

Lighting the Way to Bandwidth Equality

Dubai

18th-21st April 2016

The Role of Submarine Connectivity in Bridging the Bandwidth Divide

Emerging Subsea Networks

Presenter: Michael Ruddy
Company: Terabit Consulting



Celebrating
30
years
of SubOptic

Presenter Profile



Terabit Consulting's Director of International Research, Michael Ruddy, has overseen the company's market, traffic, and revenue analysis and forecasting since 2000.

Prior to joining Terabit, he oversaw submarine research at Pioneer Consulting and was a fiber optics market analyst at Kessler Marketing Intelligence (KMI).

He has directed dozens of submarine and terrestrial market studies in every region of the world, most recently in 2016 on behalf of the World Bank and the United Nations as well as multiple private investors.

- Name: Michael Ruddy
- Title: Director of International Research
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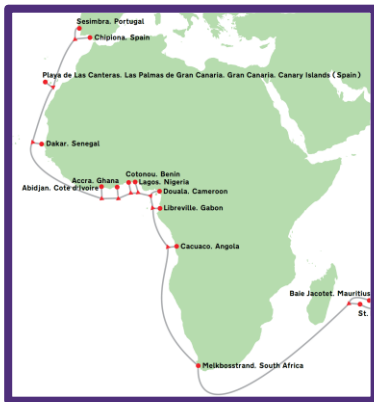
Less Developed Markets: Key to the Continued Growth of the Submarine Industry

- The submarine communications market is strong
 - Direct investment in new systems averages \$1.5-\$2 bil & 35k km/yr.
 - Upgrade market exceeds \$100 mil/yr.
- The industry owes much of its continued well-being to growth in less-developed markets

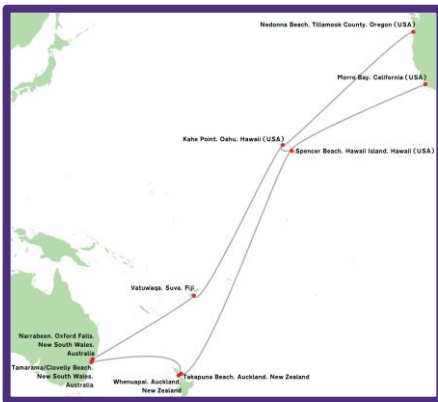
The Submarine Industry's Historical Aversion to Serving Developing Markets with Fiber

- Prior to the dot-com bubble burst, the expansion of submarine fiber connectivity to less-developed markets was a secondary consequence of more lucrative intentions.

SAT-3



Southern Cross



Sea-Me-We & FLAG Cables



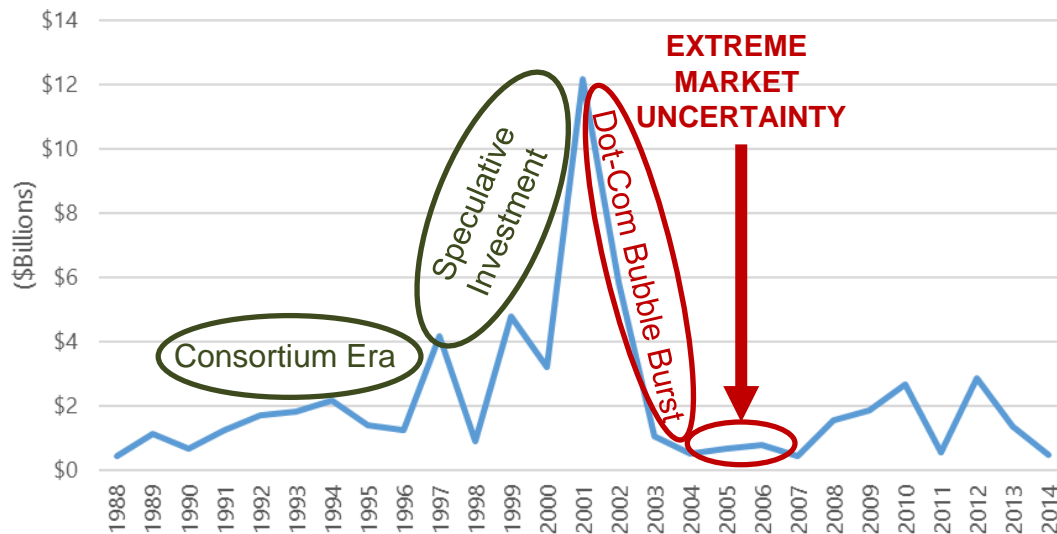
Maps:
2016 Undersea Cable Report
(Terabit Consulting)



Connecting the Unconnected & Improving Connectivity to the Under-Connected Offered a Path to Recovery for the Submarine Market

New Submarine Cable Investment by RFS Date

Source: 2016 Undersea Cable Report (Terabit Consulting)



The opportunity:

One-third of the world's countries and territories lacked fiber connectivity as of 2003, and many others were "under-connected."

Improving their connectivity required a new approach:

- Long-term commitment
- Development-oriented
- Multilateral



A New Development-Oriented Model of Multilateral Fiber Network Investment

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Private Investors

Governments

Multilateral
Development
Banks and Other
IFIs

System and
Equipment
Suppliers

Network
Developers

Fixed &
Mobile
Operators

ISPs

Content
Providers

PPP Structures

- SPV w/ Gov't. Sharehold
- SPV w/ Gov't Contribution
- BOT Concessions
- Project Mgmt. Contracts



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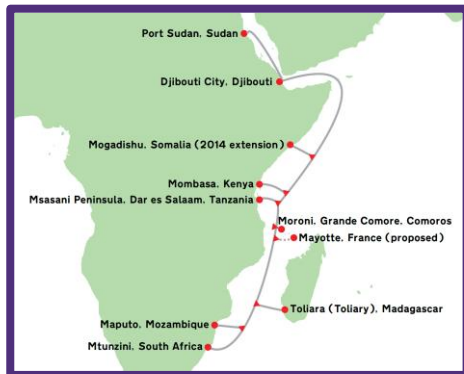
Appropriate
Cost-
Sensitive
Solutions

Successful Examples of Multilateral Submarine Cable Investment Expanding Fiber to Unserved Markets

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EASSy



TEAMS



SEAS



ACE



Tonga-Fiji



Maps:
2016 Undersea Cable Report
(Terabit Consulting)

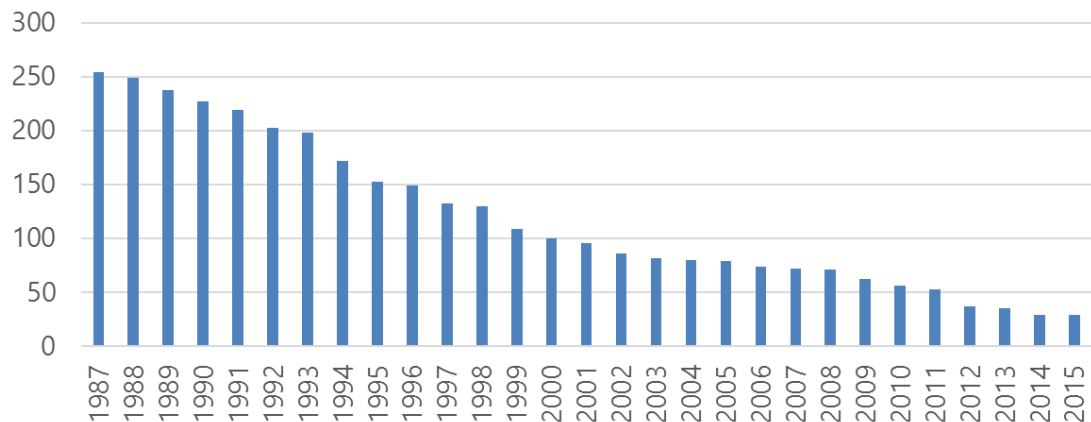


Progress in the Expansion of Fiber Connectivity to Unserved Countries

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Countries & Territories without International Fiber Connectivity

Source: 2016 International Telecommunications Infrastructure Analysis (Terabit Consulting)



In nominal terms, the industry's efforts to connect the unconnected have been impressive.

Civilian-inhabited countries and territories unserved by fiber:

- 79 in 2005
- 29 in 2015

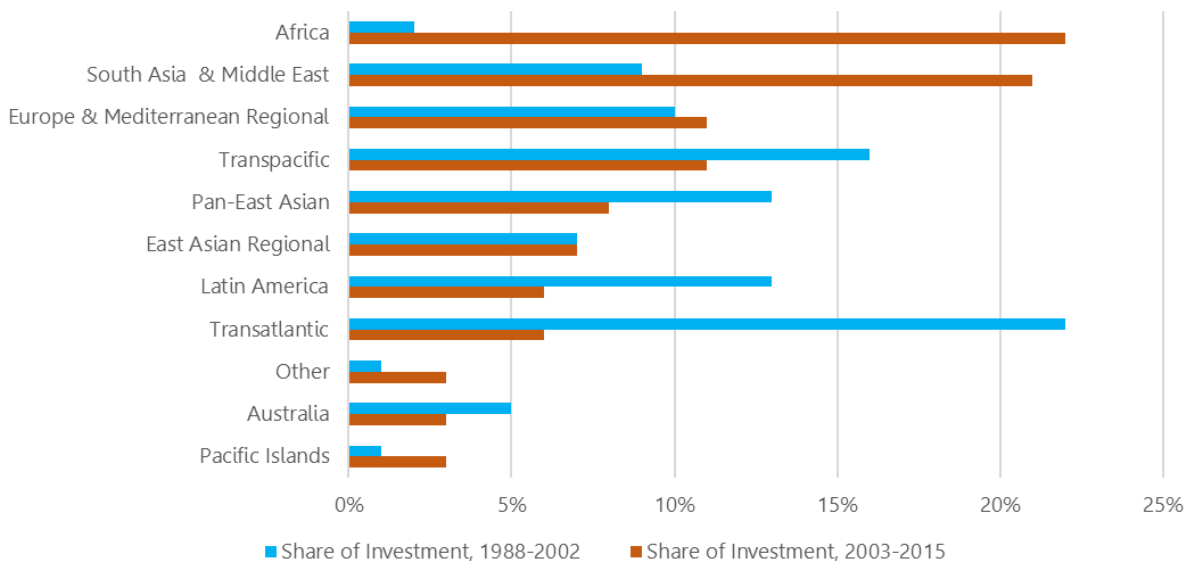
(0.5% of population)



A Realignment of Regional Submarine Investment toward the Under-Connected

Regional Share of Total Investment in New Submarine Systems

Source: 2016 Undersea Cable Report (Terabit Consulting)



Since 2003, the share of investment serving less-developed and emerging markets has increased from 33% to more than 60%.

The largest gainers:

Africa

South Asia/Middle East

Caribbean

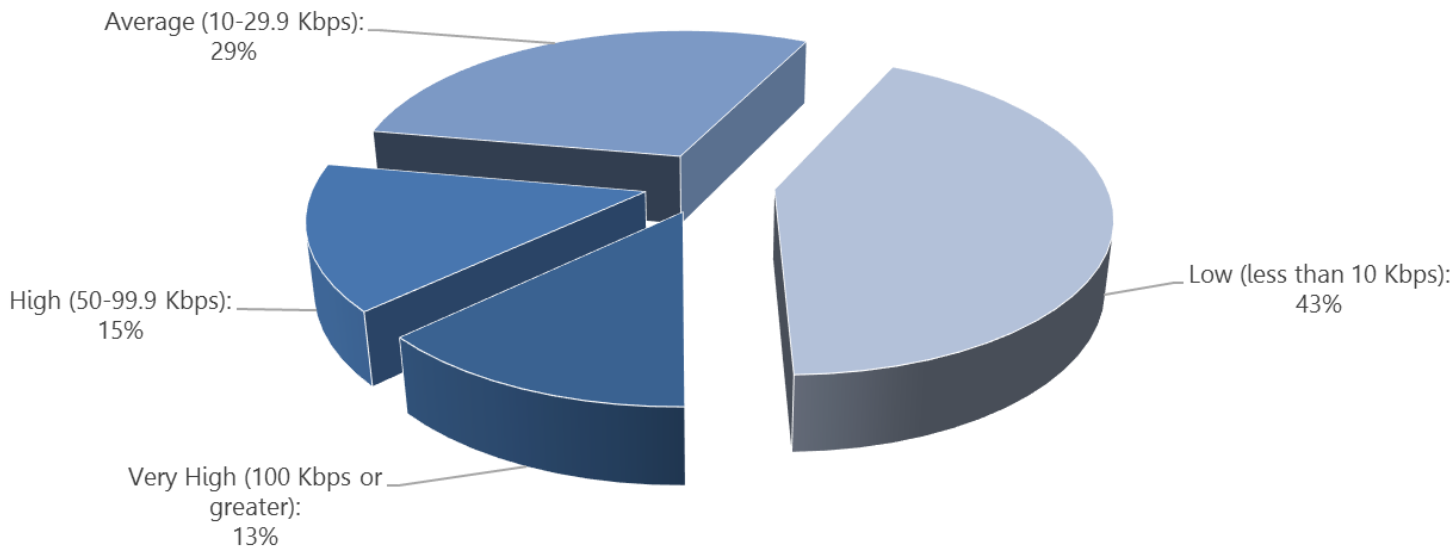
South Pacific



The Bandwidth Divide: 43% of Countries Have Insufficient Bandwidth

Classification of Countries and Territories by International Bandwidth per Capita, 2015

Source: Terabit Consulting International Bandwidth Databank



Average Per-Capita GDP of Countries and Territories in Each International Bandwidth Classification, 2015

| Terabit Consulting International Bandwidth Classification, 2015 | Average GDP per Capita, 2015 (PPP terms) |
|---|--|
| Very High (100+ Kbps) | \$45,776 |
| High (50-99.9 Kbps) | \$38,582 |
| Average (10-29.9 Kbps) | \$22,126 |
| Low (<10 Kbps) | \$6,839 |

Source: Terabit Consulting International Bandwidth Databank

The Bandwidth 'Haves' and the Bandwidth 'Have-Nots'

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- The data very clearly indicate the existence of a “bandwidth divide” that blocks the inhabitants of 43 percent of the world’s countries and territories from basic levels of affordable, reliable, quality access
 - Weak int’l. bandwidth is often accompanied by high prices and low competition
- Even within countries with average, high, or very high levels of per-capita bandwidth, reliable and affordable bandwidth is often limited in its geographic reach
 - Broadband concentrated within affluent, coastal, and urban communities
- There is a strong correlation between international bandwidth and per-capita GDP: bandwidth inequality serves to perpetuate economic inequality
 - Digital communications: a fundamental economic ‘flow’ (w/ transport, trade, finance)



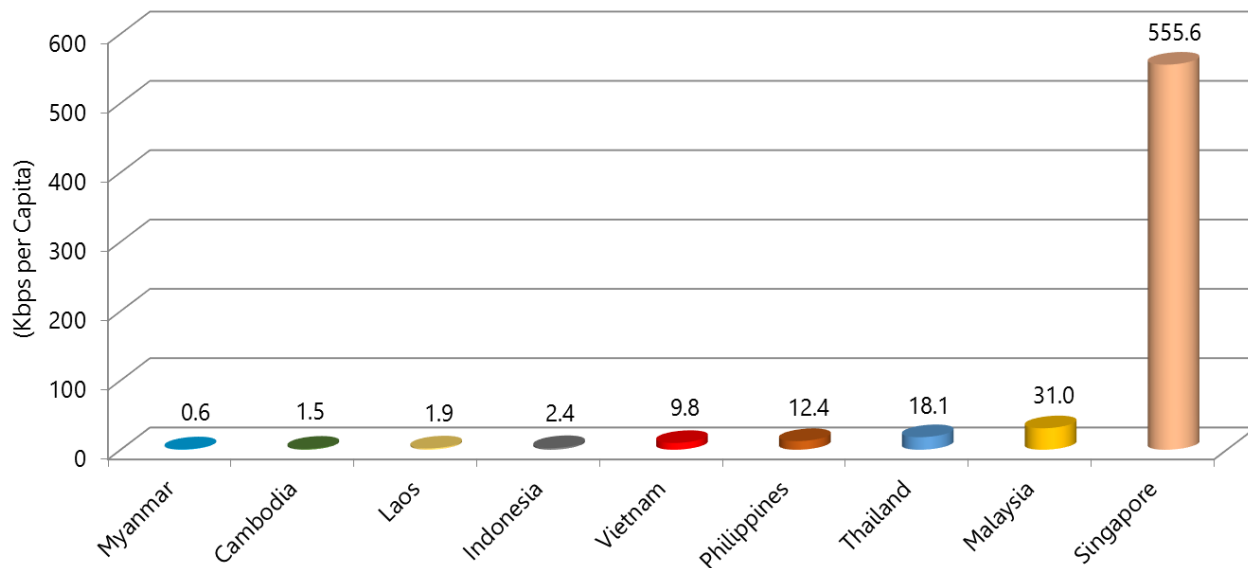
The Bandwidth Divide is Most Pronounced in Asia

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Per-Capita Bandwidth in ASEAN Countries, YE 2014

Source: An In-Depth Study on the Broadband Infrastructure in the ASEAN-9 Region (Terabit Consulting for UN ESCAP)



In the ASEAN region, the difference between the “bandwidth-richest” country and the “bandwidth poorest” country is 925x.

In more than half of countries, bandwidth is so low as to be a serious obstacle to overall development.

(based on Terabit Consulting threshold of <10 Kbps YE14)

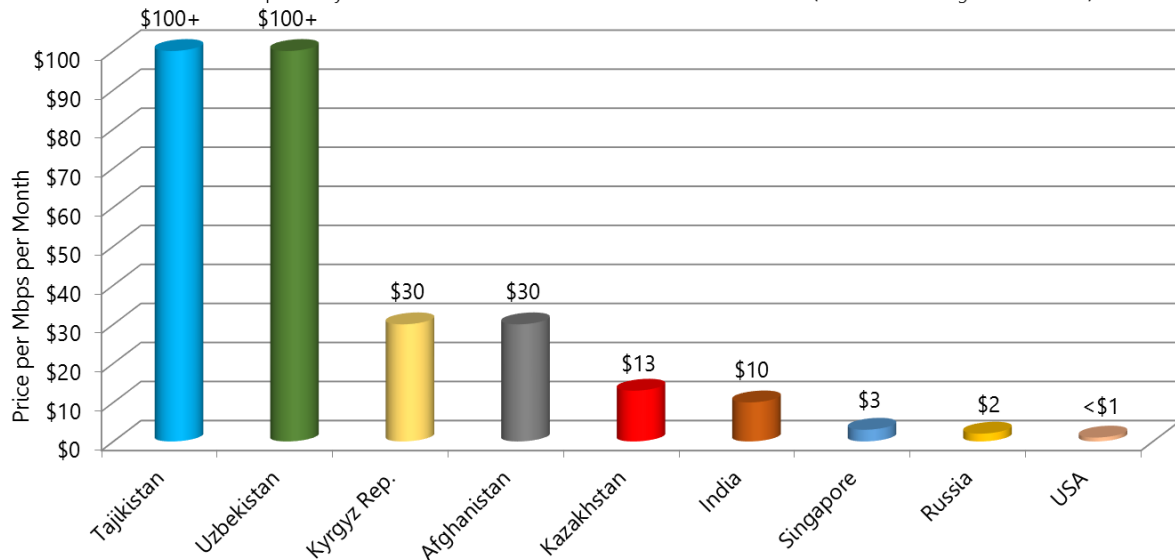
Weak International Bandwidth Infrastructure Keeps Wholesale Prices High

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IP Transit Pricing, 2015

Source: An In-Depth Study on the Broadband Infrastructure in North & Central Asia (Terabit Consulting for UN ESCAP)



Wholesale bandwidth prices are 10 to 100 times higher in some Asian markets than in North America.

Landlocked countries, in particular, have been deprived of affordable, reliable int'l. bandwidth.



The Impacts of Weak International Bandwidth

- A constrained telecom environment
 - High wholesale and consumer prices
 - Lower broadband penetration rates
 - Compromised services and applications with lower reliability and utility
- More importantly, at the macro level:
a major obstacle to economic and human development
 - Detachment from the digital economy
 - Continued economic inefficiencies and restrained growth
 - Lack of access to critical social development tools including telemedicine, distance learning, scientific/research networks



In the Developing World, Challenges & Obstacles Are Present Throughout the Supply Chain Between Int'l. Bandwidth and the End-User



Challenges of
Financing
Submarine
Cables

Limited
Competition
in Backhaul
Network

Strict Control
of Int'l.
Gateway

Weak or
Uncompetitive
Intercity
Terrestrial
Connectivity

Restricted
local access
& Expensive
Consumer
Broadband
Services

Lack of ICT
Equipment,
Lack of
Electricity



Policy Solutions for Addressing the Bandwidth Divide #1: Multilateral Projects

- In cases of market failure, pursue multilateral solutions for network development.
- Identify and involve key stakeholders on mutually-beneficial terms
 - governments, MDBs / IFIs & international organizations
 - able to provide coordination, guidance, and financing for the project
 - network operators and network developers
 - national regulatory authorities
 - incumbent operators and major international gateway providers
 - competitive telecommunications operators and ISPs
 - owners and overseers of complementary linear infrastructure assets
 - highway, rail, and power distribution infrastructure
 - suppliers and contractors

Policy Solutions for Addressing the Bandwidth Divide #2: Regional Cooperation

- In developing markets, encourage greater regional cooperation in the telecommunications and Internet sectors.
- Focus on the coordination of submarine and terrestrial fiber optic network development and investment, as well as pan-regional harmonization
 - Creation of regional working groups
 - Progressing to the exploration of streamlined regulatory, licensing, & interconnection regimes
(as well as exploration and development of common telecom market)



Policy Solutions for Addressing the Bandwidth Divide #3: Open Access

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- In uncompetitive international bandwidth markets, harness the potential of international connectivity by:
 - promoting open access and non-discriminatory terms for international bandwidth whenever possible, and
 - eliminating competitive and technological obstacles that may hinder the industry's full exploitation of bandwidth.

Policy Solutions for Addressing the Bandwidth Divide #4: Eliminate Downstream Obstacles

- Eliminate “downstream” obstacles to bandwidth utilization, including limited access, price discrimination, market dominance, and geographic limitations at each of the following network elements:
 - Backhaul
 - International gateway
 - Intercity fiber networks
 - Metropolitan and access networks
 - Consumer broadband services
 - End-user ICT equipment & electricity

Key Conclusions

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- The submarine communications industry has made tremendous progress in bringing cost-effective international connectivity to the shores of almost all the world's coastal countries and territories.
- However, the submarine communications industry cannot continue to operate in a vacuum that ignores the bandwidth divide and marketplace failures.
- A seamless and equitable global bandwidth infrastructure can only be fully achieved through a multilateral, policy-driven, public-private approach.



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