Chapter 1

INTRODUCTION

1.1 Overview

The most popular paradigm for distributed applications is the client-server (CS) model. A new paradigm, the mobile agent (MA) paradigm, has emerged for structuring distributed applications. Between the two paradigms, mobile agents can reduce network traffic and overcome network latency (Aridor, 1998). Mobile agents are intended for large-scale networks because they move computation towards destination host, thus saving communication costs.

Many researches have been carried out on developing mobile agent systems, such as Telescript, Agent TCL, Voyager and IBM Java Aglets. Java (Sun, 2002a) is the dominant language for agent systems because of its platform-independence and security. Very few researches are done for evaluating the performance of mobile agents for data retrieval in real environments. Ismail and Hagimont (1999) investigated information fetch in large-scale network using Java remote method invocation (RMI) and mobile agents. Their results showed that MA is better than CS for data more than 1000 Kbytes. Comparison of mobile agents and CS for network management functionality was done by Baldi and Picco (1998). They found out that MA was better than CS if the message containing MA code is small compared to the number of request and reply messages. An analytical comparison of CS, remote evaluation and mobile agents for data retrieval was done by Puliafito, Riccobene and Scarpa (1998), resulting in little differences among the paradigms if the network has high bandwidth. Therefore, varying results were found caused by different testing environment and conditions.

In this research, we carried out performance evaluation for file transfer using CS and MA paradigms. File transfer is chosen as it can be used for software upgrades, file upload and to serve clients' requests for files. Software upgrade is one sub area of configuration management of the International Standardization Organization (ISO) functional management areas for network management.

This research evaluates the performance of mobile agent paradigm compared to client-server model. This evaluation was performed in the Java environment using Java Aglets Software Development Kit (ASDK) for MA; and Java sockets and Remote Method Invocation (RMI) for CS to measure the costs of transferring files across Local Area Network (LAN). All implementation uses Java 2 Software Development Kit Standard Edition, version 1.4.1 (Sun, 2003). The overall dissertation process is shown in Figure 1.1.

1.2 Problem Statement

Network management is needed for various reasons: controlling assets, improving service, balancing needs of end users and applications and monitoring its resources (Harnedy, 1998). One of the areas of network management is configuration management which involves maintaining the state of network and network resources, software upgrades and provisioning of a certain service to users. This service provision can be, for example, file and information transfer from servers to clients. Normally file transfer uses file transfer protocol (FTP).

However, mobile agents can also be used for file transfer. Hauswirth (1999) states that communication on the Internet and most distributed systems uses mostly the request-reply model. There are two modes for this model, which are push and pull modes. 'Pull' mode means a client actively 'pulls' information from the server. This is in contrast with 'push' mode where an information producer 'pushes' information to consumers by announcing the availability of information and the client has to subscribe to that information. Lange (1998) states that mobile agents embody the push model, they can disseminate information such as documents, news and software updates. Therefore, document or file transfer process can use the push model by using the mobile agent paradigm.

In literature on mobile agents (Ismail, 1999; Bellavista, 1999; Buchanan, 2000), mobile agent paradigm is said to reduce network communications and network traffic. Their comparisons were made on information retrieval. However, there are a few literature which shows that MA may need more network traffic compared to other paradigms for example by Baldi (1998) and Bohoris (2000).

The motivation for this research is to propose another way to transfer files over distant locations using MA. We would like to study the efficiency of file transfer from a server to a client using MA, in comparison with CS. We examine how the size of the agent plus any load that it brings affects the duration taken to transfer files from a server to a client.

1.3 Objectives of Research

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1. to create a mobile agent prototype system with mobile agents which are able to transfer files from a server to a client using mobile agent.
2. to measure the communication cost of file transfer using the MA paradigm.
3. to measure the communication cost of file transfer using the CS paradigm.
4. to evaluate the performance of MA and CS for file transfers.

1.4 Scope of Research

This research investigates the performance of MA compared to CS with regard to file transfer in small-scale network. The measurements were done over Universiti Tun Abdul Razak (UNITAR) LAN. It comprises of personal computers under Microsoft Windows 98 and Microsoft Windows 2000, interconnected through 100 Mbits Ethernet.

IBM Aglets Software Development Kit (SourceForge, 2002) and Java 2 Software Development Kit version 1.4.1 (Sun, 2002a) have been used for the implementation.

1.5 Significance of Research

The mobile agent system developed in this dissertation is suitable for use in software upgrade systems due to the ability of the mobile agents to dispatch themselves to destination hosts, bringing the required files to be transferred. The mobile agents would then be able to write the files onto secondary storage. No interaction from users is needed from the client sites. Choosing a mobile agent-based system for software upgrade would enable software upgrade to be administered only from the server site. The upgrade can even be done when offline as long as the files needed are already transferred to the client.

This research offers great benefits for configuration management as the network administrator can perform software upgrades on client machines without the need to go to the machines.

1.6 Hypothesis

The hypothesis is performance of file transfers would vary among the three applications tested. The expectation is that the use of MA will affect the performance of file transfers, with MA would at least give some improvement over CS, either the RMI or the Java stream applications.

1.7 Dissertation Organization

This dissertation is divided into six chapters. The following is the brief description of each chapter.

Chapter 2 discusses distributed computing paradigms, network management approaches and a few literatures on mobile agents which revolve around the subject of distributed computing, request-reply models and performance evaluation. At the end of this chapter, we propose a model for the mobile agent system.

Chapter 3 covers the system analysis and the requirement specifications of the mobile agent system developed. The methodology used is also discussed.

Chapter 4 includes the system design of the agent system, inclusive of its classes, algorithms and the sequence of operations of all the classes. The design and implementation of the comparative applications on CS paradigm is also briefly explained.

Chapter 5 presents the testing environment and the testing done on the MA system, stream application and RMI application. The findings are then laid out in a graph, followed by the discussion on the results.

Chapter 6 concludes the overall dissertation. It presents the problem encountered, dissertation achievements and constraints and future enhancement of this dissertation.

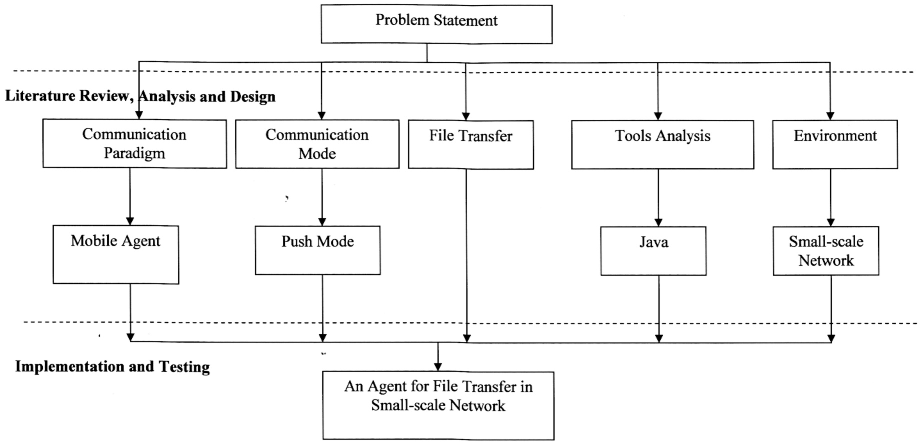

Figure 1.1
Overall Dissertation Process