Critical Skill Shortages Project: Addressing Potential Skill Shortages in Wireless Technology in Greater Austin

A Report for
*Work*Source – Greater Austin Area Workforce Board

A Research Initiative of *Work*Source-Greater Austin Area Workforce Board

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Overview and Purpose of the Project

The Critical Skill Shortages Project aims to identify ways that the workforce development system can support economic development and help assure that residents benefit from the new jobs created. The guiding vision of the project is that improving the preparation and qualifications of residents to work in the new jobs being created will help foster both economic development and the well being of Austin area residents.

The Critical Skills Shortages Project began with an examination of the nine targeted industry clusters that the Greater Austin Chamber of Commerce (GACC) launched in 2004 in its five-year "Opportunity Austin" campaign to promote economic development.[1] The project assessed the suitability and receptiveness of each of these industry clusters for implementing workforce development efforts to remedy labor shortages and support the growth of the cluster. The project sought to identify mid-skill occupations in demand that could emerge into a labor shortage situation. To meet the criteria for selection, these occupations also should be suitable for targeting by the workforce system and employers in the industry sector should be sufficiently organized and receptive to collaborate on analyzing factors contributing to the shortages and to participate in the remedies.

On the basis of this initial assessment, the project narrowed its focus to two of the most promising clusters: biosciences and wireless technology. Both industry clusters are targeted in the Chamber's Opportunity Austin campaign and in Texas state-level economic development initiatives. Both selected industry clusters are emerging industries, populated by small firms, and characterized by fast changing technologies. Both biosciences and wireless technology have strong university-based research support in Austin. In each of these clusters, there are approximately 100 firms located in the Greater Austin area. However, at this time, neither cluster has an anchor firm.

"Cultural" Differences Between Economic Development and Workforce Development

The traditional approaches of economic development and workforce development differ significantly. In economic development, the key focus is on marketing or "branding." Workforce concerns are limited to attracting high-level talent to fill top positions in management, engineering and marketing. Economic developers tend to leave details to the market after an initial assist through public sector incentives. The concerns that occupy workforce developers—including which occupations might be critical for a given cluster to flourish, how local residents might best be prepared for these jobs, how long the process of preparing the workforce might take and where the financing for it might come from—are found in these "details." Effective and timely preparation of area residents often requires considerable planning and

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[1] The nine targeted industry clusters were Automotive Manufacturing, Biosciences, including biomedical, and pharmaceutical products, Product Manufacturing, Wireless Technology, Transportation and Logistics, Clean Energy, Computer Software, Semiconductors, and Digital Media.

timely investment of public and private resources. A "market approach" may take years to accomplish, during which time area residents will not be prepared for jobs, so companies will incur added costs to recruit out-of-town.

To be effective, a workforce development system must give attention to needs for workers across the spectrum of skill levels. Workforce developers are aware that they must plan ahead to develop and deploy effective training programs. However, the workforce system is charged with addressing current workforce demands and training for jobs that exist, and businesses typically do not think ahead to foresee skill shortages until they faced with them. Firms in growing clusters frequently do not identify or project their future workforce needs and are unwilling to commit resources to planning.

The key is industry engagement, which requires farsighted industry representatives willing to engage before the need becomes critical, and workforce developers who are creative in their approaches and adept at translating cryptic information provided by industry representatives into clear training outlines and proposals for industry feedback and refinement that will lead to workable training solutions.

Characteristics of Austin's Wireless Industry

Austin Wireless and Economic Development

The wireless cluster is emerging, technically challenging, rapidly changing, and populated by many newly established small firms. The wireless cluster includes numerous categories and components, including hardware development and manufacturing, software development, semiconductor chip design, and a variety of uses and applications, which vary according to bandwidth and radio frequency spectrum allocations. The Greater Austin Chamber considers the Wireless cluster to include elements of telecom, computer software related to wireless, and digital media related to the emerging visual technology for camera phones and other wireless devices. The focus includes the major wireless phone carriers and their network of suppliers as well as wireless Internet services provided by a number of Austin companies such as Wayport and Alereon.

The Austin Wireless Alliance is a non-profit membership organization whose primary objective is to develop, sustain, and promote Austin as a global leader in business activity, technical innovation, and community participation within the wireless industry. The Alliance is composed of participants from all primary stakeholder groups in Austin including the business, academic, community, and government sectors. The Alliance is a key player in the development and coordination of major strategic wireless initiatives in Austin and Central Texas. In September 2005, Freescale Semiconductor announced "a top tier sponsorship of Austin Wireless Alliance to drive strategic wireless initiatives in Austin and Central Texas … and to promote Austin as a wireless industry center of innovation and excellence."[2]

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[2] Austin Wireless Alliance Press Release, "Freescale Semiconductor announces top tier sponsorship of Austin Wireless Alliance," September 27, 2005. www.austinwirelessalliance.org/2005_09_01_archive.html

Alliance Chairman Erin Defossé was also quoted as saying, "We and our members are committed to enhancing Austin's status as a world-renowned wireless technology community." Defossé is also acting director of the Austin Technology Incubator (ATI) and the director of the newly created **ATI Wireless**, a business accelerator for the wireless industry. ATI Wireless plans to "nurture and mentor" emerging wireless companies, much as the Austin Technology Incubator does for a variety of companies.

The *Austin Business Journal* reported that Austin Technology Incubator has been concentrating on industry sectors such as wireless, information technology and clean energy, and announced in August that it would offer more of an industry-sector focus and global orientation. ATI Wireless Board member Moris Simson, CEO of Austin-based WaveNet Inc. explained: "If you want to participate (in the wireless industry), you have to prepare locally to play globally." He noted that that "two-thirds of the $2 trillion global wireless industry comes from service revenues."[3] Simpson also observed that wireless companies are underrepresented in Austin, despite the presence of communications chip producers.

The Chamber has promoted wireless as various trade shows, and six new business relocation prospects were recently identified.[4] It also maintains contact with wireless firms in Austin. The Chamber is planning to conduct a survey of wireless companies and has agreed to add items we suggested regarding skill needs of the industry. The survey was originally scheduled to go out during the first week of September, but has been postponed to later in the fall.

Focus on High-Level Talent

The emphasis of wireless business groups is on branding and business growth, such as promoting business strategy and "buzz" through the Incubator, the Austin Wireless Alliance, and the Chamber. Conversations about workforce issues at this stage of the development of Austin's wireless industry are exclusively focused on "top level talent," including business strategists and advanced engineering research and design jobs. In a July interview for the Critical Skills project, Erin Defossé, executive director of the Austin Wireless Alliance, stated, "We don't develop local talent, rather we provide education for existing people in the industry about industry trends—leading edge stuff. I am not the best guy to ask about low-end talent."[5]

The **Wireless Networking and Communications Group (WNCG)** is an academic research center at the University of Texas, involving more than 12 engineering professors and 70 graduate and undergraduate students pursuing research in next generation wireless technologies for both licensed and unlicensed services. Their mission is to be "a premier creator of research and innovation for the communications, software, and semiconductor industries in the state of Texas and throughout the world, while fostering excellence in education and research for students wishing to pursue careers in wireless communications."

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[3] Greenwood, Giselle. "ATI targets wireless industry," *Austin Business Journal*, September 23, 2005

[4] "Looking Good for the Wireless Crowd in San Francisco," *@theChamber* Volume 7, Issue 41 (October 10, 2005)
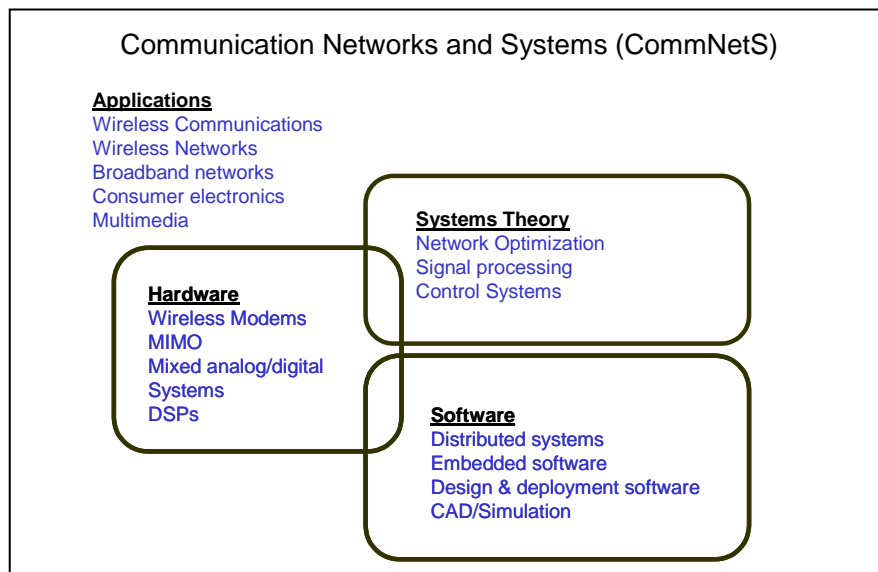
[5] Interview with Erin Defossé, Executive Director, Austin Wireless Alliance, July 8, 2005.

WNCG has been successful in engaging industry and is sponsored by an active group of Industrial Affiliates, including ADC, Dell, Ericsson, Freescale Semiconductor, National Instruments, Nortel, SBC, SigmaTel, Texas Instruments, Time Warner Cable, and the U.S. Department of Defense.

WNCG has six research focus areas: Propagation and Antennas; Modulation and Coding; Digital Signal Processing Techniques and Implementation; Sensor and Ad-hoc Networks; Network security; and Network Architectures, Software and Protocols, and several laboratories related to wireless, including an embedded Digital Signal Processing lab, and labs for Image and Video Engineering, Radio Frequency Systems and Propagation, Simulation and Design, Wireless Systems Innovation, and Wireless Networking.

The academic program of the Wireless Networking and Communications Group is organized as depicted in Figure 1. The undergraduate and graduate courses are listed in Appendix A.

Figure 1: Organization of the Wireless Networking and Communications Group at the University of Texas at Austin

WNCG promotes, "early access to high-quality, well-trained students; undergraduate part-time and full-time recruiting support, and interactions and partnerships with other sponsoring companies" as benefits for Industrial Affiliates. Benefits for students include opportunities for internships with affiliate companies, long term mentoring, industry-type environment for gaining expertise in wireless communications, practice in state-of-the-art hardware and software, and advice on cutting edge trends and access to decision-makers."[6]

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[6] Wireless Networking & Communications Group Presentation, Industry Affiliates Program (undated). http://www.ece.utexas.edu/wncg/affiliates/iap_info.php

Workforce Issues That Could Potentially Affect Economic Development

A previous report of this project outlined the workforce situation in wireless technology in the Austin area (Glover et al, August 2005). Findings did not uncover any current widespread shortages; however, some key jobs were reported to be *difficult to fill*, particularly through local sources. The Austin education and training institutions are not prepared to accommodate rapid growth in wireless technology employment at the sub-baccalaureate level, yet wireless could produce rapid growth in employment.

Indeed, rapid growth has already occurred. When Wayport needed to hire more than one hundred workers in the past year, the company instituted its own weeklong training program to bring desirable candidates who started out with some level of networking capabilities and the right attitudes "up to speed" to be able to install and troubleshoot wireless networks and provide service to clients. While the Wayport example has thus far been an anomaly, many companies are attempting to expand and wireless industry groups are devoted to their expansion. However, no wireless business groups in Austin are concentrating on ensuring that mid-level or technician-level talent will be available should those companies experience the growth they are seeking to promote and support.

A critical mass of wireless players in Austin is focused on building the industry. If Austin Wireless economic development plans for branding, wireless incubators, and commercializing university projects are successful, and indeed, if two thirds of the global wireless industry is based in service revenues, as noted by ATI Wireless Board Member Moris Simson, then Austin could lose opportunities to other areas for lack of skilled workers in wireless services locally.

During the tech boom in 1999, software, multimedia, and other technology companies were desperately seeking skilled workers, and the Austin Software Council (now the Austin Technology Council) and the Greater Austin Chamber of Commerce were scrambling to develop partnerships for recruiting and training to meet industry needs. Many of those hired were later laid off in the bust that followed. Hopefully, technology industry groups and businesses can avoid those patterns and plan for steady, sustainable growth in the wireless sector.

Skill Needs and "Difficult-to-Fill" Occupations for the Wireless Workforce

While business groups in wireless are not at all focused, at this stage, on the need for skilled, mid-level workers, individual companies have expressed needs. Wireless companies indicated that the following four types of positions were difficult to fill from local sources:

1. Test technicians and validation engineers;
2. Broadband technicians/ Integrated technicians/ Technicians for Wide-area Network (WAN) installations and support;
3. Wide-area Network Design Specialists; and
4. Technical sales

Employers noted that these jobs require the following knowledge and skills:

- Firm understanding of wireless and networking standards and protocols (802.11, TCP/IP), including security, encryption, etc.

- Firm grasp of all networking basics - what all the computer settings mean and how they interact, proxies, firewalls, server issues, etc.

- Knowledge of radio frequency (RF) technology to include microwave radio transmissions

- Ability to analyze/troubleshoot problems (with hands-on applications) – RF signal levels, software conflicts, packet loss through network - for Wide-area Networks (WANs), Local-area Networks (LANs), and laptops

Testing jobs require the following additional knowledge and skills:

- Familiarity with operating ALL radio-related test equipment (Spectrum Analyzer, Network Analyzer, Attenuators, Switches, Bus Analyzers, Signal Generators, LabVIEW, etc.)

- Data reduction techniques; document, analyze and interpret results; communicate technical information clearly and cleanly (verbal and written)

For all of these jobs, employers seek job applicants with the following characteristics:

- Excellent problem-solving, analytical, and communication skills, since technicians interact with customers and others at varying levels of technical aptitude

- People who can work through complex problems with compatibility of different types of systems, including hybrid networks; and

- "Culture fit" with aggressive, fast-moving, team-oriented wireless companies.

Industry officials involved in hiring also tend to:

- Value skills more than academic credentials;

- Rely on industry skill certifications; and

- Consider Wireless an "overlay" – not a standalone discipline.

Industry representatives said that while they are able to hire a number of qualified candidates, they also see many candidates for open positions who lack the proper foundational elements to "put it all together," with a balance of radio frequency technology, networking, all the wireless protocols, great analytical skills, testing and troubleshooting capabilities, and communication/people skills. Candidates need different balances of radio frequency technology vs. networking, testing vs. installation and people skills, etc. depending on the type and level of the position they are seeking to fill. Employers reported that they see applicants with "paper certifications" who have passed certification tests but do not have the troubleshooting experience or familiarity needed to perform well on the job without additional hands-on preparation.

Employers emphasized the need for employees who could communicate effectively about technical issues with internal and external customers with widely varying

degrees of technological acumen, ranging from an in-house engineer to a wireless broadband customer just beginning to use the Internet on a home computer.

Factors Contributing to Difficulties in Filling Occupations

The wireless industry in Austin is characterized by small companies with different niches and fast-changing needs. There is no "anchor company" with hundreds of the same job/skill needs to drive training and workforce response across the local wireless labor market.

Cross-cultural communication between industry and educators needs improvement.

Industry groups for wireless are focused on branding and recruiting top talent, not preparing skilled workers at entry- or mid-levels. Though some education and training programs have developed effective relationships with industry through personal contacts and advisory groups, educational and training institutions specializing in preparing a sub-baccalaureate wireless workforce have no streamlined process for obtaining industry input and translating it into training.

Training pathways to different types of entry- and mid-skill level wireless jobs are not clearly defined and promoted at *Austin Community College. ACC* classes related to wireless cross departments and programs, and sequences are not clear as to which programs lead to which jobs. Wireless employers consider wireless an "overlay" rather than a specialty, and hybrid wired/wireless networks are becoming more common.

Many quick training and certification programs don't provide hands-on practice or troubleshooting skills that are valued by the industry. *Companies want to see certifications, but can't count on certified candidates being able to apply their knowledge on the job to solve problems.*

Exploring Solutions

Improving Communication between Industry and Educators to Support Development of Strong Wireless Programs at ACC

Although the University of Texas is a good source for advanced research and engineering talent, the University does not address companies' needs for entry- and mid-level skilled technical workers. However, the university's Wireless Networking and Communications Group have established a successful mechanism for industry input through its Industrial Affiliates program. Capital IDEA, an area non-profit that specializes in skills training, is not prepared to meet needs for entry- and mid-skill levels at the necessary scale because of the intensive nature of its work. However, Capital IDEA has developed an effective informal, communications process with key industry representatives who support the program. Austin Community College is the logical choice for developing mid-skilled training at the necessary scale. But establishing a more streamlined mechanism for input and dialogue will be essential for ACC to develop programs that meet the needs of the wireless industry and remain "up to speed" in this rapidly changing arena.

Recommendations

- Request that the Chamber and the Austin Wireless Alliance provide assistance in connecting economic development and workforce development by designing a process to seek industry feedback to validate information on jobs that are difficult to fill and the skills required. The process should obtain information with minimal burden for industry to respond; be repeated on an ongoing, periodic basis; and be used to communicate information about industry needs to education and training providers. The process that Chamber staff proposed for obtaining this input is likely a very appropriate mechanism – linking questions to an existing survey, making the survey web-based, and keeping the item list short and focused. It requires advanced planning from the Workforce/Training Developers to be ready to pose the questions, and communication with the Economic Developers on their own surve y timeline.

- Invite businesses to be part of a "virtual advisory network" for wireless programs where interested employers can provide guidance on sub-baccalaureate skilled training programs via email or other electronic means. Businesses could help by providing information on which certifications they value and use for hiring, as well as trends in preparation deficiencies they find with incoming candidates.

- Establish an Advisory Committee for Wireless that will address a variety of wireless jobs. Limit requests for in-person meetings of a full advisory committee to the extent possible, preferably no more than one or two per year.

- Obtain industry guidance on how to organize the Wireless Advisory Committee into subcommittees for different occupations or occupational groups, rather than "lumping together" all the wireless representatives from different areas. This will make for more productive meetings and electronic communications with industry representatives because they can concentrate on the particular types of employees and training programs (e.g., engineering test technicians vs. broadband technicians) that are relevant to them. However, ensure that the subcommittees can share information as occupational needs evolve, as appropriate to prevent duplicating work.

- ACC faculty organizing wireless advisory meetings should improve preparation and follow-up after the meetings, to include:
  - Designing an agenda to facilitate decisions and industry input;
  - Cultivating and contacting a small group of industry "friends" who would provide input ahead of time on training needed and how to organized it;
  - Preparing a "straw horse" draft outline of suggested course content, describing the course names, and descriptions, including skills, knowledge, relevant equipment or software, and whether the course is proposed to be taught as a lecture, lab, or some other format;
  - Distributing discussion drafts in advance of meetings via email, to the extent possible, so that representatives can review or seek input from colleagues prior to the meeting;
  - Presenting a clear information packet at the meeting with information on the items to be discussed;

- o Refraining from discussions on the Texas Workforce Education Course Manual (WECM), per se, with industry, or at least recognize that WECM discussions tend to work against industry engagement;

- o Keeping meeting notes on key discussion and decision points, but not necessarily formal minutes; and

- o Distributing notes and any handouts electronically within a week of the meeting, offering the opportunity for additional feedback from the industry advisors.

Training

Industry representatives consider wireless as an "overlay" and not a content area in and of itself. ACC's program offerings related to wireless jobs are not obvious and easy to identify. Some companies may face rapid growth necessitating compressed training time. Many small companies are projecting steady growth, but small numbers of new employees on an annual basis. Many entry-level technical candidates lacked the hands-on experience, problem-solving, and communication skills desired by industry.

Recommendations

- ACC should provide a clearer path through its coursework by defining which programs and combinations of courses lead to which types of wireless occupations. With industry input, design a pathway of appropriate courses for wireless preparation at Austin Community College through computer technology/computer science/electronics courses. Overcome ACC "departmental lines" that tend to distract industry and potential students when presenting program offerings for wireless.

- Develop programs through a "modularized" approach to training, with different starting points for candidates, depending on prior knowledge, skills, and experience. ACC has the opportunity to develop programs in wireless that offer a two-year associates degree, a one-year certificate, or a short-term continuing education format. It can engage partners such as *Work*Source and Capital IDEA to provide supportive services for eligible training participants.

- Introduce concept of hybrid wired/wireless networks in network administration programs, whether they are focused on wired or wireless networks. Incorporate troubleshooting challenges that relate to hybrid wired and wireless networks. (This is relevant for Capital IDEA as well as ACC.)

- Incorporate opportunities for hands on, applied skills in all preparation programs, and in all courses if possible.

- Encourage internships and other opportunities for workplace learning with all credit programs.

- Assess potential of Capital IDEA's pilot training program for "Wireless Installation Technician" geared around four (4) skill certifications to meet industry needs for technicians: A+; Network+; Cisco Computer Network Associate (CCNA); and Certified Wireless Network Administrator certifications. The program was developed with input from industry about the most relevant certifications to form the basis of knowledge and skill development for this

occupational area. The first cohort of participants is scheduled to graduate from this program in February 2006.

Other

WorkInTexas.com is not "user-friendly" to either employers or job applicants in wireless and other emerging areas. As a result, employers and jobseekers in these areas are better served by private job matching programs such as those offered by Monster.com that provide easier ways to identify wireless jobs and strong wireless candidates.

Recommendations

- The Texas Workforce Commission should include special category options for emerging technology areas such as Biosciences and Wireless that are the focus of statewide economic development efforts.

Ideas for Demonstration Projects

A preliminary note is necessary. In our previous report, we found "difficult-to-fill jobs" rather than occupational shortages. We reported contributing factors rather than an assurance that we had identified the "root causes" of skill shortages (Glover, et al, August 2005). However, in the course of developing this report, it became even more evident that the priorities for workforce development are not the priorities for economic development, and vice versa.

In the month since our previous report was submitted, Chamber staff has not had the time – among other competing priorities – to submit the input we heard from one group of industry representatives to a broader group for their validation or reaction. This is not in any way a criticism of the Chamber or Austin Wireless Alliance priorities; it is simply recognition that they are not hearing from their constituents that this is a top priority, and they are responding to the identified priorities of their members. As noted in the Recommendations section, the process that Chamber staff proposed for obtaining this input is likely a very appropriate mechanism that could be refined and adopted as a regular part of doing business. Ultimately, this survey did not fit the timeline for the Critical Skills project, but it suggests an obvious opportunity for Workforce Developers and Economic Developers to coordinate requests for information from industry in the future.

ACC has not communicated with members of its Wireless Advisory Committee since the second meeting in July, in which only one industry representative attended. Despite the low turnout, ACC has an opportunity to prepare a proposed plan for industry feedback, but probably has run out of opportunities to ask open-ended questions about needs, without first responding to what industry has already communicated thus far during the initial meeting. If ACC faculty do not believe they have sufficient information to proceed, someone should approach industry representatives individually to clarify their intentions, and draft a preliminary training plan aimed at addressing the needs that were expressed, and circulate more broadly to industry for input.

The disconnect in priorities we found between Economic Developers and Workforce Developers, and the disconnect between the way the industry thinks and talks about wireless and the way ACC communicated about wireless during the two Wireless Advisory meetings may not be root causes of *current* shortages, but they may approach root causes of *future* shortages. If these culture gaps are not bridged, how will a large training institution such as ACC prepare Austin residents for emerging jobs? Will other programs be able to produce ready workers to meet the demands of industry if Austin's economic development initiatives are indeed successful?

These cultural disconnects and communication problems affect our recommendations for demonstration projects in Wireless. Demonstration projects should be developed with industry input, presuming industry engagement. While the demonstration project descriptions below incorporate input from industry sources, we recommend that *Work*Source use the demonstration project process to address these "root causes" described above, by requiring evidence of industry buy-in or at least sign-off as one component of an RFP or proposal process for demonstration projects. Funds should not be released if industry representatives are not sufficiently interested in the proposed projects based on the curriculum outlines and skill specifications. (This does not mean that the entire curriculum needs to be developed prior to project approval.) This requirement would put the onus on training providers to reach out to employers to come up with a plan and proposal designed to meet industry needs, and to demonstrate some early success with industry engagement.

As such, these demonstration project ideas are not ready to be funded immediately. However, they do respond to needs expressed by industry representatives in the course of our research, and recommendations for improving communication to address training needs, and training itself. The demonstration project ideas focus on ACC because a large, systemic partner-based approach will be necessary to prepare a wireless workforce for Austin.

DEMONSTRATION PROJECT IDEA #1

Establish an ACC Continuing Education course built around the Certified Wireless Network Administrator (CWNA) certification that includes some hands-on practice and troubleshooting, and communication scenarios involving problem-solving with internal/external customers.

This project will require

- Identification of prerequisite skills and knowledge.

- Adaptation of CWNA curriculum content to include hands-on, lab-based practice and scenarios, including issues with hybrid networks.

- Marketing/outreach about what makes this course different from a regular "paper" certification program to encourage participation by students, and preference by employers.

This project may be well suited to upgrade Computer Support Specialists and Computer Network Administrators with training in wireless to improve their employment prospects.

DEMONSTRATION PROJECT IDEA #2

Implement recommendations in the "Improving Communication" section above to engage industry in establishing a one-to-two semester "fast track" certificate program for wireless test technicians, validation engineers and wide area network design specialists that includes "modular" courses from different departments – electronics, network administration, and computer science, as appropriate.

The sequence and specific content of the courses are still *to be determined*, based on industry input. However the majority of courses in the program should integrate opportunities for hands-on, problem-solving practice through lab or "service learning" experiences, and scenarios based on industry input.

This project would address industry demands for shorter preparation times, and would provide a model for ACC to bridge internal departments to develop the combination of courses in response to industry skill specifications. As part of the project, the Greater Austin Chamber of Commerce and Austin Wireless Alliance could pilot a streamlined process to invite wireless companies to describe their needs for entry- and mid-skill positions as input for training providers. The Chamber and Alliance could investigate whether firms would like to advise the project if efficient and effective procedures can be implemented.

ACC recommends that such a demonstration begin with 12-15 students who will form a cohort to take eight courses, eight weeks each, to be able to complete a certificate in one semester.

ACC proposes two student recruitment tracks to test program development:

- Incumbent workers who need to add skills in wireless technology
- Students who lack a background in networking or electronics and need to start from a more basic level with technology

The project may include a role for Capital IDEA in performing intermediary functions, including some tasks noted in the recommendation on "Improving Communication between Industry and ACC for Wireless Programs." For example, Capital IDEA can seek advance input from a small group of the "industry friends" that Capital IDEA has already cultivated to prepare initial suggestions for reaction from the relevant Advisory subcommittees.

Potential students can be recruited through several avenues, including ACC's College Connection which provides high school students automatic acceptance for admission, through Capital IDEA, and through churches and civic organizations from Austin's economically disadvantaged areas. *Work*Source supportive services should be coordinated for eligible participants.

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Appendix A:

List of Courses
Wireless Networking and Communications Group
Department of Electrical and Computer Engineering
The University of Texas at Austin

www.wncg.org

Undergraduate Courses

- Communication Systems (EE 371M)
- Introduction to Digital Communications (EE 360K)
- Telecommunication Networks (EE 372N)
- Network Security (EE 379K)
- Network Engineering Laboratory (EE 379K-19)
- Digital Signal Processing (EE 351M)
- Digital Image and Video Processing (EE 371R)
- Real-time Digital Signal Processing Laboratory (EE 345S)
- Digital Systems Design Using VHDL (EE 360M)
- Computer-aided Integrated Circuit Design (EE 360R)
- Microprocessor Application and Organization (EE 345L)
- Concurrent and Distributed Systems
- Embedded and Real-time Systems Laboratory (EE 345M)
- Electromagnetic Engineering (EE 325)
- Linear Systems and Signals (EE 313)
- Antennas and Wireless Propagation (EE 325K)

Graduate Courses

- Digital Signal Processing (EE 381K-8)
- Time Series and Non-linear Filtering
- Data Mining (EE 380L-10)
- Introduction To Pattern Recognition and Computer Vision (EE 380L-7)
- Advanced Computer Vision (EE 380L-8)
- Introduction to Telecommunication Systems (EE381K)
- Digital Communications (EE 381K-2)
- Wireless Communications (EE 381K-11)
- Information and Coding Theory (EE 381K-7)
- Communication Networks: Tech/Arch/Protocols (EE 382N)
- Distributed Information System Security (EE 382N-16)
- Communication Networks: Analysis/Design (EE 381K-13)
- Advanced Telecommunication Networks (EE 381K-5)
- Probability and Random Processes I (EE 351K)
- Introduction to System Theory (EE 380K)
- Optimization in Engineering Systems
- Advanced Wireless Communications: Space-Time Communications
- Advanced Wireless Communications: Modulation and Multiple Access (EE 381V)