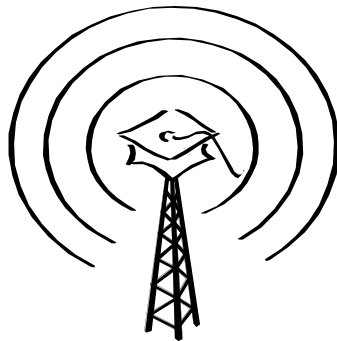


**Wireless Networks:  
Opportunities and Challenges for Foothill College**

**A White Paper**



William Pritchard  
Vice Chancellor, Technology  
Foothill - De Anza Community College District  
August 25, 2004

# Wireless Networks: Opportunities and Challenges for Foothill College

## A White Paper

*"Wireless provides flexibility by potentially turning every classroom, or anywhere else for that matter, into a computer classroom." -- Alan Wolf, Center for Learning Technology and Distance Education, University of Wisconsin*

*"Using our new wireless capability, we're making every part of our campus a center of learning." -- Tina Wing, Network Technician, University of San Diego*

*These instructors have found the combination of the mobile technology and the wireless access invaluable in planning and preparing for class, having greater flexibility to meet students, being able to discuss online projects and sources in any location, and of course, an increased ability to engage in "just-in-time" teaching. Faculty can now collaborate with students in informal settings, and both students and faculty have the freedom to accomplish their work in a mobile setting using a variety of wireless devices of their choice (i.e. laptop, PDA, tabletPC, etc.)" -- Tom Foster, Mary McGlasson, Victor Navarro and Pam Petty, Chandler-Gilbert Community College*

## Background

Foothill College, located on 128 acres in Los Altos Hill, CA, serves approximately 19,000 individual students per year. Foothill and its sibling college, De Anza, enroll one out of every six adults in their service area. Perennially one of the top transfer institutions in the California Community College System, Foothill serves a critical need in preparing students for four-year institutions as well as for workforce development.

Foothill has established itself as a leader in educational technology. The college was among the first educational institutions in the state to offer a credit course online in 1995. It also developed its own online course management software long before commercial products were available. Now nearly two-thirds of its faculty offer class material in some online format. Further, Foothill is the lead community college associated with the Sakai Project, a consortium involving Stanford University, M.I.T., the University of Michigan, and Indiana University, designed to create a universally accessible open source course management system.

The community college environment provides a unique challenge for the management of a wireless environment. In many ways today's community college environment reflects its wider community. The population demographics generally reflect the demographics of its surrounding population in terms of age, ethnicity, and economic levels. The community college campus is very much like many commercial centers in cities throughout the country. People come and go all day long, interact with resources on the campus, and participate in social and business activities together.

However, from the point of view of managing wireless technology there are some dissimilarities from the average community-based wireless environment, which make wireless technology management challenging.

- Educational technology environments are often complex environments to manage. Community colleges serve a diverse range of educational needs, from developmental education to workforce training to allied health education to the first two years of an undergraduate degree. Each of these areas often requires its own specific technology, including unique hardware and software specifications, different operating systems, different form factors, and different usage patterns.

- The personnel and network traffic flow on campus varies greatly by time of day, as well as location. At some times there will be intense and heavy activity in specific locations on campus, while at other times there may be little to none at the same location. These times and locations of heavy use overlap and jump from one area of campus to another as classes start up, engage in activity, then disband. Concurrent with this variety of activity will be the need to continue satisfactory service levels throughout the rest of campus that may not be as heavily impacted.
- Our security needs are complex. As a community college we want to serve our community by providing widely available and free access to our network resources from any location. However, at the same time we need to protect student and employee data from intrusion and unauthorized access. Some academic applications on the network need specific authentication and authorization to access. Others will be freely available to all who care to access them. Some groups will need different levels of access depending on their role (student, visitor, faculty, staff, campus police, management). So we will need to selectively grant privileges by certain individuals and certain times of day. Because of publisher and faculty intellectual property issues digital rights management is also critical.

## **Vision**

Foothill College, representing the Foothill-De Anza Community College District, proposes to deploy a campus-wide wireless network as a pilot project to demonstrate how community colleges can play a major role in rebuilding the Valley's fiscal foundation and in broadening technology use in everyday lives.

As a community college Foothill embodies the principle of universal access to educational resources. Therefore, we envision ubiquitous wireless and computing capacity so that any student, instructor, employee, or visitor to campus can have access to the online resources they need for teaching, learning, doing research and working. We propose to implement wireless networking throughout the campus in all classrooms, all labs, all phys ed areas, all offices, the library, the campus center, and eventually all parking lots. (As a community college, all of our students commute to campus; many will want access to online resources before or after attending their classes.) We want to begin implementation the wireless environment in time for the Fall quarter of 2005 and complete the current central core of the campus by the end of that academic year.

We envision many benefits for our students, faculty, and staff with the implementation of a universally accessible wireless network. Among those benefits are the following:

- Cost savings
- Efficiencies in operation
- Improved teaching and learning

However, we recognize that simply making a wireless environment available does not necessarily provide access to the desired resources. Students and employees will need the appropriate tools to access that environment. As David Brown of Wake Forest University and author of the book, "Ubiquitous Computing," points out, an institution and its students will only receive 20% of the benefits from a wireless network if less than 80% of

the students have mobile technology to access the network (e.g., wireless-enabled laptops or handheld technology). To remedy that problem we propose to work closely with Silicon Valley technology companies to negotiate contracts so that students can obtain mobile technologies at prices affordable to their budget.

### **Cost Savings**

The college envisions direct savings from implementing a wireless network throughout the campus. Among the direct cost saving we see are the following:

1. **Reductions in cost for providing additional network access points.** Adding network accessibility in an area where none currently exists will not rely on the availability of wired connections or the labor and materials necessary to install that access.
2. **A reduction in the number, and size, of institutionally purchased computer workstations.** It's time to rethink the necessity of providing computer labs to students. The "Digital Divide" is a problem that seems to be disappearing, at least among Foothill students. In a survey of 777 students conducted during the spring quarter of 2004 (*See Appendix*) fully 57% of students indicated that they already owned a wireless capable device (either a laptop or a palmtop device, or both). The college can begin to reduce the amount of equipment purchased and being supported on campus by encouraging students to bring their own mobile technology. Computer labs may not necessarily disappear, however, as there will be the need to provide continued access to high-end labs offering specialized or expensive software or hardware configurations that most students could not afford, such as CAD, engineering, GIS, or video editing. However, with creative licensing approaches (concurrent licensing accessed from college-provided key servers), and with laptops becoming ever more capable, the number of workstations and labs the college will need to provide and support can be substantially reduced.
3. **We can reduce the expense of providing fully mediated classrooms.** With the increased usage of technology by our faculty, more and more classrooms are being equipped with high-end desktop computers, projectors, large screens, and audio systems, especially as a result of our Measure E renovation and construction efforts. If all faculty had a wireless laptop, instead of needing to provide a desktop computer in their office, as well as one in the classroom, they could bring their laptop and all their materials with them into the classroom and simply plug into the AV systems present. With about 100 classrooms on campus the college could save quite a bit of money by not purchasing a desktop computer for every classroom. Faculty would also appreciate the ability to bring their own work environment with them rather than relying on the configuration of the computer currently in the room and the hassle of transferring data files to it.

### **Efficiencies in Operation**

Installing a pervasive wireless environment can help the college operate more efficiently.

1. **Wireless access can reduce the need for travel across and within the campus, thus saving time.** Imagine a facilities/plant/grounds person working on a

malfunctioning HVAC system. As she diagnoses the problem she realizes that a replacement part is needed to get the system operational again. Through the use of her handheld device she can query the campus inventory database to determine if the necessary part is available. When she discovers that the part is not in the inventory she can then search the internet for the closest and best-priced available part, thus making it possible to get the HVAC system back on line as quickly as possible. With workflow automation software that the district is currently installing she could even put in a purchase request for the correct part before leaving the work area.

2. **Faculty could become more effective teachers with technology in more traditional classrooms.** We are currently equipping classrooms with "multimedia consoles" with a hard-wired network connection and a desktop computer attached to audio and video systems. Although the consoles are popular with faculty, they often encounter problems with equipment that was reconfigured earlier by another instructor that cause disruptions at the beginning of class as they try to prepare for their class. With a wireless laptop device faculty can prepare their classroom materials in advance and walk into the classroom with confidence that the necessary tools for providing quality instruction is in their hands.
3. **Internal employee service will be able to provide better services.** For example, the campus police are eager to have wireless access from their patrol cars. They say it will make their work more effective and more efficient as they become able to immediately access online data. Technology support staff could immediately access technical help databases or online inventories while in the field to determine strategies for solving technical issues.

### **Improved Teaching and Learning**

The benefits a pervasively wireless environment to teaching and learning are numerous. Let's just examine a few of them:

1. **Laptops fit the reality of faculty workday.** Our instructors are increasingly placing more and more of their class material online. They move from their office (whether at home or on campus) to their classroom and back to teach their classes and communicate with students. Bringing their own work environment with them will help them be more comfortable with the technology and more confident that the material they need will be at their fingertips.
2. **Almost any location can be a learning place.** Students will be able to check material and ask questions of their faculty without the necessity of being in the same room at the same time. Learning can happen at multiple times and multiple locations...whenever and wherever the urge strikes them students can do their work.
3. **In some classes fieldwork can truly be conducted "in the field"** with data collection being done by the student or instructor using their mobile technology with instant transmission to larger online databases and analyses occurring while still in the field.

4. **Faculty can change the nature of academic discourse in their wirelessly enabled classrooms.** Instead of spending the entire class period lecturing, faculty can reasonably expect that their students would have immediate access to a variety of resources on the network. Lessons can be prepared that would expect students to do further research on a particular subject right in the classroom. Faculty might find that students ask more questions, and more informed questions, during class because they can verify (or not) points that the instructor is making with online support. Faculty support and training on how to teach in this new environment will be critical.
5. **Some classes could better simulate the working environment, particularly in our vocational education programs.** For example, allied health science classes could use PDAs to access "patient" records and record new patient data. More and more of the health services industry is moving to wireless access by health professionals and community colleges are training many of the allied health professionals of the future.

### **Phased implementation**

We don't expect all of the campus to be fully wireless at the same time. First, there is construction work occurring throughout the campus under Bond Measure E. New buildings are yet to be built, and existing buildings are being renovated. Turning on wireless access to such buildings will have to wait until the work is complete. However, we are ensuring that all new, and newly renovated, buildings will be wireless-capable when completed. "Wireless-capable" means that the conduit and cable will be installed at appropriate locations throughout each building. (However, it should be noted that we do not have funds to equip these buildings as we would like. Because of legal restrictions on the use of bond monies and recent budgetary difficulties we do not have funds to acquire and install the active equipment.) Second, we believe that a phased implementation will allow us to "work out the bugs" and improve our implementation as we move forward. For that reason we proposing a four stage, phased approach to implementing the wireless network at Foothill.

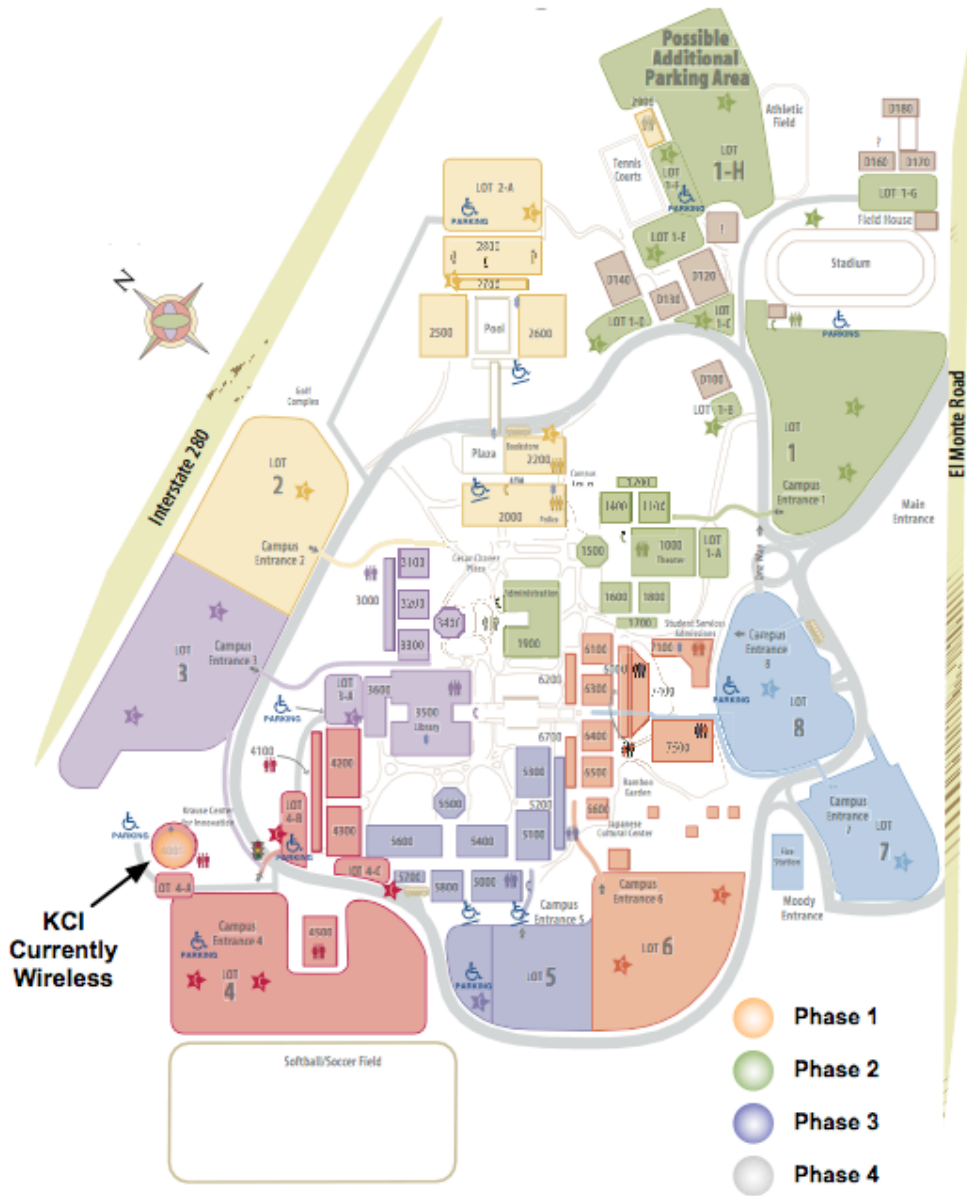
Please note that Phases 1 and 2 will occur during one academic year, beginning with a pilot phase (#1) and rolling on to current campus-wide implementation (#2). Phase 3 must wait until all new construction is complete, and the areas in Phase 4 could be done at any time as needed.

On the following pages are four illustrations representing one possible implementation sequence we are suggesting.

(The maps do not show the current configuration of buildings on campus. Instead they reflect the current plans for the campus when all Bond Measure E construction is completed in 2008. The circles represent individual access point coverage; the diameter of each circle is approximately 100 meters.)

# Foothill College Map

(circa 2008)

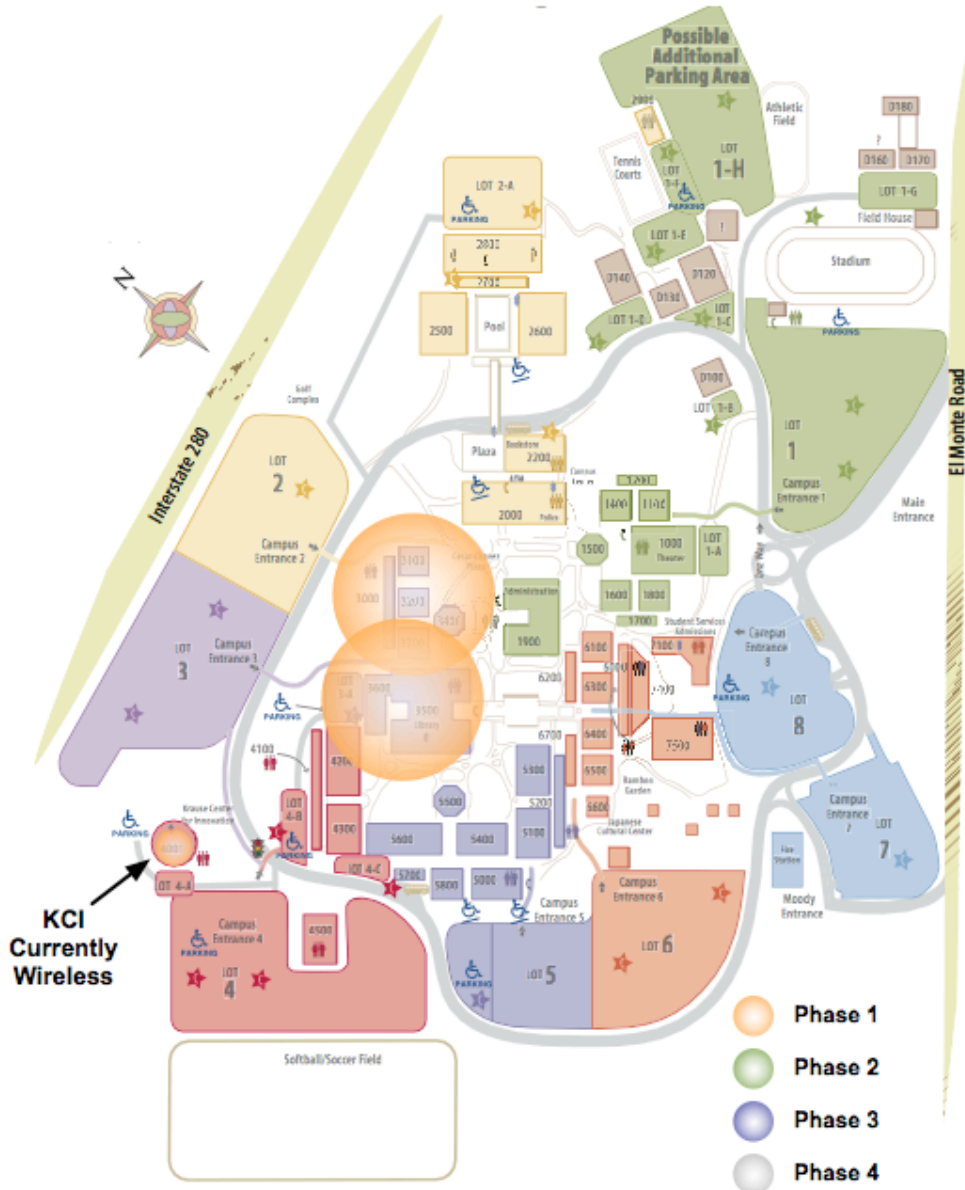


## Current Wireless Access on Campus

This first map reflects the current state of wireless access on campus. At this time wireless access is limited to the Krause Center for Innovation.

# Foothill College Map

(circa 2008)

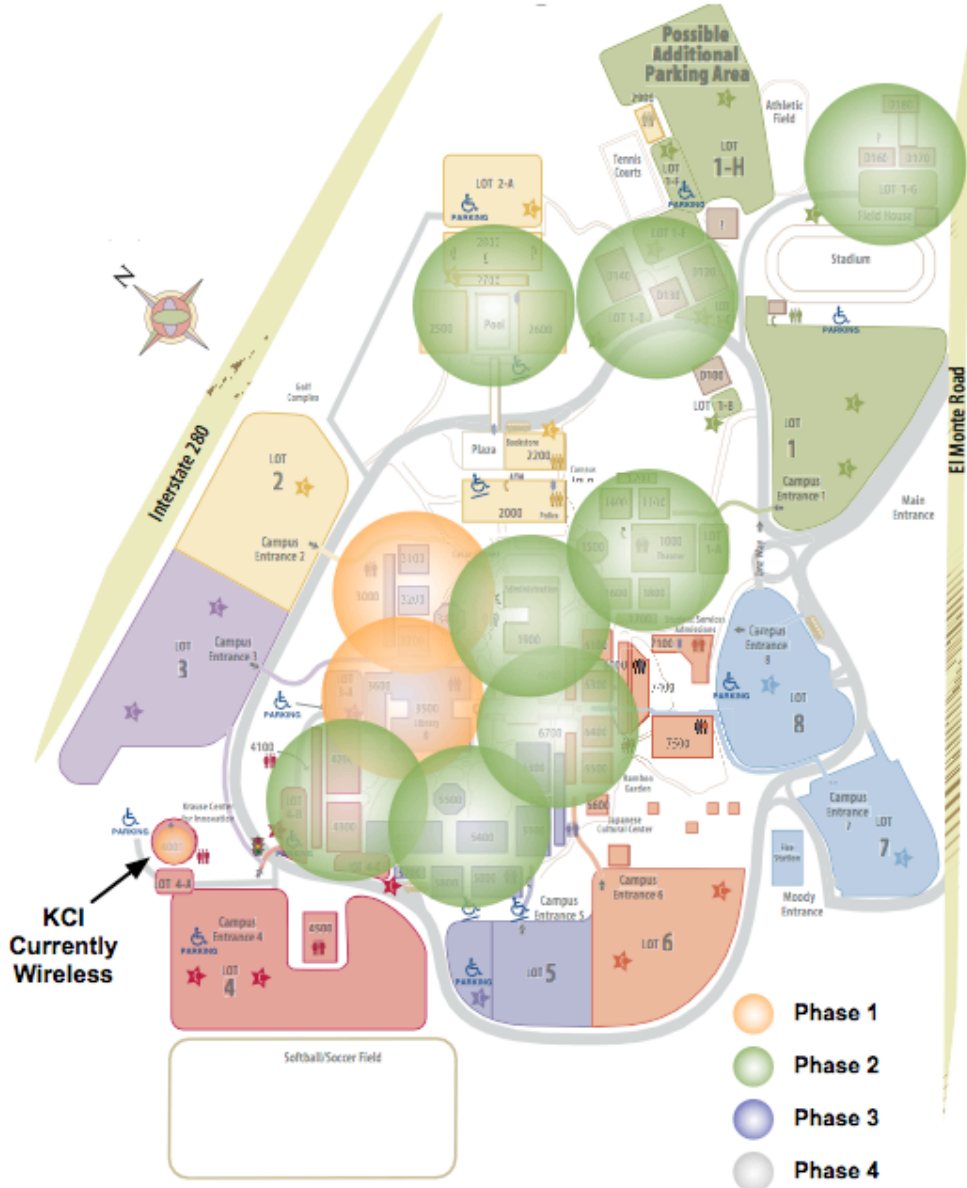


## Phase 1 Implementation

We are proposing that we start out relatively small to prototype the environment. The buildings for the Business and Social Sciences Division have recently completed their renovation and are ready for installation of active equipment at their designated access points. Also the library is an obvious location for students to access a wireless network and it will not be undergoing renovation under Measure E. So those two locations would be the first areas to receive wireless access. Tangerine-colored circles indicate the hotspots in Phase 1. These areas should be ready for implementation for the start of Fall quarter, 2005.



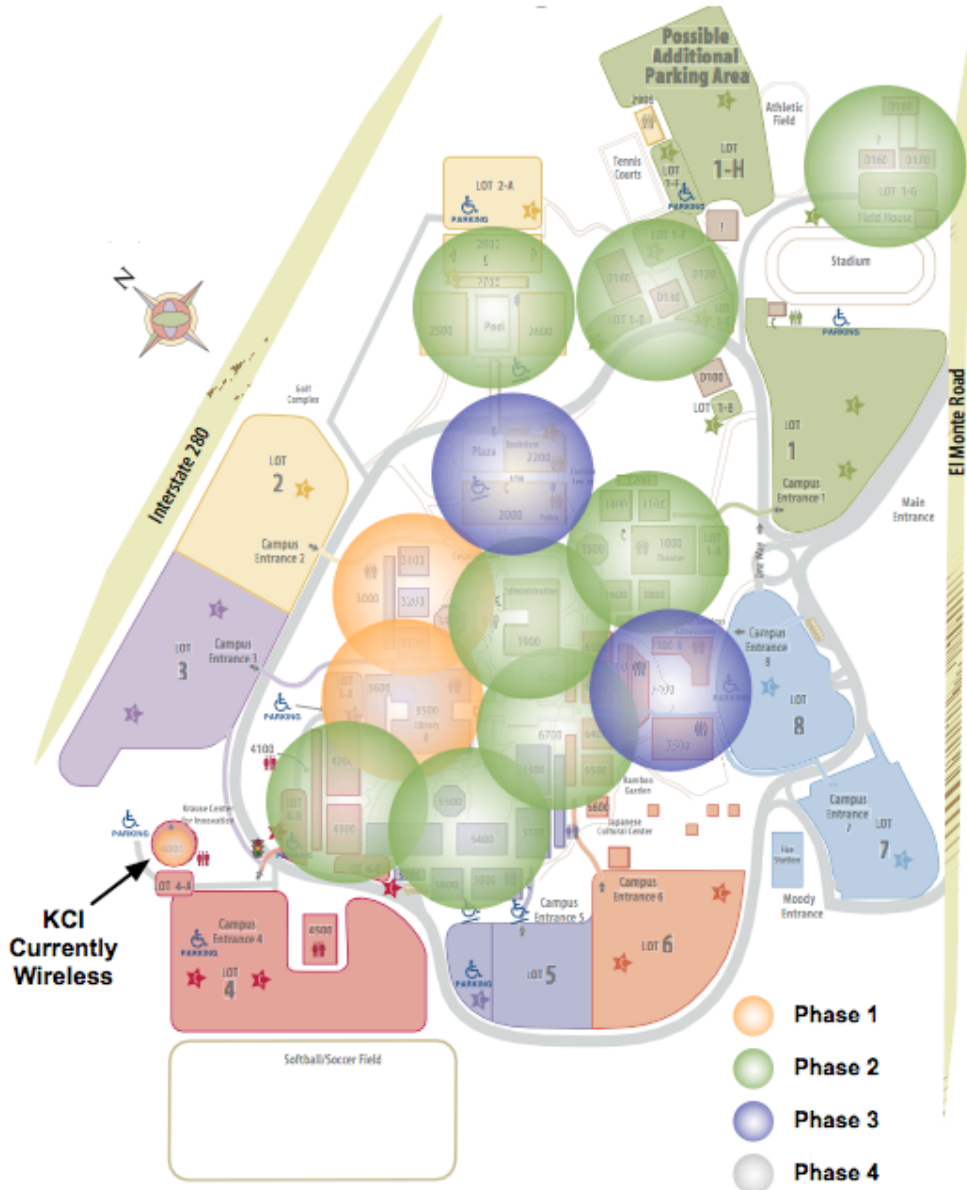
## Foothill College Map (circa 2008)



### Phase 2 Implementation

In Phase 2 substantial portions of the campus will become enabled for wireless networking. Virtually all of the campus classrooms and office space will be covered with the completion of Phase 2. Green circles indicate the Phase 2 areas. These areas would be completed during the Winter and Spring terms of 2006, so that before the end of the 2005-06 academic year, all areas of the campus will be wirelessly enabled (except for those which will be under construction).

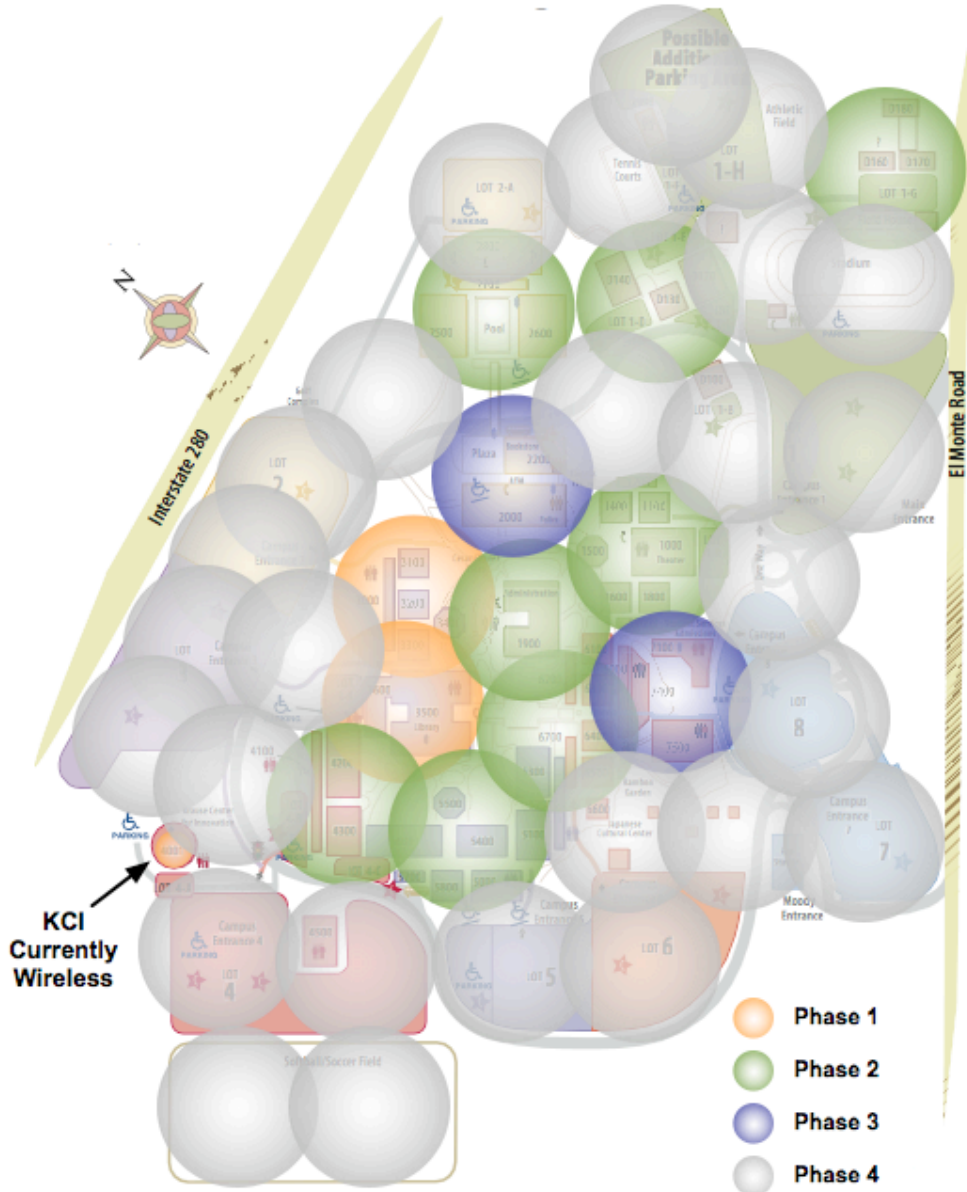
## Foothill College Map (circa 2008)



### Phase 3 Implementation

Phase 3 will take place when as new buildings are completed. At the front of the campus (on the right side of the map), two buildings (student services and life sciences) will begin construction late this calendar year and completed in 2007. The new campus center will start after the current campus center is demolished (scheduled to occur in early 2005) and the site is prepared for construction. It will come on line about the same time or shortly after the student services and life sciences building are completed. Blue circles represent these areas.

## Foothill College Map (circa 2008)



### Phase 4 Implementation

The last phase will extend the wireless network to the outer perimeter of the campus, including the parking lots. Some of these areas could be done earlier, as there is no physical reason to prevent earlier implementation. However, they are lumped into Phase 4 to indicate the lower priority that these areas have in relations to central campus and classroom-oriented buildings.

**Technical challenges:**

There are some interesting technical challenges to implementing a pervasive wireless environment at Foothill. First, the nature of college class schedules will provide periods of concentrated use during certain times of the day in certain locations. (Imagine, for example, a large lecture class with 200-300 students, each using their laptops to take notes while simultaneously searching the web to verify information or to seek further material to help in understanding the lecture.) Areas of the campus could experience virtually no activity for parts of the day and then experience intensely heavy use during other hours.

There are a wide variety of different users who have different needs. The college supports a widely diverse curriculum that covers the entire range of undergraduate academic disciplines, as well as vocational and adult education. Our course offerings cover areas as widely different as language acquisition skills, nursing, engineering, automobile technology, creative arts and design, literature, history, biotechnology, GIS, dental hygiene, and on and on. Each discipline has its own unique needs for technology that are often customized to that need.

We also expect that our users will be very mobile during the day and will want to maintain network connectivity as they move around the campus. Different periods of the term will also experience varying usage levels, with start of classes, mid-terms, and the last few weeks being more intensive than other times.

Security is also a strong concern. With widely accessible wireless connectivity there will be some users who will attempt to find ways to penetrate our security infrastructure to gain access to personal information. To combat this problem we will need to design and implement a policy that will protect essential resources while at the same time allowing easy access to those resources students and faculty need for full study of their content area. The district IT organization (Educational Technology Services, or ETS) is currently researching solutions for identity management and user authentication and authorization. This is a critical first step before implementation of any widespread wireless activity. They hope to have a decision soon on what to acquire and implement.

As a public community college we expect there will be a wide range of differing technologies to be used on our campus. In fact, as an educational institution we encourage the use of a wide diversity of technologies because of the wide variety of disciplines and technologies we offer as part of our curriculum. As a result, especially being located in the Silicon Valley, we expect that just about any type of wireless device will be accessing our network. This reinforces the necessity for using open industry standards -- e.g. 802.11x -- and requires us to implement a solution that will have a migration path as standards change. Given the variety of hardware devices and operating systems that will be brought to campus our technical infrastructure must be agnostic on this issue.

There may be some challenges in the physical geography of campus, although that will need to be determined. Because the campus was constructed nearly 50 years ago, and

changes have been made of the years, there may now be some materials in place that could pose problems for wireless penetration. Also, the campus is located on the top of hill, with most parking lots at the bottom, and a significant new building to be constructed on the side of the hill.

As a community college dedicated to providing access to everyone we have little to no control over the types of technology that users will be bringing to campus. We will undoubtedly find the wide range of handheld, laptop, and cellular technologies appearing on campus, with a corresponding range of operating systems and software applications.

Even though the college is completing renovation of many classroom and office buildings there is a challenge related to providing adequate power availability for all the expected wireless devices. Most classrooms on the campus have very few power outlets and are not wired to provide significant numbers of new outlets. The reality of a wireless environment, however, is that significant numbers of devices will need to be recharged or connected to power frequently during every day.

Finally, we have limited technical staff available to manage our already complex network environment. Educational Technology Services (ETS), the district-wide IT support organization, provides technical support for both Foothill and De Anza Colleges. On the staff are only two full-time network system administrators, who manage the entire 5,000+ active node network at two geographically separate locations. In addition, they oversee network security, respond to trouble calls, and assist in planning and installation of new networks and network applications.

For these reasons a robust and comprehensive wireless network management system that can accommodate the complexity and diversity of our needs is critical to successful implementation of a pervasive wireless environment at the college.