

# *Developing Countries to Scientific Knowledge: Quantifying the Digital Divide*

## *Experiences with the Digital Divide in Latin America*



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**Julio Ibarra, Heidi Alvarez**  
**Center for Internet Augmented Research and  
Assessment**

[julio@fiu.edu](mailto:julio@fiu.edu), [heidi@fiu.edu](mailto:heidi@fiu.edu)  
[www.ampath.fiu.edu](http://www.ampath.fiu.edu), [www.ciara.fiu.edu](http://www.ciara.fiu.edu)

# About AMPATH™

- Launched in March 2000 as a project led by Florida International University (FIU), with industry support from Global Crossing (GX), Cisco Systems, Lucent Technologies, Juniper Networks and Terremark Worldwide
- Enables wide-bandwidth digital communications between the Abilene network and 10 National Research and Education Networks (NRNs) in South and Central America, the Caribbean and Mexico
- Provides connectivity to US research programs in the region
- AMPATH is a project of FIU and the National Science Foundation's Advanced Networking Infrastructure & Research (ANIR) Division



# ***I2 Abilene International Peering***

## **Pacific Wave**

AARNET,  
APAN/TransPAC†,  
CA\*net, TANET2

## **SNVA**

GEMNET,  
SingAREN,  
WIDE<sup>(v6)</sup>

## **L.A.**

UNINET

## **San Diego (CALREN2)**

CUDI

## **STAR TAP/Star Light**

APAN/TransPAC†, CA\*net, CERN, CERNET/CSTNET/NSFCNET,  
RBNET/NAUKAnet, GEMnet, HARNET, KOREN/KREONET2,  
NORDUnet, SURFnet, SingAREN, TANET2

## **El Paso (UACJ-UT El Paso)**

CUDI

## **NYC**

GEANT\*,  
HEANET,  
NORDUnet,  
SINET,  
SURFnet

## **WASH**

GEANT\*

## **AMPATH**

ANSP,  
REUNA2,  
RNP2, RETINA  
(REACCIUN-2)

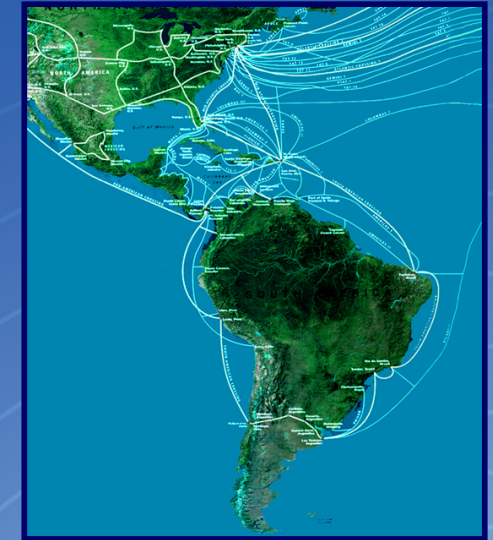
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•ARNES, ACONET, BELNET, CARNET, CERN, CESnet, CYNET, DFN, EENet, GARR, GRNET, HEANET, IUCC, JANET, LATNET, LITNET, NORDUNET, RENATER, RESTENA, SWITCH, HUNGARNET, GARR-B, POL-34, RCST, RedIRIS, SANET, SURFNET

† WIDE/JGN, IMnet, CERNet/CSTnet, NSFCNET, KOREN/KREONET2, PREGINET, SingAREN, TANET2, ThaiSARN

# Optical Infrastructure in Latin America

Submarine Fiber-Optic Cable System	Total Bandwidth Capacity (GB)
Americas 1	.560
Americas II	2.5
South American Crossing	1,280
Columbus II	.560
Columbus III	2.5
Telefonica's Emergia	1,920
ARCOS	960
Maya-1	60
360 Americas	10



*The total aggregate bandwidth capacity Latin America and Caribbean region is estimated at 4,236 GB*



# NRENs' Bandwidth in Latin America

Country	Organization	Existing REN?	National connections	External Capacity	Number of Connected Sites	Connection to US Internet2
Argentina	RETINA	yes	256Kbps – 34 Mbps	59 Mbps	56	yes
Bolivia	BOLnet	yes	64 – 128 Kbps	1.5 Mbps	18	no
Brazil	RNP	yes	2 – 30 Mbps (backbone up to 622 Mbps)	202 Mbps	369	yes
Chile	REUNA	yes	155 Mbps	45 Mbps via AMPATH	18	yes
Colombia	RedCETCol	Not known	Not known	Not known	Not known	Not known
Costa Rica	CRNet	yes	32 – 512 Kbps	Not known	34	no
Cuba	RedUniv	University Network	19.2 Kbps – 2 Mbps	Not known	23	no
Ecuador	FUNDACYT	In planning				no
El Salvador	CONACYT	In planning				no
Guatemala	Not known	Non-existent				no
Honduras	HONDUnet	Not known				no
Nicaragua		Not known				no
Panama	PANNET/SENACYT	University/Gov. Network	256 – 512 Kbps	1.54 Mbps	11	no
Peru	CONCYTEC	In planning				no
Uruguay	RAU	yes	64 Kbps to 1 Mbps	6 Mbps	46	no
Venezuela	REACCIUN	yes		45 Mbps via AMPATH	78	January 2003

Source:

**CAESAR -  
Review of  
Develop-  
ments in  
Latin  
America**

# *Divide in the R&E Community*

- Total bandwidth capacity for the research and education community to access global RENs via AMPATH is 225Mbps
- Approximately 71.2Mbps is being utilized
  - <http://www.net.fiu.edu/mrtg/ampathgsr.html>
- There is 4,236Gbps of bandwidth capacity into the region

# *Activities to Bridge the Divide*

- Cooperación Latino-Americana de Redes Avanzadas (CLARA)
- Workshops and Grants
- Center for High-Energy Physics Research Education and Outreach (CHEPREO)
- Center for Internet Augmented Research and Assessment (CIARA)



# *Cooperación Latino-Americana de Redes Avanzadas (CLARA)*

- Coordination amongst LA-NREN and other stakeholders
- Cooperation for the promotion of scientific and technologic development
- Planning and implementation of network services for regional interconnection
- Development of a regional network (here called RedCLARA) to interconnect the NRENs operated by its members
- RedCLARA to connect LA first to Europe, then to other regions



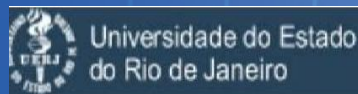
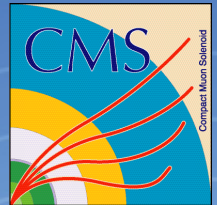
# Workshops and Grants

- FIU AMPATH Workshop to Identify Areas of Scientific Collaboration between the US and the AMPATH Service Area, NSF ANI-0123388
- First International AMPATH Conference, Valdevia, Chile, NSF ANI-0220176
- AMPATH StarLight Rio Grid Workshop, NSF ANI-0230877
- STI: AMPATH Collaborative Research and Education Operational and Functional Support, NSF ANI-0231844
- AMPATH Workshop: Fostering Collaborations and Next Generation Infrastructure, NSF ANI-0305876



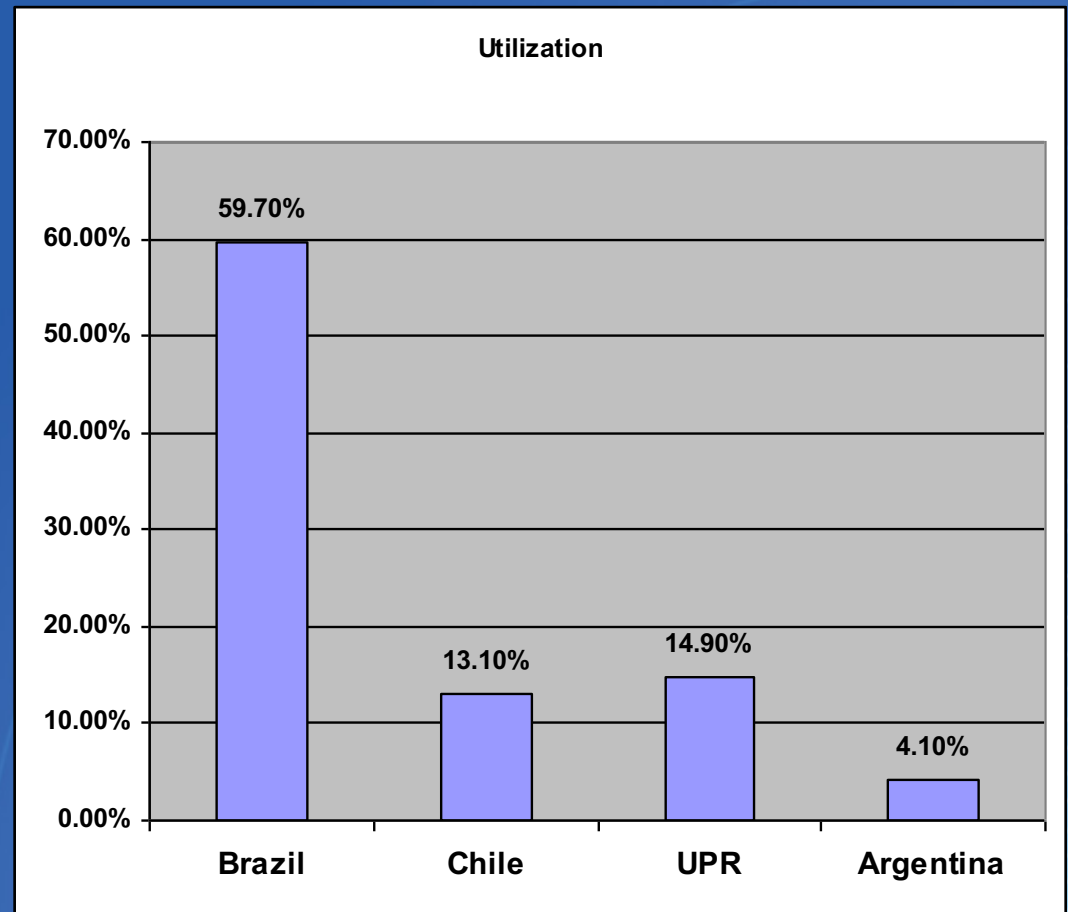
# CHEPREO

- An interregional grid-enabled Center for High-Energy Physics Research and Educational Outreach (CHEPREO)
- Fosters an integrated program of research, network infrastructure development, and education and outreach
  - Collaboration with FIU, Caltech, University of Florida, Florida State University and the State University of Rio de Janeiro in Brazil
  - Augments bandwidth capacity to Brazil
- National Science Foundation (NSF) award MPS-0312038



# Experimental Starlight Connection

- ATM OC3c IP-VPN provisioned in February, 2002 with support from the NSF Rio StarLight Grid Workshop Grant
- Upgraded for the AMPATH workshop, January 2003, interconnecting AMPATH to Starlight using a layer-2 GbE IP-VPN service
- Traffic volume has exceeded 3.4 Tbps – an average of 400 Gbps per month
- Activity supported by the NSF REU program, STI award ANI-0231844
- Report available at



<http://www.ampath.fiu.edu/Summer03REU.pdf>

# *Motivation*

- National / Local Needs
- Integrated Education and Research
- Connect Math and Science
- Create a Community of Scholars
  - Science education
  - Attract to science careers
- Model for National and International Dissemination

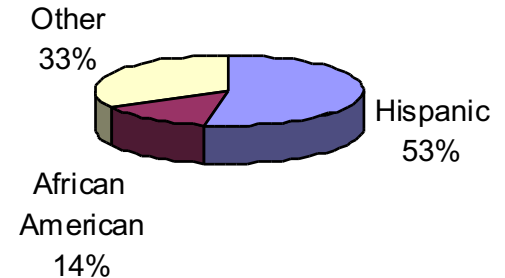




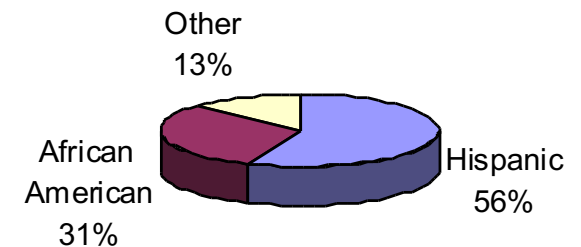
# South Florida

- 4<sup>th</sup> Largest: Miami-Dade
  - 380,000 students
  - 333 schools
  - 3,000 teachers needed
- 5<sup>th</sup> Largest: Broward
  - 261k students (68k HS)
  - 238 schools (25 HS)
- Large Diverse Urban Pool

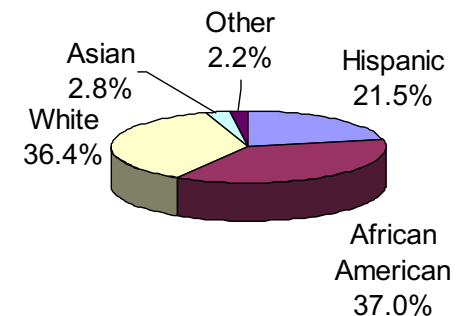
FIU Student Population



M-DCPS Student Population



Broward Schools Population





# UERJ - FIU COLLABORATION

## An Inter-Regional Center for High Energy Research and Educational Outreach at Florida International University Proposal

A. Santoro  
DFNAE/UERJ/RIO  
January 7-8, 2003

### Outline

- I - Introduction
- II - Projects
- III - HEP Group
- IV - Funding
- V - Conclusion





# I - INTRODUCTION



Our HEPgroup in Brazil is constituted by researchers Physicists, Engineers and Students from several National Institutions:

CBPF, UERJ, UFBA, UFRGS, UFRJ, UNESP, USP,

Today we are :

- ⚡ Talking not only a Proposal/Project of North America Universities
- ⚡ Also talking about a cooperation among countries
- ⚡ Talking about a birth that is a new corridor of culture between the Americas in the XXI Century

Alberto Santoro

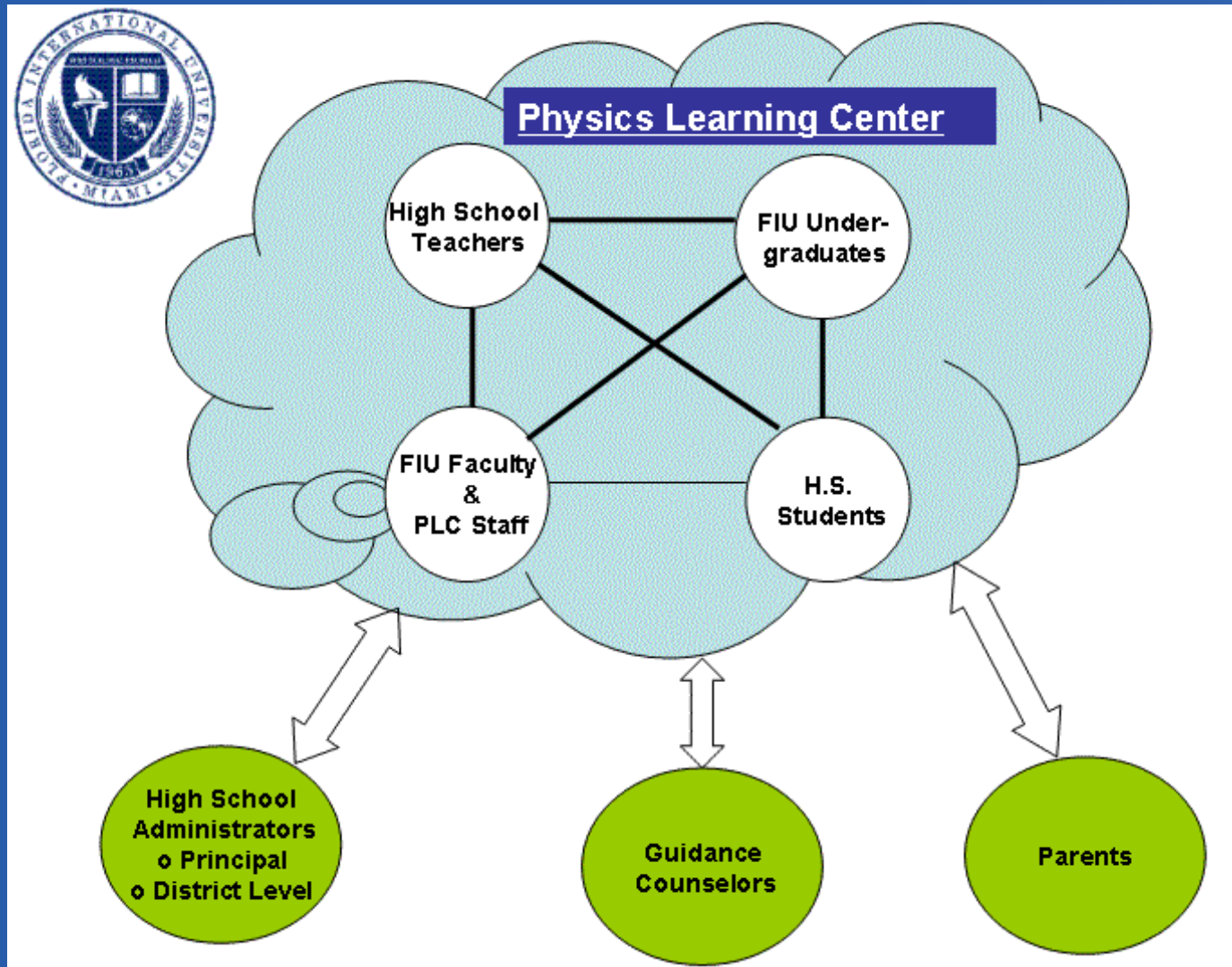
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# ***Systemic Physics Education Reform***

- Integrate Physics Research and Education
- Science for All Students
- Secondary Through Graduate Students
- High School Teachers / University Faculty
- Education Research
- Diverse South Florida
- Physical and Virtual Science Center serving South Florida, Rio, and beyond



# Community of Scholars



Collaboration for common goal

# ***Development of Globally Distributed Collaborative Learning Community***

- CMS research experience for undergraduates and graduate students
- Pre-service experiences for FIU's future teachers
- QuarkNet research opportunities for teachers
- Participation and support from area high schools
- Networking internships, experience at Terremark's NAP of the America's
- International exchanges, workshops, summer schools
- Science Education Fellowships
- Test-bed schools
- Web-based Resources



- ✿ High Energy Physicists know since long time that cooperation, to share our ideas, facilities and costs is part of our tradition.
- ✿ In our case, we have some ideas, we share the cost proportionally to the support received by our agencies.
- ✿ AMPATH offer a nice opportunity to do a collaboration in Science & Technology and Learning via a network.
  - Science → Physics in Collider
  - Technology → Networking, GRID
  - ✿ Learning → Education on Several Levels

We were involved in GRID project since the beginning of this idea.

- ✿ We had some experience in the past building networks, farms, all that we can say "the pre-grid" ideas and developments. ACP1, ACP2, ACPMaps, Client Server, CPS, and so on.

Alberto Santoro, Director of the Center for Advanced Physics and Technology

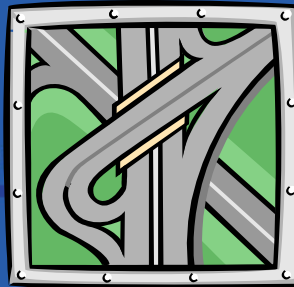
Alberto Santoro

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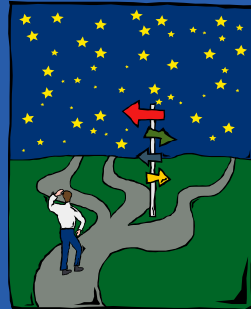
**FIU Physics**  
-Science  
-Education Reform



**Teachers**  
-Educators  
-Researchers

**FIU College of Education**  
-Education Researchers  
-Modeling  
-Contacts

**University**  
-Curricula  
-Resources



**Students**  
-HS / Undergrad / Grad  
-Future Scientists & Teachers



**Schools**  
-Test-Bed Research

# Partnership

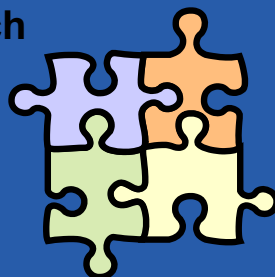
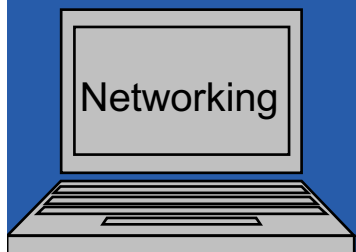
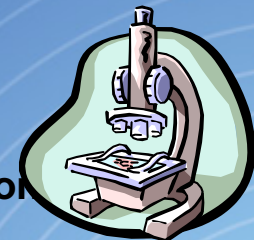


**Existing Programs**  
-Modeling (Hestenes / COMAP)  
-Education Research



**Partner Institutes**  
-FSU / UF / CIT  
-Brazil

**CMS**  
-Physics Goal  
-Context for Education  
-i.e. kinematics



**Support System**  
-Parents  
-Guidance Counselors  
-School Administration



**QuarkNet**

**Professional Associations**  
-AAPT, APS, FAST...





# CHEPREO E&O CONCEPTS

## Community

### Summer Modeling Workshops

- Teachers
- (Faculty & Students)
- Content / Pedagogy

### Peer Tutoring

- Undergraduates
- Supported by Fellows

### QuarkNet

- Teachers / Faculty
- Content / Pedagogy

### Science Fellowships

- Undergraduates
- Teaching / Research

### Science Clubs

- High School Students

### Modeling Introductory Physics

- All Undergraduates

### Outreach

### Test-Bed Schools

- Teachers/Students/Faculty
- Intensive Education Research



## We proposed to the Inter-Regional Center for HEP....

1. LISHEP - Lafex International School on High Energy Physics as a tool to work together in several directions.

LISHEP has 4 Sessions:

Session A - A Summer School dedicated to Teachers of Secondary School.

Session B - An Advanced Summer School on HEP

Session C - A Workshop on HEP - Subject Defined

Session D - A Summer School about "Associated Technologies to HEP" (Almost New)

2. An agreement between FIU and UERJ about a program of exchange of students and postdocs. To be built
3. Enlarge our Universe of Subjects with involvement of Cosmology and Phenomenology via a Virtual International Laboratory. To be built - ivdgl?

Alberto Santoro

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# Future

- Expand Through Physics
- Expand through Sciences
- Expand across Florida
- National Model
- Expand with Rio de Janeiro and San Paolo
- International Model





# Center for Internet Augmented Research and Assessment (CIARA)

- The center is uniquely designed to leverage research to benefit FIU and partner institutions:
  - Improving the rate of discovery for all investigators
  - Invigorating scholarship for graduate students, undergrads, and students in the community
  - Providing leadership in International networking
- Starting by fostering a synergy between faculty driven research, graduate students, and research scientists/technologists
- Securing private and public work force improvement, I.T. infrastructure, international partnership, and diverse domain science research funding





# ***AMPATH™: Pathway of the Americas***

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## ***Thank You***

Email: [ampath@fiu.edu](mailto:ampath@fiu.edu)

Web: [www.ampath.fiu.edu](http://www.ampath.fiu.edu)

Phone: 305-348-4105