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Computer Supported Cooperative Work in Design I

8th International Conference, CSCWD 2004
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Vega Information Grid for Collaborative Computing

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Abstract. This paper looks at computer supported cooperative work (CSCW) from an information grid viewpoint. We illustrate two collaborative instances in information grid and point out new CSCW requirements. We discuss key pieces of two models in the VEGA-IG (VEGA information grid): model of object and that of subject, which help the achievement of collaborative work and partly solve the difficulties in collaborative work such as unknown participant, dynamic cooperation channel, multi-modal communication, dynamic participants and resources. The two models take loose coupling as their main point and shield many complicated information of the collaborative work. We also discuss two examples of collaborative work in VEGA-IG.

1 Introduction

Research in Computer Supported Cooperative Work (also known as CSCW, groupware, collaboration tools) can be traced as far back as 1968, when Douglas Engelbart demonstrated his NLS with video teleconferencing features [1]. Since then, CSCW has blossomed into an exciting academic discipline with a large, growing application market. ACM now sponsors an annual international conference on CSCW. There are many industrial strength software products. More importantly, we are witnessing an accelerating trend of CSCW applications with ever increasing richness and diversity, ranging from business workflow to multiplayer games.

The term "grid" has been used in various contexts with different meanings. In this paper, we use the broad definition [2] to refer grid to an interconnected distributed system that supports resource sharing, collaboration, and integration. Grid computing [3] is a kind of distributed supercomputing, in which geographically distributed computational and resources are coordinated for solving problems [4]. In this paper, we examine CSCW from an information grid viewpoint. We first give two examples in the real word to summarize the new requirements of the collaboration work. And also we can see that information grid commit itself to the research on enabling technology for information sharing, information management, and information services in grid. We point out that object and subject are important concepts in the research on information grid. The research on the model of object and subject in VEGA-IG help to finish the collaborative work especially with the help of the virtual layer and the effective layer. Information technology as a whole is entering a mass adoption stage, with network computing a main technology characteristic. This trend will have profound implications for the CSCW community. The information grid research community is developing new technology to meet these requirements.

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The rest of the paper is organized as follows: In Section 2, we propose two examples in current information grid and discuss the new requirements for CSCW technology. In Section 3, we describe two models of VEGA-IG: the model of object and that of subject. We also discuss the central features of the two models that are relevant to CSCW. In Section 4, we illustrate how the two models help the achievement of collaborative work. We offer concluding remarks in Section 5.

2 New Requirements for Collaboration

To see the future requirements of CSCW, we can look at examples in current information systems. For instance, China Railways has the largest customer base in the world, serving hundreds of millions of customers daily. We discuss below two desired collaboration use cases from China Railways information systems. The first case is for business professionals, while the second concerns end users.

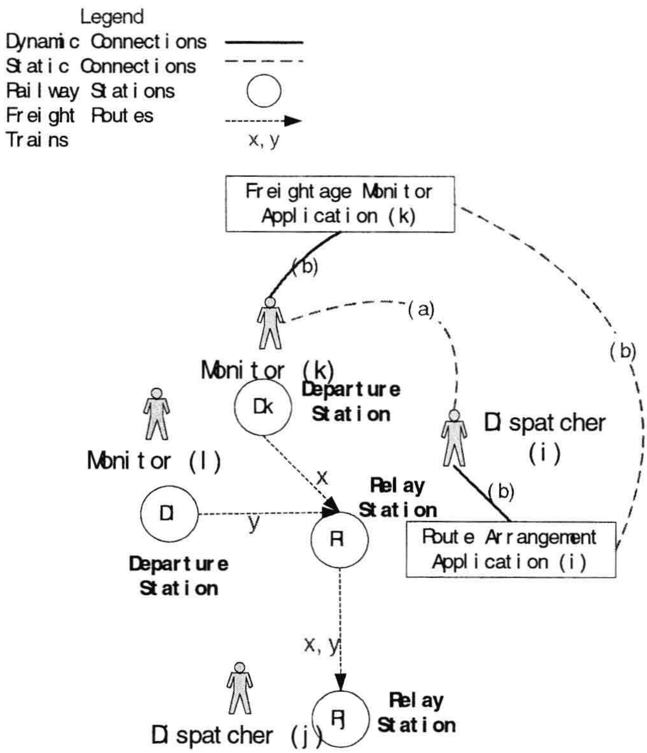

Fig. 1. Freight Route Consultation

Collaboration in Freight Routing. Every day thousands of container cargos are transported by railways. Cargoes are composed into freight trains at each departure station. When a freight train passes by a relay station, its route is often adjusted in accordance with the actual railway situation. The dispatcher in the relay station needs a comprehensive collaboration system help he or she to consult with the train's monitor to decide a reasonable route of the train.

At the same time, related applications need to be integrated together. Figure 1 shows two of such applications. When adjusting a train's route, the Route Arrangement Application must dynamically connect to the train's Freight Monitor Application to exchange information.

Hence they need build two kinds of cooperation channel. One of them is direct communication way through some audio or video conversation medium, denoted as (a) in Figure 1, whereas another one is an indirect communication way through related application(s), denoted as (b) in Figure 1. That implies the information from one participant will be processed by the related applications, and another participant can only observed the processing results.

In our scenario, because it is impossible to predict which train has to change its route in advance, the cooperation channel has to be constructed dynamically and temporarily. This will introduce many new challenges to collaboration system development.

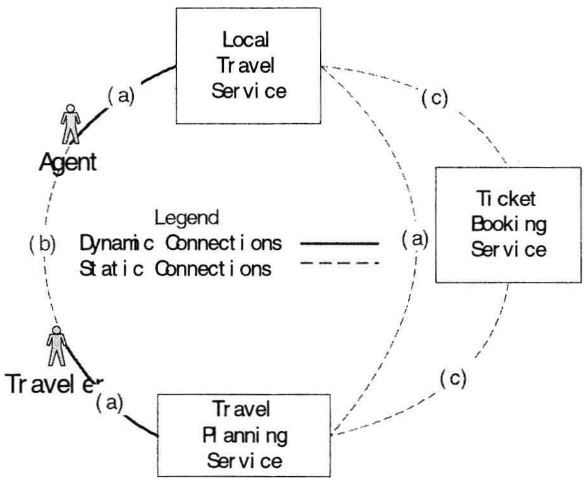

Fig. 2. Collaboration in Traveling

Collaboration in Traveling. Traveling by trains is cheap and more and more convenient with the raising quality of railway service. So in China, most common people would choose to travel by trains. Many travelers like to arrange their travel plan well, before set out on a trip. But when they discover some interesting travel program temporarily, they often want to get some service from a local travel agent. At that time, they require collaboration between their original travel service, local travel service, and even ticket booking service.

Consider the collaboration scenario of Figure 2. The traveler needs to look for a local travel service agent. In order to modify the travel plan, the traveler needs communicate with the agent. They could directly communicate through a simple chat system. In general, the traveler hopes to inherit his original plan, so the related information should be transferred from the travel planning service to the local travel service and get an appropriate new plan. And in the case to change the old travel route, or build a new travel route, the travel planning service, sometimes as well as the local travel service, need collaborate with a ticket booking service automatically. Because the related applications are not aware of each other in advance, it will introduce new challenges to perform the cooperative tasks dynamically.

From these two use cases, we can summarize several collaboration requirements.

Unknown Participant. In general, before a cooperative work begins, the collaborative initiator either is aware of the location of other participants (such as message exchange system), or can create a persistent collaborative channel (such as bulletin board system). But in a dynamic collaboration environment, the above assumptions may be broken. Because the collaborative initiator often need initiate collaboration without awareness of the concrete location of other participants, he just knows some rules to look for the other participants. So he could not create a collaboration channel in advance.

For example, in the Freight Route Consultation case, when some trains need to change their route, the dispatcher only knows the rules to look for the train's monitors, but he does not know where they are and how to contact with them. And the issues are similar in the second case.

Dynamic Cooperation Channel. After the initiator finds the other participants, to create cooperation channels dynamically will introduce other challenges. Let us look at the first use case. The resulting data must be transferred from the Route Arrangement Application to The Freight Monitor Application. This in turn requires the applications to understand the syntax and semantics of each other's data formats, as well as each other's interface.

Moreover the dispatcher and the monitor also have the possibilities to communicate though different conversation application clients. They need exchange information between the different conversation applications. But, in fact, the applications do not know each other in advance, and at most times they do not want to know so many details of each other. So the problem is how to exchange information among the related applications without knowing access details.

Multi-modal Communication. Each collaboration session may need different types of communication. It is desirable if all these communication modes are made available at the user's fingertip.

Dynamic Participants and Resources. There are more than one participant and many resources in one collaborative work usually. Much information of both subject and object may have some changes during the period of collaborative work happen. We can take the subject as an example. Users may change their attributes; their host community at any moment, and also the administrator may change some policy of user management. At this moment we must guarantee the accomplishment of the work.

3 Two Models in Vega Information Grid

We should take two important factors into account when we refer to CSCW: subject and object. From the viewpoint of philosophy, subject means the people who have the ability to cognize something and practice, while object means those things that existed besides subject in the world. To be brief we can consider that in VEGA-IG, the object is the resource and the subject is the user. As it comes to collaborative work, there should be at least two participants (users namely) who are involved in the work. And at the same work, there should be some resources that act as object. Only when all the participants work at the same resource can the collaborative work achieved. Resource sharing is also the primary method supports the collaborative work. So it is safe for us to draw the conclusion that the research of subject and object in VEGA-IG will be beneficial to that of CSCW.

We propose the object model and subject model of VEGA-IG respectively in this section.

3.1 EVP Model of Object in VEGA-IG

Firstly we discuss some points in the object model of VEGA-IG. The structure of the model is illustrated in Figure 3 [5]. There are three layers in the model named physical layer, virtual layer and effective layer from bottom-up point of view.

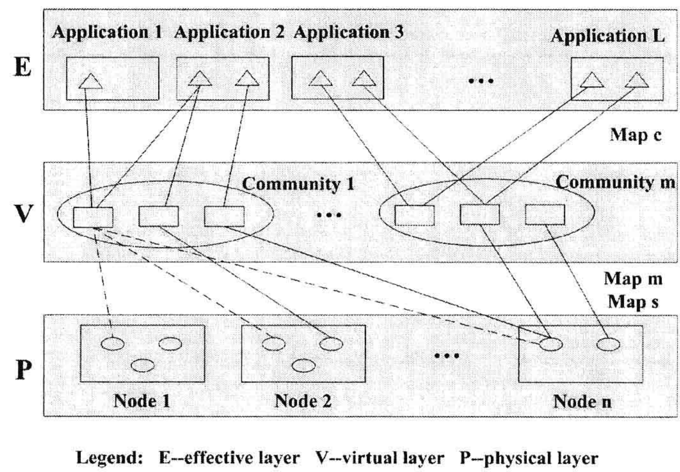

Fig. 3. EVP model of object in VEGA-IG

Physical layer is the lowest layer in the model and is actually where the resource saved and the operation of resource (such as add, delete, modify etc.) happened. The programmers and the professional mainly use resource of this layer. What really happens to the resource of this layer is unknowable to the end users.

Virtual layer has the responsibility of managing the resources in a community and dynamically adjust the map between the virtual layer and the physical layer when some kind of alteration happen. With the help of virtual layer resource, many collaborative works can be accomplished conveniently for this layer help users to locate and search the resource he or she need.

End user uses effective layer and the resource provided by this layer is available even for the secretary. A higher level language called Grid Service Markup Language (GSML) is available in this layer, which allows users (not necessarily programmers) to specify grid services and user interface in an easy to use fashion. GSML makes collaborative work among mass users possible.

Resources on grid nodes can be wrapped as Web services or grid services, and registered with the Vega GOS (Grid Operating System). Resources at this level belong to physical resources. A technical staff can use a software tool called Resource Mapper to map physical resources into location-independent virtual resources. A secretary can then use another tool called GSML composer to turn the virtual resources into effective resources in a GSML page. Table 1 gives some main features of the object model.

Table 1. Features of Object EVP Model in VEGA-IG

Layer	Program language	Developer	User	Resource assemble
Effective	High level	Secretary	Leader	Yes
Virtual	Middle level	Programmer	Secretary	Congener resource
Physical	Low level	Programmer	Programmer	No

3.2 EVP Model of Subject in VEGA-IG

Secondly, we bring forward the EVP space model of subject in VEGA information grid showed in Figure 4 according to the EVP space model of object. There are still three layers named physical layer, virtual layer and effective layer respectively. While what different from the model of object is that security instead of resource is the main point in the model. We don't treat the information of subject same as that of object. Besides one kind of resource in the information grid, the information of subject should also have the liability to be the representation of the user.

Effective layer user is mainly designed for the end user and composed of exterior user name and interior user name when it comes to implement. The exterior user name is friendly for the user to logon the grid and support the single sign on (SSO) in the information grid. In the collaborative work where one participant needs to know where and who are the other participants, the user information of this layer can do some help. What really matters in effective layer is that one user (or a grid service, a web service, an application who act as the role of subject) can easily find his or her participants in the information grid.

Virtual layer user is designed to finish such kind of works related with resource and access control (AC). It is composed of certificateID Proxy (a transformed certificateID by some algorithm in order to protect the real certificateID) and the Token where many information of resource and access control saved.

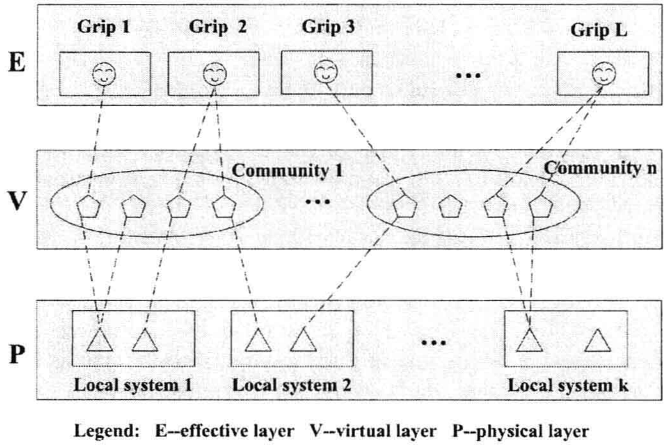

Fig. 4. EVP Model of Subject in VEGA-IG

Physical layer user is namely the local user, and the actual user who represents the grid subject to use resource. Physical layer user has much with the system who provides the resource. We can take Data Base as an example where the physical layer user maybe identified as Dbuser @ dbpasswd.

Table 2. The Features of Subject EVP Model in VEGA-IG

Layer	User Identify	Feature	Function
Effective	UserID&PassWrod Certificate ID	Exterior name Interior name	Friendly Uniquely SSO
Virtual	Certificate ID Proxy Token	Community collaborated Resource collaborated	Secretly Flexible Unique in community
Physical	Local user	Local system collaborated	Unique in local system

The three-layer partition of the information subject makes many collaborative works possible. Many features of the model is illustrate in Table 2. In the work of fee count system, it is impossible for the system that provides the resource service to know which user indeed use the service since many information grid users may be mapped into the same physical user. While with the help of virtual layer user, it is convenient for the system to distinguish the users who use the service. So it is safe to draw the conclusion that the three-layer partition of the information subject guarantees the security of the system, the character of unique, the SSO, and also the alterability of the policies.

4 The Vega-IG and Its Supports for Collaboration

With two models above, we can solve part of the problems exist in the two cases we propose in section 2. For the first case of freight route consultation, the two applications can operate on the same physical layer resource by operations on different virtual layer resource. The monitor can modify the physical layer resource by his own application when some emergences happen while the dispatcher can get the modified information as soon as the change happen. With the help of the virtual layer, there seemed to be a dynamic channel between the two applications. For the second case of collaboration in traveling, because both subject and object are well-organized in community of effective layer or (and) virtual layer, the traveler can easily find the services he or she want by many kind of tools such as Service Search. With the help of Service Search, the traveler can find those services that satisfy his or her need and then establish a dynamic channel between the two services.

From analysis above we can see that Information grid commit itself to the research on enabling technology for information sharing, information management, and information services in grid. The information grid focuses on information, and largely ignores issues such as process, transaction, and semantics. VEGA-IG has four features as follows:

1) Platform character
2) Dynamic adaptability
3) Sharing character
4) Collaborative character

The infrastructure of VEGA information grid is illustrated in Figure 5. Griplet is a kind of Grip (grid process) who represents the subject of grid to visit and use grid. Grip is a key concept in the research on other kind of grid such as computing grid. What different from other system is that VEGA information grid gives users a platform with which people can add both resource and applications into the system conveniently. Different kind of resources such as messages, databases, file systems and also white board can be added to the bottom of the platform, and at the same time, different kind of applications can be added to the top of the platform. Using this platform we can implement some kind of collaborative task and the method here is far from the traditional method of "solution".

Now we take resource transfer in VEGA-IG as an example to show how the collaborative task is accomplished based on the two models. At present, a user can transfer files to another user through the methods of mail, msn etc. All of these methods use the real resource as an attachment. That means the copy of the resource is produced and transferred to another place. While in VEGA information grid, what a user should do is just transfer the handle of the file (identifier of the file in effective layer) to the destination user. Then the receiver can use the handle to locate where the resource is by the maps between the layers. Both of the participants may have no idea about where the resource really is, they don't know the existence of the three layers either. It is obviously that the handle must keep in accordance with the rule or the policy of the model. As soon as the destination user gets the handle, he or she can parse the handle and locate the resource also by the maps between the layers. We can see that when the work happens, there seemed to be a temporary channel links all the participants through which the resource is transferred. In fact what really transmitted between the two participants is the identifier of the file in effective layer.

In the example above, the two participants are familiar with each other. In this paragraph we give another example where one participant have no idea about any

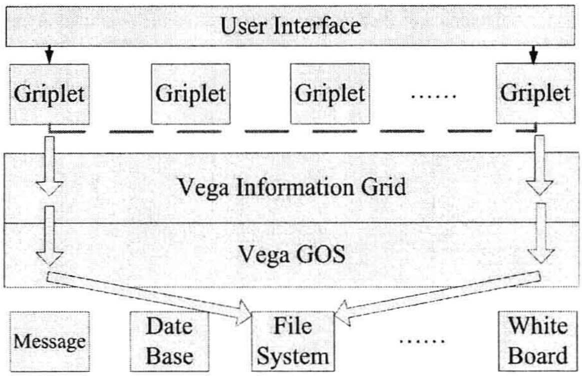

Fig. 5. The Infrastructure of VEGA-IG

things of the other participants such as who, from where they are; how many participants there are and even whether there are other participants in the task. We have implemented the projects manage tools in VEGA information grid. As we know there will be more than one person who participant into a project, the management of the project is a collaborative computing job. When we take AC (access control) into account, we can decide who have the right to manage the project by their roles. All the users who have the right to appraise the project may don't know the existence of others. Obviously they are different users in the effective layer, while when they come to the physical layer, maybe they are all mapped into the same local user who has the ability to modify the resource. Different user can modify different virtual layer resource, the collaborative task can be finished when all the virtual layer resource are mapped into the same physical layer resource. Finally we can use the physical layer resource to make a chart to illustrate the unitary state of the project.

In fact the projects manage tools in VEGA information grid use the technique of resource sharing to gain its ends. The similar collaborative work happened in VEGA-IG are flow, calendar etc.

5 Conclusions

As CSCW and information grid technology both aim to supporting collaboration, they are closely related. Information grid technology could provide a general-purpose technology platform for the CSCW community to build and run collaboration applications.