

Integration of Security into the Development and Teaching of a New 2-Year Program in Wireless Communications

Michael Qaissaunee, Mohammad Shanehsaz
(mqaissaunee@brookdalecc.edu), (mshanehsaz@brookdalecc.edu)

Brookdale Community College
765 Newman Springs Road
Lincroft, NJ 07738
732-224-2879, 732-224-2827

This work is supported by the National Science Foundation under
Grant Number DUE-0302909



ABSTRACT

Critical factors limiting the growth of the wireless industry and the even greater adoption of mobile technologies are concerns regarding data integrity and wireless network security. This work details creation of a new 2-year degree program in wireless communications that integrates security throughout. Security concepts and hands-on experiences are woven into the program itself and within individual courses. This model curriculum will benefit individuals and institutions interested in developing similar programs based on regional workforce needs.

Key topics include an overview of the current program under development and the expected evolution that will occur over the next few years. Additionally, the authors share research and insight into future trends for this new technology; describe the skills needed by this emerging workforce, community college programs presently in place, and opportunities for future program growth in these areas.

Central to the development of this program is an open source distribution and development method for Information and Communications Technology (ICT) curriculum, lecture and laboratory content. Established by The National Center for Telecommunications Technologies (NCTT) Consortium, the open source distribution and development process of faculty review, redistribution, and content modification will be contrasted to traditional development and distribution methods. The open source resource serves as a means of dynamically and rapidly distributing classroom and laboratory materials with a focus on interoperability, innovation, rapid evolution and low cost academic solutions. The method will be further demonstrated as a means of forming learning communities whereby faculty will benefit through the sharing of specialized instructional materials.

Introduction

Brookdale Community College, working as a regional partner of the National Center for Telecommunications Technologies (NCTT) and in collaboration with two other Advanced Technology Education (ATE) national centers, two of the premier engineering schools in the country, magnet high schools in Monmouth County that focus on technology and communications curricula, and a regional leader in the wireless telecommunications industry, is modifying its existing Associate of Applied Science (AAS) degree program in Electronics Engineering Technology to integrate wireless communications and security, and creating model AAS degree and certificate programs in wireless communications and security articulated from high school through community college and to the university level. As an NCTT Regional Partner, the project staff will implement similar programs throughout the region and generally contribute to program development and improvement at collaborating institutions nationwide. Facilitating this dissemination is the open source distribution and development method for curriculum, lecture and laboratory content, established by The National Center for Telecommunications Technologies (NCTT) Consortium.

Objectives

Key objectives and activities of the project are:

- Develop a state-of-the-art wireless communications program that includes security courses and concepts and is reflective of regional industry need;
- Disseminate this curriculum;
- Support NCTT in establishing a nationwide telecommunications education program by providing marketing and access to colleges and companies in the Mid-Atlantic region;
- Establish collaboration between regional industry and education;
- Form industry and academic advisory boards for wireless telecommunications;
 - Develop collaborations with regional high school, 2-year and 4-year colleges and business and industry;
 - Provide professional development opportunities for regional collaborating institutions, possibly for academic credit;
- Develop business and industry training initiatives and develop a team of faculty to provide this training;
- Plan, develop, and host academic/industry training seminars, in collaboration with NCTT;
 - Contribute to regional institutions' program improvement; and
- Assist regional institutions in applying for grants and other sources of outside support;

This project will provide technician training in wireless communications, an area of technology innovation with great industry demand. By incorporating security as an integral part of this program, the curriculum will serve to foster greater growth and adoption of mobile technologies. This project will benefit regional industry, government agencies, high school teachers and students, community college faculty and students, those switching into information technology careers, and those with bachelor's degrees in unrelated fields.

Overview

Project Goal

The goal of this project is the modification of an existing Electronics Engineering Technology AAS Degree Program to include Wireless Communications, the development and implementation of a new Wireless Communications AAS and credit certificate programs with multiple entry and exit points to prepare technicians for the wireless communications industry. The project components will include curriculum development and adaptation and program development, professional development for high school and community college faculty, and development of a 2+2+2 articulation, in wireless communications. As a part of a network of regional partners working with NCTT, this project will serve as the focal point for regional dissemination and training to regional business and industry, through the development of materials and faculty for business and industry training.

Partners

The project team includes the Engineering and Technology Department Chair, an Associate Professor of Engineering, President of Atlantic Coast Communications, and a Program Administrator. Strategic partnerships established for the project include the National Center for Telecommunications Technologies (NCTT), the National Workforce Center for Emerging Technologies (NWCET), and the New Jersey Center for Advanced Technological Education (NJCATE). Additional partnerships have been established with leading post-secondary institutions (two- and four-year), area technical high schools, and regional industry, each committing time and resources to the project. These include Stevens Institute of Technology, The New Jersey Institute of Technology (NJIT), Pennsylvania State University: Wilkes-Barre, Midlands Technical College, the High Technology and Communications High Schools in the Monmouth County Vocational School District (MCVSD), and industry partner Atlantic Coast Communications. The project team has already assembled an advisory board for the current project and will pursue additional regional and national partnerships in all of the constituencies.

Rationale

Brookdale Community College has a strong commitment to and a well-established history of responding to community and industry needs. In this regard, the college formed a consortium of regional industry leaders, two- and four-year faculty and administrators, and high school teachers and superintendents. The purpose of the consortium is to advance the college's program offerings in information technology (IT) by identifying emerging technologies and critical areas of industry need. The consortium identified the rapidly increasing regional demand for technicians skilled in wireless communications and strongly recommended that the college act immediately to address this need. Based on these recommendations, Brookdale's Department Chair of Engineering and Technology reviewed relevant literature on the wireless communications industry, and analyzed projections and trends for future workforce needs. Additionally, a survey was compiled of existing wireless communications programs in higher education that meet these demands.

Among the findings is a prediction of sustained rapid growth rates of the U.S. wireless industry over the next several years contained in the article, "Analyst View: U.S. is in line for wireless growth," from the online periodical Red Herring www.redherring.com. Additionally, a 1999 GWEC White Paper projects that close to 300,000 technicians and engineers will be

needed by the wireless industry by the year 2007. The GWEC White Paper also highlights the tremendous growth of wireless technology and the shortage of qualified workers.

“... telecommunications equipment manufacturer Ericsson... projects that the total number of wireless users (of all wireless applications) by the end of the year 2003 will top 800 million.”

This study points to the convergence of data, IT and telecommunications as a key factor driving the growth of the wireless industry.

“...convergence of the computer, telephone and wireless markets is taking place.

The future of medical organizations, automotive companies, computer equipment manufacturers and software design companies, utility companies, among others, is becoming dependent upon wireless device integration.”

Two additional studies from the International Engineering Consortium (IEC) project that the U.S. and world wireless market will continue to expand very rapidly for some years to come, asserting that by almost any measure, cellular telephony has been one of the most successful technological innovations in the last 25 years. The studies further estimate that by the year 2010, wireless revenues will increase dramatically to more than \$600 billion, or roughly 25 percent of the total telecommunications market.

More recently, the June/July issue of the Community College Journal asserts that there will be three areas of technology, which will drive the economy in the next decade, among them wireless technology. “Wireless Internet usage is likely to increase to 61.5 million subscribers by 2003, a staggering 731 percent growth increase since 1999. (IDC 2000).” Furthermore, the author proposes that there are several steps that community colleges can take “to position themselves, their communities, and their students to benefit from emerging economic opportunities.”

Not only is there a demand for wireless technicians, but the survey of existing programs shows that few community college programs exist to address this need. A search of certificate and AAS degree programs focusing on wireless communications highlights the tremendous lack of technician-level training available throughout the country. Where wireless communications programs do exist, they usually take the form of a graduate certificate or a non-credit professional certificate. These programs are targeted to engineering and IT professionals, and are thus well beyond the technician training level. Moreover, no schools in New Jersey offer wireless communications programs.

The programs of the few institutions (Seattle Central Community College, Idaho State University College of Technology, and several of the Minnesota community colleges) that do offer technician-level training in wireless communications (either as an AAS, certificate, or both) will serve as models for evaluation and assessment of this wireless project. Through reverse engineering of the existing programs in wireless communications, the project team will identify areas for innovation, and conduct comparisons of the existing programs with programs developed through the project.

Brookdale Community College, through this initiative in wireless communications has positioned the college, the community, the students served, and regional industries, to benefit from emerging economic opportunities in wireless communications.

Project Design

The wireless project has will address the demonstrated need through the development and implementation of AAS and credit certificate programs with multiple entry and exit points to prepare technicians for the wireless communications industry. The project components include curriculum development and adaptation, program development, professional development for high school and community college faculty, and development of a 2+2+2 articulation, in wireless communications. The following objectives and supporting activities ensure attainment of this goal.

Objective 1: Create education and training programs in wireless communications leading students to AAS degrees, certificates, and occupational competencies through curriculum development and adaptation, and integration of work-relevant, industry-driven curricula that integrates “best practices” in IT education with industry skills standards and certifications.

Working with partners NCTT, NWCET, and NJCATE, the project staff is developing credit courses through adaptation of industry standard materials. These courses incorporate modular, industry-driven, competency-based curricula and work-based learning units in wireless communications for two-year colleges that articulate with related curricula for a resulting B.S. degree. Key components of the curriculum are 1) modularity, 2) industry-driven, 3) competency-based, 4) integration of “soft skills”, 5) work-based learning components, and 6) well-articulated with B.S. degree programs. Modularity ensures that the programs can be adapted and re-shaped to meet the ever-changing needs of industry. The content of the curriculum is industry-driven, meaning that market-relevance is implicit to the programs. Since technology-related disciplines require specific skill sets, the curriculum is also competency-based and incorporates work-based learning content to ensure the preparation of well-qualified wireless communications technicians. Another increasingly important skill requirement for students is the realization of the so-called “soft skills” of (1) teamwork, (2) communication, (3) problem solving, and (4) leadership. Where appropriate, these skills are integrated into the learning modules. Finally, the linkage to related B.S. degree programs ensures that students have multiple pathways, and exit and entry points. Providing multiple student pathways to IT programs and degrees through occupational exit points, articulation agreements, and incumbent worker training, ensures the continuing development of highly skilled workers to meet the changing demands of industry.

Additional students who benefit from the new programs are current Information Technology (IT) workers who wish to upgrade skills, acquire industry certification in various components of the wireless communications curriculum, and receive an AAS degree. Although these certifications are not required for the new wireless communications programs, the modular nature of the curriculum and the linkage to industry and industry certifications create great opportunities for existing IT workers with existing certifications such as:

- Network+,
- CCNA,
- CNA, or
- MCP,

who may take a single module or cluster of modules to upgrade or expand their skills. The means by which the curriculum is constructed will allow these students to focus on specific short-term training needs, slightly more in-depth certifications, 2-year degrees or 4-year degrees.

Objective 2: To contribute to program improvement and implementation at partner institutions through collaboration and professional development activities. Professional development activities, for credit when appropriate, will serve to improve, expand and maintain the technical and pedagogical skills of teaching faculty from community colleges and high schools.

Working with project partners, the project staff is identifying, adapting, and implementing exemplary wireless communications, information technology, and telecommunications curriculum to provide professional development to current and future technology educators through workshops, seminars, and college credit courses. Key partners in providing curriculum for professional development will be NCTT, NWCET, and Stevens Institute of Technology. These partnerships provide access to a wide variety of educational materials that will be used for professional development of current and future technology educators. An additional resource in the adaptation of curriculum for high school faculty is Midlands Technical College. Their experience in adapting and implementing NCTT curriculum for high schools is invaluable. In addition to providing curriculum, NWCET and NCTT are working with the project staff to make certain that appropriate skills standards are incorporated into the curriculum. Project partners that are involved in the development and delivery of training include NCTT and Stevens Institute of Technology. NCTT is acting as a consultant and providing training in telecommunications and Stevens is providing training specific to wireless communications adapted from their graduate certificate program. A variety of instructional modalities are utilized and explored, including online courses, listservs, written materials, seminars, professional meetings, independent study, hands-on learning, faculty mentoring, and internships.

Objective 3: Increase the number of students who seek employment or continued education in wireless communications by creation of multiple pathways with a variety of exit and entry points. A key means of facilitating student recruitment is the development of regional corporate relationships.

A key component of creating programs that are attractive to as many potential students as possible is to provide multiple pathways. One way this is done is through seamless 2+2+2 articulation with multiple educational and occupational entry and exit points. A partnership with the Monmouth County Vocational School District (MCVSD) provide the High Technology High School, and the Communications High School as test and validation sites for the curriculum being adapted for use by secondary schools. The project staff are working closely with faculty and administration at these institutions to ensure that curricula are tailored to meet their specific needs and can be implemented within the constraints to which they are subject. Additionally, we have long-standing tech prep and articulation agreements with MCVSD and will work to include the wireless curriculum in these agreements.

Another articulation partner is the New Jersey Institute of Technology. Once again, this is a long-standing relationship that will facilitate the addition of the wireless AAS degree program to an existing cadre of articulation agreements.

Development of the AAS and certificate programs and expansion of the 2+2+2 articulation will allow students to move seamlessly from high school to community college, and finally to a 4-year program. In addition to these pathways, the certificate and AAS provide

students with two additional routes to careers in wireless networking and communications. Other students not pursuing a baccalaureate degree can complete a certificate program or a 2-year degree. As the convergence of IT and telecommunications matures, there will be a greater need for this type of training by incumbent IT workers and by IT students following traditional IT education pathways.

Working with partner entities and Brookdale's Office of Career Services, the project team is working to provide students internships, cooperative learning experiences, and ultimate job placement. Through the various partnerships, the project staff is uniquely positioned to provide a direct link between students and employers, facilitated by the Career Services staff.

Results

Curriculum Overview

The proposed curriculum is presented in *Tables 1-5*. *Table 1* shows the 2-year AAS program under development. A total of 11 (eleven) new courses will be developed in support of this new program, and combined with existing offerings and general education courses will form the complete 2-year program. Key features of this proposed program include a flexible math/science/technology elective which will allow for multiple pathways. Students wishing to transfer into the Bachelor of Science in Information Technology (BSIT) at the New Jersey Institute of Technology (NJIT) will take Applied Calculus in semester 3, while those wishing to complete their 2-year degree and begin working will take the appropriate general education math/science/technology elective. Notice that there are three (3) course that focus exclusively on security and security concepts. These concepts are reinforced throughout the entire curriculum. Other unique features include a Capstone Course and Advanced Topics in Wireless Communications, both in semester 4. The Advanced Topics course will bring in information on emerging trends and technologies relevant to the field of wireless and mobile communications. This course will serve to reinforce the skill of life-long learning, and to provide students with the most up-to-date information available. Additionally, as topics in this course mature, they will be recycled back into the program in the appropriate course in semesters 1-4. The modular nature of the curriculum is critical to ensuring that this can happen. The Capstone Course will provide students an opportunity to bring together all of the skills and knowledge gained through their studies in solving real-world problems as part of a team.

Tables 2-5 detail Certificates and Certificates of Achievement in Wireless and Security. A Certificate is distinguished from a Certificate of Achievement by the addition of general education requirements. The Certificate of Achievement (*Tables 4 and 5*) are intended for existing IT professionals who may have already completed Bachelors, Masters or PhD programs. These 1-year programs provide the necessary technical training and skills to enable workers to keep their knowledge current or to learn new skills. Tables 2 and 3 (Certificates) are intended for students with no prior post-secondary education. It is expected that many students will opt for the certificate, thus enabling them to seek gainful employment, while at the same time working toward completion of their 2-year degree and possibly pursuing a baccalaureate degree.

<u>Semester 1</u>		<u>Semester 2</u>	
Writing	3	Speech	3
<i>Introduction to Wireless</i>	3	<i>Introduction to Security</i>	3
<i>Fund. of Telecommunications</i>	3	<i>Wireless LANs</i>	3
<i>Introduction to Networking TCP/IP</i>	3	Basic Electronics	3 to 4
Humanities/ Social Science	3	Humanities/ Social Science	3
	15		15 to 16
<u>Semester 3</u>		<u>Semester 4</u>	
<i>Cellular / Broadband Technologies</i>	3	<i>Capstone Course</i>	3
<i>Network Operating Systems</i>	3	<i>Advanced Topics in Wireless Communications</i>	3
<i>Applied Wireless Security</i>	3	<i>Advanced Security</i>	3
Math/Science/Technology*	3	Tech Elective	3 to 4
Free Gen Ed	3	Free Gen Ed	3
	15		15 to 16

* *Applied Calculus required for transfer students*

Table 1: 2-Year AAS Wireless Communications (Proposed)

<u>Semester 1</u>		<u>Semester 2</u>	
Writing	3	Speech	3
<i>Introduction to Wireless</i>	3	<i>Applied Wireless Security</i>	3
<i>Introduction to Security</i>	3	<i>Disaster Recovery</i>	3
<i>Introduction to Networking TCP/IP</i>	3	<i>Forensics</i>	3
<i>Network Operating Systems</i>	3	<i>Advanced Security</i>	3
	15		15

Table 2: 1-Year Security Certificate (Proposed)

<u>Semester 1</u>		<u>Semester 2</u>	
Writing	3	Speech	3
<i>Introduction to Wireless</i>	3	<i>Applied Wireless Security</i>	3
<i>Introduction to Security</i>	3	<i>Wireless LANs</i>	3
<i>Introduction to Networking TCP/IP</i>	3	<i>Cellular/Broadband Technologies</i>	3
<i>Network Operating Systems</i>	3	<i>Advanced Topics in Wireless Communications</i>	3
	15		15

Table 3: 1-Year Wireless Certificate (Proposed)

<u>Semester 1</u>		<u>Semester 2</u>	
<i>Introduction to Wireless</i>	3	<i>Applied Wireless Security</i>	3
<i>Introduction to Security</i>	3	<i>Disaster Recovery</i>	3
<i>Introduction to Networking TCP/IP</i>	3	<i>Forensics</i>	3
<i>Network Operating Systems</i>	3	<i>Advanced Security</i>	3
	12		12

Table 4: 1-Year Security Certificate of Achievement (Proposed)

<u>Semester 1</u>		<u>Semester 2</u>	
<i>Introduction to Wireless</i>	3	<i>Applied Wireless Security</i>	3
<i>Introduction to Security</i>	3	<i>Wireless LANs</i>	3
<i>Introduction to Networking TCP/IP</i>	3	<i>Cellular/Broadband Technologies</i>	3
<i>Network Operating Systems</i>	3	<i>Advanced Topics in Wireless Communications</i>	3
	12		12

Table 5: 1-Year Wireless Certificate of Achievement (Proposed)