EUFORIA:
EU Fusion fOR ITER Applications

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Project objectives

Bringing a comprehensive framework and e-infrastructure to the fusion modelling community oriented to the development of ITER

- Deployment of Grid and HPC infrastructure
  - New VO
- Adaptation and Optimization of Fusion Codes
  - Platform oriented Grid and/or HPC
- Development of advanced tools for
  - Workflow management
  - Visualization tools
  - Data mining

EUFORIA - EU Fusion for ITER Applications

Fusion expertise:

Chalmers Univ. (Goteborg, Sweden)
CIEMAT (Madrid, Spain)
CEA (Cadarache, France)
Strasbourg Univ. (Strasbourg, France)
IPP (Munich, Germany)
Univ. Liubjana (Liubjana, Slovenia)
ENEA (Italy)

Grid computing expertise

FZK (Karlsruhe, Germany)
PSNC (Poznan, Poland)
CSIC (Santander, Spain)

High performance computing expertise:

BSC (Barcelona, Spain)
EPCC (Edinburgh, UK)
CSC (Helsinki, Finland)
ABO Akademie (Helsinki, Finland)

EUFORIA - EU Fusion for ITER Applications

14 member Institutes
3.65M€ over 36 months

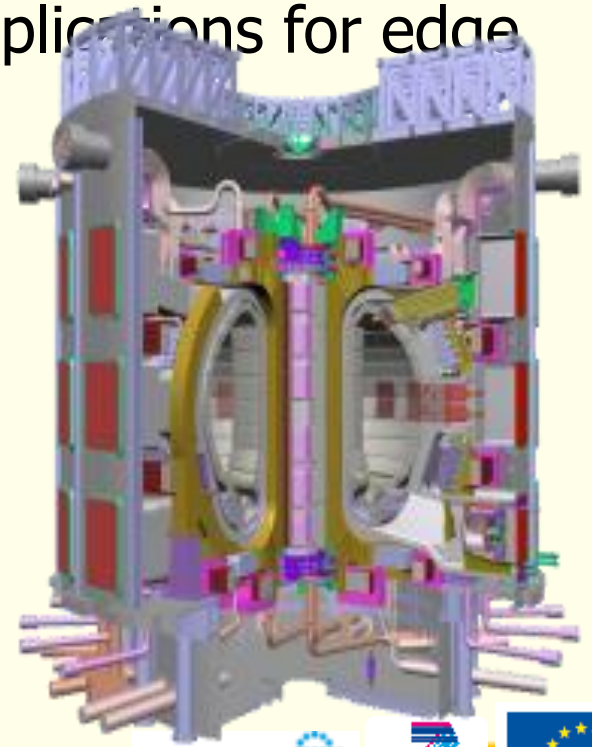
522pms covering

- Management
- Training
- Dissemination
- Grid and HPC infra-structure & support
- Code adaptation & optimization
-Workflows
-Visualization

Started January 2008
Funded under FP7
“Capacities” Programme

General Scenario

- Provide a comprehensive framework and infrastructure
  - for core and edge transport
  - turbulence simulation
- Link Grid and HPC to the fusion modelling community
- Enhance the modelling capabilities for ITER
- Simulate sized plasmas through a set of applications for edge and core transport modelling
- Dynamic coupling of codes
  - Each running on a different platform
  - Workflows organised by Workflow-engine (Kepler)



Structure of the Project

- **Networking activities**
  - NA1 – Management
  - NA2 – User Documentation and Training
  - NA3 – Dissemination
- **Service Activities - Infrastructure deployment and Operation**
  - SA1 – Grid Infrastructure
  - SA2 – HPC infrastructure
  - SA3 – User Support for HPC and Grid activities
- **Joint Research Activities**
  - JRA1 – Adaptation of codes and tools for Grid Infrastructure
  - JRA2 – Adaptation of codes and tools for HPC infrastructure
  - JAR3 – Physics Integration - Workflow orchestration tools
  - JRA4 –Visualization

Technology Components [1/2]

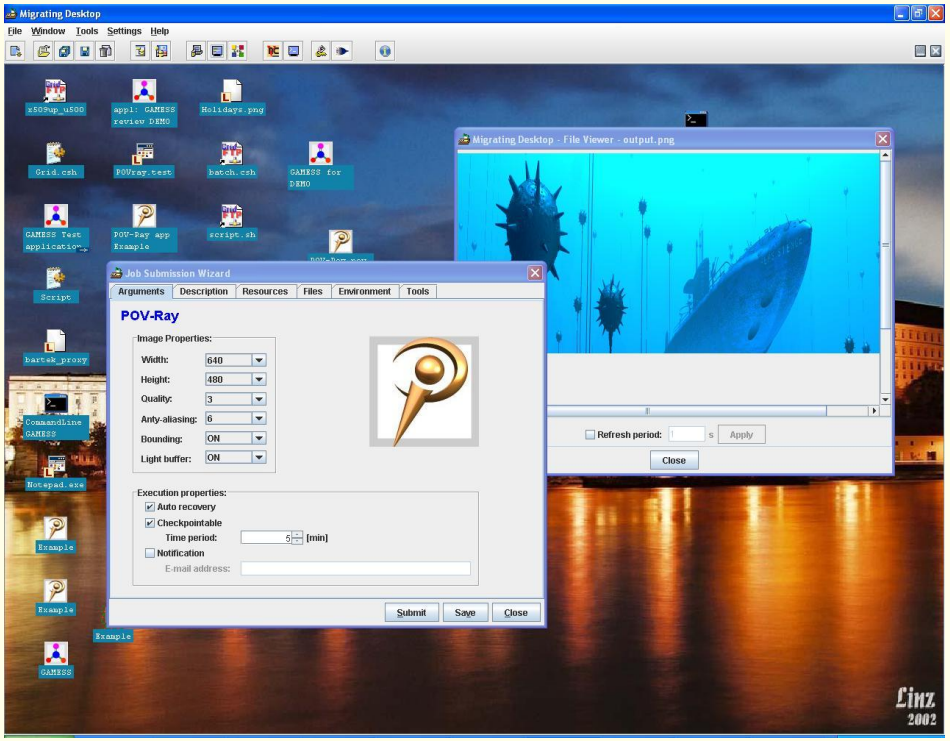
- Hardware
  - Provided via EGEE compatible grid resources
    - Sites: CSIC, FZK, CIEMAT, CHALMERS, ENEA
    - Parallel fusion codes of particular interest
  - HPC:
    - CSC, BSC and EPCC
    - Exploring DEISA2 for explorative HPC access

Technology Components [2/2]

- Middleware
  - gLite based
  - Interactive grid extensions (int.eu.grid)
    - Parallell jobs support (openMPI, pacxMPI)
    - Interactive jobs
    - F90 support
  - Vine Toolkit (UNICORE)
    - DEISA2 collaboration
- User Interfaces
  - Migrating desktop
  - Kepler Workflow
  - Commandline

Access Portal - Migrating Desktop

- An advanced graphical user interface that hides the complexity of the grid middleware
  - a flexible personalized working environment
  - independent of the user location,
  - scalable and portable
  - a single sign-on mechanism,
  - support for multiple grid infrastructure
- Used in other project (DORII aimed at exploring the Scientific Workflows)



MD is being adapted for EUFORIA use and will be extended to our HPC environment and visualization tools. Unicore and Vine Toolkit

Workflows

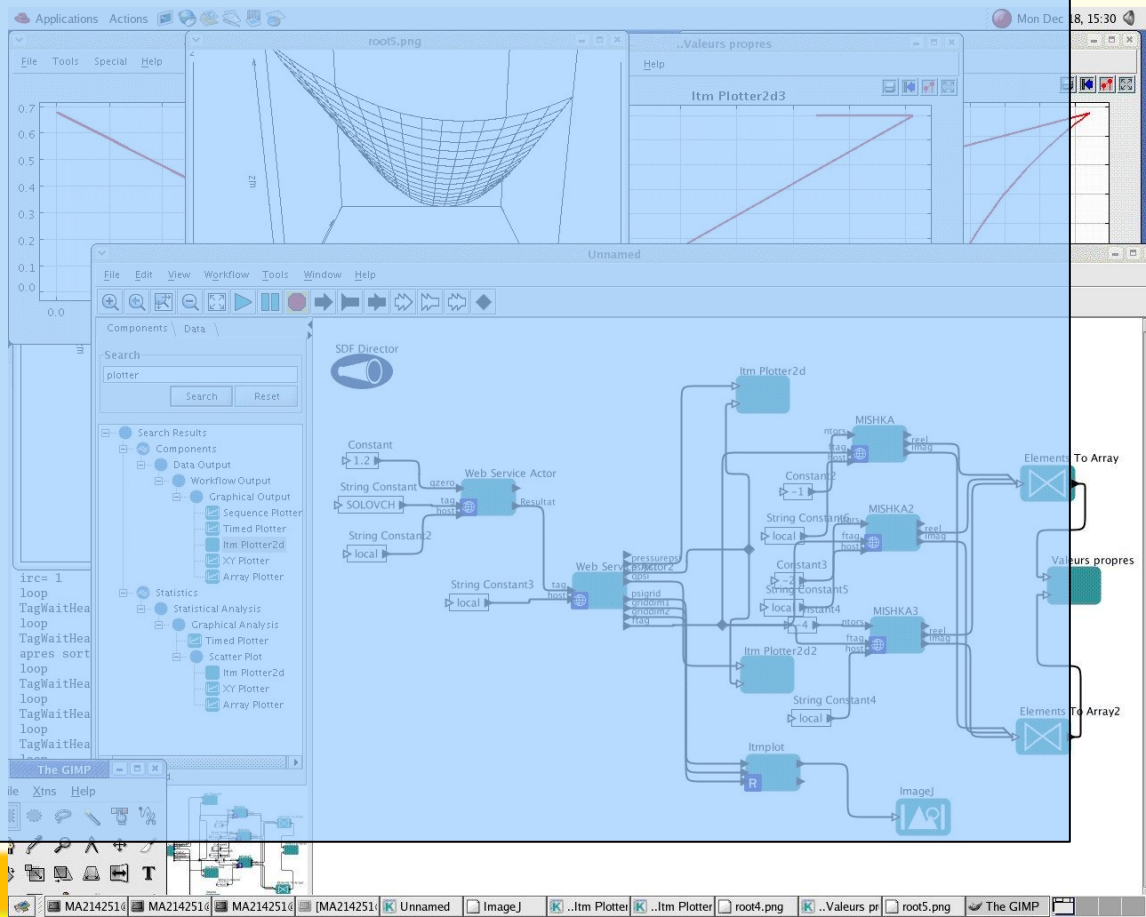
- The objective is to schedule jobs on the GRID and HPC infrastructures together with jobs running on other computing facilities.
  - launch and control jobs in a transparent manner for the users.
  - data communication: data transfers and visualizations are required at run time and to access the experimental and simulated data.
  - middleware connectivity for

    Kepler Workflow

    (java Library for gLite, HPC)
  - scheduler notification tools
  - Integration with EFDA

    ITM-TF tools (UAL –

    Universal Access Layer)



Fusion Infrastructure needs

Physics driven infrastructure needs:

- Physics and computational methodologies are rich and diverse in character: Identified needs for
  - Grid (serial) computing
  - **Grid (parallel) computing**
  - **High Performance Computing**
- Complex interactions –
  - dynamic deployment and "iterative" dependences requires advanced schedulers capable of mixing computations running on diverse resources
    - Work flow integration of grid middleware components

Infrastructure driven needs:

- Existing Grid infrastructure under-utilized within tokamak fusion community
  - Need improved access and training and help with adaptation of codes
- HPC not generally available to European Fusion Community as a whole! Future paths:
  - HPC-FF (100Tflop dedicated fusion HPC final approval stages, 2Q09)
  - IFERC (Broader Approach EU-JP agreement) 100Tflops sustained ~2011
  - PRACE association

Status and discussion

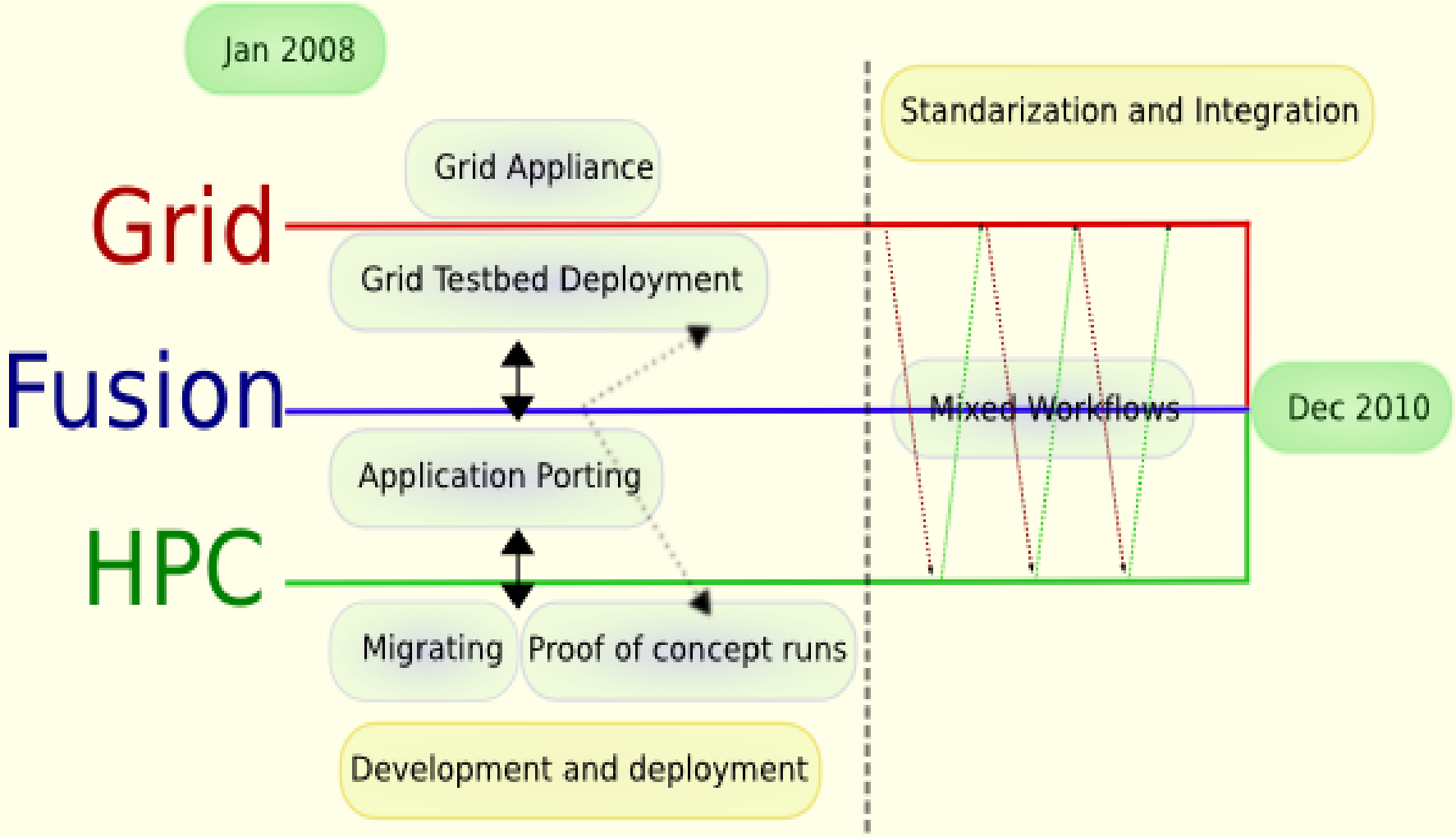
¼ of the funding period passed .... ¾ to go ...

- Software:
  - 4 codes selected for optimization on Grid
  - 6 codes running on high performance computers (incl. profiling)
  - Workflow engine Kepler: Grid and high performance computing access available

Next steps:

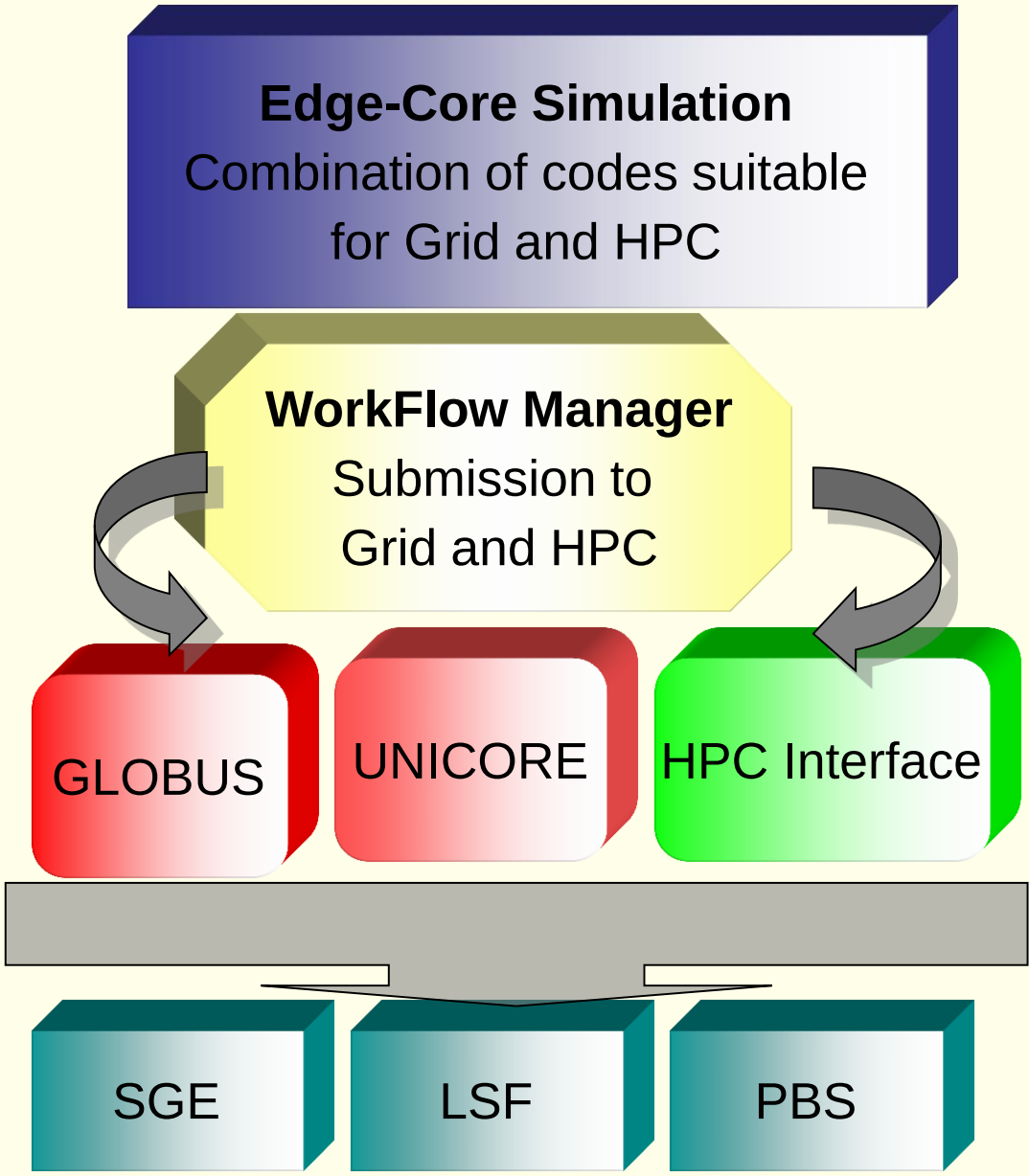
- Preparation of the codes for ITER simulations
- Preparing workflows

Work plan outline

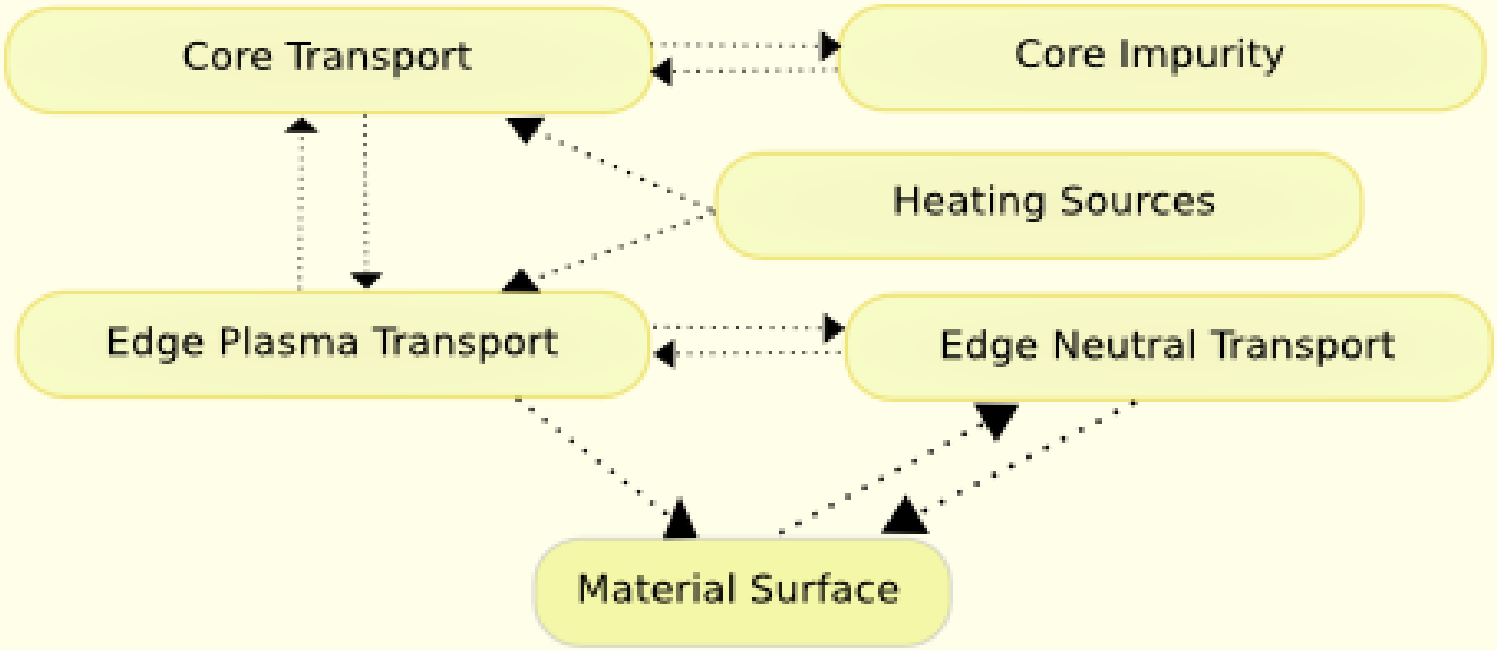


Standards related work

- **Adoption of Grid**
  - Virtualization of core services
  - Interoperation
- **User Services**
  - Data management
    - **Uniform access tools**
  - Membership handling
    - **Certified by EUGridPMA and run everywhere**
- **Complex Workflows**
  - Job submission
  - Resource Allocation
  - Data retrieval



Fusion Plasma Simulation



Stages of simulation

Summary

- 3.65M€, 36 months, 522 pm's
- Intended to boost fusion activities towards both HPC and grid computing
- "Edge and core turbulence and transport"
- Deployment of Grid and HPC infrastructure
  - EUFORIA Grid Testbed up and running
    ~ 1000 Cpucores and 2 TB of storage
  - EUFORIA HPC infrastructure range
    ~ 10 to 100Tflops facilities
  - Exploring DEISA2 for production runs and broader range ofarchitectures

- Adaptation and Optimization of Fusion Codes
  - Platform oriented Grid and/or HPC
  - First profiling and prioritisation of codes done
- Development of advanced tools for
  - Workflow management
  - Visualization tools
  - Data mining
  - Range of outreach and training activities

Missing Parts

- Omii europe fact sheet
- Architecture of Marcin
- Requirements to EGEE
  - MPI
  - Interactive CE

Summary

- **Goals for grid access**
  - **Seamless**
  - **Interactive**
  - **[illegible] matlab**

- We can
  - Use the grid from M[illegible]atlab / Fortran
  - Run simple sim[illegible]lations in our [illegible]frastructure
- We want to…
  - Use [illegible]al code
    - Cope with the data (20 GB in, 8 GB out)
  - Automatically send Matlab functions to the grid
  - Use LFC for data access
- **Actually we just want our software to run faster!**

Grid Computing – the dream

Idea: **Computer power <=> Electrical power**

From Electrical power grid => computational grid

- Across organisationsal domains / countries
- Transparent access to
  - Computing
  - Data
  - Network
- Large scale installations

Using a lightbulb in the glite world

- Describe the lightbulb
  Voltage, Watts, Amount
  Lighting_time, ...
- Submit request for electricity to broker

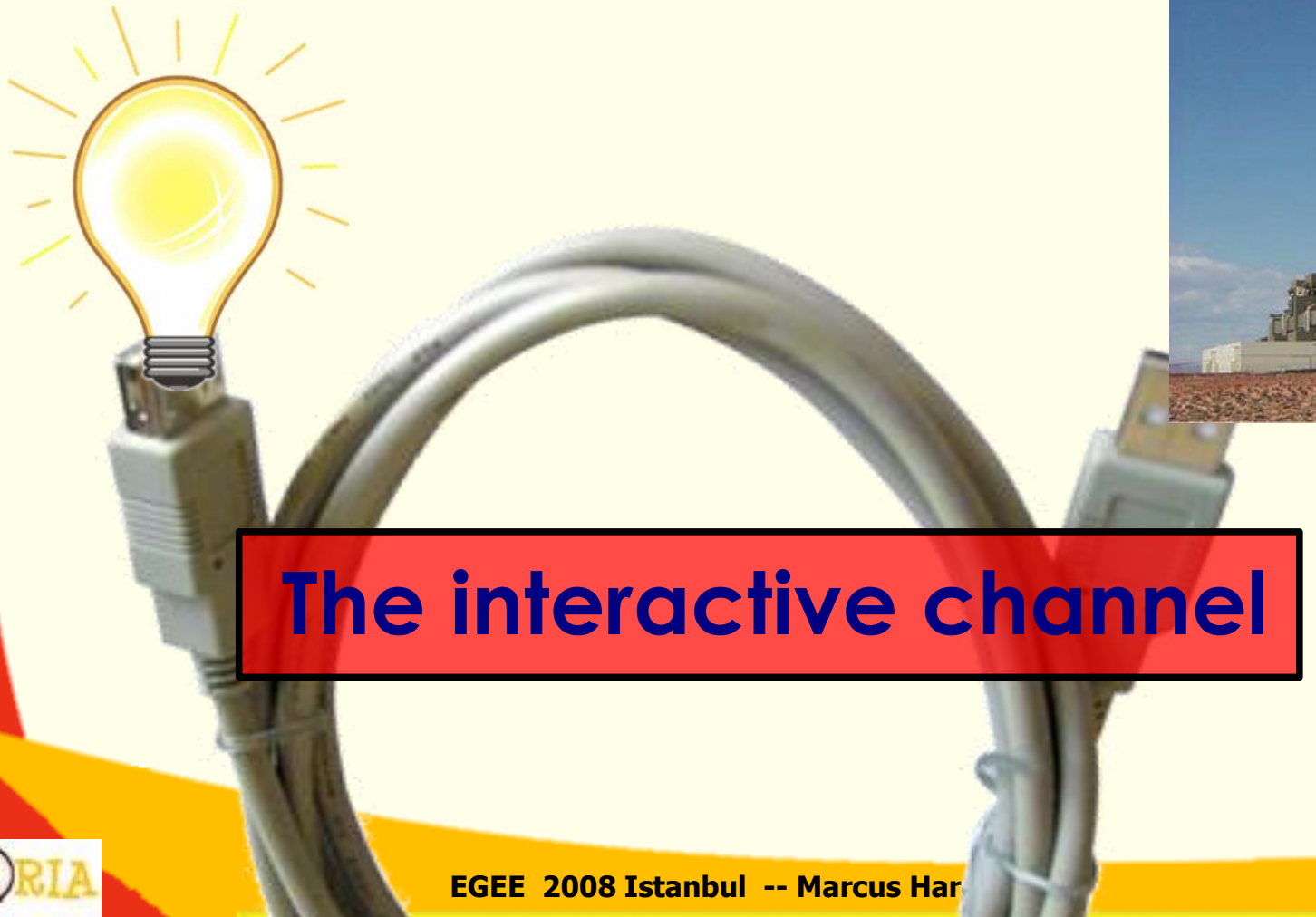
  => Powerplant automatically chosen for you

  => Send lightbulb to powerplant

  => Wait for electricity

  => Lightbulb glows
- Results come back
  - About 20% of the bulbs broken

Our idea for a solution



The interactive channel