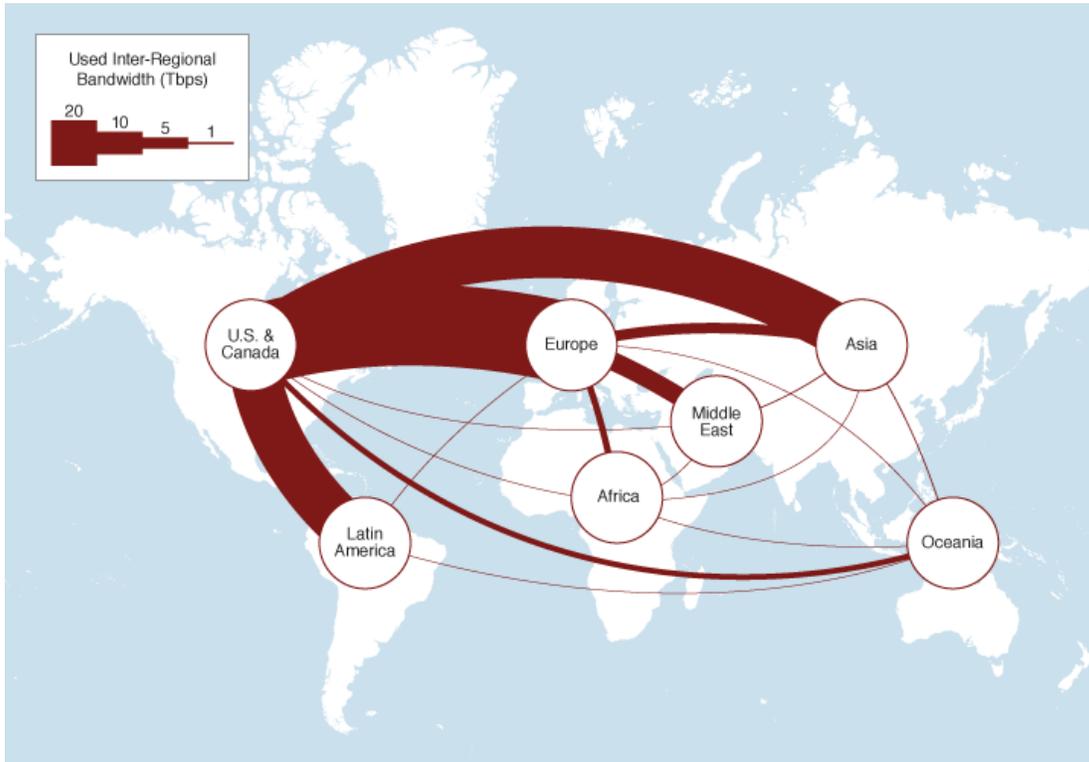


Source: TeleGeography

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While its share of inter-regional bandwidth has declined, the U.S. & Canada remains the dominant node of global connectivity. In 2015, 83 percent of used inter-regional bandwidth was connected to the United States & Canada, down from 96 percent in 2005 (see Figure Used Inter-Regional Bandwidth, 2015). Europe has gained much of the inter-regional bandwidth share lost by the U.S. & Canada as an influx of new submarine cables linking the continent to Africa, the Middle East, and Asia, has spurred greater regional reliance on Europe.

FIGURE 3  
Used Inter-Regional Bandwidth, 2015



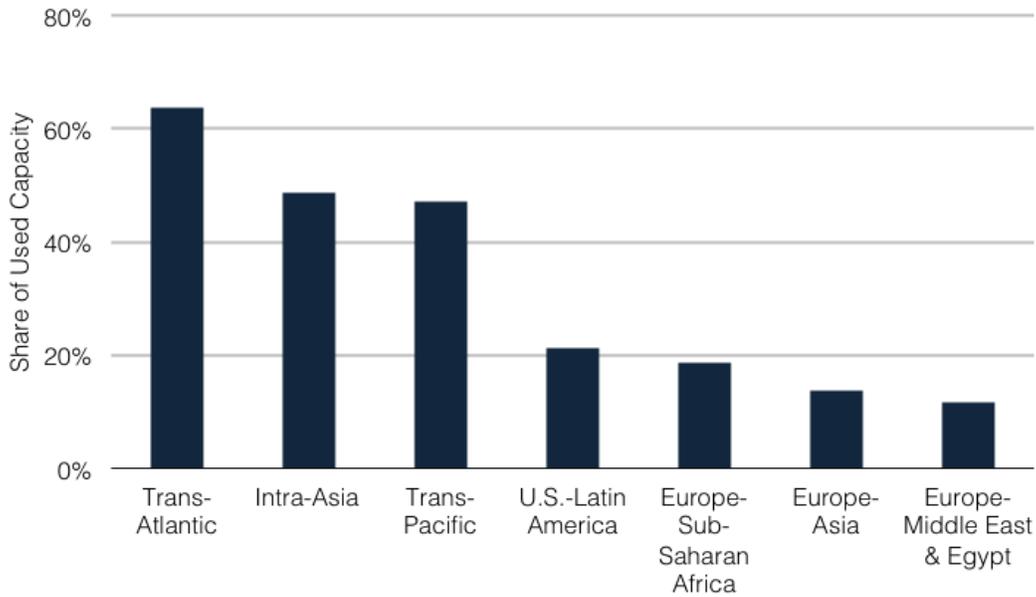
Notes: Data represent used bandwidth connected across international borders and excludes domestic bandwidth.

Source: TeleGeography

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TeleGeography has observed a significant shift in the international bandwidth market, as content providers eclipse carriers as the biggest users of capacity on the largest routes. The largest content providers, such as Google, Microsoft, and Facebook, have become major customers of long-haul capacity as they expand their own internal networks. Increasingly, these entities have capacity requirements that exceed those of the largest carriers. In 2014, private network bandwidth usage on the trans-Atlantic route overtook that of the Internet for the first time in history. This trend further solidified in 2015, as the share of used bandwidth controlled by private networks on the trans-Atlantic route reached 64 percent (see Figure: Private Networks' Share of Used Bandwidth by Route, 2015). At the same time, private networks accounted for almost 50 percent of used capacity on the intra-Asian and trans-Pacific routes. Globally, private network growth has outpaced Internet capacity growth in recent years, increasing 66 percent between 2010 and 2015, compared to 37 percent for international Internet capacity.

**FIGURE 4**  
**Private Networks' Share of Used Bandwidth by Route, 2015**

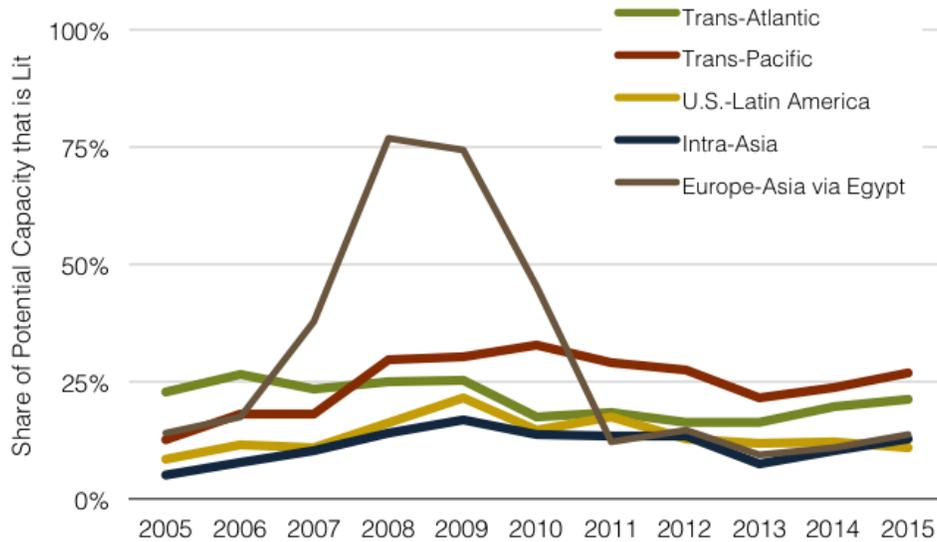


Source: TeleGeography

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Submarine cables are the primary conduits of inter-continental communications, thus supplying a significant amount of the capacity that meets global bandwidth demand. Lit capacity growth on major subsea routes has not diminished the untapped potential supply available. Advances in optical technologies, enabling transitions from 10 Gbps wavelengths to 100 Gbps transmission, have ensured that both existing and new cable systems have ample supply for years to come. For instance, the commercial introduction of higher-capacity transmission technology caused the share of potential trans-Atlantic capacity that was lit to decrease from 25 percent to 16 percent between 2006 and 2013, even though lit capacity nearly tripled during this period and no new cables entered service (see Figure: Percentage of Potential Capacity that is Lit on Major Submarine Cable Routes, 2005-2015).

**FIGURE 5**  
**Percentage of Potential Capacity that is Lit on Major Submarine Cable Routes, 2005-2015**



Notes: Data reflect the percentage of potential capacity that was lit at the end of the respective year. Potential capacity figures are based on operators' view of theoretical maximum capacity as of year-end and do not uniformly assume 100 Gbps wavelengths on all systems. Intra-Asia capacity only includes cables with landings in both Hong Kong and Japan. Trans-Pacific capacity excludes Southern Cross and Telstra Endeavour. Trans-Atlantic capacity excludes Atlantis-2.

Source: TeleGeography

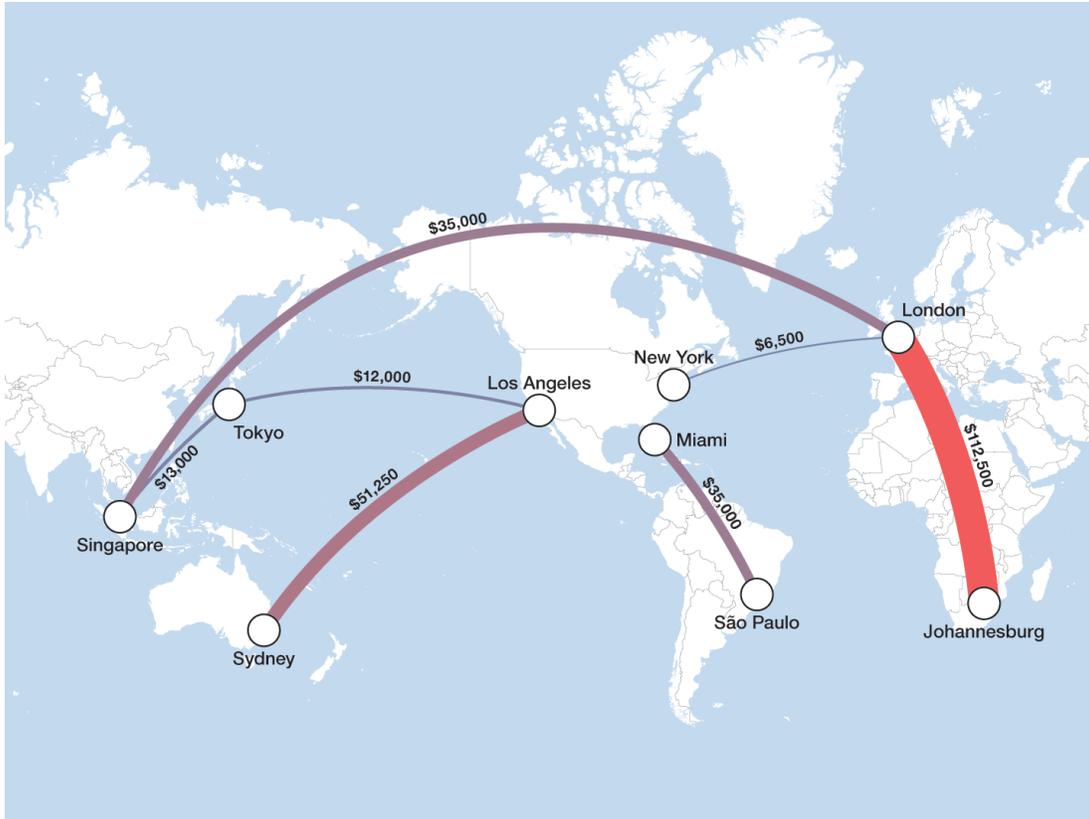
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## Pricing

Bandwidth prices continue to erode as volumes grow—even as the mix of market participants evolves. Prices vary widely by region due to differences stemming from available supply, competition, and cost of incremental upgrades.

The common denominator of capacity remains 10 Gbps optical wavelengths with Ethernet interfaces. Median 10 Gbps wavelength prices on key global routes have decreased 25 percent compounded annually since 2012. The rate of change over the past three years ranged from 10 percent on the London-New York route to 39 percent compounded annually on the Los Angeles-Sydney route. Along with a mix in the rates of price declines, median price points vary considerably by route (see Figure: Median 10 Gbps Wavelength Prices on Major International Routes, Q4 2015). In Q4 2015, the median 10 Gbps price between Los Angeles and Sydney was 4.3 times that of the Los Angeles-Tokyo route, while the Miami-São Paulo route was 5.4 times the price of a wavelength between London and New York.

**FIGURE 6**  
**Median 10 Gbps Wavelength Prices on Major International Routes, Q4 2015**



Notes: Each line represents the median monthly lease price for an unprotected 10 Gbps wavelength on an individual route. Routes are shaded corresponding to their median MRC, from least expensive in blue to most expensive in red. Prices are in USD and exclude local access and installation fees.

Source: TeleGeography

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Advances in switching and management technologies make provisioning more agile, lowering operating cost and accommodating lower wholesale prices. Innovations such as software defined networking hold the promise of novel commercial models for on-demand bandwidth and entirely new pricing regimes to complement leases with annual terms and IRUs. To date, however, few customers have warmed to bandwidth-on-demand offerings. Instead, the technological innovations driving most industry change at the moment remain of the familiar type: cheaper transmission equipment that reduces the cost per bit (and, ultimately, service prices) of long-haul capacity.

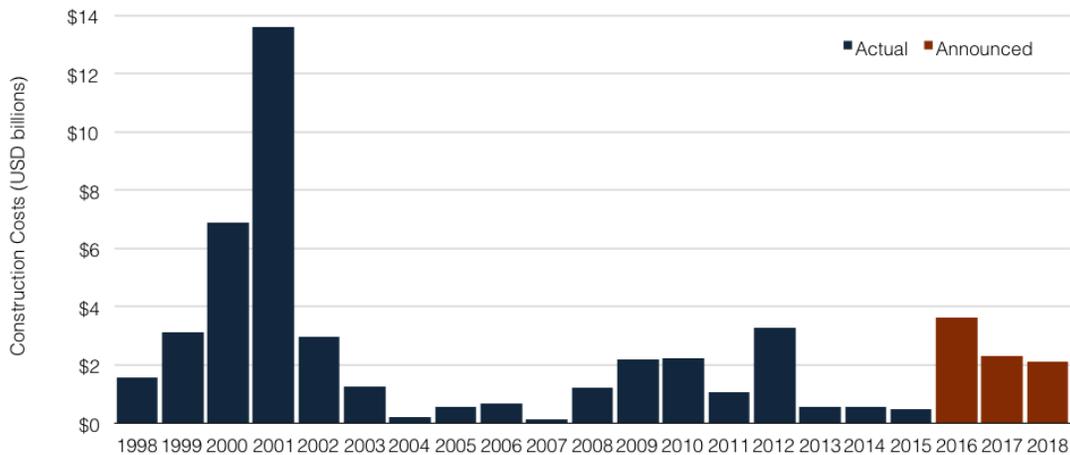
## Outlook

Persistent demand growth and price erosion couple with shifts in sources of demand and changes in network deployment strategies to create challenges for the wholesale telecom market. The following are a few of the key trends that will affect the long-haul capacity market in the coming years.

## Subsea Cable Investment Ramps Up

Aside from a flurry of activity in 2012, there has been little investment in new submarine cable deployments in each of the past five years. In 2015, only three subsea networks worth \$490 million were deployed (see Figure: Construction Cost of Submarine Cables, 1998-2018). The next three years will not be so lackluster, as 33 systems worth over \$8.1 billion could be launched. This dramatic increase is not due to any one particular factor, but rather to market dynamics unique to each region of the globe.

**FIGURE 7**  
**Construction Cost of Submarine Cables, 1998-2018**



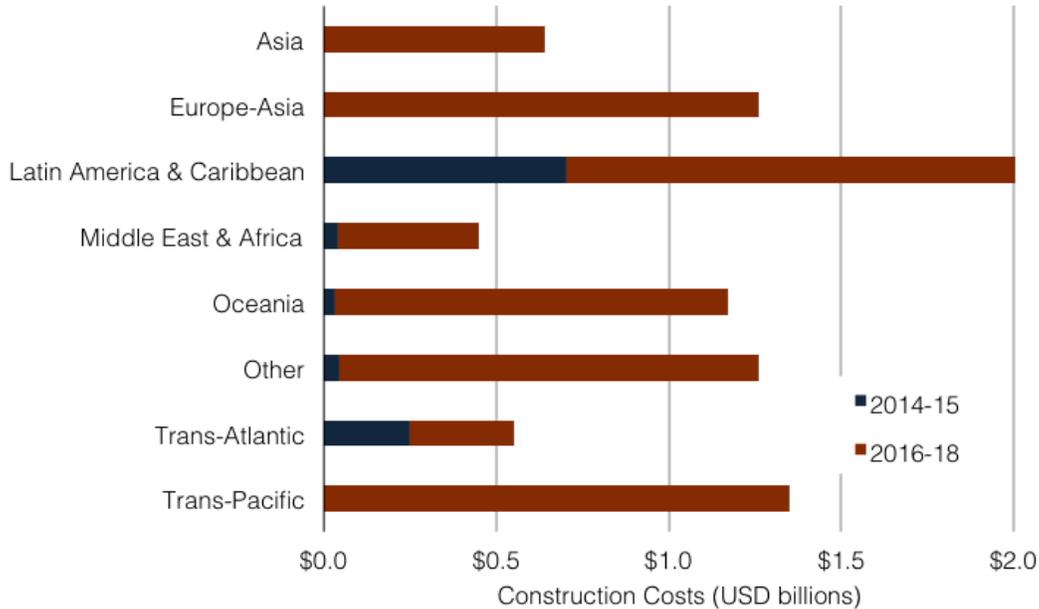
Notes: Total construction costs of all international submarine cables entering service in designated years. Construction costs exclude the cost of subsequent capacity upgrades and annual O&M. 2016-2018 construction costs based on announced contract values and TeleGeography estimates. Not all planned cables may be constructed.

Source: TeleGeography

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The accompanying figure illustrates the stark contrast between regional deployment activity seen over the past two years compared to expectations for 2016 through 2018 (see Figure: Construction Cost of New Submarine Cables Entering Service by Region, 2014-2018). In 2014 and 2015, only the Latin American and trans-Atlantic routes had any significant subsea cable investment, due to the launches of the America Movil Submarine Cable System-1 and Pacific Caribbean Cable System in Latin America and Hibernia Express across the Atlantic. By contrast, every global region is expected to be touched by new submarine cable investment in the next three years. On the Latin American and Europe-Asia routes—which are estimated to be injected with more than \$1 billion in new cable networks—pending launches include major systems like Monet, Seabras-1, BRUSA, Asia Africa Europe-1, and SeaMeWe-5.

**FIGURE 8**  
**Construction Cost of New Submarine Cables Entering Service by Region, 2014-2018**



Notes: Construction costs based on the year that the cable entered service. Construction costs exclude the cost of subsequent capacity upgrades and annual O&M. 2014-2018 construction costs based on announced contract values and TeleGeography estimates. Not all planned cables may be constructed.

Source: TeleGeography

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## New Global Network Builders

With private network bandwidth demand outpacing that of Internet carriers, content networks are increasingly supplementing their massive demand volumes with adoption of their own long-haul network infrastructure. Google is the most prominent example of a large-capacity buyer that has transitioned to a cable investor, with its investments in the Unity and Southeast Asia Japan Cable systems and the planned FASTER and Monet cables.

Facebook is taking similar steps with an investment in the planned Asia Pacific Gateway consortium cable. Microsoft is a member of the New Cross Pacific consortium cable and is a major capacity customer on Hibernia Express and the AECConnect cables.

As major capacity users, content providers will also play a leading role in future global network development. They will participate more as anchor investors and consortium members in submarine cable systems. Eventually, content providers may opt to build their own private cables. The initial example of this trend is the Junior cable that Google plans to build between Sao Paulo and Rio de Janeiro in 2017.

## Pricing Trends

In the global bandwidth market, price erosion has proven just as reliable as demand growth. Beyond opportunistic transactions, the wholesale market is limited to specialist sellers with the constitution for very high rates of both volume growth and price decline, or with unique attributes that pose fundamental differentiation, such as access to emerging markets. Price declines are ultimately enabled by cost declines in both capex and opex, in turn driven by technology advances. Adept investment can keep abreast of cost decline and ahead of price erosion.

The content on the preceding pages is a section from TeleGeography's Global Bandwidth Research Service

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TeleGeography

A Division of PriMetrica, Inc.

Washington, D.C. / San Diego / Exeter

U.S. tel: +1 202 741 0020 / U.K. tel: +44 1392 315567.

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