Fundação para a Computação Científica Nacional

Infrastructures for e-Science
@
FCCN

MCTES MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

UMIC Agência para a Sociedade do Conhecimento

POS_CONHECIMENTO Programa Operacional Sociedade do Conhecimento

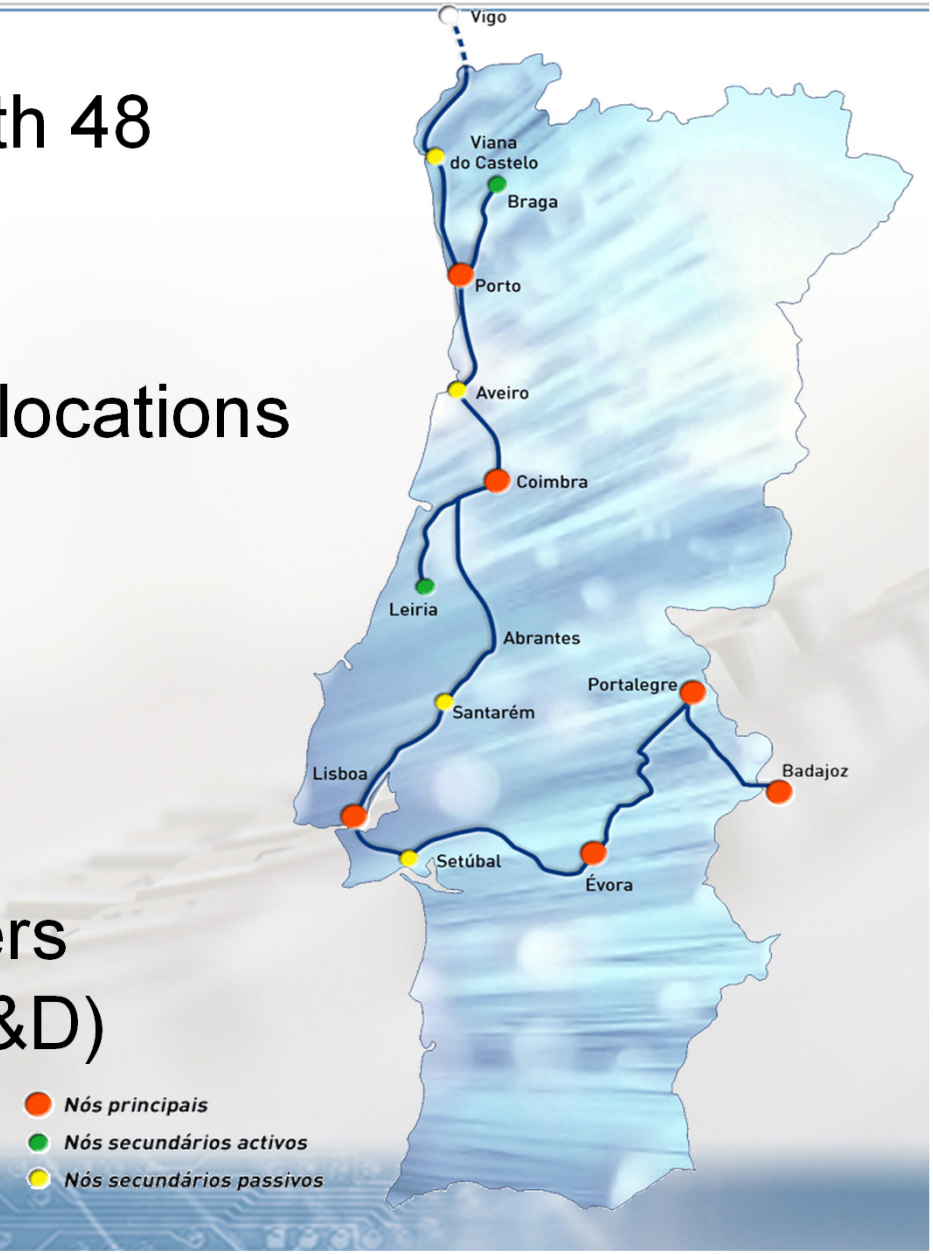
União Europeia

Fundação para a Computação Científica Nacional

RCTS – Optical Network

- 1.000Km optical cable with 48 fibres
  - 24 G-652, 24 G-655
- Connection to Spain in 2 locations
  - Fusions already done

- 17 optical nodes;
- 23 entities connected;
- Coverage of ~85% of users (Higher Education and R&D)



Fundação para a Computação Científica Nacional

RCTS – Optical Equipment

- Dynamic optical switching in main nodes (ROADM).
- Capacity of 40 lambdas at 10Gbit/s each
- Capacity to expand until 80 lambdas and suport of 40Gbit/s lamdbas
- In operation:
  - RCTS backbone
  - Connection RCTS-RedIRIS at Badajoz
  - Tier-II of LHC
  - Brain imagiology project (BING)

Fundação para a Computação Científica Nacional

Some Facts

- 10Gbps accesses in institutions connected to our fibre
  - 85% of our R&D community
  - Leased circuits for the others

- Full IPv4 and IPv6 network
  - Since 2003

- Disruptive experiments over lambdas
- 40 fibres available in FCCN owned cables

Fundação para a Computação Científica Nacional

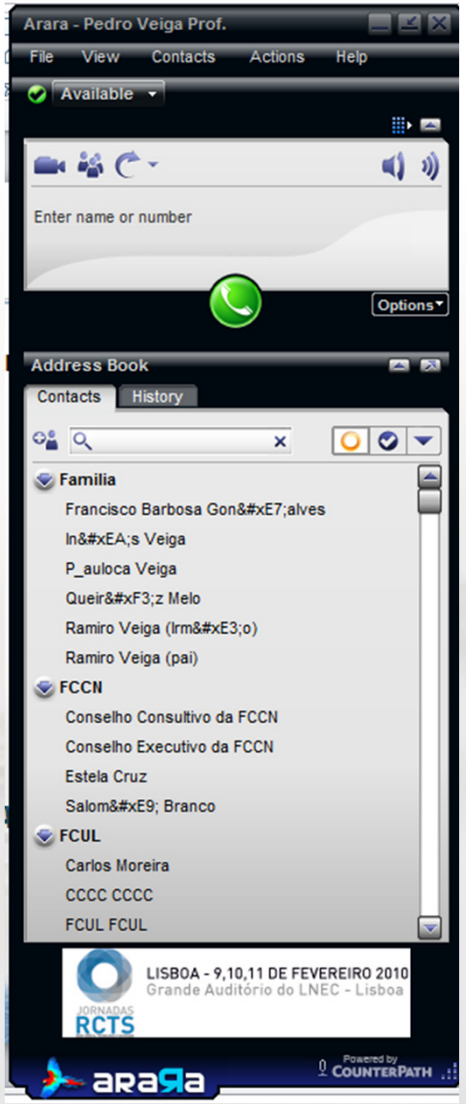
Some Facts

- Wireless networks
  - 100% coverage of Higher education institutions with Eduroam
  - Aprox. 400.000 potential users
- Videoconference
  - HD systems in all institutions
  - 2 Telepresence studios (FCCN and Univ. Porto)
- Video Services
  - Zappiens.pt
  - Broadcast and recording of Scientific events

Fundação para a Computação Científica Nacional

VoIP@RCTS

- Private VoIP network with 45 institutions
  - 32 higher education
  - 13 institutions of MCTES
  - Around 35.000 phone accesses
- VoIP Equipment
  - 500 servers
  - 206 PBXs involved
- Unified Communications Plataform – ***Arara***
- Fully integrated with RCTSaai



FCCN
Fundação para a Computação Científica Nacional

Other Activities of FCCN

- GigaPIX
  - Main Portuguese Internet eXchange

- Administration of .PT
  - Registry
  - Operation of the Primary nameserver (Lisbon) and one secondary (Porto)
  - 2 Root-servers
  - DNSSEC

Fundação para a Computação Científica Nacional

GRID Data Center

November 2010

History

- June 2007
  - Proposal by the Consortium
    - FCCN - Fundação para a Computação Científica Nacional (leading partner)
    - LIP - Laboratório de Instrumentação e Física Experimental de Partículas
    - LNEC - Laboratório Nacional de Engenharia Civil
  - **For**: building the “Portuguese Central Node for Grid Computing “
  - **Purpose**: Provide an infrastructure accessible to projects in the area of GRID computing

History

- 2008
  - Highly constrained deadlines – limited time to explore alternative technical solutions, like innovative cooling solutions, cogeneration, using renovable energy sources, etc.
  - Construction
    - Building
    - Infrastructures (electric, cooling, security, communications, racks)
  - Computers
    - 800 CPU-cores (currently 1.136 are installed)
    - Public tender won by IBM
  - Tape library and complementary systems (disk & computers)
    - 1 PB tape library (currently 2 PB)
    - Public tender won by HP
  - November – started operations
- 2009: additional, smaller, investments in infrastructures and computers

The Infrastructure

- Space: 200 square meters for racks (about 60 standard racks)
- Electric power
  - One dedicated power-transformer room with two 10KV / 230V transformers, of 1 MVA each
  - Total: 2 MVA installed on the power-transformer room
  - Traditional UPS with batteries
    - 800 KVA for non-critical loads – no protection from emergency power generator – heavy computing (GRID)
    - 400 KVA for critical loads – with protection from emergency power generator – control and comunications
  - Emergency power generator – Diesel – 800 kVA – autonomy – around 8 hours

The Infrastructure

- Cooling - chillers
  - Two 350 kW chillers with high COP - Coefficient of Performance
  - With free-cooling cycle to take advantage of cooler days in the winter (compressors shutdown)

The Infrastructure

- Cooling - Air Conditioners inside the room
  - 6 traditional 150 kW cooling units, that exchanges heat from air in the room, to water on the water circuit
  - The room is prepared to add Air Conditioner units directly in the aisle if necessary, for bigger heat densities
  - High raised floor, with 90 cm in height, for uniform air distribution
- Started operations on November 2008
  - No cases of general outage (failures)
  - 2 cases of planned shutdown of non-critical loads

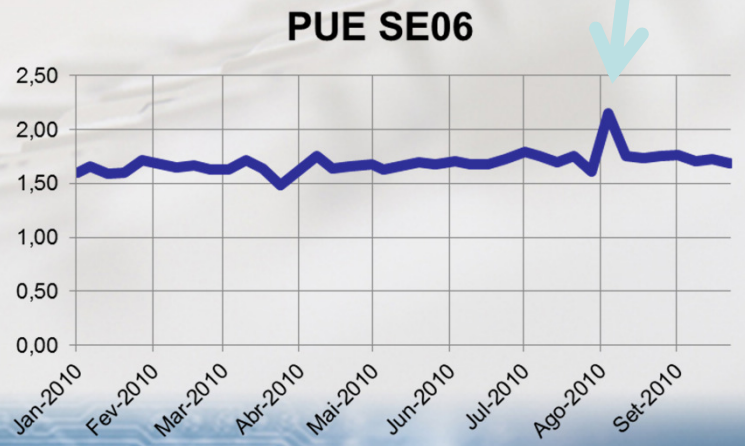
The Infrastructure

- Security
  - Early warning smoke detection system
  - Automatic fire supression system (Inergen gas)
  - Electronic access control (with cards)
  - Intrusion detection system
  - Video surveillance
  - Human security present on campus around the clock

The Infrastructure

- Monitoring e control
  - Currently processing data from several sources:
    - “dry-contacts” from infrastructure equipments like UPS, chillers, and others
    - Read registers from serial networks (RS-485), from power meters
    - IP network
  - Software:
    - Alerting system – Nagios
    - Graphing system – CACTI, that updates historical graphs every 5 minutes
- PUE - power usage effectiveness
  - 1,0 - best possible
  - 1,6 - current value on GRID Room
  - 2,5 – Industry average value

A problem with one chiller is responsable for this spike, in August



The Infrastructure

- Communications
  - Room is server by a fiber-optic cable ring
  - Currently using 10 Gbps channels
  - Direct connection (few hundred meters) to RCTS' central network core, including external connections:
    - To GEANT
    - To GigaPIX

The Infrastructure

- Staffing
  - Internal staffing
  - That staff that coordinated the project and comissioned the infrastructure, is still available
  - One person from FCCN on call around the clock
- External contracts
  - Emergency generator
    - Tests every month
    - Corrective maintenance
  - UPS
    - Anual preventive maintenance
    - Corrective maintenance
  - Cooling - chillers and air conditioners
    - Preventive maintenance every 3 months
    - Corrective maintenance

Capacity

- Free capacity - rough values
  - Power for more computers now
    - **200 kW**, considering cooling capacity with chiller redundancy
      - Solution (future): install another chiller and emergency generator
    - 500 kW, considering cooling capacity without chiller redundancy
      - Consequence: In case of chiller failure or maintenance, some computers must be shutdown within a few minutes
  - Space for more computers now: **100 square meters**
    - Possible solution (future): extend the room to adjacent spaces
  - **More capacity is possible** with improvements. Hard limit: 2 MVA on the power transformer room.
  - For any given use, a more in depth analysis is necessary to find free capacity, due to continuinity requirements or others, power fragmentation of the distribution electric network, etc.