"Academic Networks: Developing Internet 2 Communities in the U.S. and Mexico"

CENTER FOR U.S.-MEXICAN STUDIES
UNIVERSITY OF CALIFORNIA, SAN DIEGO

RESEARCH SEMINAR SERIES
WINTER QUARTER 2003

Wednesday, January 8, 2003

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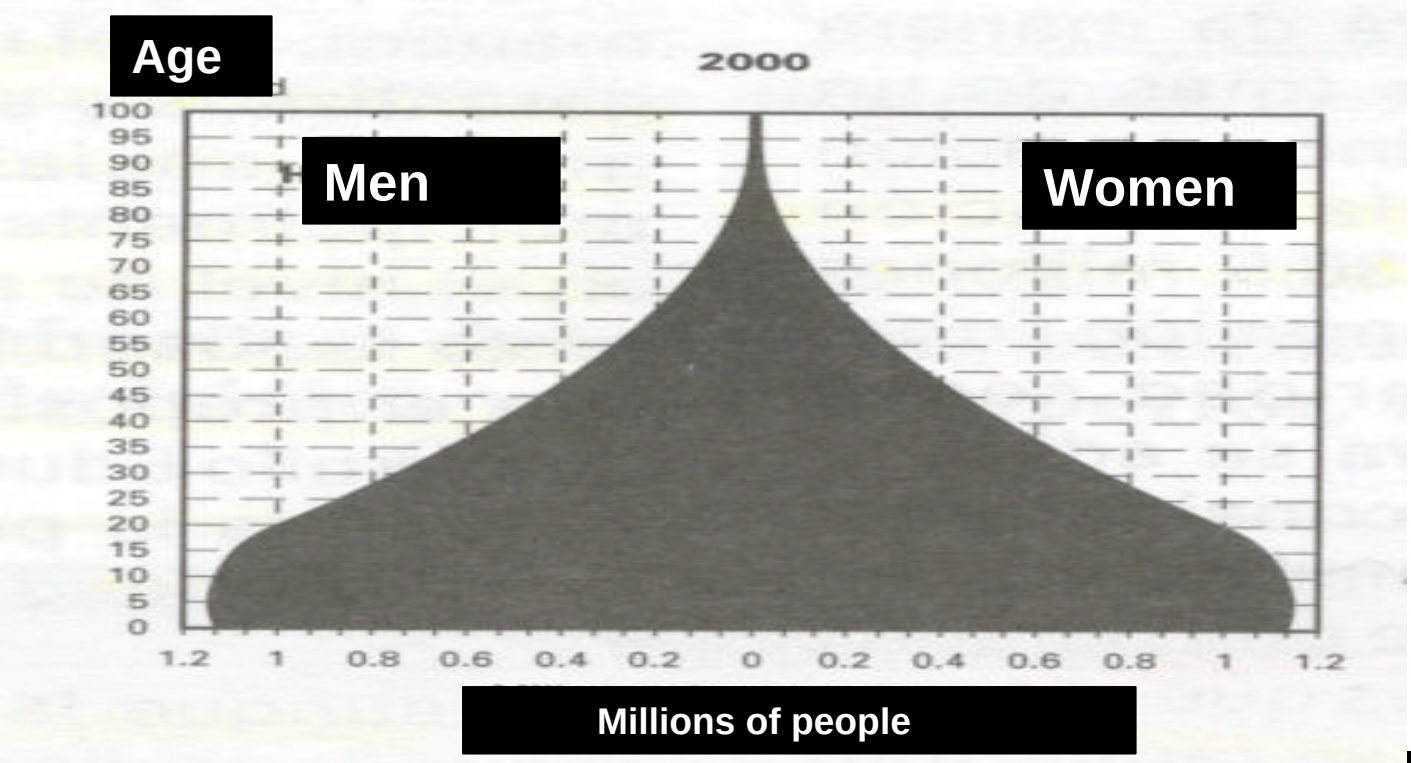
- Mexican higher education and new information technologies
- Next Generation Internet Initiatives in the U. S. and in the developed world
- Internet 2 in Mexico
- Applications (with a Mexican twist)
- New Regional Connectivity Projects
- Collaborative Projects: Developing Internet2 communities in Mexico and the US

The problem...

- A country's economic and social development is highly dependant on education
- Mexican education is facing tremendous budgetary and demographic pressures

Even though population growth rates have been going down for many years, the largest demographic cohorts, which are now 10 years old, will be reaching university age during the next decade



The Mexican higher education system is facing increased demand for its services...

- There is capacity to serve only one out of every five youths in the 18 to 23 age bracket. Chileand Argentina serve 30%; Canadá 100%
- Pressure on the system is increasing in light of the country's integration into the global economy and its demographic pyramid.

- Mexico's change from a closed to an open economy has decreased the demand for industrial and agricultural workers and increased the demand for knowledge workers

- Young Mexicans see a University education as the key to access higher standards of living.
- Practically all universities are rejecting 2 or 3 applicants for each one they accept

A solution...

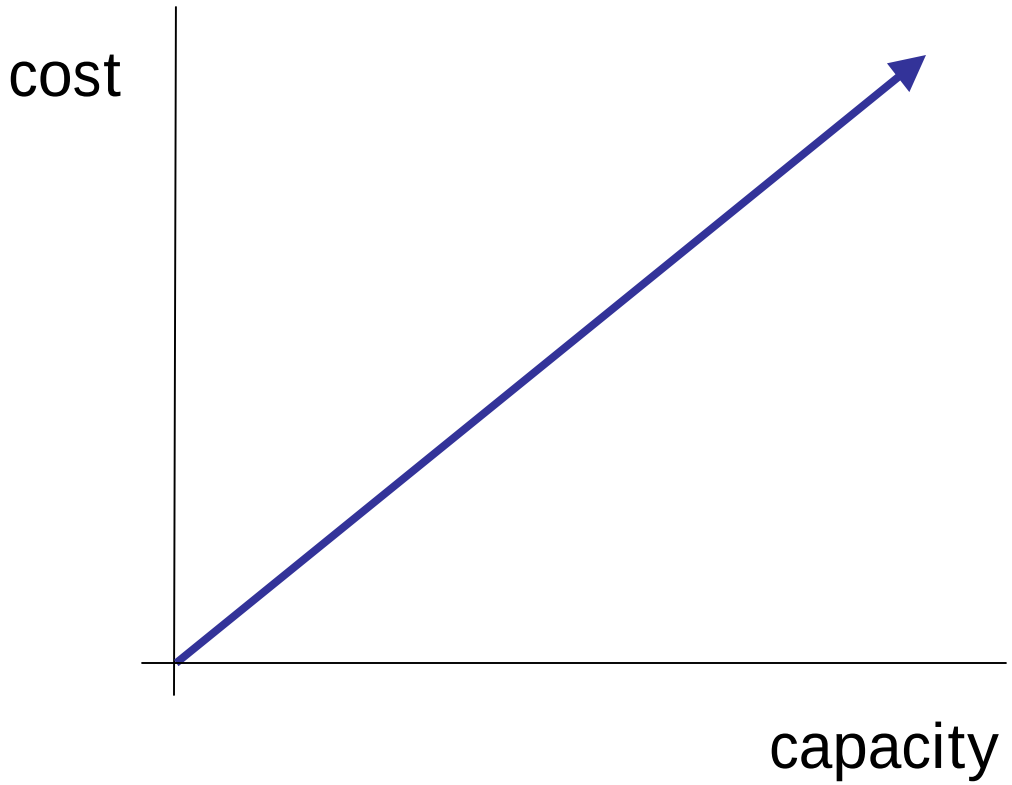
Traditionally universities served the following functions...

- A physical place to study
- A physical repository of books and learning materials
- A physical concentration of laboratories
- A physical place for scholars to exchange knowledge
- An institution that certifies the acquisition of knowledge

With traditional teaching methods the main cost components of increasing capacity are

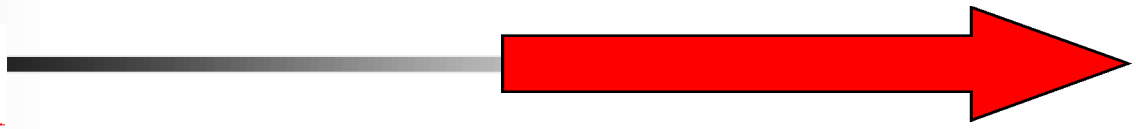
- buildings,
- teachers,
- laboratories,
- Books

These costs increase in a linear proportion to capacity. The more students, the more buildings, teachers, libraries and labs needed

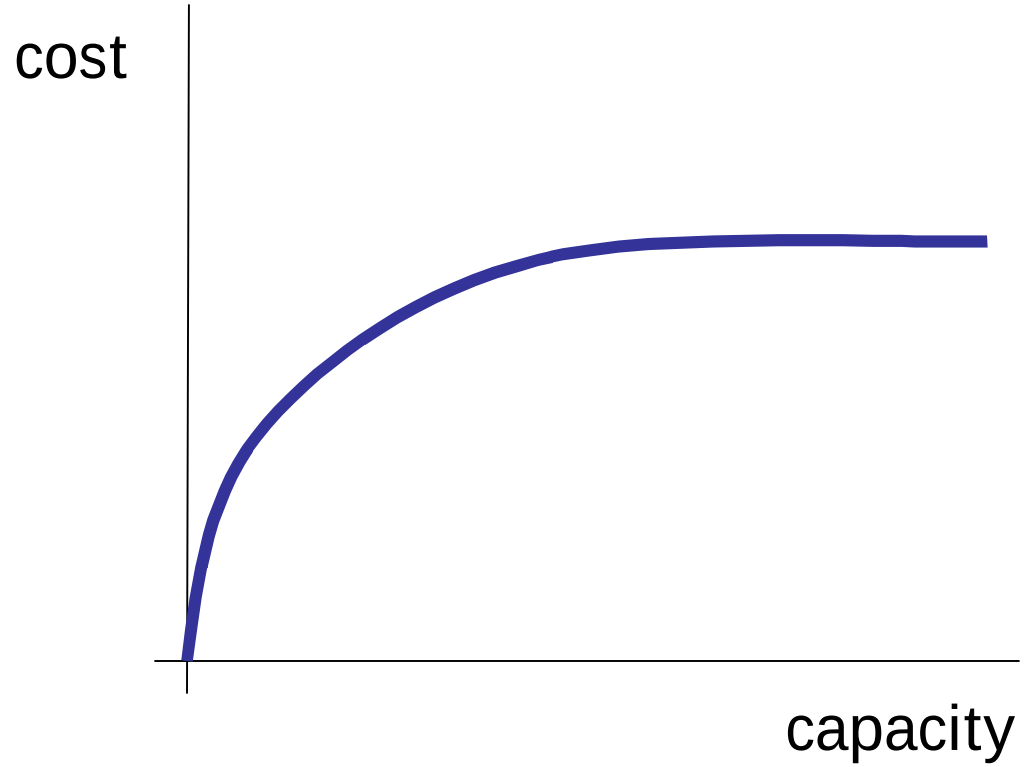


IT can change the direct relationship between capacity and cost imposed by traditional teaching methods

Library	Digital library
A physical place to study	Remote and on line teaching and learning
Laboratories	Virtual and remote laboratories
A physical place for scholars to exchange knowledge	Chats, virtual forums,videoconferencing
Presential certification of knowledge	Remote certification



IT can change the cost function allowing universities (all schools) to increase capacity and quality of education and research with less cost and financial resources



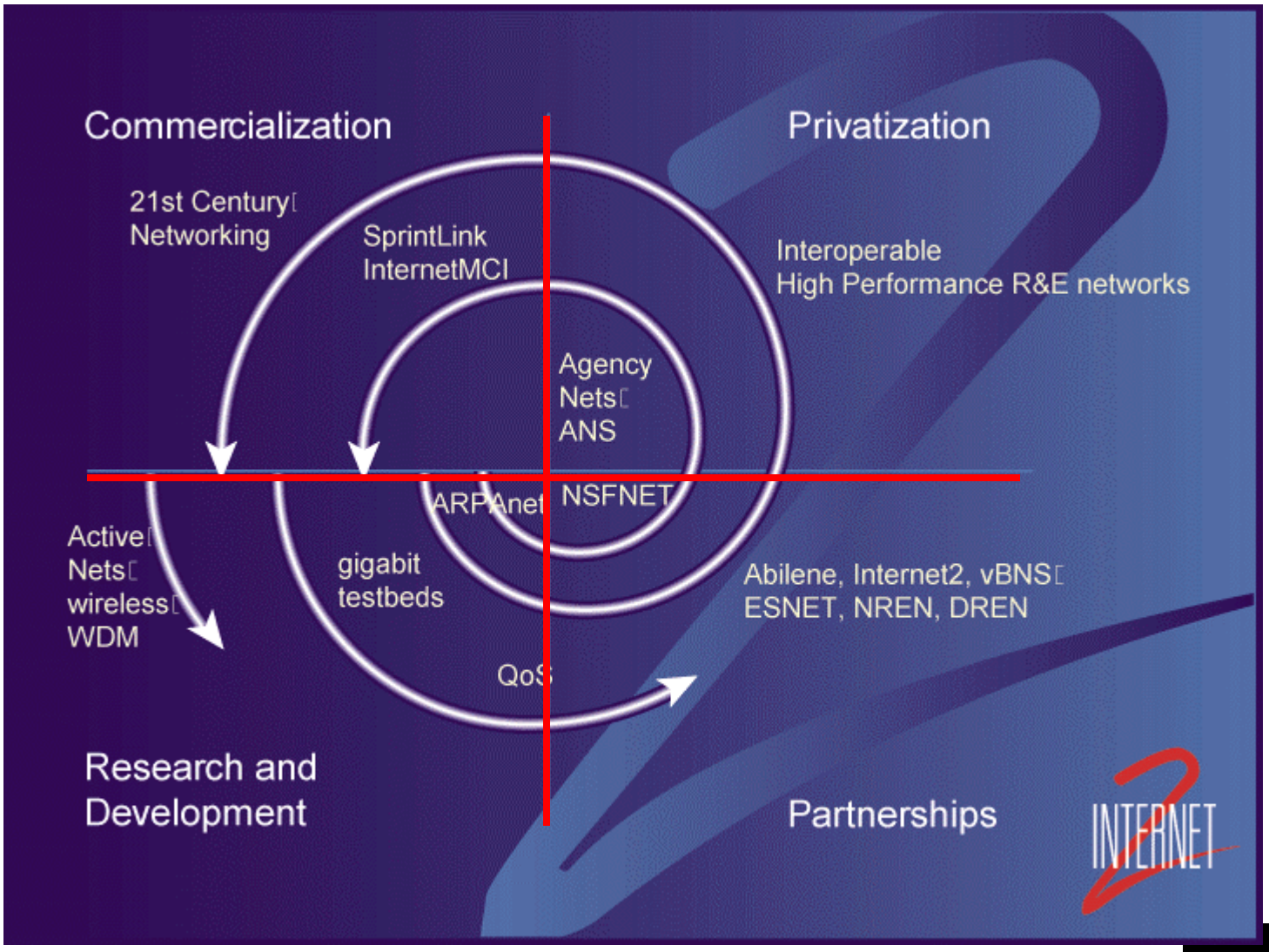
Next Generation Internet Initiatives in the U. S. and in the developed world

cudi 2

INTERNET 2

- The Clinton Administration considered that the leadership of the US in networking technologies was critical for defense purposes as well as for the continuing growth of the US economy.
- With the leadership of Vice President Gore the US Federal Government sponsors the Next Generation Internet Initiative.
- Significant resources were channeled, mainly through the National Science Foundation to support connectivity among National Laboratories and large research universities

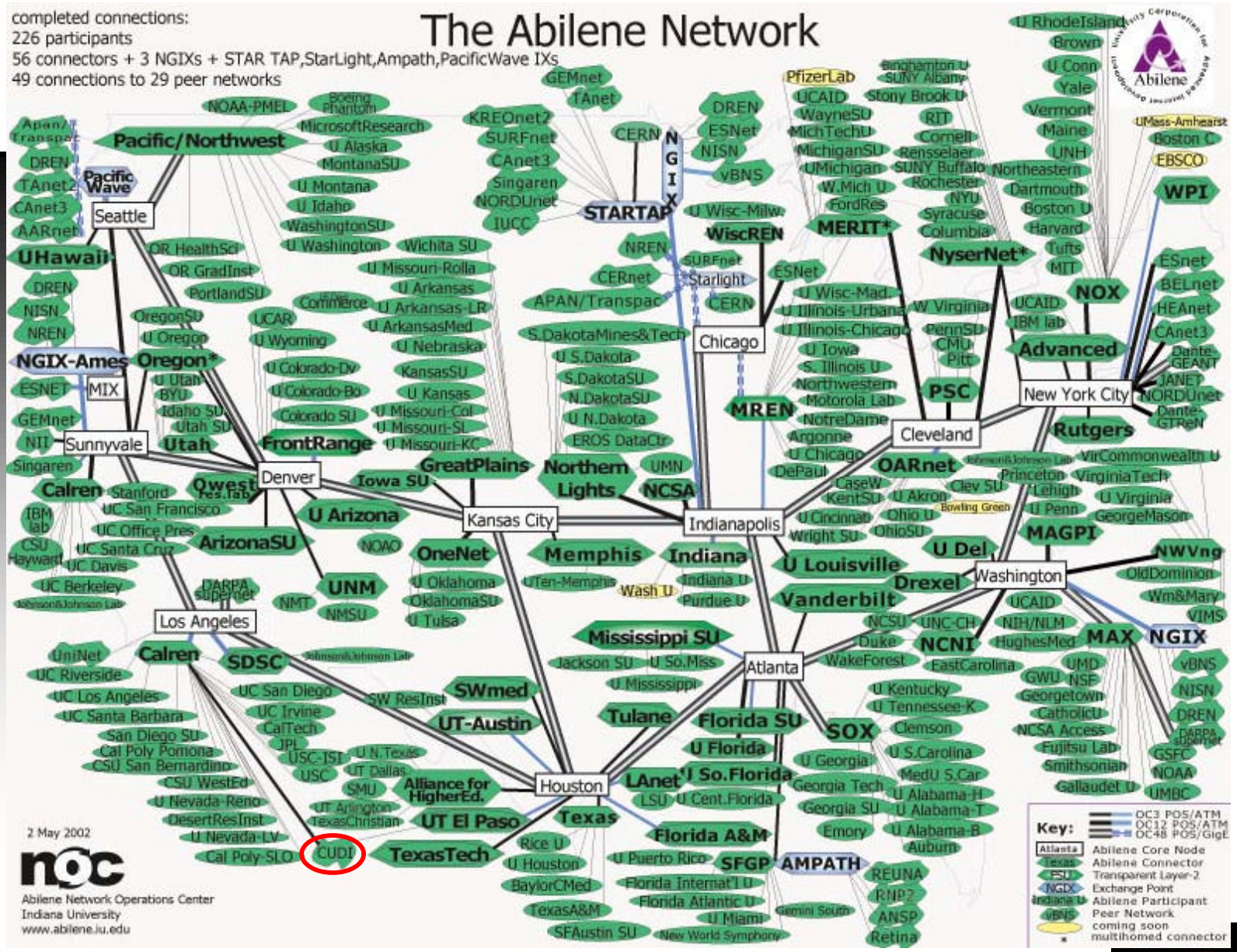
The IT technology spiral...



- As part of the Next Generation Internet Initiative, 34 major research universities formed a non-profit corporation to run a high capacity network...

Today, UCAID is a non profit consortium of more than 200 universities working with government and industry in the development of tomorrows Internet technologies and applications. Its main objectives are:

- To deploy and operate an advanced technology network for the research and higher education community
- To develop advanced applications
- To promote the transfer of new services and applications to commercial Internet


The Abilene Network
completed connections:
226 participants
56 connectors + 3 NGIXs + STAR TAP,StarLight,Ampath,PacificWave IXs
49 connections to 29 peer networks
Seattle
Sunnyvale
Los Angeles
Denver
Kansas City
Houston
Chicago
Indianapolis
Atlanta
Cleveland
Washington
New York City
Pacific/Northwest
Pacific Wave
UHawaii
NGIX-Ames
Oregon*
Utah
FrontRange
Calren
ArizonaSU
U Arizona
UNM
SDSC
Qwest
GreatPlains
Iowa SU
Northern Lights
NCSA
OneNet
Memphis
Indiana
U Louisville
Drexel
Vanderbilt
Mississippi SU
SWmed
UT-Austin
Tulane
Florida SU
SOX
LAnet
U So.Florida
Alliance for HigherEd.
UT El Paso
Texas
TexasTech
Florida A&M
AMPATH
SFGP
CUDI
STARTAP
NGIX
MERIT*
WiscREN
MREN
PSC
OARnet
MAGPI
Advanced
NOX
Rutgers
WPI
NyserNet*
MAX
NGIX
NCNI
Key:
OC3 POS/ATM
OC12 POS/ATM
OC48 POS/GigE
Abilene Core Node
Abilene Connector
Transparent Layer-2
Exchange Point
Abilene Participant
Peer Network
coming soon
multihomed connector
2 May 2002
noc
Abilene Network Operations Center
Indiana University
www.abilene.iu.edu

In other countries...

- Most developed countries have formed non profit organizations for the operation of advanced education and research networks

National
Research and
Education
Networks

NREN´s have the following common characteristics:

- They operate high capacity networks based on Internet protocol
- Networks are open to the scientific and higher education community of the country
- Run as cooperative, non profit institutions
- To facilitate international connectivity, only one network per country is recognized as NREN

40 NREN´s have interconnection agreements with Abilene. Through these agreements, more than 3,000 research and higher education institutions can be reached

Americas

CANARIE (Canada)

CEDIA (Ecuador)

CNTI (Venezuela)

CRNet (Costa Rica)

CUDI (Mexico)

REUNA (Chile)

RETINA (Argentina)

RNP, (Brazil)

SENACYT (Panama)

Asia-Pacific

AAIREP (Australia)

APAN (Asia-Pacific)

APAN-KR (Korea)

APRU (Asia-Pacific)

CERNET, CSTNET, NSFCNET (China)

JAIRC (Japan)

JUCC (Hong Kong)

SingAREN (Singapore)

NECTEC / UNINET (Thailand)

Tanet2 (Taiwan)

Europe and the Middle East

ARNES (Slovenia)

BELNET (Belgium)

CARNET (Croatia)

CESnet (Czech Republic)

DANTE (Europe)

DFN-Verein (Germany)

GIP-RENATER (France)

GRNET (Greece)

HEAnet (Ireland)

HUNGARNET (Hungary)

GARR (Italy)

Israel-IUCC (Israel)

NORDUnet (Nordic Countries)

POL-34 (Poland)

RCTS (Portugal)

RedIris (Spain)

RESTENA (Luxemburg)

SANET (Slovakia)

Stichting SURF (Netherlands)

SWITCH (Switzerland)

TERENA (Europe)

JISC, UKERNA (United Kingdom)

Internet 2 in Mexico

cudi

INTERNET 2

- To be able to increase the capacity and the quality of the higher education system at reasonable costs, many Mexican Universities have decided to invest in technologies that allow them to grow at a fraction of the cost of doing it with traditional learning models.
- Mexican Universities have adopted the Internet and have been a determinant factor in its development in our country.

- Internet was brought to Mexico by universities
- Approximately 50% of Mexican Internet users are linked to universities (students, teachers, researchers, administrators)
- The largest Mexican universities have been aggressively developing their campus networks...
  - In campus fiber deployment
  - Adoption of advanced IP platforms
- Starting to develop advanced applications

- Mexico's commercial Internet imposes severe limitations.
- Low bandwidth is inadequate for interactive video or the transmission of large data bases required for modern scientific research.

- Mexican Universities needed a solution that would permit them to connect amongst themselves and with foreign universities with greater bandwidth at reasonable costs.

- The strategy for the development of the network was based upon the willingness of seven leading Universities to bear the cost of the installation and maintenance of a high speed backbone, on a pro-rata basis

On April 8th, 1999 a non-profit private corporation was formed to implement and fund the network

Corporación Universitaria para el Desarrollo de Internet, A.C.

Cudi objectives

- Establish an advanced technology telecommunications network, based on Internet 2 technology, among Mexican Universities to:
  - Support education and research
  - Implement next generation Internet applications

Cudi has three membership categories:

- Academic Associates:

  Educational institutions that have financial responsibility in keeping the network running (15 associates)
- Institutional Associates:

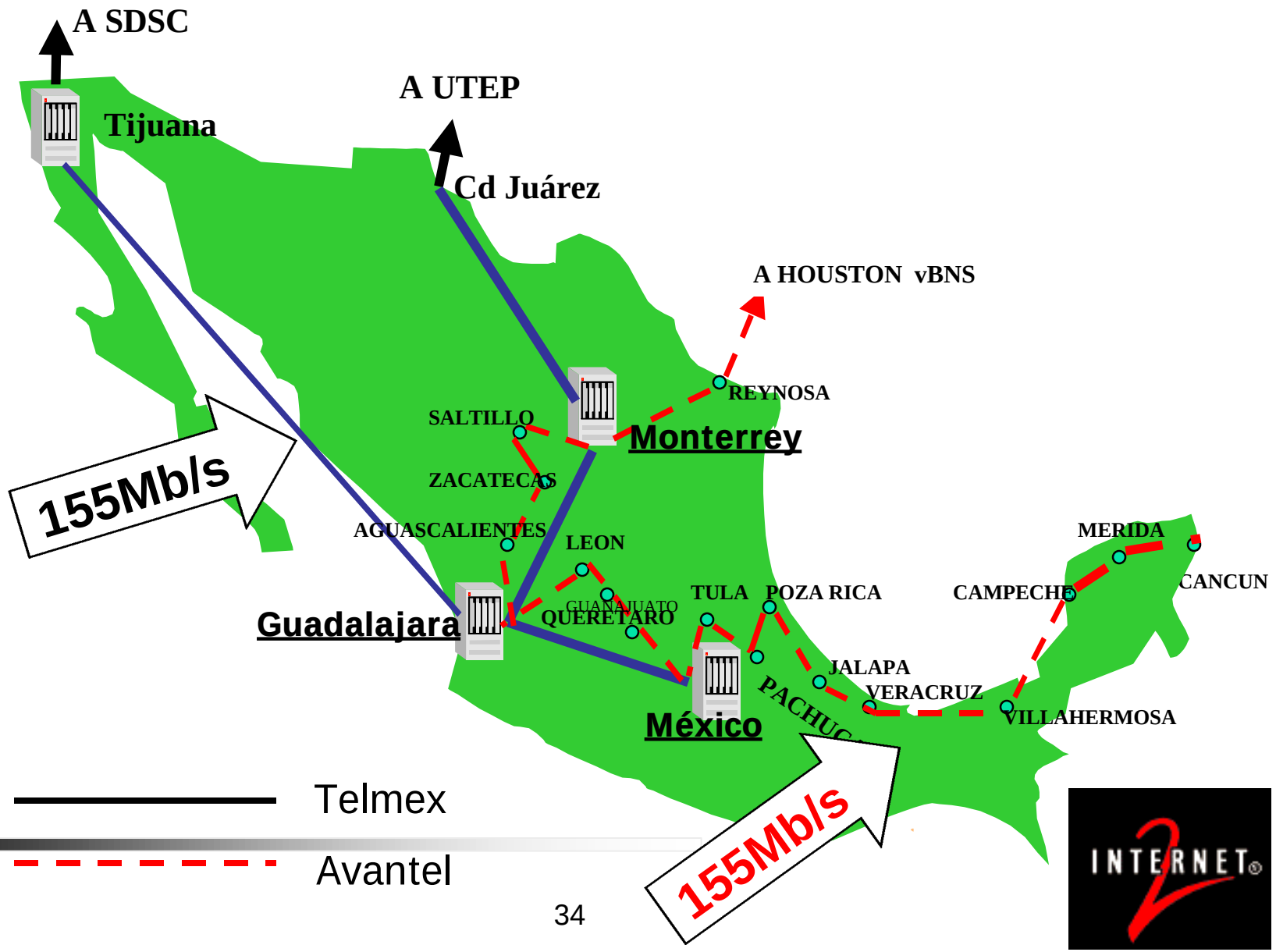
  Government and private sector sponsors (7 associates)
- Affiliates:

  Educational institutions that are connected to the network without a financial responsibility to keep the network running (27 afffiliates)

Backbone

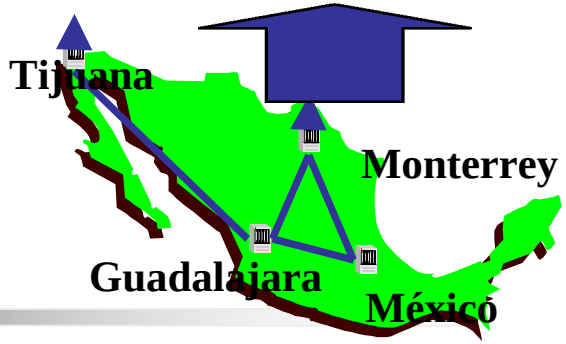
- Telmex initially donated 4,000 kms of STM1 links.
- The network can only carry educational and research traffic
- As part of their total telecommunications needs, universities are demanding access to the Cudi network
- Other carrier have requested access to the project to better serve the university market
- Avantel has recently donated an additional 4,000 kilometers of backbone

The new backbone...

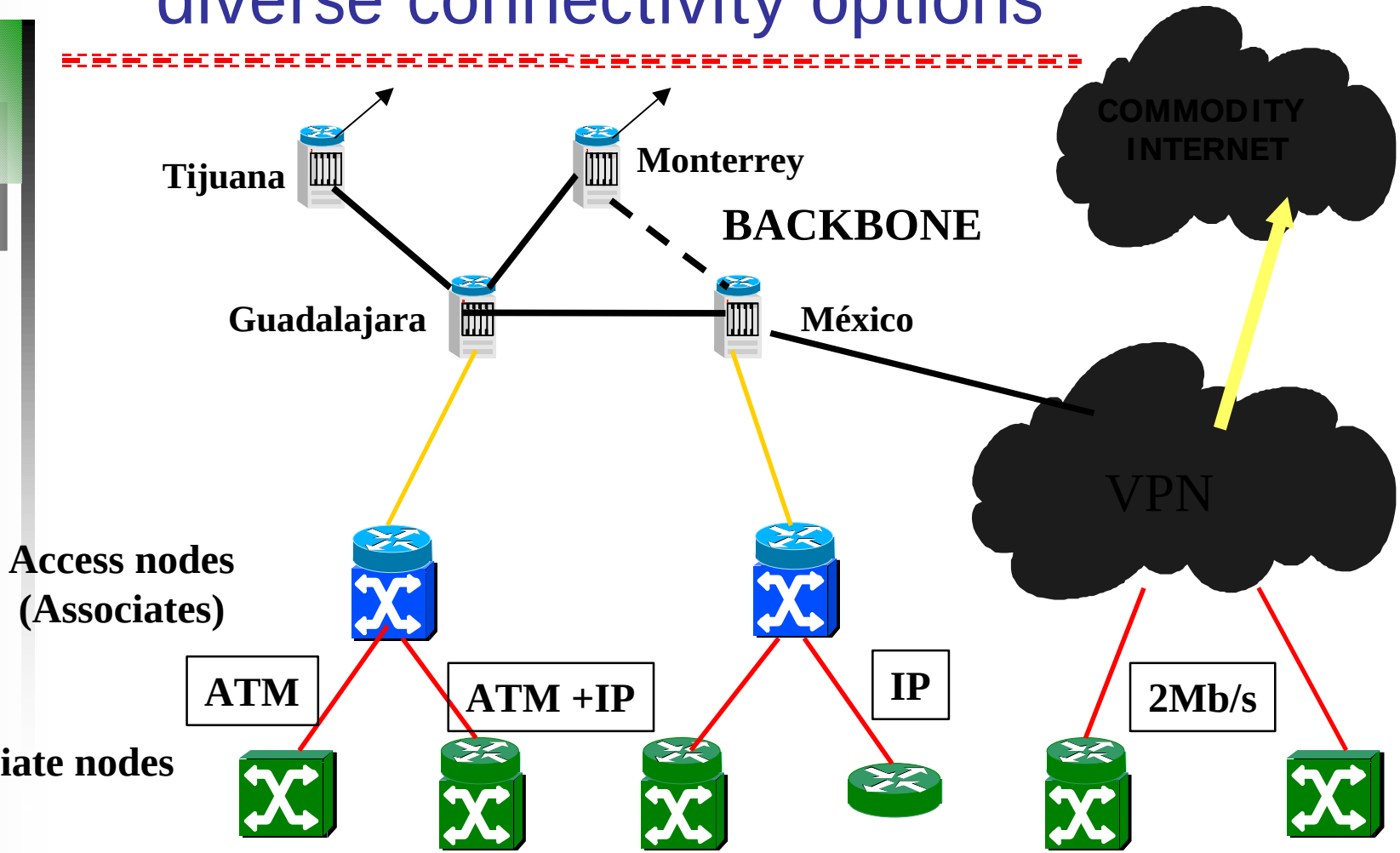


Technologies supported by the Cudi network

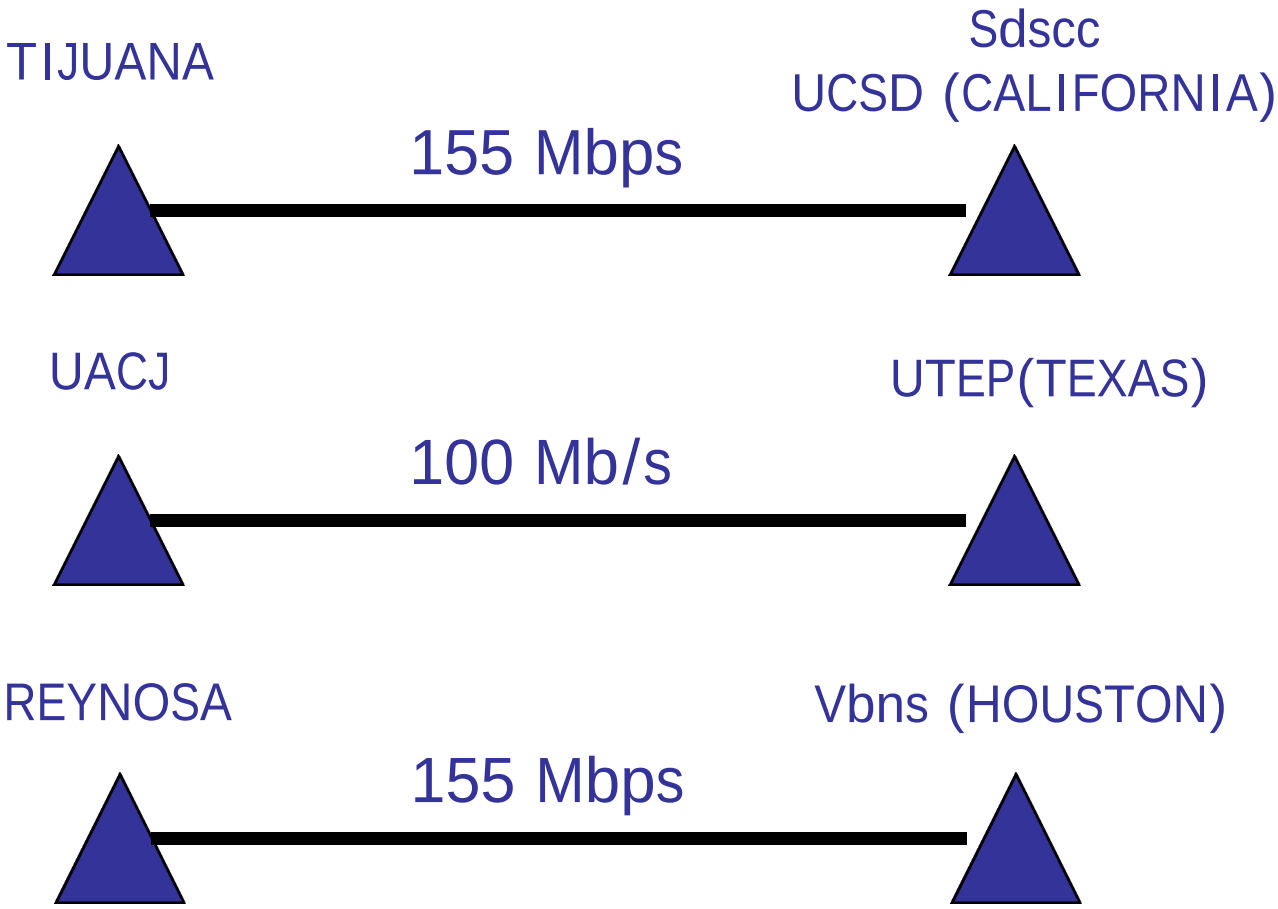
- MULTICAST
- QoS
- IPv6
- VoIP
- VIDEO BAJO DEMANDA
- H.323
- DISTRIBUTED COMPUTING
- ADVANCED SECURITY
- ADVANCED ROUTING
- CACHING
- VPN'S
- NOC



The network supports very diverse connectivity options



International Connectivity



30 SEP-Conacyt research centers have recently joined Cudi, increasing the membership in the corporation to 70 higher learning institutions

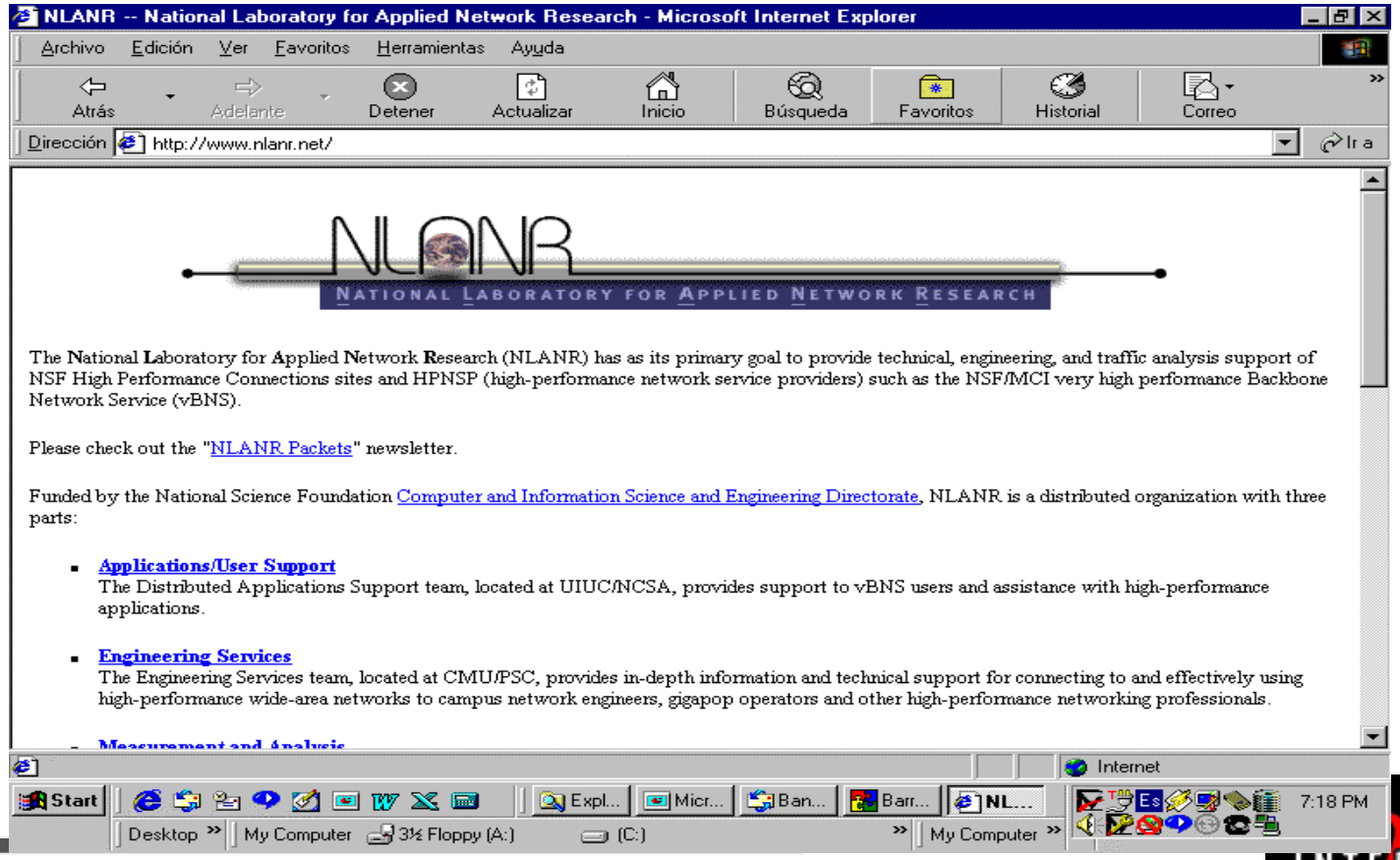
BUAP	UDG	ILCE	UAS	UTP	CIESAS	CIATEQ
CICESE	UDLAP	IMP	UAEM	CIAD	COLEF	CIDESI
IPN	ULSA	INAOE	UAEM	CIBNOR	COLMEX	CIDETEQ
ITESM	UNAM	ITAM	UCOL	CICY	COLMICH	CIQA
LANIA	UV	TAMU	UVM	CIMAT	ECOSUR	COMIMSA
UAM	CENTRO GEO	ANAHUAC	UIA	CIMAV	COLSAN	FIDERH
UACJ	CIBNOR	UABC	UP	CIO	FLACSO	INFOTEC
UANL	CENART	UACH	UPN	INECOL	IMORA	IPICYT
UAT	COLSUR	UACOAH	UTJ	INAOE	CIATEC	CINVESTAV
UAEH	IIE	UALL	UNITEC	CIDE	CIATEJ	UASLP

Approximately 2/3 of total higher education attendees study at Cudi member institutions

- Students: 1,400,000
- Teachers: 100,000
- Degree Programs: 1,100

Applications (with a Mexican twist)

Internet 2 applications cover all areas of science and technology. An inventory of applications is kept by the National Laboratory of Applied Network Research...



One of the most important fields of applications is advanced network technology

- MULTICAST
- QoS
- IPv6
- VoIP
- VOD
- H.323

- DISTRIBUTED COMPUTING
- CACHING
- NETWORK SECURITY
- MOVILE SERVICES
- VPN´S
- ETC

Advanced education and research applications

- **Distance education**
- **Digital libraries and remote data bases**
- **Telemedicine and health**
- **Life Sciences**
- **Earth Sciences**
- **Astronomy**
- **Visualization**
- **Art**
- **Grid computing**
- **Remote laboratories**

Distance Learning

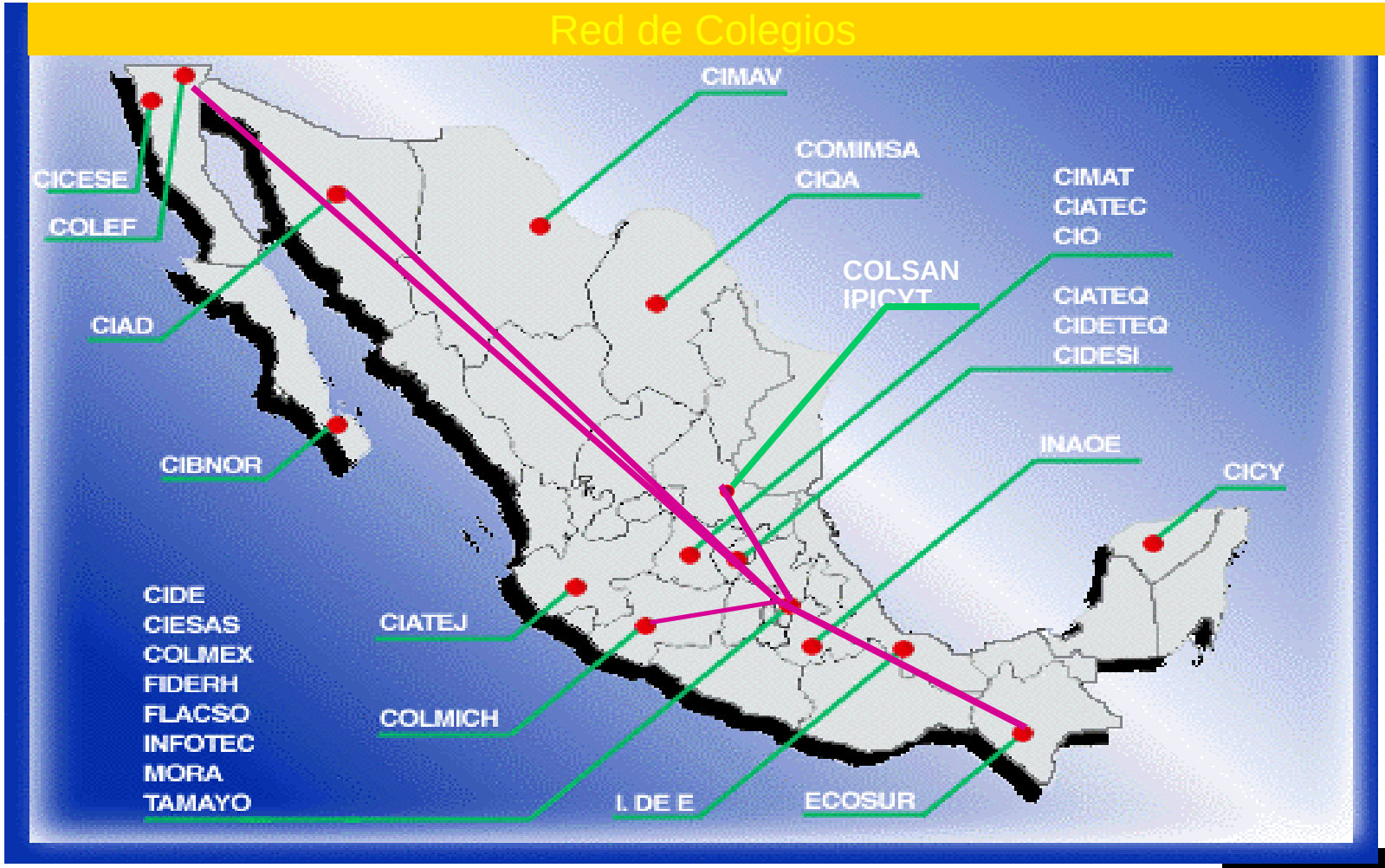
cudi

INTERNET 2

Shared courses

- A single teacher can videoconference its class to many remote students without marginal costs
- It improves the economics of having good teachers
- Examples:
  - Joint University of Texas and Universidad de las Americas MBA program
  - Universidad de Hidalgo shares teachers with Texas A&M
  - Monterrey Tech teleconferences courses from Monterrey and Mexico City to 28 remote campuses

Network of the Centros Públicos Conacyt



Digital libraries

Periodical Publications

- Internet 2 allows very efficient exploitation of remote repositories
- Cudi members have formed a purchasing consortium with EBSCO Publishing that provides preferential economic conditions for access to some 12,000 full text publications and 6,000 publications in abstracts.
- The repository comprises 10 years of publications in machine searchable form

Periodical Publications...

- The host server is connected to Internet 2
- The search engine is in Spanish
- The system has automatic translation into Spanish
- Cost to the university is significantly below what universities can contract for print or individual electronic subscriptions

Learning Objects in Internet 2

- Learning Objects are on line learning tools with a discrete and specific didactic objective,
- This permits LO´s to be integrated to be exchanged among institutions without certification concerns
- LO´s can then be integrated into many educational programs
- Internet 2 allows LO´s to use rich multimedia content:
  - Sound
  - Video
  - Animation
  - Interactivity
  - Etc.

Consortium to develop a Spanish Learning Object repository

- Several Mexican public universities are promoting the development of a Spanish LO repository
- A dozen universities can share the development of the repository. If each university contributes 150 LO per year, a 10,000 LO repository could be developed in the next 5 years
- This could support the 20 most popular undergraduate degree programs
- Access to the repository would be free

Telemedicine and health

cudi

INTERNET 2

Projects fall along 3 lines...

Clinical

•Remote health care

•Remote surgery

•Remote diagnostics

Education

•Distance learning

•Virtual relity

•Digital medical libraries

Research

• Visualization

•Genomics

•Robotics

Grid computing

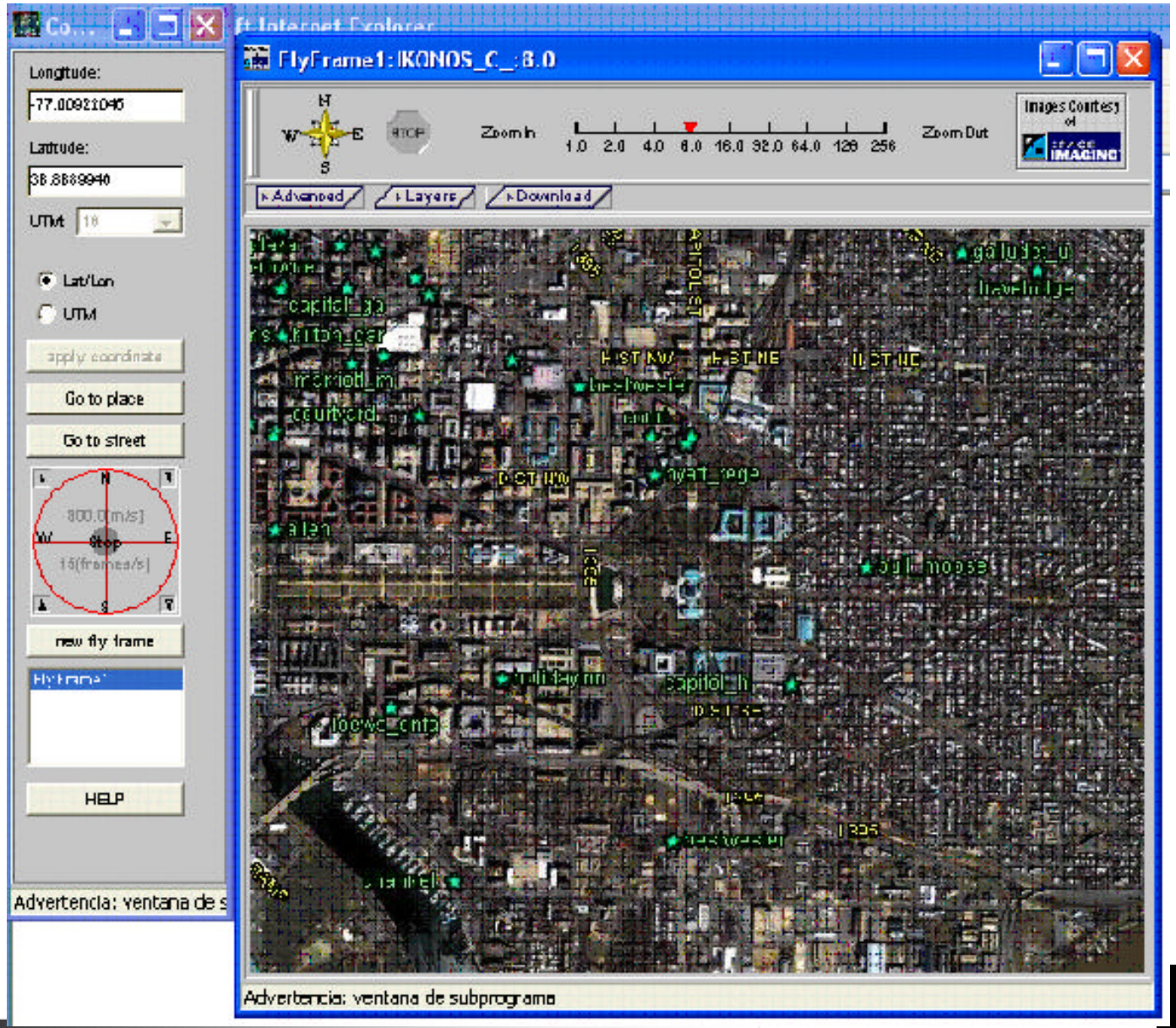
"Computing capacity is going to be acquired from a network, as electricity is today"

Grid Computing

- Connected computers that work simultaneously on a single application
- Cluster Illinois at Urbana Champaign, DOE, Caltech, SDSCC:13.6 trillion operations per second
- First grids are being installed in Mexico (Conacyt, UDG, IBM, UNAM)

Earth Sciences


COLORADO RIVER
DELTA AND UPPER
GULF OF CALIFORNIA
CICESE
Centro de Investigación
Científica y de Educación
Superior de Ensenada
UC MEXUS
The University of California Institute
for Mexico and the United States
SEP - CONACYT
Consejo Nacional de
Ciencia y Tecnología


Longitude:
-77.00921045
Latitude:
38.8889940
UTM
18
Lat/Lon
UTM
apply coordinate
Go to place
Go to street
new fly frame
HELP
Advertencia: ventana de s
FlyFrame1: IKONOS_C_:8.0
STOP
Zoom In
1.0 2.0 4.0 8.0 16.0 32.0 64.0 128 256
Zoom Out
Images Courtesy of
SPACE IMAGING
Advanced
Layers
Download
Advertencia: ventana de subprograma

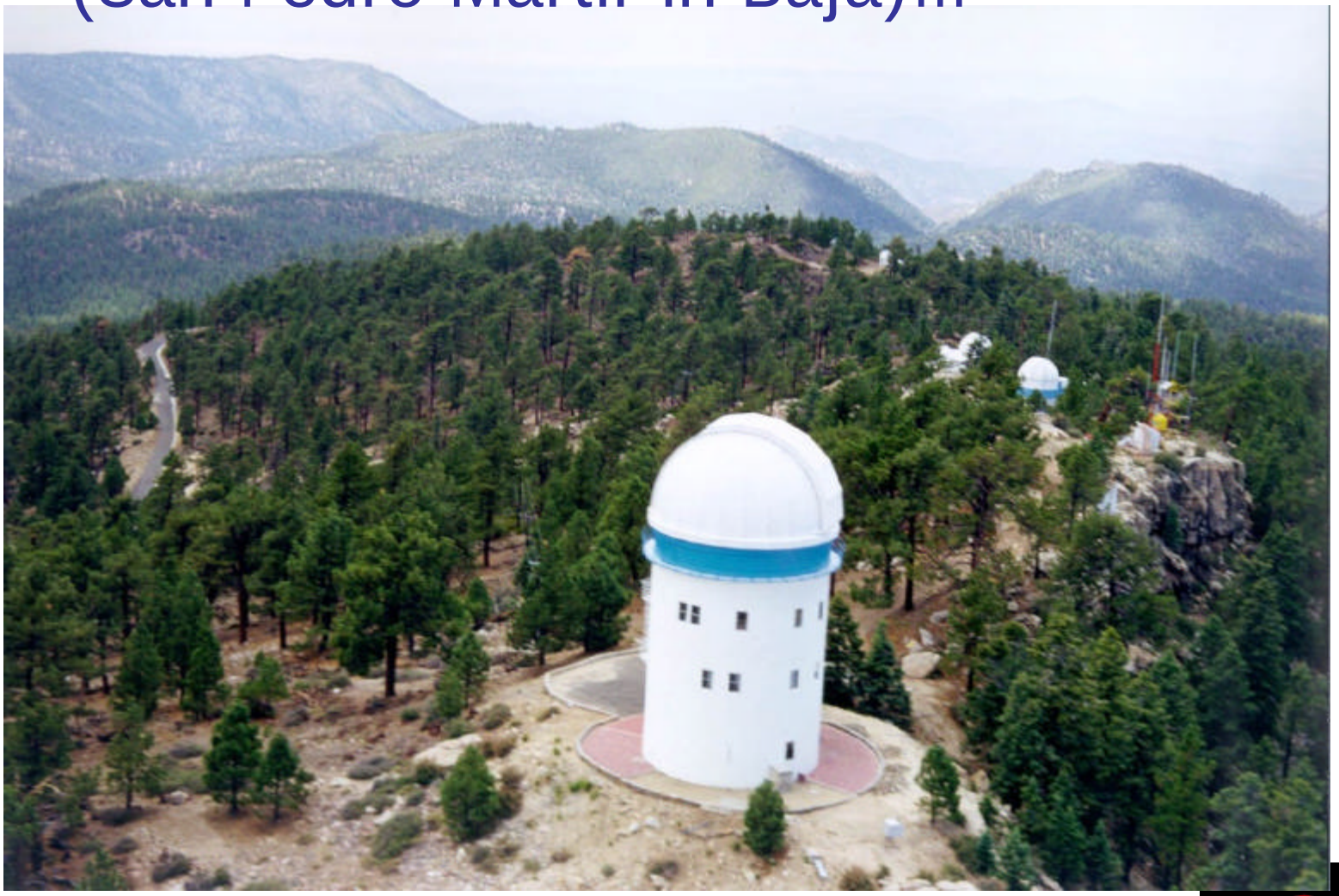
Astronomy

"Next Generation Internet will revolutionize astronomy"

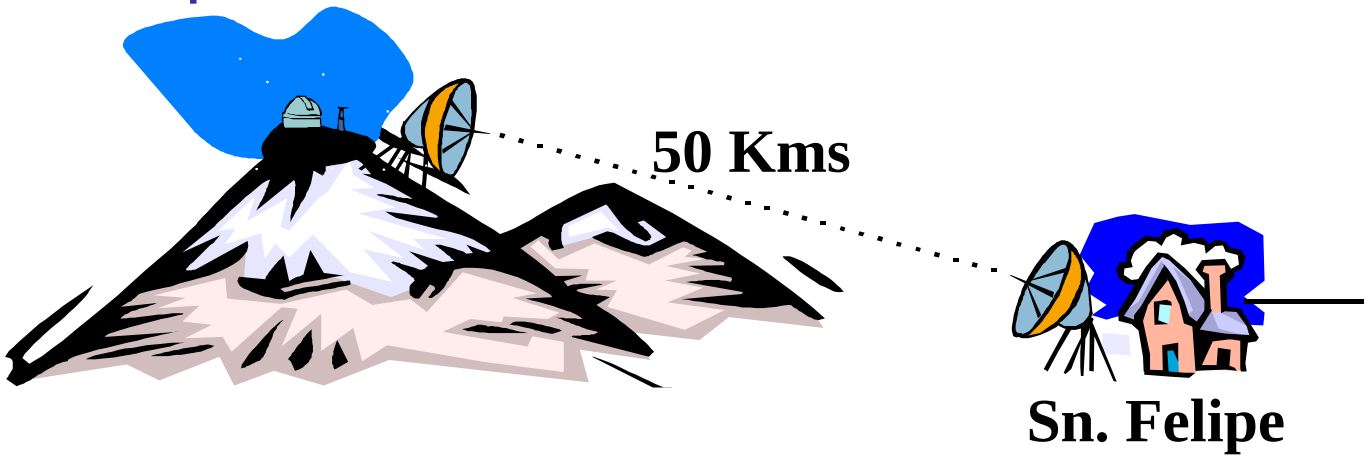
cudi

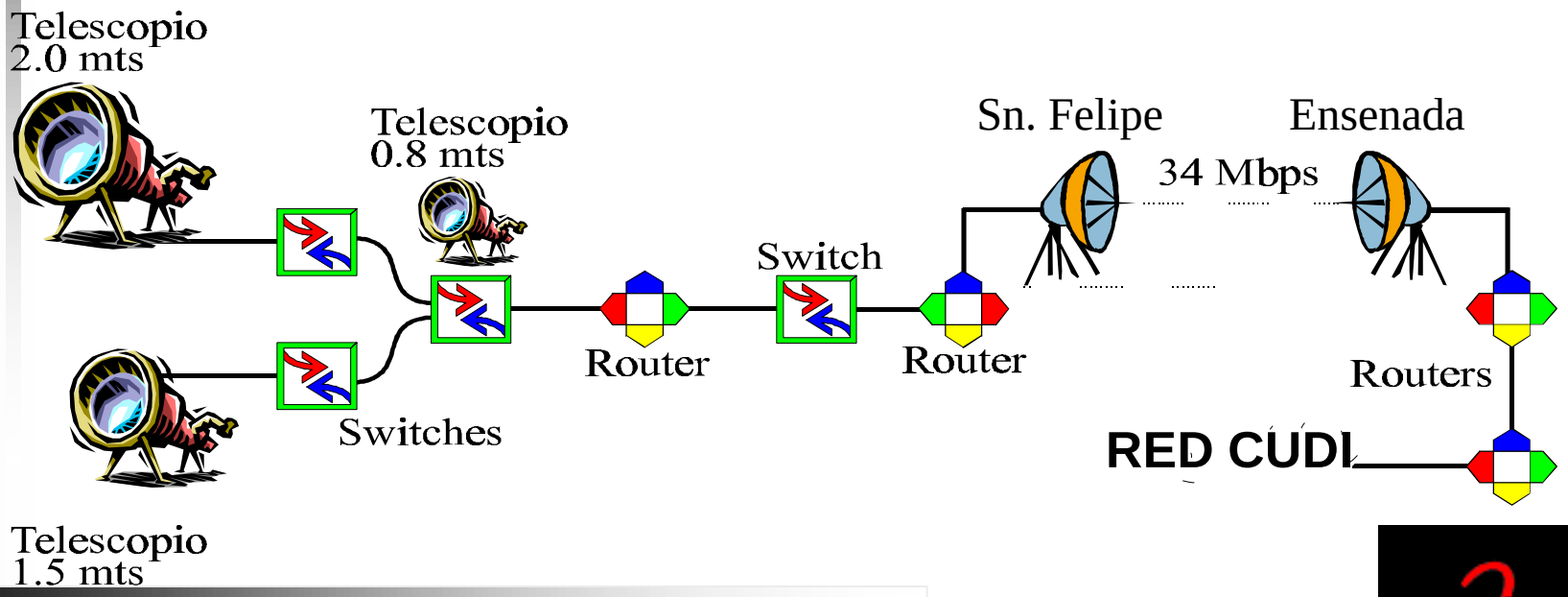
INTERNET2

Telescopes are usually in remote places (San Pedro Martir in Baja)...



Internet 2 allows remote handling of telescopes and distribution of observations...





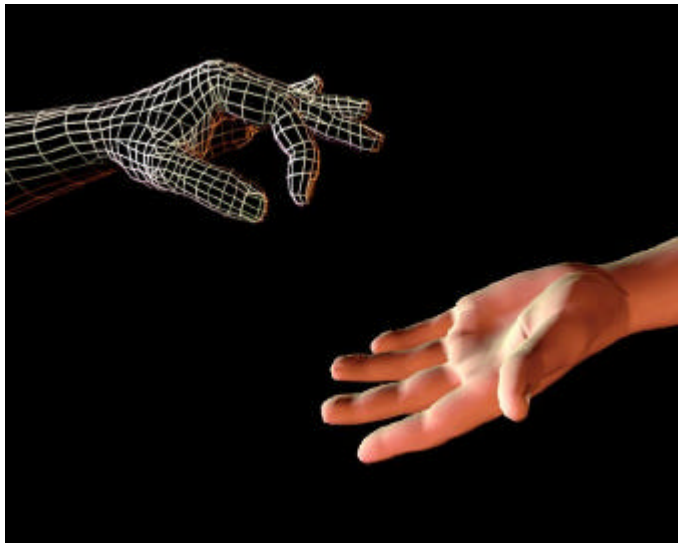
National Virtual Observatory (NVO)

- Being created with a $10 million dollar grant from the National Science Foundation
- Will allow any astronomer connected to high capacity Internet to combine all available data on a space object or region in the celestial sphere
- The project will use Grid technology to store, share and process information. The project is as much about computing as about celestial observation
- The project will impact other scientific fields that require the use of huge data bases

New data visualization technologies...

“The human brain can not analize one gigabit of information without graphic interfaces”

Tele-inmersion (Cave, immersive desks, etc.)



Art

BROADBAND LEARNING TECHNOLOGY FOR MUSIC
MAESTRO PINCHAS ZUKERMAN

http://www.columbia.edu/acis/networks/advanced/pz/

Remote laboratories

“No single university can have labs for all scientific fields”

Aplicaciones de Física

TEVATRON Acelerator - Fermilab

Internet 2 in Basic Education

cudi 2

INTERNET 2

cenic
Corporation for Education Network Initiatives in California

Overview

Digital California Project: K-12 Statewide Network

Transforming learning, everywhere in California.

The Information Age and rapid technological advances are challenging us to rethink the education experience. So compelling is the need to prepare the next generation to excel in the new network driven economy, the State of California, with Governor Gray Davis' leadership, created and funded the Digital California Project (DCP): K-12 Statewide Network. The DCP initiative lays the foundation for a statewide digital education infrastructure. The University of California has the leadership role in overseeing the project and administering the funds. CENIC, under agreement with UC/State of California, is creating the DCP-the best possible digital learning environment for California's future.

cudi

INTERNET2

Large public high schools (where most Mexican boys study) can acquire advanced telecommunications and computing equipment because its costs can be distributed among thousands of students. Secundaria Anexa a la Normal Superior is now connected to Internet 2

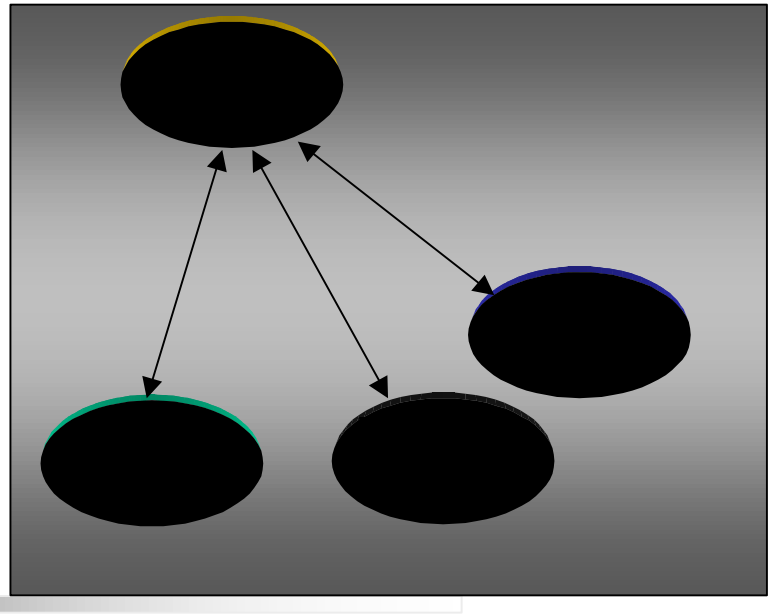
New Regional Connectivity Projects

At least four Latin American countries now have National Research and Education Networks (NREN´s) that are operational

- Chile (REUNA)
- Argentina (RETINA)
- Brazil (RNP)
- Mexico (CUDI)

Connectivity of Latin American NREN´s ...

- Scarcity of resources and bandwidth
- Links are low bandwidth and all pass through Miami



The @lis project...

- In December 2001, the European Economic Community approved the @lis project, to promote an alliance for the Information Society with Latin America
- The countries that will benefit from the project are: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Guatemala, Honduras, México, Nicaragua, Panamá, Paraguay, Perú, Uruguay and Venezuela.

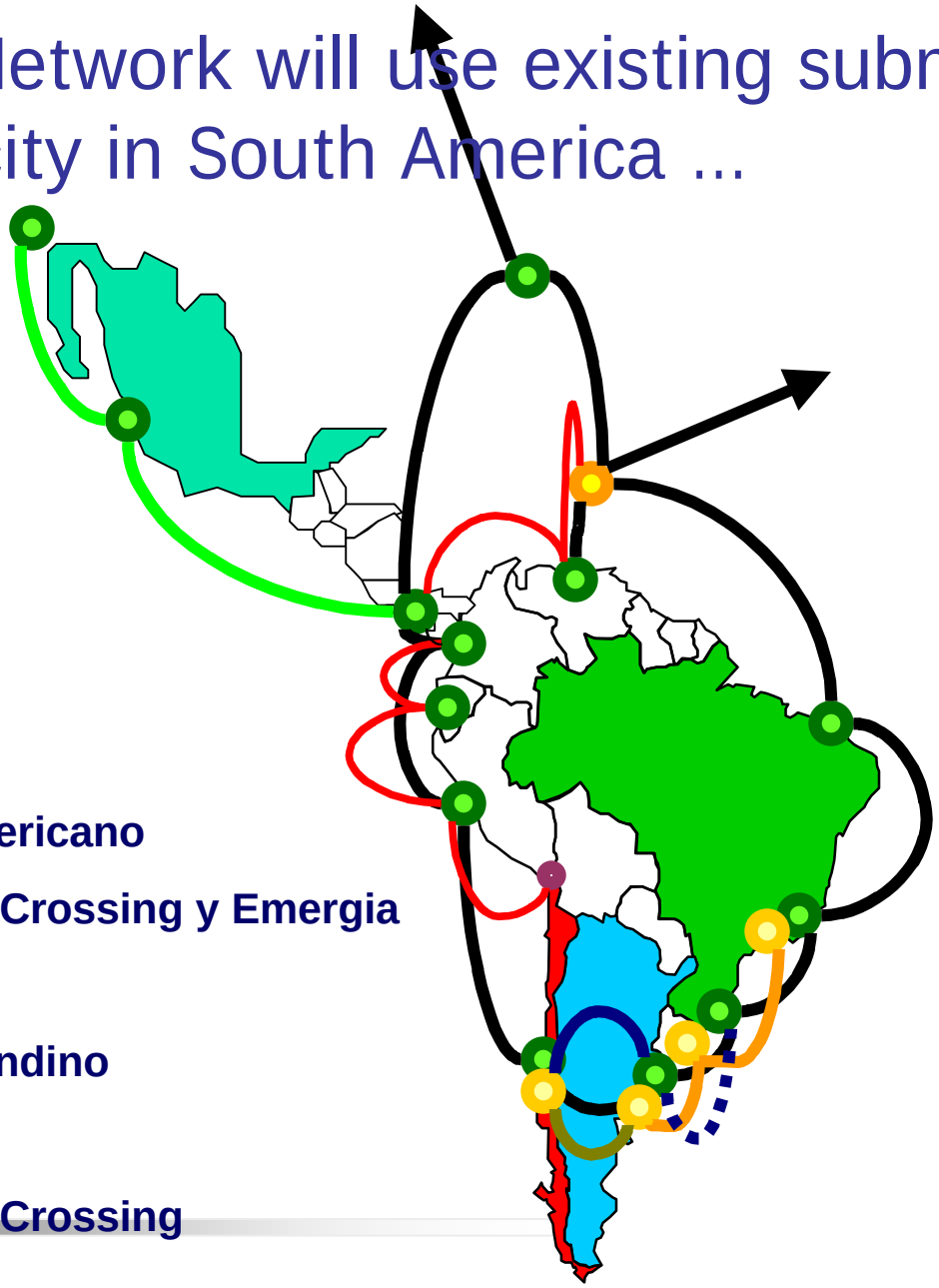
The Clara network...

- With € 10 million funding from the @lis project and € 2.5 million from the LA NREN´s, to be disbursed during the next 3 years, Latin American countries are creating Red Clara

primera reunión
primeira reunião
Clara
Cooperação Latino-Americana de Redes Avançadas
Cooperación Latino-Americana de Redes Avanzadas

The Clara Network will connect some 700 Latin American higher education institutions to the NREN´s of Europe and the US

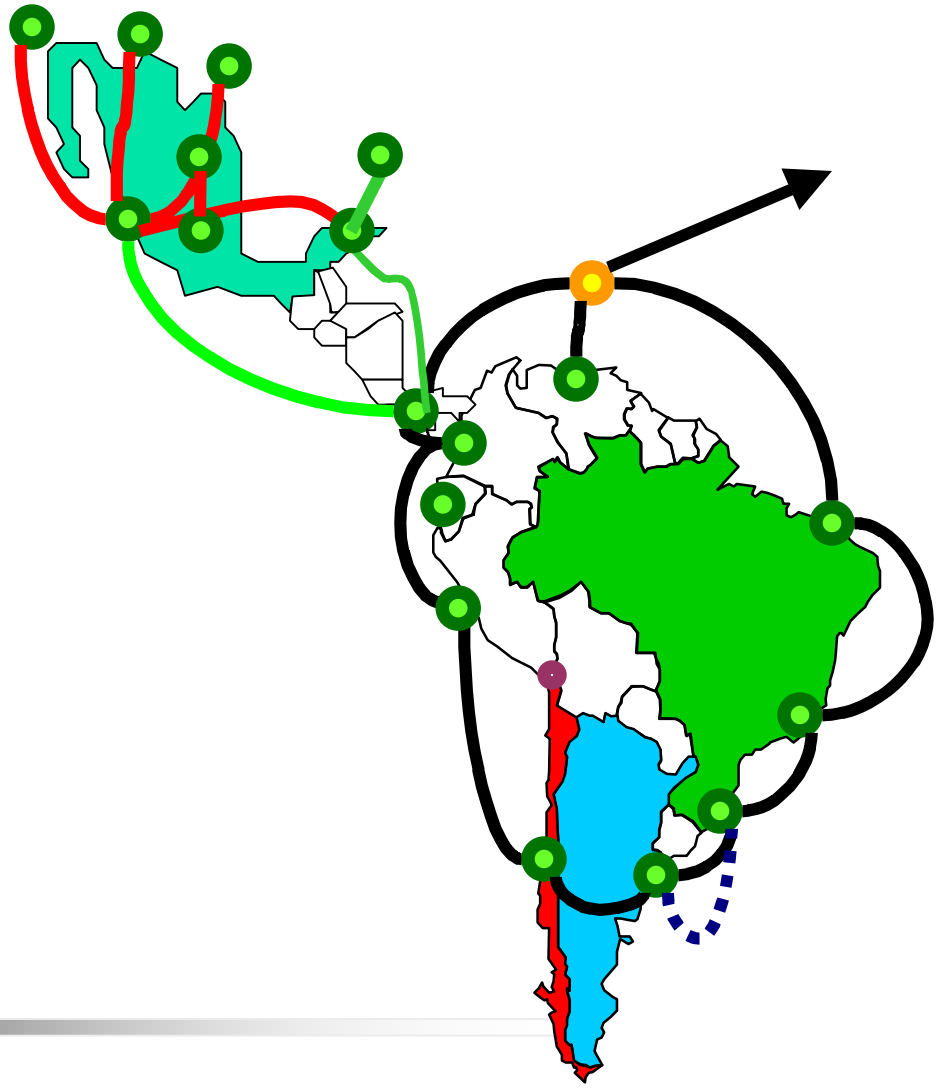
The Clara Network will use existing submarine cable capacity in South America ...



...and in Central America (Arcos and Maya cables)...

The Cudi backbone will integrate Red Clara to Central America and to the US

The Cudi backbone will integrate Red Clara to Central America and to the US



Timeline...

- Clara should be operational by the end of 2003

Collaborative Projects: Developing Internet2 communities in Mexico and the US

cudi

INTERNET2

Internet 2 connectivity can enhance the importance of international collaboration for Mexican and US Universities

- Share library and technical resources (i.e.: laboratories, supercomputers, data bases, etc.)
- Undertake distance and collaborative education efforts more efficiently
- Do collaborative research
- Share technology and know-how
- Increase social impact

The UC MexUS effort

- $4.5 million dollar a year funding has been approved by the State legislature
- Funds will be matched by Mexico´s Conacyt
- 6 programs
  - Collaborative Research Programs
  - Graduate Student Education and Training
  - Faculty and Research Exchange
  - Institutional Partnerships
  - California-Mexico Commission on Education, Science and Technology
  - Casa de California

The UC MEXUS – Conacyt-CUDI-CENIC 2001 call for proposals

UC MEXUS-CONACYT
Special Call for Proposals

UC MEXUS-CONACYT
Advanced Network Services Applications
Collaborative Grants in Research, Education, & Technology
2001

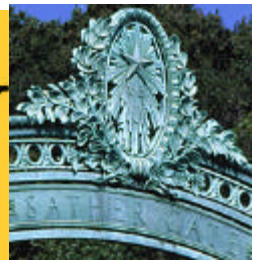
$40,000 Maximum for One Year
Deadline for receipt of proposals: July 2, 2001

A Program Established in Collaboration with
the Corporación Universitaria para el Desarrollo de Internet, A.C., (CUDI)
and the Corporation for Education Network Initiatives in California (CENIC)

version en español

A pilot Internet based distance learning course on Agroecology, involving 5 Mexican Agricultural Universities

Berkeley
University of California



Universidad Autónoma De Yucatán

Virtual collaboration in the Californias

Centro de Investigación Científica y de Educación Superior de Ensenada

CICESE

The MexLinks Consortium for Technology Access and Educational Advancement Applying Internet 2

University of California Santa Barbara

Benemérita Universidad Autónoma de Puebla

QoS for a multi-services network in a virtual campus

UC SANTA CRUZ

INSTITUTO POLITÉCNICO NACIONAL

Client Server Discrete Event Simulation Over Very Large Communications Networks (Internet 2)

UCI University of California, Irvine

Centro de Investigación Científica y de Educación Superior de Ensenada

CICESE

Internet Assisted Remote Experiments in Teaching Food and Biochemical Engineering

UCDAVIS
University of California, Davis

Universidad de las Américas-Puebla

Parallel algorithms for solving propositional satisfiability using the high bandwidth of Internet 2

UC SANTA CRUZ

Tec de Monterrey

MIRO: Adaptive Middleware for a mobile Internet robot

UCI University of California, Irvine

ITAM
Instituto Tecnológico Autónomo de México

Bioinformatics Network for Education and Research

UCI University of California, Irvine

INSTITUTO POLITÉCNICO NACIONAL

A collaborative engineering environment for global integrated product development

Berkeley
University of California

Tecnológico de Monterrey
Tec de Monterrey

cudi

INTERNET 2

New inititives...

- UC MexUS- Conacyt grants for collaborative projects for teams of UC and Mexican Researchers due March 17
- A new UC MexUS- Conacyt for collaborative projects that use advanced network services will probably be issued later in 2003
- As the UC MexUS- Conacyt programs pick up there will be 200 Mexican students doing doctoral studies in UC

How to leverage this efforts...

- Identify research and education projects already going on between UC and Mexican universities, and explore directly with some of the faculty involved how could better connectivity enhance their efforts.

- Establish a personal contact with campus personnel responsible for Internet 2 connectivity. We should be able to have a contact persons in Mexico and each UC campus to be able to set up videoconferences and special links, until the interested parties get the know-how to establish them on their own.

- Start a process to identify pairs of researchers from UC and Mexican universities that could start collaborations using Internet 2.
- Explore access to special research tools that are not widely available yet for Mexican researchers, such as laboratories, test equipment and medical facilities, which could be jointly used through Internet 2 connectivity.
- Simultaneously, we could explore interest among UC researchers for access to specialized Mexican facilities like telescopes handled by UNAM and INAOE.

- Explore interest to support ongoing joint educational activities already taking place between UC and Mexican universities with Internet 2.
- Explore the possibility to share digitized content from specialized libraries.
- Projects can now include other Latin American countries linked to the Clara network

Cudi spring meeting

- April 3th and 4th in Ensenda, Baja California
- Focussed on California- Mexico colaboratrion

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