

Chapter 92

Carrier-Grade Distributed Cloud Computing: Demands, Challenges, Designs, and Future Perspectives

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ABSTRACT

This chapter discusses and surveys the concepts, demands, requirements, solutions, opportunities, challenges, and future perspectives and potential of Carrier Grade Cloud Computing (CGCC). This chapter also introduces a carrier grade distributed cloud computing architecture and discusses the benefits and advantages of carrier grade distributed cloud computing. Unlike independent cloud service providers, telecommunication operators may integrate their conventional communications networking capabilities with the new cloud infrastructure services to provide inexpensive and high quality cloud services together with their deep understandings of, and strong relationships with, individual and enterprise customers. The relevant design requirements and challenges may include the performance, scalability, service-level agreement management, security, network optimization, and unified management. The relevant key issues in CGCC designs may include cost effective hardware and software configurations, distributed infrastructure deployment models, and operation processes.

INTRODUCTION

Cloud computing allows ubiquitous, convenient, on-demand network access to share configurable computing resources (networks, servers, storage, applications, services, and so on) with some attractive features, such as scalability, location

independence, user-metering, and use-based billing (Michael Armbrust, 2010). According to the different deployment models or ways for users receiving the cloud services, such as different payment methods and access ways, the cloud services may be classified as private cloud, community cloud, public cloud, and hybrid cloud

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(Mell & Grance, 2011). We may call the quality cloud services provided by Telecommunication Operators (TOs) as carrier-grade cloud computing or carrier cloud computing (Telecom Grade Cloud Computing, 2011) (Meng, Han, Song, & Song, 2011) (Shimizu & Nishinaga, 2012). Note that carrier-grade cloud computing may support private cloud, community cloud, public cloud, and hybrid cloud based on different deployment modes. This chapter will discuss and survey the concepts, demands, requirements, solutions, challenges, and future perspectives and potentials of Carrier Grade Cloud Computing (CGCC). This chapter also will introduce a carrier grade distributed cloud computing architecture, and discusses the benefits and advantages of the carrier grade distributed cloud computing.

DEMANDS AND CURRENT EFFORTS OF CLOUD SERVICES PROVIDED BY TELECOMMUNICATION OPERATORS

Through constructing large data centers, TOs may deliver Service-Level Agreement (SLA) guaranteed flexible services to individual consumers and enterprise customers using centralized management system to orchestrate cloud services, such as computing, storage, and networking. Cloud computing may reduce the cost by 75% for introducing new applications to markets, and it has been estimated that, in 2014, 80% of the software would be provided to individuals and enterprises in the form of SaaS (Software as a service), meanwhile, over 90% of the companies or organizations would provide mobile applications based on cloud computing. Virtualization technologies may help network operators reduce CAPEX (Capital Expenditure) investment, reducing OPEX (Operating Expense) cost through deploying automatic management systems as well as adding new profitable services into service catalogs, such as cloud storage, virtual machine lease

and cloud application hosting services, and so on. Amazon, Google, Microsoft, and some other IT (Information Technology) companies have been investigating cloud computing for several years, and have successfully launched chargeable service for both individuals and business customers. According to a market research report by Gartner, it has been forecasted that the worldwide cloud computing-related investment would grow from 2.85 billion Euros in 2011 to 8.08 billion euros in 2014 (Ben Ping, 2010). It has been estimated that, in 2014, the investment in three areas of SaaS, PaaS (Platform as a Service), and IaaS (Infrastructure as a Service) in China would achieve 861 million euros, and the relevant annual compound growth rate would reach 38.2%.

The demands for cloud services are growing quite fast, thus it is quite possible that traditional TOs would be out of the market if without proper strategic transformations. In order to meet the demands of the customers, telecommunication operators may necessarily construct cloud infrastructure supporting the new cloud business requirements for the broadband networks, access networks, computing networks, and the digital storage networks. Some major telecommunication operators are now able to properly integrate network transmissions with the provision of basic cloud services, which may distinguish themselves from other independent cloud infrastructure operators and cloud service providers. Some leading TOs have carried out the cloud computing deployment plans. AT&T has provided SME (Small and Medium Enterprise) customers and application developers with simple, flexible, secure cloud computing services, including the data center services, cloud based enterprise application development platform, and flexible cloud storage services (Cloud Computing, Medical Image, and Online Storage, 2012). Meanwhile, AT&T has developed a smart medical service system with cloud-based file sharing capabilities so that patients cases stored in the cloud could be accessed anywhere, anytime by any authorized doctors or

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