Chapter X
Small World Architecture for Building Effective Virtual Organisations

Lu Liu
University of Leeds, UK

Nick Antonopoulos
University of Surrey, UK

ABSTRACT

A Virtual Organisation in large-scale distributed systems is a set of individuals and/or institutions with some common purposes or interests that need to share their resources to further their objectives, which is similar to a human community in social networks that consists of people have common interests or goals. Due to the similarity between social networks and Grids, the concepts in social science (e.g. small world phenomenon) can be adopted for the design of new generation Grid systems. This chapter presents a Small World Architecture for Effective Virtual Organisations (SWEVO) for Grid resource discovery in Virtual Organisations, which enables Virtual Organisations working in a more collaborative manner to support decision makers. In SWEVO, Virtual Organisations are connected by a small number of inter-organisational links. Not every local network node needs to be connected to remote Virtual Organisations, but every network node can efficiently find connections to specific Virtual Organisations.

INTRODUCTION

Grids are large-scale distributed computing systems providing mechanisms for sharing and integrating computing resources, data and services.

The rapid growth of distributed resources in Grids makes resource discovery far more challenging than traditional computer systems. In order to provide information that is actually useful and essential for decision makers, we need new mod-

els for resource discovery from multiple service providers in the large-scale Grid systems.

The new concept, Virtual Organisation, is emerging in the recent distributed system design (Foster, Kesselman, & Tuecke, 2001). Dynamic and distributed resources in large-scale distributed systems, such as Grids and peer-to-peer (P2P) networks, can be organised as Virtual Organisations for coordinated resource sharing and problem solving (Foster et al., 2001; Walker, 2001).

Many properties need to be considered in design of effective Virtual Organisations, such as availability, affordability, security, dependability, flexibility and scalability. In effective VOs, users should be able to communicate with each other easily and securely, and share and discover desirable resources for specific purposes. In the last decade, many studies have been made to address the problem of communication and resource sharing in dynamic, multi-institutional Virtual Organisations, while the study of resource discovery in Virtual Organisations was paid little attention to. However, we will not reap all the benefits of utilising these shared resources in Virtual Organisations unless we have an efficient way to discover them. Owing to the dynamic and distributed nature of Virtual Organisations, efficient resource discovery remains a challenge for designing effective Virtual Organisations, which will be addressed here.

A Virtual Organisation in large-scale distributed systems is a set of individuals and/or institutions with some common purposes or interests that need to share their resources to further their objectives (Walker, 2001), which is similar to a human community in social networks that consists of people having common interests or goals (Khambatti, Ryu, & Dasgupta, 2002). Due to the similarity between social networks and Grids, where Grid nodes can be regarded as people and connections can be regarded as relationships, the concepts and theories in social science (e.g. small world phenomenon (Watts &

Strogatz, 1998)) can be adopted for the design of new generation Grid systems.

In this chapter, we present a Small World architecture for Effective Virtual Organisations (SWEVO) focusing on the issue of resource discovery for building effective Virtual Organisations, which is based on the previous research on resource discovery in P2P networks and Grids (Antonopoulos & Salter, 2004; Liu, Antonopoulos, & Mackin, 2007a, 2007b, 2008). In SWEVO, a semi-structured P2P search algorithm is utilized for efficient resource discovery in Grid network, which enables Virtual Organisations working in a more collaborative manner to support decision makers.

BACKGROUND

Resource Discovery in Virtual Organisations

In many existing VOs, a centralised resource index provides the functionalities to publish and discover resources (Foster, Kesselman, & Tuecke, 2001; Winton, 2005). Using a centralised resource index, a resource can be quickly found and consumed. However, the centralisation of the resource index service raises the issues of scalability caused by the limitation of resources at the index node, such as network bandwidth, CPU capability and storage space. Moreover, the centralisation of the resource index also introduces a single-point-of-failure to the system. The index node centralises all responsibilities for publishing and handling enquiries about resources. Once the resource index fails, all the information about accessible resources will be unavailable.

To reduce the problem of single-point-of-failure, each network node should have the capability to efficiently discover desirable resources by interacting with connected nodes. In SWEVO, each Grid node does not rely on a centralised index to provide resource discovery service, which can

Related Content

An Autonomous Agent Approach to Query Optimization in Stream Grids

Saikat Mukherjee, Srinath Srinivasaand Krithi Ramamritham (2012). *Grid and Cloud Computing: Concepts, Methodologies, Tools and Applications (pp. 407-428).*

www.irma-international.org/chapter/autonomous-agent-approach-query-optimization/64494

Abstractions and Middleware for Petascale Computing and Beyond

Ivo F. Sbalzarini (2010). *International Journal of Distributed Systems and Technologies (pp. 40-56).*

www.irma-international.org/article/abstractions-middleware-petascale-computing-beyond/42975

Two Rough Set Approaches to Mining Hop Extraction Data

Jerzy W. Grzymala-Busse, Zdzislaw S. Hippeand Teresa Mroczek (2008). *Rough Computing: Theories, Technologies and Applications (pp. 227-238).*

www.irma-international.org/chapter/two-rough-set-approaches-mining/28476

Monitoring and Metering in the Cloud

Eduardo Oliveros, Tommaso Cucinotta, Stephen C. Phillips, Xiaoyu Yang, Stuart Middletonand Thomas Voith (2012). *Achieving Real-Time in Distributed Computing: From Grids to Clouds (pp. 94-114).*

www.irma-international.org/chapter/monitoring-metering-cloud/55244

Integrating Production Automation Expert Knowledge Across Engineering Domains

Thomas Moser, Stefan Biffl, Wikan Danar Sunindyoand Dietmar Winkler (2011). *International Journal of Distributed Systems and Technologies (pp. 88-103).*

www.irma-international.org/article/integrating-production-automation-expert-knowledge/55423