Current Optical Infrastructure in the Americas:

New Opportunities for Science and Technology in the Hemisphere

Dr. Saúl Hahn

Organization of American States

FIU- AMPATH Workshop: Fostering Collaboration and Next Generation Infrastructure
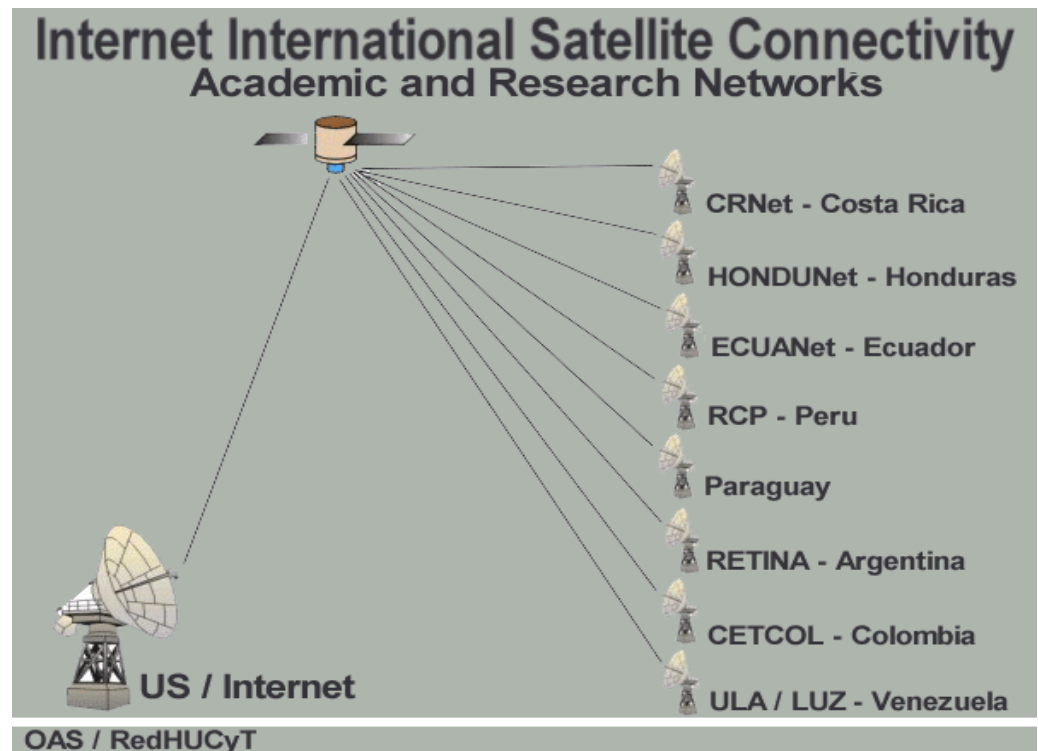
Miami, Florida, January 29-31, 2003

Initial Development of the Internet in Latin America and the Caribbean based on Satellite

(role played by the OAS/RedHUCyT, NSF)
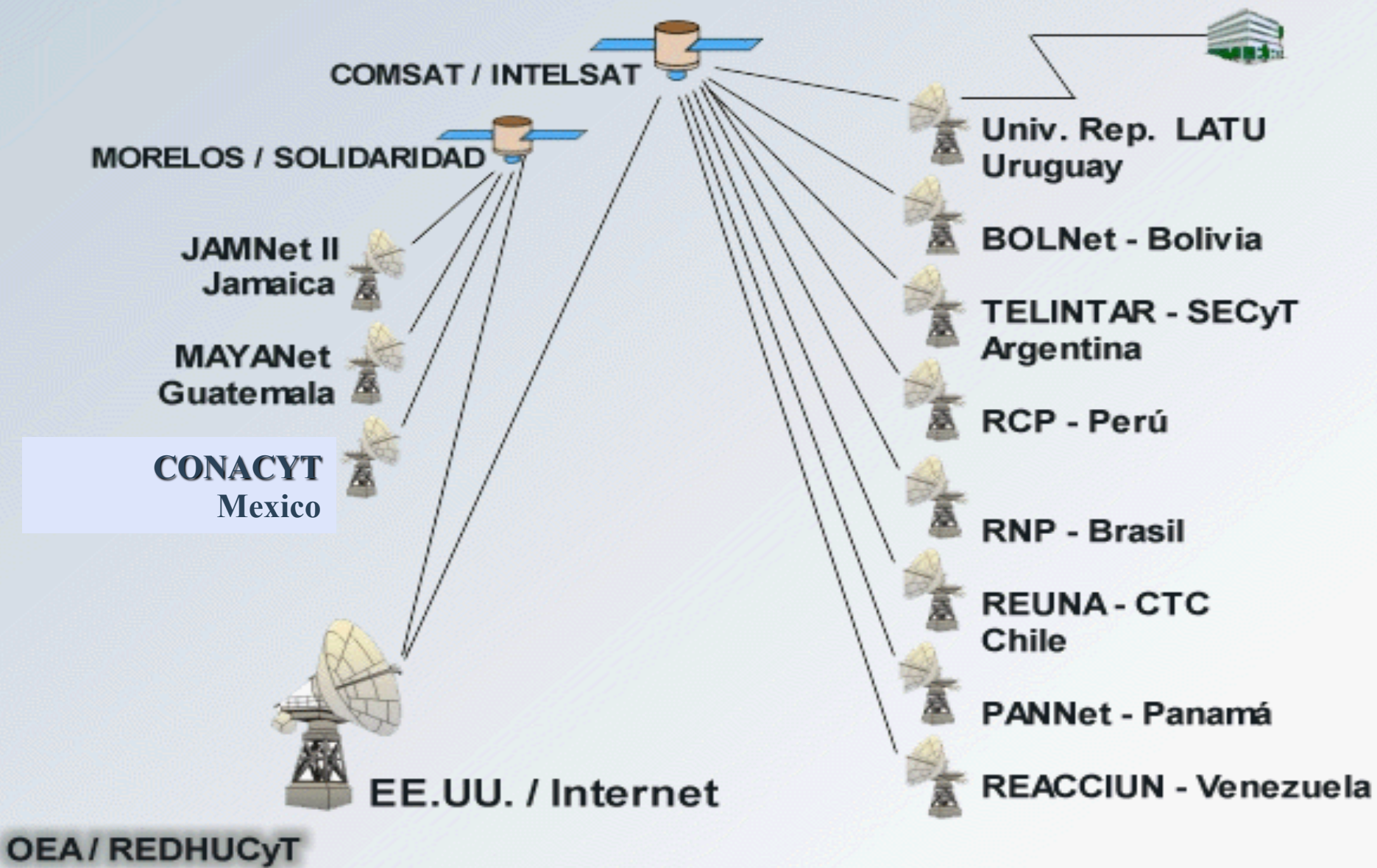
Role of The OAS/RedHUCyT in Connectivity

- The OAS, through the RedHUCyT project, assisted in the connection to the Internet , for the first time, of many of the Latin American and Caribbean Countries . Most of the connections were achieved via satellite into the US. The OAS financed earth stations and other basic equipment. Key collaboration with **NSF**.

- **Countries** paid telecommunications recurrent costs, which were very high and the capacity of the connection was limited, (64 K)bps, but it was a good start.

Schematic configuration of academic and research networks connected via satellite, early 1990's

Internet International Satellite Connectivity
Academic and Research Networks

- CRNet - Costa Rica
- HONDUNet - Honduras
- ECUANet - Ecuador
- RCP - Peru
- Paraguay
- RETINA - Argentina
- CETCOL - Colombia
- ULA / LUZ - Venezuela

US / Internet

OAS / RedHUCyT

OAS/RedHUCyT

Conexiones Internacionales vía Satélite a la Internet
Redes Académicas y de Investigación

COMSAT / INTELSAT

MORELOS / SOLIDARIDAD

JAMNet II
Jamaica

MAYANet
Guatemala

CONACYT
Mexico

EE.UU. / Internet

Univ. Rep. LATU
Uruguay

BOLNet - Bolivia

TELINTAR - SECyT
Argentina

RCP - Perú

RNP - Brasil

REUNA - CTC
Chile

PANNet - Panamá

REACCIUN - Venezuela

OEA / REDHUCyT

OEA/RedHUCyT

• Currently, the recently installed infrastructure of fiber-optics networks in the region provides new levels of connectivity between the countries of the Hemisphere . This opens exciting new possibilities for cooperation in advanced technological and scientific applications.

Examples of this level of cooperation:

• AMPATH (AR, BR, CH, USA, other countries)

• CUDI (MX, US); agreements with other countries including Canada

• Internet2 (US, Canada, Europe, Asia, Latin America)

• Star Tap

• CLARA (Latin American Cooperation of Advanced Networks) which is comprised of academic networks. CLARA is being sponsored by the EU, @LIS.

Current Infrastructure

Facilitating Establishment of Regional and Subregional Backbone
(GX, Emergia, ARCOS-1, etc)

Global Crossing Network - Latin America

Brookhaven
Tijuana
Monterrey
Mazatlan
Guadalajara
Mexico City
Hollywood
St. Croix
Puerto Viejo
Caracas
Fort Amador
Fortaleza
Lima
Lurin
Sao Paulo
Río de Janeiro
Valparaiso
Cordoba
Santos
Santiago
Rosario
Mendoza
Buenos Aires
Las Toninas

Source: http://www.globalcrossing.com

OAS/RedHUCyT

Global Crossing

SAC System

- Use of a four-fiber-pair system
- Implemented in 2001
- Initial system capacity of 40 Gbps that will be upgraded to at least 80 Gbps
- Length of the SAC system exceeds 16,000 km
- **AMPATH uses GX infrastructure**

Mexican Crossing

- Connects with PAC at Mazatlan and Tijuana to provide connectivity between Mexico and the rest of the Global Crossing' worldwide network
- Activated in October 2000.
- 10 Gbps terrestrial optical system in commercial service
- The 3,483 km ring transports voice, data and multim. services at speeds up to 320 Gbps over a single fiber pair, or carriers ~ 500,000 simultaneous phone calls over a single fiber

OAS/RedHUCyT

Emergia

• A subsidiary of Telefónica S.A., Emergia S.A. provides connectivity from Latin America to the United States and Europe through the largest undersea fiber optic cable network built in Latin America.

• Cable length: ~ 25,000 km

• Initial Capacity: 40Gbps

• Final capacity: 1.92 Tbps

• The network includes 1,600 km of terrestrial fiber optic cables, and landing stations in all major cities in Latin America, USA and Puerto Rico

Source: http://www.telefonica.es/index/emergia_des.html.

OAS/RedHUCyT

GlobeNET Network System

Map labels: Tuckerton, Bermuda, Boca Raton, Caracas, Fortaleza, Rio de Janeiro

Source: http://www.360networks.com/

- *GlobeNET* operates a 2-ring, 22,000 km. undersea fiber-optic cable system, currently connecting the United States, Bermuda Islands, Brazil, and Venezuela

Source: Based on a report provided by GlobeNET

- Maximum capacity : 1.36 Tbps on each segment using 4 fiber pairs with state-of-the-art, 34-wavelength technology.

- System recently completed by *Alcatel Submarine Networks (ALCATEL)*

OAS/RedHUCyT
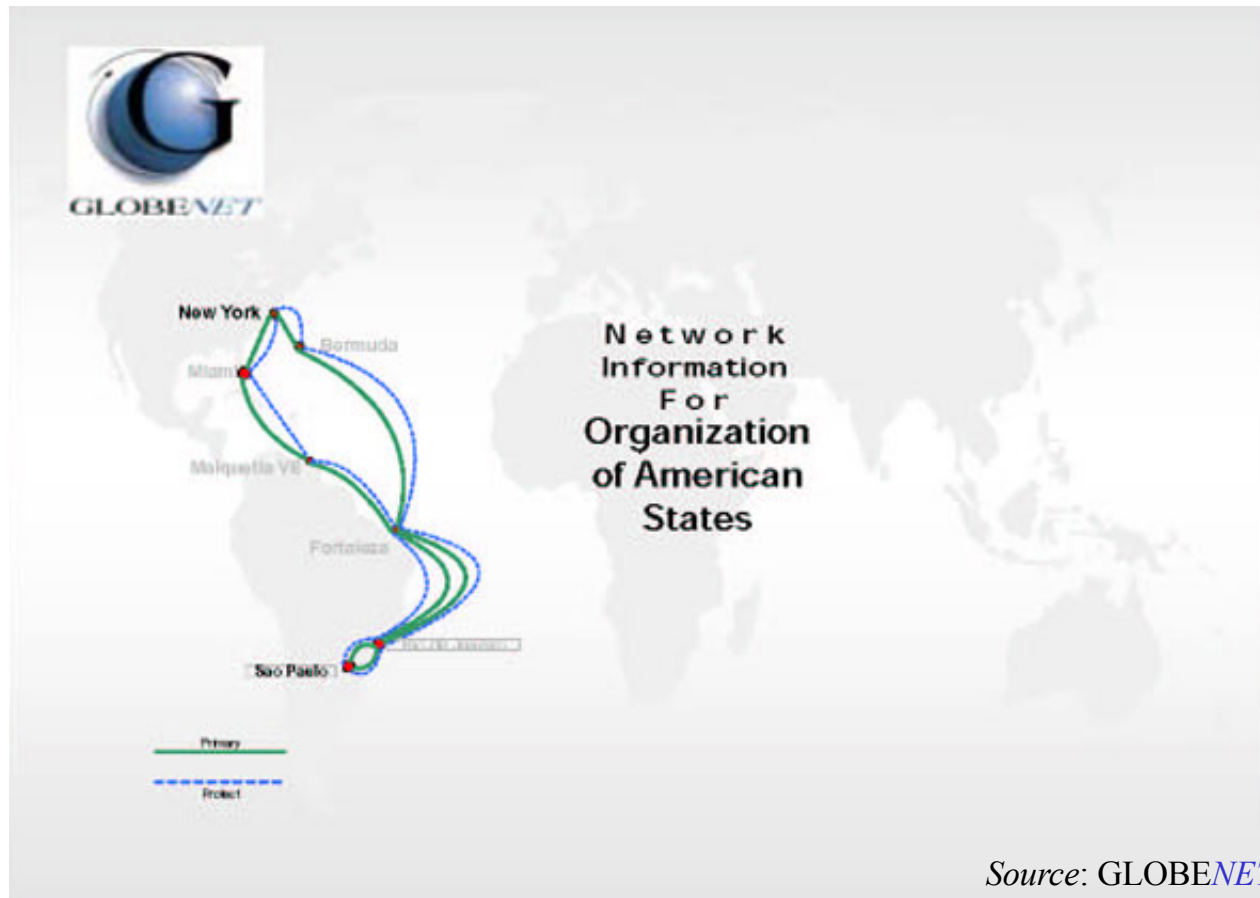
Source: GLOBE*NET*

- The largest South American system ever built: 22,000 kms.

- Two tandem connected, self-healing ring provides internal restoration in event of link outage.

- Greater than 99.99% of availability.

- 24h x 7 days monitoring and management

- Operational system since September 2001

- Low latency design

- The lowest operational cost submarine system in Latin America

OAS/RedHUCyT

# AmericasPATH (AMPATH) Network

- FIU Project of *the FIU* in collaboration with *Global Crossing* and other telecommunication carriers

- The mission of AMPATH is to serve as the pathway for Research and Education (R&E) Networking in the Americas and to the World

- Intends to use DS3 connections to link each participating country's R&E networks to R&E networks in the US and abroad, via Internet2's Abilene backbone. The donated DS3 by Global Crossing will help to connect each participating country's R&E networks to the AMPATH PoP in Miami.

- Contributions from Cisco Systems (GSR 12012 Router), Lucent Technologies (CBX-500 ATM Switch), Juniper Networks (M10 router), and Terremark (collocation space in the NAP of the Americas) .

Source: http://www.ampath.fiu.edu/about.htm

RETINA - ARGENTINA

- Connects more than 25 institutions

- At this time there are 3 POP in Buenos Aires

- Peering agreements with the Ministry of Justice, COMSAT, IMPSAT, SECYT, and CABASE

- Provides, without cost, the international link to the Ministry of Foreign Affairs and Cult

- International connectivity of RETINA is provided by IMPSAT through a connection of 2Mbps with the NOC of RETINA

Source:http://www.retina.ar

**Academic Teleinformatic Network**
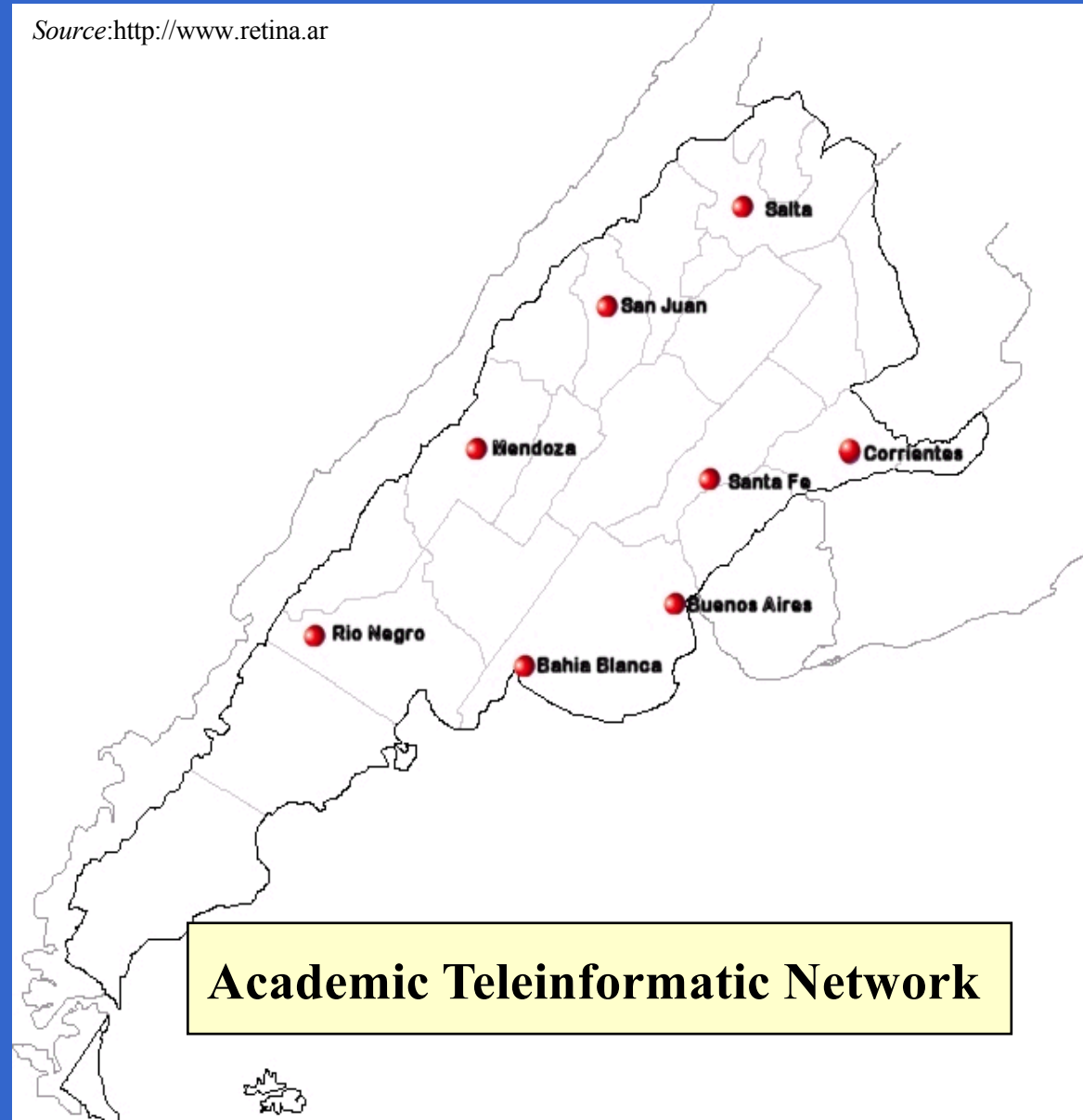
RETINA2

• Effort to start connection of RETINA to high speed academic
networks of USA and other countries through an agreement between
Ciencia Hoy with *INTERNET2.*

• It is working towards the upgrading of its network to provide to
the academic population new applications and technologies
which are already available in other countries.

• Involves the participation of the AmPATH Project, a joint
project promoted by the Florida International University (FIU)
and Global Crossing to provide connectivity between Latin
America and Internet2.

REUNA2 - CHILE

Connecting Chile to Internet2 via AmPATH

Source: http://www.reuna.cl
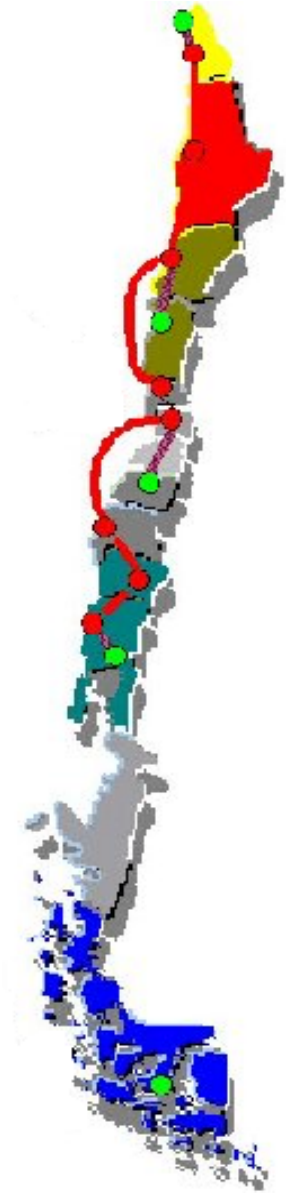
REUNA2 - POP's

- 10 POP's from Arica to Valdivia

- 155 Mbps ATM/SDH Network

- Centrally operated from Santiago

- Basic Internet and Internet2 services

- 10 points of access: Iquique, Antofagasta, Copiapó, La Serena, Valparaíso, Santiago, Talca, Concepción, Temuco, and Valdivia.

- 20 institutions connected

OAS/RedHUCyT

Iquique

Antofagasta

Copiapó

La Serena

Valparaíso

Santiago

Talca

Concepción
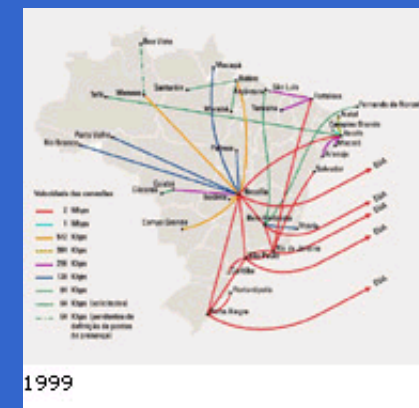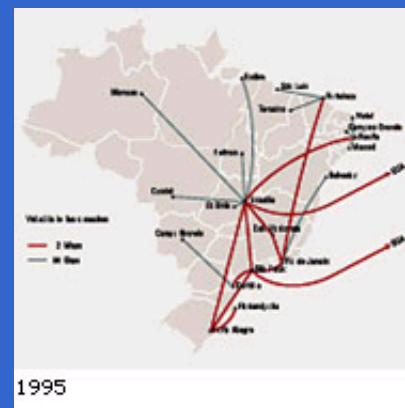
Temuco

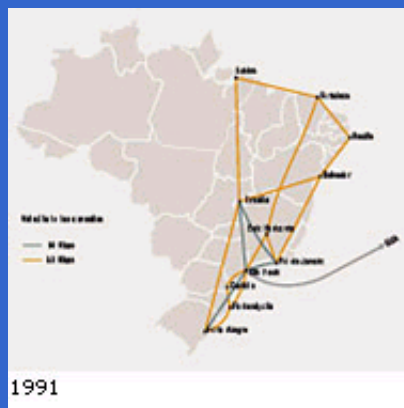Valdivia

Source: http://www.reuna.net
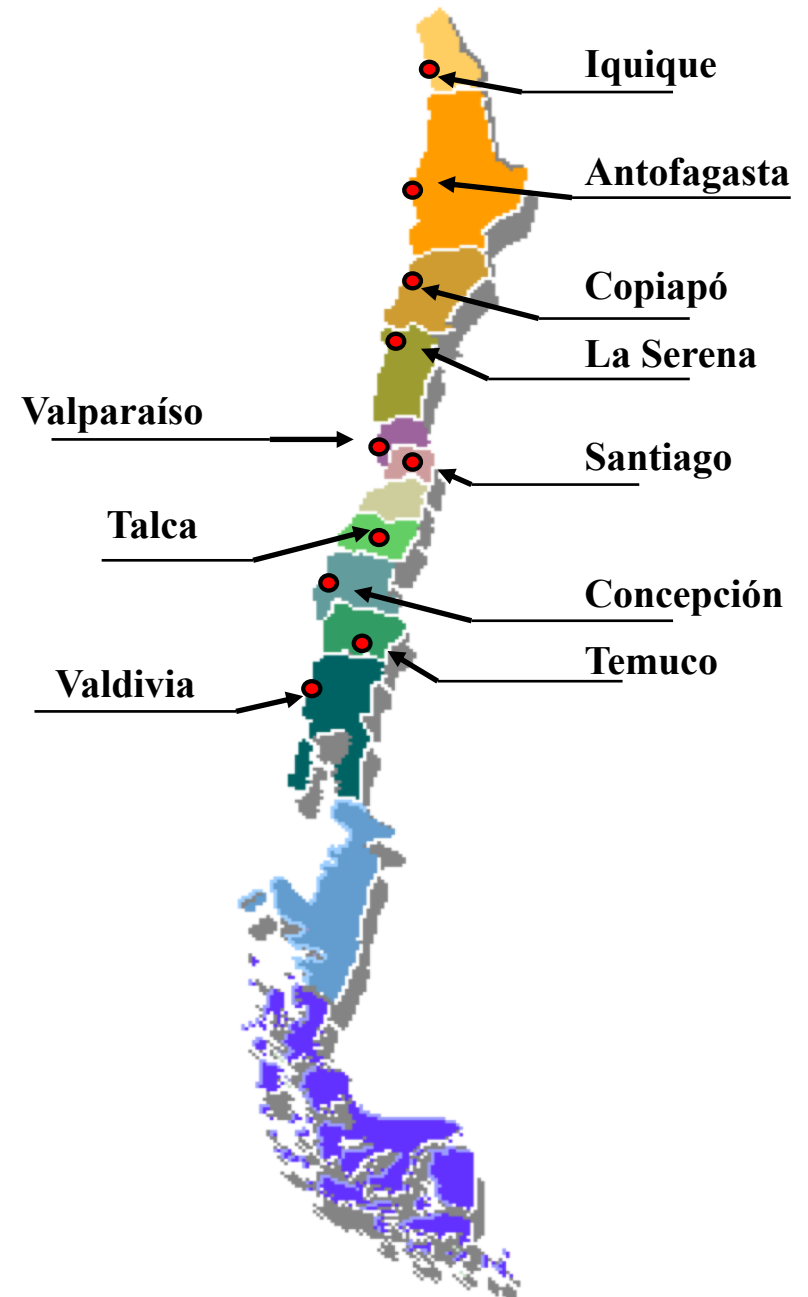
RNP - BRAZIL

- It has been active in the nationwide development of Internet technology since 1991, consolidating the national backbone and interconnecting the academic community

- Connects around 27 Brazilian states at 155 Mbps

- Interconnects more than 800 institutions in Brazil

- Since 2000, operates essentially as a research and education network

- Links all federal institutes of high education with federal institutes of research
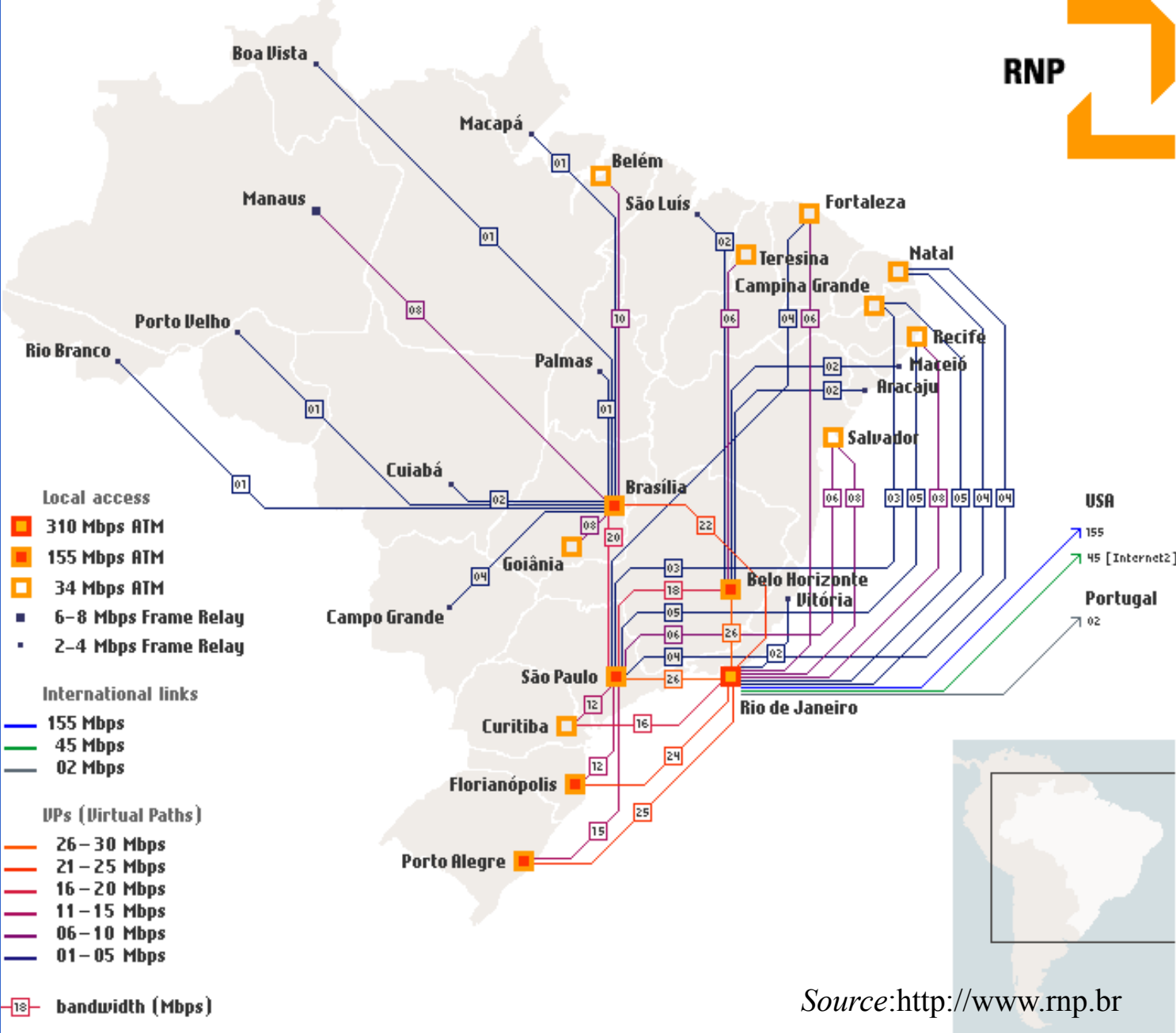
Evolution of the Backbone

http://www.rnp.br

1991

1995

1999

OAS/RedHUCyT

RNP2 - BRAZIL The National Research Network

current backbone

RNP

Local access
- ■ 310 Mbps ATM
- ■ 155 Mbps ATM
- □ 34 Mbps ATM
- ▪ 6–8 Mbps Frame Relay
- ▪ 2–4 Mbps Frame Relay

International links
- 155 Mbps
- 45 Mbps
- 02 Mbps

VPs (Virtual Paths)
- 26–30 Mbps
- 21–25 Mbps
- 16–20 Mbps
- 11–15 Mbps
- 06–10 Mbps
- 01–05 Mbps

- ▭ bandwidth (Mbps)

Cities: Boa Vista, Macapá, Belém, São Luís, Fortaleza, Natal, Teresina, Campina Grande, Recife, Maceió, Aracaju, Salvador, Manaus, Porto Velho, Rio Branco, Palmas, Cuiabá, Brasília, Goiânia, Belo Horizonte, Vitória, Campo Grande, São Paulo, Rio de Janeiro, Curitiba, Florianópolis, Porto Alegre

USA: 155, 45 [Internet2]
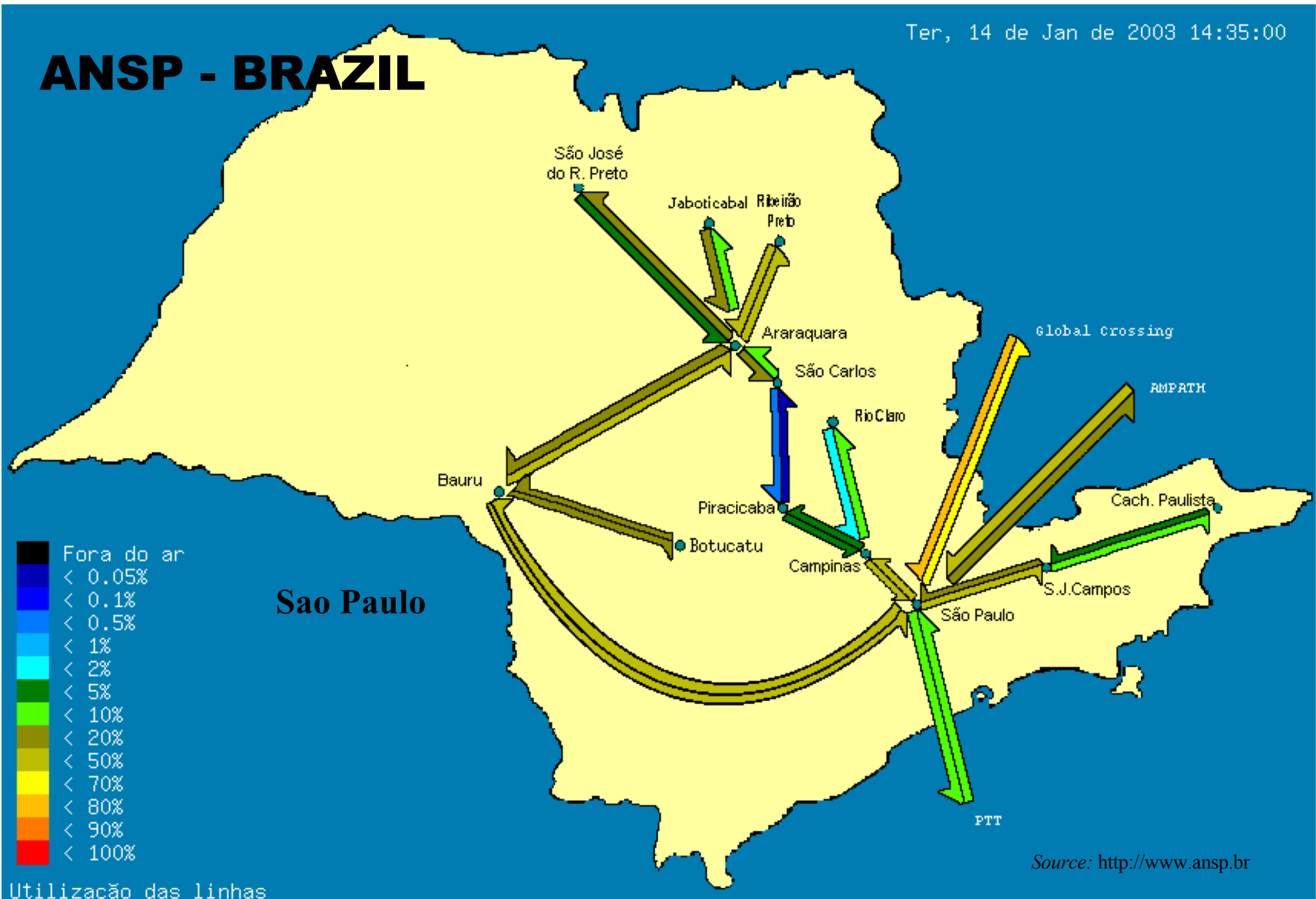Portugal: 02

Source:http://www.rnp.br

OAS/RedHUCyT

... RNP2 - BRAZIL

➡ March 2000: RNP & UCAID signed MOU guaranteeing Brazilian participation in the American Internet2 project.

➡ May 2000: RNP2 backbone was launched

➡ August 2001: Connection of RNP to the Internet2 was established by means of a 45 Mbps channel, provided by Global Crossing through the AmPATH project

➡ Jan.2001- today: reaches 27 Brazilian states with a capacity of up to 155 Mbps connected to the major Internet2 backbone, Abilene.

Source:http://www.rnp.br

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ANSP - BRAZIL

Ter, 14 de Jan de 2003 14:35:00

Source: http://www.ansp.br

OAS/RedHUCyT

... ANSP - BRAZIL

➢2002: AmPATH project announced its connection to the ANSP

➢Unites Sao Paulo's university networks and scientific and technological research centers in Sao Paulo

➢It is the main Internet connection point of all the institutions in Sao Paulo S&T system

➢Institutions connected to ANSP will be able to expand their cooperation with US universities and research centers

➢ANSP connects to AmPATH through a 45 Mbps fiber optic connection provided in part by Global Crossing.
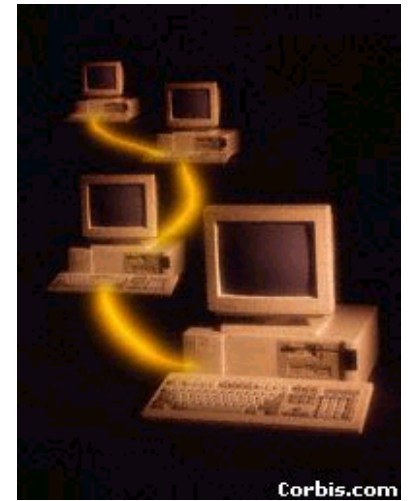
➢Funded by FAPESP

... ANSP - BRAZIL

➢ANSP peers with the high-speed Abilene research network

➢International traffic of the ANSP network is encoded independently through a 155 Mbps fiber optic connection

➢ANSP encompasses the PoP of the RNP in Sao Paulo

CUDI - Mexico

Corporación Universitaria para el Desarrollo de Internet

➢High speed network that connects Mexico to the **Internet2**

➢First association of Research and Education networks of Latin America to sign an agreement with the UCAID

➢Will allow to create a new generation of researchers providing them advanced tools for the development of scientific and educational applications

➢Participation of 1.2 millions of students (around 60% of the students of the Mexican higher education system), 90 thousands educators, and 70 academic and R&D institutions.

➢Requirements for the connection:
  ▸ Backbone: 156 Mb/s
  ▸ Node of academic partners: minimum 34 Mbps
  ▸ affiliated nodes: minimum 2 Mbps

Source: http://www.cudi.edu.mx/

OAS/RedHUCyT

... CUDI

Advanced Applications

Backbone

- SDSC
- Tijuana
- UTEP
- Cd Juárez
- HOUSTON vBNS
- REYNOSA
- SALTILLO
- ZACATECAS
- Monterrey
- AGUASCALIENTES
- LEÓN
- MÉRIDA
- CANCÚN
- GUADALAJARA
- QUERÉTARO
- TULANCINGO
- POZA RICA
- CAMPECHE
- JALAPA
- VERACRUZ
- PACHUCA
- MÉXICO
- VILLAHERMOSA

155Mb/s

——— Telmex

– – – Avantel

cudi2

- ●Digital libraries
- ●Tele medicine
- ●Distance education
- ●Astronomy
- ●Sciences of the earth

- ●Co-laboratories
- ●Robotic

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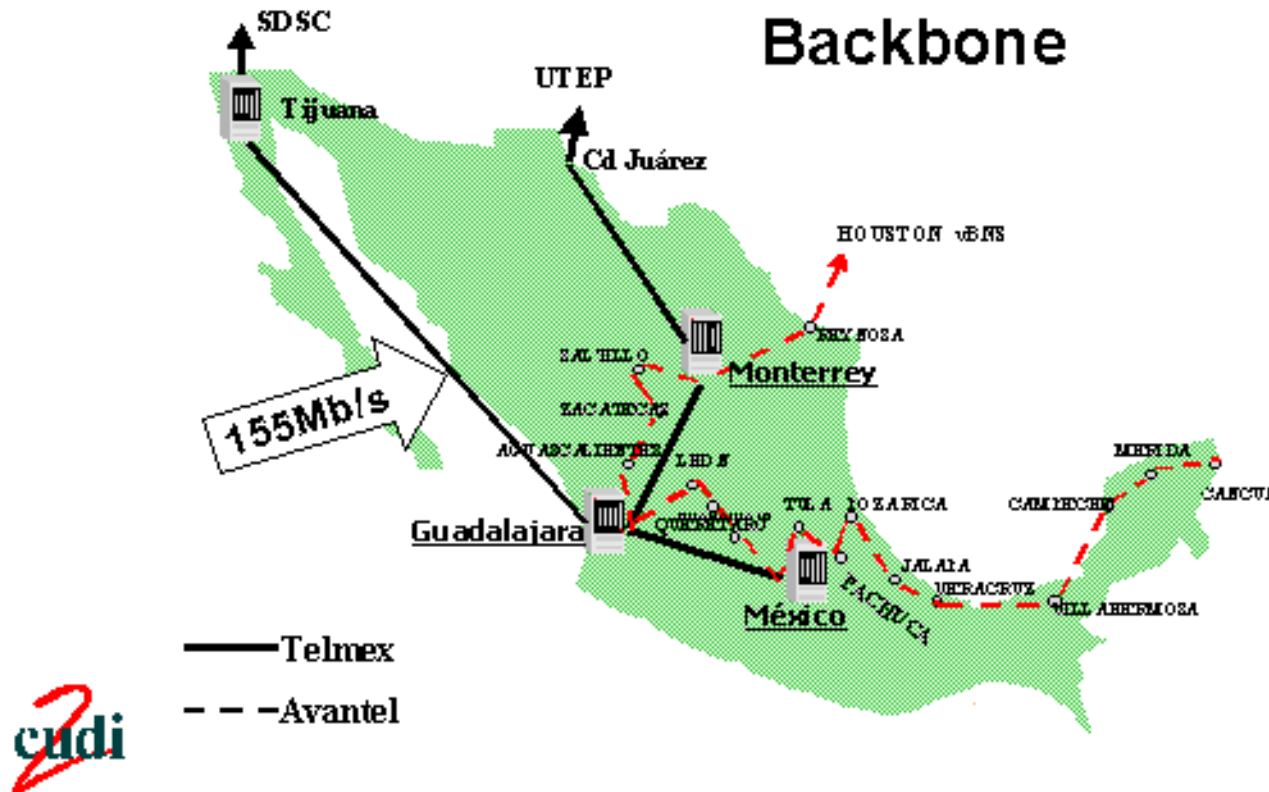
Central America and the Caribbean

… MAYA-1

➢July 1997: ICE- CR signed MOU with AT&T, MCI, SPRINT, Trescom, Telmex, France Telecom, Hondutel, Cable & Wireless (Cayman Island), Cable & Wireless (Panama), and Telecom (Colombia).

➢Sept.1998: ICE signed agreement for construction and maintaining with 38 international telecommunication firms.

➢Sept.1998: beginning of construction.

➢MAYA-1 is formed by a self protected ring of 2-fiber-pairs of optical fiber (Synchronous Digital Hierarchy ("SDH") technology with 7 nodes.

➢Cable length: 4400 kms.

➢Capacity: 20 Gbps.

Use of an undersea fiber optic cable

Source: http://www.ice.go.cr
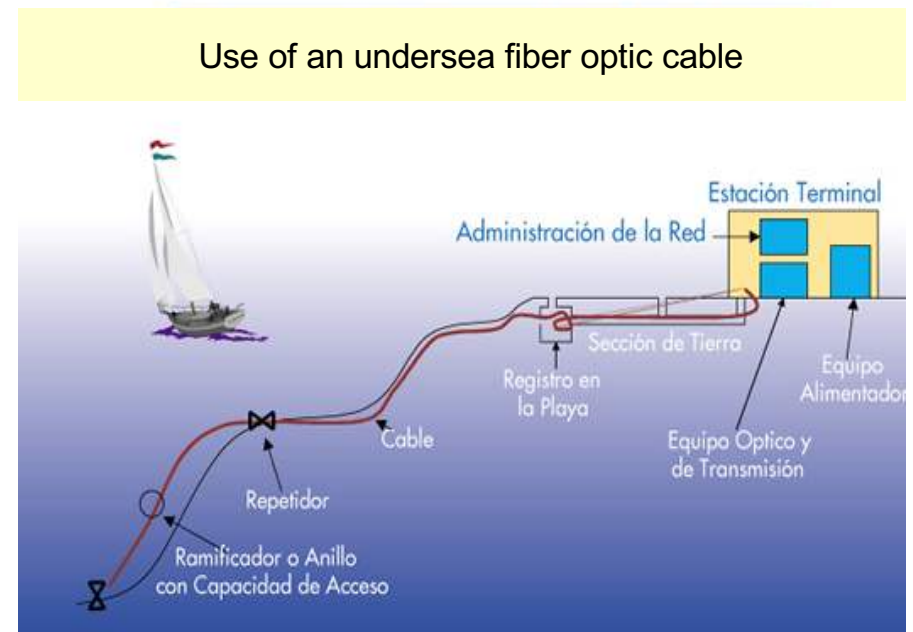
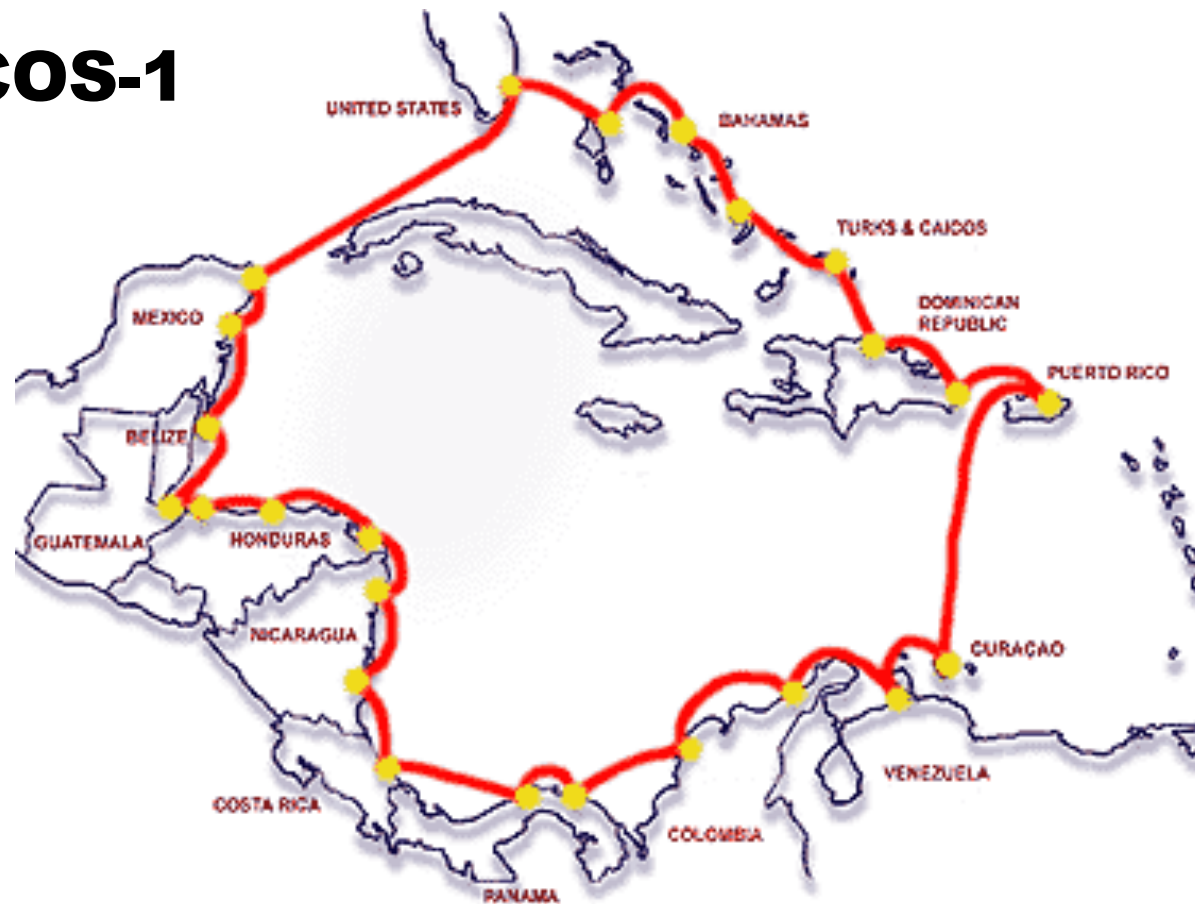# MAYA-1 Landing Station Map

OAS/RedHUCyT

ARCOS-1 - The Americas Region Caribbean Optical Ring System

Self-healing ring that connects 15 countries: US, Mexico, Belize, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Curacao, Puerto Rico, Dominican Rep., Turks and Caicos Islands (UK), and the Bahamas.

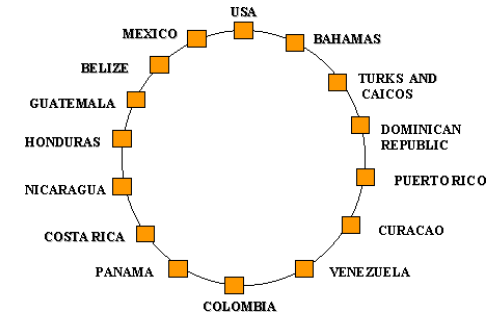**OEA/RedHUCyT**

... ARCOS-1

●Undersea fiber optic cable system developed by New World Network Ltd.

●Cable length: 8,600 km fully redundant ring.

●Currently operating at 15 Gbps with a multiple upgraded design capacity of over 4 Tbps.

●Uses Dense Wavelength Division Multiplexing ("DWDM") and Synchronous Digital Hierarchy ("SDH") technology.

The entire ARCOS ring is completed and in commercial service.

OAS/RedHUCyT

... ARCOS-1

Carriers Parties

Source: http://www.nwncable.com

Carrier Party	Country	Carrier Party	Country
AAC&R	Dominican Republic	GTE (Genuity)	USA
Alestra	Mexico	Impsat	USA
Antelecom	Curacao	ISA	Colombia
AT&T (Concert)	USA	Lambda	Puerto Rico
Avantel	Mexico	MCI	USA
Batelco	Bahamas	Nicatel	Nicaragua
Belize Telecom, Ltd.	Belize	Orbinet, Inc.	USA
Cable Onda	Panama	Tricom	Dominican Republic
CANTV	Venezuela	Tricom USA	USA
Codetel	Dominican Republic	Ultracom	Puerto Rico
		New World Network	Guatemala

OAS/RedHUCyT

... ARCOS-1

Landing Points

Source: http://www.nwncable.com/
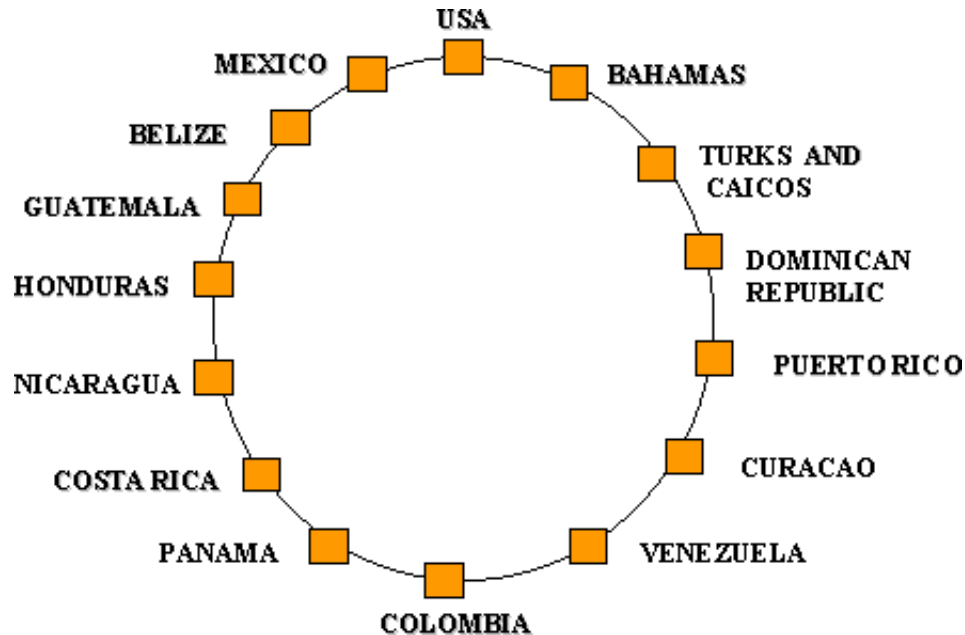
Because ARCOS-1 is a real physical ring, it provides a complete bi-directional signal redundancy, allowing ARCOS-1 to automatically select the strongest signal for optimal transmission quality and reliability, while providing built-in, real time signal restoration.

OAS/RedHUCyT

... Costa Rica

Latest updates!

CRNet

➤The National Research Network of Costa Rica (CRNet) designed a joint project of the Ministry of S&T (MICIT) and the Instituto Costarricense de Electricidad (ICE) to provide broadband connectivity.

First phase of this project
> Successfully implemented with the installation of a DWDM ring in the metropolitan area and xDSL access.

Second phase
> This phase will provide broadband Internet connectivity all across the country with installation of 100,000 xDSL lines and a strong IP Core Network based on Gigarouters with an aggregate bandwidth of 30 Gbps, using 5200 km. of fiber.
>
> The advanced network will also carry high bandwidth academic and research Internet2 traffic under CRNet, which will enter a new phase as CR2Net.

OAS/RedHUCyT

... Costa Rica

CR2Net

➢It is expected to be the coordinating entity for advanced research and academic networking applications in Costa Rica.

➢It is a joint initiative of the Center for Advanced Technologies (CENAT), the Ministry of S&T and the National Academy of Sciences of Costa Rica.

➢CR2Net started with 7 institutions.

➢The access is provided by a VPN over MPLS to a local Internet2 (inter-institution) access.

OAS/RedHUCyT

...PUEBLA - PANAMA PLAN

President Vicente Fox's political program includes, as priority, the creation of a corridor of development in the Puebla-Panama Zone (Southeast of Mexico, Central America, and Panama).

...PUEBLA - PANAMA PLAN

Created to take advantage of the human and ecological riches of the Mesoamerican region.

It proposes a strategy that includes a series of initiatives and projects being sponsored by institutions such as the IADB, ECLAC, UNDP, etc.

Aimed to reinforce integration in Central America and Panama and the Southeast region of Mexico and to promote dialogue between civil society and authorities.

Efforts to contribute to sustainable development, improvement of quality of life, and reduction of poverty of the Mesoamerican region
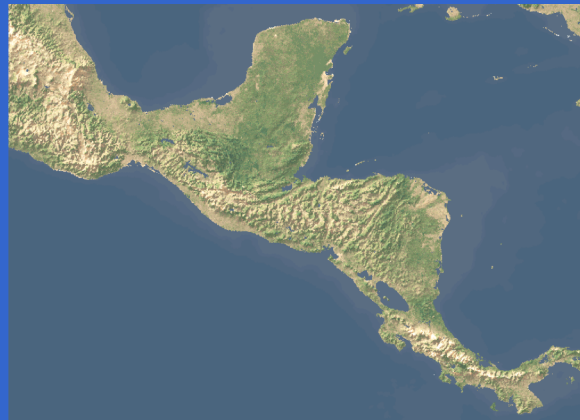
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...PUEBLA - PANAMA PLAN

TELECOMUNICATIONS
SECTOR

The "Puebla Panama Plan"involves, among its areas of action, the Telecommunications sector, which is focused in expanding connectivity to the interior of the countries.

Ministries of telecommunications, IADB and other institutions are involved at present.

PUEBLA - PANAMA PLAN

A proposal on
Information Technology and Internet2
for the Southeast Region of Mexico, Central
America and Panama

OAS/RedHUCyT

➢Purpose: to make use of current telecommunication infrastructure of the region, in particular ARCOS, to foster the development of information technologies and the creation of a high technology corridor (Mexico-Central America-Panama), based on ICT, as an engine for development.

➢Take advantage of the installed backbone of fiber optic cable to connect main universities of southeast of Mexico, Central America and Panama.

➢This backbone could connect to CUDI and the INTERNET2 via Abilene in San Diego and El Paso independently.

...PUEBLA - PANAMA PLAN

➢ This proposal, would complement the AMPATH Project, benefiting also, institutions not connected yet to this network.

➢ Infrastructure provided by ARCOS-1, the undersea fiber optic cable system developed by New World Network Ltd. and other partners, could would be used in this project.

Conclusions

- Telecommunication infrastructure in Latin America has improved during the last 2 years at levels never seen before.

- Advanced technology and reduction in costs have contributed to this fact

- Until 2000, 4 main undersea cables in the region:

  ∗ Maya-1   ∗ Panamericano   ∗ Atlantis-2   ∗ Americas-2

  At this time they present limited capacity, require high level investment to improve their system capacity, and are not ringed configured.

- During the last 2 years several firms have been building optical fiber rings in Latin America:

  ▸ Global Crossing (SAC and PAC)
  ▸ New World Networks (Arcos-1)
  ▸ Emergia (SAM-1)
  ▸ 360 Networks (360 Americas)

- Unfortunately, some of these companies are having serious financial problems.

Other Important Developments:

- ALCUE: Latin America, Caribbean and European Union.

- Science Ministers meeting in Brazilia, and Presidents and Prime Ministers in Madrid.

- @lis (information technologies).

- CLARA (Cooperación Latinoamericana de Redes Avanzadas).

Thanks!