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THE OPEN-SOURCE SOFTWARE-BASED SOLUTION FOR DEVEOPMENT OF INFORMATION INFRASTRUCTURE OF MEDICAL UNIVERSITIES

Summary: The role of the information technologies in the education process of the medical universities is signed. A solution to development of the information infrastructure based on the maximal open source software usage for medical (pharmaceutical) universities is proposed. Examples of the system and application and specialized open source software are presented. The capabilities of the open source software usage in the healthcare and medical education fields are demonstrated. The advantages of the hardware virtualization and platform-independent web-applications usage are presented. The complex process of the web applications deployment in a new network cluster in the I.Ya. Gorbachevsky Ternopil State Medical University is given as example.

Keywords: medical education; open-source software; application software; information system; content-management system; learning management system; virtualization.

ROZWIĄZANIE NA PODSTAWIE OPROGRAMOWANIA OPEN SOURCE W CELU OPRACOWANIA INFRASTRUKTURY INFORMATYCZNEJ UNIWERSYTETU MEDYCZNEGO

Streszczenie: Rola technologii informatycznych w procesie edukacyjnym uniwersytetu medycznego jest wyświetlana. Zaproponowane jest rozwiązanie dotyczące opracowania infrastruktury informatycznej uczelni medycznej (farmaceutycznej) w oparciu o maksymalne wykorzystanie oprogramowania open source. Przedstawiono systemowe, stosowane oraz specjalizowane oprogramowanie open source w branży zdrowia i edukacji medycznej. Zwracamy uwagę na zalety korzystania technologii wirtualizacji sprzętu i stosowania aplikacji

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webowych niezależnych od platformy. Jako przykład przedstawiono proces rozwijania zestawu aplikacji webowych w tworzonym klastrzu PUMwT.

Słowa kluczowe: edukacja medyczna, oprogramowanie open source, system informacyjny, system zarządzania treścią, system kształcenia zdalnego, wirtualizacja.

1. Introduction

The processes of formation of information infrastructure in the field of higher medical (pharmaceutical) education in Ukraine are acquired great importance during recent years. It driven by the active implementation of various information technology in the educational environment of universities. Modern doctor must have skills to use capabilities of up-to-date medical information systems (MIS) and abilities to participate in the MIS development and support processes. Important challenges for the modern medical education are to provide qualitative training process for education of such future specialists.

1.1. Main part

Modern trends in development of information infrastructure of any organization are oriented toward the transition to web-oriented technologies and corresponding server software applications [1]. Major benefits of this approach are included:
1. Elimination of binding of application software to a specific hardware and software platform. Processes of application software installation, configuration and administration are simplified, as well as the list of required software for workstations is minimized also (to OS + web-browser only in an ideal case).
2. An efficient usage of heterogeneous set of workstations, including outdated as well as mobile devices (e.g. tablets), which are owned by the university staff and students.

The main difficulty of this approach underlie in the laborious process of setting up a server, which will host and provide access to software applications. Virtualization technology usage and network cluster deployment are helpful methodologies to solve this difficulty. The open-source Proxmox VE (http://www.proxmox.com/proxmox-ve) platform has excellent capabilities to implement both those techniques. This way system administrator get tools to create high-available, manageable, scalable and effective network infrastructure environment of the organization (fig. 1). [2]
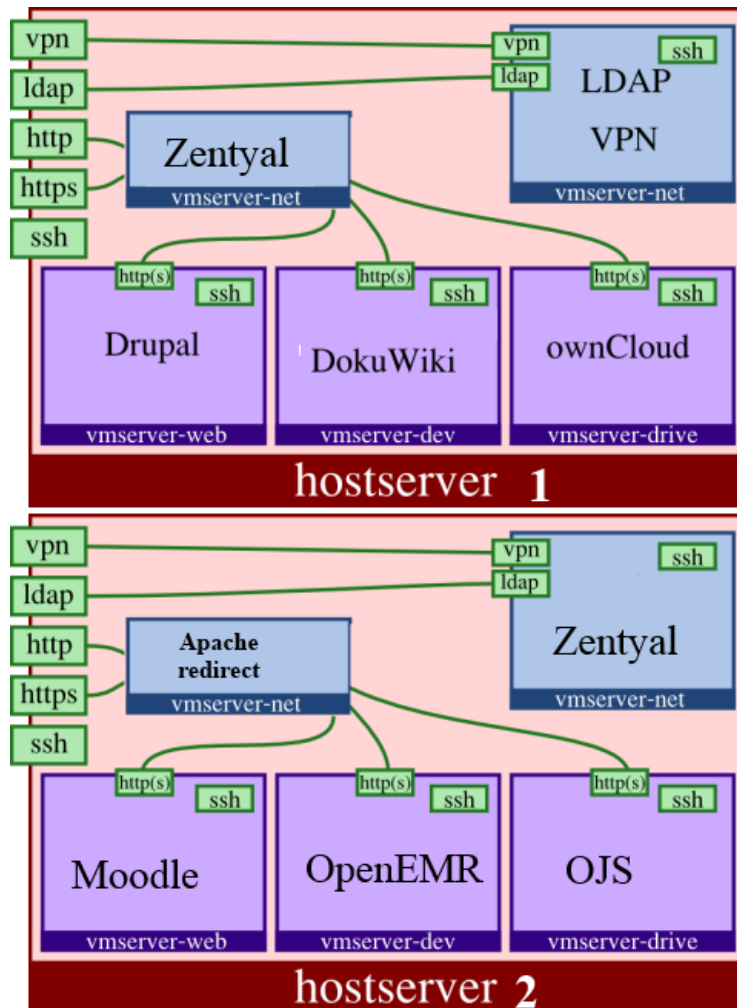
Figure 1. Two-nodes network cluster design.

High availability network cluster of the I.Ya. Gorbachevsky Ternopil State Medical University (TSMU) was established in early 2013, as an initiative of both, author and supervisor. This task was completed as a significant step of implementing of complex process of the university information infrastructure reorganization [3].

At the end of 2016, the TSMU network cluster includes 4 physical servers and more than 20 virtual machines (virtual servers). Some servers are working as test platforms for the analysis and evaluation of capabilities of application software. Results of such examination are used to establish and implementation of new information technologies in the TSMU educational process (fig. 2). The main group of virtual servers provide a number of key services of information infrastructure TSMU. Among them:

1. Web-servers, which host the TSMU main web site (http://tdmu.edu.ua) with dedicated redirect- and cache- servers. Proposed approach increase performance and security. The TSMU main web site is executed by the WordPress CMS.

1. LMS Moodle servers (http://moodle.org). Main Moodle server contain electronic versions of the TSMU online courses (http://moodle.tdmu.edu.ua). Separated Moodle server is used for support of the Distance Learning Centre of TSMU (http://dl.tdmu.edu.te.ua). [4]

2. Site of scientific journals which are published by the TSMU (http://ojs.tdmu.edu.ua/). This site is executed by the special open source CMS - Open Journal System (http://pkp.sfu.ca/?q=ojs).

3. The TSMU owns Hosting server. This system is used to host sites of individual divisions and units of TSMU. All of hosted web sites are executed by the open source CMS, especially WordPress or Joomla. To manage web hosting an open source software – special CMS called ISP Config (http://www.ispconfig.org) is also used.

4. Two servers that implement dean's office management system "Contingent" in the TSMU – a local TSMU database server and a global statistic server which is used by the Ministry of Healthcare of Ukraine (http://contingent.tdmu.edu.ua).

5. Servers of the CSE information system. This system is used to support examination process in TSMU. The CSE system consists of Windows client-server application which is used to prepare written exams and web-application which supports oral part of exams and used to create reports (http://cse.tdmu.edu.ua). All components of this information system are programmed in TSMU by the development team that both, author and supervisor, belongs to. [5]

6. The server, which runs "SysAdminka" – another information system, developed in TSMU, which perform integration of the Google Apps for Education cloud services with the existing informational infrastructure of the TSMU. Main task of this system is to synchronize user account data. This information system is also written by the TSMU code development team. [6]

7. Server of educational videos (http://videotube.tdmu.edu.ua/). This server also implemented via a special open source CMS ClipBucket (http://clip-bucket.com/).

8. Several experimental and researcher's servers, especially: two TSMU EMR servers – open-source OpenEMR (http://openemr.tdmu.edu.ua) and proprietary Doctor Eleks (http://doctor.eleks.com/en/). [7, 8]

Finally, significant attention to data and information integration problems is payed. Our integration solution is based on enabling of controlled access to the student's personal data and exchanging information about their scores. Student's personal data and marks main storage is represented by the database of the dean's office management system "Contingent". The CSE information system [5] is used to support examination process in TSMU. This system allows extract student's data and update their grades by obtained examination marks. The "SysAdminka" information system's [6] main task is to create a new user account in the Google Apps for Education service automatically when a new student is registered in the dean's office management system "Contingent"[9]. Lately, the "SysAdminka" is also used to synchronize (by schedule) data values of student's records or delete it if necessary.
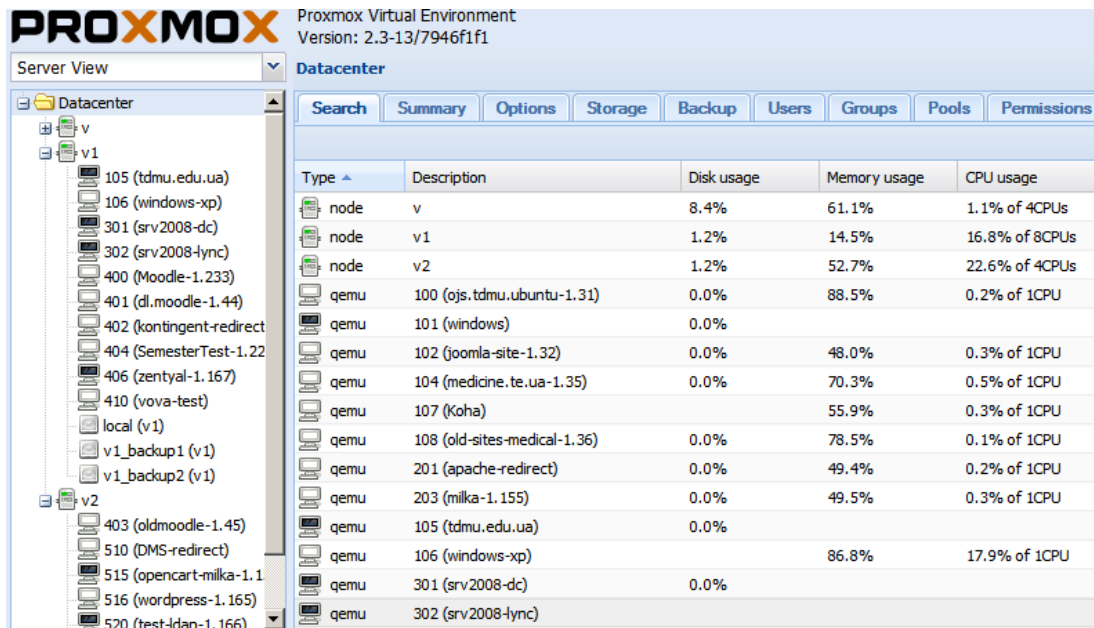
Figure 2. The TSMU network cluster based on the open-source virtualization platform Proxmox VE

2. Conclusions

The solution for development of the information infrastructure of medical (pharmaceutical) universities based on maximum usage of free, open source software is suggested. The advantages that it makes use of hardware virtualization and platform-independent Web-applications software solutions usage are provided. The example of mentioned above solution usage in the I.Ya. Gorbachevsky Ternopil State Medical University for the information infrastructure re-organization and re-novation is presented. The approach of the integration of the Google Apps for Education cloud services with the existing information systems based on the Google Apps for Developers features is also offered.

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