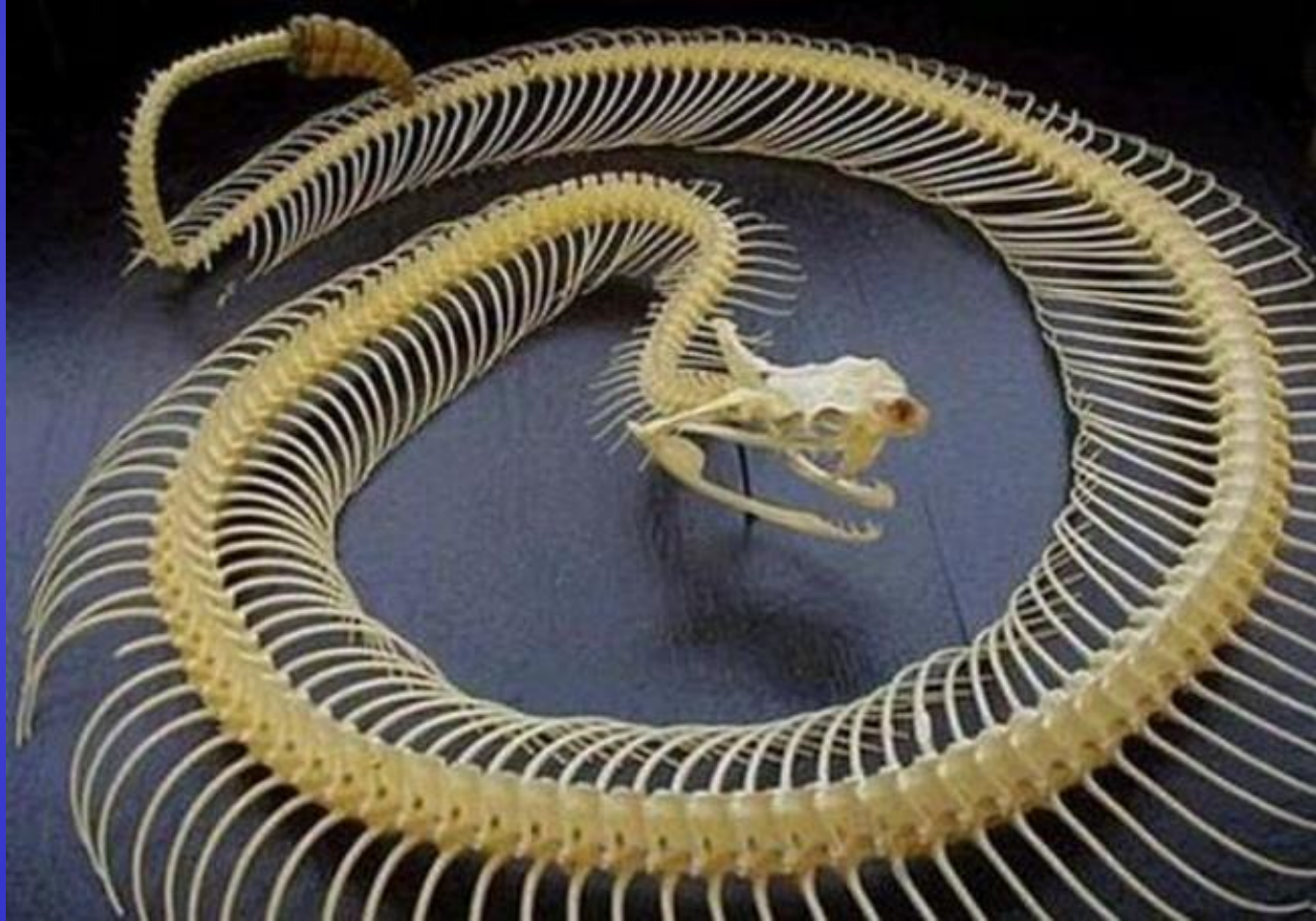
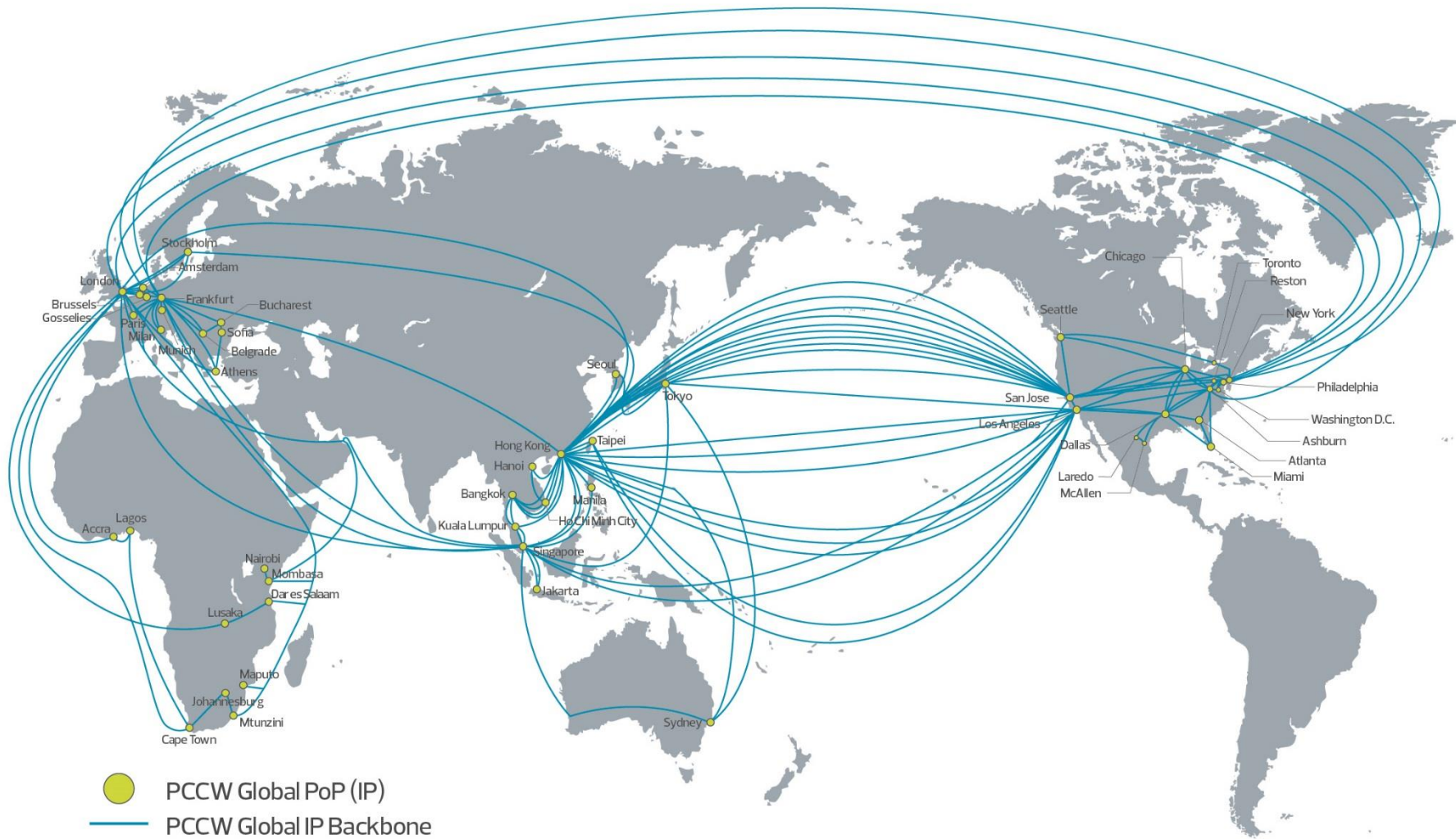


# The Internet Backbone



# Connectivity vs. Bandwidth

- **Connectivity** describes a physical connection to the Internet (wired or wireless)
- **Bandwidth** describes the speed of a physical connection



# The Bandwidth Conundrum

- “**Bandwidth**” is our term for measuring how much information can traverse the network from one point to another in a given time
- The amount of bandwidth between point A and point B determines
  - the amount of information that can be transferred in a given amount of time
  - the types of communication to be employed
  - how many can participate effectively

# The Bandwidth Conundrum

The size of the network “pipe” determines which sorts of things can be done over the network

Multimedia, video, audio, large documents, and pictures require much more bandwidth...

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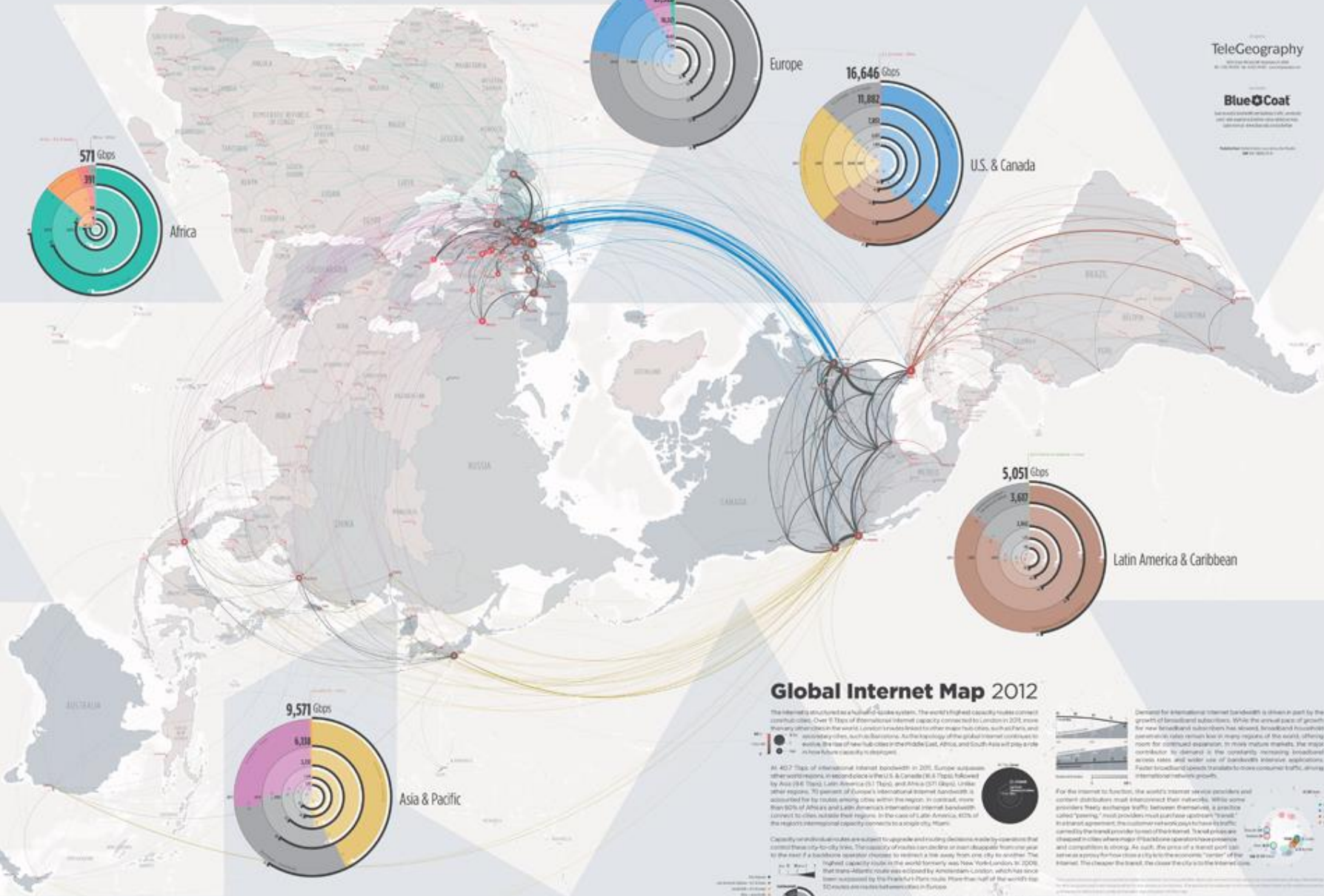
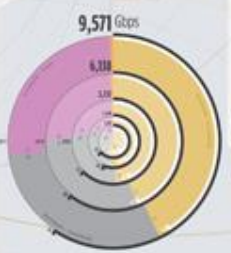
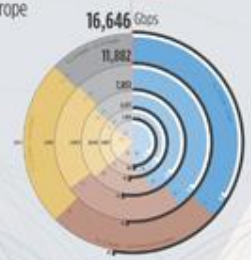
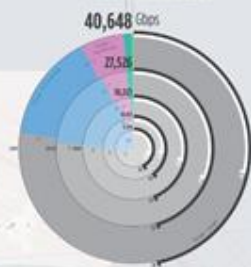


56Kb modem

128Kb satellite

1Mb satellite

10Mb local area network



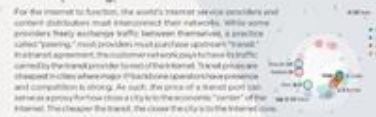
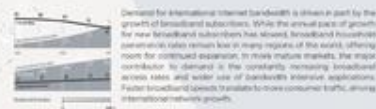
### Global Internet Map 2012

The Internet is structured as a hub-and-spoke system, the world's highest capacity nodes connect continents. Over 10 Tbps of international Internet capacity connected to London in 2011, more than any other city in the world. London trades bandwidth for other major hub cities, such as Paris, and secondary cities, such as Barcelona. As the backbone of the global Internet continues to evolve, the rise of new hub cities in the Middle East, Africa, and South Asia will play a role in the future capacity expansion.

At 40.7 Tbps of international Internet bandwidth in 2011, Europe outpaces other world regions in bandwidth (followed by the U.S. & Canada at 16.6 Tbps), followed by Asia (9.6 Tbps), Latin America (5.1 Tbps), and Africa (0.57 Tbps). Unlike other regions, 70 percent of Europe's international Internet bandwidth is accounted for by links among cities within the region. In contrast, more than 90% of Africa and Latin America's international Internet bandwidth connects to cities outside their regions. In the case of Latin America, 85% of the region's international capacity connects to a single city, Miami.

Capacity in individual markets is subject to upgrade and routing decisions made by operators that control these city-to-city links. The capacity of video services or mail drops from one year to the next, if a backbone operator chooses to redirect a link away from one city to another. The highest capacity node in the world formerly was New York-London. In 2008, that trans-Atlantic route was eclipsed by Amsterdam-London, which has since been surpassed by the Frankfurt-Paris route. More than half of the world's top 10 routes are routes that connect cities in Europe.

While bandwidth growth remains strong, the pace of growth has slowed. Overall world bandwidth growth dropped below 50% in 2010 for the first time since 2006. Even in the lowest-percentage region of Africa, the pace of bandwidth growth slowed from 152% in 2009 to 40% in 2010.



Demand for international Internet bandwidth is driven in part by the growth of broadband subscribers. While the annual pace of growth for new broadband subscribers has slowed, broadband penetration rates are still rising in many regions of the world, offering room for continued expansion. In more mature markets, the major contributor to demand is the constantly increasing bandwidth across rates and wider use of bandwidth-intensive applications. Faster broadband speeds translate to more consumer traffic, among other international network growth.

For the Internet to function, the world's Internet service providers and content distributors must interconnect their networks. While some providers already exchange traffic between themselves, a practice called "peering," most providers must purchase peering transit. In a peering agreement, the customer will only pay for transit to traffic carried by the provider provider transit. The deal provides a cheaper transit option where major ISPs and content providers have peering and competition is strong. As such, the price of a transit port can fall as a provider has more of a say in the economic "market" of the Internet. The cheaper the transit, the closer the city to the Internet core.

# Two distinct flavors of Connectivity

- **Store and Forward**
  - the user interacts sporadically with the Internet, does the bulk of work off-line
  - the most popular application in developing countries
- **Interactive (Direct Connection)**
  - the computer is attached in real time to the Internet and can browse the World Wide Web
  - rare in the less developed countries

# Store and Forward

- asynchronous
- scalable from “sneaker net” to full IP connection
- Most cost effective communication available
- Hybrid solutions that “sync”
- Users sometimes “Pay by the bit.”

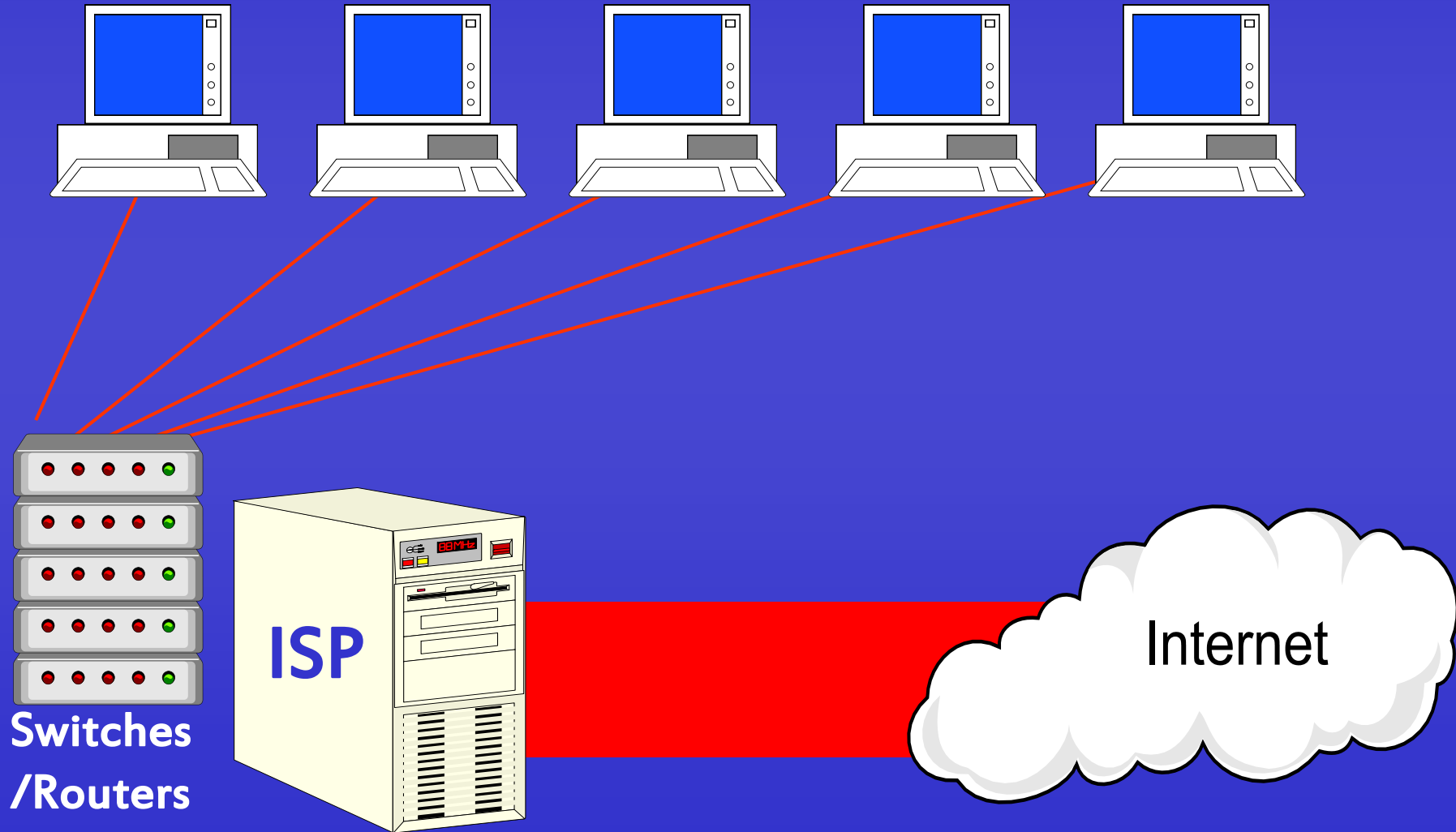


**Asynchronicity**  
is the  
Poor Person's  
Best Friend

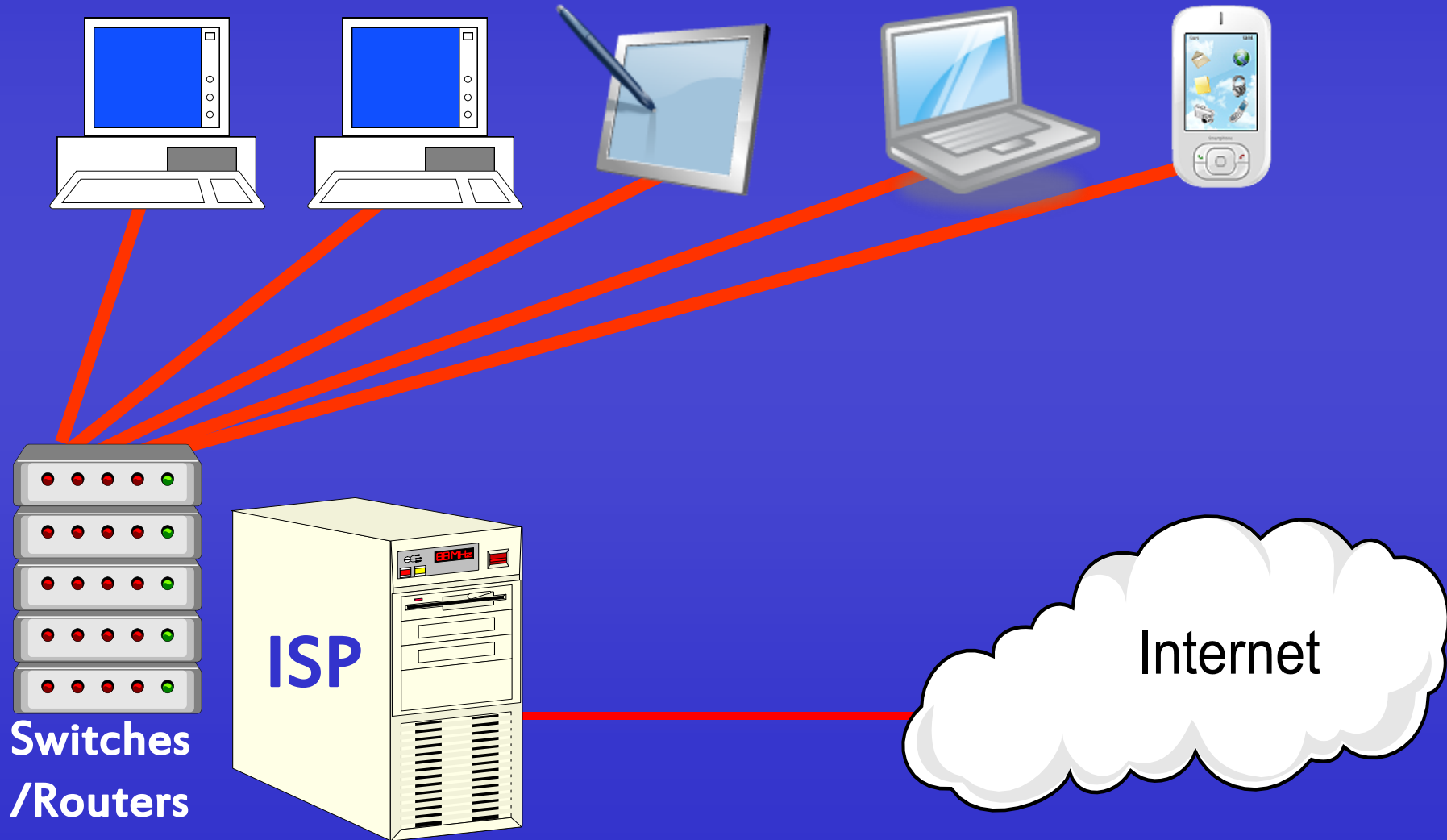
# Interactive: TCP/IP

- an actual network “wire” to the Internet
- scalable throughput
- via network card or modem
- Works on packet level: interacting computers can negotiate transmission in real time
- Basis of the “World Wide” Web

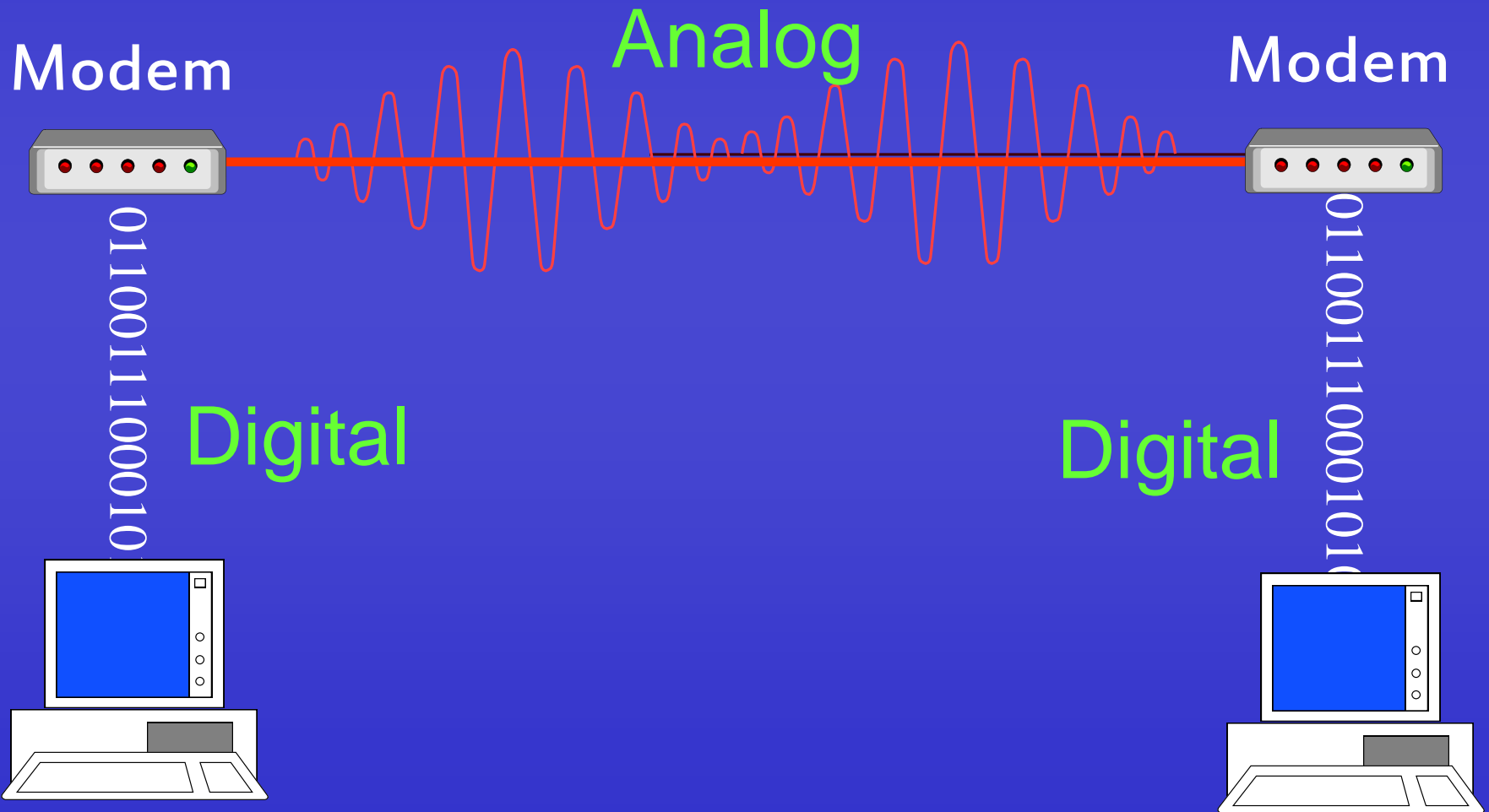
# Ideal Internet Service Provider



# Internet Service Provider



# Modems

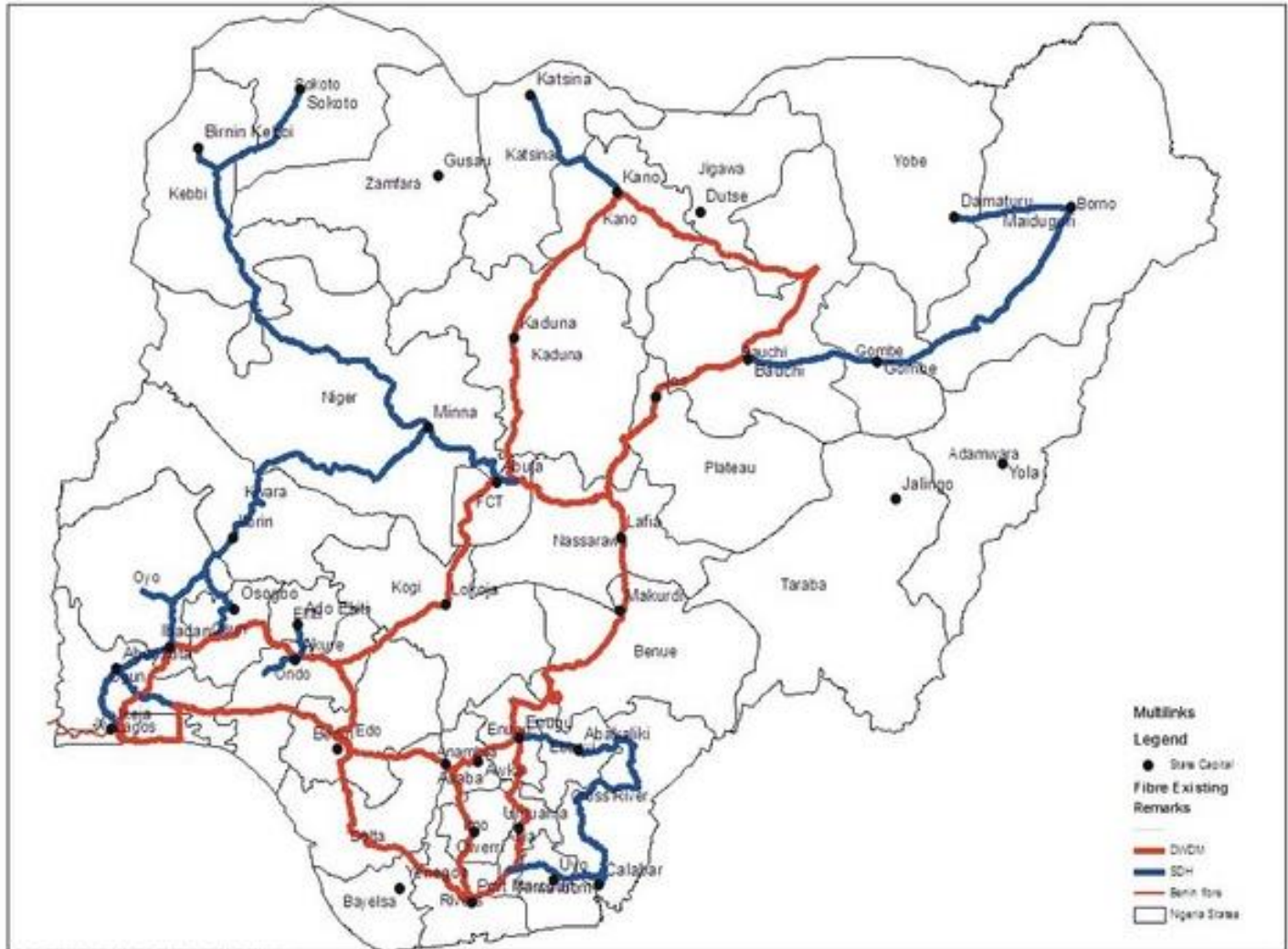


# Ethernet Speeds

Cable	10	10Mb/s	10BASE-T
	100	100Mb/s	100BASE-TX
	1,000	Gigabit	1000BASE-T
	10,000	10 Gb/s	10GBASE-T
	100,000	100 Gb/s	100GBASE-T
Wireless	54	54 Mb/s	802.11a
	11	11 Mb/s	802.11b
	54	54 Mb/s	802.11g
	65	65 Mb/s	802.11n
	150	150 Mb/s	802.11n
	300	300 Mb/s	802.11n
73Tbit record			

# Long Distance Options

- Fiber Optics
- Copper Wires
- Microwave Terrestrial Radio
- Satellite

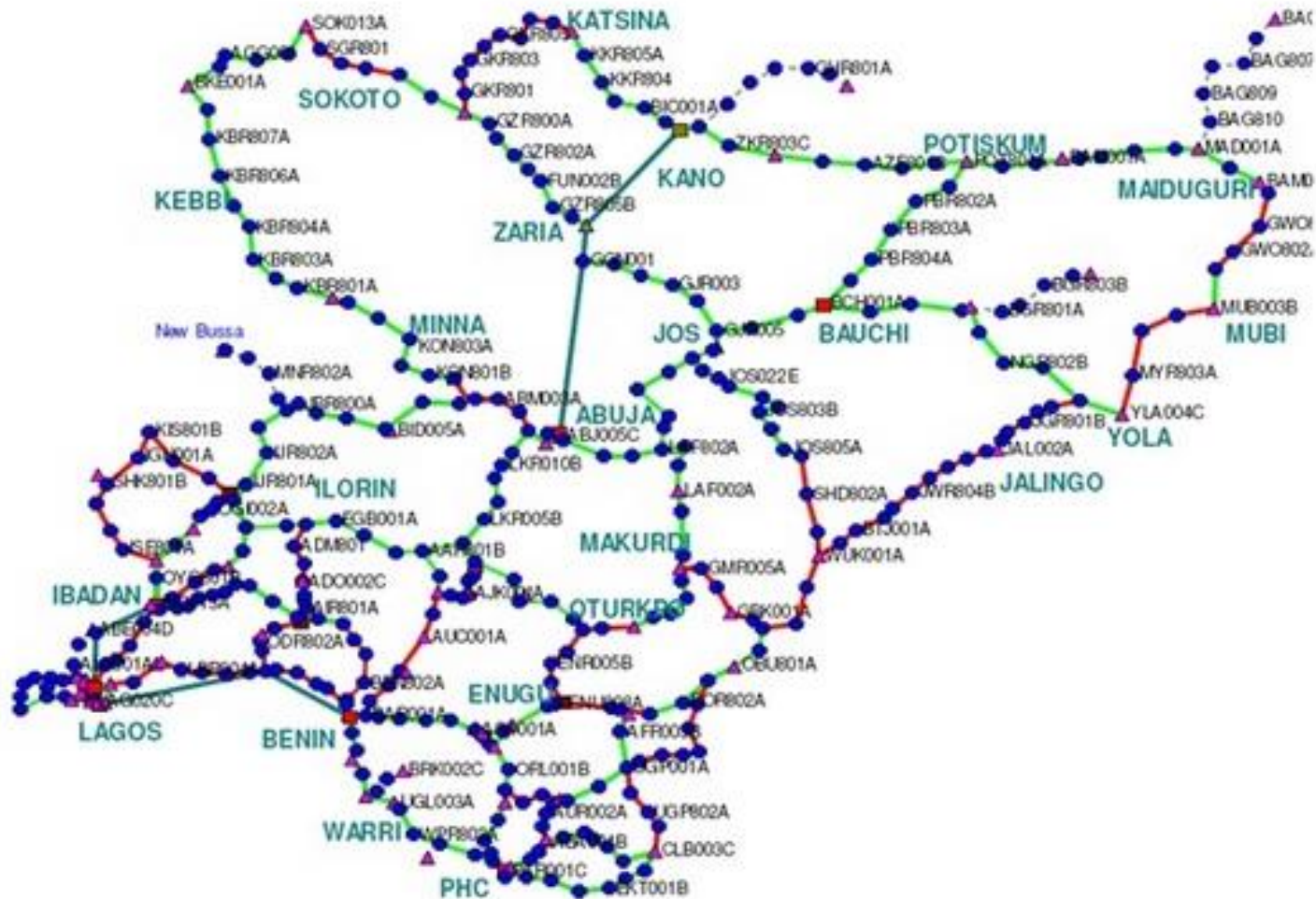


Prepared by Abie Terblanche CTO Strategy

## Nigeria - MultiLinks Fibre Backbone

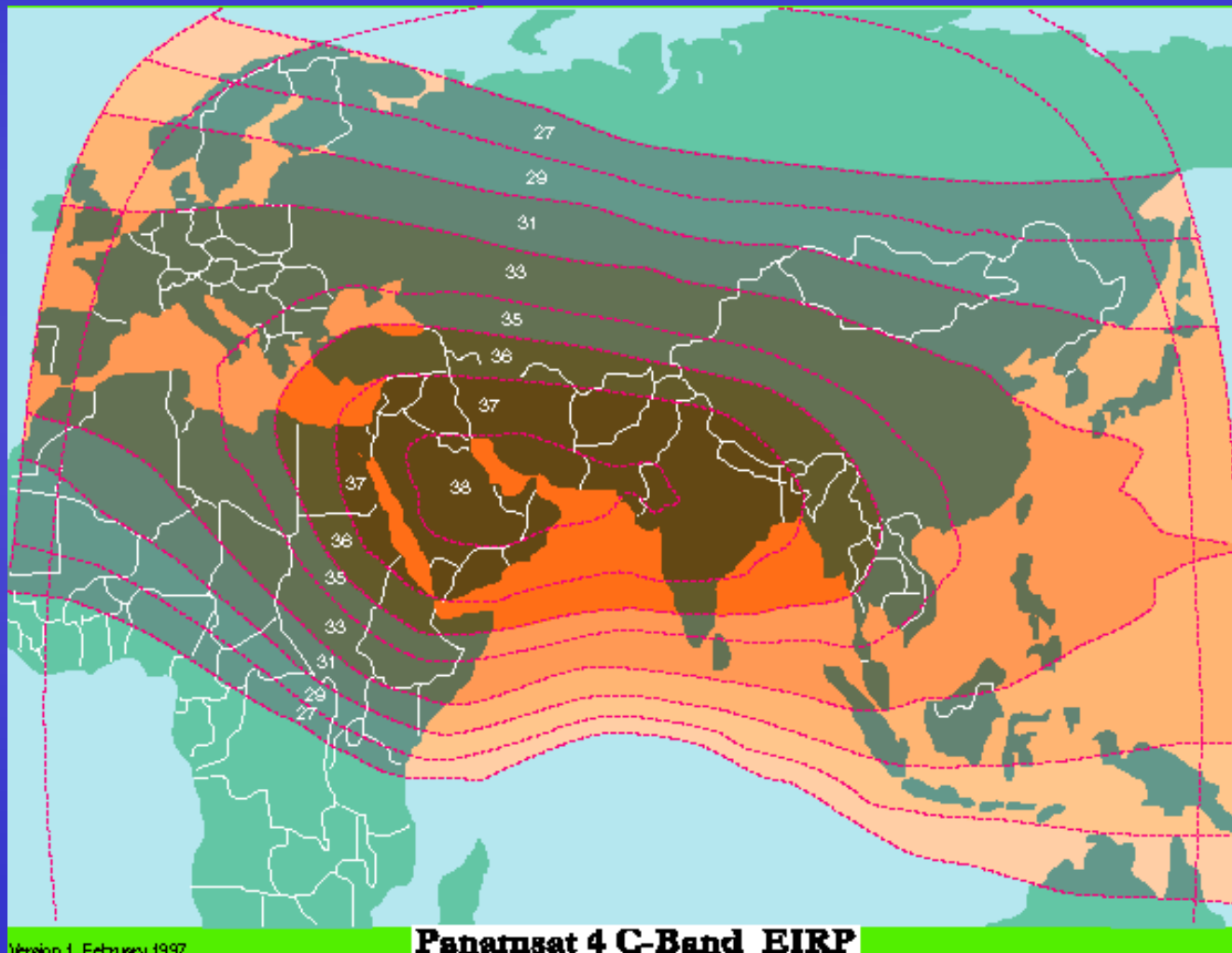


# Microwave Network



Globacom have a Microwave network that practically spans the whole of Nigeria. On the SDH network the capacity is a minimum STM2 with 1+1 redundancy. This network alongside OFC network is used to carry most of our traffic nationwide.

# Satellite Footprints

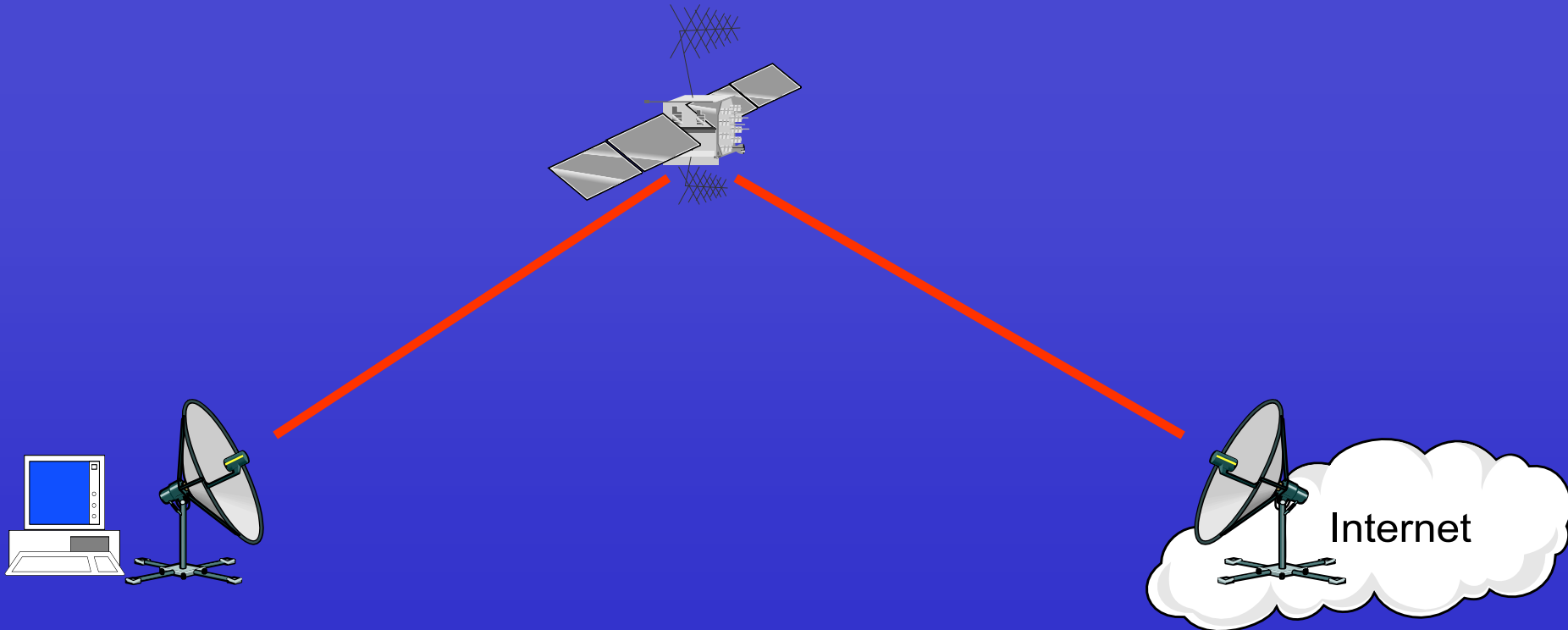


# Satellite communications

- Inmarsat, IntelSat, PanAmsat, Hughes, etc:
  - full scale telecommunications links
  - large footprints covering several continents
  - gigabits of bandwidth
- VITASAT
  - intermittent links, small footprints
- Still a fraction of what fiber can deliver

# Bent Pipe

- Satellite simply relays data using radio
- Users contract for a portion of the “birds” bandwidth





**WiderNet**  
*Casting a Wider Net*  
**.Org**

**The End**