Chapter VII
Dynamic Scheduling of Multi-Agent in Agent-Based Distributed Network Management

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ABSTRACT

Agent technology has played an important role in distributed network management, and agent scheduling is an inevitable problem in a multi-agent system. This chapter introduces a network management scenario to support dynamic scheduling decisions. Some algorithms are proposed to decompose the whole network management task into several groups of sub-tasks. During the course of decomposition, different priorities are assigned to sub-tasks. Then, based on the priorities of these sub-tasks, a dynamic multi-agent scheduling algorithm based on dependences of sub-tasks is proposed. An experiment has been done with the decomposition algorithms, the results of which demonstrate the advantage of the algorithms. The performance test demonstrates that the competitive ratio of the dynamic scheduling algorithm is always smaller than that of the existing online scheduling algorithm, which indicates that the performance of the dynamic scheduling algorithm is better than the existing online scheduling algorithm. Finally, as an application example, the process of network stream management is presented. The authors hope that this scheduling method can give a new approach or suggestion for studying dynamic agents scheduling technology.
INTRODUCTION

Conventional network management is mostly based on the simple network management protocol (SNMP) and often runs in a centralized manner. The SNMP-based management systems give network administrators the flexibility of managing the whole network from a single place. When a manager needs a small amount of data from a small set of managed nodes, SNMP is a better choice, but when a large amount of MIB (managed information base) data is to be retrieved from multiple managed nodes, mobile agent based management is preferred (Kona, 2002). The increasing dependence on network management station makes network management station a bottleneck. The network management member in conventional network management manner runs short of adaptability to the changing environment and also lacks the ability of self-organization, so it can hardly manage with the more and more complex network management tasks. It is the properties of the intelligent agent, such as autonomy, mobility, and so forth (Buchanman, Naylor, & Scott, 2000) that makes it possible to solve the problems. The merits of using agent in network management are also discussed in another paper (Liu, Luo, & Li 2005). But when using agent technology in network management, problems arise: how to integrate the agent with the functions of network management and by what manner to assign tasks to multi-agents in large-scale network management task.

Agent scheduling in multi-agent system is an important factor influencing task execution efficiency. The traditional scheduling algorithm often assigns task to agents statically. The scheme or plan of task always has been established before execution in static scheduling methods. These static (offline) algorithms (Zhuang & Pande, 2003) generate output with complete knowledge of the entire input (job sequence). However, this assumption is often unrealistic in practical applications. Many of the algorithmic problems that arise in practice are online. A dynamic (online) algorithm (Albers, 2003) must generate output without knowledge of the entire input. Making good scheduling decisions requires a careful analysis of the relationships among tasks. Knowing the relationship among tasks, task dynamic decomposition can be achieved during agent dynamic scheduling.

BACKGROUND

In recent years, many researchers have interests in task decomposition and scheduling, especially in the area of distributed computing, the research area ranging from serial program decomposition (Luo, Huang, & Li, 1995) to program slicing (Morel, 2003). But in multi-agent-based large-scale network management task, if we adopt the method of program decomposition, there will be many sub-codes, which make it very complicated to create and assign agent; even if we reassemble the sub-codes, the integrality of network management function will be destroyed and the intelligent exertion of agent will be affected. So we propose a method of decomposing network management tasks into sub-tasks considering the dependences among sub-tasks. Then these small-scale tasks are assigned to multi-agents.

Some researchers take the scheduling problem into consideration integrated with agent migration itinerary. Singh and Pande (2002) proposed two strategies for agent migration. The first strategy: attempting to carry all the live definitions of variables from a given node when visited, the goal of which is to minimize the number of migrations; the second strategy: attempting to carry only those definitions that will be used in the destination node, it aims to minimize bandwidth consumption during a migration. These two strategies both have their merits, but neither of them can resolve the problems in dealing with tasks in large-scale complicated network management. Zhuang and Pande (2002) regarded minimal number of migra-