THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

To: Roger Stancil, Chapel Hill Town Manager

From: Chapel Hill Connectivity Working Group

Date: April 20, 2007

RE: Connectivity Improvement & Public Wireless Access Interim Report

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Background of the Chapel Hill Connectivity Working Group

The Chapel Hill Connectivity Working Group was convened to investigate the potential connectivity projects in the Town which could further enhance governmental, citizen, visitor, and business access to the Internet. In addition, the group offered expert guidance to the Town on those strategies which would be most feasible and demonstrate the greatest public value.

Members of the working group include John Streck, UNC, Shannon Schelin, UNC SOG, and Lee Mandell, NCLM. Internal staff members participating in the group meetings include Roger Stancil, Flo Miller, Bob Avery and Arek Kempinski.

This interim report summarizes the factual background information about connectivity models, expresses the opinions of the group, and offers a variety of options for Chapel Hill Town Council consideration.

The Goal and Objectives for Town Connectivity Improvement

Prior to discussing technological solutions, the group first sought to understand the goals and objectives for improved connectivity. Based upon conversations with Town staff and Council members, the following goal and objectives are offered for review and comment:

Town Goal: To use technology to improve the community life, economic environment, and government operations in Chapel Hill.

> **Objective 1:** Improve connectivity in all areas of the Town to all citizens in such a manner as to reduce the "digital divide" and its associated impacts.

> **Objective 2:** Spur economic development by providing publicly available connectivity in key business areas.

> **Objective 3:** Improve Town access to in-field applications by utilizing non-tethered connectivity options, such as Wi-Fi or Wi-Max.

THE UNIVERSITY
of NORTH CAROLINA
at CHAPEL HILL

KNAPP-SANDERS BUILDING
CAMPUS BOX 3330
CHAPEL HILL, NC 27599-3330

T 919.966.5381
F 919.962.0654
www.sog.unc.edu

Each of the aforementioned objectives has a variety of technical solutions that can achieve the desired outcomes. Costs, benefits, and legality must be investigated in each alternative analysis. In addition, the Council must establish priorities for the articulated objectives in order to ensure that appropriate financial resources will be allocated to the selected projects.

Before outlining alternatives for meeting the goals of the Town Council and staff, a brief overview of connectivity is offered as a means of increasing awareness and creating a standard operating framework for the remainder of this report.

General Connectivity Background Information

Advances in communications and information technology continue to have a profound effect on the way we work and live. Personal communications are available virtually anywhere and anytime. Traditional cellular voice and data communications on personal devices are giving way to broadband Internet access for voice, data, and video services. Coupled with smart devices that continue to grow in capabilities while dropping in price and size, the public demand for these "personal" services will no doubt continue to grow and will become more integrated into business functionality.

The Internet is also playing a major role in the growth of mobile devices. It has become as much a part of our daily lives as the telephone did in the twentieth century. Mobile access to the Internet's range of information resources - anytime and anywhere - is changing from novelty to essential.

As the commercial sector rushes to fulfill the growing demand for mobile services, there are a number of technologies and standards being applied. This often results in adoption of certain personal devices that are wedded to a particular vendor or technology. For example, mobile phone companies each have phones specifically designed for their communications technologies and services and are not transferable to another carrier's system.

Fulfilling the goal of a truly nomadic Internet access will require moving beyond the anytime and anywhere to also include the anyhow – being able to access information resources through a wide range of personal devices that operate across a spectrum of technology delivery services. Fulfilling the goal will also require improvements in the power efficiency, battery capacity, and convenience of auxiliary or recharging power for the devices.

The nature of this nomadic connectivity goal is germane when considering a more specific process such as providing wireless Internet access for metro-Wi-Fi hotspots in neighborhood zones or throughout a metropolitan area. The questions of "for whom, by whom, and for what purpose?" should be answered in a way that is clear to all.

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Wired and Wireless Connectivity

Fundamental to the municipal wireless initiatives in a number of cities is the desire to extend the accessibility of broadband Internet access to areas that are underserved by wired access and to public areas that would benefit citizens and visitors alike. The key goal is to enable universal access to the Internet through a broadband connection.

Wireless is clearly the answer for the mobile or "in motion" user and is a cost effective means to reach users scattered over wide distances or in locations that are difficult to outfit with wired connections. However, wireless solutions are not without limitations, including topographical constraints, interior building penetration challenges, and channel interference.

Conversely, wired Internet connections generally provide higher speeds (bandwidth), as compared to wireless connections, and are usually not subject to radio frequency interference. Traditional telephone companies provide wired services via digital subscriber lines (DSL) and cable television companies provide wired service through the same cable used for video connections. Fiber-optic cable connections provide the highest bandwidth connections but also have the highest cost of deployment. Obviously, wired solutions do not offer the nomadic experience for the user that is found in wireless solutions.

Current Connectivity Providers in Chapel Hill

Studies by the e-NC have shown that Orange County has broadband services available to 92% of the county residents. Although specific analysis is not available, the broadband service availability within Chapel Hill is estimated to be well above that level. Traditional cable and telecommunications providers are well-entrenched in the Chapel Hill market and provide the majority of broadband access via wired solutions.

The recent addition of commercial wireless broadband services by Clearwire, Inc. has further increased the available broadband choices for residents of Chapel Hill. The Clearwire service is wireless and portable but not mobile; primarily because the connection device is powered by standard household electrical power. Clearwire has indicated plans to offer mobile service in the future.

Moving from Vision to Reality

Based on conversations with Town Council members and Town staff, the working group has developed four scenarios to examine the alternatives associated with the objectives previously identified. The scenarios are ordered based on the cost (both real capital outlay and staff resource utilization) and scope of coverage.

Scenario # 1: Hot Spot Model (Town sponsored) - Limited number of Wi-Fi hot spots installed by a Town sponsored program. Provides outdoor (and in selected areas, indoor) Wi-Fi access at best available speed (note that best speeds occur when 40 or less users are connected to an access point). No advertisement or subscription unless hotspot services are donated by ISP. No direct user support. Examples of specific sites to be considered: Park and Ride Lots, downtown bus stops, downtown outdoor benches, and parking deck upper level.

Scenario # 2: Limited Downtown coverage model (Town sponsored) - Limited Wi-Fi network covering about one-half square mile installed in downtown area by a Town sponsored program. Provides outdoor Wi-Fi access at best available speed. No advertisement or subscription unless Internet access service is donated by an ISP. Limited user support. May include extension from the edge of the UNC campus for outdoor access.

Scenario # 3: Extended Downtown coverage model (ISP operated) – An extended downtown Wi-Fi network covering one square mile installed in downtown area by an ISP sponsored program. Provides outdoor Wi-Fi access at reduced speed for all (advertising may apply) and at higher speeds for subscription-based users. Advertising and/or subscription supported. User support provided by ISP.

Scenario # 4: Town-wide or WiMax model (ISP operated) – Town-wide Wi-Fi and/or WiMax network installed in stages with intended Town-wide access for both outdoor and indoor use. Advertising and/or subscription supported. User support provided by ISP. The installation, operation, and maintenance to be funded by ISP. This may include a quid pro quo from the ISP for limited transport and connection for town related functions and public service functions

These scenarios offer a range of opportunities, challenges, and cost structures, which should be considered by the Town Council.

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Other Local Governments in North Carolina

As Chapel Hill begins to examine the costs, benefits, and legal constraints associated with government-enhanced connectivity options, it is critical to examine the other efforts underway in North Carolina jurisdictions.

A variety of jurisdictions offer publicly available wireless connectivity in their local libraries or local government buildings. For the purposes of this report, those jurisdictions are not included because they do not meet the scope of the work outlined to the working group. Please note that this is not a comprehensive list of municipal wireless efforts in North Carolina, rather it is a brief overview of some of the efforts currently underway.

1. **Buncombe County:** Buncombe County offers publicly available wireless access in the downtown area of Asheville.
2. **City of Greenville:** Greenville is in a test phase with 13 wireless access points in the downtown area. The coverage area is a 5 X 6 block area.
3. **City of Raleigh:** Raleigh offers publicly available wireless on the Fayetteville Street Mall area.
4. **City of Salisbury:** Salisbury offers publicly available wireless access in their downtown area, as well as at a public park.
5. **City of Wilson:** Wilson offers downtown wireless access. The pilot project covers approximately 30 blocks of the downtown.
6. **City of Winston-Salem:** Winston-Salem, through a partnership with WinstonNet, is scheduled to begin a pilot project with publicly available wireless access covering one square mile in downtown.
7. **Town of Carrboro:** Carrboro offers publicly available wireless access in its downtown area.

It is important to note that in many of these deployments, including Greenville, Wilson, and Winston-Salem, the cities have a fiber optic backbone which supplies the Internet connection to the wireless system.

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Challenges and Issues

This section articulates several challenges, legal, practical, and political, that need careful consideration and attention as the Council assesses the various options for community connectivity projects.

Legal:
One area of legal concern would be initiatives that give fuel to the challenge that public funds are unfairly used to trump commercial offerings from the private sector. There are increasing challenges by the commercial sector to add regulations at the state level. In fact, a bill (HB 1587) was introduced on April 19th to induce "fair competition" between the private and public sectors with respect to telecommunications provision (wired and wireless). This bill essentially seeks to limit local government entrance into the service provider market and will have a direct bearing on the Town's ability to deploy large-scale publicly available wired or wireless networks.

Another area that might entertain not a direct legal challenge but more an economic burden to the communication network providers would be compliance to the federal rules under CALEA (Communications Assistance for Law Enforcement Act). Essentially, CALEA mandates that any public network provider must create avenues or probe points on their network for federal electronic surveillance of Internet traffic (including content). Often, the CALEA regulations are described as "wire tapping" for the Internet.

Partners:
UNC
When looking at any venture of a public/private nature and coverage of this magnitude (spanning a municipality) it is always fruitful to look at partnerships. For the Town of Chapel Hill, the obvious partner is the University of North Carolina at Chapel Hill (Carolina). What at first blush would look like a natural solution, the extension of the university wireless network, has a number of serious operational issues. First, the university needs to be cognizant of how the allowing of any non-university person onto its network affects how the federal government views the university's status in respect to CALEA compliance. If the university was deemed to be a public network, the possible financial ramifications to bring the university into compliance could be millions of dollars. Here is an instance that care must be taken and must constantly be reassessed since legal interpretation of CALEA is under constant change (i.e. more requirements which in turn brings on more financial burden.) There are other concerns with regard to network security and the like but with proper design and planning, there are probable workarounds.

	THE UNIVERSITY
UNC	*of* NORTH CAROLINA
SCHOOL OF GOVERNMENT	*at* CHAPEL HILL

KNAPP-SANDERS BUILDING   T 919.966.5381
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A possible scenario for coverage adjacent to the University grounds would be for the university to supply the equivalent of a wireless bridged network connection with hand-off to a Town wired connection point. The wireless network would be designed to allow university faculty/staff and students direct connection into the Carolina network but would partition non-university entities to the town connection. This technical solution would need intense review by legal counsel. With the correct amount of coordination, this technique could be extended to the downtown business sector offering Wi-Fi connectivity.

Private Sector Telecom/Cable Companies:
With the M&A (merger and acquisition) of BellSouth and AT&T, there exists a local provider that could be approached for partnership in a public/private venture. Very similar to the Carolina scenario, a similar connectivity option may be possible to bridge common areas in the town back to a town network point. Time Warner Cable or Time Warner Telecom may be another partner in a public/private venture.

Technical and Financial:
Each of the four wireless scenarios previously identified would require extensive planning and involve costs to the Town to implement. A sample list of the considerations that must be examined for any project is attached (Appendix A).

Even the simplest approach, installation of hotspots, involves some degree of antenna installation, network and Internet connectivity, and a management and support group for system operation, maintenance, and user support. The study group estimates a wireless hotspot scenario could cost as much as $10,000 to install, operate and maintain for a year for even a limited number of locations. At the other end of the scenario list, a system that is installed and operated by a third party using subscription and advertising to cover costs would likely require $25,000 to $50,000 to cover the consulting fees and preliminary site surveys.

In some cases, the agreements necessary to install antenna and provide electrical power can become stumbling blocks. For example, agreements with utility companies to mount equipment on their poles and obtain power are often more difficult and sometimes more costly than initially estimated during project design. This can delay the project or introduce unexpected costs that must be resolved by the municipality.

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One concern discussed within the group is the limited number of Town-owned facilities and sites that could be used to install equipment and antennae. Power, telephone and light poles in Chapel Hill are owned by utility companies and the Town would need to establish agreements to use these poles. The number of Town-owned poles is too small to accommodate a sizeable wireless network. The Town also has few active facilities in the downtown area that could be used as sites for networking equipment and Internet service provider connections. Additionally, the Town does not own any fiber optic cable for connecting widely separated equipment sites.

To the group, the limited Town-owned facilities, hilly terrain, and the high penetration of the customer base by existing commercial broadband Internet providers, represents a difficult market for a new Internet service provider and especially for one that would seek to be self supporting.

Future Steps

As the Council considers this interim report, the working group would like to encourage the Council to include the following items for serious consideration.

1. Chapel Hill should continue planning for fiber optic capability. Fiber is one of the most critical technological investments the Town can make, in terms of expanding the capacity of the government to serve its citizenry effectively and efficiently.

2. If the Council decides to pursue some pilot connectivity projects, they should consider short-term wireless projects, such as hotspots in key locations, in order to keep the costs relatively low and to avoid potential legal conflicts.

3. Once the legislative agenda related to the "Fair Competition" bill is resolved, further study, including hiring a consulting firm to examine the potential for a large-scale connectivity project, is recommended. The Council should consider allocating funds for this study in order to ensure that the appropriate design, specifications, and business model are used.

In addition to these items for consideration, the working group solicits feedback, questions, and commentary from the Council so as to guide any future work that may be undertaken by this group.

Appendix A: Sample Planning Considerations for a Wireless Public Access System

Design Concept – Determination of Intended Uses
Public (outdoor access)
Public (indoor access)
Public Safety (secure channels)
Municipal Services
Businesses

Project Planning
Draft concept
Site survey
Site survey costs
Request for Proposals
Consultant services
Consultant costs
Non-profit participation or formation
Contracts

Antenna Site and Equipment
Antenna equipment cost per location
Installation cost per location
Number of antenna sites
Network management equipment costs
Network management installation costs
Antenna and networking maintenance costs

Special Agreements
Right-of-way agreements
Pole agreements
Antenna site agreements for buildings and towers
Power agreements
Anchor tenant agreements
Supporting network access agreements
Service level Agreement for supporting services

Internet Connection
Internet connection source
Internet access cost

Network Management
Network management equipment requirements
Network management equipment operator
Network management equipment cost
Network management equipment maintenance and support costs
Source of user support