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A Distributed Approach for Structured Resource Discovery on Grid

著者： A.Clematis, D.D'Agostino, A.Quarati, A.Corana, V.Gianuzzi, A.Merlo
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発表者： 本多 · 近藤研究室　1053003 于金波

1 Introduction

With the development of Grid technology, available Grid resource discovery has become more and more important. Most previously proposed resource discovery systems in current middlewares adopt a centralized or hierarchical approach. However, Grid architectures have evolved to adapt large scale systems with thousands of nodes. So it has been impossible to rely on centralized structures. Recently some techniques used in P2P computing [1] which are inherently distributed and very dynamic are applied to Grid.

This paper proposes a structured view of resources obtained by GEDA, joined to a super-peer approach to efficiently search large Grid.

2 Related work

P2P computing techniques are used in resource discovery on Grid. The requirements for P2P networks and Grid platforms are similar but partially different. This paper proposes many points to make effective the P2P approach to Grid resources discovery: (1) provide a uniform interface. (2) suitable publication of information. (3) a suitable and modular architecture. Use messages, procedure/service calls and mobile agents to explore the net. This approach greatly reduces message interchange and flooding.

3 The proposed architecture

3.1 The graph of trees

The paper divides the potentially available computational resources of a Grid into three classes: Single Machine (SM), Homogeneous Cluster (HoC), Heterogeneous Cluster (HeC). The proposed approach combines a structured view of computational resources (SM, HoC and HeC) at the Physical Organization (PO) level. The structure is a logical Grid structure with a tree topology, composed by a hierarchical disposition of the resources.

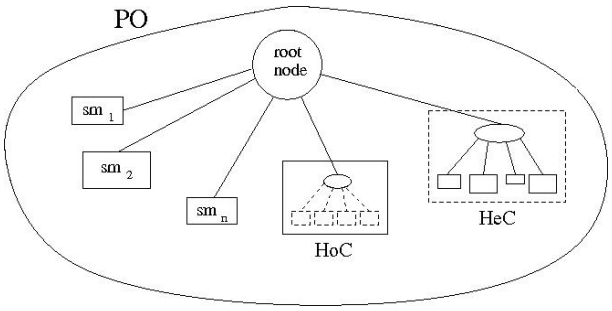

Figure. 1: Example of a PO with tree structure

Take each root node of a PO as a super-peer node, with arcs connecting neighboring super-peer node, with arcs connecting neighboring super-peer node. Thus the Grid is logically depicted as a graph of trees like showed in Figure 2. In fact, this paper use super-peer nodes to partition the Grid into sub-domain along with suitable search algorithms. The architecture is efficient for avoiding the flooding of the network. There are two models in the graph of tree. The nodes below the super-peer are structured following the proposed classification, but in the normal super-peer model, the leaf nodes are unstructured, and all belong to the same sub-level.

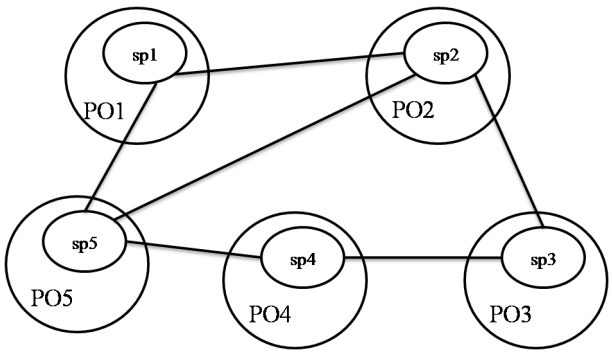

Figure. 2: Graph of trees

All the relevant features of the PO elements, both the local (single machine and cluster attributes) and the

global ones (the tree structure itself, network topology, bandwidth info), are expressed using GEDA in a structured view aimed at facilitating the discovery process, and exposed by the root node to the other root nodes.

3.2 GEDA as a service for structured resource searching

GEDA is a modular and flexible tool. In this context, GEDA works at the PO level. The development of GEDA as a Grid Service comprises two phases. (1) the methods of GEDA are used in the implementation of a Java library. (2) the deployment of the library in an appropriate Grid Service. GEDA keeps updated a data structure (GEDA Data Structure, GDS) with information about the state of all resources of the PO. This structured information, once published at the super-peer node, is used by the P2P environment. GEDA provides two main services: Resource Discovery Service and Reservation Service.

4 Implementation

In this section, I will present an implementation that uses Globus Toolkit 4 (GT4) as middleware and JXTA as framework.

In GT4, MDS (Monitor and Discovering System) is the default information provider. It includes the Index Service (IS) which yields information about Grid Services that are registered to it. There is a IS on every host. See an example of PO structure with the GT4 based version showed in Figure 3.

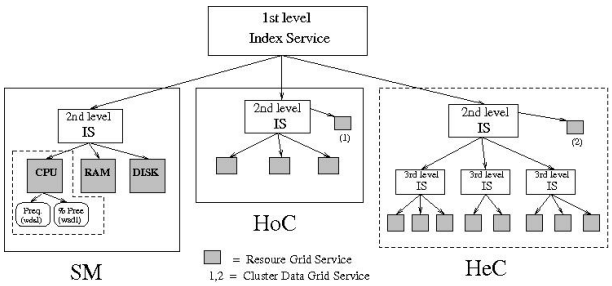

Figure. 3: The PO structure with the GT4 based version

The implementation of the graph of trees is accomplished using the JXTA framework (Figure 4). The JXTA protocols create a virtual network overlay on top of the existing physical network infrastructure. JXTA uses Rendezvous (RdvP), Edge (EP) and Relay (RP) to organize the overlay network. Based on the JXTA default discovery policy, the RdvPs are organized into a loosely -coupled network and maintains its own Rendezvous Peer View. The User Agents, querying for resources, reside on EPs. The EP directly addresses the Discovery Agent on the RdvP. RPs maintains information about the routes to other peers and routes messages between peers. The proposed approach is based on two key issues of JXTA: (1) advertisements. (2) SRDI (Shared Resource Distributed Index) service. There are two points about the proposed discovery mechanism: (1) use limited-range walker algorithm to propagate queries within the rendezvous network. (2) GDS is translated into the Advertisement format ready to be published at the RdvP node.

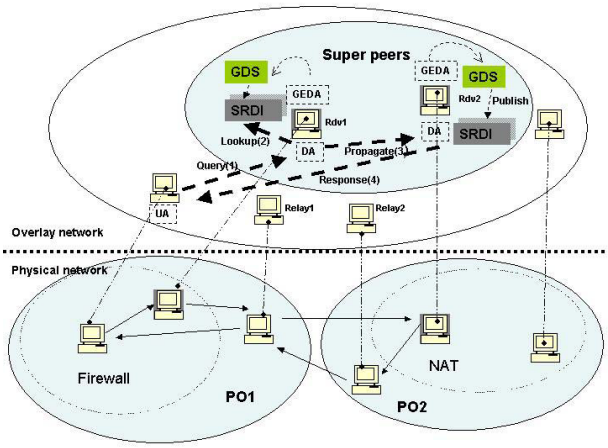

Figure. 4: Integration of GEDA with JXTA

5 Conclusions

The paper presented a distributed approach for Grid resource discovery which based on the union of a structured classification and view of available resources at the Physical Organization level. The super-peers of POs interact at a higher level. The proposed architecture allows the efficient search of large Grids, and the structured view of resources is suitable to computational resources discovery for high performance applications.

Reference

[1] S. Basu, S. Banerjee, P. Sharma, S.-J. Lee, " NodeWiz: Peer-to-peer Resource Discovery for Grids ", In *Proc.5th IEEE Int. Symposium on Cluster Computing and the Grid (CCGrid'05), 2003, pp.213-220*