The Research on Distributed Decision Support Technology Based-on Multi-Agent

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ABSTRACT

In this paper, aim at the complex multi-task processing system, we put forward the technology based on multi-agent alliance architecture to solve the problem of decision progress control in distributed group decision support system.

INTRODUCTION

Group Decision Support System (GDSS) and Distributed Decision Support System (DDSS) is the new type information system based on Decision Support System (DSS). DSS is good at personal decision. But GDSS and IDSS can solve the problem about structure, half-structure and non- structure more effectively than DSS.

Though GDSS and IDSS came to being and develop, there are other requirements for DSS. Distributed group decision and intelligent decision technology are both asked for in decision progress of business, government organizations, and army. To solve the problem that concerned with mass of decision tasks in decision support system, which we call it as multi-task process system, we bring forward the intelligent decision technology based on multi-agent alliance.

THE DISTRIBUTED GROUP DECISION PROCESS

The Distributed group decision progress can be described as Figure 1. Firstly, The organizer put forwards the decision goal on networking. Secondly, the decision goal is discussed by the higher tier of the decision group and decomposed into a serial of decision tasks (We call them as sub-task). Thirdly, each decomposed decision tasks is decided by the lower tier of the decision group in GDSS supported by distributed Support environment to produce a serial of scheme of decision. These schemes are fed back to the higher tier of the decision group to evaluate and further decide.
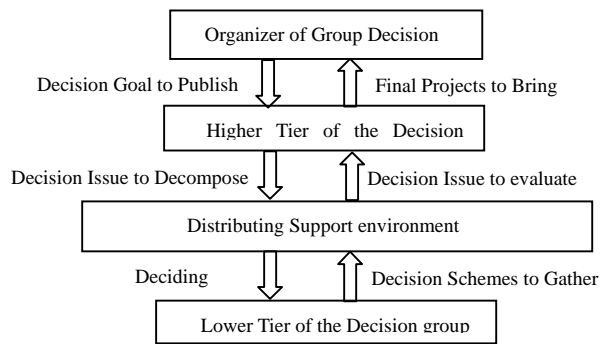
Figure 1   Progress of Distributed Group Decision

DISTRIBUTED GROUP DECISION SUPPORT SYSTEM'S ARCHITECTURE
Hardware Environment

The hardware environment of distributed group decision support system is based on Client/Server structure. The decision group can be distributed into ever-small decision group. The distributed architecture is based on centralized control modules, which is composed of a master server and several slave servers. Furthermore, we distribute the model, data and knowledge into two types: public model and private model. The master server used not only to store public model, data and knowledge but also to implement the mapping function between the client and the server. When any client wants to access a server, it must send a request to the master server firstly. Then the master server mappings the client's request to one of the slave servers according to a distributed algorithm which should be considered of the factors of the load of networking, distance of transfer, etc. Lastly, the client accesses the slave server directly.

The advantages of distributed architecture based on Client/Server structure can be described as below :(1) It facilitates to store and manage data. (2) It will lighten the communication load of networking. (3) It can promote the security of the system. (e.g. the decision of military layout, the model concerned is confidential. By setting the purview of access, the security of the system can be promoted.)
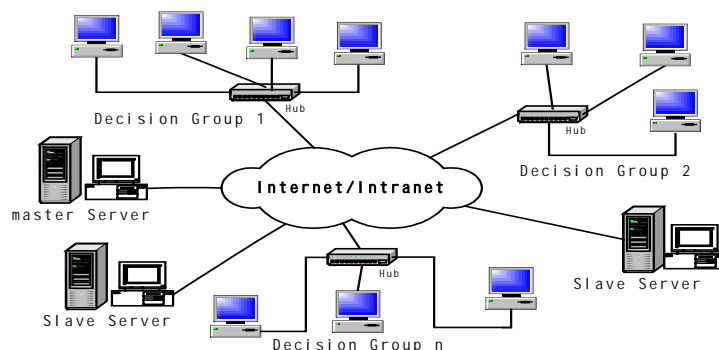

Figure 3   The System Hardware Environment

Software Architecture

As shown in Figure 4, the software architecture is composed of four components.
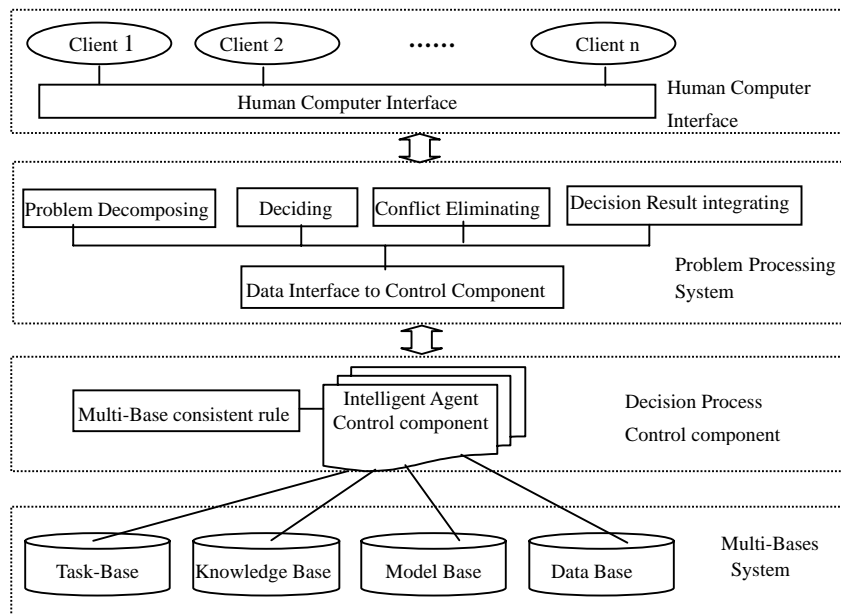
Each Component is described as below:

Figure 4   Distributed Group decision Support System Components

(1) Human Computer Interface Component: It is the interface between human to computer, which can be implement by providing interface software and command for users.
(2) Problem Processing System (PPS): PPS is composed of four sub-components. This four sub-components implement the four step of decision problem solving. Because the system is concerned with complex multi-task, PPS firstly decomposes the total decision problem into many sub- problems and then decides. After each sub-problem is solved, all results will be integrated for evaluating. In the process of problem processing, the conflict caused by accessing distributed data must be eliminated.
(3) Multi-Base System: It includes problem base, model base, knowledge base and database.   In the group decision and distributed decision process, more than one decision client may access the same base at the same time. Thus must cause conflict and the problem of data consistency. The multi-base system implements the function of managing these bases.
(4) Control Component: In the decision process, intelligent agent is the control component. Intelligent Agent dedicates to organize the task flow by negotiating, fulfils the function of decomposing task, supervising decision process, eliminating conflict, combining model, etc.

DISTRIBUTED KNOWLEDGE ORGANIZING

In the multi-task system such as GDSS and DDSS, it concerned with complex knowledge. The knowledge not only is too much but also orients many domain

problems. So we put forward the method of organizing knowledge by distributed the knowledge into several layers. The below layers orients the domain knowledge stores in distributed node. The above layers is the abstract knowledge of its below layer. The top layer orients the total control knowledge such as task decomposing knowledge, sub-task distributing knowledge, etc.
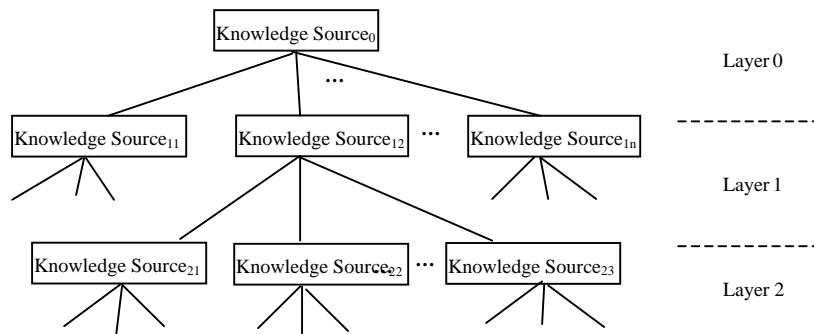

Figure5   Distributed Knowledge Organizing

MULTI-AGENT DECISION PROCESS CONTROL

Multi-Agent Alliance Architecture

Orienting multi-task decision process, we bring forward the multi-agent alliance architecture as shown as figure 6.

In the system, each decision-client has an agent and this agent receives the decomposed sub-problem and solves them. Several agents of adjacent decision-client form an agent alliance. Several agent alliances form the multi-agent alliance architecture. To promote the efficiency of communication and negotiating among the agents, an assistance agent exits in each agent alliance. Furthermore a global agent runs in master serve of the system. So the there are two types of communication in the system: one is the communication among the assistance agents, the other is the communication between the assistance agent and the global agent.
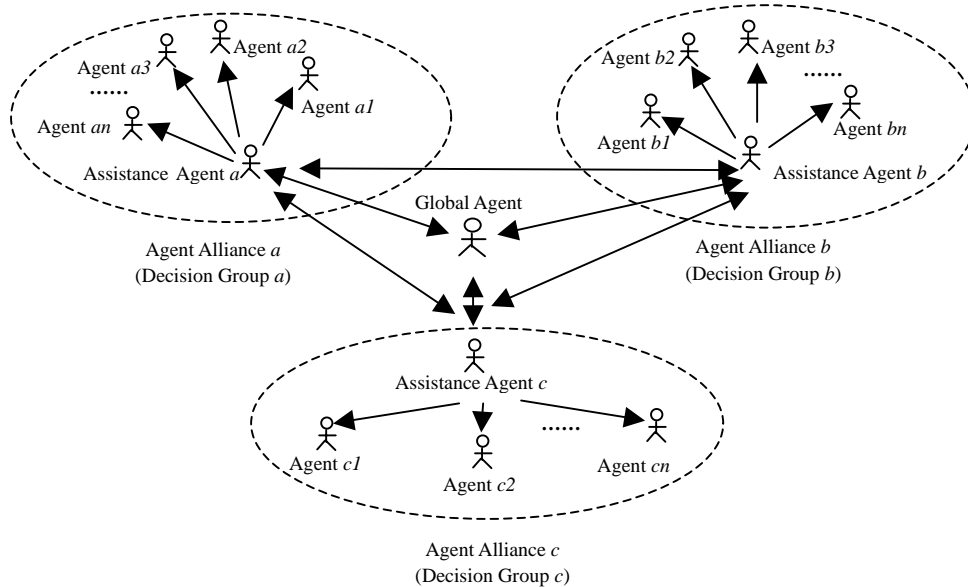
Figure 6 Multi-Agent Alliance Architecture

Decision Process Control

The process control of problem processing in the system can be described as shown in Figure 7:
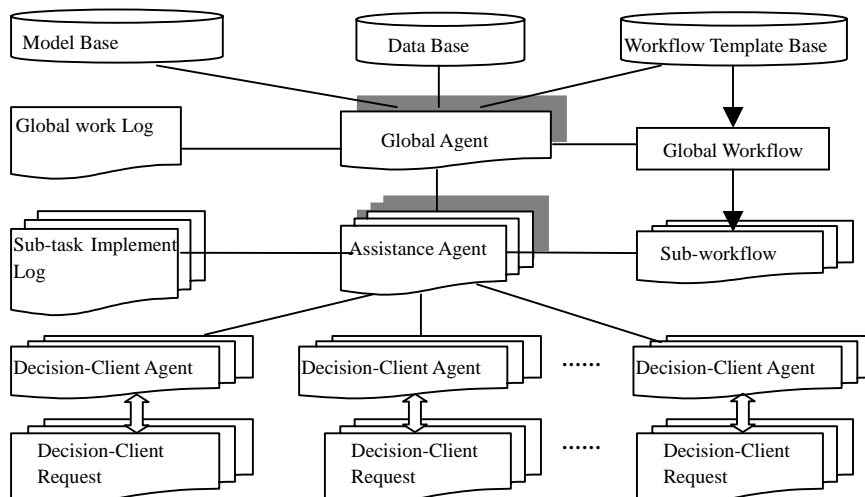

Figure7   Decision Process Control Based on Agent

(1) In the system a workflow template base is built to store workflow templates used for making out decision workflow. The global Agent makes out the total decision workflow and supervises the activity of all workflow. Assistance agents make out sub-workflow by negotiating with global Agent. They receive the request from decision-client agent and negotiate with the global Agent. By negotiating they implement the function of task decomposing and sub-task distributing. The decision-client agent receives the sub-task from the assistance agent and run model to solve decision problem by itself.

(2) A global log is set in the global Agent to record the situation of work submitting, such as time of work submitting, executor, etc. The logs in assistance agents are used to record local situation of problem solving.

CONCLUSIONS

From above described, complex multi-task processing system can be effectively built based on multi-agent alliance architecture. Because of the characteristics of agent, such as self-determination, autonomy, Intelligence, etc, the decision process will be well controlled. Furthermore, based on the multi-agent alliance architecture, the system can be extended easily.

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