Virtualized Disaster Recovery Model for Large-Scale Hospital and Healthcare Systems

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ABSTRACT

Healthcare organizations face rising costs in effective management of hospital information systems. Adding to this burden is the Joint Commission’s mandate for disaster preparedness, which demands restoring access to information after unexpected catastrophes. Disaster recovery within healthcare organizations is essential because of its inherent critical nature and the possible losses’ impact on patients’ lives. This paper presents a virtualized disaster recovery model and presents steps for setting up the recovery environment and implementing the virtualized plan across multiple network systems. A large scale hospital and healthcare system in Minnesota participated in this study, and results indicate that the virtual model can provide acceptable performance when a limited number of client workstations are functioning. However, its performance is not as good as the traditional physical model, and its workload performance decays much quicker. Future research is suggested that tests more sophisticated models and incorporates finer granularity in the tabular distribution methodology.

Keywords: Data Loss, Disaster Recovery, Healthcare Organizations, Hospital Information Systems, Virtualization

1. INTRODUCTION

The cost of healthcare in the United States (U.S.) over the last several decades has proliferated to a level that causes great anxiety among consumers, policy makers, and regulatory agencies. A study by Sullivan (2002) estimated that annual healthcare costs were over $1 trillion and has grown to more than 14% of the total gross domestic product (GDP). Healthcare costs are projected to hit more than 17% of our GDP by 2011 (Weshsler, 2002). Past research has pointed out that effective maintenance of hospital information systems (HIS) contributed to the high rise in healthcare costs. Indeed, HIS related costs grew at an annual rate of 11.5% from 1995 to 2000, reaching $20 billion in 2001 (Bandyopadhyay, 2002). Adding to this cost increase are the expenditures associated with developing an effective disaster recovery plan (DRP) to recover lost information due to unforeseen interruptions, as required by the Joint Commission.

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A disaster in a healthcare environment refers to the downtime of the HIS or loss of data as a result of unexpected interruptions. These interruptions can be caused by internal sources such as technical failure and misuse of the information system, or external sources such as natural disasters and malicious hackers. Disaster recovery in a healthcare setting takes a very different perspective because the loss of information is critical for diagnostic decisions that can be a matter of life and death. A complete failure to provide immediate access to medical histories may be fatal for critical care patients. Even a seemingly straightforward decision, such as the right drug dosage, is dependent on the retrieval of patients’ medical history and treatment records. The fact that lives are at stake reflects a critical need to develop a cost-effective and reliable DRP that allows healthcare providers to resume their service operations as quickly as possible following a disaster.

By examining some of the promising characteristics of distributed processing and virtualization, this paper describes how those characteristics could be adapted to create a virtual recovery model featuring off-site virtualized replication. A large-scale HIS in Minnesota participated in this study. Its main HIS production infrastructure is virtualized on a smaller scale. In other words, their physical host structure is reduced down to separate logical zones on a single computer resulting in less processing power than the original multi-computer architecture. To determine the effectiveness of this virtual model multiple computer-generated simulations using the HIS’s workload distribution for network traffic will be used to determine workstation delay and other performance metrics. These values will be calculated using the same workload transaction profile on both systems. Then the performance potential of the original physical model which features many computers can be compared to the new virtual architecture. The results then can be compared to ascertain if the virtualized system offers a performance level that is adequate for large-scale health care applications.

2. HOSPITAL INFORMATION SYSTEM

Hospital information systems (HIS), also referred to as clinical information systems (CIS), are comprehensive and integrated information systems designed to manage the clinical aspects and business administrative functions of healthcare organizations. The scope of HIS varies, but essentially these systems comprise one or more software applications with clinical specialty extensions, administrative functions and ancillary support, or a large variety of sub-systems in medical specialties such as the laboratory information and radiology information systems. Historically, HIS were used as remote data processing applications to handle routine operations such as accounting, billing, payroll, drug inventory, computer-assisted diagnostics and clinical instrumentation. Available to internal users only, these applications were designed based on ad-hoc demands and were often unable to interact with existing legacy systems. Frequently, users printed out the results generated by one system, and manually entered them into another system. Since most HIS were used to perform only specific operating tasks, users relied on paper trails for documentation and records for backup information.

Today, HIS are no longer stand-alone systems with limited applications. Healthcare systems in the current digital era are designed to connect with every end user, supplier, and vendor. Increasingly, clinics, hospitals, and healthcare providers are relying on HIS for clinical and business information. More and more healthcare organizations are dependent on HIS for integrated healthcare administration and service delivery. Information services are no longer an 8-5 operation. Physicians demand 24/7 uptime to utilize clinical applications and make decisions. Crucial information for attending physicians to derive sound treatment plans include the accessibility of medical histories through electronic medical records (EMR), and cataloging of results of large image files of CAT scans, MRIs, Ultra-sounds and X-rays results via