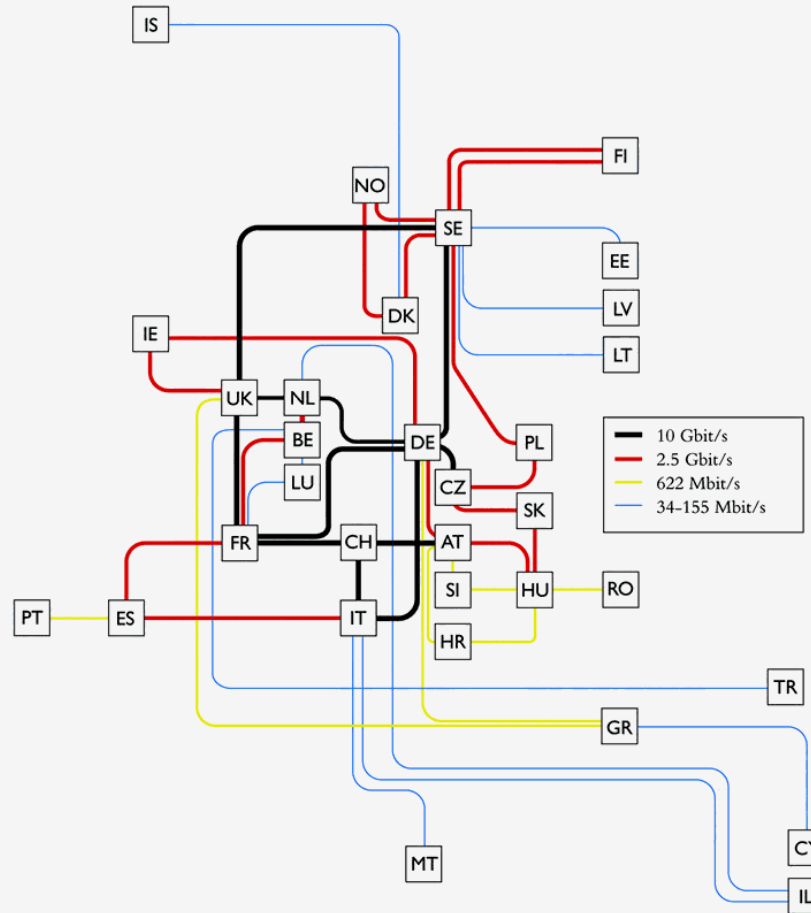


GÉANT

- First network of the “Bandwidth Age”
- 20-fold increase in capacity over TEN-15 for the same cost
- Principal connections are 10 and 2.5 Gbps wavelengths
- Currently the largest capacity operational IP network in the world



AT Austria	DK Denmark*	GR Greece	IS Iceland*	MT Malta	RO Romania
BE Belgium	EE Estonia	HR Croatia	IT Italy	NL Netherlands	SE Sweden*
CH Switzerland	ES Spain	HU Hungary	LT Lithuania	NO Norway*	SI Slovenia
CY Cyprus	FI Finland*	IE Ireland	LU Luxembourg	PL Poland	SK Slovakia
CZ Czech Republic	FR France	IL Israel	LV Latvia	PT Portugal	TR Turkey
DE Germany					UK United Kingdom

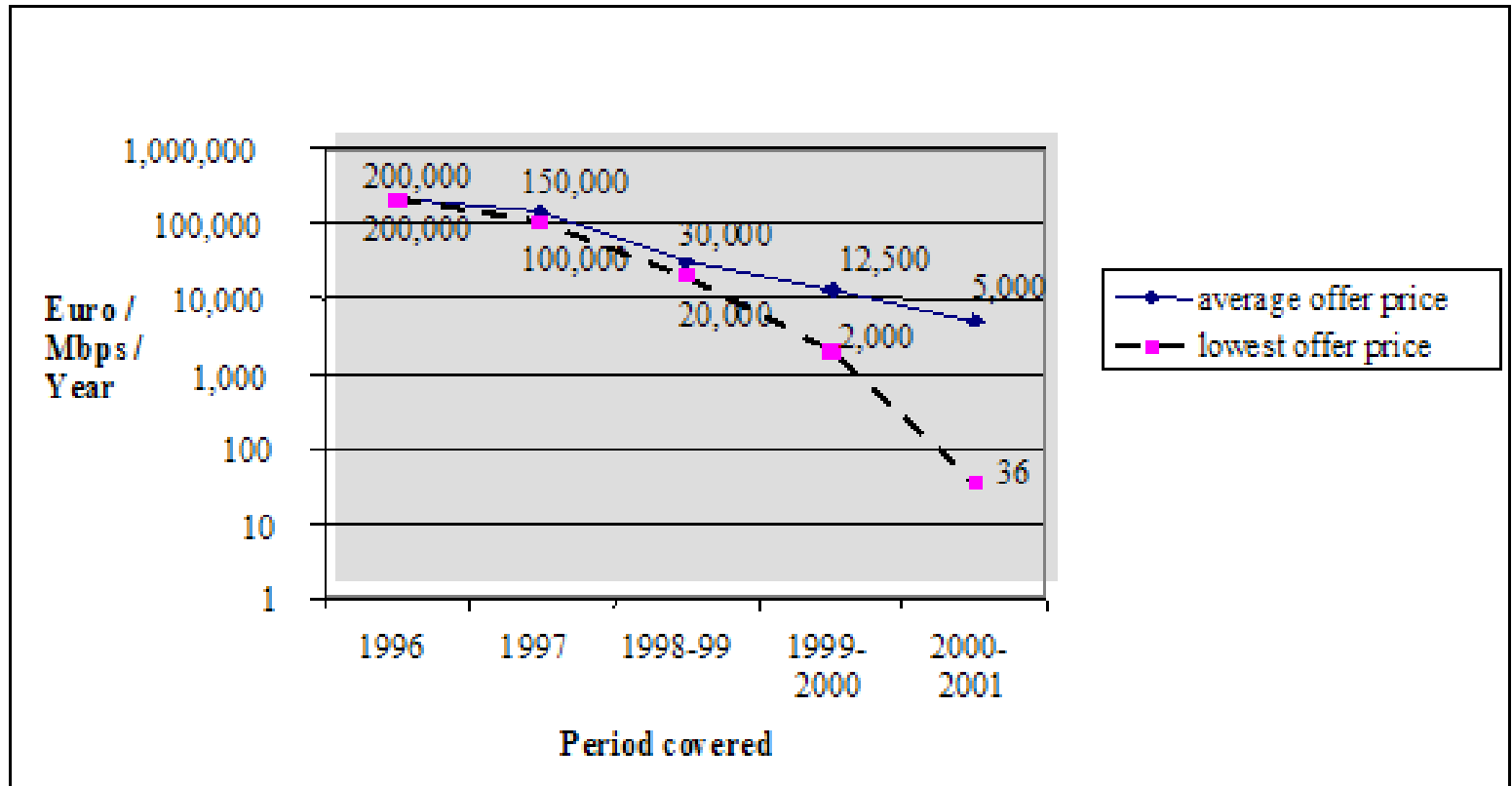
Connections between these countries are part of NORDUnet (the Nordic regional network)



Multi-Gigabit pan-European Research Network
Backbone Topology June 2003



Falling costs in the Bandwidth Age



The @LIS initiative



- Through GÉANT, the European R&E community enjoys high bandwidth connectivity with N. America
- Initiatives already taken to improve connectivity to Asian-Pacific, Mediterranean and Latin American regions, with support from the European Commission
- @LIS: Alliance for the Information Society (2003-2005)
 - 62.5 Million Euros for EU-LA on Information Society Issues
 - 10 Million Euros for Interconnecting Europe & Latin American Researchers



CAESAR: Connecting All European and South American Researchers.



European initiative to prepare for the @LIS program

- Promote EU-LA connectivity through regional connectivity within LA plus a large pipe to Europe
- Participants: DANTE, NRENs of Spain and Portugal
- CAESAR Workshop 2002 in Toledo became starting point for CLARA
 - cooperative organisation for advanced networking in LA
 - regional network:
feasibility study showed that @LIS budget sufficient to establish advanced connectivity to all LA countries



Clara



Cooperação Latino-Americana de Redes Avançadas Cooperación Latino-Americana de Redes Avanzadas

- Association of NRENs in LA open to all LA Countries
 - constituted in Uruguay (like LACNIC)
- CLARA is not limited to @LIS/CAESAR time scale and restrictions
- Will connect LA to Europe and to other regions
- Cost to connect to the backbone will be the same for every country at equal bandwidth
- Improve Internet2 connectivity by optimising LA participation in AMPATH



CLARA Members



- Argentina
- Brasil
- Bolivia
- Chile
- Colombia
- Costa Rica
- Cuba
- Dominican Republic
- Ecuador
- El Salvador
- Guatemala
- Honduras
- Mexico
- Nicaragua
- Panama
- Paraguay
- Peru
- Uruguay
- Venezuela



CLARA Activities



- May 2002: Brussels @LIS Interconnection Initiative Launched (CAESAR Project)
- June 2002: EU-LA Meeting in Toledo. *Toledo Statement signed.*
- July 2002: LA Networking Initiatives meet in Rio. CLARA agreement established.
- September 2002: Coordinating Committee of CLARA meets in Buenos Aires
- September 2002: CLARA & ICT TF meeting in Rio.
- November 2002: EU-CLARA meeting in Santiago
- February 2003: ALICE Project begun, with participation of CLARA countries
- June 2003: CLARA statutes approved
- July 2003: formalisation of CLARA in Uruguay



Comments about CLARA



- CLARA responds to long-standing need for coordination between LA NRENs.
- Builds on trust-building already carried out between major partners
- Offers support for NREN building in other LA countries by provision of support and int'l connectivity



ALICE project: May 2003 to April 2006



ALICE - América Latina Interconectada Con Europa

- Successor project to CAESAR
- Coordinated by DANTE, with participation of NRENs from Italy, France, Spain, Portugal and the CLARA countries, and eventually CLARA itself
- February 2003: technical definitions complete
- June 2003: Open tender for provisioning of links
- September/October 2003: Link contracts assigned
- January 2004: Network operational

Notes:

- DANTE is the project coordinator and will sign contracts with users and providers
- CLARA is expected to represent interests of LA users in the medium term (one year)



Suggested network topology

- Major connectivity between Argentina, Brazil, Chile and Mexico (at least 45 Mbps)
- Other countries connect to major nodes (between 10 and 45 Mbps)
- Large pipe to Europe (at least 155 Mbps)



Two possible ALICE network scenarios (based on first responses to connectivity tender)



NOTE: tender is still not finalised

Network expected to be operational in January, 2004

Experimental networking in Latin America



- Internet2 style networks provide for today's connectivity needs of the P&E community
- In future, with the growth of this community and its needs, new solutions will need to be provided
- Such solutions are currently being developed and demonstrated in experimental networking testbeds



Networking testbeds

- NSF classification of networking testbeds beyond Internet 2 (Tom Greene)
 - Experimental Infrastructure Networks (EIN) - **Internet 3**
 - Networking Research Testbeds (NRT) - **Internet 4**
- Internet 4 optical networks
 - dynamic lambda-switched, OPS, OBS networks
- Internet 3 optical networks
 - Based mostly on statically lambda-switched networks
 - growing number of networks providing production networking support for advanced applications



Some current experimental optical networking projects in Latin America



- **Chile:**
G-REUNA - Advanced Applications Testbed
- **Brazil:**
Project GIGA - Optical Networking and Applications Testbed

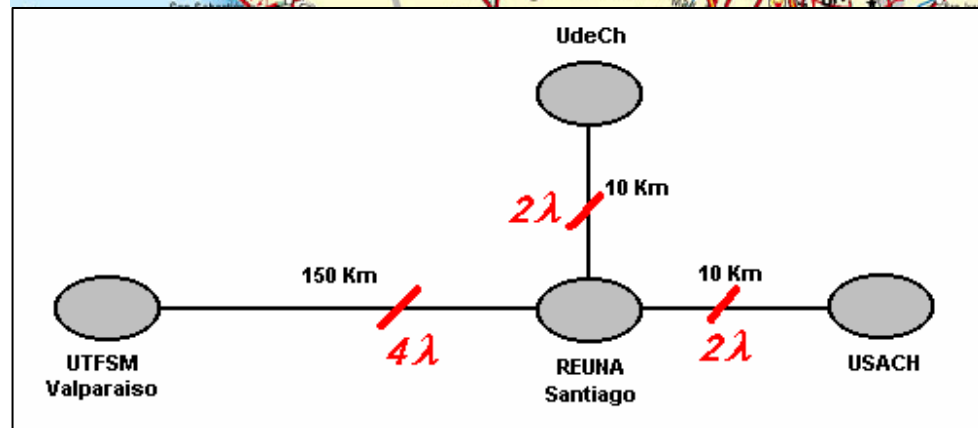
Both of these are a mixture of EIN and NRT
(Internet 3 and 4)



G-REUNA (Chile) experimental network (2002–2003)



- **Phase I of G-REUNA:**
 - R&D in optical networking and advanced applications
 - IP/DWDM
 - govt. and telco support
 - 250 km network between Santiago and Valparaíso
 - participation of leading research universities and national academic network (REUNA)
- <http://redesopticas.reuna.cl>



Project GIGA (Brazil)



- Partnership between
 - RNP (Brazilian NREN) www.rnp.br
 - CPqD (telco industry R&D centre in Campinas, SP) www.cpqd.com.br
 - R&D community in industry and universities
- Build an advanced networking laboratory (GIGA network) for development and demonstration purposes
- Support R&D subprojects in optical and IP networking technology and advanced applications and services
- Industry participation (telcos provide the fibres; technology transfer of products and services required)
- Government funding for 3 years - started December 2002



GIGA network: objectives



- explore user control of optical fibre infrastructure
 - interconnect 20 academic R&D centres in S.E. Brazil
 - use of IP/DWDM with Ethernet framing
- provide Networking Research Testbed (NRT) for optical and IP network development
- provide Experimental Infrastructure Network (EIN) for development and demonstration of applications
- expected to operate before end 2003.



GIGA network: geographical localisation (states of São Paulo and Rio de Janeiro)

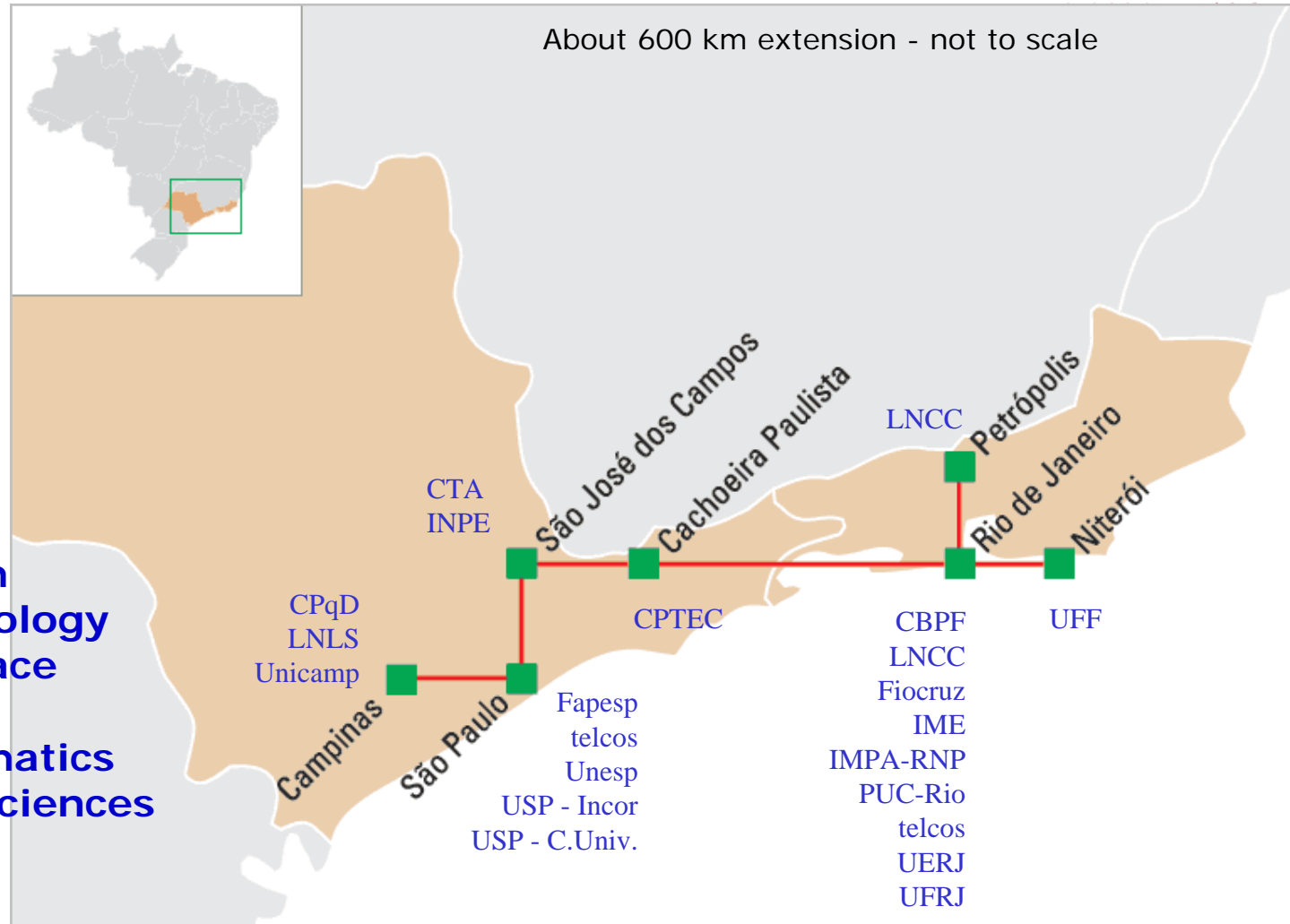


Universities

IME
PUC-Rio
UERJ
UFF
UFRJ
Unesp
Unicamp
USP

R&D Centres

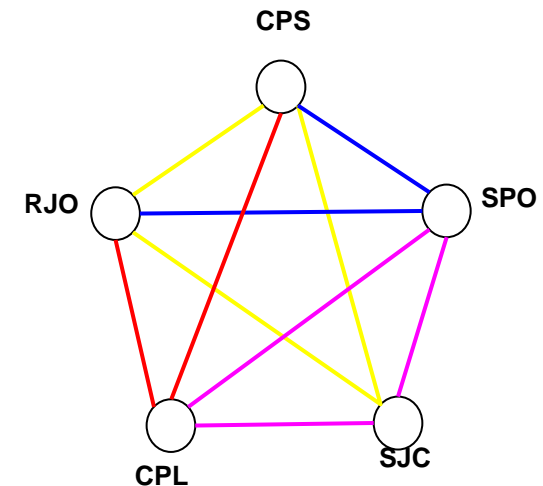
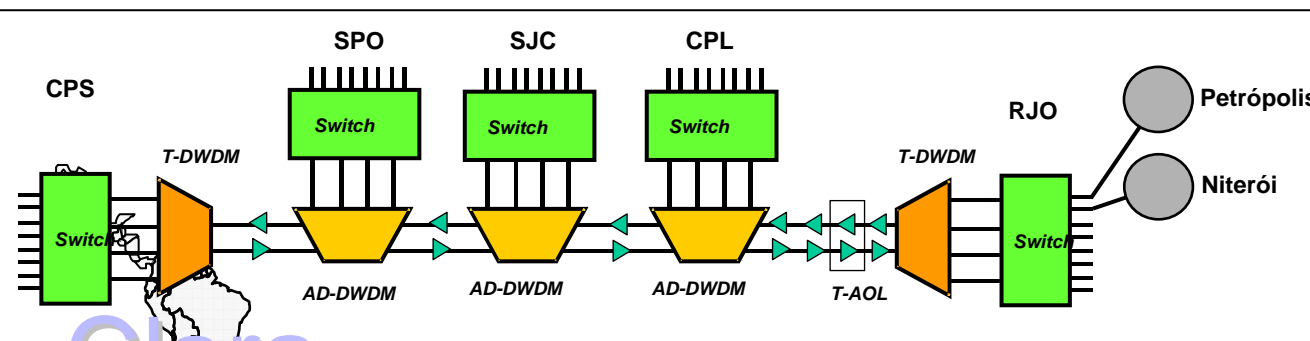
CBPF - physics
CPqD - telecom
CPTEC - meteorology
CTA - aerospace
Fiocruz - health
IMPA - mathematics
INPE - space sciences
LNCC - HPC
LNLS - physics



GIGA Project: Initial design of the network

- DWDM WAN between Campinas and Rio de Janeiro
- WDM MANs in Rio, S. Paulo and Campinas
- Switches between WAN and MANs for IP packets and lambdas (under study)
- **later:** redundant topology and optical switching

CPS - Campinas
SPO - São Paulo
SJC - São José dos Campos
CPL - Cachoeira Paulista
RJO - Rio de Janeiro



Some GIGA R&D subprojects



- intelligent optical network with monitoring and control of physical parameters
 - optical amplification, dispersion, equalisation, SNR, ...
- optical switching architecture
 - control plane: dynamical bandwidth provisioning and mesh restoration
 - provisioning end-to-end optical circuits for specific applications
- IP over WDM: unified control plane and integrated network management
- high performance distributed applications
- advanced multimedia applications



Conclusion



- Both international cooperation (through AmPath and CLARA) and development of experimental networking have repercussions:
 - provides valuable opportunities for academic user community in LA to collaborate with peer groups in other countries
 - permits the acquiring and diffusion of experience in advanced networking technologies, often absent in LA countries



Acknowledgements and references



- With thanks to many colleagues from both Europe and Latin America, too many all to be mentioned here individually. Most of the LA maps are by Florencio Utreras, from REUNA (Chile).
- ALICE website:
www.dante.net/alice
- ALICE brochure (in English, Spanish and Portuguese):
www.dante.net/alice/ALICEbrochure.pdf
- RNP website:
www.rnp.br

