# Teaching Computer Networks through Network Simulation Programs

## Dr S. Y. Zhu
### Faculty of Business, Computing and Law – School of Computing

email: s.y.zhu@derby.ac.uk
telephone: 01332 591672

UNIVERSITY *of* DERBY

LEARNING TEACHING & ASSESSMENT CONFERENCE

## Introduction

**Computer networking concepts are difficult to be assimilated due to the complex processes involved which are not immediately visible.**

**Computer networking courses clearly need the support of a lab-based approach due to the practical nature of the subject (1,2,3,4).**

However, the initial costs of the equipment, as well as costs for maintenance and frequent upgrading as demanded by ever changing technologies are extremely high. Due to these costs, students are often provided only with limited network equipment during their studies.

In addition, typically only a small number of students can use the equipment at any time which puts restrictions on class sizes and teaching resources. The size and location of physical laboratories further restrict the students' experience.

Due to these reasons, we have decided to use network simulation programs for lab exercises. This is also backed up by a number of studies reported in the literature (1,2,3) which have confirmed the usefulness of network simulation programs.

In our research we therefore investigate the use of network simulation software, namely Packet Tracer ™, developed and distributed by the Cisco Learning Institute, as an alternative to help students learn the relevant networking concepts in Network Interfaces and gain practical experience in learning Cisco CCNA integrated computer networking.
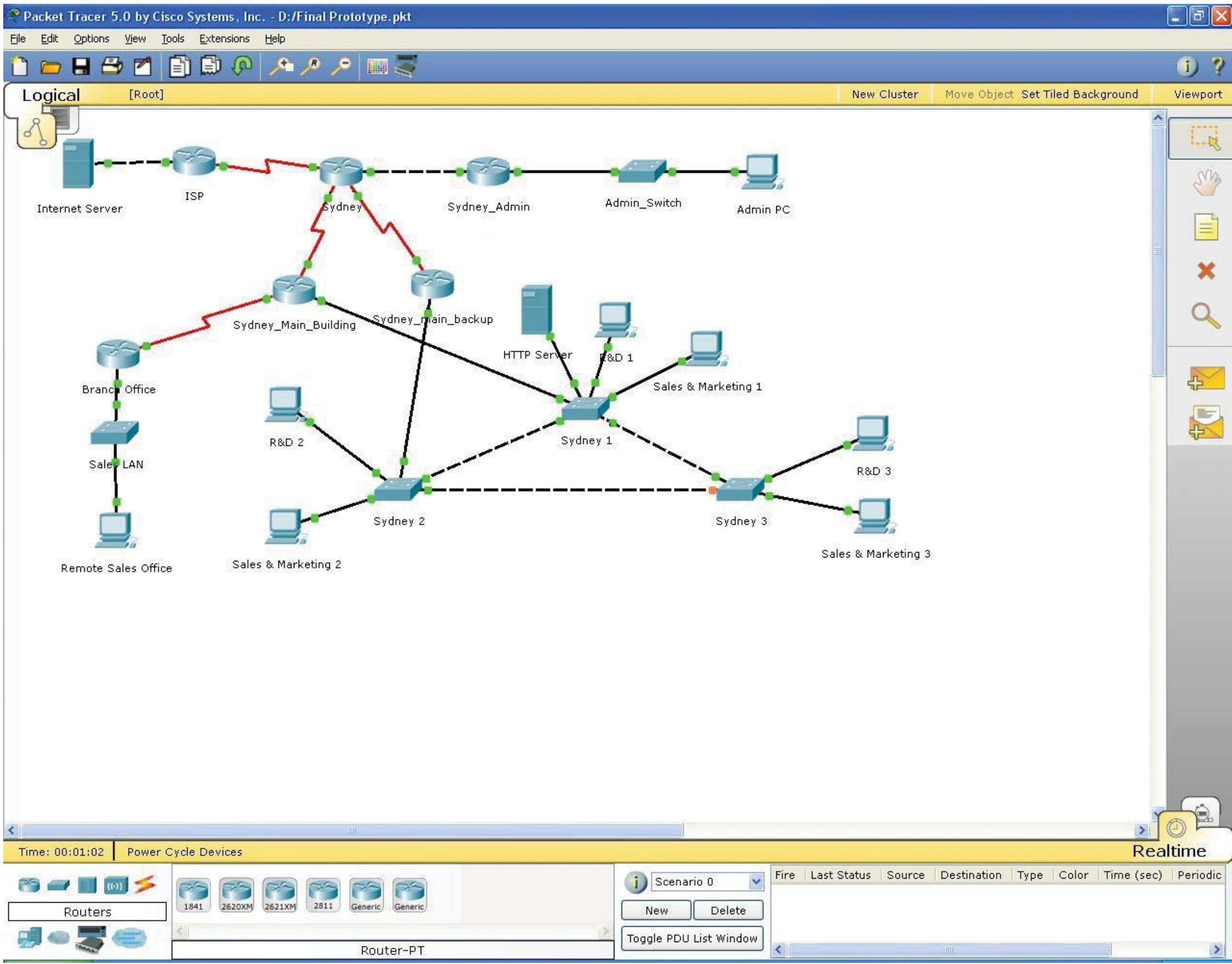


## Project aims

- Evaluate the effectiveness of network simulation programs in supporting teaching computer network modules
- Find out whether network simulation programs can replace physical laboratories
- Transfer the research outcomes to the taught curriculum in computer network program

## Disadvantages of physical laboratories

- **Expensive.** The cost of network components is high and sometimes beyond the reach of higher education institutions
- **Difficult to maintain.** Networking equipment and software need to be upgraded regularly
- **Hard to secure.** The safety of the equipment cannot be guaranteed, and it is difficult to prevent accidental damages to hardware by inexperienced students
- **Lack of flexibility.** Students need to conduct lab session on campus within a certain time limit. It is difficult to replicate the same lab without wasting time on initial setup. After the lab sessions, students may need to leave the room to make way for another class. If they have not finished their exercises, they will need to wait for the next available timeslot to continue with their lab session. In addition, time is wasted in reconfiguring the network equipment to the former network topology

## Advantage of network simulation programs

- **Cost-efficiency**
- **Easy to maintain and upgrade**
- **Easy to secure**
- **Flexible learning environment. Student can conduct the lab at any time and place that is convenient**

## How effective is network simulation software?

According to survey, interview and observation with UG Computer Network Students:

- Network simulation software can play an effective role in helping student understand networking concepts
- Network simulation software stimulates students' interest in learning computer networking related modules
- Network simulation software helps student achieve better marks

## Can network simulation program replace physical laboratory?

According to student feedback, although network simulation software is as effective as physical laboratory, in some place even better, it cannot replace hands-on experience in some small areas such as wiring and initial setup.

## Conclusions

Students perceive network simulators as a valuable learning tool which helps them to focus on the tasks at hand and helps them to make more efficient use of their laboratory time. While a simulation can never replace experience with real networking equipment, it provides great benefit to all parties involved, i.e. to students who gain more experience in their courses, to lecturers who can better focus on the actual aims of the laboratory sessions, and to the department which will appreciate the reduced costs involved.

## References

1. Sarkar, N. I. (2006) Teaching TCP/IP Networking Using Practical Laboratory Exercises, *International Journal of Information and Communication Technology Education*, Vol. 2, No. 4, pp. 39-50.
2. Goldstein, G., M Leisten, S, Stark, K.,& Tickle, A. (2005) Using a Network Simulation Tool to Engage Students in Active Learning Enhances Their Understanding of Complex Data Communications Concepts, *Proceedings of the 7th Australasian conference on Computing Education*, pp. 223-228.
3. Javidi, G. & Sheybani, E. (2008) Content-Based Computer Simulation of a Networking Course: An Assessment, *Journal of Computers*, Vol. 3, No. 3, pp. 64-72.
4. Dixon, M. W., Mcgill, T. J. & Karisoon, J. M (1997) Using a Network Simulation Package to Teach the Client-server Model. *Proceedings of the 2nd Conference on Integrating Technology into Computer Science Education*, pp. 71-73.

### Benefit to student

- Easy access to interactive learning resources
- Flexible learning environment
- Better motivation
- Improve students' learning experience
- Improve student satisfaction and achievement
- Improve student employability

### Benefit to staff

- Better management of students' lab activity
- Provide better student support
- Significant savings in time spent on troubleshooting irrelevant hardware problems
- Improve student engagement in the subject

### Benefit to university

- Significant saving in cost
- High employable graduates
- Overall learning enhancement