int.eu.grid

http://www.interactive-grid.eu

Interactive grid-access for USCT

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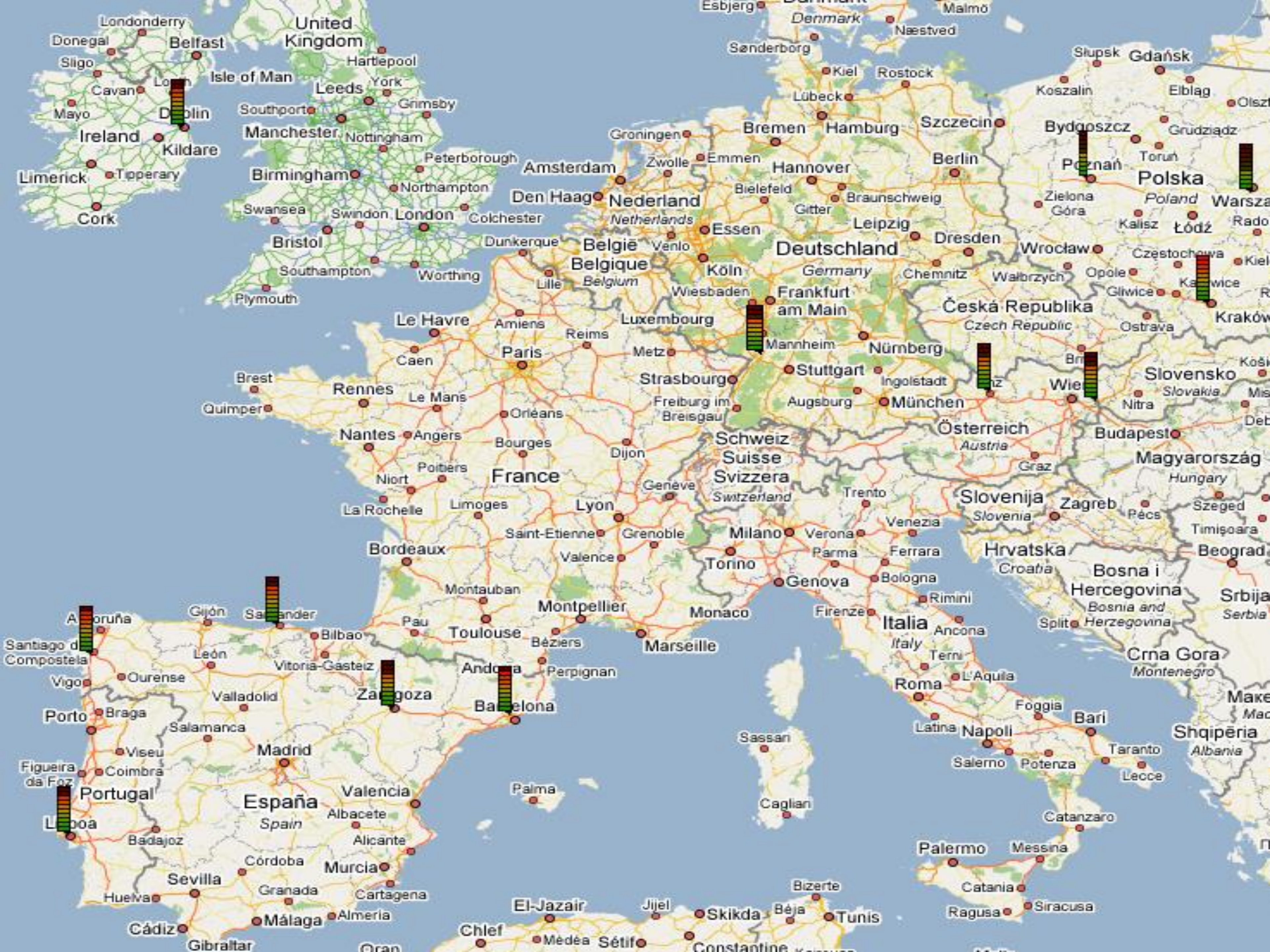
Background

- The grid
- The application
- Interactive access

The grid

- The grid
  - **Interactive European Grid (int.eu.grid)**
  - 2 Year I3 Project (May'06 - April'08)
  - 2.5 M€ EU-funding
  - Mission
    - 100% gLite compatible
    - MPI for the grid (int**ra** and int**er** site MPI)
    - Bring grid to new user communities
    - Improved useability
  - 12 clusters in 7 countries
    ~ 400 CPUs & 25TB disk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Malmö
Næstved
Sønderborg
Kiel
Rostock
Słupsk
Gdańsk
Londonderry
Donegal
United Kingdom
Belfast
Hartlepool
Sligo
Isle of Man
York
Leeds
Lübeck
Koszalin
Elbląg
Cavan
Grimsby
Mayo
Southport
Dublin
Bremen
Hamburg
Szczecin
Bydgoszcz
Grudziądz
Ireland
Manchester
Nottingham
Groningen
Kildare
Emmen
Toruń
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Peterborough
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Berlin
Limerick
Tipperary
Birmingham
Amsterdam
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Beograd
Croatia
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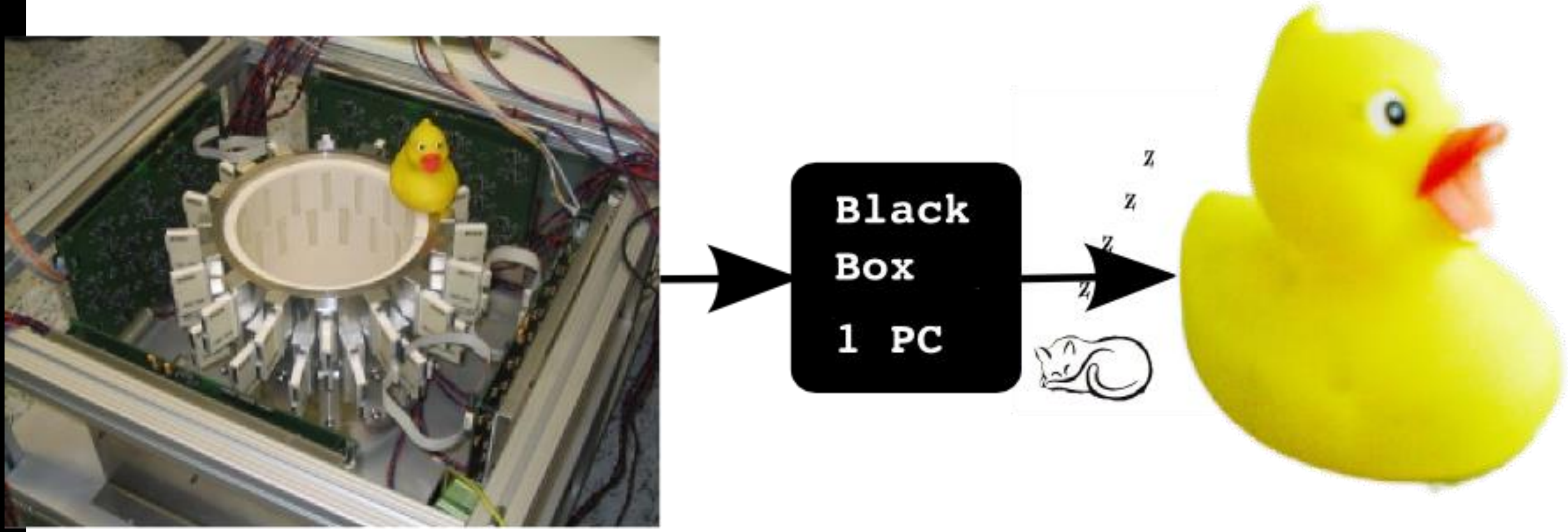
Almeria
Ragusa
Siracusa
Cádiz
Málaga
Chlef
Médéa
Sétif
Gibraltar
Oran
Constantine

USCT Reconstruction

- Current focus: development of
  - Reconstruction Algorithms
  - Improved hardware
- Matlab
  - Problem solving environment
    Maple, Mathematica, ...
  - Strategic development platform
    => 95% code in Matlab
- Data:
  - 20GB input
  - Output: 3D volume graphics (est. 8GB)

USCT Reconstruction



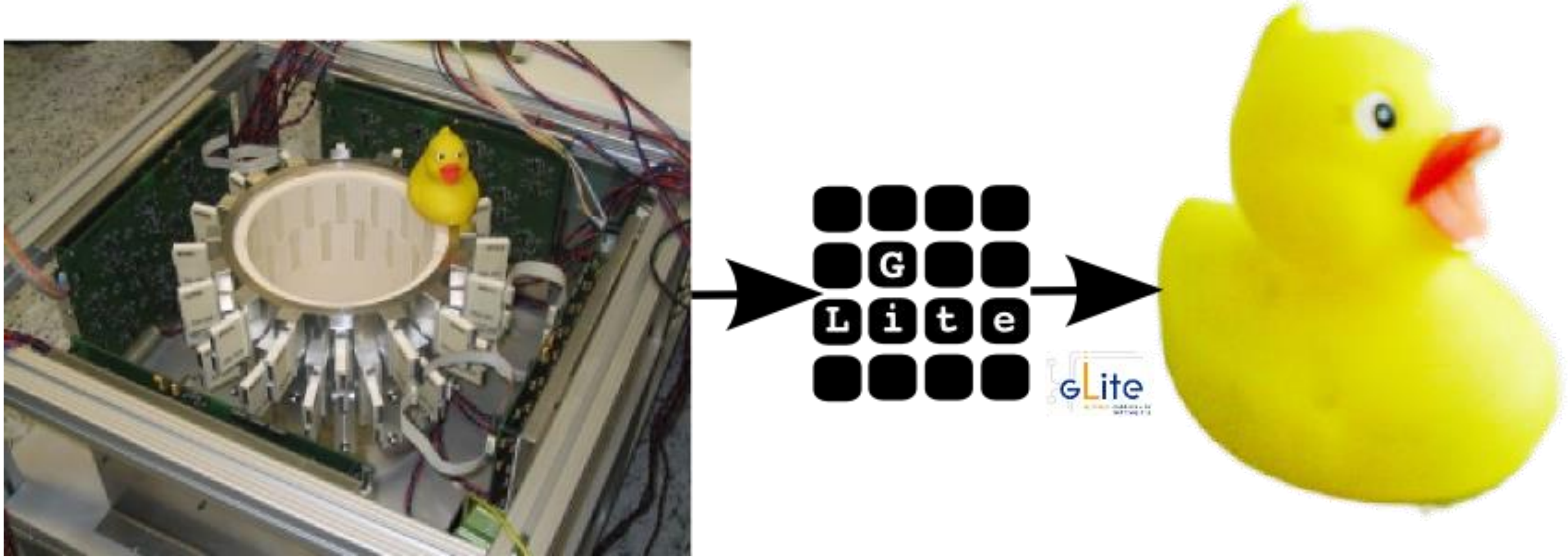
Black Box

1 PC

- Computation takes long (days, weeks, years)
- **Goal: Seemless + interactive grid access from Matlab**

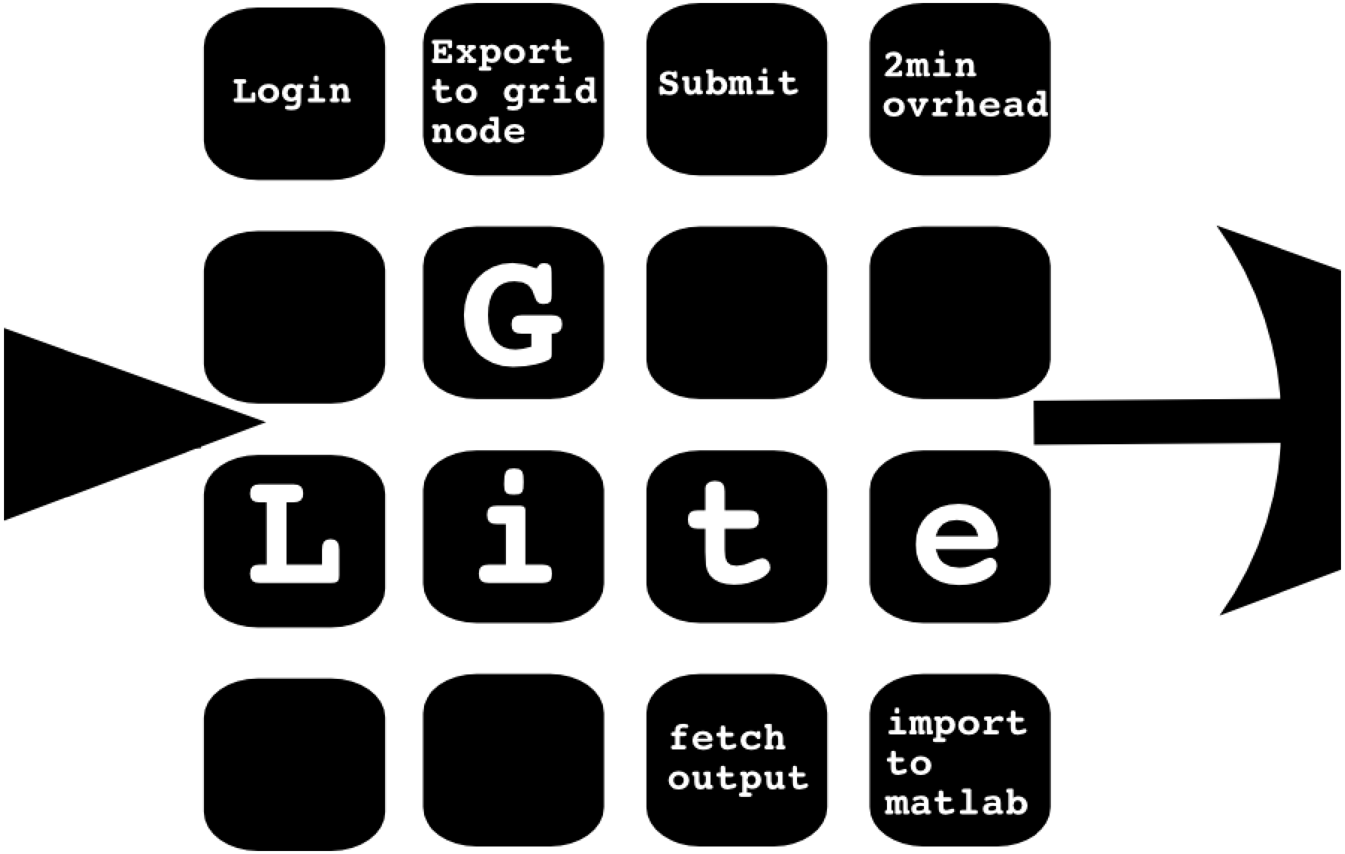
Using the grid

- 1st Approach to parallel execution:
  - Partitioning of data
  - Many parallel jobs



Using the grid

- Lets take a close look



Using the grid

- gLite
  - Good resource allocation system
- Users will run away

Improve grid access!!

- 2nd Approach
  - Grid access -- directly from Matlab
- RPC tool: **GridSolve**
  - **Developed at ICL, University Tennessee, Knoxville**
  - **Hides complexity of grid in <u>one simple call</u>**
    - **Client** interface for Java, C, Fortran, Matlab, Octave

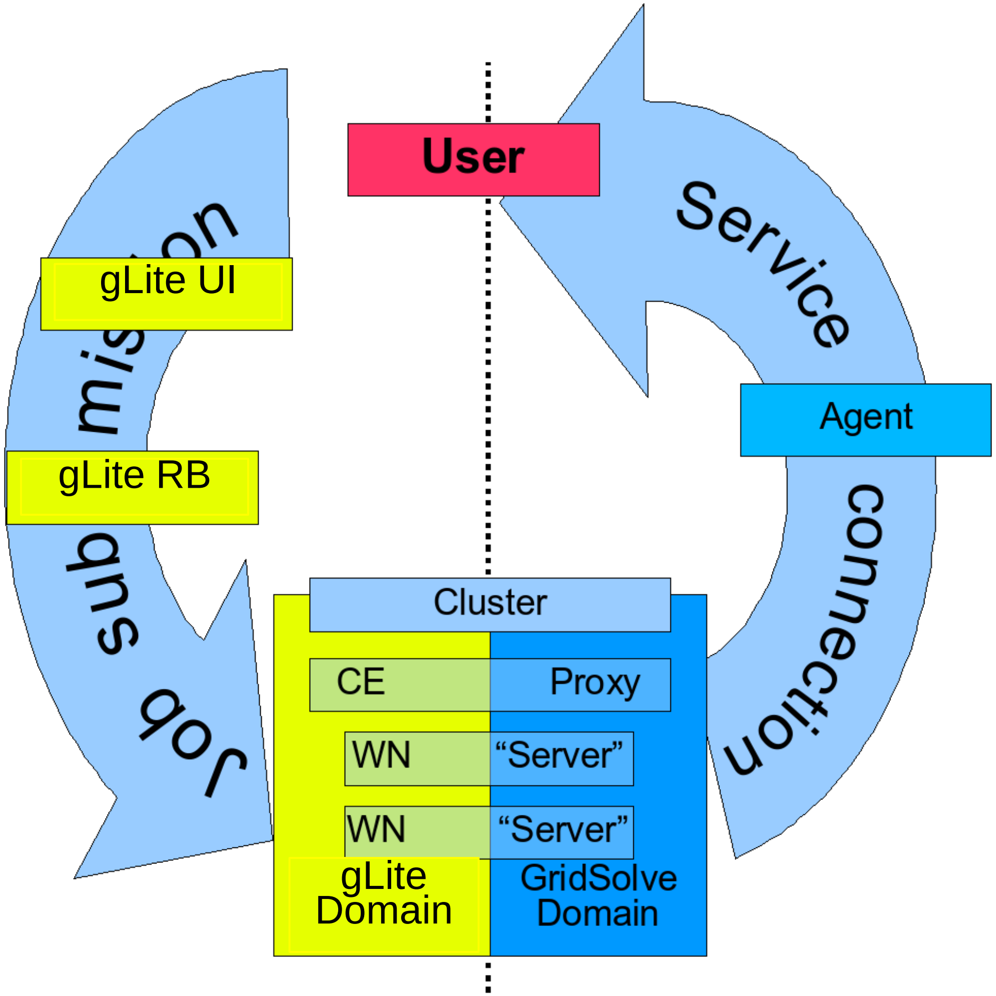
```
y=problem(x) <=> y=gs_call('problem', x)
```

    - Transport input parameters to remote side
    - Execute "problem"
    - Transport result back
  - Major side benefit
    - Parallelisation of Matlab code
      (Matlab is only single threaded)

Integrate...

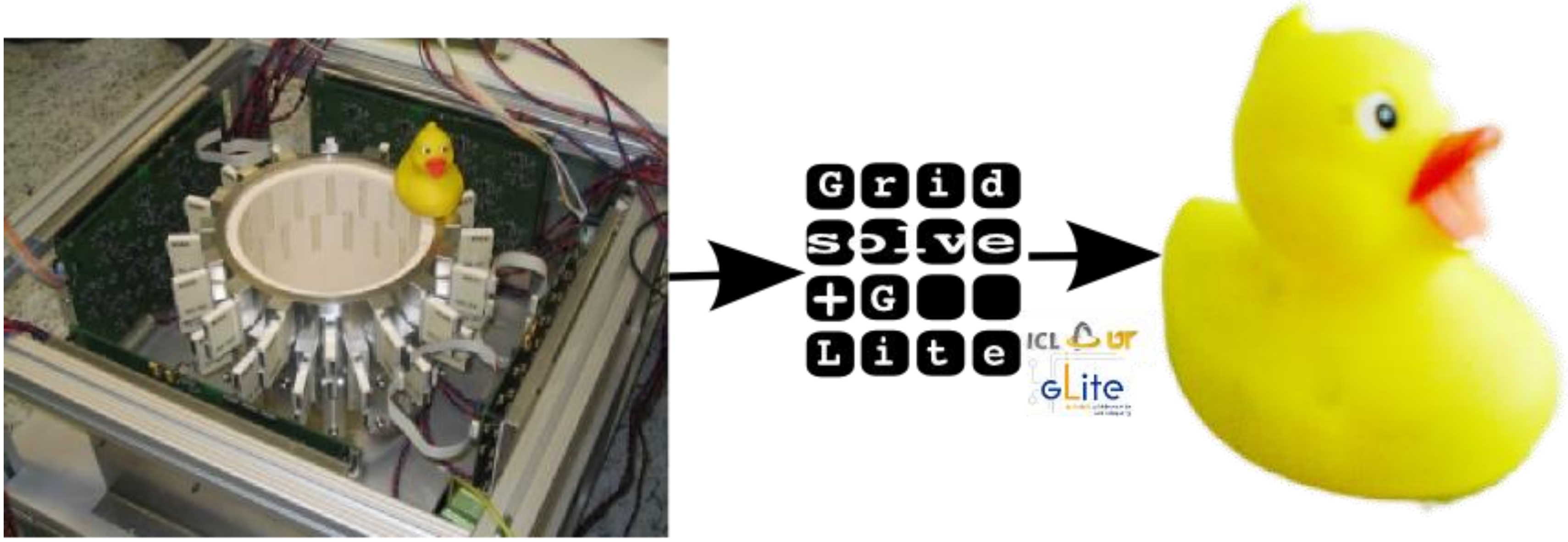
- ... GridSolve + gLite
  - Create Service hosts (GS-agent + GS-proxy)
    - Public IP address
  - Encapsulate GS-server into gLite job
    - Install GS-server on the fly
    - Deployment of problems
- ... GridSolve + Matlab
  - Point ML to the right service host
  - Support for service creation
  - Deployment of services (on the fly)
- ... Matlab + gLite
  - Matlab Compiler Runtime (MCR)
    - Install on the fly
    - Linux version incompatibility
      - Install new glibc on the fly

GridSolve on top of int.eu.grid/gLite



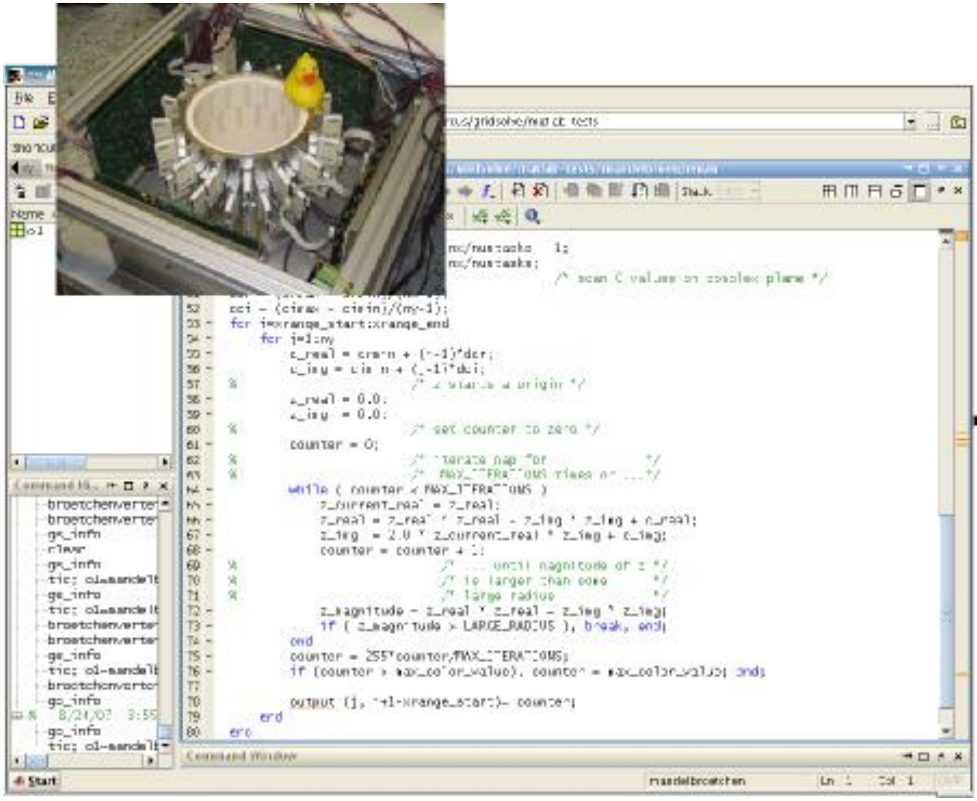
Solution

- GRPC with GridSolve on top of gLite



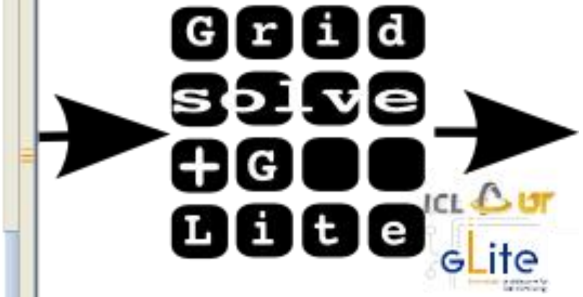
Demonstration

- USCT is a complex Application
  => Simulation for proof of concept



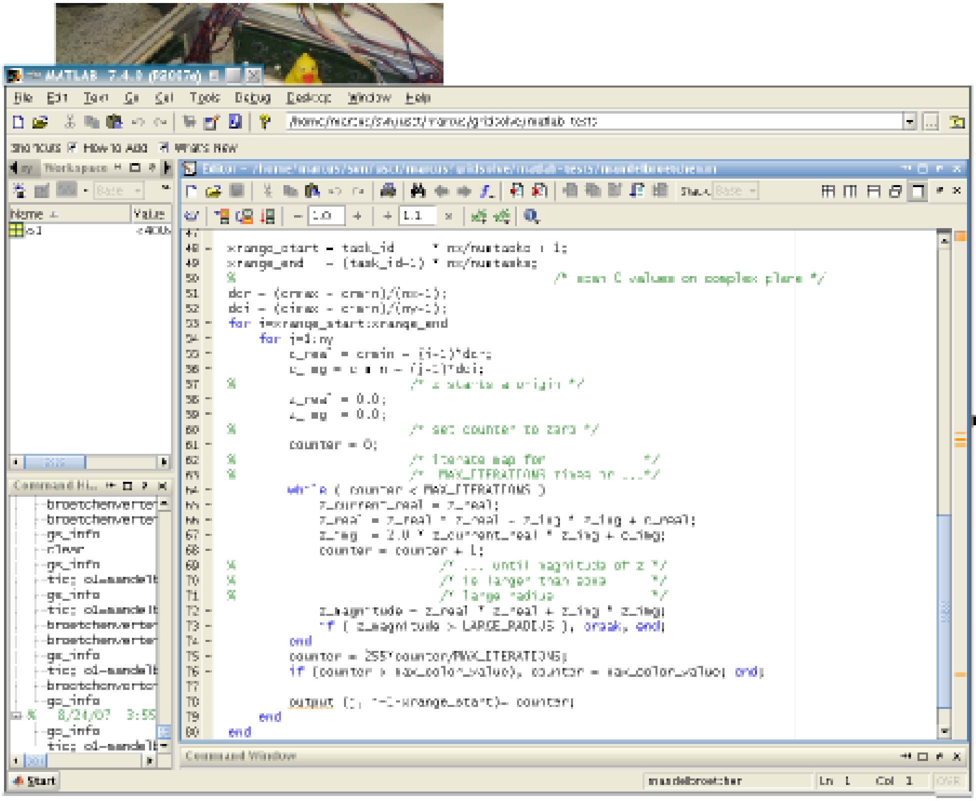
```
mx/numtasks   1;
mx/numtasks;
                        /* scan C values on complex plane */
cci = (cimax - cimin)/(my-1);
for i=xrange_start:xrange_end
    for j=1:my
        c_real = crmin + (i-1)*dcr;
        c_img = cimin + (j-1)*dci;
%                       /* z starts a origin */
        z_real = 0.0;
        z_img  = 0.0;
%                       /* set counter to zero */
        counter = 0;
%                       /* iterate map for              */
%                       /*  MAX_ITERATIONS times or ...*/
        while ( counter < MAX_ITERATIONS )
            z_current_real = z_real;
            z_real = z_real * z_real - z_img * z_img + c_real;
            z_img  = 2.0 * z_current_real * z_img + c_img;
            counter = counter + 1;
%                           /* ... until magnitude of z */
%                           /* is larger than some      */
%                           /* large radius             */
            z_magnitude = z_real * z_real - z_img * z_img;
            if ( z_magnitude > LARGE_RADIUS ), break, end;
        end
        counter = 255*counter/MAX_ITERATIONS;
        if (counter > max_color_value), counter = max_color_value; end;

        output (j, i+1-xrange_start)= counter;
    end
end
```



Demonstration

- Simulation: Mandelbrot fractal
  - Using the same infrastructure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```
xrange_start = task_id     * nx/numtasks + 1;
xrange_end   = (task_id+1) * nx/numtasks;
%                                          /* scan C values on complex plane */
dcr = (crmax - crmin)/(nx-1);
dci = (cimax - cimin)/(ny-1);
for i=xrange_start:xrange_end
    for j=1:ny
        c_real = crmin + (i-1)*dcr;
        c_img = cimin + (j-1)*dci;
%                       /* z starts a origin */
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        while ( counter < MAX_ITERATIONS )
            z_current_real = z_real;
            z_real = z_real * z_real - z_img * z_img + c_real;
            z_img  = 2.0 * z_current_real * z_img + c_img;
            counter = counter + 1;
%                           /* ... until magnitude of z */
%                           /* is larger than some      */
%                           /* large radius             */
            z_magnitude = z_real * z_real + z_img * z_img;
            if ( z_magnitude > LARGE_RADIUS ), break, end;
        end
        counter = 255*counter/MAX_ITERATIONS;
        if (counter > max_color_value), counter = max_color_value; end;

        output (:, i+1-xrange_start)= counter;
    end
end
```
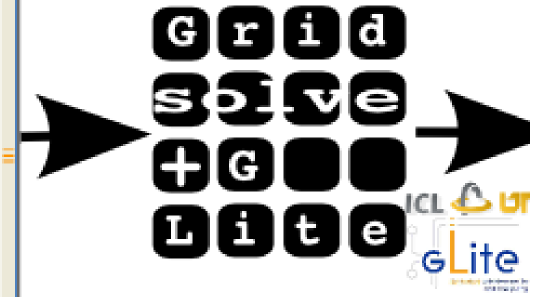
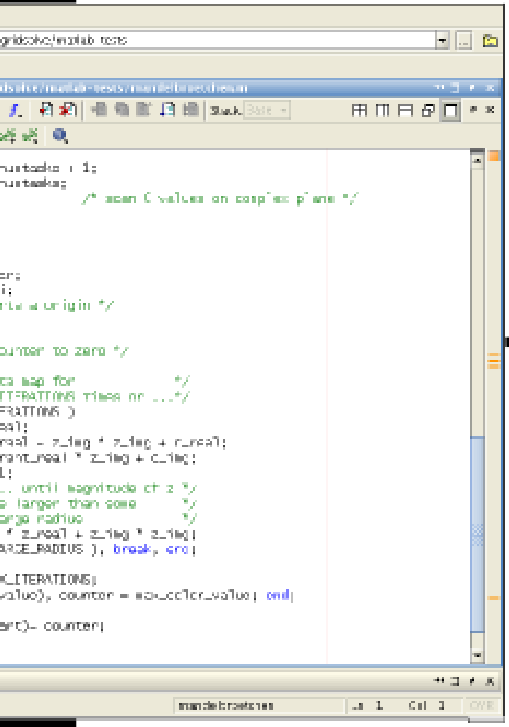



Demonstration

Demonstration

- Simulation works
  - Reasonable speedup



```
numtasks : 1;
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            /* scan C values on complex plane */




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* z_real + z_img * z_img;
ARGE_RADIUS ), break, end;

X_ITERATIONS;
value), counter = max_color_value; end;

art)- counter;
```

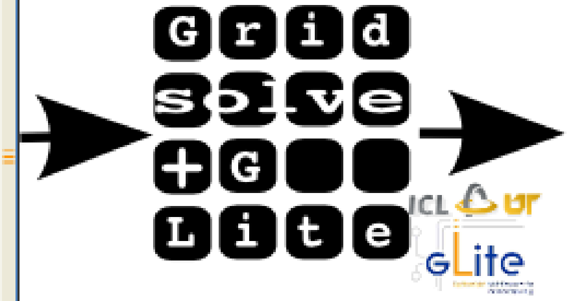

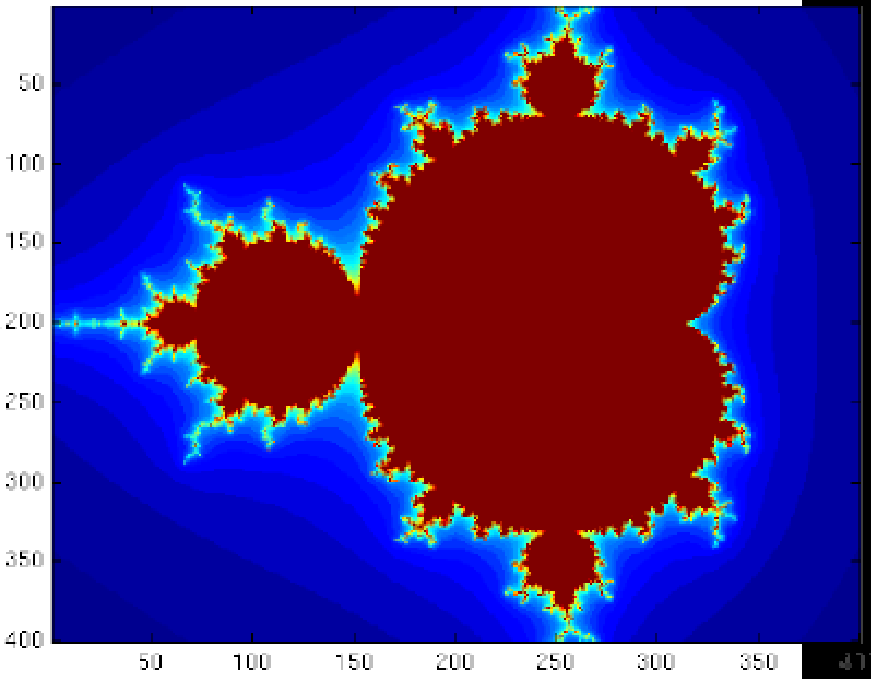

Current work

- Use real code
  - Cope with the data (20 GB in, 8 GB out)
    - MPI abilities might be beneficial (depending on algorithm)
  - Identify Bottlenecks
  - Improve useability
- Data Handling (Future)
  - Distribute Input on the grid
  - Collect output efficiently
  - GFAL + gLite-DICOM

Questions?

Contact:

interactive grid