ASSISTCONF
A Tool to Execute ASSIST Programs on Globus-based Grids

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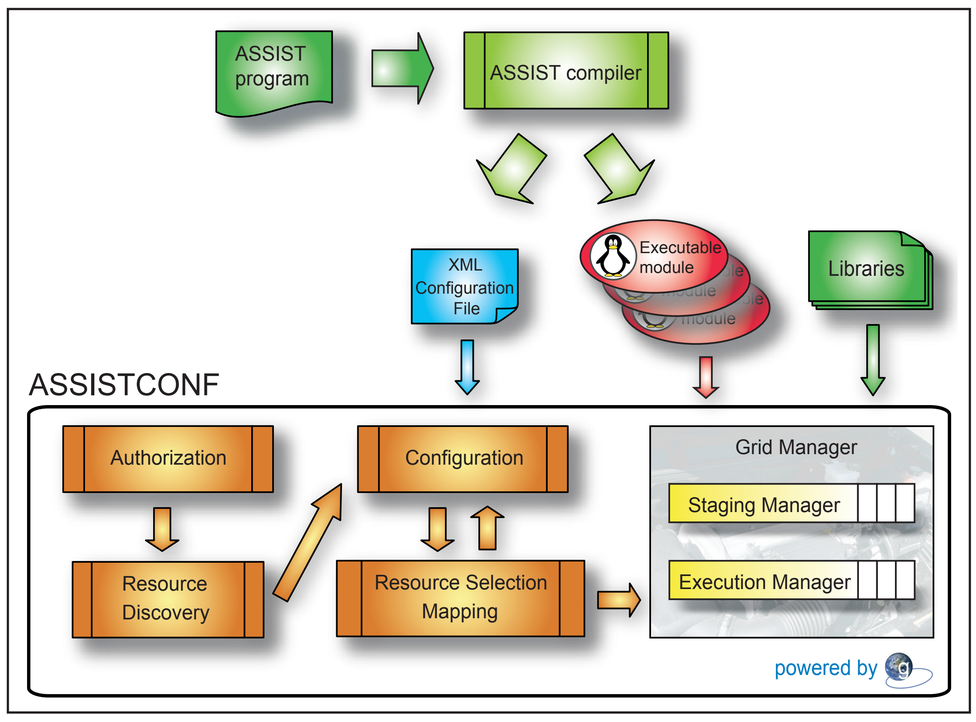
ASSIST is a programming environment aimed at providing user-friendly, efficient, portable, fast ways of implementing parallel applications to programmers . It includes a skeleton-based parallel programming language (ASSISTcl, cl stands for coordination language) and a set of compiling tools and run time libraries. The ensemble allows parallel programs written using ASSISTcl to be seamlessly run on top of workstation networks supporting POSIX and ACE (the Adaptive Communication Environment) and computational grids.

ASSISTCONF is a graphical user interface designed to configure and execute ASSIST applications on Globus-based grids. It hides the structure of the grid used and provides the interaction between the ASSIST Run Time Support and the Globus middleware (Globus Toolkit 2.4).

The programming environment, the coordination language and the graphical user interface have been designed in a joint project ASI/CNR (Italian National Space Agency and Italian National Research Council), by people of the Dept. of Computer Science of Pisa and of the CNR Institute of Information Science and Technologies (ISTI). Recently, this program terminated and the development of ASSIST has been moved to other italian national research projects (Strategic projects "Legge 449/97" No. 02-00470-ST97 02-00640-ST97 and a FIRB project No. RNBNE01KNFP "GRID.it").

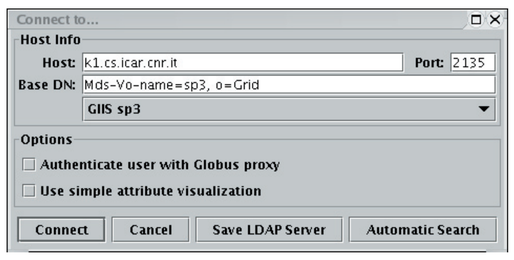
Using ASSIST the programmer may structure parallel applications as generic graphs of either sequential processes or parallel modules. Nodes in the graphs (i.e. the processes or the parallel modules) are connected by means of data streams. Non-deterministic control is provided to accept inputs from different streams and explicit commands are provided to output items on the output streams. Sequential portions of code can be written using C, C++ or FORTRAN77.

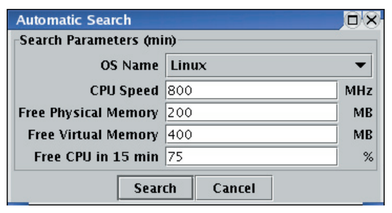


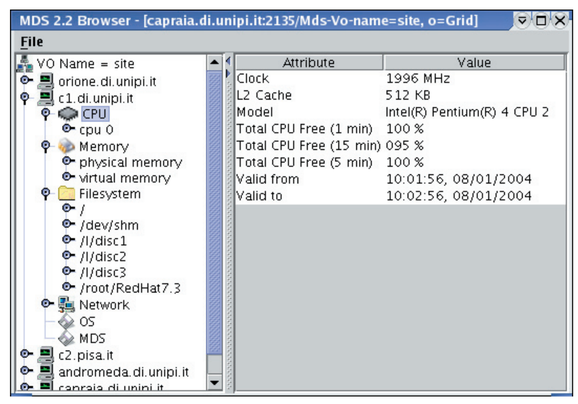
The compiler produces various binary modules, and a XML configuration file. The type of the modules produced by the ASSIST compiler is function of the target computational platform used to run the application. When a computational platform belonging to a single administrative domain (e.g. a COW located in a department) is used, the modules are implemented as dynamic libraries handled by daemon processes running on each computational node.
When the target computational platform is a grid, the ASSIST compiler produces executable modules, that embody functionalities owned by the daemon processes. The executable modules are POSIX/ACE object code, which is suitable to be run on a grid through ASSISTCONF interfaces for Globus Toolkit 2 services (GSI, MDS, GRAM, GridFTP). The object code is actually produced using standard C++ compilers.
Along with the object code, an XML configuration file is generated, storing all the information needed to run the parallel code. Such information include parallelism degree, mapping of specialized code to processing nodes and the alike.
This configuration file will contain information about the ASSIST application, logically subdivided as follows:
• a static section that specifies the binary modules produced by the compiler for a given ASSIST program;
• a section that specifies the configuration of the program, i.e. parallel modules parallelism degree and farms replication;
• a section that contains mapping/execution information.
The first section is built by the compiler, the last two are built by ASSISTCONF.

Resource Discovery

In order to carry out a mapping for an application, the programmer needs to select the suitable machines by accessing a list of available machines.
ASSISTCONF can obtain the list and the characteristics of the available machines by accessing the Grid Information System, implemented by the Monitoring and Discovery System (MDS).
A simple graphical filter window allows to select suitable resources based on particular requirements, specified by the user or stored in a file.

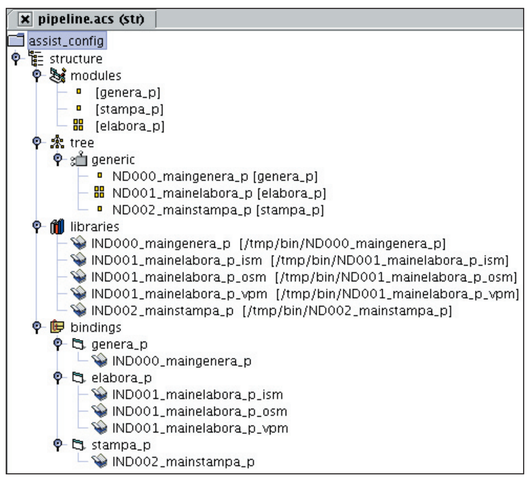




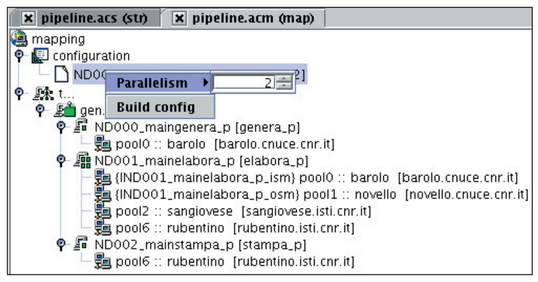


Configuration and Mapping

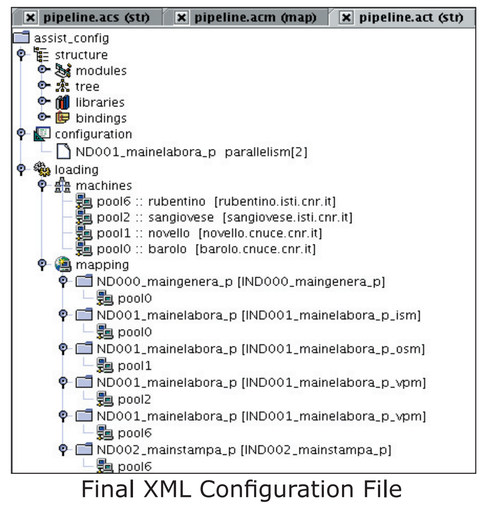
By accessing the context menus of ASSISTCONF it is possible to load an XML Configuration file created by the ASSIST compiler and to specify the parallelism degree of a parallel module and the number of instances of a replicated module. The final step of the configuration process is to establish a mapping between the program modules and the machines in the computational grid.
The final XML file produced by ASSISTCONF can be saved for latter use, e.g. in the case of repeated experiments.



XML Configuration File created by ASSIST



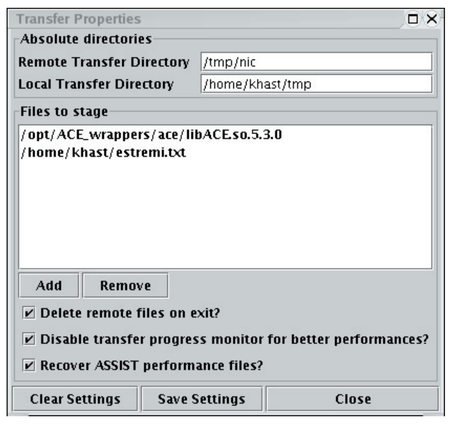
Configuration and Mapping window

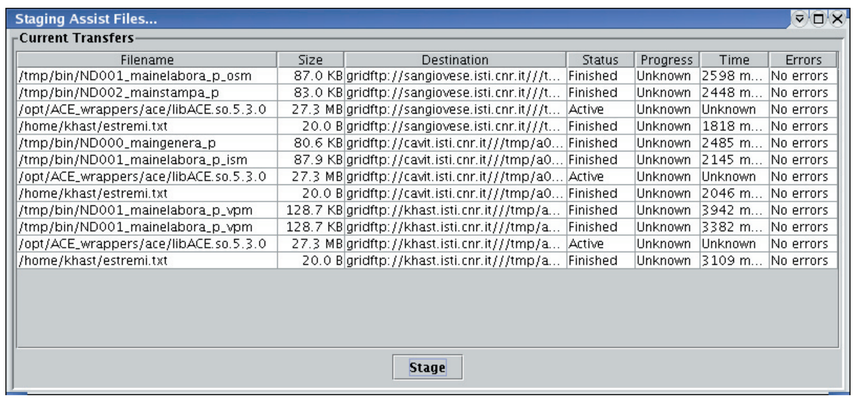


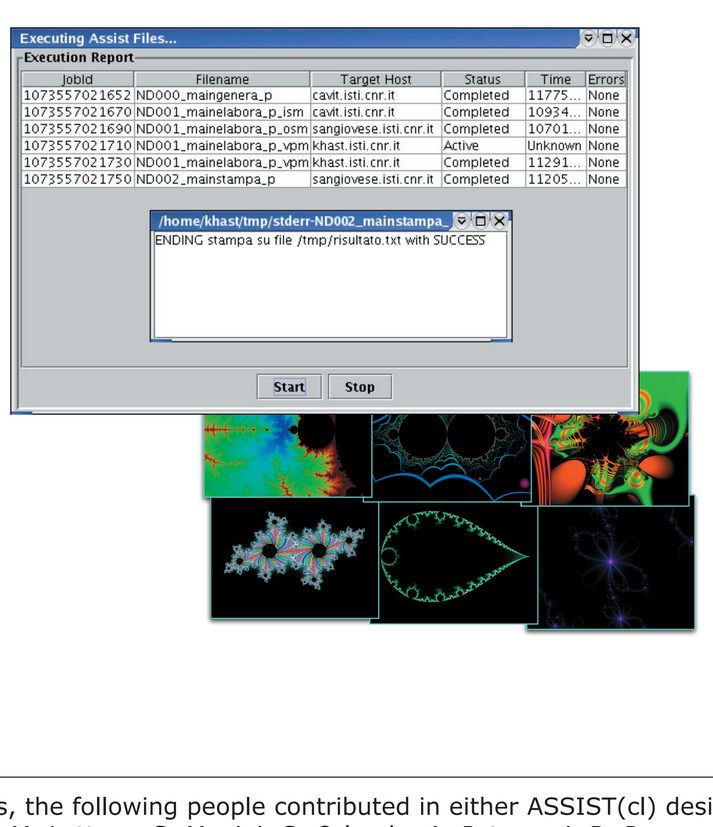
Final XML Configuration File

Staging & Execution

In order to execute an ASSIST application on a grid we exploit the Globus staging and execution mechanisms (GSI, GridFTP, RSL and GRAM APIs). To do this, ASSISTCONF provides functionalities to create and manage a proxy of a valid X.509 certificate. The input files and libraries to be staged can be selected from a list of local files; the executable files are selected by directly accessing the configuration file. To execute the application, ASSISTCONF generates a RSL string for each executable module using information obtained by the configuration file. The execution parallel activation is synchronized by the integration of the GRAM and the ASSIST Run Time Support. It uses a inter-VO communication mechanism similar to the Globus Toolkit firewalls management.
At the end of the application execution the output/error/performance files can be staged back and removed, with the previously staged files, from the resources.







ASSIST has been mostly designed by people of the Dept. of Computer Science, University of Pisa, Italy. Among the others, the following people contributed in either ASSIST(cl) design or implementation: M. Aldinucci, S. Campa, P. Ciullo, M. Coppola, M. Danelutto (project leader), D. Guerri, D. Laforenza, M. Lettere, S. Magini, S. Orlando, A. Paternesi, R. Perego, P. Pesciullesi, A. Petrocelli, E. Pistoletti, L. Potiti, R. Ravazzolo, M. Torquati, L. Vaglini, P. Vitale, M. Vanneschi (group leader), G. Virdis, C. Zoccolo.
ASSISTCONF has been mostly designed by people of the Information Science and Technologies Institute of the Italian National Research Council (ISTI-CNR). Among the others, the following people contributed: R. Baraglia, D. Laforenza (group leader), T. Fagni, F. Furfari, P. Ciullo, S. Orlando, R. Perego, F. Silvestri, P. Pesciullesi, N. Tonellotto, M. Vanneschi.
The ISTI-CNR homepage is http://www.isti.cnr.it/ResearchUnits/Labs/hpc-lab/index.html; for information please contact domenico.laforenza@isti.cnr.it or nicola.tonellotto@isti.cnr.it.