Chapter 5
Mobile Agent–Based Collaborative Computing Framework for Handling Constraint Resources

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ABSTRACT

Information processing and collaborative computing using agents over a distributed network of heterogeneous platforms are important for many defense and civil applications. In this chapter, a mobile agent based collaborative and distributed computing framework for network centric information processing is presented using a military application. In this environment, the challenge is to continue processing efficiently while satisfying multiple constraints like computational cost, communication bandwidth, and energy in a distributed network. The authors use mobile agent technology for distributed computing to speed up data processing using the available systems resources in the network. The proposed framework provides a mechanism to bridge the gap between computation resources and dispersed data sources under variable bandwidth constraints. For every computation task raised in the network, a viable system that has resources and data to compute the task is identified and sent to the viable system for completion. Experimental evaluation under the real platform is reported. It shows that in spite of an increase of the communication load in comparison with other solutions the proposed framework leads to a decrease of the computation time.

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INTRODUCTION

The biggest challenge in today’s information systems is to integrate data from several distributed and heterogeneous sources. We need to process this data to facilitate decision making and reduce the information overload on users to provide accurate and timely results. Client Server distributed computational models like Remote Method Invocation (RMI) (SUN) and CORBA systems assume high bandwidth between the systems to pass the data and are not fault tolerant as it involves many low level interactions in the form of request and replies. This type of distributed computing uses static communication protocols and lacks runtime adaptive behavior. Traditional distributed applications do not scale well when the network delay increases. Low level interactions in C/S model can fail and the task of recovering from fault is highly complicated. Also, these systems are challenged for efficient processing capability in case of mobility in the distributed system, or when a network consists of heterogeneous systems with different software and hardware platforms. In dynamic distributed environment, the number of workstations available for computations continually changes in the network. The network continuously undergoes reconfiguration and the application programs should continually adapt to the changing requirements of the network. At the same time the network should be able to maintain the operational efficiency. To achieve such efficiency we need some kind of inbuilt intelligence inside the network for decision making. One such possibility is Mobile Agents (Wang, 2001; Puliafito, 1999; Gian 2001; Lange, 1999; Harrison, 1995; Oshima; IKV++; Aglet; Kurkovsky, 2004) which are software programs that can be dispatched from client system and transported to a remote system for execution. In mobile agent based application models (Lange, 1998; Papastavrou, 1995) each agent once created can autonomously move according to its goal and to the system where resources are available for computation. The mobile agents can cooperate with other agents on the fly. Many defense and civil applications need to perform information processing in a collaborative computing environment over a distributed network of heterogeneous platforms. For example a soldier in the military battlefield needs to correlate and integrate many geospatial and temporal features to make a safe move from one point to another. To obtain these features manually with accuracy in a shoot and move environment is not easy. There is a need of a support system which can provide a feasible route, by accessing the accurate, network-centric dynamic information faster. It will be of great help to the soldier to execute the mission timely. Moreover the systems should operate in a low bandwidth environment by utilizing the wireless connectivity which may not be reliable. In this type of environment it is difficult to achieve the timely data processing using traditional client server communications as they require continuous connectivity and high bandwidth. Mobile agent technology is the most suitable choice in this type of application development as they can be transported from one node to another node and then takes advantage of being present in the same host or network as the service. Distributed applications can be written with programming interface to the agents so that they can take care of computations with maximum flexibility. Mobile Agents (MAs) move the computations to the data rather than data to the computations and thus, reducing the network traffic.

The problem tackled in this paper is to develop a mobile agent based distributed computing framework for network centric information processing and collaboration satisfying multiple constraints like computational cost, communication bandwidth and energy in a distributed network. The objective is to utilize the advantageous characteristics that mobile agents provide for effective communication and collaboration between systems in the network to achieve network centric information processing. We use java (SUN)