

New Program Development on Networking Information Technology

DEVELOPING THE 21ST
CENTURY WORKFORCE

Dr. Xiaobing Hou
Dr. Karen Tracey
Dr. Shuju Wu

Central Connecticut State University
New Britain, CT



The Association of
Technology,
Management, and
Applied Engineering



Abstract

This paper describes the ongoing development

of a new Networking Information Technology (NIT) program as well as its curriculum and laboratories. As the only such program in the state of Connecticut, NIT offers students a broad yet solid background in the area of study. This paper focuses on the balanced curriculum and laboratory that not only provide students with foundation and principles of networking and IT systems but also expose students extensively to new emerging technologies and equipment. In addition, this paper introduces the important role of industry in the program development and how the extensive collaboration with industry makes sure that the up-to-date curriculum offers the industry highly qualified workforce.



Introduction

The rapid growth of computer networking and

information technology requires broader technical expertise at all levels to support applications, apply the new technologies and maintain the competitive edge required for success in the global environment. Having recognized these needs, the Computer Electronics and Graphics Technology (CEGT) Department at Central Connecticut State University (CCSU) developed a new degree program in Networking Information Technology (NIT) which will continue to educate and train the necessary workforce for supporting these initiatives.

The predecessor of NIT is the Networking Technology option under the BS Industrial Technology degree, started in Fall 2001. With its multidisciplinary curriculum, such as electronics, computer science, business, and technology management, the enrollment of the option successfully grows to about 100 students. This provides a solid foundation for an independent degree program in this area. In addition, the feedback from industry demonstrates that a broad curriculum with more up-to-date networking technologies as well as related information technology areas is more favorable. Therefore, we have proposed the new NIT program with an updated curriculum.

Standard engineering courses focus on the technical aspects, but under-address the challenges in system design and configuration, maintenance and troubleshooting, whereas traditional technical schools do not equip students with enough theoretical background. We believe that a curriculum balancing both the theoretical and technical requirements is the best for student's career future and

industry's needs in a long run. The new degree program is unique in this aspect because it not only tries to expose students to new emerging technologies and equipments through its updated curriculum and laboratories but also offers students foundation and principles of system design and development. The department has been working with the industry to make sure that the curriculum reflects the rapid growing IT industry and covers a wide spectrum including networking theory and technology, server and system administration, information and network security, computer hardware and software, electronics, telecommunications, fiber optics, business management and marketing. To enhance the foundation, a new 100-level major course has been added to introduce essential skills in networking and computer information technology.

The new program's laboratory is under continuous update to enhance student's hands-on experience with the cutting-edge equipment. Recently, state-of-the-art networking routers, switches, security appliances and wireless devices have been added to the laboratory. Students will gain design, deployment, administration and troubleshooting skills in a variety of networking and information technology environments. As a member of the VMware IT Academy Program, the new program applies virtualization technologies to offer students enriched and more complicated laboratory scenarios without increasing the overall cost and budget. Similar as the curriculum design, the laboratory development benefits significantly from industry help and donation.

Overall, this paper presents the curriculum and laboratory prototype and discusses the important role of industry in the program development and running. The paper is organized as follows. Firstly, the role of industry is introduced. Then based on the feedback from industry, the updated NIT curriculum is presented, followed by the upgraded NIT laboratory. Finally, the paper concludes with the future work.

Collaboration with Industry

The CEGT department has a very good relationship with local industry. The program's Industry Advisory Board (IAB) consists of members with broad backgrounds in networking and IT. The annual IAB meeting is very fruitful with great deal of constructive suggestions and feedback on curriculum revision, laboratory set up, job and outreach opportunities, soft skills students should equip with, etc. The Board is highly motivated with and supports the initiative of a new degree program from the very beginning.

The areas that the IAB believes lacking in the old program include information and network security, virtual systems, messaging systems, logical thinking, career soft skills, etc. Without IAB's support, the new NIT program would be difficult to stay on the correct track.

Local industry is also a rich source of the program's part time faculty. We feel very fortunate to have highly qualified adjunct faculty in our classrooms. Their expertise is essential to enriching the curriculum and set up a direct connection between students and industry's needs. The courses taught by them, for example, server and system administration, usually require the content reflecting industry change more timely than the fundamental courses.

Our connection with industry also set up a channel for students to explore internship opportunities, which is required for their graduation. They are also invited to visit our classroom frequently and interact with students directly.

Their presentation always gives students an insight to what industry is looking for. It's worth mentioning that this connection is also set up at school level [1] and university level [2] collaborated with the department, providing students multiple but consistent channels to industry. In addition, donation from the local industry helps upgrade the NIT laboratory with cutting edge equipment. Recently, more than 20 Cisco switches have been received, significantly improved student's hands-on experience especially in switching labs when multiple switches are needed for each lab.

In a summary, the industry has provided the new program with all kinds of support, from ideas, expertise, equipment, to workshop and internship. NIT Students will be exposed to industry right after they enter the program until they graduate.

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The NIT Curriculum

To address the feedback from the industry and meet future needs, the new program's curriculum has been significantly updated. Firstly, CET 179 Basic Network Administration is added to the new curriculum. We believe a 100-level major course can provide students a more solid foundation with various concepts and skills required by upper level courses. Also it allows students to get familiar with their major as well as the program and faculty from their early time on campus, which is essential to their success in the program.

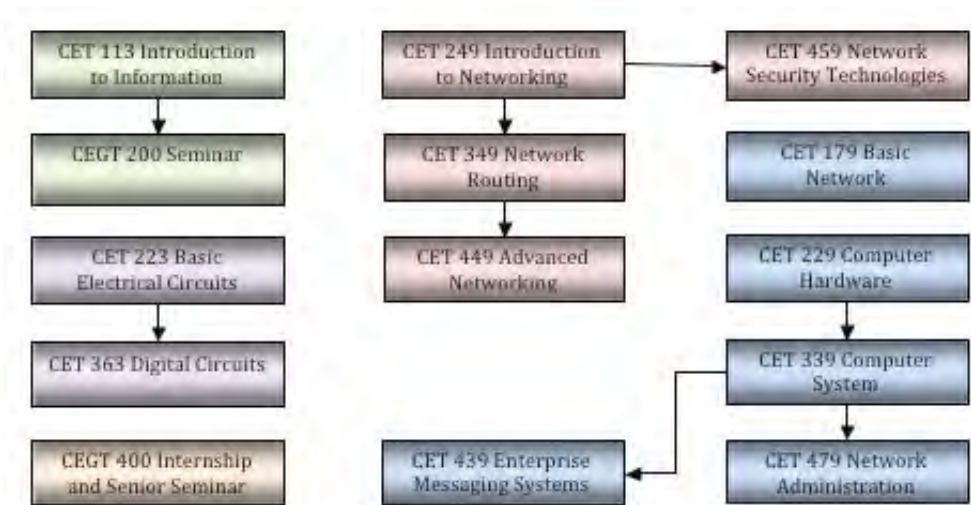


Figure 1. NIT Major Courses

Another area addressed is the network security with a new required major course CET 459. The course is designed to give students a broad introduction to network and information security such as security services, threats and mechanisms; principle of cryptography; system security such as viruses, intrusion detection and firewalls.

Due to the important role of timely communication in today's globalized economy, CET 439 Enterprise Messaging Systems is developed and added to the program. This course complements the existing Windows Server and Linux server administration courses and allows students to build up more comprehensive and important system management and administration skills.

In addition to the new courses, some of the existing courses are also updated. The required NIT major courses are shown in Figure 1. CET 113 is a first year experience (FYE) course providing students with basic computer applications and problem solving skills. CET 223 and CET 363 are electronic courses allowing students to have a bettering understanding of hardware and signals. CET 249, CET 349, and CET 449 are the core networking courses. Cisco Network Academy curriculum is adopted and upgraded to the most up-to-date version 5.0 in Fall 2013, when it is first released. System and server administration is another focus of NIT. The newly added CET 179 equips students with essential skills and logical thinking capability by training students to use command line interface and write scripting programs. Then students focus on different systems: hardware (CET 229), Windows Server (CET 339), Linux (CET 479), and messaging systems (CET 439). The last two courses are designed to help students prepare for their future career with various soft skills (CEGT 200) and start their career with internship (CEGT 400).

The courses shown in Figure 1 are the NIT major courses and students have to finish other core courses including management, marketing, accounting, project management, and quality management. To further expand student's academic background, various directed or free electives are available in related areas such as software development, fiber optics, electrical communications, management information systems, etc.

The NIT Laboratory

Ma & Nickerson [3] found that hands-on laboratories adhered to goals of the Accreditation Board for Engineering and Technology [4] and gave students a conceptual understanding of engineering, as well as, design, social and professional skills. Survey results from Etkina & Murthy [5] indicate that laboratory activities help students learn the content, work in groups and apply the content to the real world. Accompanying the NIT curriculum are the advanced and state-of-the-art equipment such as computers, routers, switches, security appliances, wireless access points, virtual machines, etc., extensively used by the students for class experiments and course projects. For each of the NIT major courses, we have developed more than ten lab experiments and strongly believe that hands-on, real-life examples will be invaluable for students to absorb, consolidate/strengthen and apply theoretical knowledge.

Currently, the department has two laboratories to support NIT curriculum, an electronics lab and a networking lab. The electronics lab supports the two electronics courses, CET 223 and CET 363, as well as other courses offered by the other programs in the department.

The networking lab supports all other major courses in the program. With limited space, supporting so many courses requires an integrated design. Aside from the 24 PCs solely used for CET 229 Computer Hardware Architecture, all other devices are integrated and used by multiple NIT courses. The center of the networking lab is 25 computer stations used by students to set up, configure, and troubleshoot networking equipment and server systems. To make sure students from different courses have their own software set and do not interfere with each other, the computer stations support removable hard drives. Every student in every course is assigned an exclusive hard drive for the whole semester.

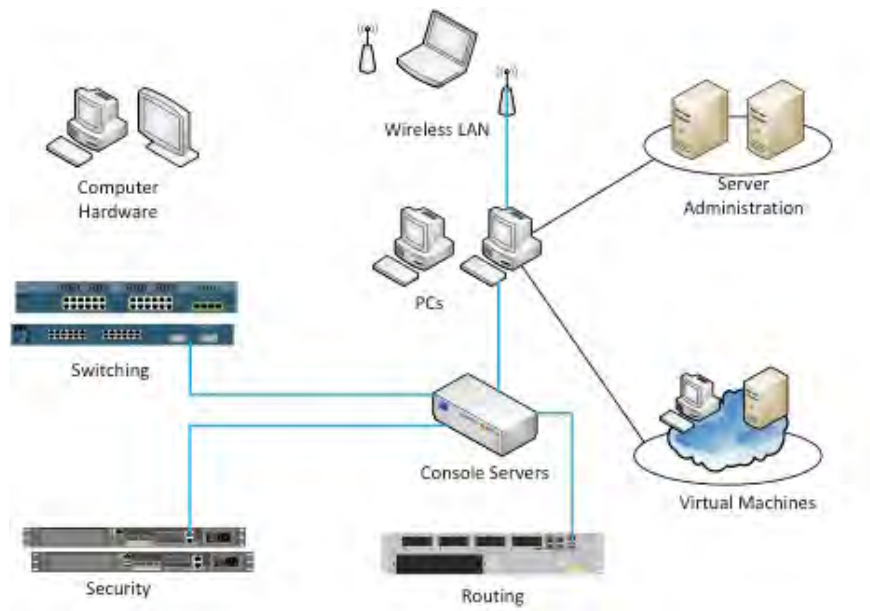


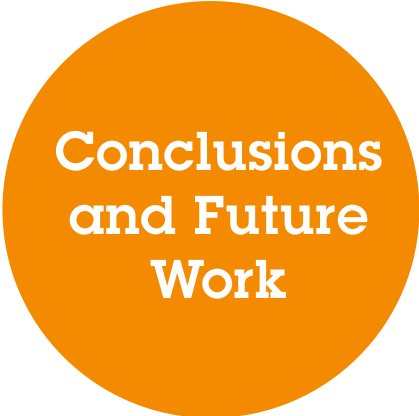
Figure 2. NIT Networking Laboratory

The removable hard drive makes various system administration labs fairly feasible, with every student installing, configuring, and troubleshooting his/her own system while being able to connect to other systems if necessary. Virtual machines are also implemented for different courses. For example, some labs in CET 459 require four different operating systems. Without virtual machines, students have to work in groups with very limited hands-on experience.

Every computer station has three network interface cards (NICs) to make sure every station can be used as part of the network or system in a class lab, and at the same time there are out of band configuration and management connections available to perform the lab and manage the stations. The first NIC is reserved for consoling and connected to the console servers, which in turn connects to all devices that require out of band configuration, such as routers, switches, and security appliances. The second and the third NICs can be used with other devices to create a lab network, although one of them is usually used for management purpose, like hard drive imaging.

Thanks to the school's support and industry donation, the networking lab has 9 Cisco 2911 routers, 16 Cisco 2811 routers, over 30 Cisco switches (2950 series, 2970 series, 3500 series, etc.), and 3 Cisco ASA 3510 security appliances. The rich networking equipment provides each student plenty of hands-on practice in individual or small group labs.

To expose students to wireless LAN configuration, six wireless access points and six wireless network adapters have been added and will be integrated into some of the courses. In addition to the above equipment, network simulation packages are available to simulate environments and situations that cannot be implemented in laboratories.



Conclusions and Future Work

In this paper, we describe the development of a new networking information technology program, and its curriculum and laboratory. The program has been approved by the university and Board of Regents and will be launched in Spring 2014. Currently, we are working on the new program assessment and evaluation plan on how the new curriculum and laboratory affect teaching and the learning experience. We will continue to work with industry advisory board to expand and update the curriculum and laboratory, eventually, to help students pursue success on campus and their career.

Accompanying the NIT curriculum are the advanced and state-of-the-art equipment such as computers, routers, switches, security appliances, wireless access points, virtual machines, etc., extensively used by the students for class experiments and course projects.



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Author information

Xiaobing Hou, Central Connecticut State University, (860) 832-1843
xhou@ccsu.edu

Karen Tracey, Central Connecticut State University, (860) 832-1842
tracey@ccsu.edu

Shuju Wu, Central Connecticut State University, (860) 832-3446
swu@ccsu.edu