# Chapter 15

# Service-Oriented Networking for the Next Generation Distributed Computing

**Qiang Duan**
*Pennsylvania State University, U.S.A.*

## ABSTRACT

*With the rapid development of various emerging technologies, such as Web services, Grid computing, and cloud computing, computer networks have become the integrant of the next generation distributed computing systems. Networking systems have a significant impact on distributed application performance; therefore, they must be integrated with other computational resources in distributed computing systems to support the requirements of high-performance distributed applications. This chapter presents a new Service-Oriented Networking (SON) paradigm that enables the integration of networking and distributed computing systems. The SON applies the Service-Oriented Architecture (SOA) principle and employs network virtualization for abstracting networking resources in the form of network services, which can be described, discovered, and composed in distributed computing environments. This chapter particularly discusses network service description and discovery as key technologies for realizing the SON, and describes a network service broker system for discovering the network services that meet the performance requirements of distributed applications. A general modeling approach to describing network service capabilities and an information updating mechanism are also presented in this chapter, which can improve the performance of the network service broker system in heterogeneous and dynamic networking environments.*

DOI: 10.4018/978-1-61350-110-8.ch015

## INTRODUCTION

The past decade has witnessed many exciting developments in the area of distributed computing. Some of the most significant progresses in this field include Web services, Grid computing, and Cloud computing, which have enabled the utilization of a wide variety of distributed computational resources as a unified resource. These emerging distributed computing technologies, with the rapid development of new networking technologies, are changing the entire computing paradigm toward a new generation of distributed computing.

The notion of Web services evolved from the concept of software-as-a-service, which first appeared as the application service provider model. Web services extend the software-as-a-service concept to include the delivery of complex business processes and transactions as services. When comparing Web services to Web-based applications we may distinguish the following key differences: Web services act as resources to other applications that can request and initiate those Web services with or without human intervention; Web services are modular, self-aware, and self-describing applications; Web services are more flexible and manageable than Web-based applications; and Web services may be brokered or auctioned (Papazoglou, 2008).

Grid computing started off in the mid-90s to address large-scale computing problems using a network of resource-sharing commodity machines that deliver the computation power affordable only by supercomputers and large dedicated clusters at that time. The idea is to federate the heterogeneous computational resources across geographically distributed institutions and make them to be utilized as a unified resource by various applications. Grid computing was initially developed by the high-performance computing community with its own standard specifications. Then Web services have been gradually adopted into the key technologies and standards for Grid computing.

Cloud computing is a relatively recent term that can be defined as a large scale distributed computing paradigm that is driven by economics of scale, in which a pool of abstracted, virtualized, dynamically-scalable computing functions and services are delivered on demand to external customers over the Internet (Foster et al., 2008). A Cloud is massively scalable and can be encapsulated as an abstract entity that delivers different levels of services to customers outside the Cloud. Cloud services can be dynamically configured and delivered on demand.

Cloud computing is closed related to Grid computing. Though having different technical details, they share essentially the same vision − to reduce the cost of computing, increase reliability, and enhance flexibility of managing computing infrastructures. Both Cloud computing and Grid computing need to manage large scale facilities, to enable customers to discover, request, and use computing resources provided by central facilities, and to implement highly parallel computations on those resources. Cloud computing can be viewed as the next evolution step after Grid computing in the field of distributed computing.

Data communications play a crucial role in all the aforementioned emerging distributed computing systems. Federation and coordination of geographically distributed computational resources to deliver better-than-best-effort services is a key feature of both Web services and Grid computing. Cloud services are typically accessed through communication channels provided by computer networks. Networking performance has a significant impact on the end-to-end service quality experienced by the applications and customers supported by these distributed computing systems. Therefore, communication networks with Quality of Service (QoS) provisioning capabilities become an indispensable ingredient of the next generation high-performance distributed computing systems.

However there exists a gap between the demands of the emerging distributed computing for data communications and the services that can be

## Related Content