



Computational Grids: the contribution of RNP (update)

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Requirements for advanced applications



- Most R&E network providers, like RNP, traditionally provide lowest common denominator services (“best effort”) for all users
- However, new applications are appearing with specific requirements relating to performance:
 - interactive multimedia applications
 - grid applications
- Principal performance requirements:
 - guaranteed bandwidth
 - guaranteed delay
- These require architectural changes in network design

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Improvements in network and grid infrastructure since WCGA05



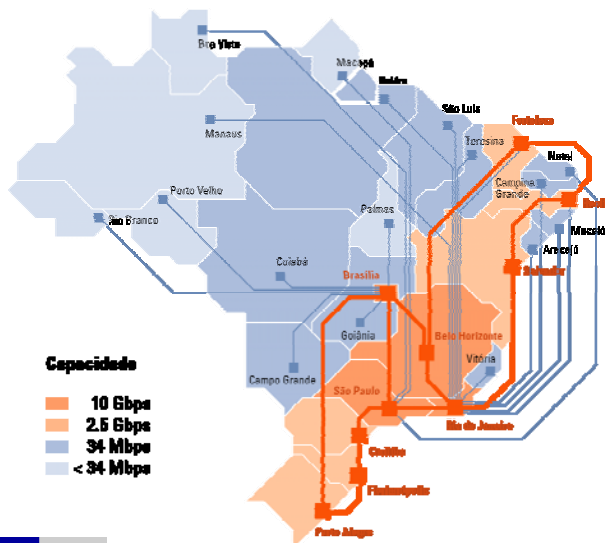
- Nova RNP:
 - New national network core (Rede IPÊ) – Oct 05
 - Optical metro networks in capitals – from Jun 06
 - New connectivity to US (WHREN/LILA) – Feb 06
- In the pipeline:
 - Educational PKI – pilot in 2006

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Brazil: RNP's Ipê network (Oct 2005)



Connections to all 26 state capitals and Brasília:

- Network core (12,000 km):
 - 10 Gbps to 4 capitals
 - 2.5 Gbps to 6 capitals
- Access links
 - 34 Mbps to 11 capitals
 - < 34 Mbps to 6 capitals



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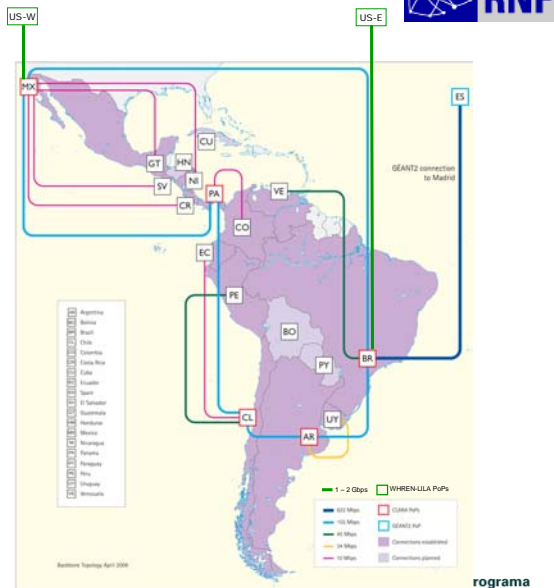


Augmented RedCLARA topology



New links are:

- MX US-W (3Q05)
initially 2x 1 Gbps
(CWDM)
 - RedCLARA has 1 Gbps
- BR US-E (1Q06)
initially 1.2 Gbps
 - capacity shared between RedCLARA and Brazilian partners (RNP and ANSP)



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Project GIGA: GRID computing subprojects



- Of the 33 subprojects, 13 are related to grid computing, with different areas of application:
 - 4 “generic”
 - 4 biology (incl. genome, bioinformatics, etc)
 - 2 physics
 - 3 other applications
- Most of these projects were presented at WCGA05

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Some relevant international grid network projects



- High-energy physics (HEP)
 - LCG (LHC Computing Grid)
 - for processing and visualising future LHC experimental results
 - talks at WCGA05 by Santoro and Seixas
 - Ultralight
 - talk at SBRC06 by Xun Su – some slides follow
- E-science:
 - EGEE (Enabling Grids for E-science in Europe)
 - EELA (E-infrastructure shared between Europe and Latin America)

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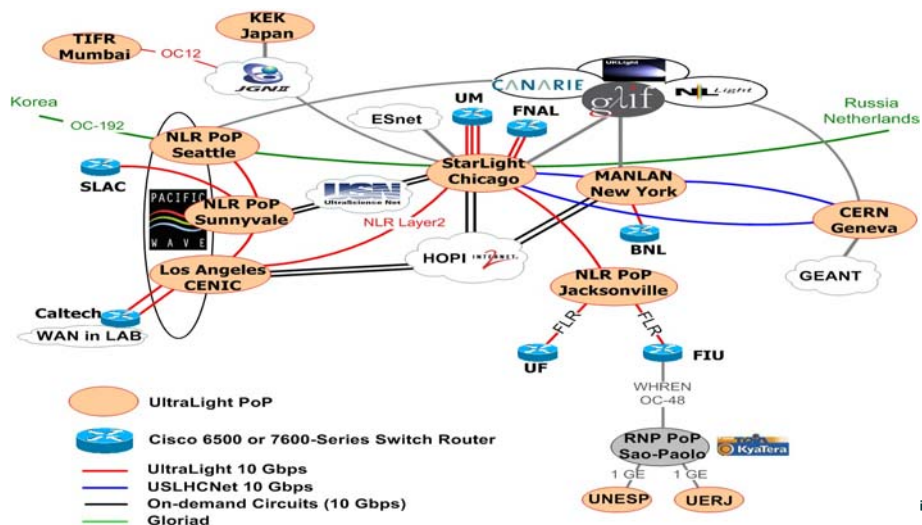
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UltraLight



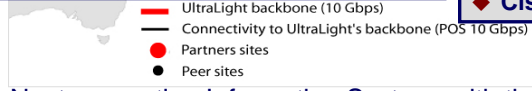
• 4 Continent Testbed



UltraLight



- ◆ **Goal:** Enable the network as an integrated managed resource
- ◆ **Meta-Goal:** Enable physics analysis & discoveries which otherwise could not be achieved
- ◆ Caltech, Florida, Michigan, FNAL, SLAC, CERN, BNL, Internet2/HOPI
- ◆ UERJ (Rio), USP(Sao Paulo), FIU, KNU (Korea), KEK (Japan), TIFR (India), PERN (Pakistan)
- ◆ NLR, ESnet, CENIC, FLR, MiLR, US Net, Abilene, JGN2, GLORIAD, RNP, CA*net4; UKLight, Netherlight, Taiwan
- ◆ Cisco, Neterion, Sun ...



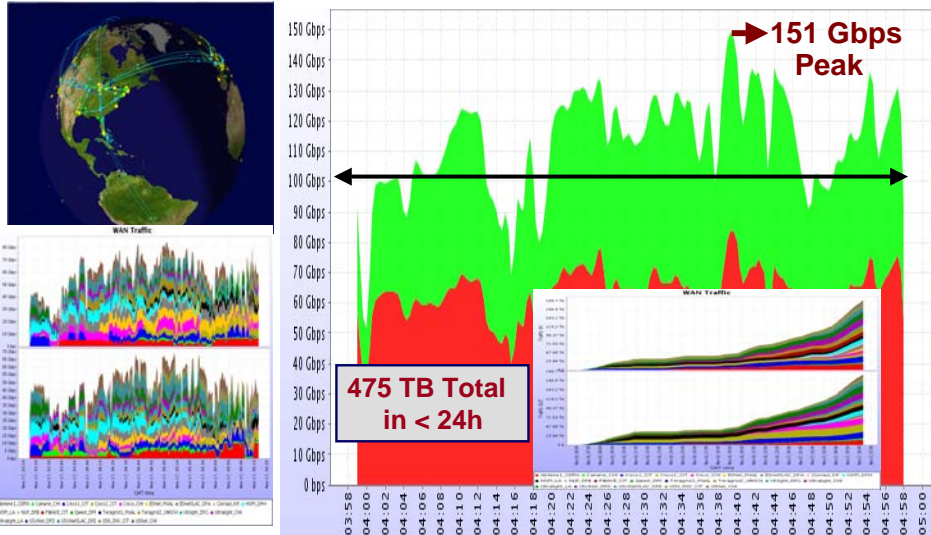
- Next generation Information System, with the network as an integrated, actively managed subsystem in a global Grid
- ◆ Hybrid network infrastructure: packet-switched + dynamic optical paths
- ◆ End-to-end monitoring; Realtime tracking and optimization; Dynamic bandwidth provisioning; *Agent-based services spanning all layers.*

SC|05 Ultralight in Bandwidth Challenge (Seattle, Nov 2005)



- We previewed the global-scale data analysis of the LHC Era
Using a realistic mixture of streams:
 - * Organized transfer of multi-TB event datasets; plus
 - * Numerous smaller flows of physics data that absorb the remaining capacity
- We used Twenty Two [*] 10 Gbps waves to carry bidirectional traffic between Fermilab, Caltech, SLAC, BNL, CERN and other partner Grid sites including:
Michigan, Florida, Manchester, Rio de Janeiro (UERJ) and São Paulo (UNESP) in Brazil, Korea (KNU), and Japan (KEK)

Bandwidth Challenge at SC2005



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SC|05 Bandwidth Challenge



• RESULTS

- 151 Gbps peak, 100+ Gbps of throughput sustained for hours: 475 Terabytes of physics data transported in < 24 hours
 - 131 Gbps measured by SCInet BWC team on 17 of our waves
 - Sustained rate of 100+ Gbps translates to > 1 Petabyte per day
- Linux kernel optimized for TCP-based protocols, including Caltech's FAST
- Surpassing our previous SC2004 BWC Record of 101 Gbps

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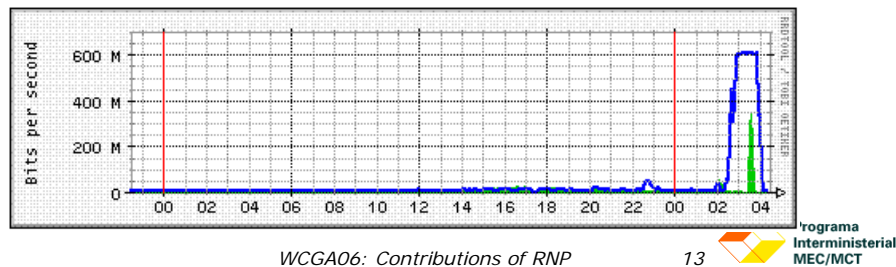
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SC2005 Bandwidth Challenge - Brazilian participation



- Ultralight also connects processing clusters in Rio (UERJ) and São Paulo (USP).
- SC2005: Backbone (Rio – S. Paulo) and international traffic generated by the cluster in Rio de Janeiro was 600 Mbps.



EGEE: Enabling Grids for E-science in Europe (slides adapted from F. Gagliardi)



- The EGEE project is funded by the European Commission and aims to build on recent advances in grid technology and develop a service grid infrastructure in Europe which is available to scientists 24 hours-a-day
- References:
 - www.realitygrid.org/workshop-2004/presentations/gagliardi.ppt
 - public website:
<http://public.eu-egee.org/>
 - technical website:
<http://egee-intranet.web.cern.ch/egee-intranet/>

What is EGEE?



- EGEE is a seamless Grid infrastructure for the support of scientific research, which:
 - integrates current national, regional and thematic Grid efforts, especially in HEP (High Energy Physics)
 - provides researchers in academia and industry with round-the-clock access to major computing resources, independent of geographic location
- 70 leading institutions in 27 countries, federated in regional Grids
- 32 M Euros EU funding (2004-5), O(100 M) total budget
- an ultimate combined capacity of over 20,000 CPUs (the largest international Grid infrastructure ever assembled)
- ~ 300 persons



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EGEE Infrastructure



- Access to networking services provided by **GEANT** and the **NRENs**
- Production Service:
 - in place (based on HEP LCG-2)
 - for production applications
 - MUST run reliably, runs only proven stable, debugged middleware and services
 - Will continue adding new sites in EGEE federations
- Pre-production Service:
 - For middleware re-engineering
- Certification and Training/Demo testbeds



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EELA: E–infrastructure shared between Europe and Latin America



Take advantage of:

- network development (RedCLARA, GEANT)
- EGEE Project

Extend EGEE Grid technology and infrastructure to LA

Project approved 2005 (22 partners, 2.5 MEuros budget)

Execution: Jan 2006-Dec 2007.



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EELA: Objectives



- Set up an interoperable infrastructure
- Identify applications on scientific research between Europe and Latin America
- Encourage participation in new projects at national and international level
- Increase awareness on Grid computing
- Presentation here by Diego Carvalho (UFRJ)



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RNP involvement in EELA



- To provide grid-capable network infrastructure, it is necessary to support better than best-effort services
- RNP participates in
 - Providing connectivity to Brazilian partners in EELA
 - introducing advanced services in RNP backbone



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Conclusion



- RNP continues to extend and improve the networking infrastructure made available to R&E institutions throughout Brazil
- This provides support for grid computing, which is a natural ally for high performance networking, but is not limited to this
- Many opportunities for establishing partnerships

Thank you!
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