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Efficient Migration of Service Agent in P-Grid Environments based on Mobile Agent

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Abstract: - This paper describes the efficient peer-to-peer migration method of Grid service agent on the mobile agent based P-Grid. The migration mechanism for transmitting service agent upon the service request is based on the peer's logic network topology. The network topologies that this system uses are organized as star topology, ring topology and tree topology, and agents are migrated by the master/slave method and serial/ parallel method. The migration method of services is chosen based on the execution range and characteristic of the requested service. Also, the entire execution time of service is affected by the performance of peer that is a part of network topology, and the migration order. Therefore, the system monitors the performance of peers, and determines the migration priority based on analyzing and learning history. The system can reduce service execution time efficiently with decisions of migration method for service agent and priority of peers.

Key-Words: - Mobile Agent; P-Grid; Migration; Grid Service

1 Introduction

P-GRID SYSTEM is the system that various computers participate in one shared job, and work on requested cooperating jobs [3]. It indicates Grid System constructed by desktops, Grid System that uses P2P technology and so on. To construct this P-GRID System, this paper uses mobile agent. Mobile agent retrieves available resource until it can not use current resource, and it migrates from one peer to another peer. Also, it moves on the network autonomously during execution of the job [1][4].

This paper describes efficient migration technique for agents that move for execute Grid service on P-Grid environment based on mobile agent. The mobile agent for executing Grid service (called service agent) migrates by itself based on logical network topology of peers in P-Grid System. The migration scheme of service agent for star topology is master/slave migration method, and scheme for ring topology is serial transmission migration method. Also, tree topology uses the parallel migration method. The migration scheme for service agent is decided based on the requested service's execution range and characteristics. Also, peer's performance and migration sequence affect the entire execution time of service. Therefore the system decides migration sequence after it monitors each peer's performance and analyzes it, and learns from the monitored history. The service execution time is reduced by deciding service agent's migration scheme and priority of peers which are ready to migrate.

The remainder of this paper is organized as follows. Section 2 describes the service agent's migration method and priority decision mechanism for migration, and section 3 shows P-GRID SYSTEM. Section 4 shows P-GRID SYSTEM, implementation of it and experiment result, and section 5 presents our conclusion.

2. Migration of Servcie Agent

2.1 Migration scheme for logical network topology

To migrate service agent in P-GRID SYSTEM, the logical topologies for participating peers are star, ring, and tree. When n is the number of peers in P-GRID SYSTEM, service agent is sent by three different ways as shown Fig. 1.

To execute Grid service, service agent is migrated from P_0 peer. Like Fig. 1(a), star topology uses mater/slave migration that all of peers migrate for executing job on peer P_0. In the transmission method of the ring topology like (b), if peer P_0 sends service agent, serial transmission will work until P_n. The transmission method of tree topology in (c) uses parallel method, so the execution time is reduced.

However this paper uses binomial tree to construct tree topology.

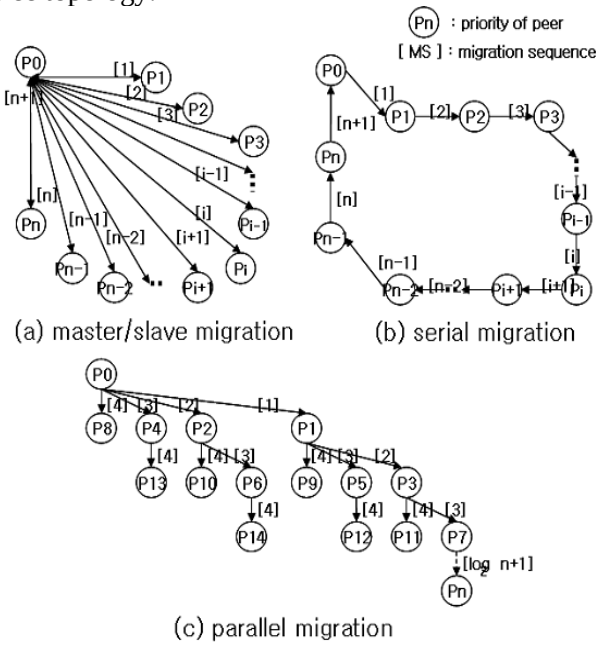


Fig 1. Logical Topology in P-GRID SYSTEM

The migration scheme of service agent is selected by the job range and characteristics instead of execution time. It sends requested service agent from only one peer, or it will select Master/Slave migration method when the job range is small and amount of data is large. In addition, the serial migration method is selected when they want only job result after they sent jobs, or data amount after execution of job is small. Lastly, when they want faster job execution and job range becomes large, the parallel transmission method is selected. In this paper, we do not discuss fault-allowing policy from service agent's migration, and we follow the basic fault-allowing policy from [8].

Classification of service type

- Master/Slave type : data access with large data, when the range of service execution is small, centralized service
- Serial type : data access with small data or only query, when the range of service execution is small
- Parallel type : information retrieval, fast access to peer, when the range of service execution is large.

2.2 Migration sequence with concerning peer's performance

When service agent works on its job by migration, the entire execution time is affected by the performance and sequence of migrating peer [5][6]. After the migration schema of service agent is decided, the migration sequence is decided for establishing migration path. The migration sequence of service agent decides migration priority based on the performance of peer.

Peer Name	CPU	Memory	Network Bandwidth	Priority	Used	Fault Frequency

Fig 2. Peer Information Registry

- PeerName : peer's IP and Port
- CPU : CPU performance
- Memory : available memory which peer can use
- Network Bandwidth : network bandwidth which service agent migrate other peer
- Priority : priority of peer's migration
- Used : whether or not other service agent migrated
- Fault Tolerance : fault percentage of existing service agent's job execution

Before transmitting service agent, the system monitors performance of peers which will be migrated. The peer's performance factors for migration are CPU, Memory and Network Bandwidth. After analyzing these factors, the migration priority of service agent is decided. The weights of peer performance factors were 1 when deciding priority, but the system defines weight based on service for deciding priority.

In addition, there are two consideration points to establish migration path. First is to figure out that other service agents are migrated or not. Second is to consider the fault-percentage during execution of existing jobs. They are recorded at Used, Fault Frequency in peer's performance registry.

Also, the system continues to learn and update record of service agent migration though performance registry, so it can reorganize sequence of migration path. This paper improves the efficiency with concerning 6 major performance factors of peer, but more factors should be concerned for the safer job execution and smooth resource allocation. We will continue to research it as future works.

3. System Components

3.1 System overview

In this paper, all of peers that participate common job in P-GRID SYSTEM are equipped with mobile agent system. We applied *[KMAS]* [7] as the mobile agent system. Fig. 3 shows the overview of one P-GRID SYSTEM, and arrows show the flow of each peer's execution that started from peer0 that transmits service agent.

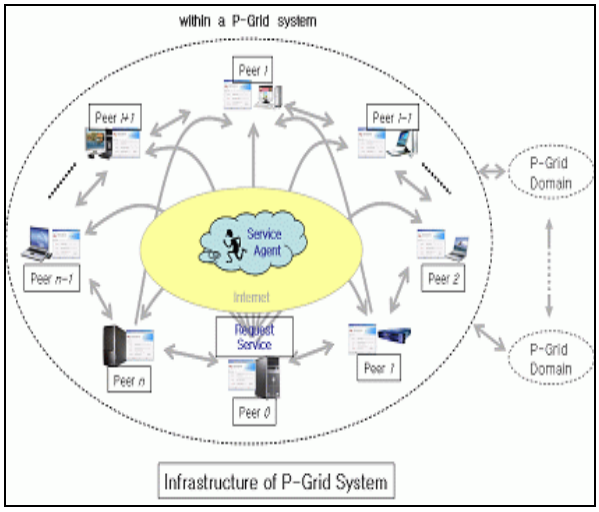


Fig 3. P-GRID SYSTEM Overview

3.2 System compositions

The mobile agent system that this paper uses has Network Layer, Peer Layer and Service Layer, and the structure of *[KMAS]* is shown at Fig. 4.

First, Network Layer is Network Layer for peers, and it is the important module for construct P-GRID SYSTEM. It mediates communication before service agent's migration, monitors each peer's performance factors. Also, it is in charge of service agent's authentication processing, and records all the events from system.

This paper uses basic security package from Java for authentication processing at the Security Manager, and authenticates service agent by using this module. The second module is Peer Layer. It defines the basic information of system, and set up information for accessing each peer. Also, it establish migration scheme and migration path that are constructed based on peer information registry which is written on peer's performance factors. Agent Manager is in charge of service agent transport. Lastly, Service Layer selects various services that P-GRID SYSTEM supplies. The services that P-GRID SYSTEM currently provides are data accessing and collecting service and simple operation service. Lastly, Application Layer should be extended for utilizing P-Grid executable services in applications. However creation of the service which will execute job should be decided with considering resource allocation and peer's performance, so further research is needed.

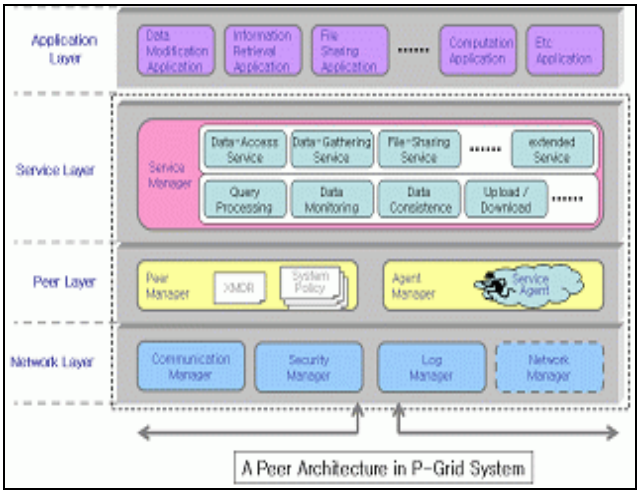


Fig 4. P-Grid System Compositions

4. Implementation and Result Analysis

In this section, we present the implementation of P-GRID SYSTEM using mobile agent. Also, we analyze the performance from the migration scheme of service agent and consideration of peer information

4.1 System Implementation

The implementation of *[KMAS]* that is a part of P-GRID SYSTEM is shown below. Fist, the user sets up the basic information that will be the policy of system.

Fig. 5 shows the list of peers that are connected to P-Grid System. Each peer has its basic information; peer name, CPU capacity and JVM status.

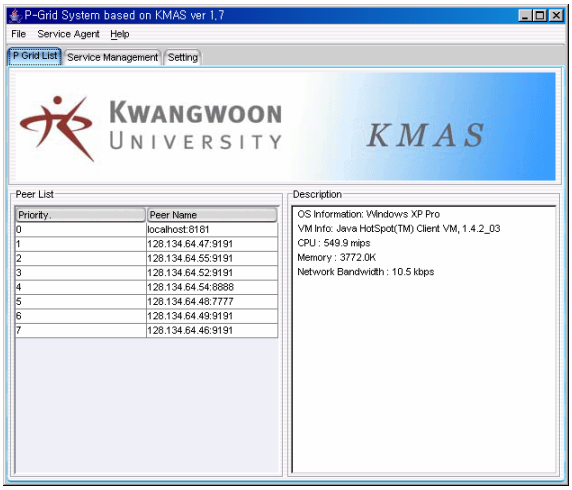


Fig 5. Peer List connected P-Gird System

Fig.6 decides the migration path. After user sets up migration sequence, scheme and scope, system establishes migration path. The result of migration path describes each peer's priority, host IP, port, CPU, memory, network bandwidth and so on.

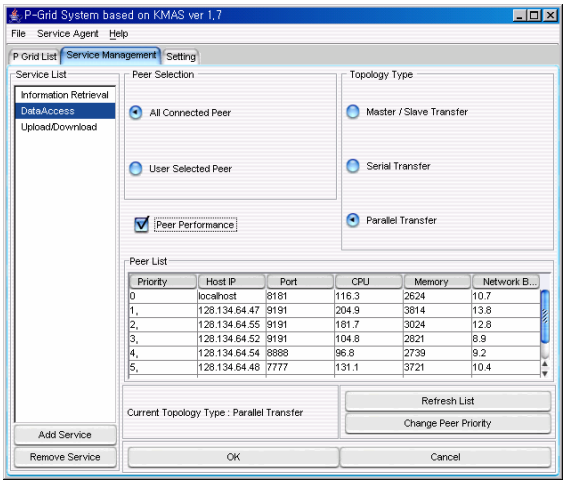


Fig 6. Decision of Migration Path

Fig.7 sets up peer's status information. Each peer sets local host port and database environment for data access.

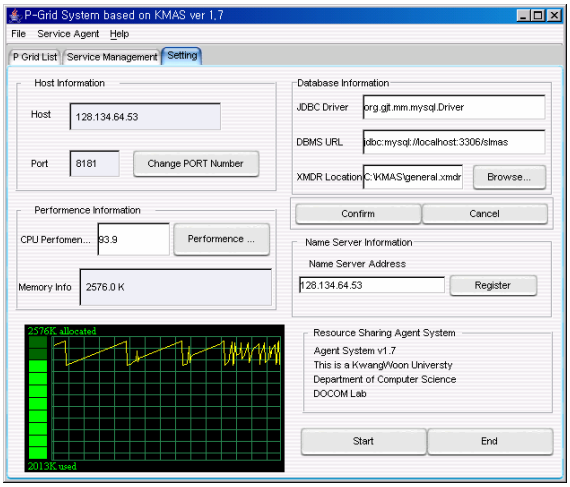
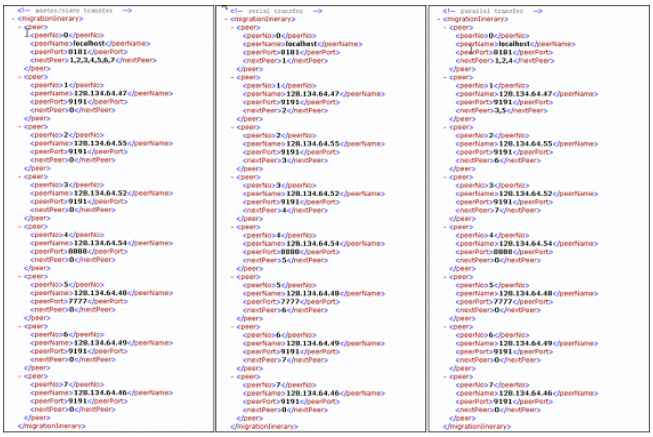


Fig 7. Setting peers in P-Gird System

When peer's migration sequence, migration scheme and migration scope are defined for deciding the migration path of service agent, the migration path is decided as shown at fig. 8; Master/Slave type, Serial type, parallel type.



(a) master/slave type (b) serial type (c)parallel type

Fig 8. Migration Itinerary

Also fig. 9 presents the result of service agent's job.

Fig 9. Service agent Job Completion

4.2 Result Analysis

We have the performance test of simple operation on the proposed P-GRID SYSTEM. For performance test, P-GRID SYSTEM is installed on Windows.
We concerned two factors for performance. It is the test for migration scheme of service agent and each peer's information. The number of peer is from 5 to 40 systems. Even it is the simple operation job; the entire execution time is increased linearly as the number of peers is increased in Master/Slave method and serial method as shown at fig. 7. Also, the parallel method shows almost flat line, because service agent reduces migration time.
We can figure out that identifying peer's information does not take a lot of time from the test result. However if we consider peer's information more and mechanism is improved, we can reduce entire execution time more.

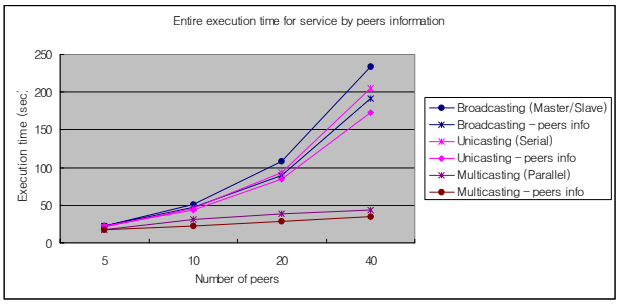


Fig 10. Performance test of simple operation service on P-Grid System

5. Conclusion

This paper uses mobile agent system to implement P-Grid, and describes the efficient migration method for service agent. We can reduce the execution time of service agent by establishing migration path after setting up migration priority based on performance of peers, and we can also vary the job execution time as the topology of logical network in each peer for migration. As future work, the mechanism improvement is necessary for considering each peer's performance and providing safer service

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