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Potential Role of Brazil's Undersea Cable Infrastructure for the FIFA 2014 World Cup & the Rio 2016 Olympic Games

Background, Observations, and Considerations

Prepared for:

◆IEEE

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Outline

- Two world-class events, two years apart!
- Background info (Hosting cities and venue location)
- Overview of Brazil's undersea cable infrastructure (UCI)
- Overview of Brazil's land-based fiber-optic infrastructure
- Observations
- Future Considerations

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FIFA 2014 World Cup: Twelve Host Cities

FIFA World Cup: Facts

- Most watched world-class event in the world over the course of the 31-day event

- Soccer teams from 32 nations

- Usually 8-12 hosting cities

- FIFA 2006 was held in Germany

  - Total Cumulative Television Audience: 26.29 Billion

    - 24.2 billion in-home and 2.1 billion out-of-home
    - 715 million watched the final match

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Rio 2016 Olympic Games: Venues

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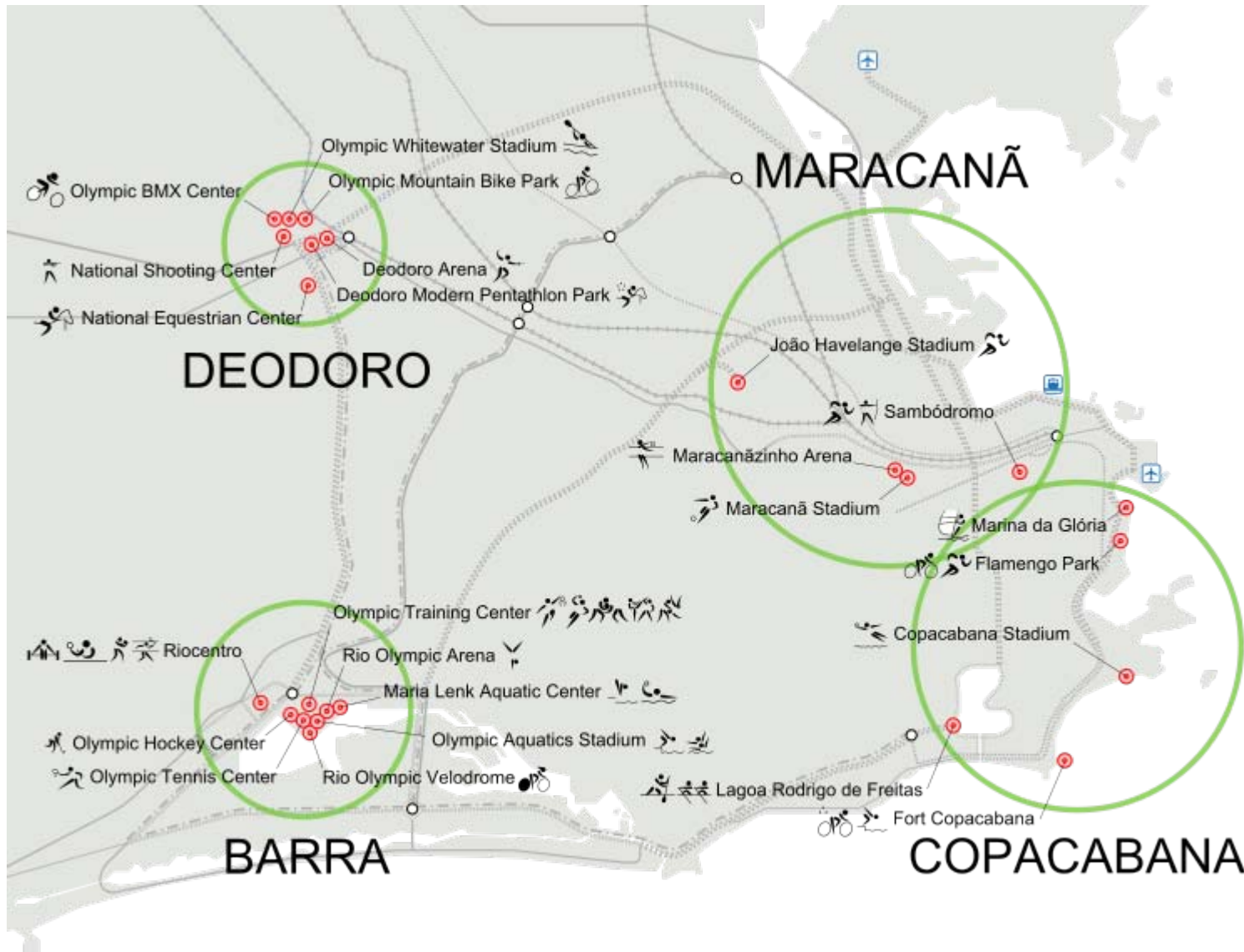
Some Fundamental Questions

- How will the demand for international traffic (voice, data, video) from Brazil to Asia, U.S., and Europe change as a result of the Games?
    - Which carriers have capacity, and to which countries?

    - How do we provide quality telecommunications service (with back up) to Europe and Asia for the Games?
    - With only one direct undersea cable to Europe (Atlantis-2) and none to Asia, how do we ensure timely connectivity and delivery of service on a worldwide basis?

- How do we leverage the capacity that goes from Brazil to the U.S.?
    - Is there a need to establish a distribution "hub" in the U.S. (e.g., Miami) to the rest of the world?

- Will there be enough interconnected, local, regional, and international capacity available for all stakeholders in the Games?

- How do we leverage the major cable systems into an "integrated" system capable of delivering bandwidth in and out of the region to the rest of the world?

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Undersea Cable Systems in South America

Source: Alcatel-Lucent, 2007

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Major Undersea Cable Systems Landing in Brazil

U.S. to Brazil

- **GlobeNet** – a subsidiary of Oi; connects U.S. to Brazil; 480 Gbps capacity

- **South America-1 (SAm-1)** – operated by Telefonica, connects U.S. to Brazil; 400 Gbps capacity

- **Americas-II** – consortium cable that connects Florida to Fortaleza, Brazil; largest owners are Embratel, AT&T, Verizon, Sprint; 80 Gbps capacity

- **South American Crossing (SAC)** – owned by Global Crossing, a ring around South America connecting St. Croix, U.S. Virgin Islands and Fortaleza; 200 Gbps capacity

- **Latin American Nautilus (LAN)** – majority owner is Telecom Italia; a dedicated fiber pair on South American Crossing's ring around South America; 120 Gbps capacity

Europe to Brazil

- **Atlantis-2** – consortium cable that connects Portugal to Fortaleza, Brazil and Las Toninas, Argentina; largest owners are Embratel, Deutsche Telekom, and Telecom Italia; 40 Gbps capacity

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Atlantis-2: Some Facts

Ready For Service (RFS): Feb. 2000

Cable Length: 8,600 Km

Landing Stations

- Lisbon, Portugal
- Praia, Cape Verde
- Dakar, Senegal
- Fortaleza, Brazil
- Las Toninas, Argentina
- El Médano, Canary Islands, Spain

Total Capacity

- 2009: 40 Gbps
- Potential: 160 Gbps

Source: TeleGeography Research

	Lit Fiber Pairs	Lit Wavelengths per Fiber Pair	Gbps per Wavelength	Total Capacity (Gbps)
2009	2	8	2.5	40
Potential	2	8	10	160

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Brazilian Undersea Cable Landing Stations

Landing Station City	Americas II	Atlantis 2	GlobeNet	South America 1 (SAm-1)	South America Crossing (SAM)	Total
Fortaleza *	1	1	1	1	1	5
Rio de Janeiro **			1	1	1	3
Salvador *				1		1
Santos				1	1	2

Fortaleza is a key city, with connectivity to all major cable systems

* **FIFA 2014 host city**
** **FIFA 2014 and 2016 Olympic Games host cities**

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Countries with UCI Connectivity to Brazil

Country	Count of Landing Stations (No. of Submarine Cables)
Argentina	Las Toninas (4 cables)
Bermuda	St. David's (1 cable)
Cape Verde	Praia (1 cable)
Chile	Arica (1 cable) and Valparaiso (2 cables)
Colombia	Barranquilla (1 cable)
Ecuador	Punta Carnero (1 cable)
French Guiana	Cayenne (1 cable)
Guatemala	Puerto Barrios (1 cable), Puerto San Jose (1 cable)
Martinique	Le Lamentine (1 cable)
Netherlands Antilles	Willemstad (1 cable)
Panama	Fort Amador (1 cable)
Peru	Lurin (2 cables), Puerto Mancora (1 cable)
Portugal	**Lisbon (1 cable)**
Senegal	Dakar (1 cable)
Spain	**El Medano (1 cable)**
Trinidad & Tobago	Chaguaramas (1 cable)
Uruguay	Maldonato (1 cable)
USA	**Boca Raton (2), Hollywood (1), Miramar (1), St Croix (2), San Juan (1), Tuckerton (1)**
Venezuela	Camuri Chico (1 cable), Maiquetia (1 cable), Puerto Viejo (1 cable)
Grand Total	**48 cables**

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Global Undersea Cable Infrastructure (UCI):
Primary Routes with Rich UCI Connectivity

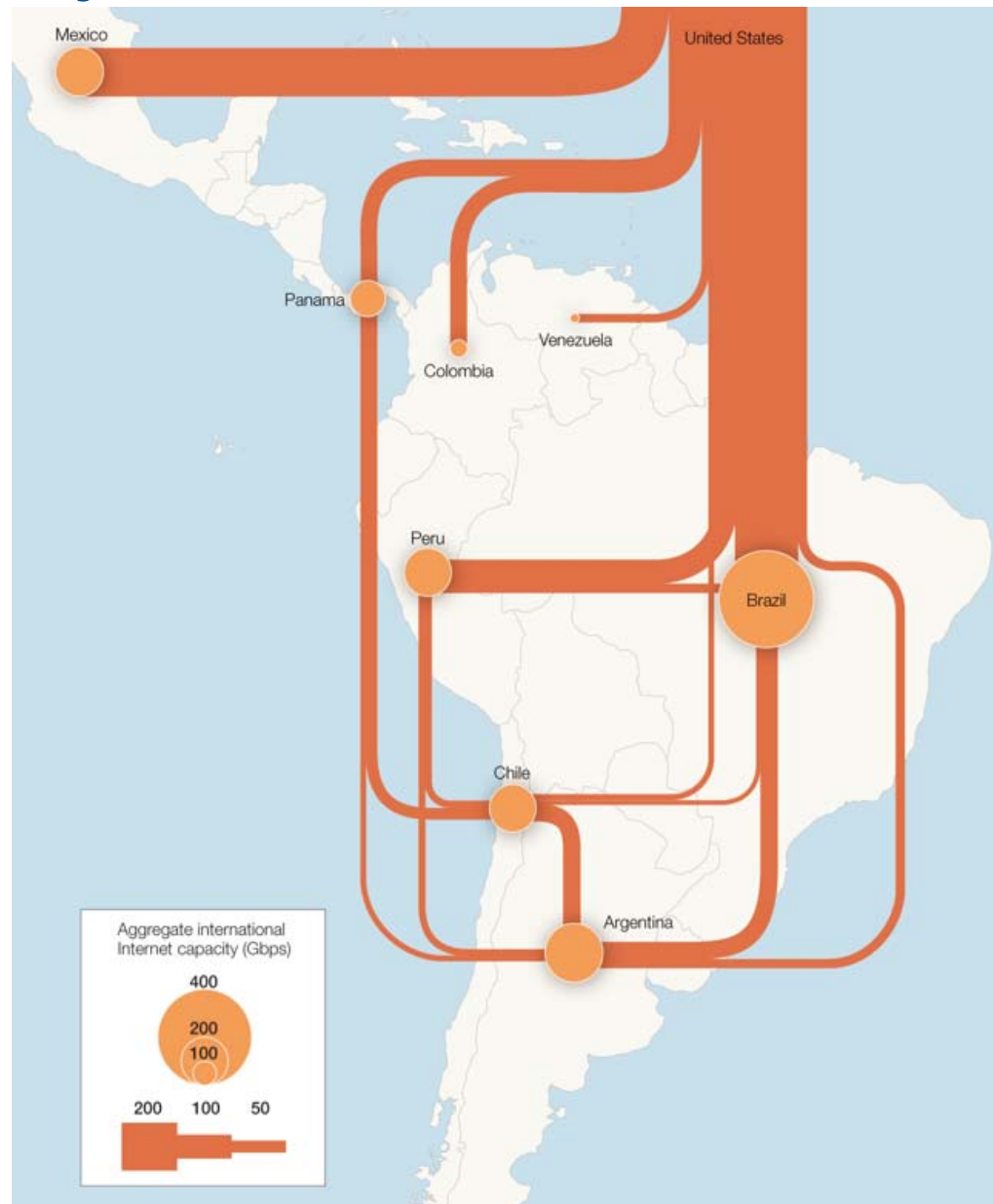*Note lack of major routes to South America*

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Global Undersea Cable Infrastructure (UCI):
"Choke Points"
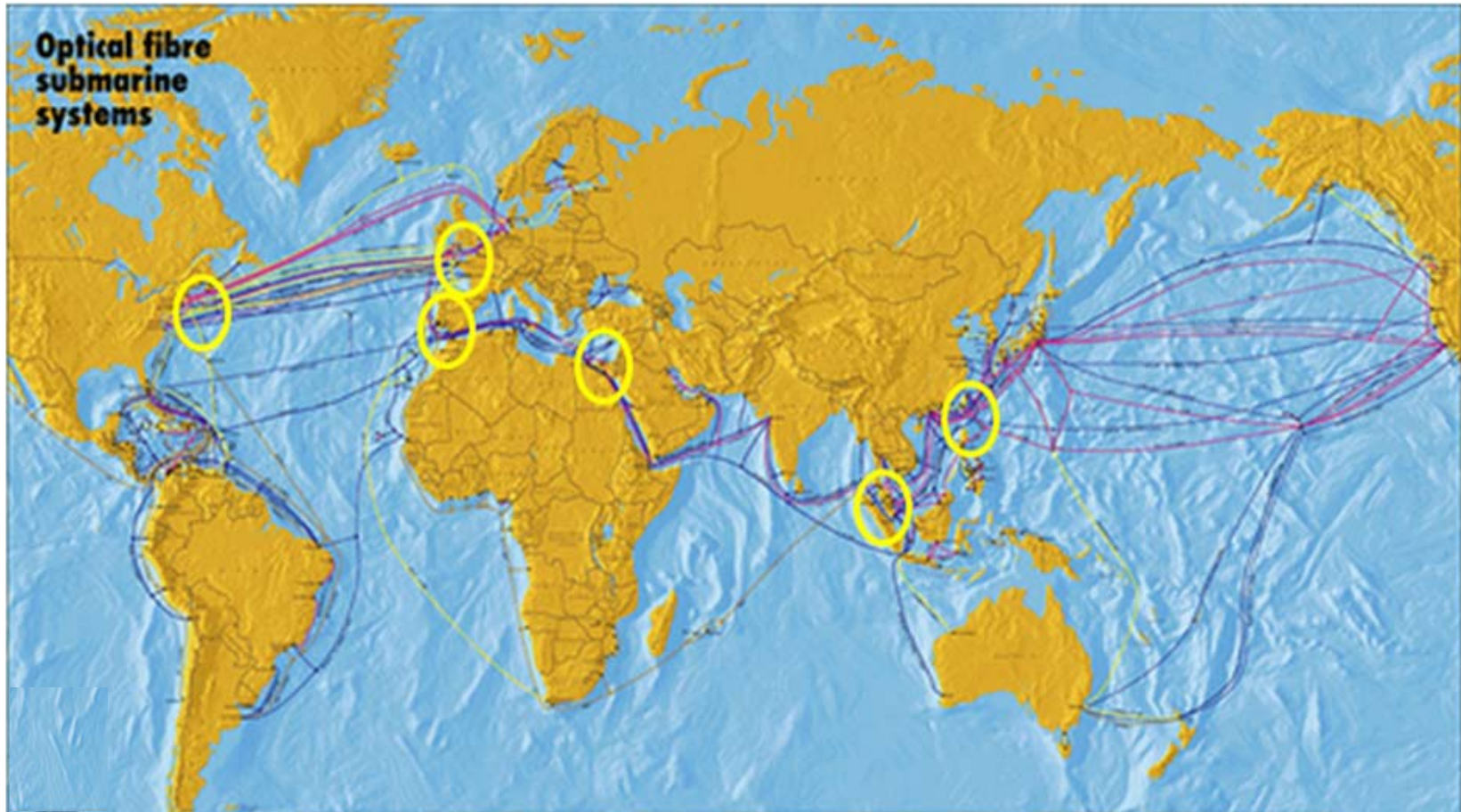
"Choke Points" are areas of high concentration of undersea cables and high risk of cable faults (natural or man-made)

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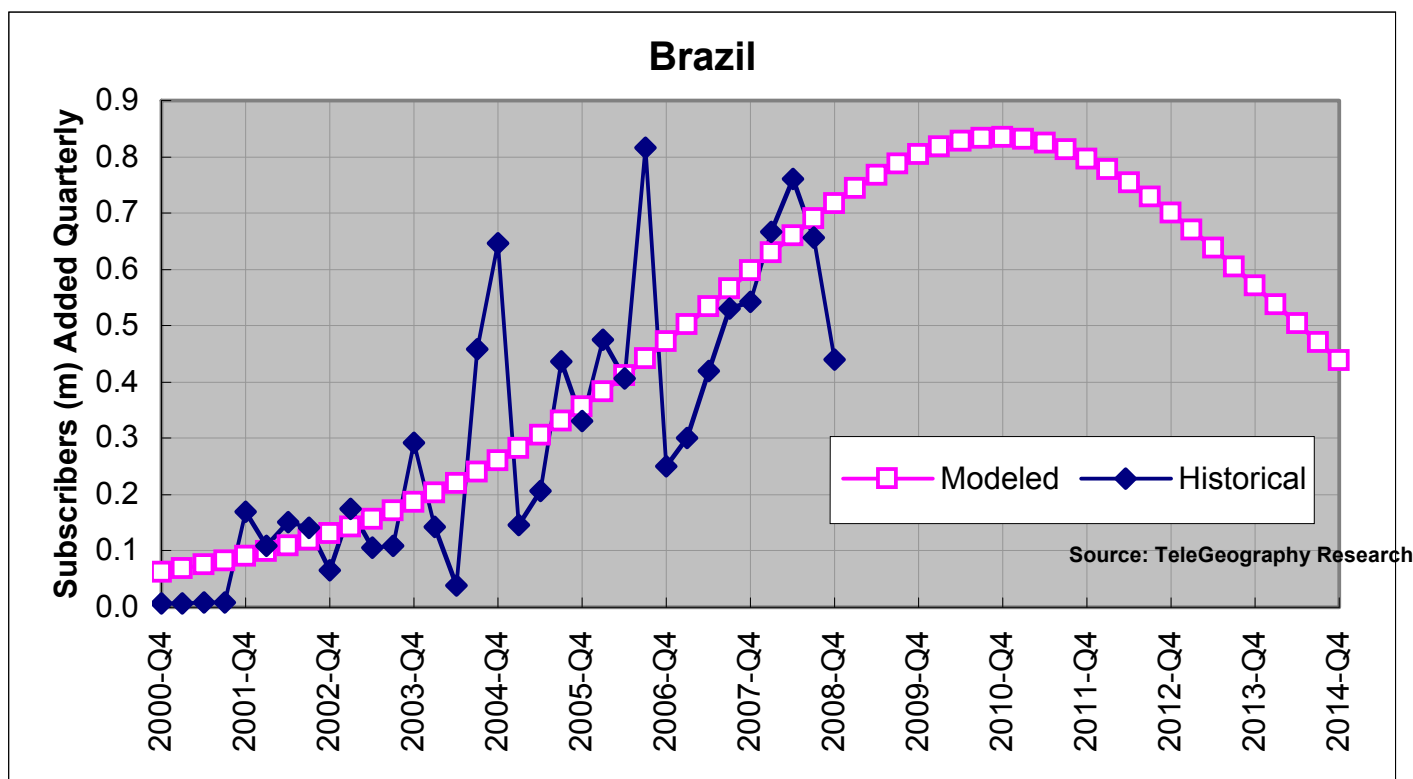
Miami: a Major Telecom Hub for Latin America

Latin America Broadband Markets – Brazil:
Future Growth

Why a dip after 2010?

Do industry projections take into consideration demand from "outlying" events, such as FIFA 2014 & Rio 2016?

Brazil

Source: TeleGeography Research

	CAGR '03-'08	CAGR '08-'13
Latin America	66%	**20%**
World Average	**32%**	**11%**

Source: TeleGeography Research, AHCIET, 2009

CAGR: Compound Annual Growth Rate

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Who are Brazil's Major Telecom Players?
Potential Grand Telecom Sponsors

Participation of the Groups

	Gross Revenue	Fixed Accesses	Broad Band	Cellulars	Pay TV
Telefonica/Vivo/Tim/TVA	40%	31%	29%	55%	7%
Oi/BrT	31%	58%	44%	16%	—
Embratel/Claro/Net/Vivax	19%	3%	15%	24%	45%

■ Telefonica/Vivo/Tim/TVA   ■ Oi/BrT   ■ Embratel/Claro/Net/Vivax
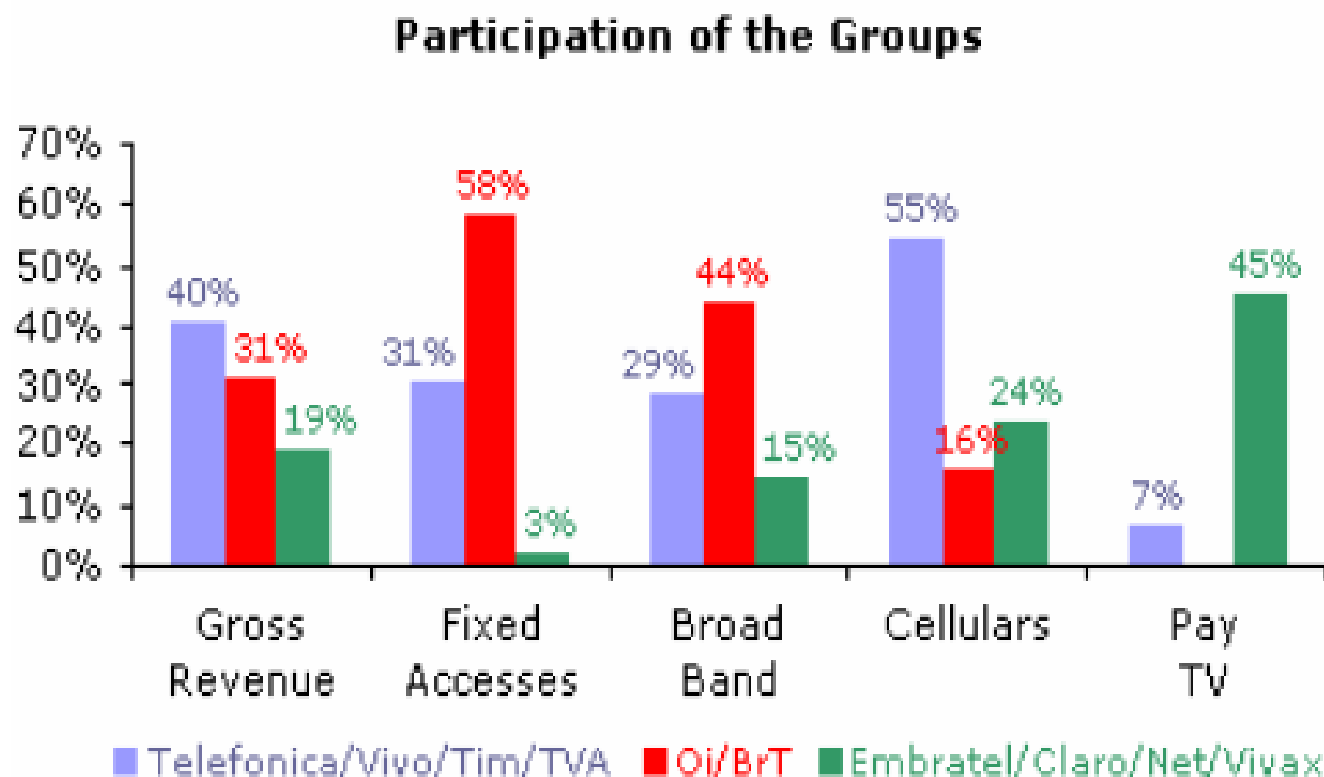
Source: MOITI, "Brazil Telecom/IT Industry" June 2007

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OI's Brazilian and Global Network

Oi - official telecommunications service provider for the FIFA 2014 World Cup in Brazil
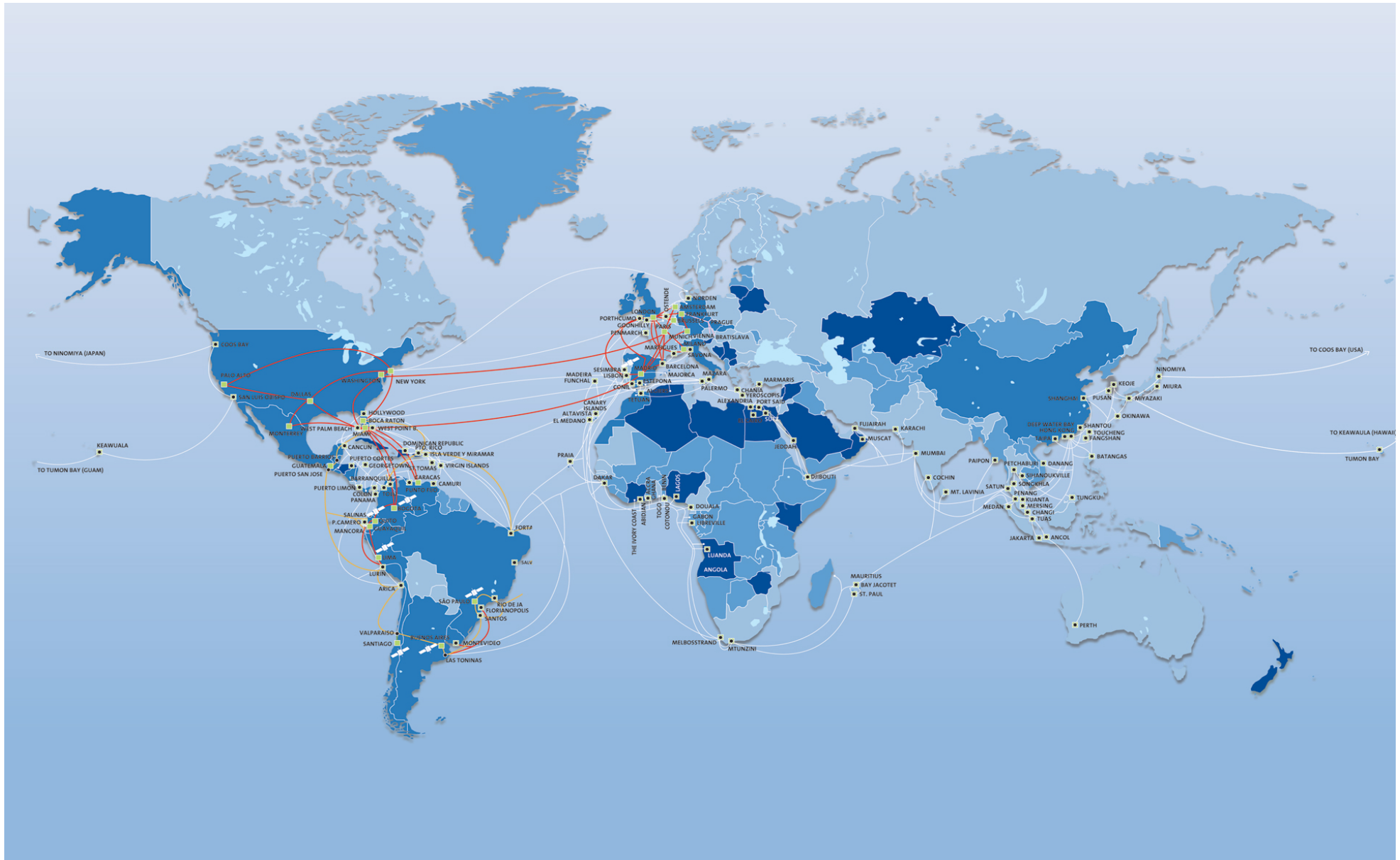
- Oi is the largest landline telephone company in Brazil and the second biggest in Latin America

GlobeNet, an international carrier's carrier, owns and operates an undersea cable network
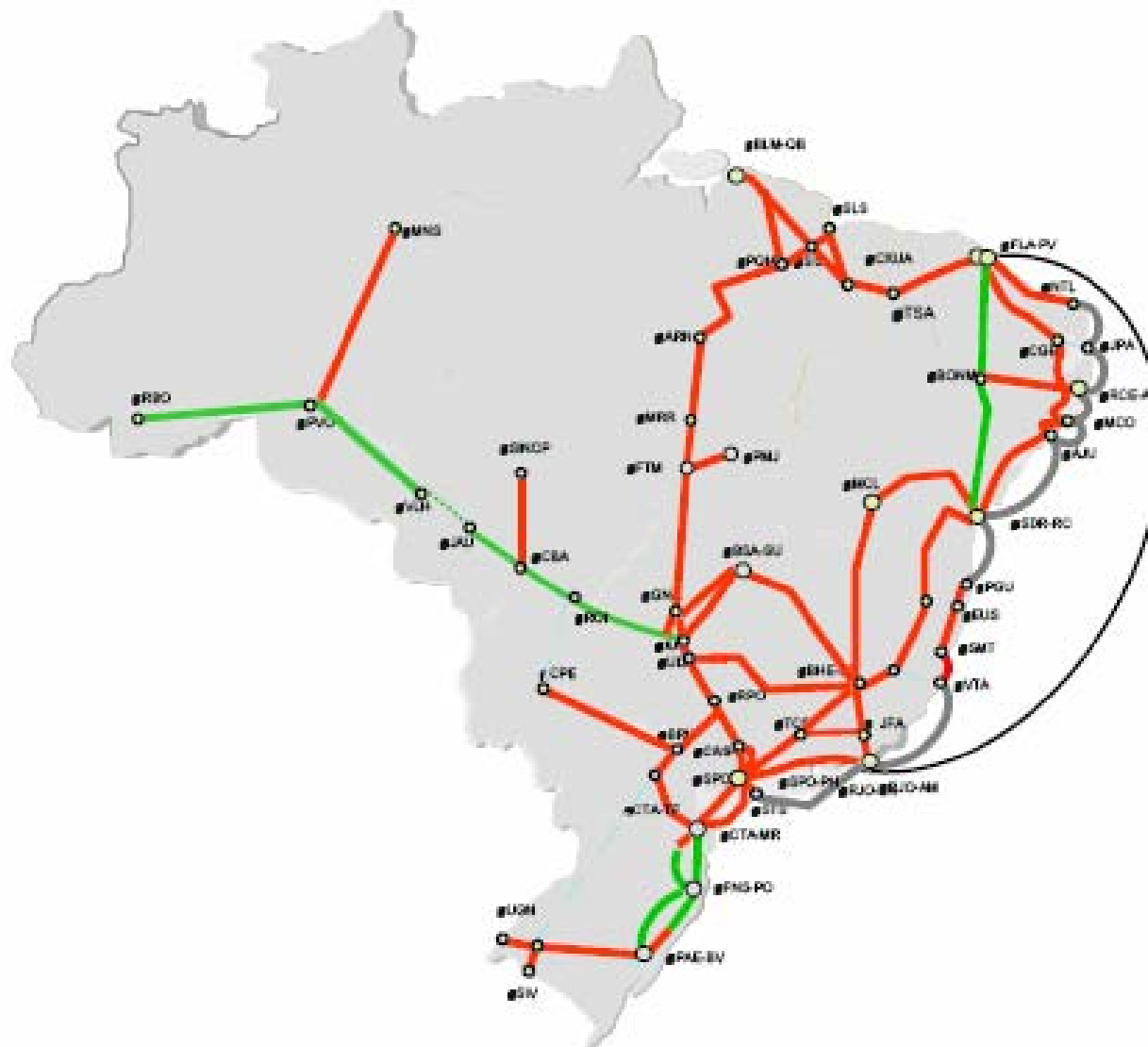
- The network links cable landing stations in the U.S. with cable landing stations in Fortaleza and Rio de Janeiro, Brazil, St. David's, Bermuda as well as Maiquetía (Caracas) Venezuela

- GlobeNet is a wholly-owned subsidiary of Oi (formerly Brasil Telecom)

Source: http://www.mzweb.com.br/oi/web/mobile/conteudo_mobile.asp?idioma=1&tipo=28213&conta=44

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Telefonica's Global Network

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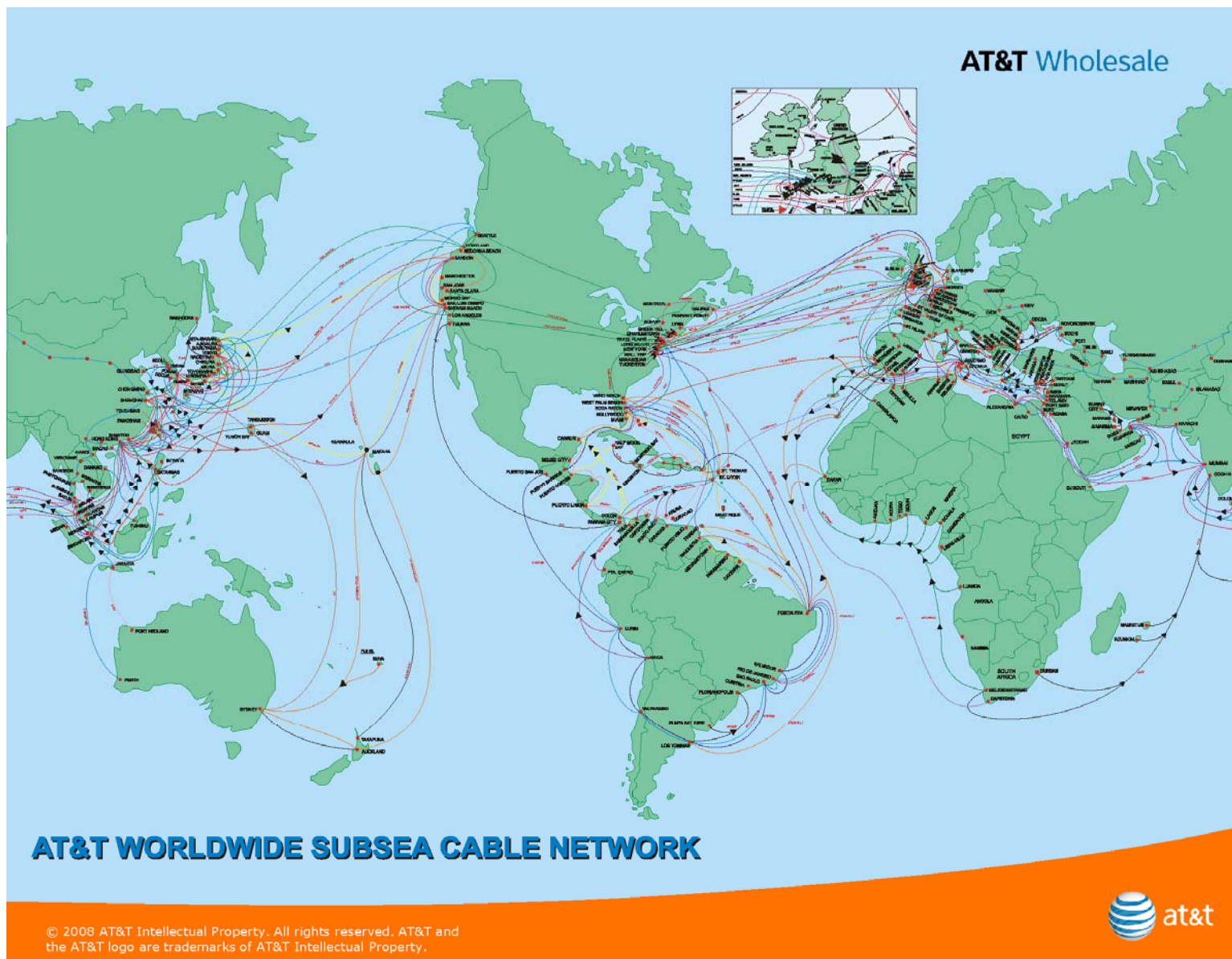# Embratel's Long Distance Fiber-Optic Network

FIBER NETWORK Figures:
Km of Cable : 35.846
Km of Fibers : 1,2 M
Availability : > 99,999 %

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AT&T's Global Mesh Network
Played a Major Role in Recent Olympiads Helping NBC

AT&T Wholesale

AT&T WORLDWIDE SUBSEA CABLE NETWORK

at&t

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Observations – 1 ("Bird's Eye View")

- ## International Connectivity

  - Brazil is <u>not</u> in the Asia - U.S. - Europe ("north hemisphere") highly interconnected UCI corridor

  - Brazil depends <u>heavily</u> on the UCI of the South Atlantic region and <u>less</u> on the South Pacific region

  - There is a multi-hop connection to Miami and a direct connection to New York City (important if NBC wins the broadcasting rights for the Rio 2016 Olympic Games)

- ## Hub locations – Fortaleza and Rio de Janeiro are key

  - Fortaleza is the major UCI hub in Brazil (the largest 5 cables land there) and a Single Point of Failure (SPOF) for <u>all</u> UCI going from Brazil to the U.S.

  - Rio is the second major UCI hub in Brazil (the largest 3 cables land there)

  - Fortaleza, Salvador, and Rio are interconnected via a festoon* UCI architecture

  - Santos is the UCI landing station serving San Paulo

  - <u>All</u> four cables from Brazil to Argentina land in the city of Las Toninas

  - Brazil's land-based fiber-optic infrastructure shows rich interconnectivity between the three major UCI hubs (i.e., Fortaleza, Rio, and Salvador)

* The <u>**festoon**</u> is basically a series of loops between major coastal landing points, and it is often deployed – though not always – as a repeaterless system

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Observations – 2 ("Bird's Eye View")

- Brazil's UCI *may* be adequate
  - Oi's GlobeNet completed a 110 Gbit/s upgrade in March 2010
  - There is a potential upgradeable and lit capacity of approx. 14 Tbps for UCI to Latin America between 2010 and 2015
  - No newsworthy outages for UCI cables landing in Brazil were found by searching public data for the 1999-2009 time period
  - Three (i.e., Fortaleza, Rio, and Salvador) out of the 12 hosting cities for the FIFA 2014 have landing stations and are UCI hubs connecting to the U.S.

- But questions remain
  - Bandwidth and trends shown in an earlier viewgraph may not have considered the FIFA 2014 and Rio 2016 Olympic Games (e.g., FIFA 2014 soccer games and 2016 Olympic events may be broadcasted in HD 3-D)
  - Quality of connectivity and diversity of telecommunications infrastructure for the FIFA 2014 twelve hosting cities varies and requires further analysis

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Future Considerations

- Considering the two world-class events in 2014 and 2016, regional and international telecommunications providers for the FIFA 2014 World Cup & the Rio 2016 Games should consider options for reducing risks, such as:

- Review and develop alternate routing capabilities across the Andes mountain range and consider leasing capacity from other service providers for diversification
- Conduct detailed capacity planning studies of Brazil's UCI to estimate the potential upgradeable and lit capacity between 2010 and 2016

  <local traffic> → <regional traffic> → <international traffic> → <UCI traffic>

- Re-assess the future growth models and curves for Brazil's broadband markets; be sure to include traffic from the two world-class events
- Engage undersea cable infrastructure providers to determine if undersea capacity is leased on a long-term basis and if peak traffic during the world-class events could be accommodated without paying a heavy premium
- Be aware that Brazil's connectivity to the world relies heavily on U.S. landing stations and only one cable (Atlantis-2) connects Brazil to Europe

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