Porting applications to Distributed Computing Infrastructures incorporating Desktop Grids

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Distributed Computing Infrastructures for Scientists

Desktop grids (DGs)
(volunteer DGs – home computers, organizational DGs – institutional desktops)

• Inexpensive,
• very large number of CPUs (~100K – 1M)
• Bag of task appls

Cluster based service grids (SGs)
(EGI, OSG, etc.)

• Very expensive,
• small number of sites and large number of CPUs
• MPI appls

Supercomputer based SGs
(DEISA, TeraGrid)

• Moderately expensive,
• moderate number of sites and CPUs
• any appls

OGF PGI

EDGeS

EDGI

Presentation title: Porting Applications to DGs
Author: Tamas Kiss
EDGeS - EDGI - DEGISCO
European projects to interconnect SG and DG infrastructures

• **EDGeS – Enabling Desktop Grids for e-Science**
  – Duration: 01 January 2008 – 31 March 2010
  – To provide desktop grid infrastructure for EGEE users running computation intensive applications

• **EDGI – European Desktop Grid Initiative**
  – Duration: 01 June 2010 – 31 May 2012
  – To provide desktop grid infrastructure for EGI users running computation and data intensive applications, and extend DGs with Cloud based QoS

• **DEGISCO – Desktop Grids for International Scientific Collaboration**
  – Duration: 01 June 2010 – 31 May 2012
  – To support the creation of DG infrastructures based on the EDGeS technology in countries outside Europe
Supporting application developers and end-users
The EDGI/DEGISCO Application Support Services

- **Aims and objectives:**
  - facilitate the porting of applications to the combined SG/DG infrastructure by targeting
    - user communities already associated with SGs or DGs
    - new user communities

- **Activities:**
  - develop a generic methodology for application porting
  - identify user communities that require the power of the SG/DG infrastructure
  - provide a service in order to aid the migration to and running of applications on the SG/DG infrastructure

- **European users:** EDGI Application Support Service / IDGF European Chapter
- **Non-European users:** DEGISCO Application Support Service / IDGF International Chapter
Which applications are suitable for SG/DG infrastructures?

- Applications should run on both SGs and DGs
  - SGs support a much wider scale of applications than DGs
  - We should assure that the application runs on DGs
- Requirements towards an application to be executable on DGs:
  - **Parallelization:**
    - Only *master/work* or parameter sweep parallelisation
    - No MPI or internal communication between worker nodes
    - Nodes can only use the results of other nodes through the server
  - **Data handling:**
    - small or medium-sized (max. 100 MB per worker) inputs and outputs (especially for public DGs, could be larger in local DGs)
    - No shared data storage (in public DGs)
    - No confidential data (sent down to potentially un-trusted worker in public DG)
Which applications are suitable for SG/DG infrastructures?

- To achieve good performance
  - the execution time of individual jobs should be
    - **Minimum:**
      - over 10 minutes (otherwise the overhead caused by the DG will reduce the performance)
    - **Maximum:**
      - less than 2-3 hours (if longer, application level check-pointing is required to avoid loss of computation caused by user interventions)
      - the execution of individual jobs should take around the same amount of time (better scheduling, less load on the server)

- Operating systems
  - Depends on the DGs where the application will run
    - windows version may be required to utilise larger number of resources
Application Development to SG/DG platforms

Challenges before the EDGeS/EDGI /DEGISCO projects

For the Developer

- **DG version of the application has to be developed**
  - Only low level APIs (e.g. BOINC API)
  - Specific expertise is required
  - Platform dependent solutions (different BOINC/XtremWeb version)

- **Application composition**
  - Creation of workflows is not supported

For the user

- **Transparency for the user**
  - User would require the same or similar user interface for DG and SG applications
  - Total lack of UI for DG systems (e.g. only BOINC Admin can run the application)

- **Only validated applications can be run on a DG**
  - Requires an application repository
  - Publish, select, download, parameterize and execute applications
Tools supporting application development and execution on SG/DG platforms

**API level support — for the developer**

**DC-API:**
- Provides a uniform interface for different Grid systems (BOINC, Condor, XtremWeb)

**GenWrapper:**
- Generic wrapper to port legacy applications to a BOINC platform without “Boincification”

**High level graphical user interface — for the developer and the user**

**WS-PGRADE portal:**
- To support the transparent exploitation of SG/DG systems at workflow level

**EDGeS Application Repository:**
- Publish, select, download, parameterise and execute validated applications
Developing a DG application

- **Source code available**
  - DC-API
- **Only binary available**
  - GenWrapper

**WS-PGRADE portal**

**EDGeS Application Repository**

**BOINC enabling**

**GUI**
### SG/DG Applications on Production infrastructure (ported by EDGeS, EDGI and DEGISCO)

<table>
<thead>
<tr>
<th>Community</th>
<th>Number of Applications</th>
<th>Academic</th>
<th>Industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioscience</td>
<td>9</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Healthcare</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Physics</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Audio and video processing</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Business</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Applied mathematics</td>
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<td>2</td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>31</strong></td>
<td><strong>28</strong></td>
<td><strong>3</strong></td>
</tr>
</tbody>
</table>
SG/DG application scenarios

1. Application runs on DG and uses SG resources via the DG to SG bridge
2. Application submitted to SG and uses DG resources via the SG to DG bridge
3. Application uses both SG and DG resources via an external scheduling and job submission system
Scenario 1 – DG to SG via bridge

- User entry point is DG – using SG is completely transparent from user’s point of view
Visage processes Image pairs over the BOINC/EDGeS grid and paints movement in yellow.

Video options: forward, backward, pause, play..

Insert video source:

Insert Url of Server:

Set mode to EDGeS
Scenario 2 – SG to DG via bridge

Desktop Grid 1

EDGI Services
DG CE + EDGI AR

EGI VO

WMS and other EGI services

Desktop Grid n

SG (EGI) user (using EGI UI machine or portal)

– User entry point is SG
– using DG is transparent from user’s point of view
- a suite of software tools for creating customized views of 3D renderings from astrophysical data tables

- **User community**: INAF Catania (Osservatorio Astrofisico di Catania) + University of Portsmouth

- **Grid enabled version:**
  - For g-Lite based grids
    - Runs on the Cometa Consortium Grid – Catania, Messina, Palermo
  - Ported to the EDGeS platform to utilize Desktop Grid resources
  - Subcontractor in EDGI to further develop ported application
Application porting

- Desktop Grid version is deployed and running on UoW Local DG and EDGeS@home
- Application is validated and published in Production Application Repository
- Application runs from EGEE to DG (UoW Local DG and EDGeS@home)

Data distribution

- Medium sized input files (up to 100 Mbytes) are currently feasible

Work in EDGI:

- Division of input file (potentially GBytes) and better data distribution using ADICS will be investigated
- VisIVO Web portal will be connected to DG infrastructure – potential access by the general public in museums
Scenario 3 – SG/DG resources but not through EDGeS/EDGI bridges

- Using external job submission and scheduling system to submit jobs to both SG and DG resources
  - P-GRADE/WS P-GRADE portal supports this scenario by default
    - E.g.:
      - CancerGrid application uses EGI and DG resources via the WS P-GRADE portal
  - Could be justified with specific user requirements
    - E.g.:
      - WISDOM project uses only pull jobs on EGI that are unsuitable to be bridged to DG
  - Both solutions use EDGeS/EDGI technology: 3GBridge
Scenario 3 – DG submitter for WISDOM

- WISDOM: Meta middleware to submit pull (pilot) jobs to EGI
- The DG submitter:
  - Submit push (direct) jobs to the DG when EGI resources are overloaded
Grid application development is very often ad-hoc
- Developers do not follow any methodology
- Poorly documented systems
- User expectations not fulfilled

Systems design and development methodologies are too generic
- Special focus is required when porting/developing an application to a SG/DG platform
Porting Applications to DGs

1. Analysis of current application
2. Requirements analysis
3. Systems design
4. Detailed design
5. Implementation
6. Testing
7. Validation
8. Deployment
9. User support, maintenance & feedback
Thank you for your attention ...

Any questions?

Please contact us if you need support in porting your application!

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Join the International Desktop Grid Federation:

http://desktopgridfederation.eu