

# Incorporating vendor-based training into security courses

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*Abstract: This paper discusses the call for more relevant knowledge and skills by industry and details of the incorporation of the Cisco Fundamentals of Network Security (FNS) into undergraduate degree programs at Curtin University.*

**Index terms – Network security education, Cisco FNS**

## I. INTRODUCTION

The expansion of corporate and government computer networks and global communications systems has resulted in more opportunities for theft of intellectual property, sabotage by viruses and worms, and unauthorized access. The latest FBI computer crime survey [1] reports unauthorized network access is still one of the major security problems faced by organizations. Viruses still rate very highly in occurrence and dollar losses. The CSI/FBI study also reports network security technologies are increasingly being used by organizations in the quest to minimize the risks associated with computer networks.

The need for network security education cannot be ignored. The DTI Information Security Breaches Survey 2004 (a study carried out by a consortium of companies including Microsoft, CA and Entrust) reported that 74% of all business and 94% of large companies had a security incident in 2003, and suggests that there is a clear skills gap [2].

In the quest to achieve more secure information systems Conti and Others [3] state we must provide the appropriate information security education to the people who have to build these systems.

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Industry is constantly requesting universities provide graduates with a balance of theory and practical skills relevant to current requirements. Universities continue to aim to provide a reasonably sound theoretical base in order for students to be able to apply general computing principles into any environment.

Industry-standard skills in network security are in continual demand and the shortage of expertise in this area is frequently in the press worldwide [4][5][6][9]. Education, training and certification are seen by some as the means to address major shortages in industry [7]. Frewin claims that people with good Cisco skills were extremely rare and that Cisco cannot train people fast enough [8].

The recent downturn in the IT industry is reflected in a continuing reduction in university enrolments in computing-related degrees [6]. This could mean that in 2-3 years there will be a marked shortage of IT graduates to fill entry-level IT roles in industry. On the other hand, Australian sources report there is no shortage of university graduates with IT qualifications [4].

It appears, however, that universities may not be providing the IT expertise required by industry as employers report difficulty in attracting local applicants with specialized skills although there is no difficulty in attracting university IT graduates in general [4].

It seems we have a skills shortage in the area of network security, a surplus of university graduates who cannot obtain jobs in the IT industry, and a gradual recovery in employment demand for IT professionals.

This paper describes the incorporation of the Cisco training programs into the Bachelor of Technology (Computer Systems & Networking), with particular emphasis on the Fundamentals of Network Security (FNS) to assist industry fill those areas of particular demand in new graduates.

## II. MERGING EDUCATION AND TRAINING

In an effort to address the needs of industry Curtin University has incorporated several of the Cisco courses

from the Cisco Networking Academy Program (CNAP) into the Bachelor of Technology (Computer Systems & Networking) degree. This degree is a three-year full-time program and the Cisco CNAP courses are integrated into the curriculum across the full course. A fourth year of the program is offered where the students may undertake an honors research project.

The Cisco courses utilized are IT Essentials I and II, Fundamentals of Unix, Cisco Certified Network Associate 1-4, Fundamentals of Wireless LANs, and Fundamentals of Network Security (FNS) (see [10] for details).

The integration is as follows –

Year	Cisco Course	Bachelor Course
1	IT Essentials 1	Computer Engineering
1	IT Essentials 2	Computer Engineering
2	Fundamentals of Unix	Real Time O/S
2	CCNA 1-2	Data Communications & Network Management
3	CCNA 3-4	Distributed Networks
3	Fundamentals of Wireless	Wireless Data Networks
3	Fundamentals of Network Security	Network Engineering

Table 1: Cisco Courses in the Bachelor degree

Fundamentals of Network Security is the most recent addition to the Bachelor program, being incorporated into the program in the second half of 2004.

### III. NETWORK SECURITY COMPONENT

The FNS curriculum focuses on the overall security processes based on a security policy with an emphasis on hands-on-skills in the areas of security perimeter, secure connectivity, security management, identity services, and intrusion detection [10].

The areas of network security covered include –

- Overview of network security - security goals, network vulnerabilities and attacks, network security policy, network security devices and solutions.
- Router and Switch security – topologies and configuration, access, securing router services and configurations, device management, securing switches and LANs, layer 2 security, port security and VLANs
- Router ACLs and context-based access control, port to application mapping, inspection rules, testing and verifying

- Authentication, network access server, TACACS, RADIUS, Kerberos, IOS firewall authentication proxy, HTTPS authentication proxy, FTP and Telnet authentication proxy
- Router IDS, configuration, logging, SNMP security, managing and maintaining, security device manager
- Site-to-site VPNs, tunneling, cryptosystems, digital certificates, IPsec, IKE, configuring and testing
- Remote Access VPNs, tunneling, configuring VPN server and client, VPN management
- The above areas with application to AAA PIX security, i.e. authentication, network access, configuration, protocols, intrusion detection and systems management.

The Cisco e-learning materials are used in conjunction with lectures and laboratory sessions presented by academics who are also certified Cisco instructors.

### IV. NETWORK ENGINEERING COURSE

In addition to the FNS curriculum, the students also study a number of other areas within the Network Engineering course. These include –

- Detailed network design
- Network structures
- Cabling systems
- LAN and WAN protocols for data communications
- Network devices including bridges, switches and routers
- Installation, configuration and operation of LANs, WANs, and dial access services.

The teaching mode is a 2 hour seminar (lecture and discussion) and 3 hour laboratory each week for a total of 12 weeks.

The objectives of the course are to provide the students with the knowledge and skills to

- Select appropriate security hardware, software, policies, and configurations based upon an organization's assessment of its security vulnerabilities in order to provide protection against known security threats.
- Perform advanced installation, configuration, monitoring, troubleshooting, maintenance and recovery of routers and firewalls
- Configure intrusion detection routers and PIX firewalls
- Install and configure CSACS for AAA service
- Configure site-to-site VPNs between devices and remote access VPNs between device and clients to ensure privacy and confidentiality.

Two major textbooks are used to aid student learning – Fundamentals of Network Security, 2004, by Cisco Systems, and Network Security Essentials, 2003, by William Stallings.

The assessment consists of a student journal 15%, a practical skills exam 25%, internal module exams 20% and a final exam 40%. The emphasis on the assessment is regular submission of work in the laboratories rather than the final examination. The Cisco FNS exam requires a minimum pass mark of 75% and this is carried through to the entire assessments for this course. The different types of assessment are designed to ensure the above objectives are met by the course.

## V. PROGRESS SO FAR

The Cisco Fundamentals of Network Security and Fundamentals of Wireless programs were offered for the first time in 2004, however, other CNAP courses have been incorporated into the Bachelor of Technology curriculum since 2002. The attrition rate is very small in this undergraduate program and the number of enrolments keeps growing. By the end of 2004 a total of 18 students had graduated from the program with Cisco certification, with an additional 30+ students set to graduate in 2005, and at least 50 in 2006 (these figures are fairly reliable as they are based upon numbers of currently enrolled students in the second and third year of their studies). All of the graduates so far have found employment within a short period of completing.

A number of additional students from other faculties also undertake these units, so the graduation figures do not reflect the true class sizes. This program attracts single and double degree students mainly from computer science, information systems and computer engineering, however students studying computing as a minor in other faculties are also enrolled in the courses providing Cisco certification. It is rewarding to note that as enrolments in computing programs at Australian universities drop drastically due to the downturn in demand for IT graduates, the enrolment numbers in the programs incorporating Cisco certification steadily increase.

The same Cisco CNAP courses are also offered within postgraduate courses, attracting masters students from the faculties of computer engineering, computer science and information systems.

The Department of Electrical and Computer Engineering at Curtin University hosts a certified Cisco Academy and also is the world's first certified Cisco Academy for the Vision Impaired. The academy currently offers the Cisco CNAP curriculum to students with a number of disabilities, allowing these students to gain not only relevant industry certification but also a transfer path into

the bachelor program for those wishing to further their studies [11].

The incorporation of the FNS course into the academic curriculum is only one of several new initiatives to offer more security-related studies within computing degrees at Curtin University. Other programs in Internet security and security technologies are also offered in different faculties. The lack of government support for IA education in Australia and many other parts of the world means demand for IA skills must be generated from other sources, predominantly industry. Unless there is a sustained need, demand for IA knowledge and skills will diminish.

## VI. DISCUSSION

The USA is unique in the prominence of IA issues and the amount of support in IA education provided by the US government. Few, if any, other nations have a similar level of support from national security, intelligence, and law enforcement organizations. Hence, many academics in non-US education institutions face difficulty in convincing their academic council of the need for specialized education in IT security.

Universities worldwide are increasingly being expected to finance their own activities and become profitable in their own right. This means universities must develop a much closer relationship with industry in order to provide teaching and research which is relevant and of benefit to industry organizations.

On the other hand, universities incorporating vendor-based education into their academic programs may face a number of risks including –

- becoming slaves to industry masters
- focusing on skills rather than knowledge resulting in graduates with built-in obsolescence
- choosing vendors or products with decreasing relevance in an ever-changing ICT environment
- keeping up with the most current releases.

Similar concerns have been raised with relation to security industry certification programs such as the Certified Information Systems Security Practitioner (CISSP) and Systems Security Certified Practitioner (SSCP) [12][13], however these certification programs are not vendor-driven.

## VII. CONCLUSION

As the need for IA skills grows universities are being faced with difficult decisions in order to remain relevant and also prepare students for employment. The literature

speaks of graduates who cannot find employment at a time when a significant number of IT positions remain unfilled. Although there will always be a small percentage of graduates who will not inspire potential employers to offer them employment, this trend is a warning to tertiary education institutions. IT and IA degree programs are not giving industry graduates with the knowledge and skills they need.

One of the solutions to this problem is for universities to offer vendor-based training and certification as part of university degree programs. The decision to incorporate industry standard training into university IA and IT academic programs has both advantages and pitfalls. On the one hand it provides skills which are immediately applicable to a work environment which attracts more students into the programs and employers to hire graduates from those particular programs. On the other hand, it is important that academic institutions be aware of the risks associated with such partnerships and regularly review their programs to ensure the students are being offered a balance of theory, knowledge as well as skills as part of the life-long learning process.

IT security knowledge is of no value to new graduates unless it can be applied. Graduates need to be able solve security problems, and this requires knowledge and applicable skills based upon firm theoretical foundations. Incorporating vendor-based security certification into academic programs can assist by providing immediately relevant skills. However, the integration of those skills into an academic learning environment must be carefully designed to ensure the quality of degree programs are not diminished in the quest for more employable graduates.

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