vl·e virtual laboratory for e·science

Ibis: Java-Centric Grid Computing

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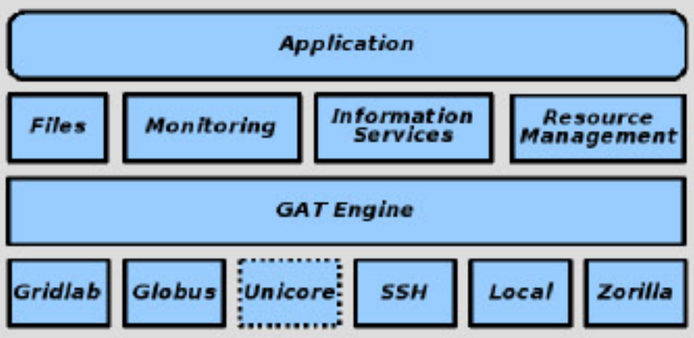
Introduction

The main goal of the Ibis project is to create an efficient Java-based platform for grid computing. The Ibis project currently consists of the **Ibis communication library**, a variety of **programming models**, the **Java Grid Application Toolkit**, and the **Zorilla** peer-to-peer grid middleware. All components can be deployed on any grid platform, due to the use of Java. Each of the components will be described in detail below. On the right there is a selection of the projects currently using Ibis software. Ibis is part of SP 3.1 of the VL-e project.

Java Grid Application Toolkit

The Java Grid Application Toolkit (JavaGAT) offers a set of coordinated, generic and flexible APIs for accessing grid services from application codes, portals, data managements systems.



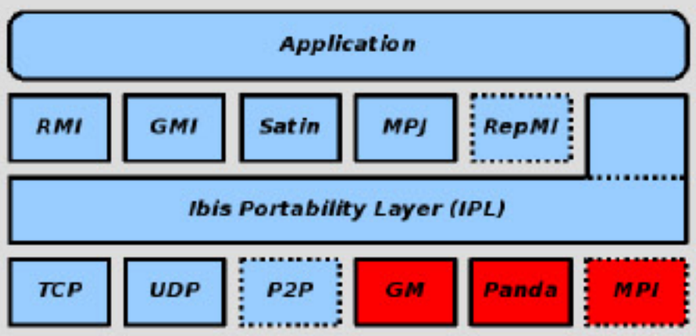
As shown in the above figure, the JavaGAT sits between grid applications and numerous types of grid middleware, such as Globus, Unicore, SSH or Zorilla. JavaGAT lifts the burden of grid application programmers by providing them with a **uniform interface** that provides **file access**, **job submission**, **monitoring**, and access to **information services**. As a result, grid application programmers need only learn a single API to obtain access to the entire grid. Due to its modular design, the JavaGAT can easily be extended with support for other grid middleware layers.

Zorilla

Zorilla is peer-to-peer grid middleware. It implements all functionality needed to run applications on a grid in a fully distributed manner, such as scheduling, file transfer and security. Deployment of Zorilla is easy; only a single application needs to be installed on the participating machines. Zorilla requires little configuration, since machines automatically organize themselves into a grid. Due to its peer-to-peer design, Zorilla scales to large numbers of machines. Jobs can be submitted to Zorilla directly or using the JavaGAT. Although Zorilla was explicitly designed to support supercomputing applications, it is possible to run any type of application.

Ibis Communication Library

The Ibis communication library is specifically designed for usage in a grid environment. Its **run-everywhere** property and support for **fault-tolerance**, **malleability** and **high-speed networks**, make it an easy to use and reliable grid communication infrastructure. The modular design of Ibis is shown below:



Ibis Programming Models

Ibis offers a wide range of programming models, suitable for different classes of applications: **RMI** is best suited for client-servers application, **Satin** offers a master-worker/divide and conquer programming model, **GMI** implements object-oriented group communication, while **MPJ** offers pure Java MPI.

MultimediaN

MultimediaN

The MultimediaN institute performs various types of multimedia research, such as feature learning, object recognition and multimedia databases. One of their demonstrations, which is used to illustrate the effectiveness of using a grid in Multimedia computing, shows object recognition performed by a robot dog. The dog is connected to a wide-area Grid system, which potentially consists of hundreds of computers distibuted world-wide. The JavaGAT is used to start computations on the grid.

ProActive

ProActive
Programming, Composing, Deploying on the Grid

ProActive is a grid Java library for parallel, distributed, and concurrent computing, also featuring mobility and security in a uniform framework. With a reduced set of simple primitives, ProActive provides a comprehensive API allowing to simplify the programming of applications that are distributed on Local Area Network (LAN), on cluster of workstations, or on Internet Grids. See the ProActive website for more information. ProActive has been ported to Ibis by Fabrice Huet. Laurent Baduel used this version for a Java version of EM3D: a parallel solver for electromagnetic waves propagation.

MEG Data Analysis

VU medisch centrum

The Vrije Universiteit Medical Centre has a magnetoencephalography (MEG) scanner which produces large amounts of data which must be processed. MEG is a tool to study the function of the human brain. It measures the magnetic field intensity at hundreds of points over the surface of the skull up to several thousand times per second. The size of a data set from each session is typically hundreds of megabytes. The task-farming application used for data analysis uses the Ibis communication library to distribute the data over the workers.

Parallel simulation of soil-structure-interaction

IIB
Institut für Numerische Methoden und Informatik im Bauwesen

The Institute of Numerical Methods and Informatics in Civil Engineering is implementing a Grid-System for the parallel simulation of soil-structure-interaction for geotechnical problems. Parallelization is based on mobile Java-Agents, taking advantage of agent features such as portability, mobility, reactivity etc. In the time critical parts of the parallel simulation, mainly solving a linear equation system, Ibis is used for a more efficient communication. Ibis offers all features needed for an efficient and trouble-free implementation, such as one-to-many communication and the possibility to send objects efficiently.

Triana

the Triana project.

Triana is a workflow-based problem solving environment developed at Cardiff University that combines a simple and intuitive visual interface with powerful data analysis tools. Already used by scientists for a range of tasks, such as signal, text and image processing, Triana includes a large library of pre-written analysis tools and the ability for users to easily integrate their own tools. Triana is capable of using the JavaGAT to run parts of the task graph on the grid.

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This work was carried out in the context of the Virtual Laboratory for e-Science project. This project is supported by a BSIK grant from the Dutch Ministry of Education, Culture and Science (OC&W) and is part of the ICT innovation program of the Ministry of Economic Affairs (EZ).

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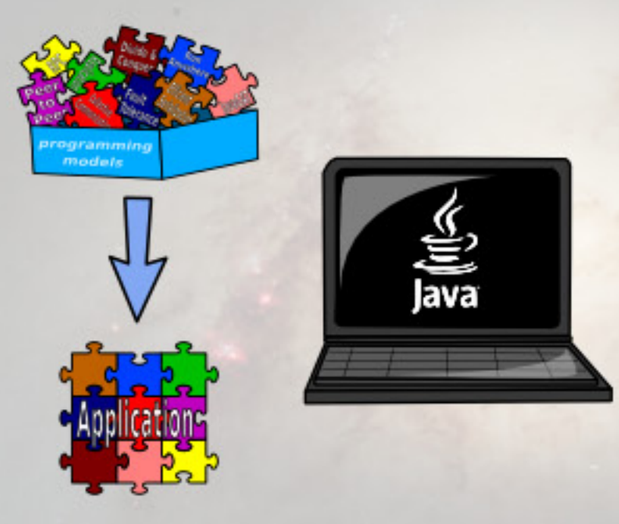
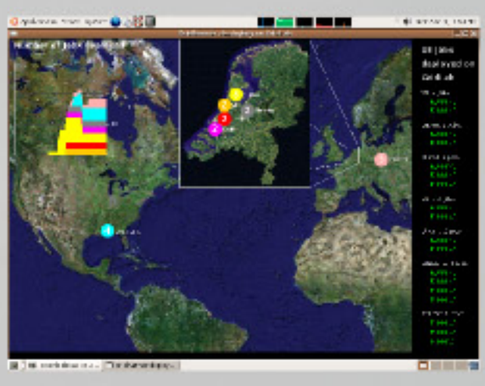
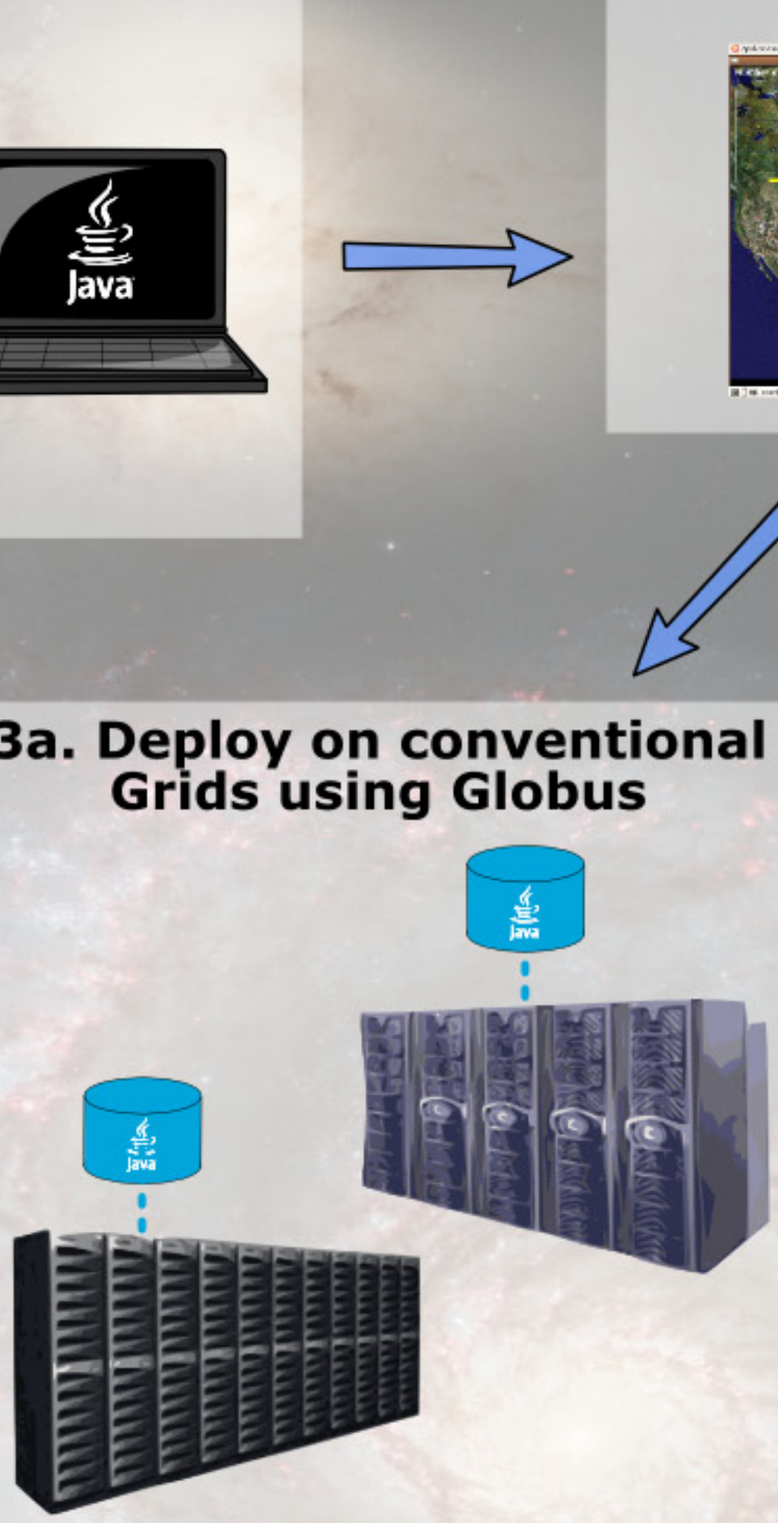
1. Develop application on local workstation



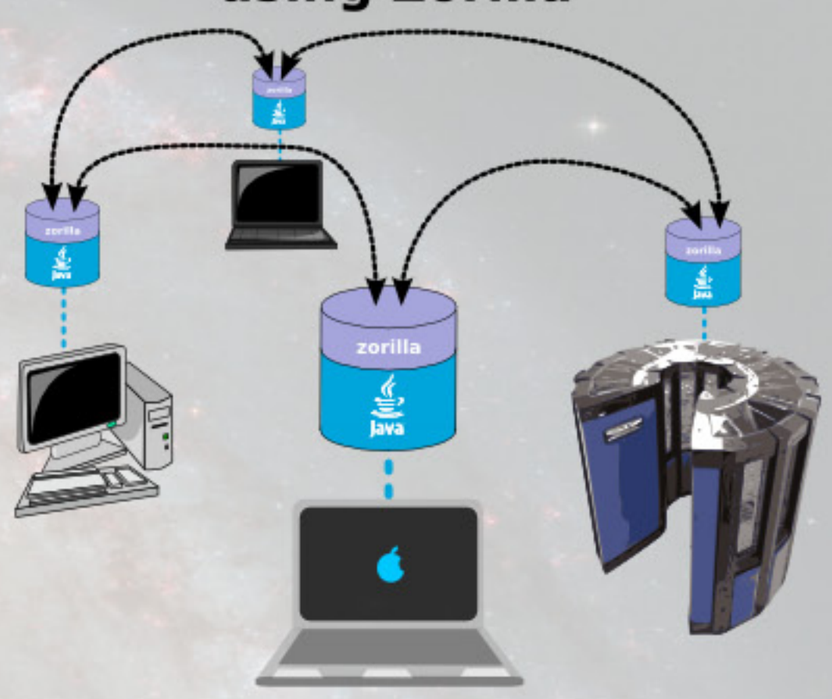
2. Submit, monitor and steer using JavaGAT



3a. Deploy on conventional Grids using Globus



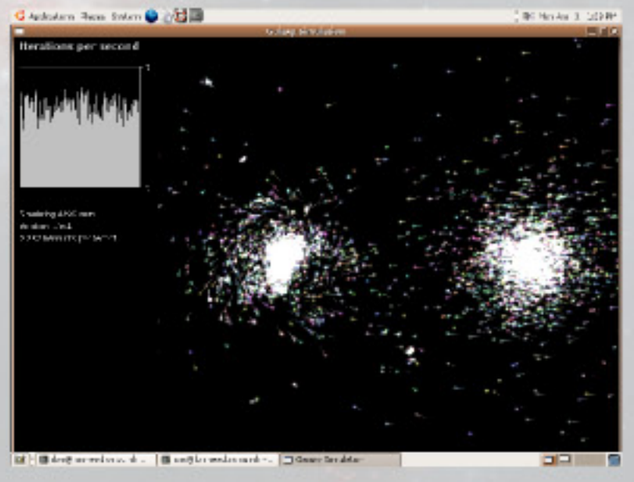
3b. Peer-to-Peer deployment using Zorilla



The Ibis Project:

- Grid aware programming models
- a uniform interface to the Grid
- peer-to-peer Grid middleware
- Grid enabled communication

4. Application on the Grid!



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