DGAS

An Economy-based Accounting Infrastructure for the DataGrid

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Objectives

- keep track of the resource usage by Grid users
- avoid abuses of the resources
- help the Workload Management System in balancing the workload by supporting economic resource brokering
  - → facilitate the fair and balanced exchange of computing resources
- basic assumption: every entity in the Grid (Users, Computing Elements, Storage Elements,…) spends or earns "GridCredits" (virtual currency).
- some examples:
  - Virtual Organizations (VOs) can redistribute the GridCredits earned by their resources to their users.
  - users can submit jobs only if they have the necessary funds.
  - Computing Elements can buy access to Storage Elements.
  - a Storage Element can buy a file from another Storage Element.

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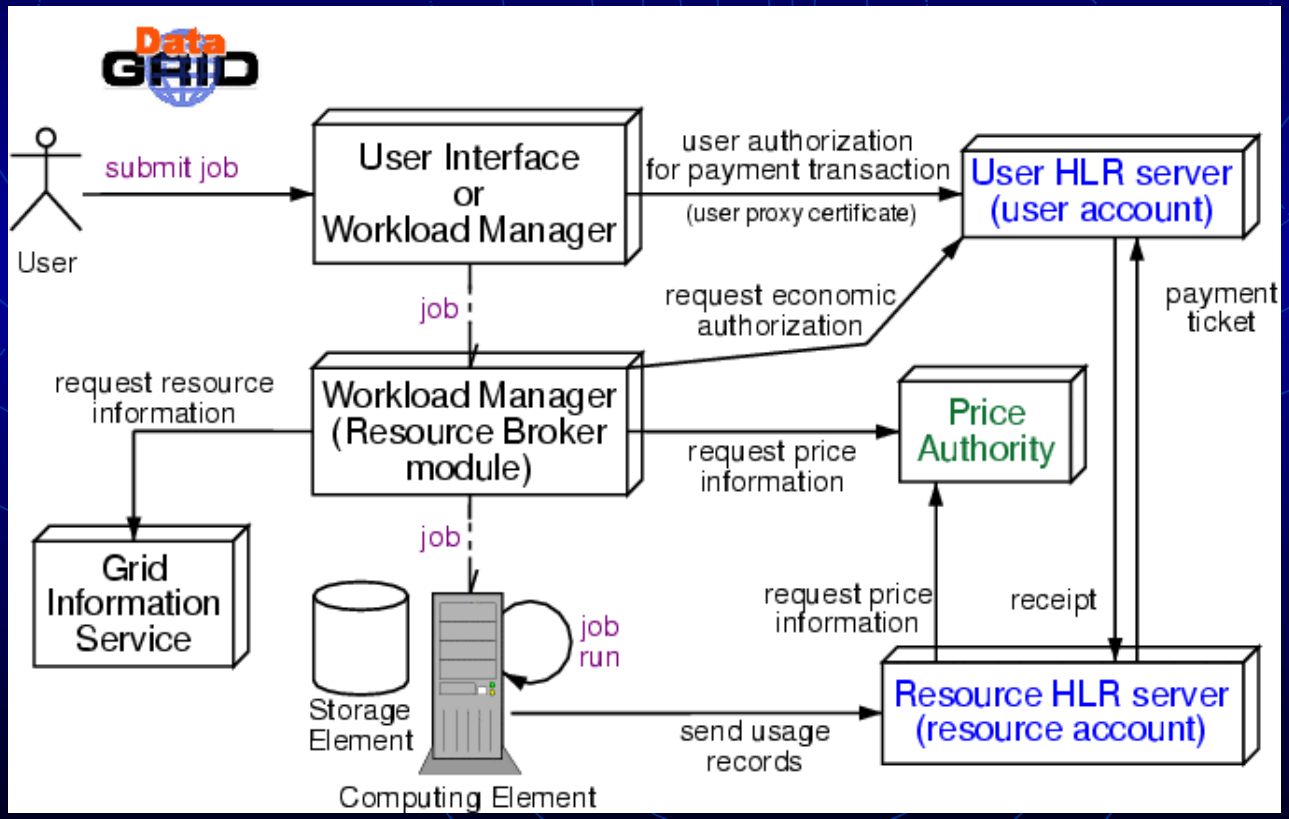
DGAS Infrastructure

The DataGrid Accounting System (DGAS) is an optional component of the Workload Management System (WMS) of the European DataGrid (EDG) project



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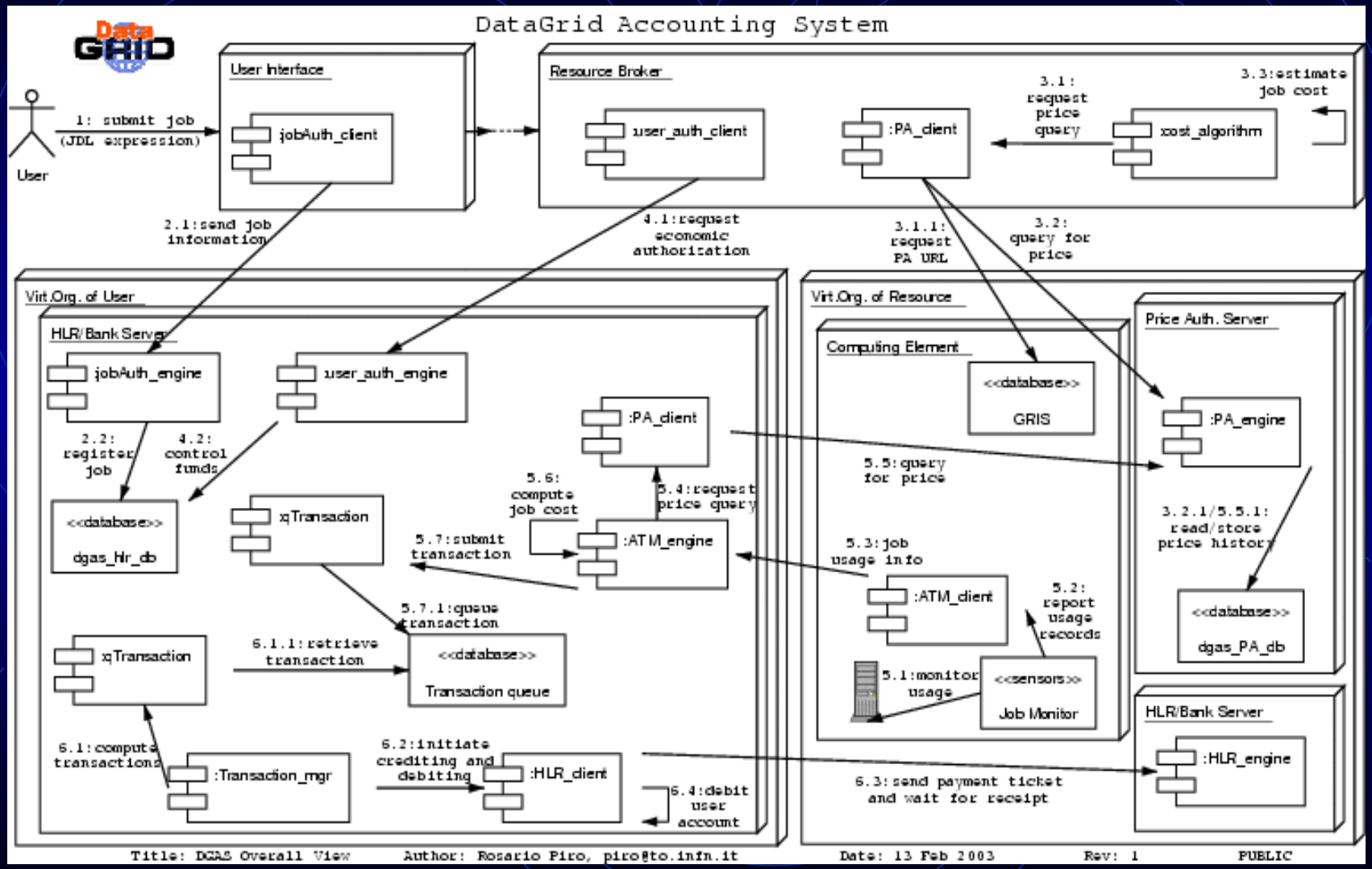
DGAS Infrastructure



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Structure

- DGAS is composed of two basic services:
  - **bank service**: Every entity (User, CE,…) has an account on a bank server known as *Home Location Register (HLR)*. Usually one HLR per VO.
  - **Price Authority**: The service responsible for assigning prices to the Grid resources. Usually one PA per VO.
- scalability due to decentralization and arbitrary number of HLRs and PAs.
- complemented by an *economic model*: PAs can work with different pricing algorithms (DLLs). Different pricing schemes result in different behaviors of the Grid.

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SW Characteristics

- **Modularity:** ease of expansion and customization.
- **Client/Server structure:** flexibility.
- **XML-based communication protocol :** easy for third parts to interface to the system.
- **Developed using widely known standards:** C/C++, XML, MySQL, Globus GSI (for authentication and secure communications).

DGAS can be adapted to other Grid projects with similar needs.

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Pricing schemes for economic brokering (I)

- goal: improve workload balancing by including price information in the resource selection process.
- examine pricing schemes that do not compute or approximate global equilibrium prices, but determine resource prices "locally" (for single resources):
  - less information required (less network traffic)
  - less computational overhead
  - local policies of different VOs can be respected

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Pricing schemes for economic brokering (II)

- Hybrid Pricing Model:

$$price = P_0 + \Delta P \frac{W - \frac{1}{2}W_{max}}{\frac{1}{2}W_{max}} \qquad 0 \leq W \leq W_{max}$$

- static parameters: base price P_0, variation limit ΔP and maximum Queue Wait Time W_{max}
- dynamic parameter: current (estimated) Queue Wait Time W

→ price dynamically varies between $P_0 - \Delta P$ and $P_0 + \Delta P$

- simplicity and low computational overhead.
- fixed limits of price variations prevent a long-term degeneration of prices (resource exchange fairness).
- requires an accurate estimation of current QWTs

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Pricing schemes for economic brokering (III)

- Derivative Follower Model:
  (Kephart et al., 2000; van Bragt et al., 2002)

  - approximates game-theoretic equilibrium prices (demand equals supply) by incrementally increasing/decreasing prices until the observed (immediate) profitability level falls, then the direction of price adjustments is reversed.
  - problem: can balance incoming workload, but does not consider pre-existing unbalanced queues.
  - possible adaption for DGAS: use QWT and its variation as stimulus for price adjustments (instead of profit).

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Current activities

- Final integration of the DGAS software into the EDG.
- Plans for the deployment of DGAS on the INFN-Grid testbed (testbed of the Italian National Institute for Nuclear Physics).
- Simulation tool DGAS-Sim to study the impact of different pricing schemes on the workload of simulated Grid resources (first simulations of the Hybrid Pricing Model have been done, but the activity is still ongoing).

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