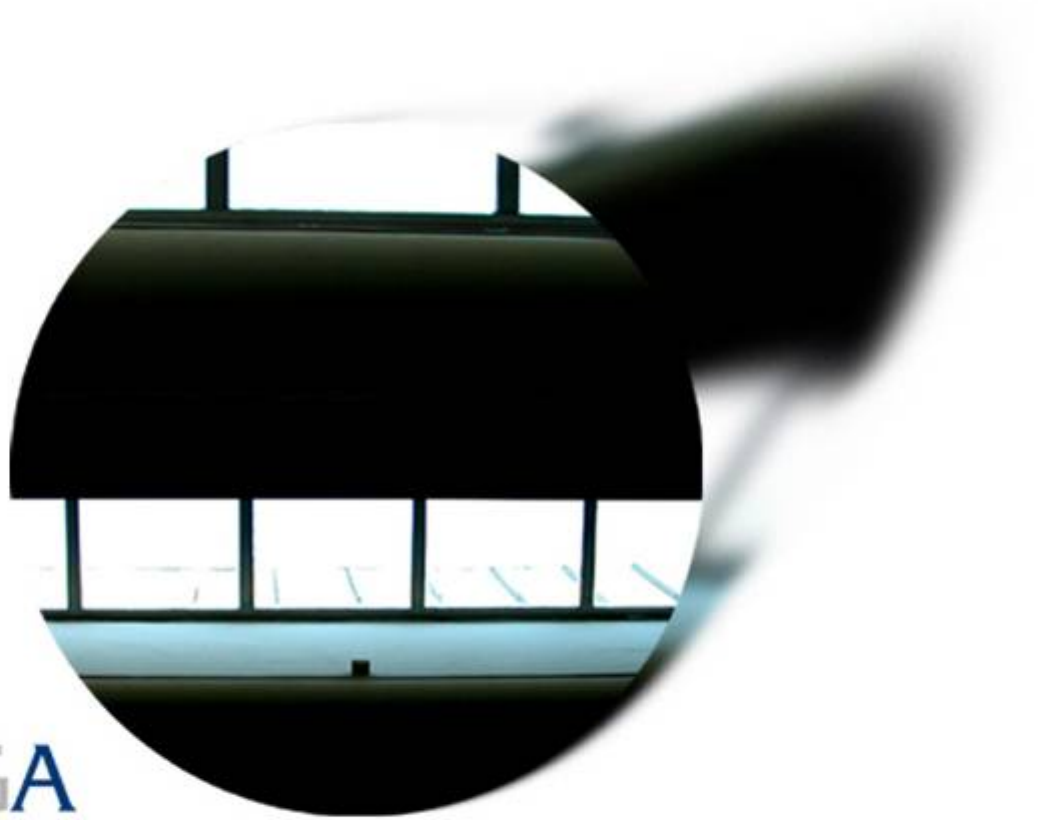
GRID TECHNOLOGIES AND RESEARCH AT CESGA



CESGA

Dr. Andrés Gómez Tato

Adm. Aplicaciones y Proyectos
agomez@cesga.es

CENTRO DE SUPERCOMPUTACIÓN DE GALICIA

CESGA

ESTABLISHED IN 1993

IN SANTIAGO DE COMPOSTELA [SPAIN]

Legal entities

- **Public Company**
- **Public Foundation**

Partners

- **Regional Government of Galicia** 70 %

Xunta de Galicia

- **National Research Council of Spain** 30 %

CSIC

CESGA

mission statement

- **To provide** high performance computing, communications resources and services to the scientific community of Galicia and to the National Research Council, as well as, to institutions and enterprises with R&D activity.

- **To promote** the use of new information and communication technologies applied to research within the scientific community of Galicia.

- **To become** a consolidated RTD Centre of Excellence serving as international scientific and technological reference in the field of computing science and numerical simulation.

CESGA

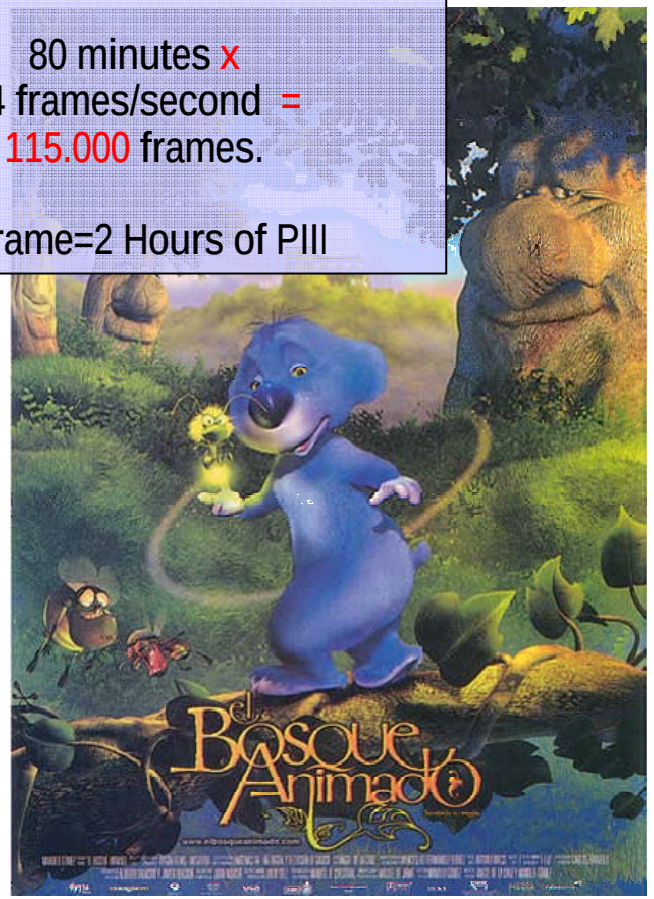
CESGA Services

- HPC y HTC
- User Data Storage
- Communications Network (only in Galicia)
- E-Learning Rooms (Access Grid)
- GIS
- e-Business

"O bosque animado". First 3D film in Europe (by DYGRA)

80 minutes x
24 frames/second =
115.000 frames.

1 Frame=2 Hours of PIII



CESGA

High Performance Computing Group

- Dr. Ignacio López Cabido (Physics)
- Dr. Andrés Gómez Tato (Physics)
- Dr. Carlos Fernández Sánchez (Physics)
- Dr. Javier López Cacheiro (Physics)
- Dr. José Carlos Mouriño Gallego (Computer Eng.)
- Dr. Aurelio Rodríguez López (Chemistry)

OUR POLICY

➲ **CESGA:**

- More than 40 technicians
- 22 active projects in Nov. 2006
- 35 ended projects in the last 5 years
- **ALWAYS in Collaboration**.

CESGA

13 years of history

1993

VP 2400

2,5 GFLOPS

1998

VPP 300

14,1 GFLOPS

AP 3000

12 GFLOPS

1999

HPC 4500

9,6 GFLOPS

STORAGETEK

51 TERABYTES

2001

SVG

9,9 GFLOPS

2002

HPC 320

64 GFLOPS

BEOWULF

16 GFLOPS

2003

SUPERDOME

768 GFLOPS

2004

SVG

512 GFLOPS

CESGA

VP-2400 AND Superdome 2003

1993: VP-2400 2,5 GFLOPS 0,5 GB RAM

Nº 1 in Spain and Nº 145 in the World

2003: SUPERDOME 768 GFLOPS 384 GB RAM

Nº 1 in Spain and Nº 227 in the World

XUNTA DE GALICIA
CONSELLERÍA DE INNOVACIÓN, INDUSTRIA E COMERCIO
Dirección Xeral de Investigación e Desenvolvemento

cofinanciado por FEDER Fondo Europeo de Desenvolvemento Rexional

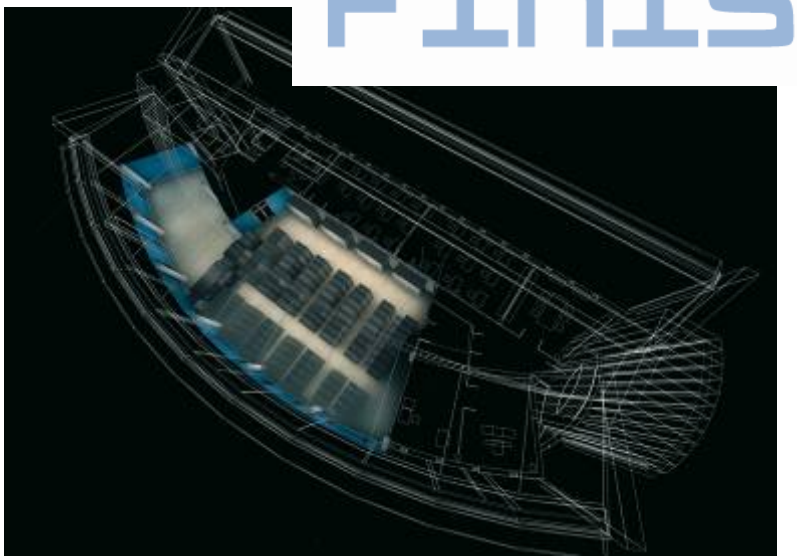
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS CSIC

MINISTERIO DE CIENCIA Y TECNOLOGÍA

CESGA

FinisTerrae 2007

FINISTERRAE



New Server HPC 2007

More than **16 TFLOPS** and **19TB RAM** Memory

Joint Venture of

XUNTA DE GALICIA
CONSELLERÍA DE INNOVACIÓN, INDUSTRIA E COMERCIO
Dirección Xeral de Investigación e Desenvolvemento

intel

hp invent

CESGA

CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS CSIC

CESGA

FINISTERRAE

SUPERCOMPUTING:

146 ccNUMA Nodes with **Itanium II** CPUs connected through a high efficiency INFINIBAND network

- 1 node: 128 cores, 1.024 GB memory
- 1 node: 128 CPUs, 384 GB memory
- 142 nodes: 16 cores, 128 GB memory
- 2 nodes: 4 cores, 4 GB memory for testing

DATA STORAGE:

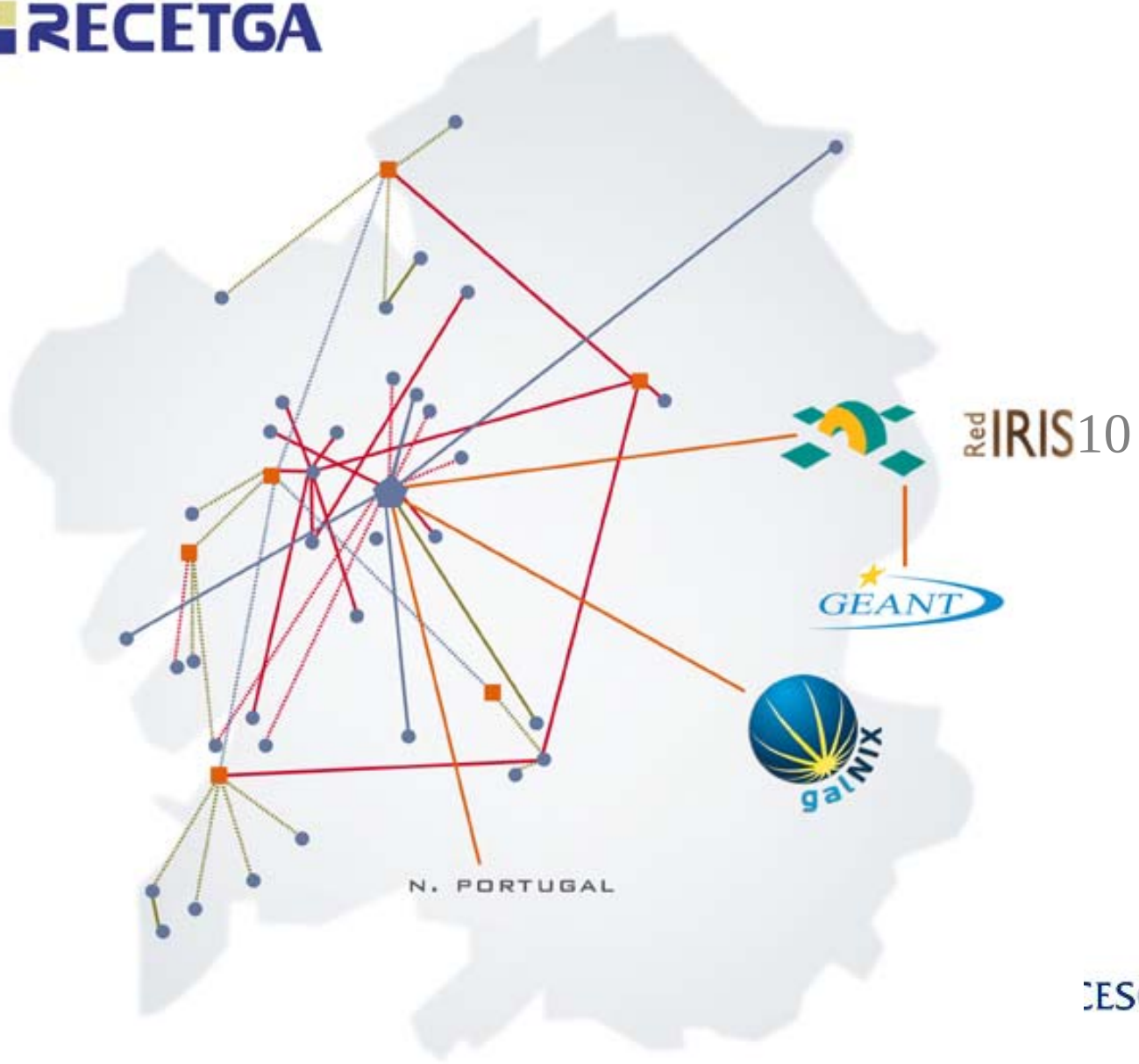
- 22 nodes with 44 cores for storage management
- 390 TB on disk
- 1 PB Robot on Tape Library

MORE TECHNICAL INFORMATION ON REQUEST

CESGA

GALICIAN' SCIENCE & TECHNOLOGY NETWORK

RECETGA



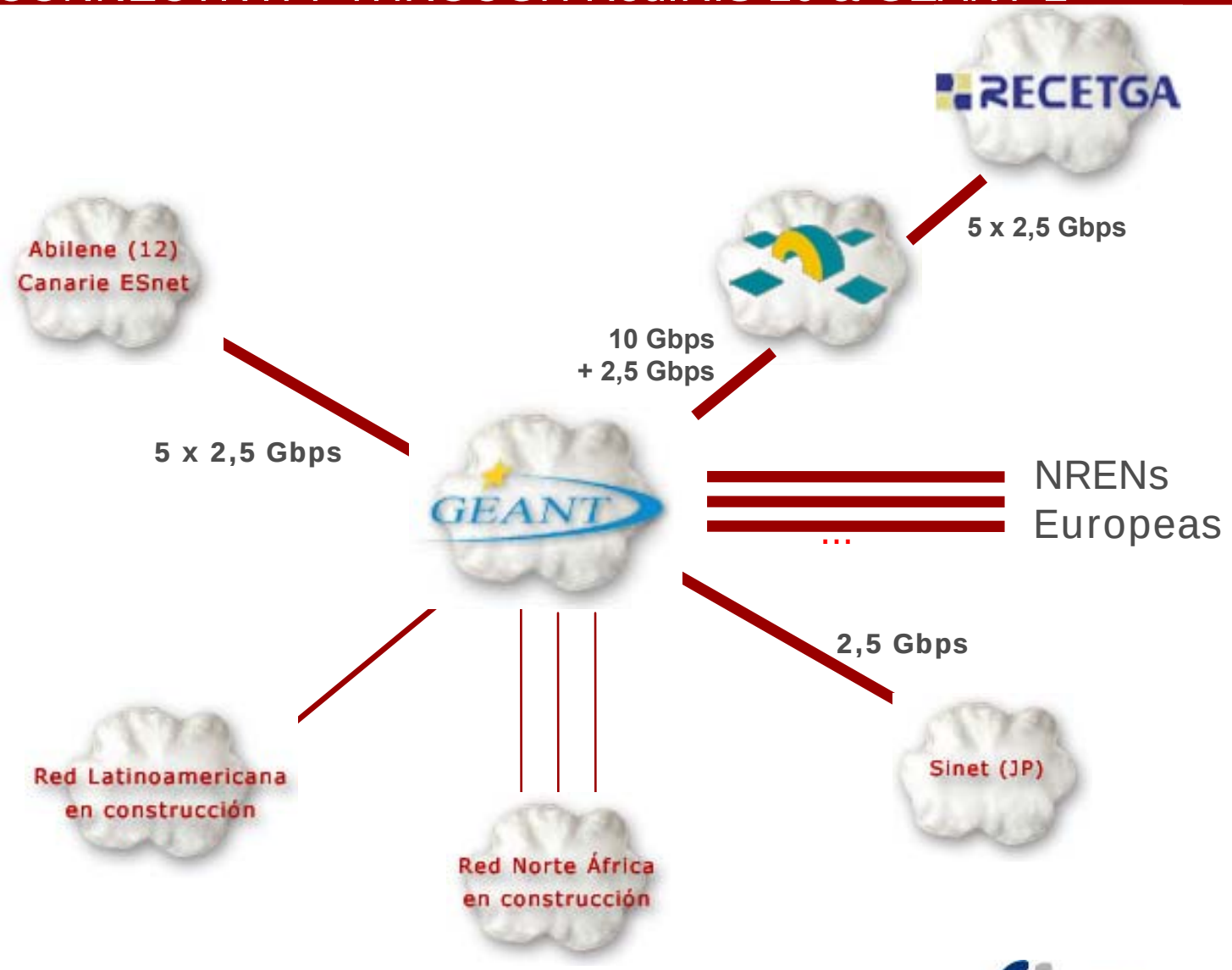
Red IRIS10

GEANT

galNIX

CESGA

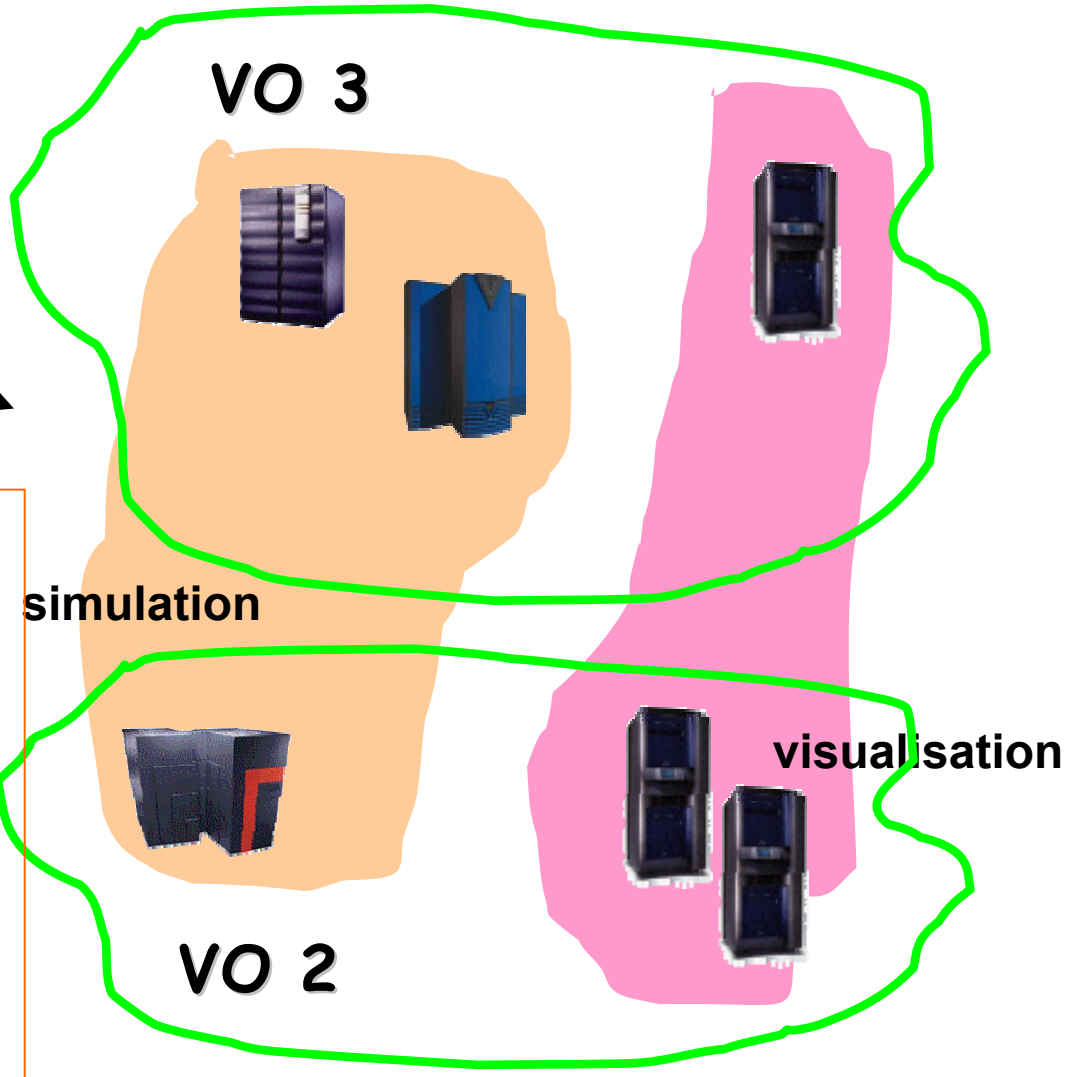
CONNECTIVITY THROUGH RedIRIS 10 & GÈANT-2



CESGA


GRID PROJECTS:
EGEE
Int.eu.Grid
CESGA-CESCA
E-IMRT
CESGA

What is a Grid??



Sharing Resources using a Common Authorization Framework based on PKI

CESGA

LARGEST GRID INITIATIVES in SPAIN (10/2006)

- EU DataGrid
- EU CrossGrid
- LCG (LHC Computing Grid)
- IRISGrid
- EGEE
- EGEE II
- DEISA
- Int.Eu.Grid
- IBERGrid Initiative
- Spanish Middleware Thematic Network
- EUMEDGrid
- EELA

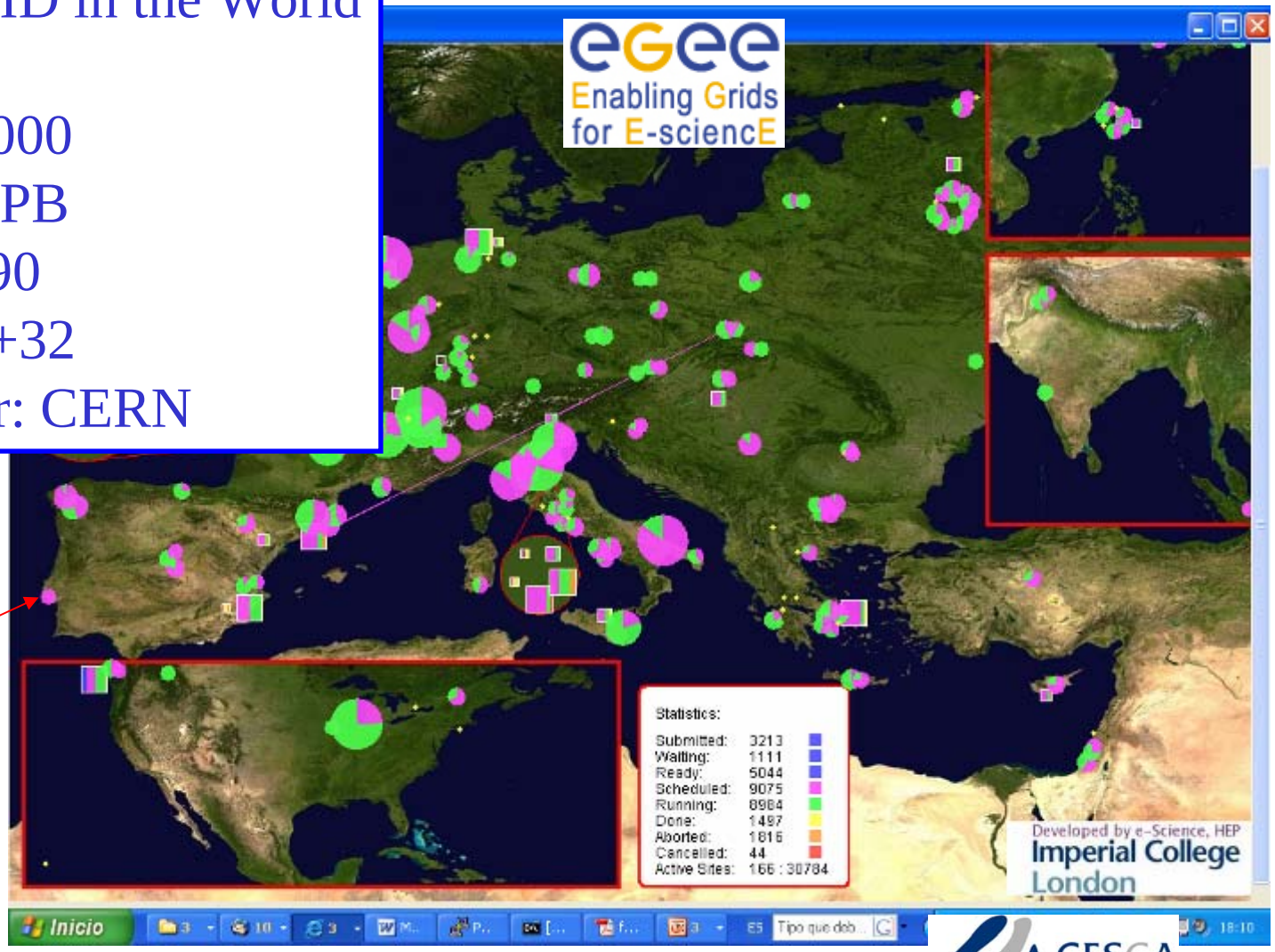
CESGA is/was partner in all projects marked in red

CESGA

EGEE

Largest GRID in the World

CPUs: +20000
Storage: +5PB
Partners: +90
Countries: +32
Coordinator: CERN



LIP

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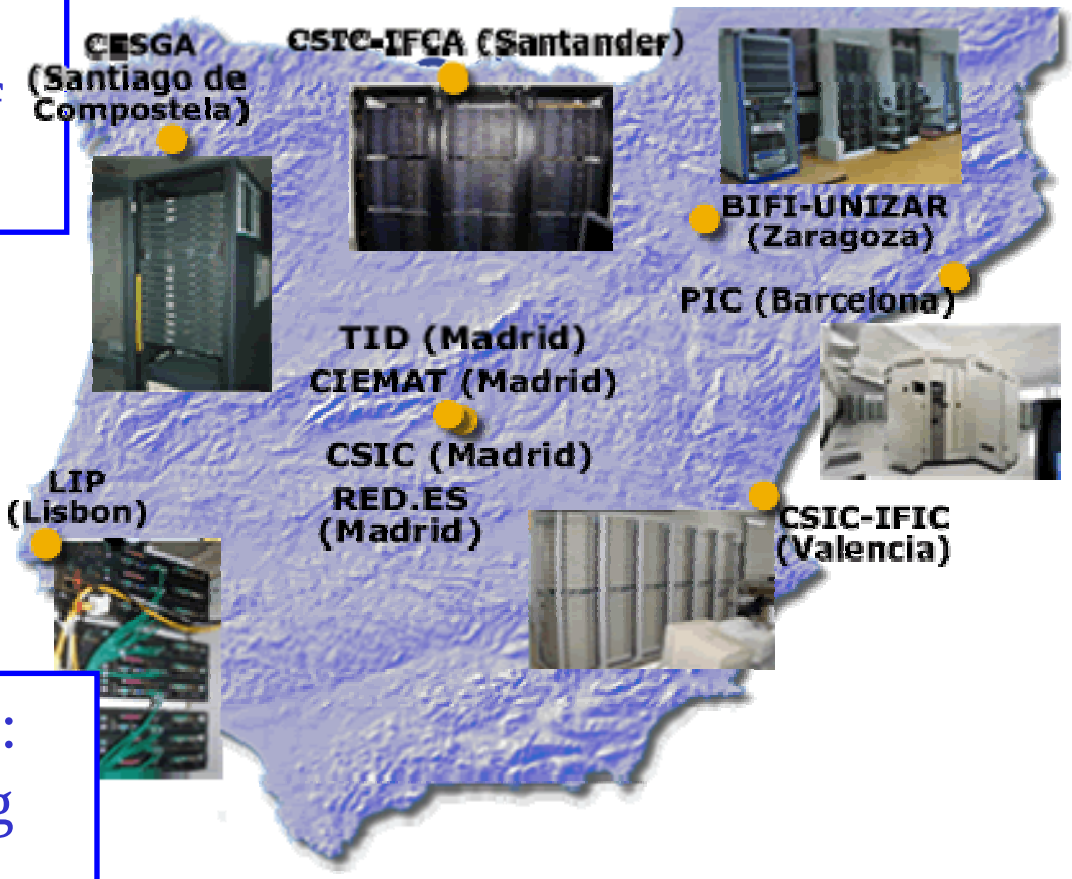
EGEE SW Federation

It is a federation joining the national GRID initiatives of Spain and Portugal



CESGA main contribution: Monitoring and accounting

http://www.egee.cesga.es/

http://grid.ifca.unican.es/egee-sa1-swe/

CESGA

The Interactive European Grid Project

"Interoperable production-level e-Infrastructure for demanding interactive applications to impact the daily work of researchers"

http://www.interactive-grid.eu

Instrument I3
Duration 2 years may ´06-april ´08

- Distributed Parallel (MPI) Interactive Computing
- Distributed Storage at the Tera level
- User Friendly Access
- Grid Interactive Desktop

because researchers need answers in seconds, not in hours.

CESGA

The Interactive European Grid Project

- the **int.eu.grid** project aims to ***change the way researchers can use the available e-Infrastructure***, exploiting the interactivity and collaboration possibilities
- **Researchers need to be convinced** that they can:
  - Transfer and process gigabytes of information in minutes
  - Foresee more complex algorithms on larger statistics, test and tune them, use more powerful visualization techniques
  - Collaborate across the network in a rewarding mode, from sharing information to discussing and presenting remotely through enhanced videoconference environments.

because researchers need answers in seconds, not in hours.

CESGA

The Interactive European Grid Project

*"To **deploy and operate a production-quality** Grid-empowered eInfrastructure oriented to **service** research communities supporting demanding interactive applications."*

- **Deployment of e-Infrastructure**
  - Oriented to interactive use
  - Site integration support
  - Grid operations service
- **Middleware for interactivity and MPI**
  - Adapt/integrate existing middleware
  - guarantee interoperability with EGEE
- **Provide a complete interactivity suite**
  - Desktop
  - roaming access
  - scheduler with prioritization services
  - complex visualization.
- **Support for interactive applications**:
  - setup of collaborative environment and VO
  - consideration of performance
  - interactivity and visualization requirements
  - identification and selection of research oriented interactive applications
- **Support remote collaboration activities:**
  - research, management, integration, training
- **Approach target research communities**
- **Provide security measures for interactivity**

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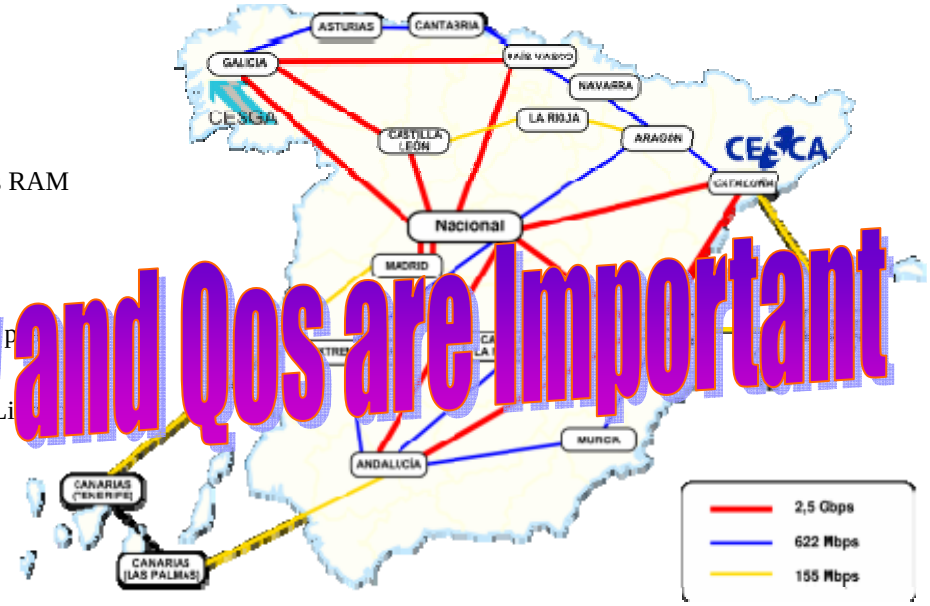
CESGA Experiences: a proof of the concept

Some time ago... Year 2003: Grid between 2 supercomputation centers CESGA/CESCA

Real application, a lot of memory required

- 2 HPC320
- 64 CPus
- 100 Gbytes RAM
- 4 TB disk



Latency and Qos are Important

- **Run OK**
- **Many initial tests needed (firewall, application start)**
- **QoS mechanism needed, high availability..**
- **The network behave very reasonably, no problem in that sense**

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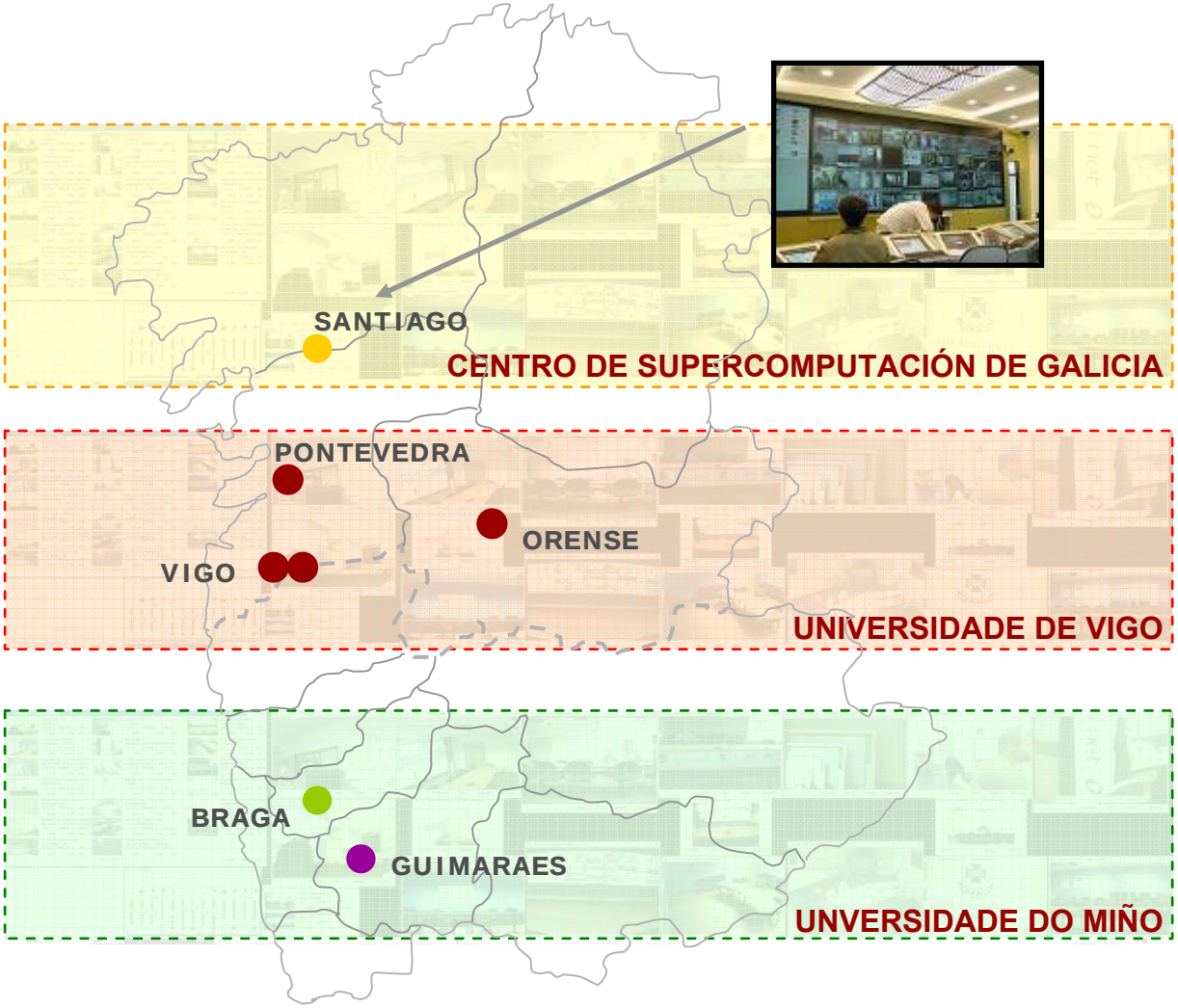
ACCESS GRIDS (TORGA.net)



- CCG
- Universidad de Miño
- Universidad de Vigo
- CESGA

CESGA




ACCESS GRID ROOM NETWORK



E-IMRT

A web-based tool for Monte Carlo optimization and verification of treatment plans

J. Pena[1], F. Gómez[1], D. González-Castaño[1], **A. Gómez[2],**

C. Fernández[2], J. C. Mouriño[2], F. J. González-Castaño[3],

D. A. Rodríguez-Silva[3], M. Pombar[4]

[1]Departamento de Física de Partículas, University of Santiago de Compostela, **Spain**

[2]Fundación Centro Tecnolóxico de Supercomputación de Galicia (CESGA), Santiago de Compostela, **Spain**

[3]Departamento de Ingeniería Telemática, University of Vigo, **Spain**

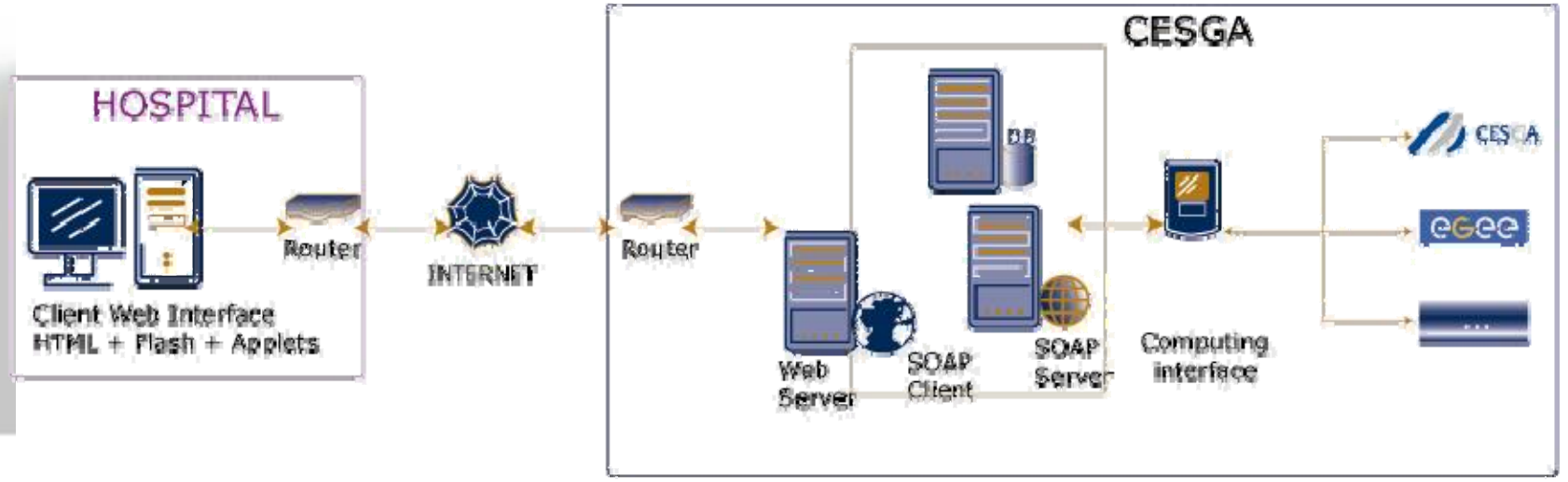
[4]Hospital Clínico Universitario de Santiago, Santiago de Compostela, **Spain**

Financed through Xunta de Galicia project PGIDT05SIN00101CT and partially by the *European Social Fund*

WHAT IS e-IMRT?

It is a project to develop a remote computational platform for treatment

VERIFICATION and OPTIMIZATION



What is NOT ?? **Commercial // TPS substitute**

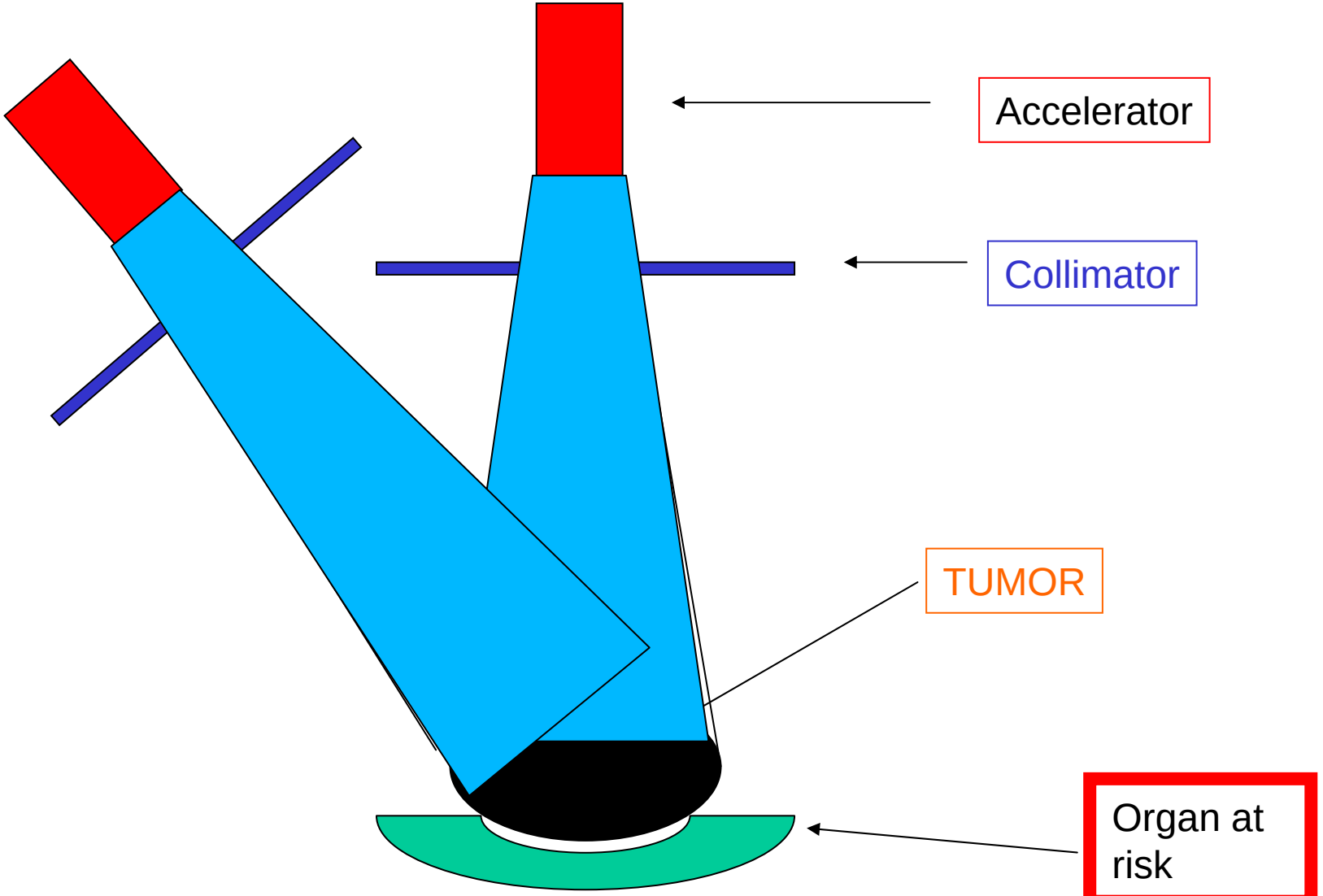
e-IMRT Components

- **Three major components (services):**
  - **Treatment VERIFICATION (Monte Carlo)**
  - **Treatment OPTIMIZATION (3DCRT & IMRT)**
  - **Treatment RESERVOIR: case studies and interesting treatments**

Under development !

- **General requirements**
  - **Simple, user friendly and algorithm-independent**
  - **Lowest possible human intervention**
  - **Run on low-end hardware & software (client side)**
  - **Anonimization of patient DICOM files**

WHAT IS CRT?



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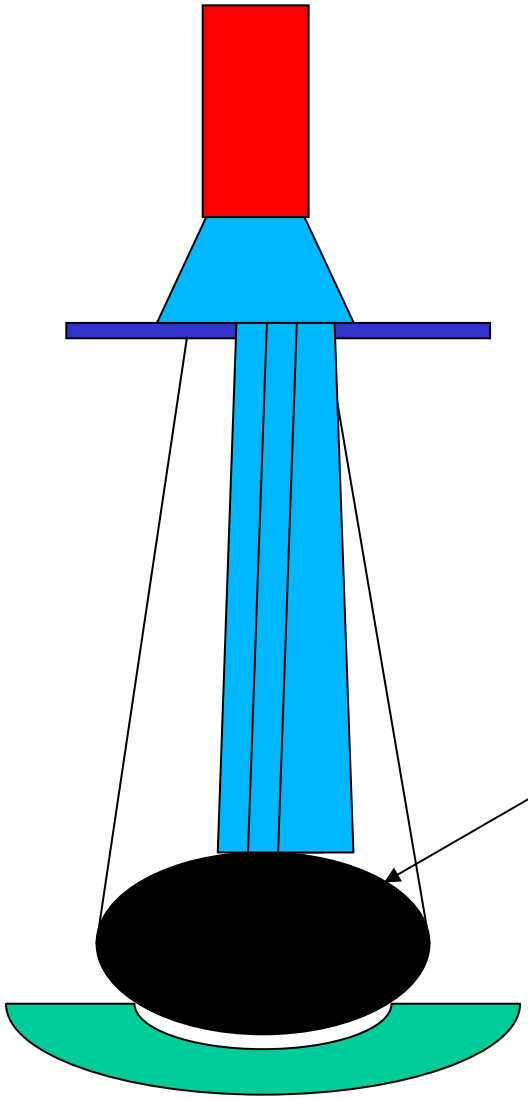
IMRT



TUMOR

Organ at risk

CESGA

Comparison between a TPS-calculated dose distribution and a Monte Carlo-calculated dose distribution for a certain beam arrangement

- **Dose comparison tools:**
  - Gamma maps (Normalized Distance in R^4)
  - Distance to agreement (DTA)
  - etc ...
- **Retrieval of:**
  - Monte Carlo dose distribution & DVHs

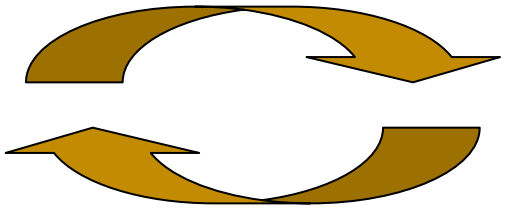
Workflow (I)

Pre-processing

Storage in databases
Hounsfield units → density
Couch removal

Data upload

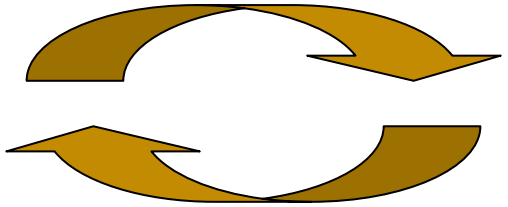
RTplan
RTstruct
RTdose
DICOM CT



Visualization

User identification

Approval



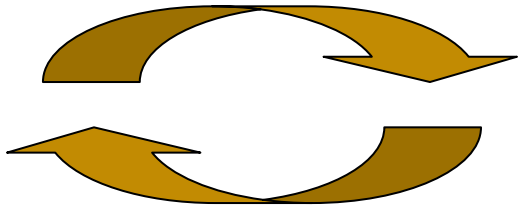
Logout

Off-line tool !!

Workflow (II)

After notification of completion:

Request of gamma map



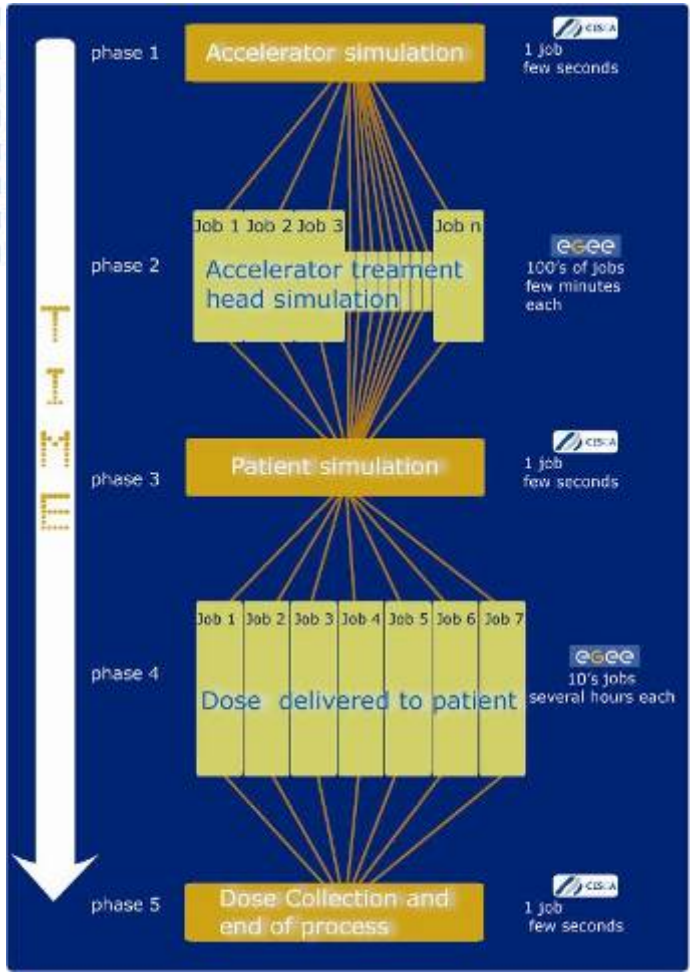
Dose & gamma maps

Data retrieval

Monte Carlo dose

Service-oriented (NOT product-oriented) platform !!

e-IMRT Treatment verification (III)



Linac HEAD simulation

CRT: 1 job per field

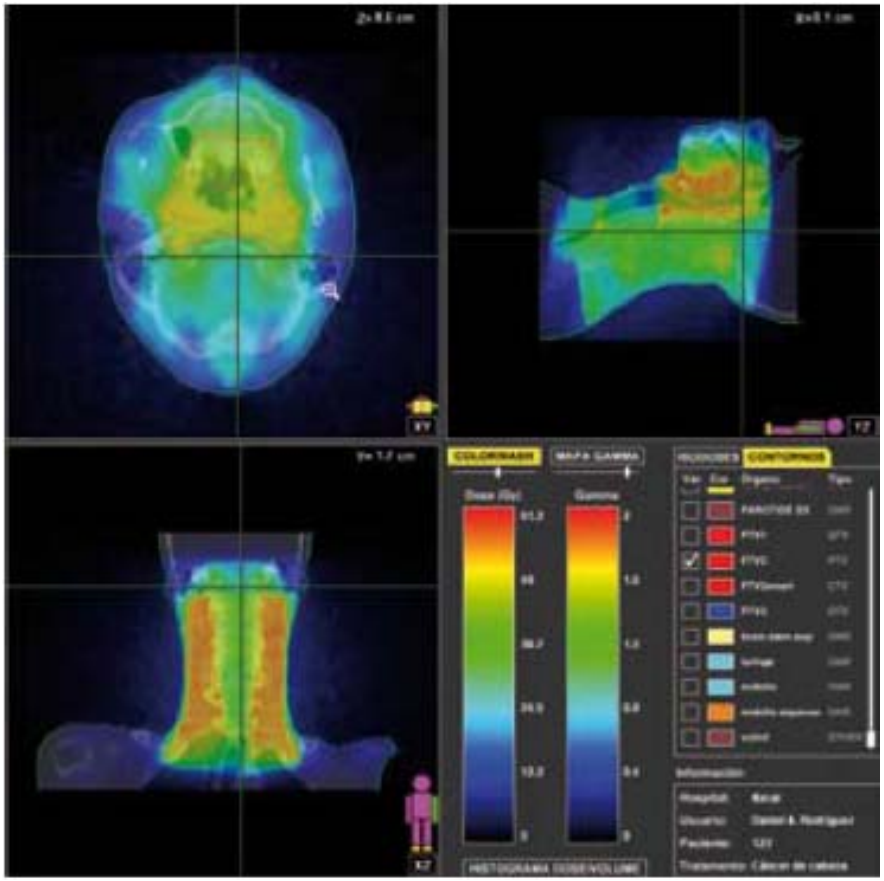
IMRT: 1 job per

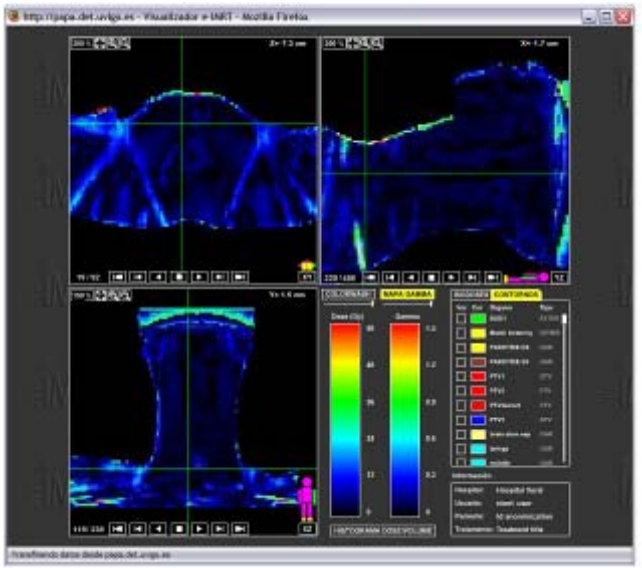
- Beamlet (step-and-shoot)
- Control point (dynamic)

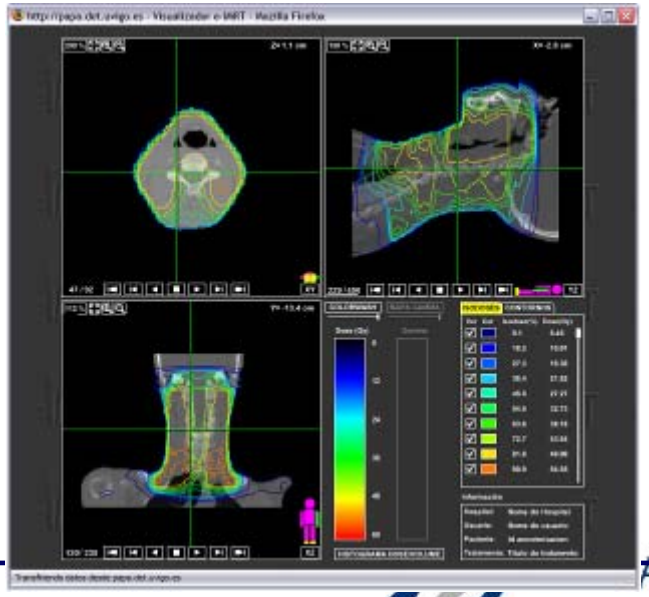
Phantom simulation

1 job per beam

e-IMRT Treatment Visualization(IV)







e-IMRT Optimization

- **Unconstrained optimization model derived from Wu & Mohan Med. Phys 27-4 2000**
  - **Quasi-Newton minimization.**
  - **Alternating Quasi-Newton stages with heuristics to vary the weights of the constraints → Getting multiple solutions.**
- **New optimization models welcome!**

Under development !

OTHER GRID PROJECTS AT CESGA

PROJECT	CESGA'S RESPONSIBILITY
Retelab Oceanographic Model Implementation	Researcher access management Design & implementation of a virtual lab
Irisgrid: Spanish National Grid Initiative	Executive Committee Member
INES: Spanish Technological Platform for Software & Services	Grid Technology Task Group Coordinator
Galigrid: Study & implementation of a Grid technology based computing platform	Design & implementation of the infrastructure
Producción Grid: Management of the production and use of resources in a Grid environment	Grid architecture definition. Design, development & implementation of GT3 based solution
LCG: LHC Computing Grid	Hosting & support Tier-2 USC

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OTHER ICT PROJECTS

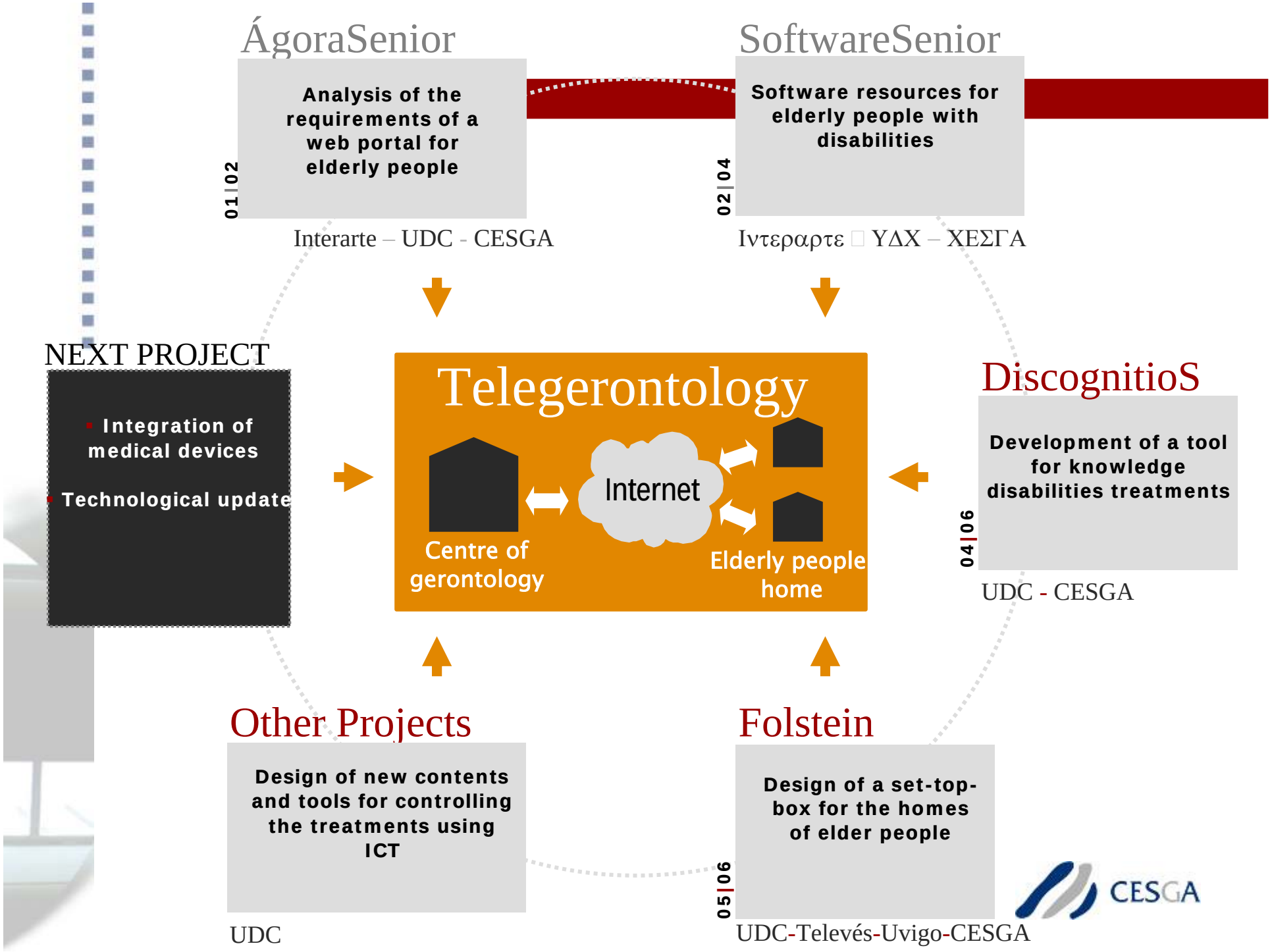
- FOLSTEIN
- ADVANCED SERVICES FOR VEHICHES

CESGA

Centro Gerontológico de Estancias Diurnas
La Milagrosa
Asociación Provincial de Pensionistas y Jubilados de A Coruña (UDP)

FINANCIADO POR: XUNTA DE GALICIA

TELEGERONTOLOGÍA PROTOTIPO II


ÁgoraSenior
Analysis of the requirements of a web portal for elderly people
01|02
Interarte – UDC - CESGA
SoftwareSenior
Software resources for elderly people with disabilities
02|04
Ιντεραρτε ΥΔΧ – ΧΕΣΓΑ
NEXT PROJECT
Integration of medical devices
Technological update
Telegerontology
Internet
Centre of gerontology
Elderly people home
DiscognitioS
Development of a tool for knowledge disabilities treatments
04|06
UDC - CESGA
Other Projects
Design of new contents and tools for controlling the treatments using ICT
UDC
Folstein
Design of a set-top-box for the homes of elder people
05|06
UDC-Televés-Uvigo-CESGA
CESGA

- It is a new resource for elderly people at home as evolution of classical telemedicine.

- Follows the basic principles of gerontology, TELEGERONTOLOGY allows “on line” **knowledge evaluations** and personalize treatments

- Using a usual phone line, TV and a special set-top-box developed by the project

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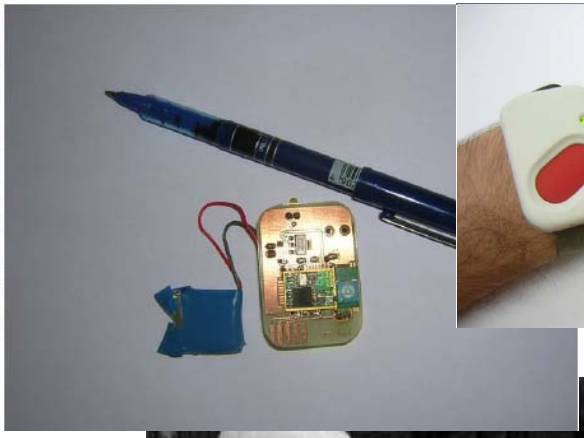
TELEALARM for ELDERLY PEOPLE in OUTDOORS and INDOORS



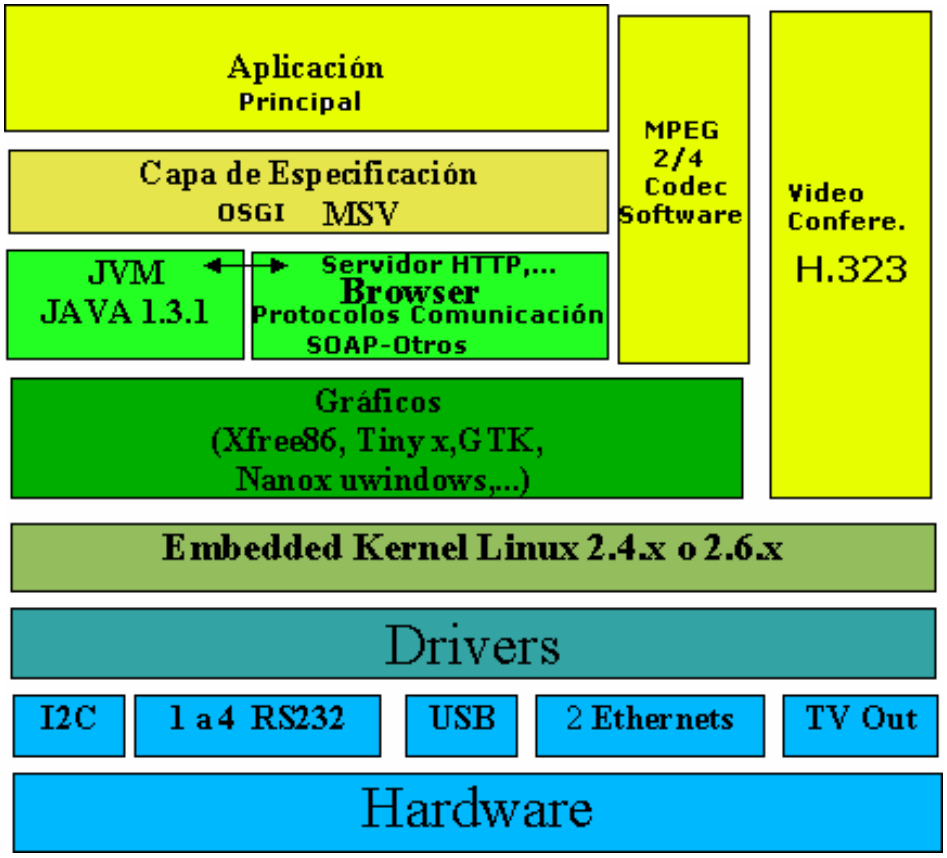
From outdoors to indoors

Mobile

Set-top-box

CESGA

SET-TOP-BOX ARCHITECTURE



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Interface designed for elderly people

CESGA

GEROPAD

- Allows the supression of barries between the user and the set-top-box.
- Ergonomic and easy to use
- Tested with elderly people
- Still a prototype.

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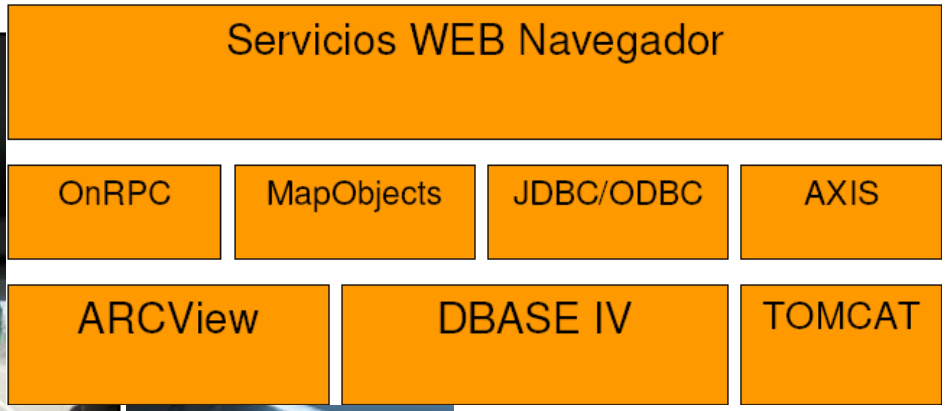
ADVANCED SERVICES FOR VEHICLES

- **CESGA.** Web services for off-board car route calculation.
- **OTHER: in-board computer, Digital TV, local positioning using WIFI**



UNIVERSIDAD DE VIGO

Televés

CTAG
Centro Tecnológico de Automoción de Galicia

CESGA