



Global Enterprise Networks and Submarine Cable Capacity

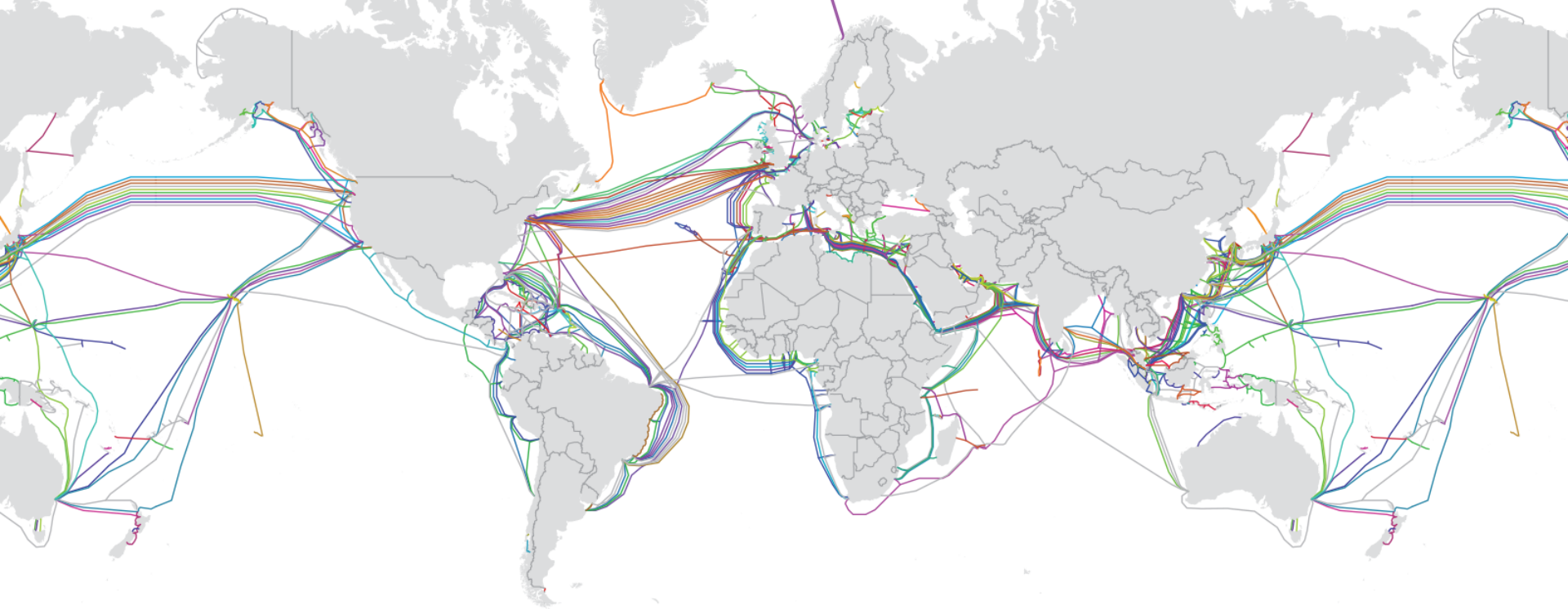
Coverage, Pricing & Traffic Trends

Patrick Christian

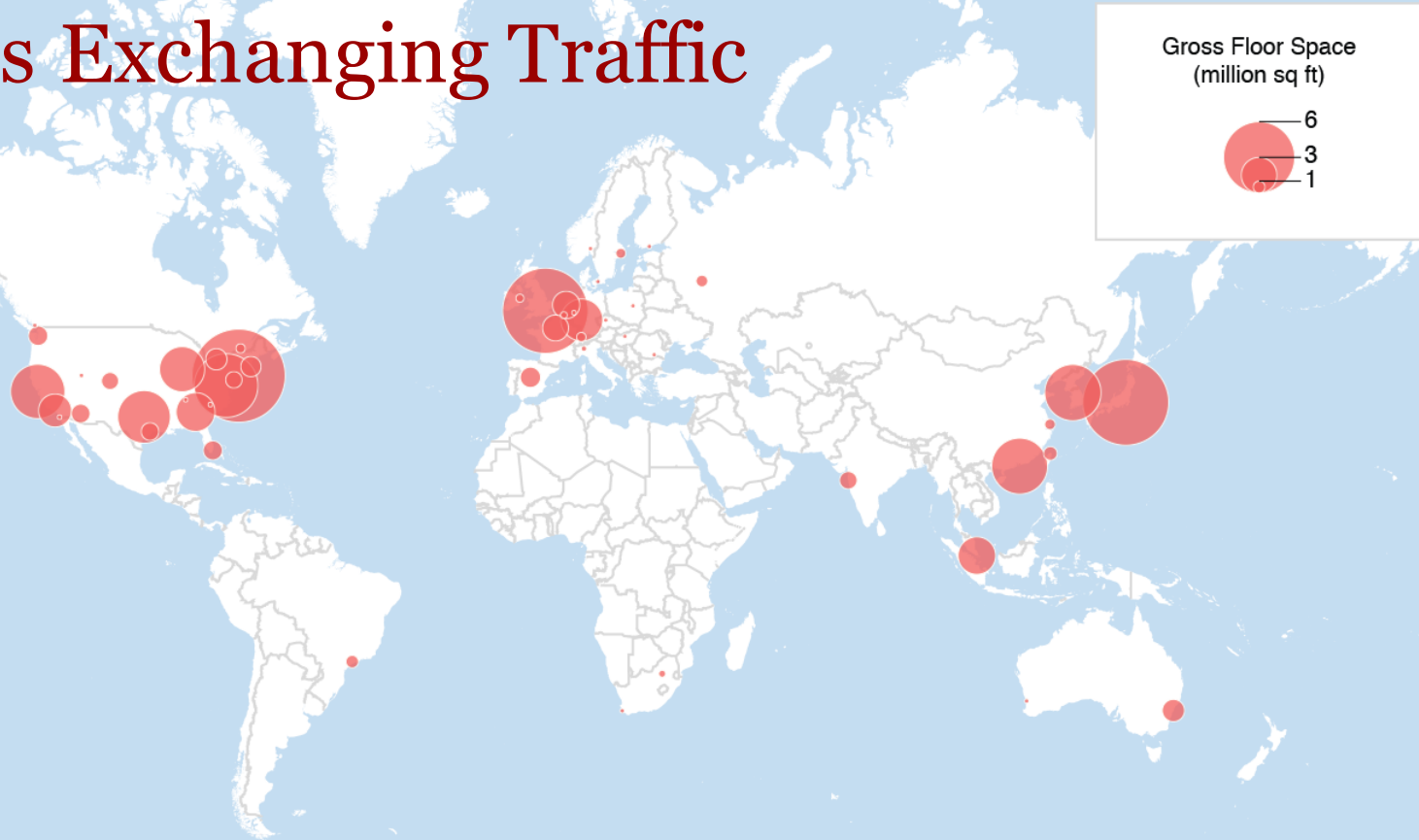
Senior Analyst, TeleGeography

Cables, Colo and Capacity

Global Submarine Cable Network



Carriers Exchanging Traffic



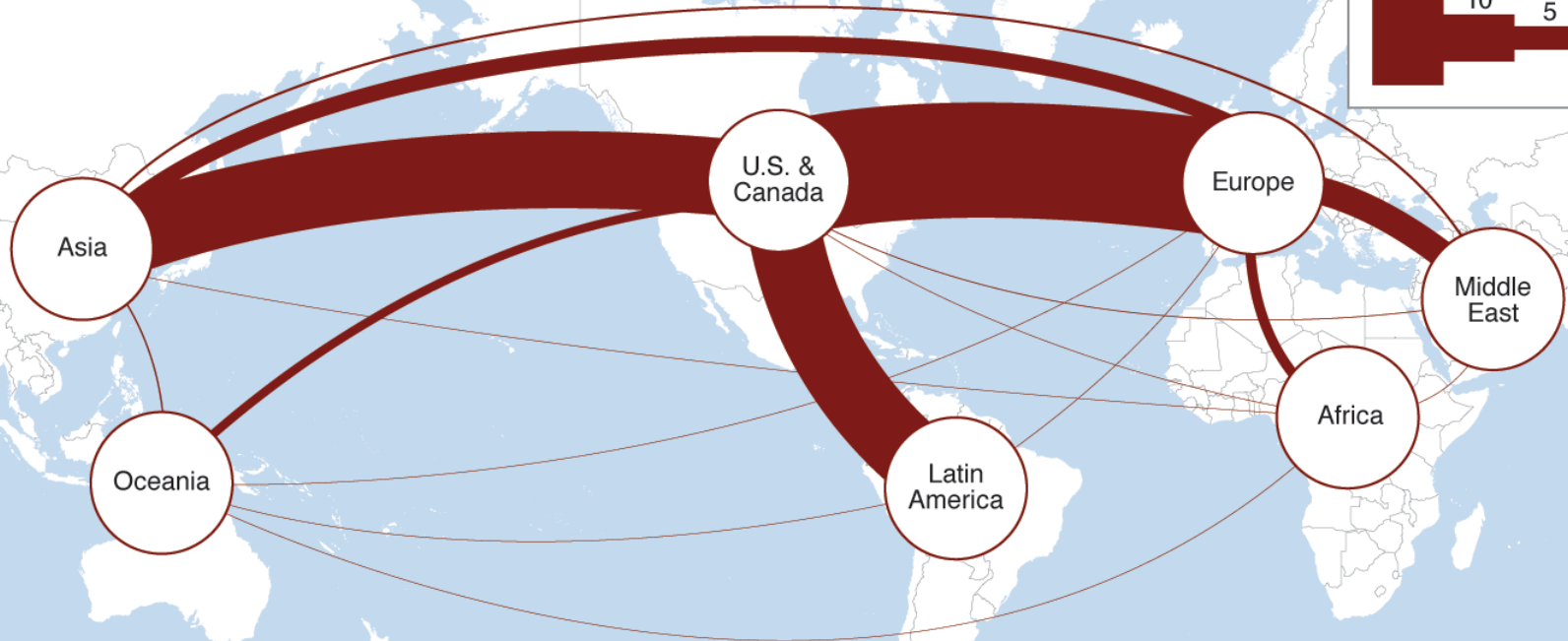
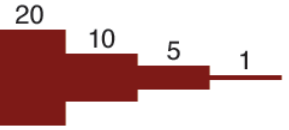
Linking Content and Applications



Major Content Provider Data Center Locations, 2017

Aggregate Global Bandwidth

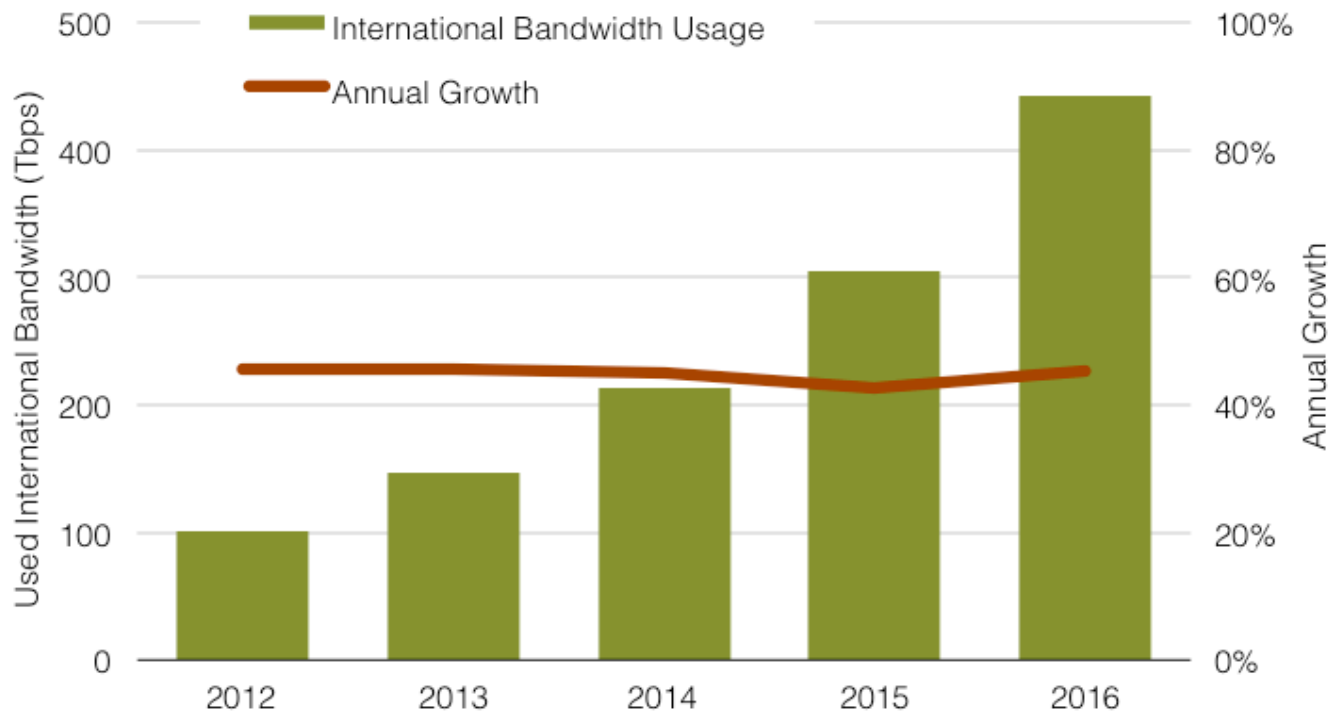
Used Inter-Regional
Bandwidth (Tbps)



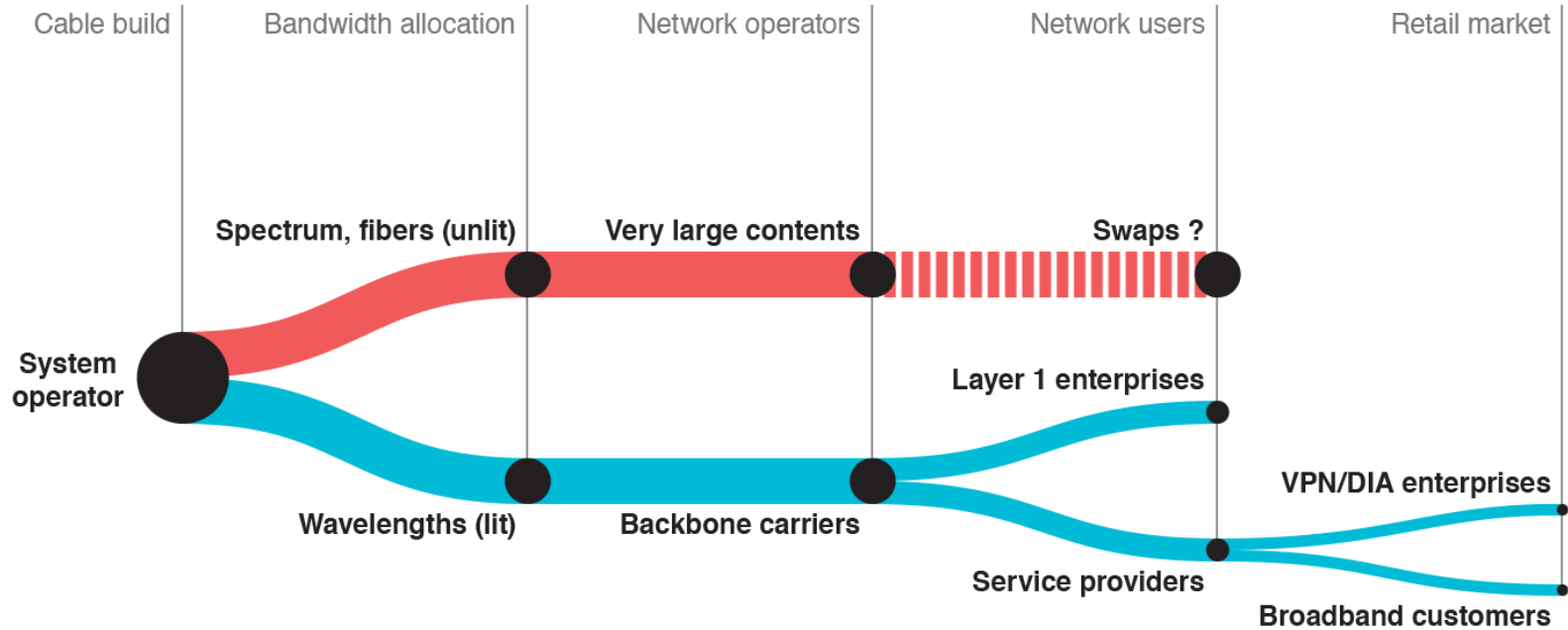
- Linking global hubs and users to hubs
- Favorable space, power, connectivity, population, business climate, etc.

Aggregate Demand Growth “Flat”

Used International Bandwidth Growth, 2012-16



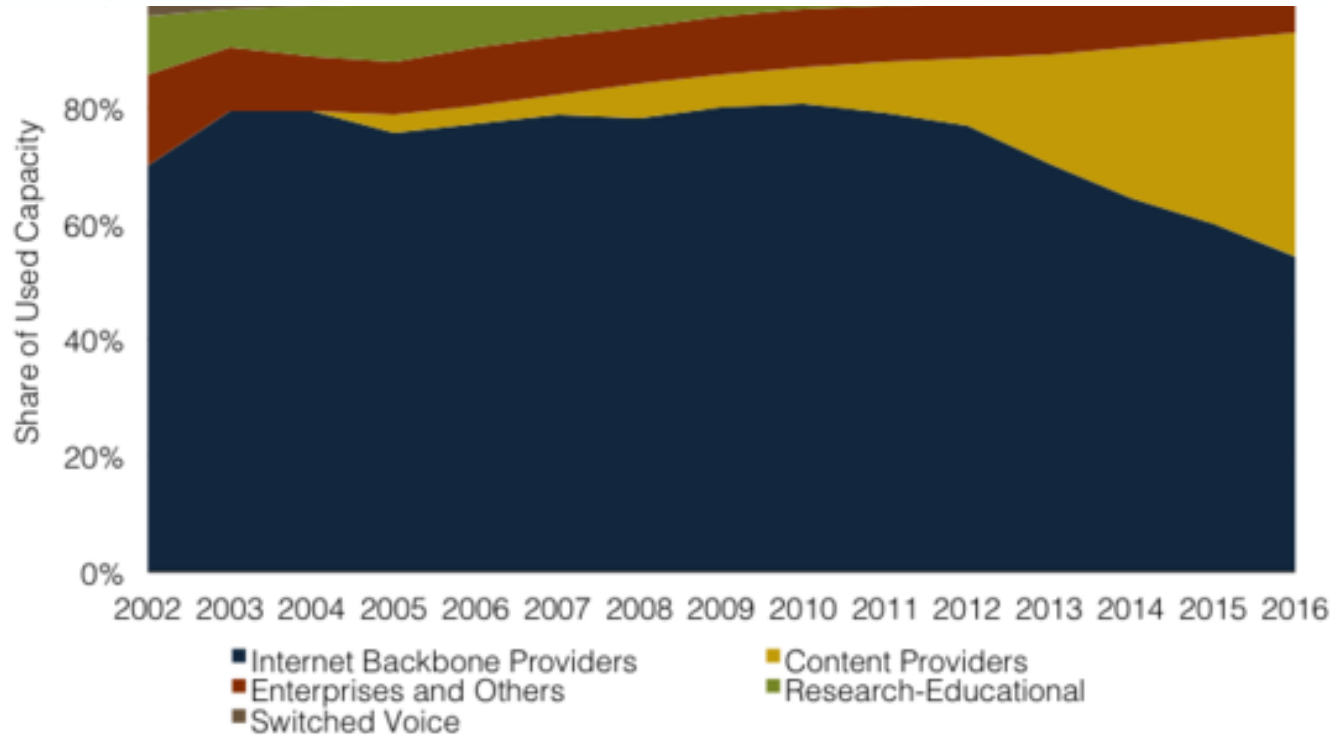
Cable Bandwidth Distribution



Content Providers

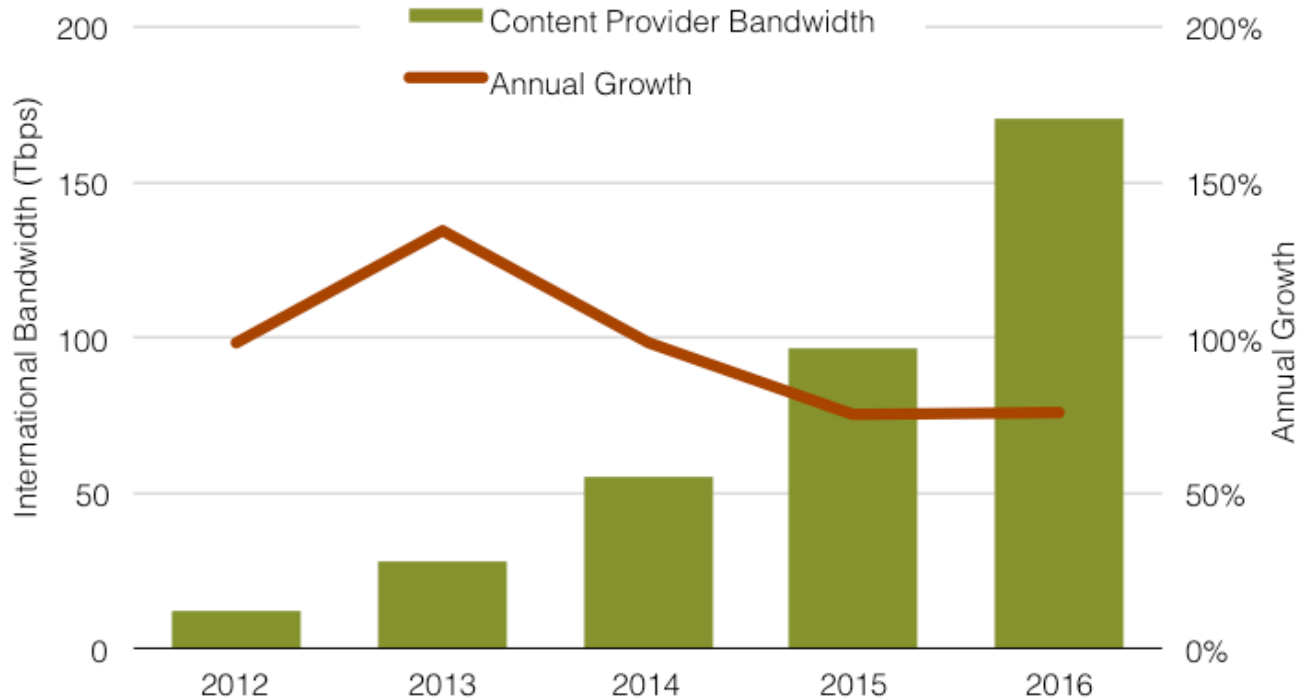
Private Networks Gaining Share

International Internet, Private Network, & Switched Voice Capacity, 2002-16



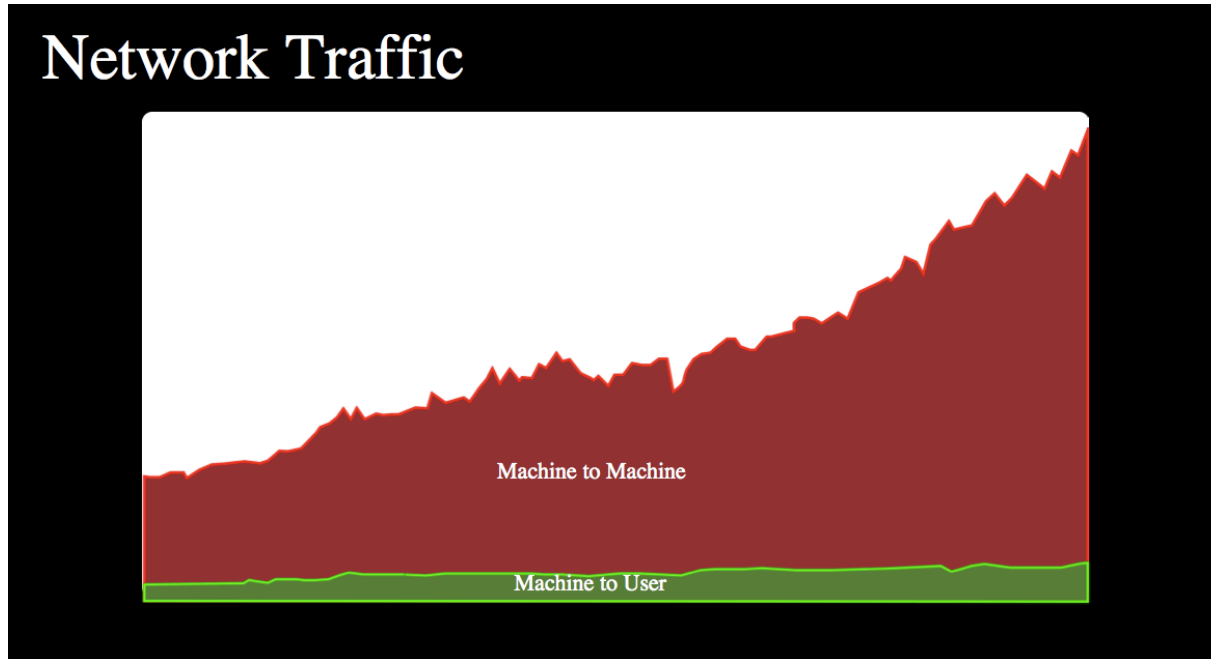
Content provider growth

International Bandwidth Growth, 2012-2016



Machines versus users

Facebook Network Traffic Profile

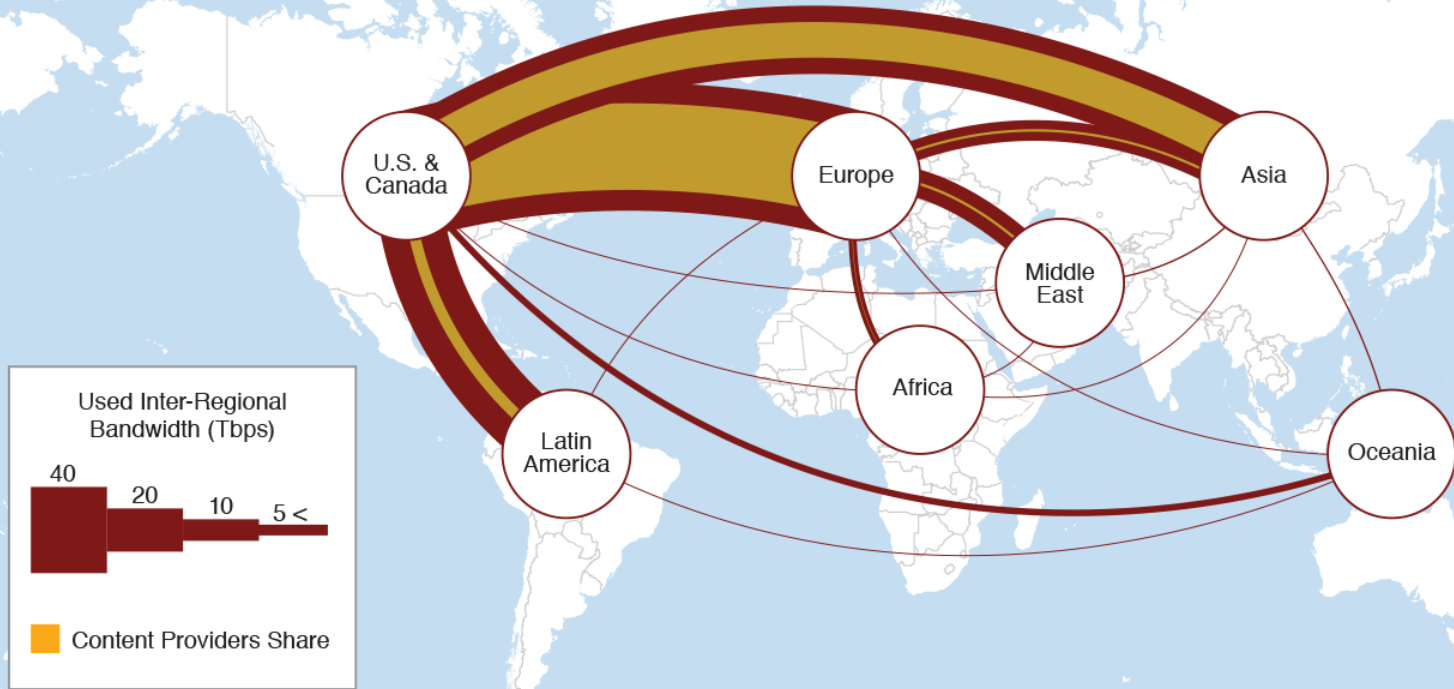


Content provider cable investments

Provider	Cable	RFS
Google	Unity	2010
	Southeast Japan Cable (SJC)	2013
	FASTER	2016
	Monet	2017
	Tannat	2017
	Junior	2017
	Pacific Light Cable Network (PLCN)	2018
	INDIGO-West	2019
	INDIGO-Central	2019
Facebook	Asia Pacific Gateway (APG)	2016
	MAREA	2018
	Pacific Light Cable Network (PLCN)	2018
	AE Connect	2018
Microsoft	Hibernia Express	2015
	AEConnect	2016
	New Cross Pacific	2018
	MAREA	2018
Amazon	Hawaiki	2018

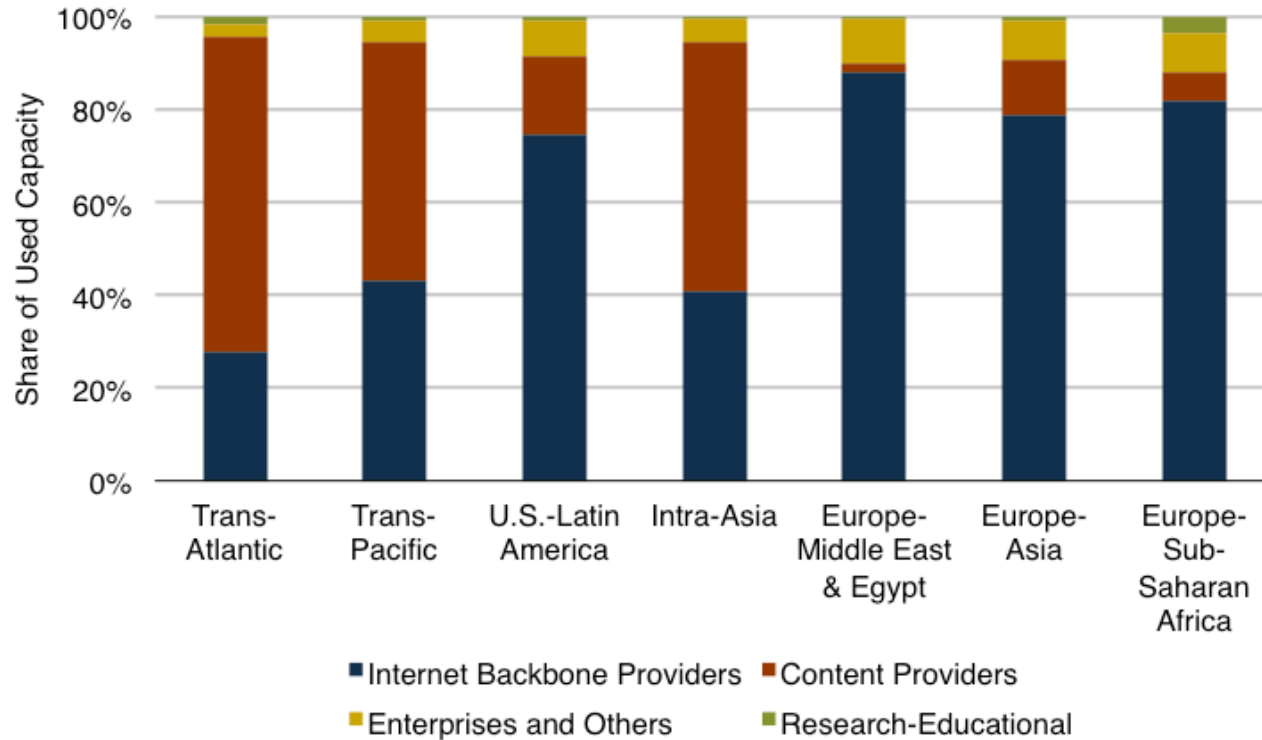
Note: Only publicly disclosed content provider investments shown.

Content provider share of capacity



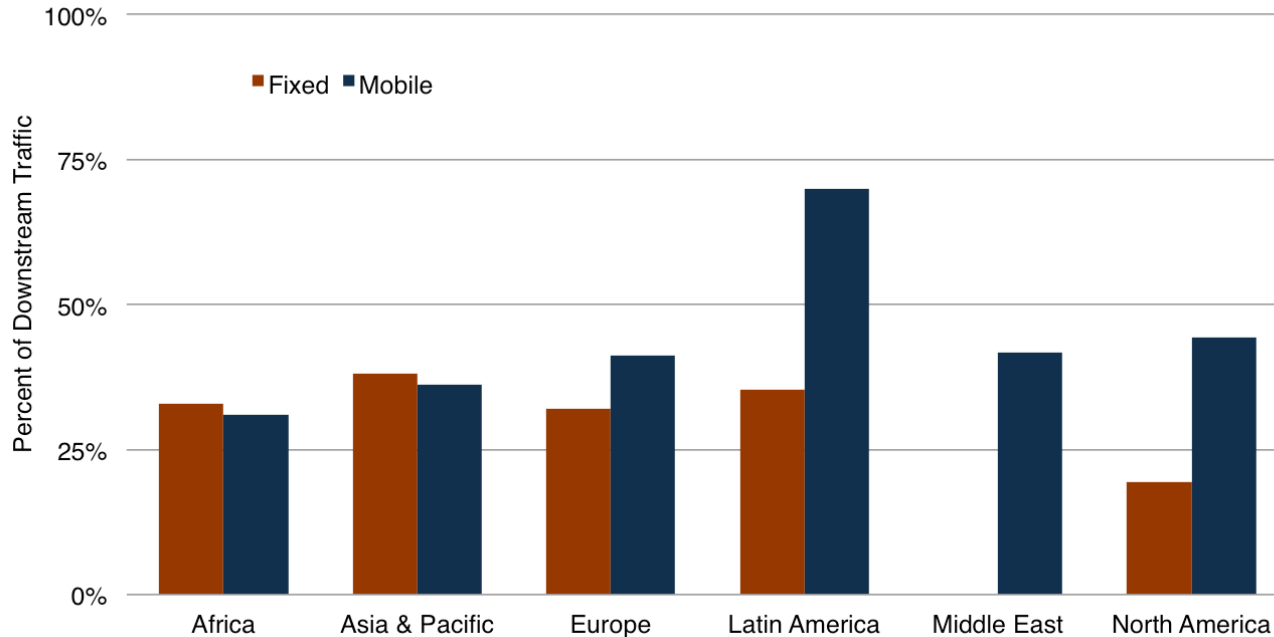
Private Network Share Varies by Route

Private Network Bandwidth Share by Route, 2016



Concentrated demand

Google and Facebook Share of Fixed and Mobile Traffic by Region



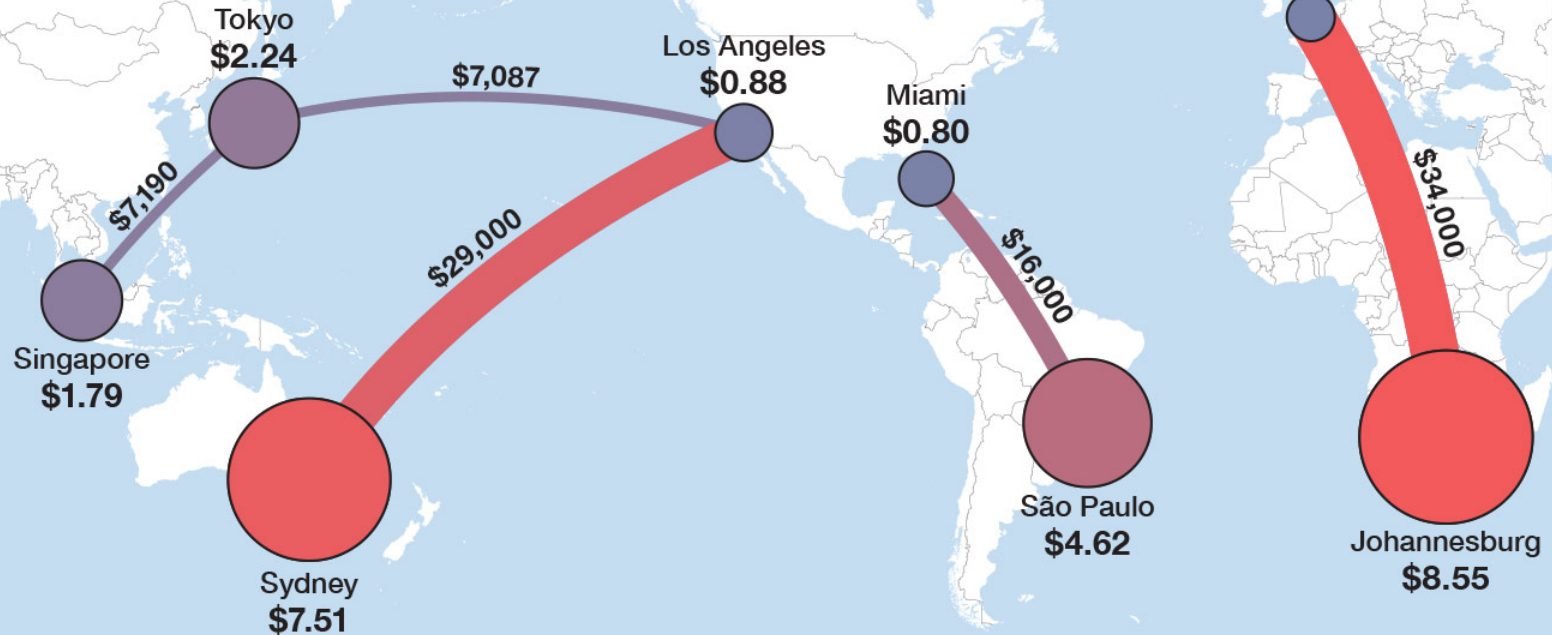
Notes: Data reflect sum of the share of traffic attributable to Google and Facebook appearing in the top 10 list of downstream traffic sources in Sandvine's Global Internet Phenomenon report. Data for Europe is from October 2015. Data for North America and Latin America is from June 2016. Data for Africa, Middle East, and Asia & Pacific is from October 2016. Fixed data unavailable for the Middle East.

Source: Sandvine

Pricing

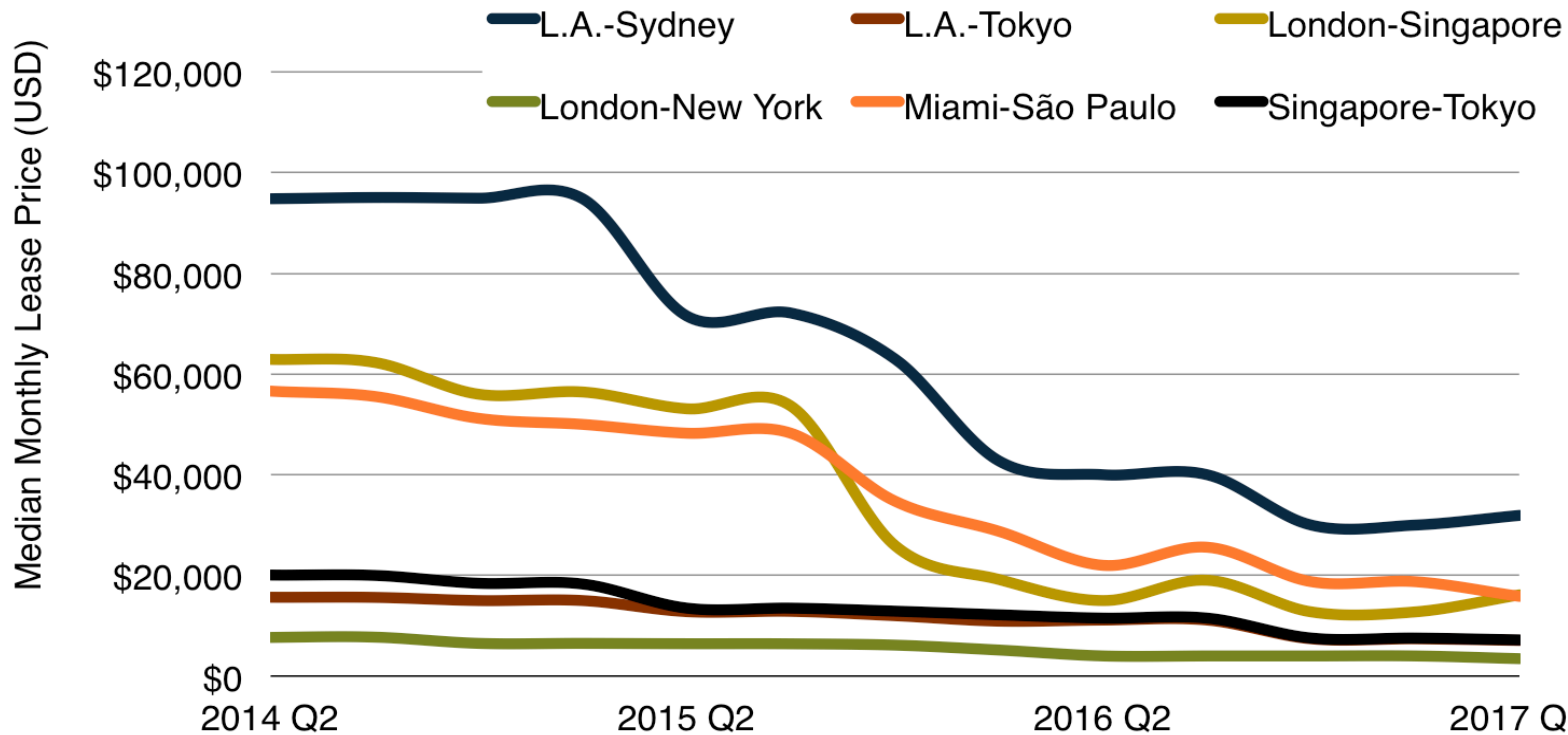
Prices Vary by Geography

10G Wavelength MRC, 10G IPT Port MRC.



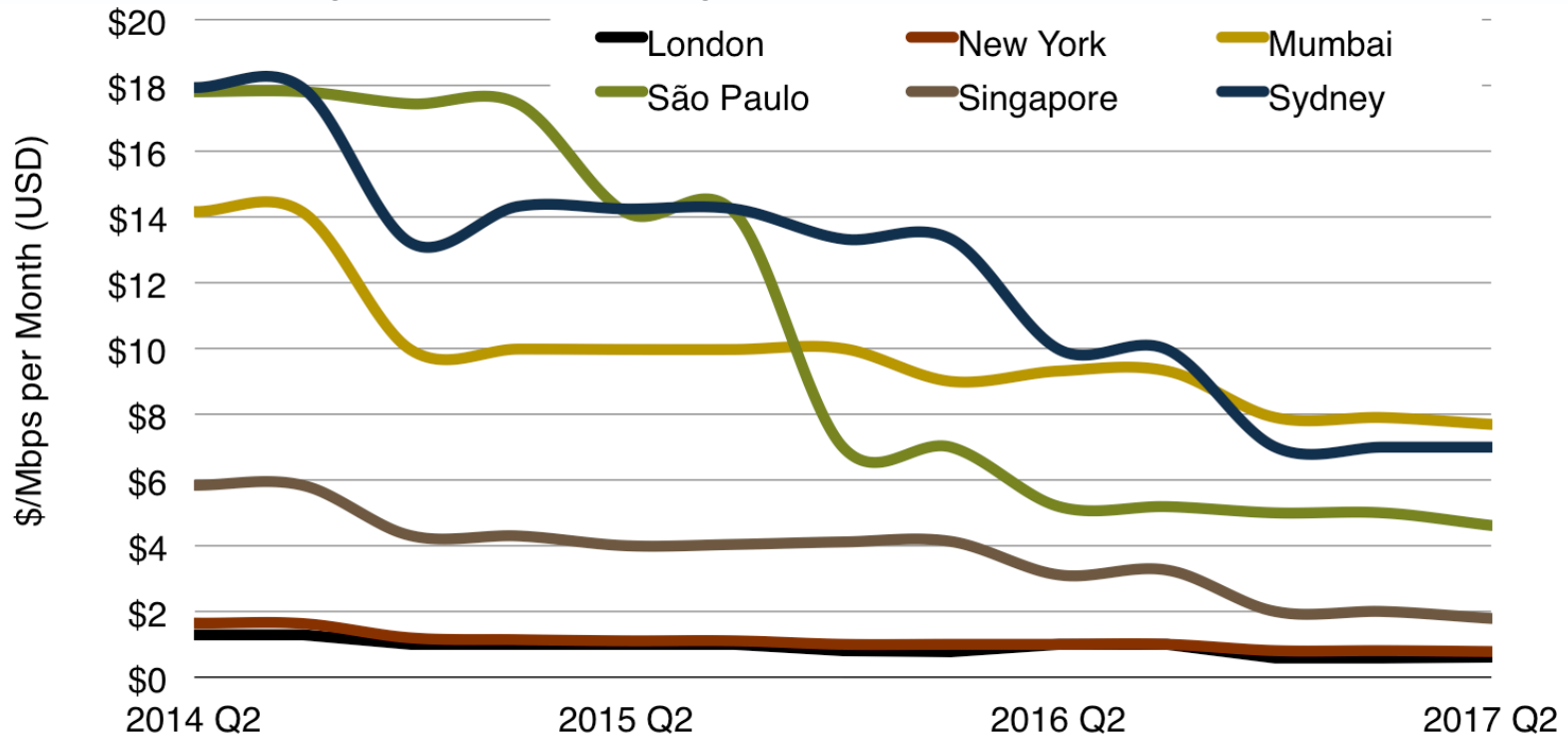
Transport Prices Decline

Weighted Median 10 Gbps Wavelength Monthly Lease Prices, 2014-17



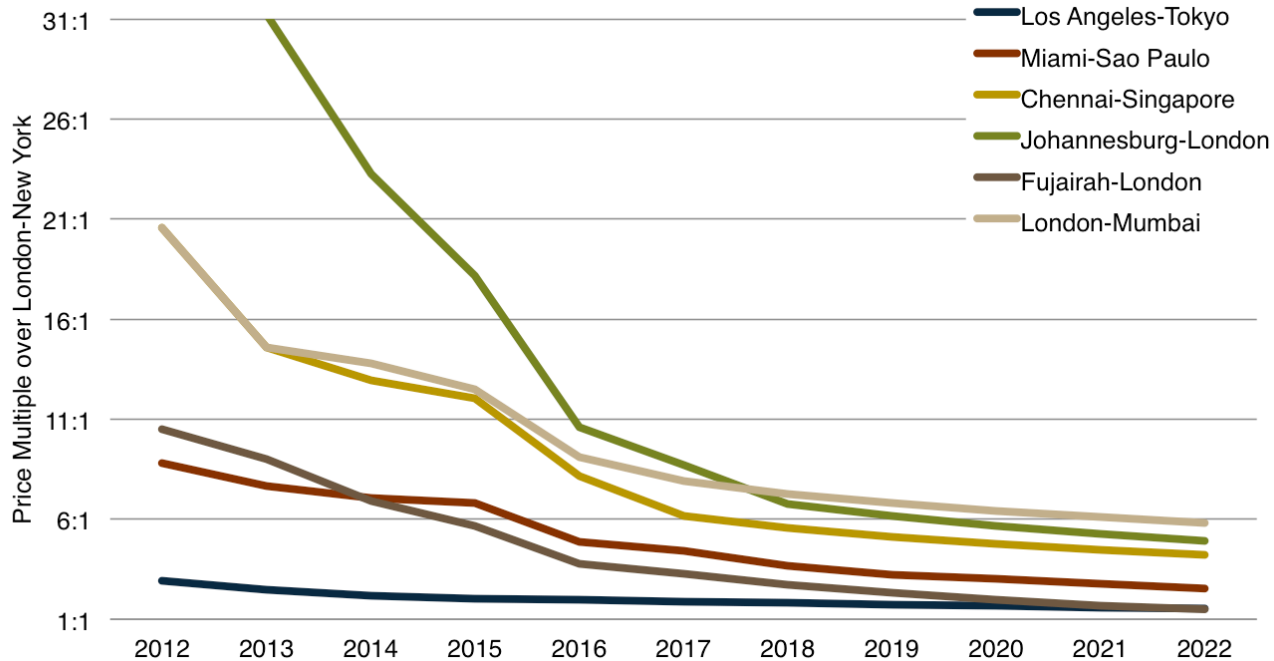
Transit Prices Follow

Weighted Median 10 GigE IP Transit Port Prices, 2014-17



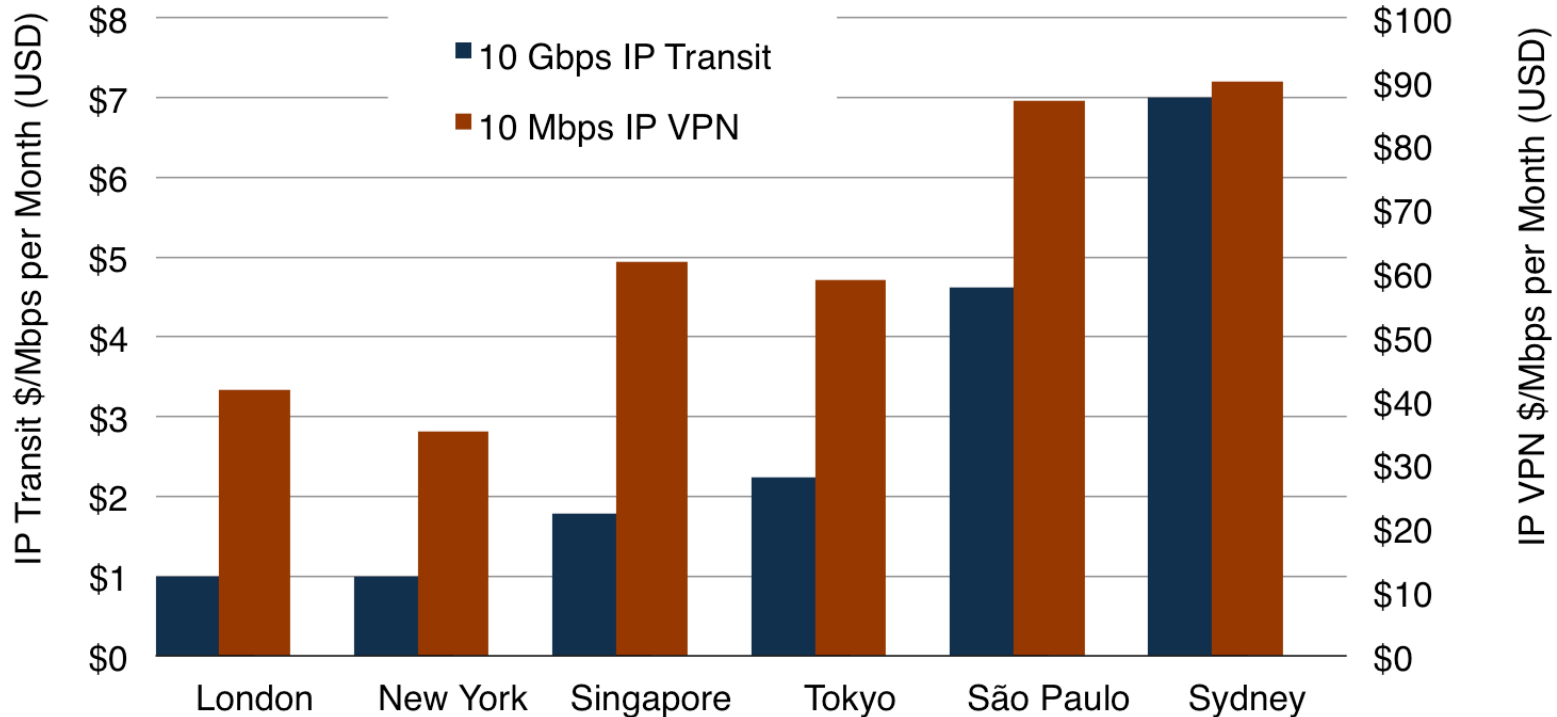
Price differences narrowing

10 Gbps Wavelength Lease Price Multiples over London-New York

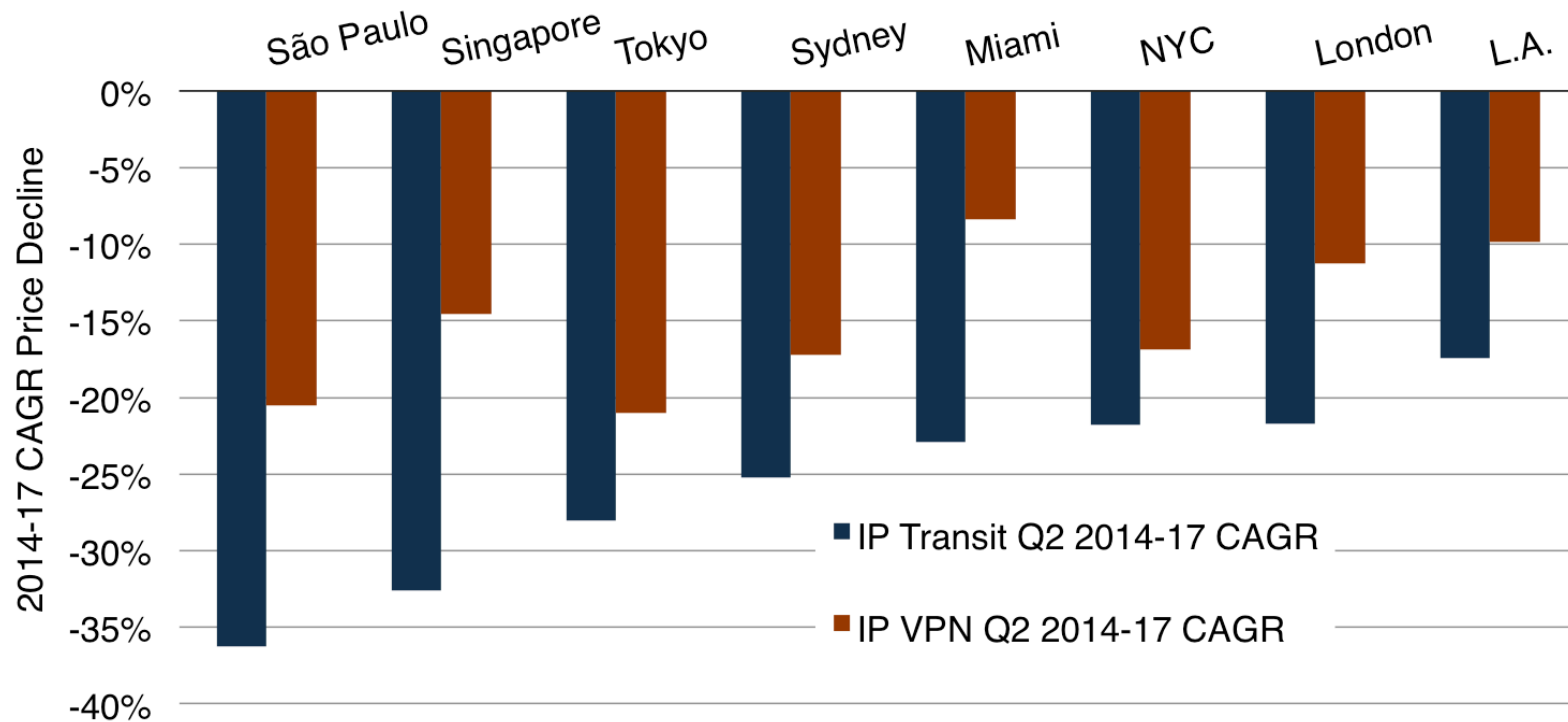


Enterprise Prices Map to Wholesale

Median 10 GigE IP Transit & 10 Mbps IP VPN Port Prices, 2017

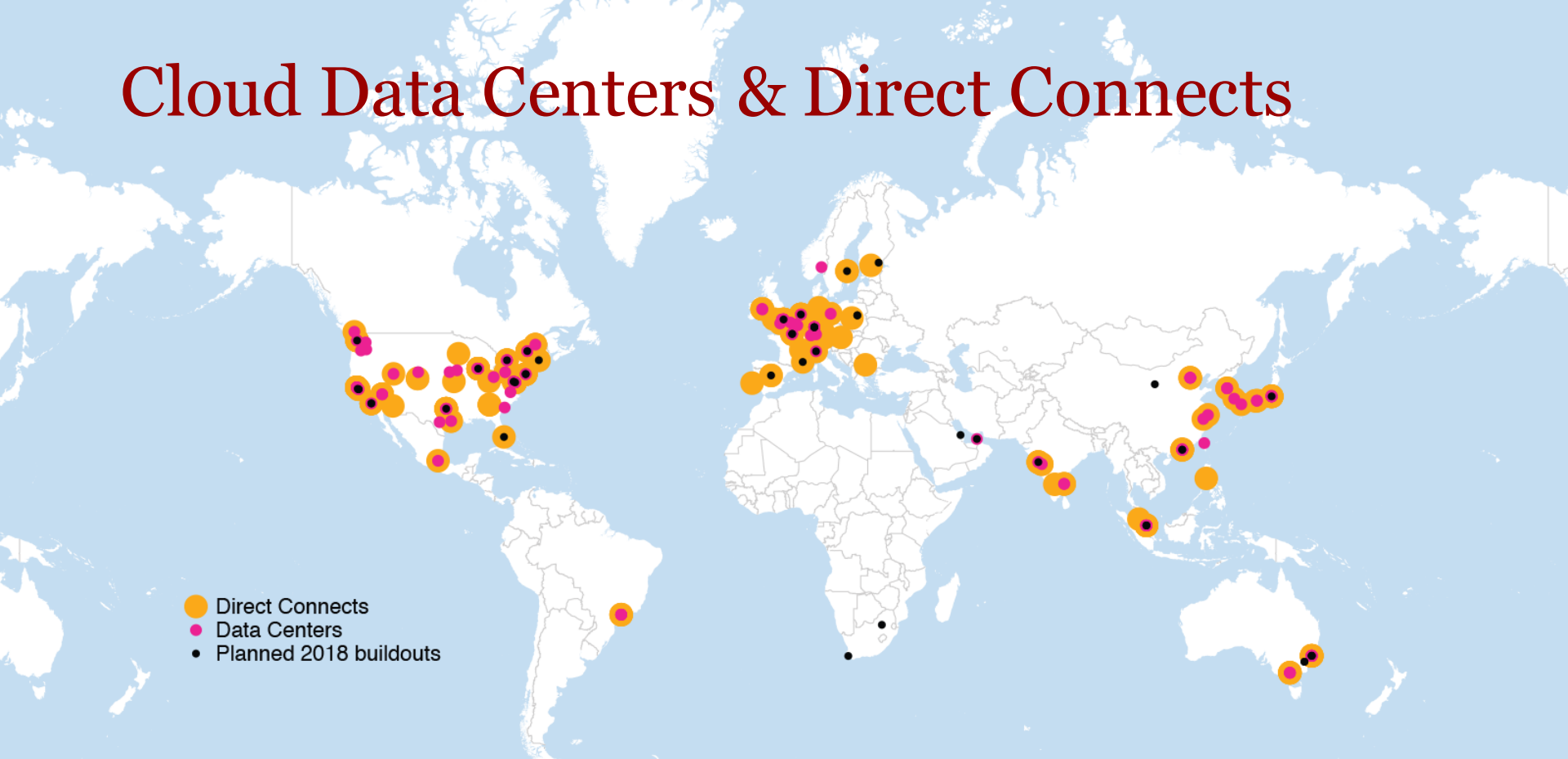


...and Exhibit Similar Trends

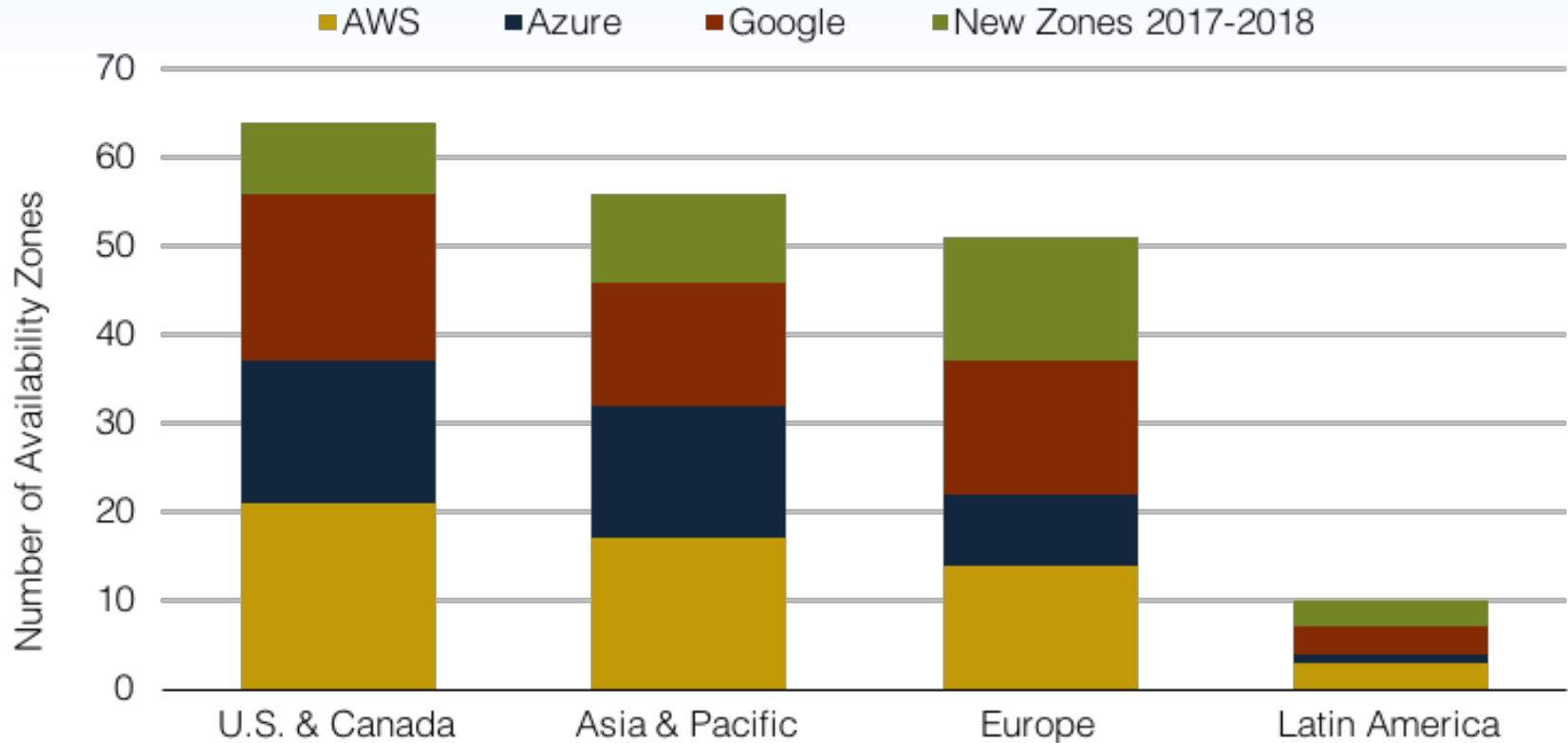


Cloud Providers

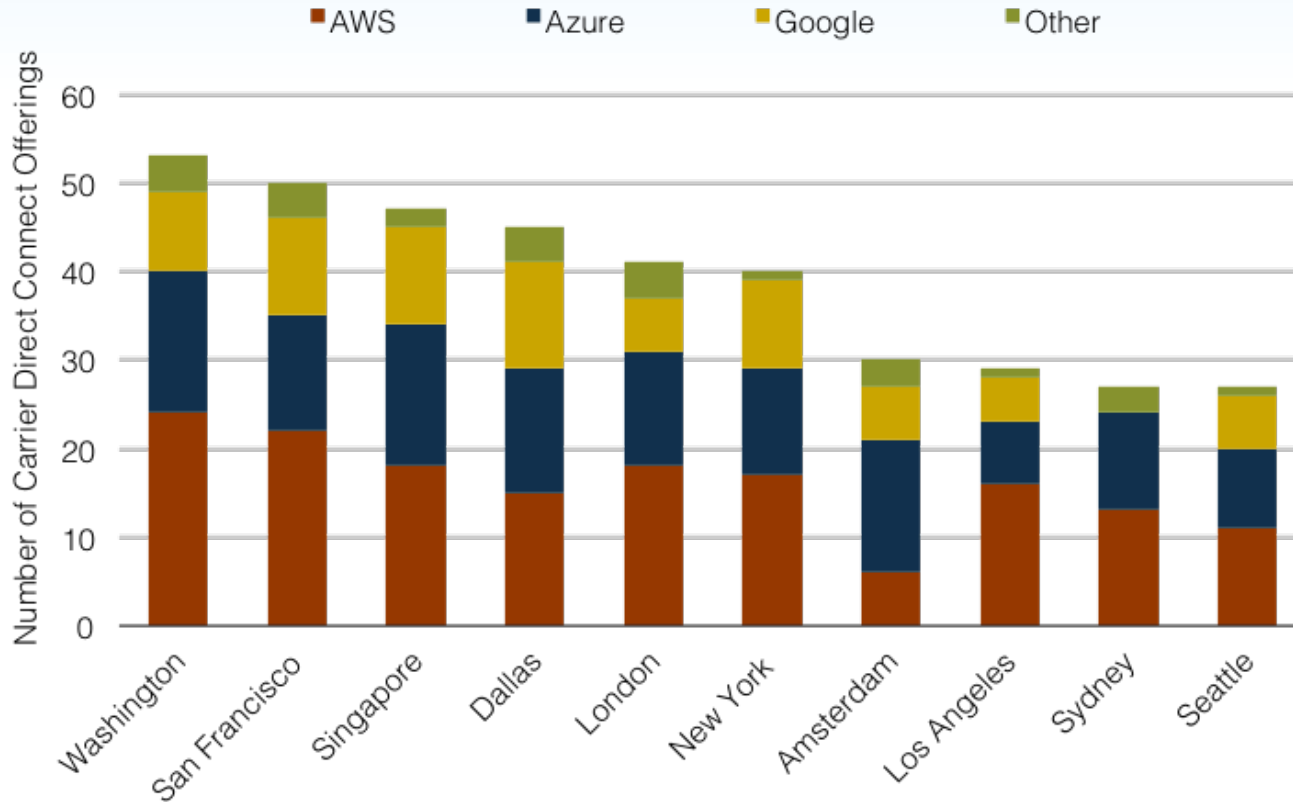
Cloud Data Centers & Direct Connects

- 
- A world map with a light blue background and white landmasses. The map is populated with colored dots representing data centers and direct connects. The dots are concentrated in North America, Europe, and Asia. A legend in the bottom left corner identifies the symbols: a yellow circle for Direct Connects, a pink circle for Data Centers, and a black circle for Planned 2018 buildouts. The map shows a high density of data centers and direct connects in the United States, particularly in the West and Midwest, and in Europe, particularly in the UK and Germany. There are also several data centers and direct connects in Asia, particularly in China and Japan. Planned 2018 buildouts are scattered across the map, including in South America, Africa, and Australia.
- Direct Connects
 - Data Centers
 - Planned 2018 buildouts

Cloud Provider Zones & Regions

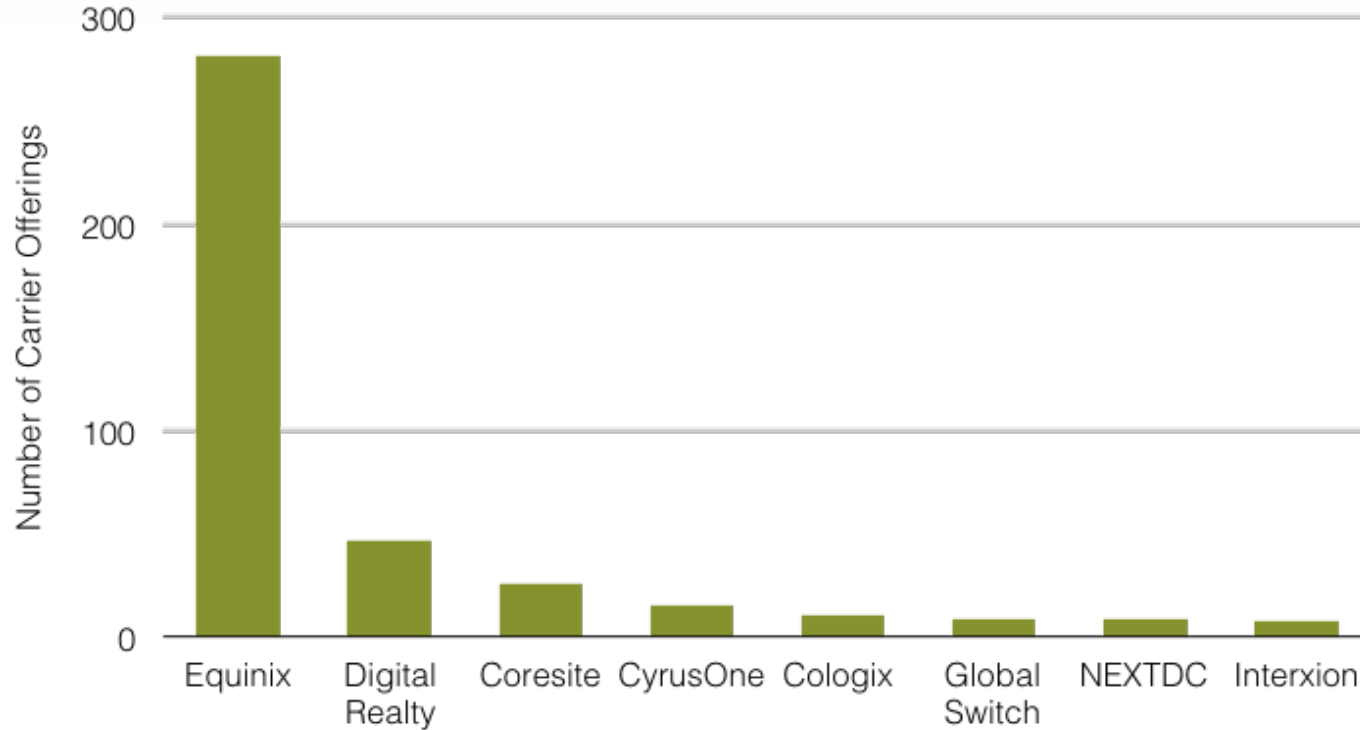


Direct Connect Offerings by City



Colo Facilities Connecting WANs to the Cloud

Total Carrier Direct Connect Offerings to Cloud Providers, 2017



Summary

- Global network of primary hubs
- Demand growth is as reliable as price erosion
- Enterprise WAN costs predicated on wholesale prices
- Content Provider growing faster than the internet
- Content Providers building out their networks to end-users
- Cloud Data Centers rapidly expanding in same markets, and starting into developing markets



Thank You!

Questions?

pchristian@telegeography.com