HPC and Cloud Computing:
A view from LNCC

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Executive Secretary of SINAPAD

Laboratório Nacional de Computação Científica

SINAPAD

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Agenda

- About LNCC

- About SINAPAD

- HPC in Brazil: Growing pains

- Scientific clouds: Challenges and opportunities

- Some cloud(-like) developments in (or involving) LNCC/SINAPAD

About LNCC

- National Laboratory for Scientific Computing

  - Petrópolis (~70km from Rio)

- MCTI Research Unit

- ~45 researchers in **Computer Science**, **Applied Maths**, **Computational Mechanics**, and **Systems and Control**

 - MSc and DSc **multidisciplinary** programs in Computational Modeling
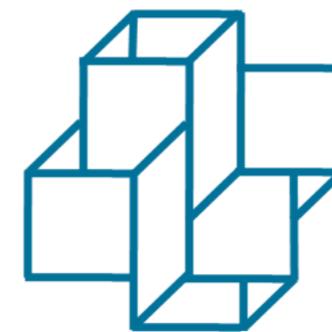
- +70 research projects (as of Oct/2011) on **Computational Biology**, **Reservoir and Prospection Simulations**, and **Computer-Aided Medicine**

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About SINAPAD

- Roles:

  - Provide **on-demand HPC services** to Brazilian academy and industry

  - Give support to the **development of HPC applications**

  - Foster **education** in HPC

  - Transfer **knowledge** in HPC

Source: redeIpê RNP

SINAPAD

- 10 Gbps
- 3 Gbps
- 200 Mbps
- 36 Mbps
- 20 Mbps

Installed CENAPADs
On acquisition

Internet Comercial (5 Gbps)
RedClara (1,45 Gbps)
Americas Light (20 Gbps)
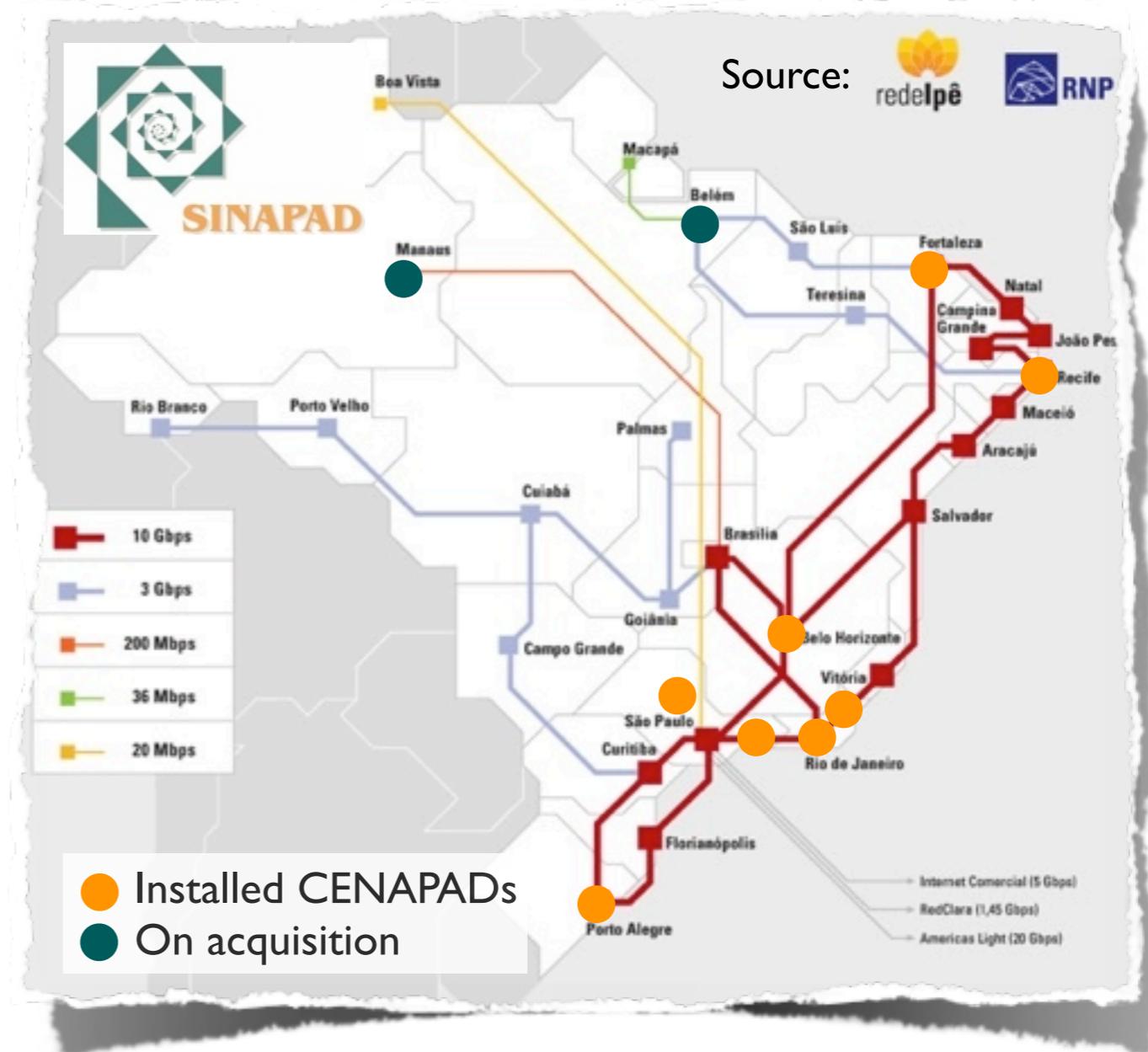
- General coordination: MCTI

  - Representation through LNCC

- Integration of running HPC centers

  - **CENAPADs**

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CENAPAD	Equipamento (#cores)	Desempenho teórico (TFlops)	Memória RAM (TBytes)	Capacidade de disco (TBytes)
COPPE	Sun Fire V20Z (4 CPUs) * SGI Altix 450 (64 CPU Cores) SGI Altix ICE 8200/8400LX/UV100 (672 CPU Cores + 896 GPU Cores)	0,017 0,384 8,33	0,004 0,128 1,3	0,072 3 32
CPTEC	Sun Fire V20Z (4 CPUs) *	0,017	0,004	0,072
LNCC	Sun Fire V20Z (4 CPUs) * Sun Blade X6250 (640 CPU Cores) SGI Altix XE340 (240 CPU Cores)	0,017 5 2,4	0,004 1,2 0,72	0,072 48 6
UFC	Sun Fire V20Z (8 CPUs) * Bull bullx (576 CPU Cores)	0,034 6,128	0,008 1,152	0,072 27
UFMG	Sun Fire V20Z (4 CPUs) * Bull NovaScale (878 CPU Cores)	0,017 9	0,004 1,7	0,072 45
UFPE	Bull NovaScale (576 CPU Cores)	6	1,1	11
UFRGS	Sun Fire V20Z (4 CPUs) * Sun Fire X2200M2/X4240/X4600M2 (516 CPU Cores + 1920 GPU Cores) SGI Altix ICE 8400LX (768 CPU cores)	0,017 12,94 7,07	0,004 1,2 2	0,072 60 16
UNICAMP	Sun Fire V20Z (4 CPUs) * SGI Altix 1350 (70 CPUs) SGI Altix 450/ICE 8400LX (560 CPU cores) IBM P750 (1280 CPU cores + 5376 GPU cores)	0,017 0,42 5,96 43,18	0,004 0,274 1,496 5,120	0,072 7 36 224
SINAPAD (storage)	NetApp - NFS distribuído – FAS3160 (1 unidade central) – FAS3140 (1 unidade de backup) – FAS2050C (8 unidades remotas)			720 302 832

6840 CPU Cores + 8192 GPU Cores
~106.6 TFlops / ~17.3 TBytes RAM / ~ 2.3 PBytes Storage

SINAPAD

terça-feira, 18 de outubro de 2011

HPC in Brazil: Growing pains

- Lack of seamless e-Infrastructures **integration**

  - Many "disconnected" (T)NGIs: SINAPAD, OurGrid, GISELA, GridUNESP, Galileo...

- Lack of e-Infrastructures **user orientation**

  - Narrow user interfaces for improved **usability** (Clouds!)

  - Resource **elasticity** for improved performance (Clouds!)

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Scientific Clouds:
Challenges and opportunities

- Enabling technology: **virtualization**

  - Portability

  - Availability (live migration)

  - Security (???)

  - Performance (???)

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Scientific Clouds:
Challenges and opportunities

- Security in virtualization: **simplicity is key**

  - "Minimalist" hypervisors (e.g. Xen):

    - Complex I/O functionality

  - Privileged I/O partitions in the hypervisor:

    - Isolate VMs from hosting OS, but not from other VMs (aka. cross-VM attacks)

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Scientific Clouds:
Challenges and opportunities

- Perf in virtualization: **isolation and non-indirection is key**

  - VM mem mgmt in paravirt-based hypervisors (e.g. Xen):

    - Larger latency due to additional indirection

      - Drepper (2008): ~17% degradation for large data in mem

  - I/O mgmt in OS-level virt (e.g. OpenVZ, VServer):

    - Qúetier et al (2006): much improved I/O

    - Lack of VM flexibility

  - One-queue-per-core devices (e.g. virtualized PCI bus)

    - Not readily available (as of Aug/2010)

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Scientific Clouds:
Challenges and opportunities

- Perf in virtualization (cont'd):

  - **Multi-tenancy**
    (a must-have in clouds?!)

  - Iakymchuk et al (2010):
    DGEMM in Amz EC2

    - CPU competition
      (cache space)

    - EC2 still unstable from a perf
      POV => difficult cost model

    - CCI in EC2 is gaining
      momentum...

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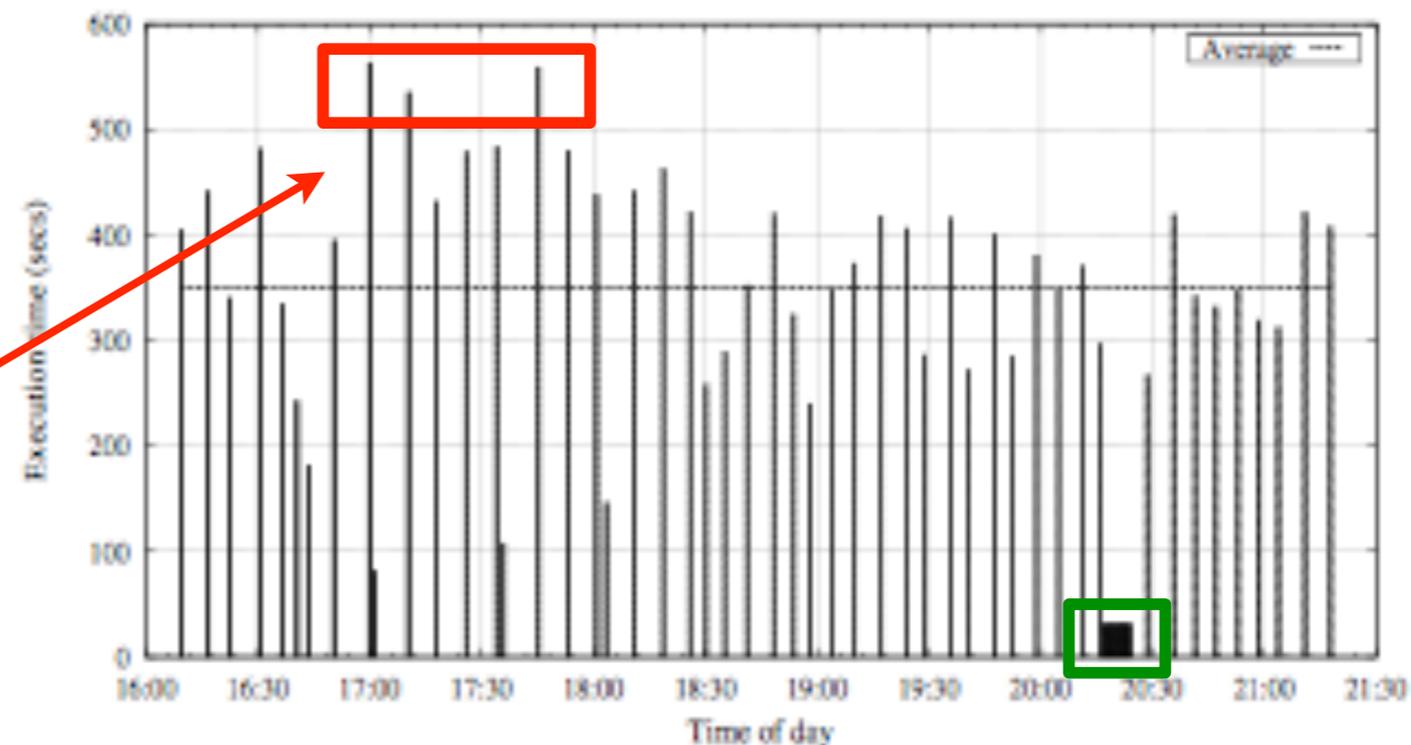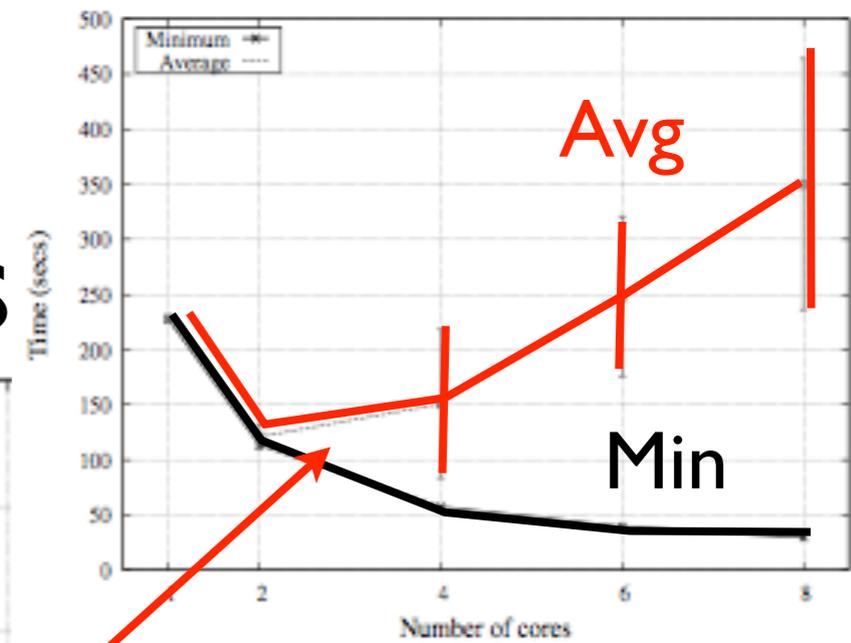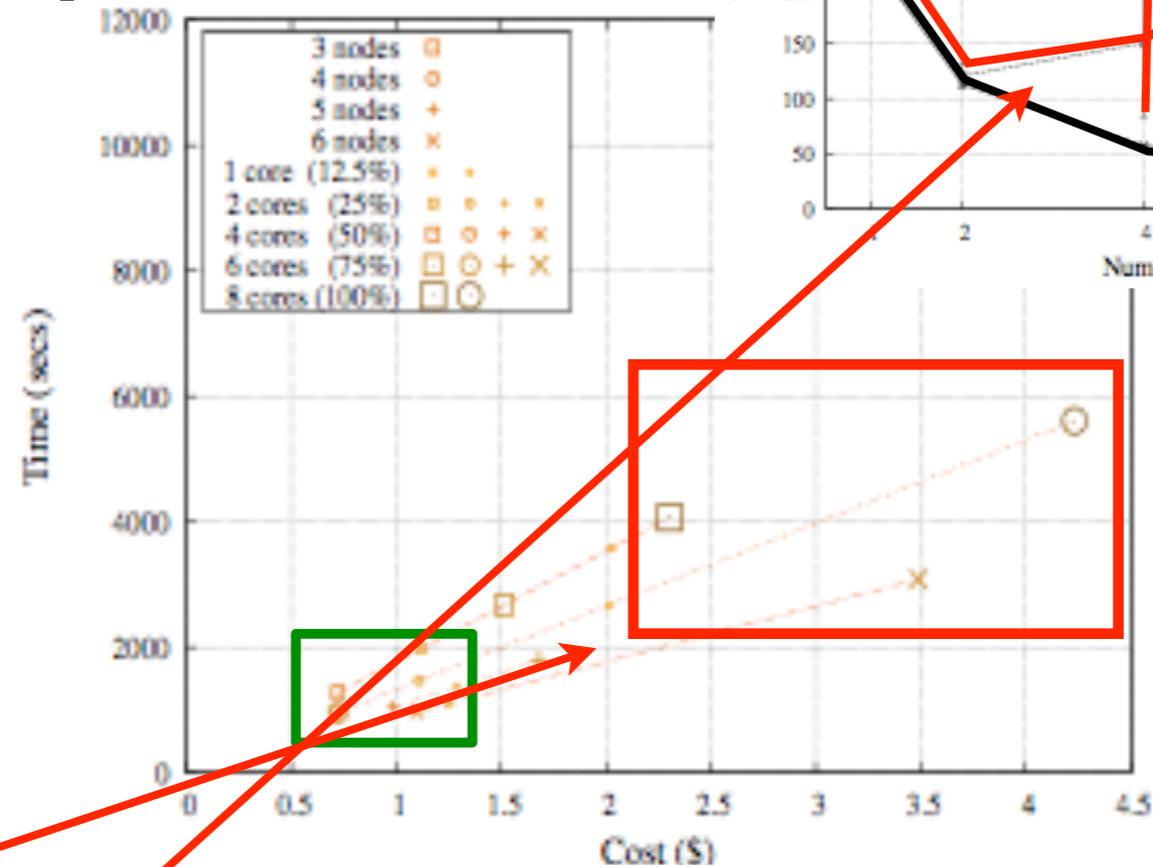
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February 14, 2011

The Cloud-Enabled Space Weather Platform

Everett Toews

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Bruce Maches

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Boosting Biology with High Performance Clouds

Some cloud(-like) developments in (or involving) LNCC/SINAPAD

- Seamless centers integration

- Web-based portals

- Just-in-Time clouds

- mc^2 PaaS->SaaS platform

- Neblina platform

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CENAPADs
(dedicated resources)

Data

Appls

Appls

Appls

Appls
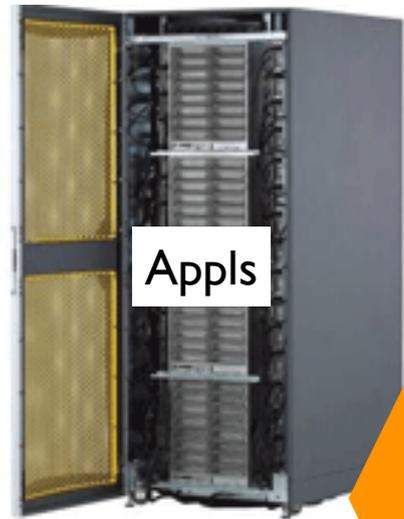
OurGrid
(opportunistic resources)

SINAPAD
data and applications bus
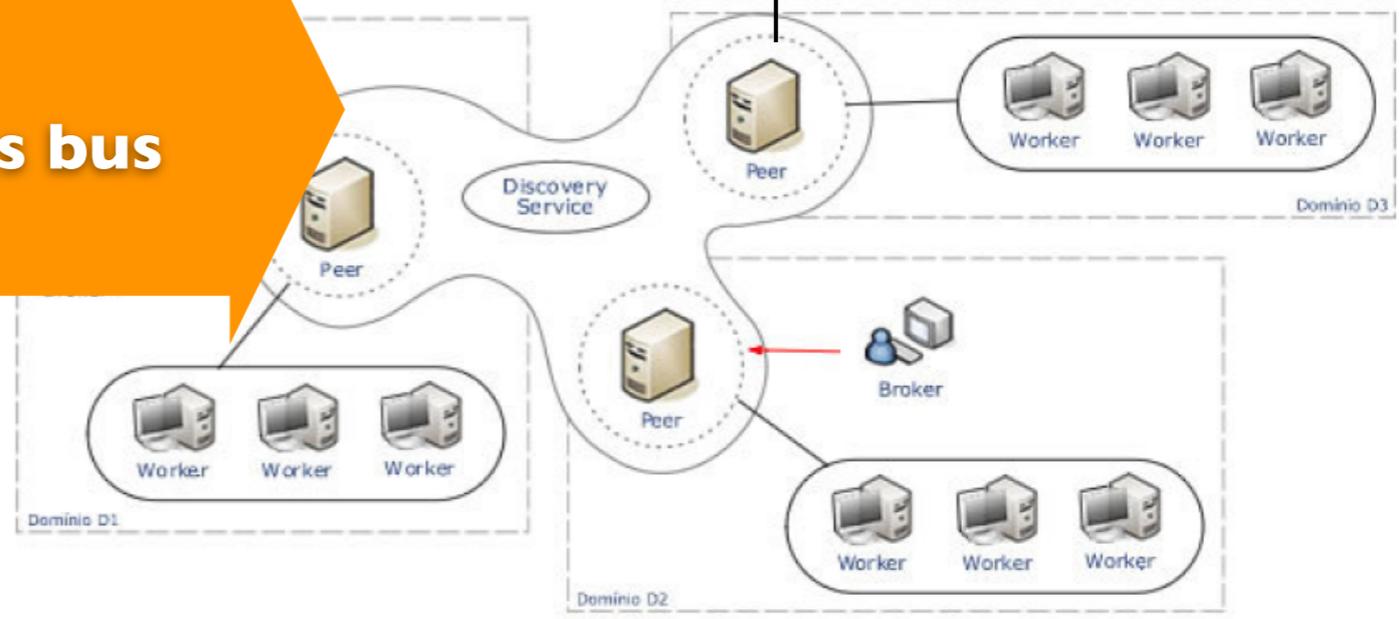
SINAPAD users
(Desktop/Web portals)
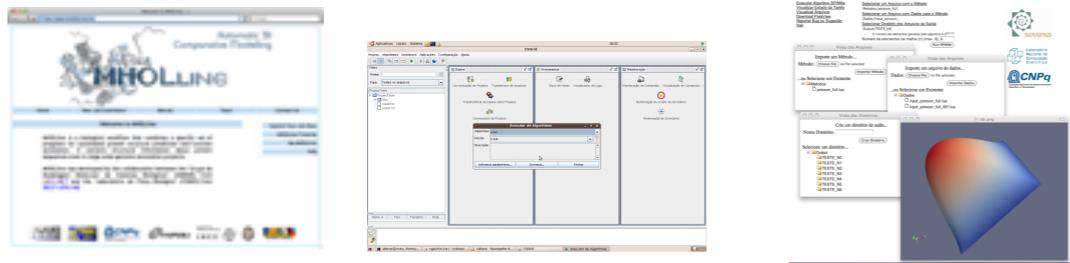
Seamless centers integration
(100% BR technology!!!)

SINAPAD

Laboratório
Nacional de
Computação
Científica

UFCG
SUPRA OMNES LUX LUCIS

PUC
RIO

Web-based portals

JiT Clouds

mc² platform

Neblina platform
(Bruno Schulze <schulze@lncc.br>)

Final thoughts

- There:

  - are demanding applications...

  - is (Brazilian!) middleware...

  - is some (fruitful!) collaboration with EU initiatives...

- But there isn't or there is only too few (to date):

  - User orientation

  - Technological/governance integration

- Clouds are a way to go, but provisioning and cost models need to evolve for a proper "HPCaaS"

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Thank you!!

Antônio Tadeu Azevedo Gomes <atagomes@lncc.br>

http://www.lncc.br

http://www.lncc.br/sinapad