

The Tools for Amendment Knowledge and Competencies in Computer Networking

Feliksas KULIESIUS and Gintaras DIKCIUS

Physics faculty, Vilnius University,
Sauletekio 9, b. 3, LT-10222, Vilnius, Lithuania

ABSTRACT

This paper reviews the complex teaching system of the network design and management course, taught at Vilnius University. Special stress to solidify practical skills is foreseen in this course. The set of training tools, blending emulators, the real in-class lab and the remote laboratory, deployed with the aim to expand advantages of interactive teaching, as well as their benefits and limitations are discussed.

Keywords: Network Management, Remote Laboratory, Virtual Machine Technology

INTRODUCTION

Despite the evidence that excellent skills in computer network administration, data transfer and security are most welcomed in the challenging 21 century, the gap between supply and demand of highly qualified graduates possessing such skills still remains [1]. To train highly qualified professionals it isn't enough to convey bare knowledge. The complex teaching system, in which special stress to solidify practical skills must be foreseen.

This paper reviews the training tools of hands-on labs in the network design and management course, taught at Vilnius University, and the experience needed to teach the subject. In general, University studies create an excellent opportunity to sustain experimental skills applying modern IT as a reasonable approach. On the other hand science (physics) students are the most adoptive to technical questions always existing when IT is used.

DISCUSSION

The main points of such the aforementioned networking course are i) to enhance hands-on proficiency, working with real network equipment, solving cabling problems, as well as ii) to develop and solidify team coordination skills when deploying the case studies.

The well known Cisco Networking Academy Program and other readings (W. Odom, T. Lammler Study Guides) are unrivalled materials and have been used in the course, additionally discussing their topics during the lectures and seminars.

However, special attention has been paid to the lab part of the course. The simulators – Packet Tracer, Boson, LabSim etc – have been used as self test tool, since they are available everywhere and anytime, but unfortunately have limited and reduced functionality. The real networking lab is more preferable, since students can perceive all aspects of network sets: solving emerging problems, simulating (quasi)real situations, setting cabling structures and, what may be the most important – learning to work in teams.

The computer network laboratory installed at the Physics faculty of Vilnius University is based on Cisco, Linksys and HP ProCurve devices. Students have the possibility to design and implement various elaborate wired and wireless network sets (there are supplied more than 20 routers, more than 10 switches and other communication equipment), to monitor and investigate the load behavior, and its influence on traffic, as well as to thoroughly analyze the data traffic and to investigate peculiarities of Intrusion Detection Systems.

The weakness of in-class laboratory is limited access to the lab and the price of equipment. From the point of the instructor, it is difficult to track and evaluate student performance, since he/she often sees only the final result, without intermediate actions. So, it is difficult to help students timely, if needed. The way to utilize the resources and possibilities of the facility most effectively for numbers of students is to enable remote access [2,3], at least to part of the resources, and make them available via time reservation by registered students themselves. Time distribution ensures students the possibility to experiment with real equipment, not only with emulators, choosing a convenient time slot.

The last tool, i.e. the remote networking laboratory, has been created on the base of a real one, using part of it's equipment. This lab solved the access problem, since registered students can make reservations and access the lab plenty 24x7. With the deployment of the remote laboratory the advantages of interactive learning have been realized. These advantages are as follows: i) students got the possibility to access the real experimental equipment anytime, ii) the teacher was enabled to extend his possibilities not only to grade the final results of the experiment, but to watch and evaluate step-by-step students deeds, sometimes to discuss/advice intermediate actions and finally to assess properly.

The remote lab was realized by using an access server, which provides web based user and administrator (teacher) interfaces, combined with MySQL Data Base, and a communication server. The last enables direct address to physical devices: routers, switches and other appliances in our case (see Fig.). The user interfaces were realized as a

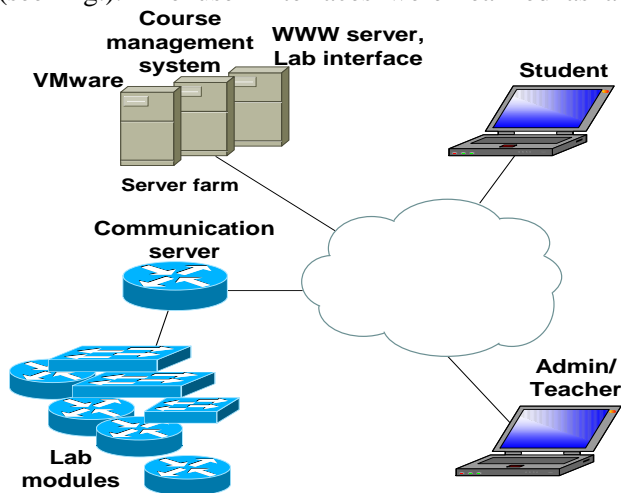


Fig. Structure of remote networking lab

dynamic web site which was created using PHP and Java scripts. Console access to any unit of equipment was realized using a communication server on the base of a Cisco 2522 router. The log server was included and used to track the sequence of intermediate actions during the lab work.

Such structure can be easily broadened by virtual devices by using VMware (Virtual Machine) technology [4]. To expand access and accustom to equipment, missing in the lab (due to the limited budget, mainly), the virtual part of the lab is under testing now. As the main component of this part the Dynamics/Dynagen [5] packages and ideas of "Dr. Li's Networking Studio" [6] have been chosen and aggregated under the same remote lab access interface.

Vilnius University's remote networking laboratory system can be found at: www.cna.ff.vu.lt/NetLab/

CONCLUSIONS

Summarizing: when combining the on-line teaching materials and in-class discussions with hands-on labs using i) simulators, ii) real equipment and iii) remote labs – each of them having different benefits – it has been succeeded to prepare highly qualified network administrators and designers, feeling confidence in the challenging labor situations.

REFERENCES

- [1] Bureau of Labor statistics, Occupational Outlook Handbook (OOH), 2010-11 Edition, <http://www.bls.gov/oco/>
- [2] J. Hua, A. Ganz, "Web enabled remote laboratory (R-lab) framework", 33-rd ASEE/IEEE Frontiers in Education conference, Nov 5-8, 2003, Boulder, CO, T2C pp. 8-13.
- [3] J. DeHart, F. Kuhns, J. Parwatikar et al., "The Open Laboratory a resource for networking research and education", ACM SIGCOMM Computer Communication Review, Vol. 35, No 5, 2005, pp. 75-78.
- [4] G. D. Hickman, "An Overview of Virtual Machine (VM) Technology and Its Implementation in I.T. Student Labs at Utah Valley State College", Journal of Computing Sciences in Colleges, Vol. 23, Issue 6, 2008, pp. 203-212.
- [5] G. Anuzelli, "Dynamips / Dynagen Tutorial. Documentation Revision 1.11.7",

<http://dynagen.org/tutorial.htm>

- [6] Ch. Li, “Developing an Innovative Online Teaching System”, International Conference on Education, Training and Informatics: ICETI 2010, Apr 6–9th, 2010, Orlando, Florida USA, http://www.iiis.org/CDs2010/CD2010IMC/ICE TI_2010/PapersPdf/EB531TD.pdf