Toward an International Sparse Linear Algebra Expert System by Interconnecting the ITBL Computational Grid with the Grid-TLSE Platform

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Abstract. In the present paper, the methodology of interoperability between ITBL and Grid-TLSE is described. Grid-TLSE is an expert web site to provides user assistance in choosing the right solver for its problems and appropriate values for the control parameters of the selected solve. The time to solution of linear equation solver strongly depends on the type of problem, the selected algorithm, its implementation and the target computer architecture. Grid-TLSE uses the Diet middleware to distribute computing tasks over the Grid. Therefore, extending the variety of computer architecture by Grid middleware interoperability between Diet and ITBL has a beneficial impact to the expert system. To show the feasibility of the methodology, job transfering program as a special service of Diet was developed.

Key words: Interoperability, expert system, sparse linear algebra, Grid computing

1 Introduction

The Japan Atomic Energy Agency (JAEA) Center for Computation Science and e-Systems (CCSE) and the Test for Large Systems of Equations (TLSE) partners (Cerfacs, Irit, LaBRI, and Lip-ÉNS) have launched an international collaboration, within the framework of the Redimps Project (Research and Development of International Matrix Prediction System Project) [1]. In this collaboration, an international expert system for sparse linear algebra will be constructed using an international Grid computing environment. The TLSE Project [2][4][5] is an expert web site that aims at providing tools and software for sparse

matrices. It allows the comparative analysis of a number of direct solvers (free or commercially distributed) on user-submitted problems, as well as on matrices from collections available on the site. The site provides user assistance in choosing the right solver for its problems and appropriate values for the control parameters of the selected solver. It also includes a bibliography on sparse matrices and access to collections of sparse matrices. The computations are carried over a computational Grid managed by the Distributed Interactive Engineering Toolbox (DIET) Grid middleware [3]. DIET is developed by the GRAAL INRIA Project at LIP-ÉNS Lyon. Implementing the GridRPC paradigm, it is designed to make the access to computers transparent from the users. On the other hand, JAEA has developed the middleware of "IT based laboratory" (ITBL)[6]. The ITBL middleware is deployed on the foundation of the Ministry of Education, Culture, Sports, Science and Technology of Japan from FY 2001 to 2005. ITBL was designed to have security network and a great variety of computers available in the ITBL Grid. The time to solution of linear equation solver strongly depends on the type of problem, the selected algorithm, its implementation and the target computer architecture. Thus we believe that extending the variety of computer architectures by Grid middleware interoperability between DIET and ITBL has a beneficial impact to the expert system. In the present work, a prototype of interoperable system of ITBL-DIET is described.

2 Architecture of Grid middleware

In this section, we give a brief overview of the two Grid middleware, ITBL and DIET.

2.1 The ITBL middleware

ITBL is developed by JAEA to provide the secure and easy access to the supercomputers from the user terminal through the Internet. In figure 1 the architecture of ITBL is illustrated. In ITBL, supercomputers are isolated from the Internet by a firewall for security reasons. Therefore, computers that are set outside of ITBL are not allowed to access the supercomputers directly. This aspect is the main issue to achieve interoperability with ITBL. Users access to the computers by relaying several servers which are the gateways of ITBL network.

2.2 The DIET middleware

The Distributed Interactive Engineering Toolbox (DIET) is developed by the GRAAL Team. The DIET project aims at developing a scalable middleware. Scheduling is distributed over a hierarchy of agents (Master and Local Agents). DIET consists of a set of elements that can be used together to build applications using the GridRPC paradigm. This middleware is able to find an appropriate server according to the information given in the client's request (*e.g.,* problem to be solved, size of the data involved), the performance of the target platform

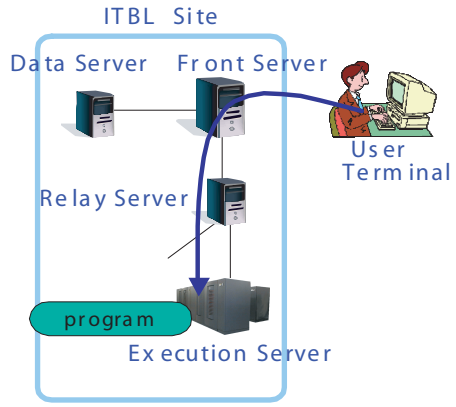

Fig. 1. Illustration of ITBL

(*e.g.,* server load, available memory, communication performance) and the local availability of data stored during previous computations. The scheduler is distributed using several collaborating hierarchies connected either statically or dynamically (in a peer-to-peer fashion). Data management is provided to allow persistent data to stay within the system for future re-use. This feature avoids unnecessary communication when dependencies exist between different requests.

3 Interoperable system

3.1 Overview of interoperable system

In figure 2, a conceptual architecture of interoperable system is shown. Master Agents (MA) and Local Agents (LA) are the components of DIET that are used for job scheduling. The DIET Server Daemon (SED) is the program which launches the resolution of the request on behalf of the user on the distant computer. In the present interoperable system, we developed a special SED that behaves like ITBL client. This special SeD was implemented to transfer the job request from DIET to ITBL computers. In the present research, the special SED was developed with the ITBL Common API. The API includes authentication function, file transfer (send and back) function, and job submission function. Therefore, it could be built without difficulties and all connection passing over the Internet was curried out with encrypted communication.

3.2 Security issues

One of the most important aspect in the interoperable system is the security model, because we must pass over the Internet which can be qualified of insecure.

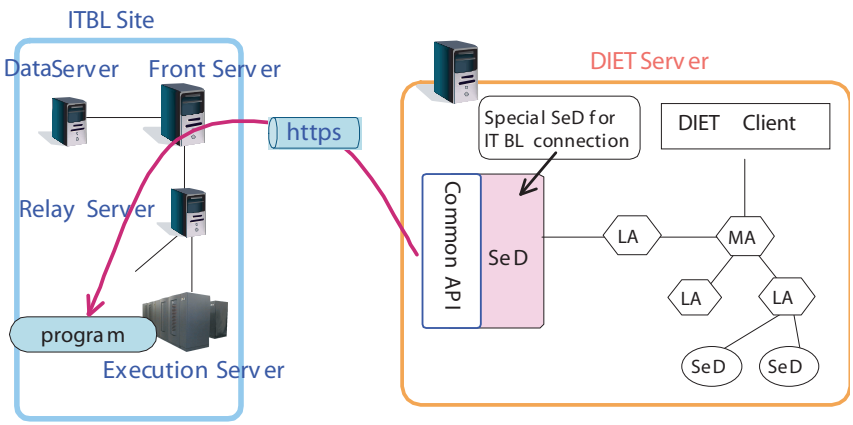

Fig. 2. Architecutre of inteoperable system

In this research, we mainly rely on the robustness of ITBL system. That means that we register the certification file of the ITBL user on the DIET server, and the SED accesses to ITBL with the certification. In figure 3, we illustrate the location of certification file and how to use it in the interoperable system. In this figure, user A and B who have the permission to access the ITBL registered their certification file and user A tried to access the ITBL through TLSE. Originally, DIET does not have the functions which require user identification. On the other hand, the interoperable system must identify the user in order to specify the user ID of ITBL. In order to avoid such mismatch, we decided to use the ID of TLSE. That is to say, in the interoperable system, the ID of TLSE was converted to the ID of ITBL with one by one matching rule.

4 Conclusion

The goal of the Japanse-French Research and Development of International Matrix Prediction System (REDIMPS) Project that we have introduced in this paper, is to promote the TLSE platform as a widely used international expert system for sparse linear algebra.

We have described a first step of the REDIMPS Project that consists into achieving interoperability between the DIET and the ITBL middleware. This allows to extend the TLSE platform with the computers and the solvers available within the ITBL computational Grid. The DIET-ITBL interoperable system transfers the jobs from DIET to ITBL and allows to recover back the results.

Some parts of the TLSE platform are currently available on the `http://gridtlse.org/` web page. We are currently deploying sparse solvers within the platform.

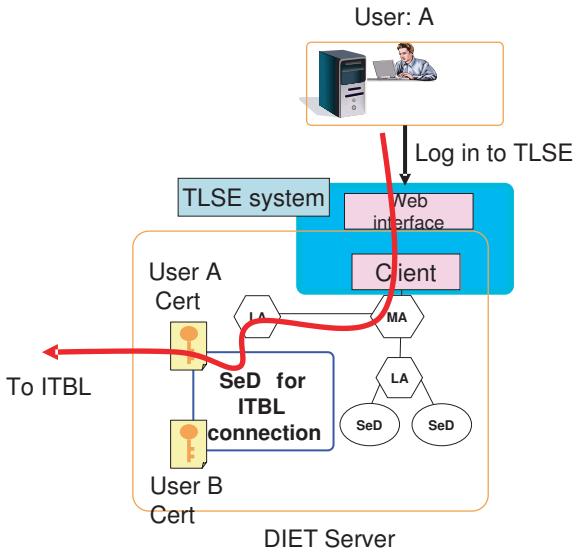

Fig. 3. Location of user certificate

By the time of the VECPAR conference, the TLSE platform will include several sparse solvers and will have all its features available. It will be interconnected with ITBL.

Acknowledgement

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References

1. PREDIMPS web site. URL: http://www.redimps.org
2. Amestoy, P., Daydé, M., Hamerling, C., Pantel, M., Puglisi, C.: Management of services based on a semantic description within the Grid-TLSE project, VECPAR'06 - Workshop on Computational Grids and Clusters (WCGC 2006), Rio de Janeiro, Brésil, Springer-Verlag, LNCS 4395,(2006), 634–643.
3. Caron, E., and Desprez, F.: DIET: A Scalable Toolbox to Build Network Enabled Servers on the Grid. International Journal of High Performance Computing Applications, vol. 20., (2006), 335–352.
4. Daydé, M., Desprez, F., Hurault, A., Pantel, M.: On deploying scientific software within the GRID-TLSE project, Computing Letters, VSP/Brill Academic Publisher, Vol. 1, No. 3, (2005), 85–92.

5. Daydé, M., Hurault, A., Pantel, M.: Semantic-based Service trading: Application to Linear Algebra, VECPAR'06 - Workshop on Computational Grids and Clusters (WCGC 2006), Rio de Janeiro, Brazil, Springer-Verlag, LNCS 4395, (2006), 622–633.
6. Fukuda, M.:ITBL–Toward Constructing a New R & D Environment, Japanese scientific monthly, Vol. 55, No. 2, (2002), 19–23.