

# Learning Management System Arrangement on Virtualization Server at UCS, Kalay

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**Abstract**— Nowadays, the massive proliferation of computers, portable devices, networking connectivity and digital education content has increasingly led to use ICT to transform and promote education. This paper presents how to consolidate and implement Learning Management System (LMS) server, Mail server and DNS server onto one physical server for effective use of LMS at University of Computer Studies, Kalay (UCSK). Virtualization technology is used in implementation of those servers onto one physical computer. As a result, Virtual Servers are running on a physical machine and students, teachers and staff can access web-based LMS server for course contents sharing, assessments by assignments or quizzes and Mail server for community collaboration.

**Keywords**— *Virtualization, Learning Management System, Moodle, Mail*

## I. INTRODUCTION

LMS is a digital platform used to administer and monitor the delivery of eLearning. Thus, many higher education organizations have been deploying LMSs to provide the educators to create effective online learning sites in universities, to build richly collaborative communities of learning, to deliver teaching and learning contents to students and to assess learning.

IT professionals can achieve flexibility in systems and applications by managing a virtual infrastructure. VMware offers a solution to improve the organization's profitability, robustness and responsiveness [9].

Thus, a physical server running on which virtual LMS server, Mail server and DNS server is implemented to deliver digital contents to students and assess learning with assignments or quizzes and to build collaborative learning community.

## II. RELATED WORK

LMS are widely used in most of the universities for promoting teaching and learning using ICT. The open-source LMSs are a good solution for small and medium size Higher Education Organizations. In [1], it is described that some open-source LMSs such as Moodle, Sakai, Dokeos and eFront LMS, should be considered. In [2], the authors examined various supports offered by Moodle for E-learning and described that Moodle is a great tool for tutors because it is a platform to create and save teaching material easily and a collaborative online platform for teachers and students to learn together. According to Moodle statistics on May 9, 2019, Moodle had

158,217,486 users from 229 countries. Thus, Moodle LMS is selected to be implemented.

Because of the emergence of ICT, LMS is implemented using cloud and IoT technology. The framework for a future LMS enhanced by IoT capabilities was proposed in [3]. In this framework, the university campus is transformed by utilizing IoT services into a smart learning environment. In [4], an Integrated Moodle System using VM Technology was implemented for higher availability and lower TCO.

The following sections present learning management system arrangement on virtualization server at UCSK. At first, network configuration is designed in section III. In session IV, server virtualization is described and in session V, virtual servers' performances are analyzed and finally we conclude the presentation in session VI.

## III. NETWORK CONFIGURATION

UCSK wired and wireless networks which connect computers and mobile devices spread over UCSK is constructed first. Private IP addresses space, 192.168.0.0/24 is decided to be used. IP address for each virtual server hosted on VMWare ESXi is statically assigned. IP addresses of all connected clients are specified dynamically. The detail information is described in Table I.

TABLE I. IP Designation

Devices	IP address	Subnet Mask
DNS	192.168.0.6-10	255.255.255.0
Domain Controller	192.168.0.16-20	255.255.255.0
File server	192.168.0.21-25	255.255.255.0
Mail Server	192.168.0.26-30	255.255.255.0
Moodle Server	192.168.0.31-35	255.255.255.0

## IV. SERVER VIRTUALIZATION

Server virtualization enables multiple operating systems to run on a physical server as efficient virtual machines. The key benefits are reduced operating costs, increased application performance and higher server availability. A virtual machine (VM) is an idea layer or the situation between hardware components and the end user. Virtual machines have a capacity to run any working systems on them [6].

Virtualization by a host operating system supports multiple isolated and virtualized guest OS's on a single

physical server with the characteristic that all are on the same operating system kernel with exclusive control over the hardware infrastructure. The host operating system can view and has control over the Virtual Machines. [7]

A physical server is configured using VM ware ESXi6.5, an enterprise class, type1 hypervisor on 16 GB of RAM, two 1000GB and 250GB of HDD computer. On this physical server, three virtual machines (LMS server, Mail server and DNS server) are hosted.

The UCSK virtualization system architecture is illustrated in Figure 1.

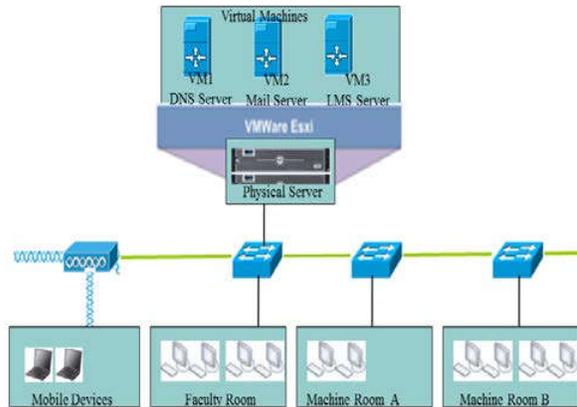


Figure 1. Virtualization System Architecture

## V. IMPLEMENTING VIRTUAL SERVERS

### A. Virtual LMS Server Implementation

Moodle LMS is a web application which is Open Source software under the GNU Public License. Uploading assignment and lecture materials, providing quiz and prompt analysis on attempted answers can be performed with the use of Moodle LMS. Moreover, discussion, survey, forum and chat features are also supported for teaching and learning network. [10]

LMS Components used in UCSK are the sharing of lecture materials, provision of quizzes and assignment, checking the score and prompt analysis on attempted quizzes.

The services offered from UCSK LMS server for the students are downloading lecture slides and notes, attempting quiz, checking score of the attempted quiz, uploading assignments and discussion within forum.

The services offered from UCSK LMS server for the teachers are provision of assignment and quiz, analysis of attempts and uploading teaching materials.

In order to provide those services, Virtual machine running Microsoft Server 2012 on virtual 500GB HDD is deployed on the ESXi server and Moodle LMS is implemented on it. And LMS admin perform the activities such as manage courses, create users and assign user roles.

The specification of VM for local LMS server is described in Table II. For getting the services offered by

UCSK LMS, user has to access “http://lms-server/ucskalay” as shown in Figure 2.

TABLE II. LMS Server VM Specification

Description	Specification
Guest OS	Microsoft Server2012 R2
RAM	8GB
HDD	500GB
IP	192.168.0.31
Domain Name	lms-server

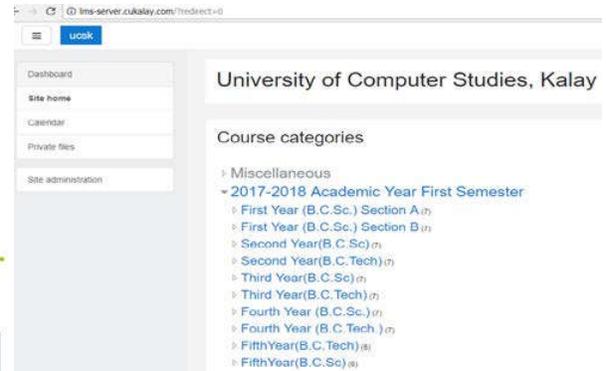


Figure 2. UCSK LMS Home Page

The sample course page (CS-406 Artificial Intelligence) is illustrated in Figure 3.

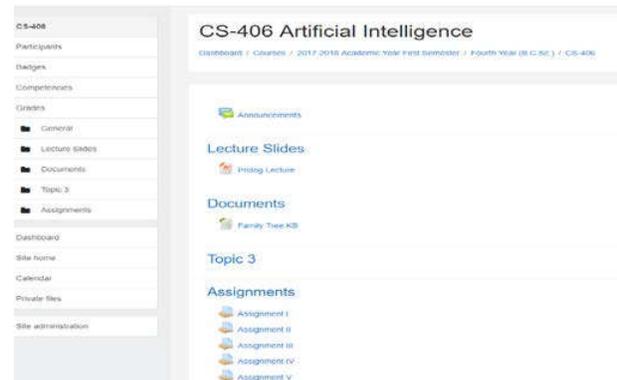


Figure 3. Sample Course Page

### B. Virtual Mail Server Implementation

The computers in the machine rooms at UCSK have no internet connection. In LMS features, we can send the email to LMS users. iRedMail is an open source and works on Ubuntu, Red Hat, CentOS, Debian, Free BSD and Open BSD. Thus, Virtual machine running Ubuntu 16 is hosted on the ESXi server. On this virtual machine, local email server is configured with the use of the shell script iRedMail. The specification of VM for local mail server is described in TABLE III.

TABLE III. Mail Server VM Specification

Description	Specification
Guest OS	Ubuntu 16
RAM	8GB
HDD	900GB
IP	192.168.0.26
FQDN	mail.cukalay.com

The following steps are done for setting up iRedMail on virtual server hosted on UCSK server.

- i. A fully qualified domain name (FQDN) is set as “webmail.cukalay.com” in /etc/hostname
- ii. iRedMail is downloaded and setup
- iii. Location to store all mailboxes is set
- iv. MySQL is selected to store mail accounts
- v. Mail domain name, “ucsk.mm”, is added
- vi. Admin password is set for usk.mm mail domain [8]
- vii. 247 accounts are created for teachers and students and set 1GB storage size for each account mailbox

Running local mail server allows us to store personal data email on hard disk of our own university server. Therefore, other organization can never see the contents of emails. Moreover, we can manage mailboxes size and create as many mail accounts as we want and view mail logs. At UCSK mail server, there are 247 users under “ucsk.mm” domain and 1GB Quota is provided to each user as shown in Figure 4.

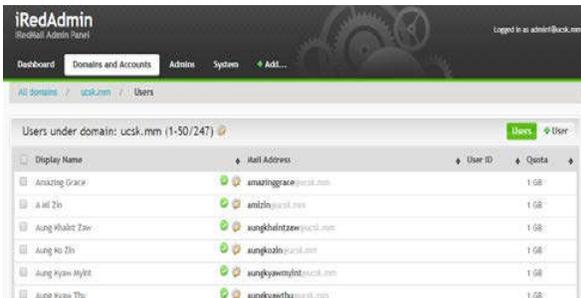


Figure 4. UCSK mail users (Admin View)

### V. SERVER PERFORMANCE ANALYSIS

The Hardware Configuration, Host CPU and Memory usage and General Information for DNS server is illustrated in Figure 5.

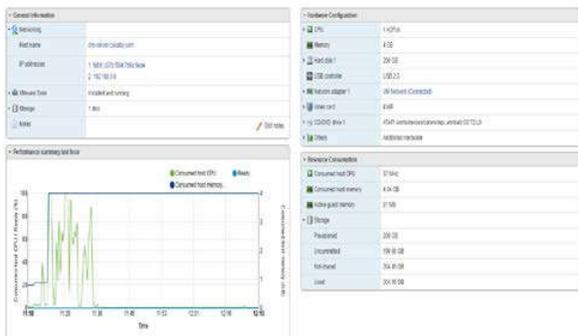


Figure 5. DNS Server Virtualization Report

The performance summary (1 hour) of each virtual machine is shown in Figure 6, 7 and 8 respectively. According to performance summary analysis, it was found that consumed host (CPU) of Mail server is very low. The Memory consumption is over 4GB.

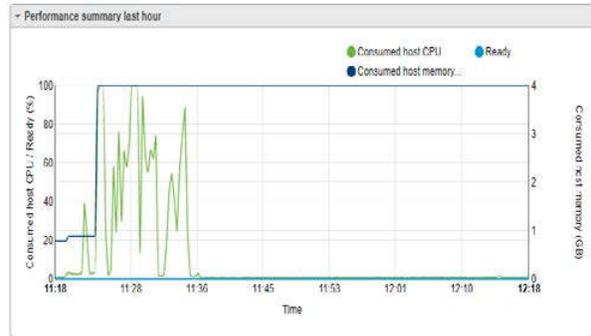


Figure 6. Performance Summary of DNS Server

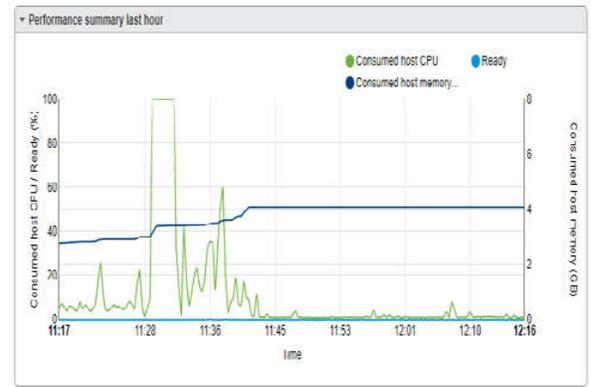


Figure 7. Performance Summary of LMS Server

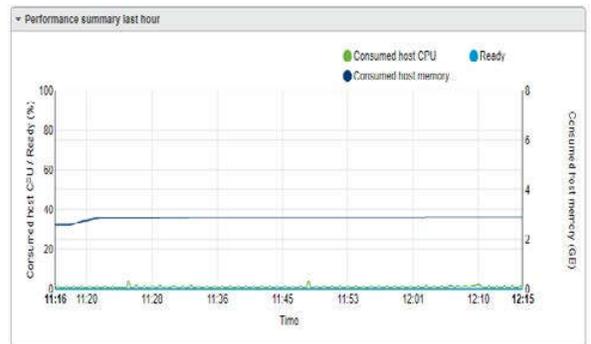


Figure 8. Performance Summary of Mail Server

### VI. CONCLUSION

VMware ESXi server is configured and the virtual machines run on it. Thus, it could save money on IT costs and reduce the number of physical server to manage. All students and teachers can access services offered by UCSK virtualization servers via domain name: <https://webmail.cukalay.com> for Mail service and <https://lms-server.cukalay.com> for LMS service. User doesn't need to memorize the IP of the server to access the service because of local DNS server configuration.

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