

Chapter 113

Cloud Bioinformatics in a Private Cloud Deployment

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ABSTRACT

This chapter describes service portability for a private cloud deployment, including a detailed case study about Cloud Bioinformatics services developed as part of the Cloud Computing Adoption Framework (CCAF). The Cloud Bioinformatics design and deployment is based on Storage Area Network (SAN) technologies, details of which include functionalities, technical implementation, architecture, and user support. Bioinformatics applications are written on the SAN-based private cloud, which can simulate complex biological sciences and present them in a way that anyone without prior knowledge can understand. Several bioinformatics results are discussed, particularly brain segmentation, which demonstrates different parts of the brain simulated by the private cloud. In addition, benefits of CCAF are illustrated using several bioinformatics examples such as tumour modelling, brain imaging, insulin molecules, and simulations for medical training. The Cloud Bioinformatics solution offers cost reduction, time-saving, and user friendliness.

1. INTRODUCTION

Healthcare informatics has played a strategic role in the National Health Service (NHS) and has been influential to the way in the IT project development for different NHS Trusts. The ICT initiatives include Cloud Computing, which has investigations to understand how to process with Cloud adoption and the capacity to maximise the added value as a result of Cloud adoption. Cloud Computing offers a variety of benefits including cost-saving, agility, efficiency, resource consolidation, business opportunities and Green IT (Chang

et al., 2010a; 2010b; 2011a; 2011b; 2011c; 2012a; 2012b; 2012c; 2013a; 2013b; Kangermann et al., 2011). As more organisations adopt Cloud, the need for a standard, or a framework to manage both operation management and IT services is emerging. This framework needs to provide the structure necessary to ensure any Cloud implementation meets the business needs of industry and academia and include recommendations of best practices which can be adapted for different domains and platforms. Our framework is called the Cloud Computing Adoption Framework (CCAF). It helps organisations to achieve good Cloud

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design, implementation and services (Chang et al., 2011a; 2011b; 2011c; 2011d; 2011e; 2012a; 2012b; 2012c; 2013a; 2013b; Chang & Wills, 2013; Chang, 2013a; 2013b; 2013c). CCAF may be used from service strategy to design, development, test and user support stages. The CCAF seeks to address two problems in particular:

- Calculating risk and return analysis of a large computer system adoption such as Cloud adoption systematically and coherently.
- Risk mitigation to migration of the Cloud.

1.1 Service Portability for Cloud Deployment

This paper focuses on service portability which is the term we use to describe a recommended approach to Cloud adoption that plays an important role in having a smooth transition to the Cloud environment. Service portability also influences the design and implementation of healthcare bioinformatics services. Beaty et al. (2009) and Chang et al. (2011a; 2012c; 2013) identify portability as an adoption challenge for organisational Cloud adoption. Although it is domain specific as there are different requirements for portability in each domain, communication between different types of clouds supplied by different vendors can be difficult to implement. Often work-arounds are needed which entail writing additional layers of APIs, or an interface or portal (Beaty et al., 2009; Armbrust et al., 2009).

Service portability (portability in short) is illustrated using examples from Cloud bioinformatics projects in the Healthcare industry where portability is influential in migrating the existing platforms and applications to the Cloud and later developing new applications and services. Bioinformatics is provided using in-house private clouds, initially to provide a working IaaS infrastructure for medical databases, images and analysis in a secure and collaborative environment. These Cloud projects

have been successfully delivered and provide a high level of user satisfaction and were followed up with further work to upgrade from IaaS to PaaS, which allows greater benefits, including better efficiency and better management of resources.

1.2 Two Stages in the Development of the Private Cloud

There are two phases in the development of the private cloud. The first phase is the design and deployment of the architecture to consolidate infrastructure, platform and resources. The objective is to provide a consolidated infrastructure before beginning the software development and offer of application services. The second phase is the application development built on top of the consolidated architecture. These applications offer both Platform as a Service (PaaS) and Software as a Service (SaaS). PaaS allows the developers to develop the code in the Cloud repository, which is a central platform for the developers to implement and test their prototypes. The internal cloud is used as a knowledge-based sharing resource so that any team members can be informed with the latest updates and lesson learned as a result of service delivery or troubleshooting experience. New knowledge and repository for best practices can be kept up-to-date. SaaS is the service offered to the internal users. From users' points of view, they do not need to know the complexity behind the scene but they can use the service at any way and any time. These SaaS services are easy to use and allow users to interact with simulations and obtain their experimental results, even without themselves involved with experiments.

The structure of this paper is as follows. Section 2 describes the first phase of the Cloud deployment and its architecture and Section 3 presents the bioinformatics services on offer. Section 4 explains one specialist area of the bioinformatics project, brain segmentation and its demonstrations. Section 5 presents three topics for discussions and Section 6 sums up Conclusion and future work.

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