Research on Concepts and Technologies of Grid Collaborative Designing to Supporting Cross Enterprises Collaboration

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Abstract. The original Cross Enterprises Grid Collaborative Designing System could not meet industrial demands on dynamic sharing of various and transient manufacturing resources and collaboration due to their inherent weakness. The concept of collaborative designing technology under the guidance of Grid theory based on the principle of facing to business users, supporting "Integration on Demands" and "Instantaneous Integration." During application integrating process, Business-driven Grid technology breaks the barriers between computer experts, domain experts, business designers and business executants, and supports instantaneous integration. Unlike traditional network collaborative design technology, Resources is integrated instantly according to the directives of its business users, and thus comes the concept Grid Collaborative Designing. This paper analyzes the different between manufacturing and computing resources, gives the definition, connotation and the problem which Grid Collaborative Designing attempt to solve, discusses the differences and similarities between Grid Collaborative Designing and other related technologies, analyzes the limitation of traditional technology supporting cross-enterprise collaboration. At last an architecture of WSRF based OGSA is yielded, it encapsulate manufacturing resources into services using WSDL description, services mapping and deploying method, and the core research issues in Grid Collaborative Designing are submitted and the related technologies are summarized.

Keywords. Grid Collaborative Designing ,Grid Computing, Web-based Manufacturing, Web Service.

1 Instructions

The modern complicated products are an achievement of using multi-field knowledge, usually involve the knowledge in fields such as electromechanics, hydraulic pressure, control, information,etc.. In today in high development such as information technology, how about be under the assisting of computer, integrate the design knowledge in the multi-disciplinary field effectively, it is the key point that the products succeed in designing. And single enterprise rely on oneself only resource and ability meet its product design's demands alone while being very difficult, with the increase collaboration among enterprises, more and more enterprises have already realized that realize the necessities of information sharing, resource-sharing among enterprises through Internet, on the basis of to design with

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manufacture system because of inherent weakness their in coordination Web a traditional one, make it unable to deal with the environment of the dynamic change, especially can't deal with the sharing of instantaneous resources.

Appearance of Grid, design, exploits resources, innovate and design offering new theory and infrastructure. Grid can realize the virtualization of many kinds of distributedly computing resources, such as handling the course, memory capacity, data and network broadband, thus establish a single fictitious system, offering for users and applications to a large number of IT functions visiting that has not sewn. The concept of the Grid has already been applied to a lot of fields such as calculation, astronomy, biology information, and intensive in calculation, intensive application of data, such as Globus[1], SETI2@home[2],Global Grid Forum[3], European Union (EU)DataGrid[4], so many research projects have got application. In order to satisfy and realize fundamentally the demand of solving in dynamic resource-sharing and question among the cooperative enterprises of the dynamic change, the concept of the Grid Collaborative Designing rises in the field of product design. In order to explain the feasibility of the Grid Collaborative Designing in the manufacturing field, this paper is yielded an architecture of WSRF based OGSA, it encapsulate manufacturing resources into services using WSDL description, services mapping and deploying method, and the core research issues in Grid Collaborative Designing are submitted and the related technologies are summarized.

2 The characteristic of the manufacturing resource

Manufacturing resources is that enterprises finish the general name of the physical elements of activities in production of whole lifespan of the products, can include material resource, information resources, technological resource, human resources, fund resource,etc. comprehensive resource inclusive, for instance the apparatus, processing tool, extensive application software, design resources bank,etc.. On design phase, manufacturing resources including various design tools, for instance various application software such as CAD, PDM, FEA; Products data existing with various forms; And other various relevant information,etc. such as customer's demand. Computing resources include CPU, Memory, Data, Software, and distributed system,etc[5].. Manufacturing resources in the form of existing, management style, etc. have characteristic that is different from computing resources.

There are a large number of physical resources in manufacturing resources. These resources must solve the virtual problem at first，if they want to share through the Grid. The virtual source of so-called resource means that releases the functionality and handles these functions from the particular physical apparatus, include a lot of mechanism and technology which slacken those frameworks and users and perceive behavioral from physics realizing of resources of software and hardware [6]. On the manufacturing field, realizing the foundation facing integration of enterprise served virtually of resources, through fictitious to turn Web service realize in resource of environment entity[7].

On the management style, manufacturing resources have the same characteristics with computing resources. If distributed in different organizations of different regions, the owner of resources has top administration authority to their resources, all dispersible resource owner determine according to one's own condition whether to share his resource at the Grid, make dynamic change of quantity of resources at the whole net, meanwhile, because the fast changes of market and the change of peripheral economy, the political environment, dispersible resource requirement person's demand for resources in the region is dynamic change too, this causes resources shared to have very obvious distribution and dynamic characteristic.

3 Definition of Grid Collaborative Designing and key problem

3.1 Grid Collaborative Designing

It means under computer support, every member focus on a design object to design in coordination, undertake the design task of the corresponding part, carry on the design work alternately, get the design result design method according with designing requirement finally. The basic goal of the Grid Collaborative Designing is that the intelligence share, resource-sharing, aim at based on resource-sharing of material, for instance resource-sharing of software, resource-sharing of apparatus,etc.; Be distributed in different fields through the network, the organization stand up organically on the intelligence resources of different trade or different specialty, synthesize each side's advantage, improve the whole design level of the products. Collaborative Designing has characteristic that cooperates on a large scale, i.e. the disperse of the mutual colony's region range, the different constructing of the environment, the extension of business and discipline domain, variety of information,etc.. So the research on Grid Collaborative involve a lot of respects, mainly include system integration and information sharing, the negotiation and clearing up of the conflict question, collaborative and exchange, organization and management of knowledge,etc.

The Grid Collaborative Designing regards the Grid as the infrastructure, it based on the principle of facing to business users, supporting "Integration on Demands" and "Instantaneous Integration." It collaborates and organize a lot of design units, business-driven Grid technology breaks the barriers between computer experts, domain experts, business designers and business executants, and supports instantaneous integration. It fully utilize the computing resources of the Grid, data resources, the service,etc., resources is integrated instantly according to the directives of its business users, and thus comes the concept Grid Collaborative Designing, use field knowledge to make policy in coordination, output the comprehensive course of the products. Supported by Grid. Users use the resources on Internet like using local resources synthetically. Users will design the task to be referred to the door, the task will be assigned to corresponding resources to finish through the course of task decompose and resources mapping.

3.2 Key problem of Grid Collaborative Designing.

The Grid Collaborative Designing utilizes net and relevant advanced computers and information technologies, to realize the resource-sharing in the net and the collaborative designing question to ask and solve. In order to realize this goal, on the basis of grid computing research, fully consider the characteristic of the manufacturing industry, study and solve the key technology of the manufacturing operations characteristic, design the grid framework suitable for manufacture resource sharing and product collaborative designing, develop one the middle the application facing manufacturing field, construct the grid collaborative designing system which meets the demand characteristic of manufacturing operations.

Grid framework

After several years of research and practice, the grid technology system structure has been already mature day by day. In the abstract structural level, the most important and most representative one is the structure of five layers of sand filters[8]; In 2002, GGF propose Open Grid Services Architecture[9] [10]. In OGSA frame, it make everything abstract into service, including the computer, the procedure, the data, instrument and equipment,etc.. this kind of idea help to manage and use the grid by unified standard interface[11].

But traditional computing grid or general service grid framework can't be totally competent at manufacturing grid. First of all, manufacturing resources is disperse, mutual and complicated, and its operation is not always automatic, which make it more complicated and challenge to set up the grid of manufacturing service. Second, the traditional computing grid lays particular emphasis on solving computing question on a large scale, it is often a comparatively simple calculation task that its homework is submitted. There is a lot concrete complicated business treatment not computing in the grid to deal with, which have the characteristic of long periodicity, complexity, flexibility and cross-organizing collaborative with,etc.; Third, the nodal institutional framework of manufacturing grid is complicated, consider fully considering nodal autonomy in the design, the sense of organization, adapt to the need of the construction of the grid, expand and the business operate.

Manufacturing resources modeling and encapsulation of resources

Manufacturing resources modeling is an important basic work in manufacturing grid research. It needs to study and manufacturing grid resource-sharing implementation method, especially the systems approach to realize resource-sharing under facing the service framework at first, show resources, resources encapsulate and the resource scheduling are made into the whole consideration; Need to study the expression model which makes resources emphatically, can contain different types of manufacture resources, solve the problems of the various types and different shapes, at the same time considerate the demands on resource find and match; Study the encapsulation of resources and virtual on this basis, solve the manufacture resources of a large number of physics, encapsulate in appropriate form, become the problem that can visit resources on the network.

Deployment and job management of the Grid Service

The main business form of the grid collaborative designing is cross organizations collaborative homework of fictitious enterprise's modes ,except what a resource that deployment dispersed in different organizations is needed to

consider, and to the procedure dynamics of the homework and uncertain support among them; Meanwhile, it designs to be one trends and confirmed course in coordination, it carry out course distribute until by different to construct and among the distributed environment that independent enterprise form, customer's enterprises need to control and coordinate the manufacture process. Consider the characteristic of application of net, study how to provide convenience, the modeling tool of flexibility, dynamic choice is served and tied and served definitely to combine, make resource noumenonn, come on, solve and serve and make the dynamics problem up, design and realize the net homework administrative system, deployment of resources while supporting the homework to carry out.

4 Grid Collaborative Designing And other Network Technology

The grid collaborative designing system can be regarded as the distributed system finished the particular task through cooperating each other by a lot of independent nodes. And the grid computing system is a kind of information technology infrastructure formed by hardware and software, in a dynamic and distributed virtual organization, offering reliable, coordinate, expanding and low-priced resources sharing and collaborative. Dispersible all kinds of construct resources differently and serve as fictitious whole through the grid in geography, realize computing resources, store resources, the resources of the data, information resources, knowledge resource, overall sharing of expert resources. The grid service has broken the traditional sharing or collaborative restriction, the sharing to resources often stayed in the level of file transfer of data in the past, and the sharing of net resource allows to directly control other resources, and each side of the shared resource can exchange information in many ways while cooperating, utilize grid technology to well solve the dynamic deployment of the design task in the design, questions such as the sharing and analyzing and calculating collaborative of distributed knowledge,etc., help to further accelerate the design process of the products.

Grid collaborative designing offer an integration sustain environment for the integration and share for the enterprises and social resources, collaborative designing among enterprises and management. Through integrating and encapsulating the dynamic design information dispersed in different enterprises, resources of production and products all other information and resource in lifespan, hide these details of manufacturing resources, and present it to users in form of operating. Collaborative grid designing share and optimize belong to the manufacture resources of different organizations, utilize the standard, open, common agreement and interface come to meet single enterprises demands on resources share and collaborative designing question. Its' core question is to coordinate the manufacturing resources share and designing solve. The sharing here is not the file exchanging in the past, but visiting the computer, software, data and other devices more directly, on the demands of collaborative designing question ask and resources agent policy which appear in the fields of the enterprises ,science and project.

Web service passes standard Web agreement in a manner to independent of the platform, is logic unit of application program[12], that can be visited by the

procedure. Outwardly, Web service is a application program, it exposes one API that can be transferred to the external world through Web, the programmer transfers this application program by Web. Meanwhile, because Web services structure is consider extensively one contractual mutual method of the distributed software, Web service offer the standard working technique[13] each other while operating different application software on various platforms and/or frames. It can use Web service to solve the distributed computing problem of nonstructural differently.

The grid service is a kind of special Web services. It including lasting service and instant service, joining the dynamic information at the same time, to meet grid system's demands. With the constant development of grid technology and Web service technology, especially the introduction of Web services resources frames (WSRF), have accelerated the integration of grid technology and Web services. Resources are defined as the one with the state in WSRF, but the service is no state. For manufacturing resources, each resource regard as one reliable service that can be added or deleted in grid at any time. The essence difference of collaborative designing grid with the web service in the past lies in dealing with dynamic resource in coordination. The grid technology not only can share permanent resources, but also share instantaneous resources, which has solved the sharing problem of manufacturing resources dynamically fundamentally.

5 The system of Across Enterprises Grid Collaborative Designing

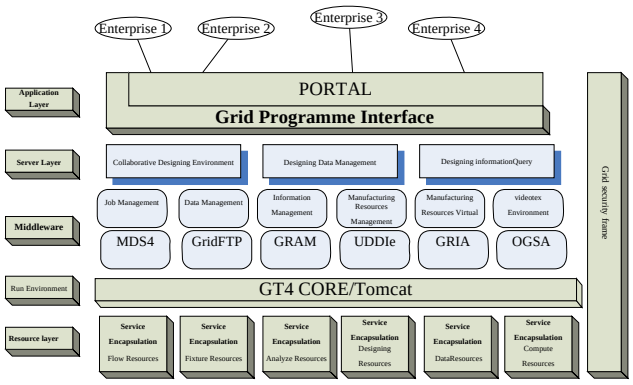

Fig. 1. The system of Across Enterprises Grid Collaborative Designing

This paper provides a kind of support across the grid system structure which enterprises design, as shown in Fig. 1. This structure is adopted on the basis of facing service , follow OGSA normal hierarchical structure set up. Encapsulate for Web service and register and form its storey of resource in the net from dispersible manufacture resources. Utilize GT4 CORE / Tomcat / Axis put up environment operate, it waits to be comparatively ripe one under grid as the foundation at present with piece to GRIA that industrial circle employ, dispose MDS4, GridFTP, GRAM, OGSA-DAI, UDDIe,etc. construct the back-up environment of ground floor based on kernel service, offer resource management, data transmission,

scheduling of resource, different core of constructing nets such as the access to data,etc. to support the function; Under the support of a technology between the design, shield the different resources that constructed of ground floor, support the realization that the net of design employed in coordination of the fictitious organization's mode.

Resource layer

The resource layer is gathering layer of all kinds of resources, including the organizations of all kinds of data, knowledge and some logic deal with, even including relevant designers and apparatus. These manufacturing resources are offered by the enterprises participated in the grid collaborative designing, these resources carry on the packaging in form of serving, ones that finished resources are virtual, to the resource type of manufacturing field and characteristic of describing, offer different kinds of encapsulation models to encapsulate them.

Resource of physics can be used by grid only after encapsulating. So main job of resource layers is virtual. Resource can have two way while being virtual, first to express as resource standard Web service by provider of resource, until sharing of resource use, turn into to request that Web serve correctly, resource taken to serve dispose at resource night host computer of provider. Another kind of encapsulate, accord with WSRF normal service (abbreviate as WSRF serve) as one, concrete manufacture as a resource registration that WSRF serve this resource, and the WSRF serve, can register get net service registration center too, equivalent to one " container" of resource; Each kind of resource has offered one to encapsulate the template, the resource provider can download this model, use it to encapsulate a kind of manufacture resource, it can already be in order to register the resources containers that entered to encapsulate good resources on the resource provider's local constellation host computer, can pass the net Portal to public resource container registration too.

Grid Middleware

Distributed because of different constructing and wide area manufacturing resources, these resources belong to different enterprises at the same time, it is difficult to apply in net directly, so it need the corresponding software system to dispel the difference between the systems joint differently, realize the unified management of the whole net resource. Each research institution in the world has carried on a large amount of research in such aspects of system structure of grid , Grid middleware, agreement, programming running environment. And it has developed some middleware tools and frame, such as Globus, Condor-G, Storage Resource Broker, DataCutter, Legion, Cactus and common framework. These research results establish the foundation for designing the implementation of grid collaborative designing intermediate.

Design Middleware

The upper strata of one the middle the net are to face each the middle the design that is designed in coordination, include some special-purpose services that are developed in the middleware, core to the manufacturing field on a foundation among them, in order to support the application that is designed in the net together, among them mainly include setting up in job management, data management, grid information management, manufacturing resources management, virtual tool of resource and visual environmental foundation of grid, in coordination with the design environment, designing data management, designing the information management,etc.

Application Layer

Employ layer offer interface of contents of grid, which is the aspect that ordinary users can perceive. It including the door entry based on Web and application interface using the interface of the net service to develop among other systems. Application layers of user needn't understand that design the structure of ground floor of the net in coordination.

6 Conclusions

Through integrating and sharing of manufacturing resources, grid technology will bring the prominent advantage to manufacturing industry. Design research and application of the grid present the good development trend in coordination. However, grid collaborative designing is still a new developing field, its research is at the starting stage at present, no matter theoretical research or application is not ripe. This paper encapsulate manufacturing resources into services using WSDL description, services mapping and deploying method. It give a reference model of grid collaborative designing, to solve the main problem of the research on the grid collaborative designing, make the net widely used in the business circles in coordination with designing technique.

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