UNIVERSITI PUTRA MALAYSIA

AGENT-BASED RESOURCE DISCOVERY IN PEER-TO-PEER NETWORKS

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AGENT-BASED RESOURCE DISCOVERY IN PEER-TO-PEER NETWORKS

By

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To

Whom beyond all thoughts

Abstract of thesis presented to the Senate of University Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

AGENT-BASED RESOURCE DISCOVERY IN PEER-TO-PEER NETWORKS

By

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March 2009

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Faculty: Computer Science and Information Technology

Large-scale resource sharing environments like Peer to Peers (P2P) are intrinsically distributed, heterogeneous and dynamic. Without having an efficient discovery mechanism, it is impossible to employ available resources and their related potential services that are geographically dispersed in heterogeneous platforms. Agents as an abstract encapsulated system with useful characteristics such as mobility, autonomy and intelligence can be considered as an applicable idea in different parts of P2P environments. The resource discovery model in an agent based environment can be observed from two different perspectives, in order to being improved. First, a model can be reviewed by its underlying architecture and arrangement of the network nodes. Component architecture specifies how the various components are linked together and what the components are supposed to expect from one another. It's crucial to study the underlying architecture as it is the base platform to apply the resource discovery mechanism on top and a proper node federation will affect and facilitate the resource discovery process. The second perspective, is revisiting roles and

features of the agents involved in the agent-based resource discovery model and improving their capabilities in order to achieve a higher performance.

We proposed two improvements based on two perspectives mentioned above. The first one will be a modification on the underlying architecture and the second one is developing an informed mobile agent with enhanced features, capable of planning about a more suitable route during the resource discovery process.

First improvement is a classified cluster based model for resource discovery using collaborative agents. This type of clustering can be used in environments that the nodes are providing quantitative services, like storage devices, processing elements or bandwidth and also queries on the resources should be satisfied range conditions on attributes. A mobile agent can find its way, by a simple comparison formula, when underlying architecture is classified properly.

The second is an informed mobile-agent- based resource discovery mechanism which plans and directs routing process intelligently, and also adapts itself toward intermittent movements of the environment. A planning technique is added to the mobile agent such that clusters are not visited uninformed, but will be selected according to the highest probability of containing the requested resource. A heuristic-based informed function administers the JMA planning procedure.

In order to investigate the performance of the model, both contributions is simulated and developed and also compared with a based model. Several parameters is measured to

highlight the significance of the proposed models. In both contributions, it is been tried to direct JMA to a more favourable path and limit the search space. These two contributions, attempt to reduce JMA number of hops, and number of hops reduction contributes optimization in resource discovery time, rejection ratio and bandwidth utilization. These parameters are evaluated for different scenarios like static and mobile environment and in different size of environment.

The results show that clustering the peers in a classified manner optimizes the resource discovery process. Moreover, the proposed informed mobile agent discovery mechanism has provided less number of hops, discovery time rejection ratio and bandwidth utilization.

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Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

PENEMUAN SUMBER BERASASKAN AGEN DI DALAM RANGKAIAN P2P

Oleh

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March 2009

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Persekitaran perkongsian sumber di dalam skala besar, seperti Peer-to-peer (P2P), adalah secara intrinsiknya teragih, kepelbagaian dan dinamik. Tanpa mekanisma penemuan sumber yang efisyen, penggunaan sumber dan potensi servis tidak mungkin dapat digunakan di platform berlainan yang dan teragih. Teknologi Agen, sebagai sistem enkapsulasi abstrak yang dipenuhi dengan ciri-ciri mobiliti, autonomi dan kecerdasan, dilihat sesuai untuk digunakan di dalam bahagian-bahagian di dalam persekitaran P2P.

Model Penemuan Sumber, di dalam persekitaran Agen, boleh dilihat dari dua sudut. Pertama, dari sudut arkitektur asas dan aturan nod-nod rangkaian. arkitektur komponent menjelaskan bagaimana komponen-komponen berlainan di gabungkan dan berinteraksi. Penelitian kepada arkitektur asas bagi platfom Penemuan Sumber adalah kritikal bagi melihat bagaimana mekanisma Penemuan Sumber dan penggabungan nod mempengaruhi proses penemuan sumber. Dari perspektif kedua, peranan dan ciri-ciri Agen di dalam model Penemuan Sumber berasaskan agen dikaji untuk menaikkan lagi prestasi agen tersebut.

Di dalam tesis ini, kami menganjurkan dua improvisasi ke atas kedua-dua perspektif di atas. Pertama, perubahan kepada arkitektur asas, dan kedua, membina agen berpengetahuan

bergerak dengan ciri-ciri yang lebih baik, dan boleh merancang perjalanan semasa process penemuan sumber. Sumbangan utama bagi tesis ini termasuk:

Cadangan untuk sebuah model penemuan sumber berasaskan gugusan klasifikasi menggunakan agen kerjasama. Ini ialah satu kaedah alternatif bagi pengerumunan sumber di dalam persekitaran P2P bagi agen bergerak. Kaedah pengerumunan sumber in boleh digunakan oleh nod-nod bersekutu bagi memberi servis kuantitatif seperti peranti storan, elemen pemprosesan atau elemen lebar jalur dan pertanyaan untuk sumber. Sekiranya arkitektur asas diklasifikasi dengan betul, agen bergerak boleh mencari jalan sendiri menggunakan formula perbandingan mudah.

Cadangan sebuah mekanisma untuk model penemuan sumber berasaskan gugusan klasifikasi menggunakan agen kerjasama, yang boleh merancang proses perjalanan secara cerdas dan boleh menyesuaikan diri dengan pergerakan tak terarah di dalam persekitaran. Teknik perancangan juga digunakan oleh agent bergerak tersebut supaya gugusan tidak dilawati secara rambang. Sebaliknya, pemilihan dibuat berasaskan kepada kebarangkalian bagi gugusan yang memiliki sumber tersebut. Kaedah fungsi penemuan swakaji pula digunapakai di dalam prosedur perancangan JMA.

Di dalam kedua-dua sumbangan di atas, percubaan telah dibuat dengan mengarahkan JMA ke laluan yang lebih sesuai dan menghadkan ruang carian. Sumbangan ini juga mengurangkan jumlah lompatan di dalam JMA. Ini secara tidak langsung mengoptimumkan masa, ratio penolakan dan penggunaan lebar jalur.

Untuk menilai prestasi model, dua simulasi model dibina dan dibandingkan dengan model asas. Beberapa parameter juga digunakan untuk menilai sejauh mana signifikan model yang diuji. Di antara model-model yang diuji, teknik JMA diubahsuai menggunakan pengarahan yang lebih baik dan menghadkan sudut pencarian. Ini dibuat dengan mengurangkan jumlah loncatan dan mengoptimumkan masa pencarian sumber, ratio penolakan dan penggunaan jalurlebar. Parameter yang digunakan juga diuji untuk senario lain seperti statik dan persekitaran mobile yang berbeza saiz.

Keputusan menunjukkan teknik kelompok peers menggunakan teknik pengkelasan dapat memberikan process pencarian sumber yang optima. Selebihnya, teknik ini juga dapat mengurangkan jumlah loncatan dan mengoptimumkan masa pencarian sumber, ratio penolakan dan penggunaan jalurlebar.

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APPROVAL

I certify that an Examination Committee has met on **2010-02-02** to conduct the final examination of Mina Sedaghat on her Master of Science thesis entitled "AGENT BASED RESOURCE DISCOVERY IN PEER TO PEER NETWORKS ", in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

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Saya mengesahkan bahawa satu Jawatankuasa Peperiksaan Tesis telah berjumpa pada **2010-02-02** untuk menjalankan peperiksaan akhir bagi Mina Sedaghat bagi menilai tesis beliau yang bertajuk "**PENEMUAN SUMBER BERASASKAN AGEN DI DALAM RANGKAIAN P2P**" mengikut Akta Universiti dan Kolej Universiti 1971 dan Perlembagaan Universiti Putra Malaysia [P.U.(A) 106] 15 Mac 1998. Jawatankuasa tersebut telah memperakukan bahawa calon ini layak dianugerahi ijazah Master of Science.

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.

Mina Sedaghat

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LIST OF ABBREVIATIONS

Word	Definition
P2P	Peer to Peer
FIPA	Foundation for Intelligent Physical Agents
AO	Actual Organization
VO	Virtual Organization
JMA	Job Mobile Agent
AORBA	Actual organization Resource Broker Agent
VORMA	Virtual Organization Resource Broker Agent
PE	Processing Element
SE	Storage Element
CRB	Cluster Resource Brokers
BS	Base Station Servers
TTL	Time To Live
DT	Discovery Threshold

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CHAPTER 1

INTRODUCTION

1.1 Background

Existing internet frameworks like grids, wireless grids and Peer to Peer (P2P) networks are now providing effective channels for gathering and processing widespread information by using the available resources within reasonable cost. In each of these networks, distributed computing nodes share and exchange their services and resources with the aim of providing a more robust and massive structure to facilitate knowledge sharing and collaboration.

Grids are environments that rely on persistent, standard-based service infrastructures that allow well established mainly scientific communities to share computers, storage spaces, software application and data across organizational boundaries, when a P2P system is a new approach to utilize computational transient resources in a decentralized manner to achieve a higher performance and scalability in different criteria.

In a P2P network, nodes with equal roles and capabilities share their resources and services with no centralized supervision. Main features of a P2P network include decentralization, self-organization, dynamism, which make them naturally scalable and seems an attractive solutions for information sharing and data exchange. Despite mentioned advantages of P2P networks, they confront serious problems. Heterogeneity, non-stability of the users and resources, the dynamic nature and the decentralized control

are some of key challenges of this type of network. Peers that are mostly personal computers are almost unpredictable and unreliable.

Unlike grid, which nodes in each domain are under a strict control by an upper level node and all queries and interactions between them is channelized through a responsible node, P2P networks are totally free of centralization. In grid, nodes are part of an administrative domain and are controlled by a goal specific organization but in a P2P network the nodes are independent entities that have the right to leave or join the network whenever they like.

Problems like finding out an abstract virtual model on the constitution of these high churn nodes and issues like resource management, resource discovery, load balancing or handling the intermittent user departs and rejoins are some of the main challenges in a P2P network.

Agent is a well suited technology with powerful and adaptable features for resource discovery in a heterogeneous dynamic environment. System management in Grid and P2P environments can be distributed and scaled by the use of mobile agents. An agent model for P2P systems enables the description of complex systems with a higher level of abstraction (Kelash et al. 2005).

Agent-based systems are intrinsically peer-to-peer: each agent is a peer that potentially needs to initiate a communication with any other agent as well as it is capable of providing capabilities to the rest of the agents (Bellifemine et al. 2003). Agents are also active entities, when they are also loosely coupled.

In environments like P2Ps, ad hoc's and wireless grids where there is no guarantee for a node to be a fixed member, an independent way of interaction, seems necessary.

An autonomous entity called agent can act wisely on behalf of its client, a resource node or a PC user. Available agent standards, like FIPA (Foundation for Intelligent Physical Agent), specify a safe environment for agents and the language of communication between them that can be used as an upper application layer, which is not dependant on the underlying physical network anymore. Other features of agents like intelligence and mobility used in distributed systems and still are beneficial in these environments.

1.2 Problem Statement

The main advantage of P2P networks is exactly their unstructured nature. They do not require specific protocols for joining the system and the maintenance costs for the whole network are very limited. Although this fact simplifies the management of the network, it makes the search for specific resources more difficult. The only way for resolve a query is to forward it along the entire network (Lv et al. 2002; Cholvi et al. 2004). This solution is clearly not scalable.

In a resource-sharing P2P network, the first step in utilizing a service is to discover and locate resource nodes that are requested by another peer across the network. Resource discovery starts when a peer asks for a specific resource or service by initiating a query message. The main goal of resource discovery is to find a node that satisfies minimum requirements specified in request message(Mordacchini; Kutten and Peleg 2007).

Discussing about how and to which nodes this message should be forwarded, which routing technique should be applied and lots of other issues are questions that arise during the design of a resource discovery mechanism. Locating resources in a P2P environment is difficult because of the geographic dispersion and dynamic nature of its resources and the lack of information about the environment. In a large distributed network, issues such as large numbers of users, heterogeneous resources and dynamic status of resources over time make resource discovery more difficult than the case of traditional networks(Darlagiannis et al. 2004). A resource can be a storage device, a processor, a shared file or a service.

Resource discovery in a P2P network should support mobility, dynamism and intermittent rejoins of nodes while respecting the independency of each. It is also expected that resource discovery in P2P network supports scalability as one of the main advantages of a type of system in comparison with other traditional distributed networks like grid(Li et al. 2004 et al. 2008).

1.3 Research Objectives

Main objectives of this research are:

1. To propose an agent based resource discovery model, based on new classification of peers in a P2P network to optimize the resource discovery process by reducing resource discovery time, rejection ratio and bandwidth utilization.