

# Improving Performance and Scalability of Fiji National University Campus Information System Using N-Tier Architecture

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## ABSTRACT

*Software architecture is very important in the development of large scale software solution and plays a very active role in achieving business goals. This research is an attempt to utilize the N-Tier software architecture for developing a prototype campus information system for Fiji National University (FNU-CIS), to address the issue of performance and scalability. To assist in the design and implementation of FNU-CIS, an extensive evaluation of campus information systems is carried out to provide the bench mark on the current technology. FNU-CIS software architecture is designed with the implementation using JEE and CORBA. Experiments were carried out to assess the performance and scalability of the newly developed system. Several tests were carried out to measure the response time, throughput and latency of our system in distributed settings, and the results mainly favored FNU-CIS. This research makes a significant contribution to the field of software engineering in today's world where performance and scalability of IT applications are often equated with better business, the process and techniques used in building such systems is paramount. The ideas presented in this paper can be easily utilized for the development of other large scale systems with similar issues such as performance and scalability to be addressed.*

*Keywords:* Distributed Systems, Fiji National University, Performance, Scalability, Software Architecture

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## INTRODUCTION

Performance and scalability are two words very often used synonymously however they mean different things. Performance refers to the capability of a system to provide a certain response time, throughput or latency. Scal-

ability refers to the characteristic of a system to increase performance by adding resources (Haines, 2006).

Poor performance and scalability are the main quality related short comings that cause software projects to fail. In the last decade there has been a growing interest in the research and

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software industry communities toward techniques and methods that allow one to develop software by addressing these two major issues (Cortellessa et al., 2011). Growth of distributed systems has attained unstoppable momentum. Distributed systems can provide the necessary power to meet the growing demands of the user community. We are demanding capability faster than the advances in devices alone can supply, and to meet these demands we will have to rely innovative software architectures such as N-Tier. N-Tier architecture provides a model for developers to break up an application into tiers and easily create flexible and scalable applications (Christian et al., 2010).

Prior to the merger and formation of the Fiji National University (FNU) and due to the autonomous operations of different colleges, three different campus information systems exist. After the formation of the FNU the usage of these systems has increased dramatically, with the increase in number of users there is endearing need for a system with high performance and scalability. In addition to this the system should be flexible, highly secured and fault tolerant. It is a challenging task to develop a system to meet these demands, current campus information systems cannot fully address these issues because of its monolithic architectural design. A new system FNU-CIS is proposed to be built using N-Tier architecture.

The main focus of FNU-CIS is to address the issue of performance and scalability. The system should be able to process user requests with acceptable response time, provide high throughput, low latency and easily enlarged to handle growing workload in graceful manner. FNU-CIS should have relatively clean separation between presentation, business logic, and data access layers, with solid data architectures and a well defined set of business processes thus making it easier, faster and less expensive to change existing processes and activities as well as introduce new ones in future.

N-Tier architecture provides a model for developers to create a scalable, flexible and reusable application (Tafti et al., 2008). FNU-CIS presentation, application processing, and the data management will be logically separated

into tiers. By mapping layers to tiers, we will create a cluster or a farm on the same tier to increase performance and scalability. We can deploy the user interface layer to one tier such as a farm of web servers, the business logic to another tier, then the data layer to yet another tier. By breaking up an application into tiers, in future we only have to modify or add a specific layer, rather than having to rewrite the entire application over.

The article is organized as follows. It provides background of the campus information systems and sets the criteria for development of FNU-CIS with design and implementation details of FNU-CIS using JEE and CORBA. Finally, we provide experimental evaluation results and conclude with discussing future work for research in this area.

## RELATED WORK

Campus Information System (CIS) is a transaction processing system that serves at the operational level of the colleges and universities. It performs and records the routine transactions necessary to conduct its business (Peng, 2003). CIS also matches the structure, management tasks, instructional processes and special needs of the institution, like the traditional MIS, CIS integrates data from multiple sources to provide information people need to make important management decisions.

Traditionally CIS were mainly mainframe applications, since the late 1990's it has been changing and are fast adopted through the presence of a web medium as channel for accessing CIS without any hassle upon viewing relevant information (Ethridge, 2000). Higher education institutions have made and continue to make substantial investments in these systems which have helped them run increasingly complex business processes handle growth in key areas and offer services to end users (Dodds, 2007). These systems are required to support the broadest possible range of users and activities across a wide range of institutions and make it as simple as possible to support new activities and initiatives.

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