WI-LINC Commission

FINAL REPORT

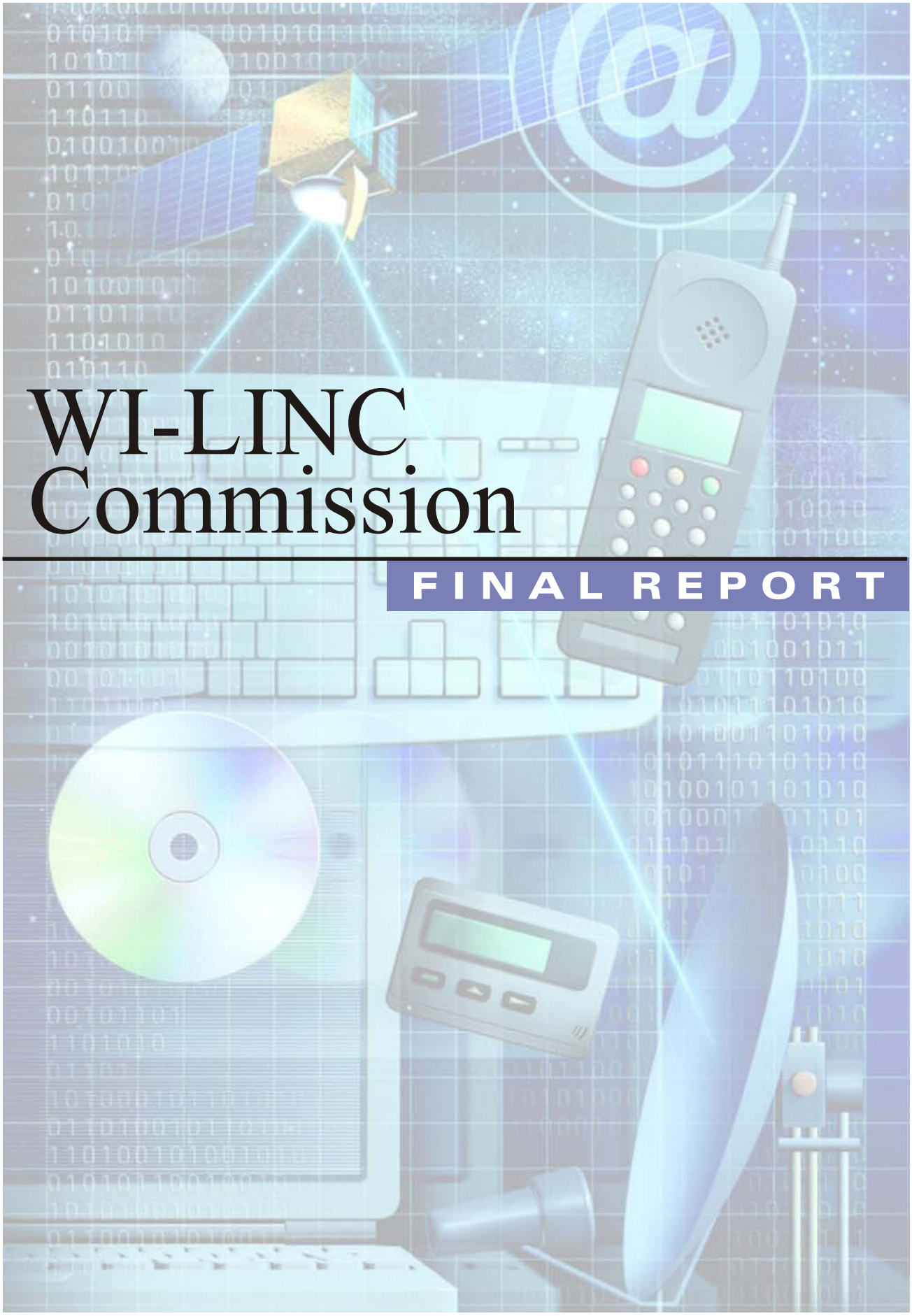


TABLE OF CONTENTS

Executive Summary and Recommendations …….…….1

Introduction …….5

Subcommittee Structure – Process …….…….5

Community Research and Analysis Subcommittee …….……...5

Technology Subcommittee …….……8

Legal Subcommittee …….……10

Appendix

Commission Membership/Participation ……....12

WI-LINC Commission Meeting Minutes

June 27, 2007 ……....14

January 16, 2007 ……...18

September 28, 2006 ……..23

Technology Subcommittee Minutes

March 8, 2007 ……...25

February 8, 2007 ……...28

WI-FI Cost Estimate Report …….31

WI-MAX Summary ……..33

Two-Way Radio Systems Report ……..34

Research Bibliography ……..44

Other Research Material: WI-LINC Public Survey Results, WI-LINC Business Survey Results , Lincoln Hot Spot Map, and Community Research and Analysis

Executive Summary and Recommendations

The WI-LINC Commission was established in the fall of 2006 by Councilman Jonathan Cook to examine the viability of wireless Internet for Lincoln and what role the government should play in facilitating such access. The Commission convened for the first time in September 2006 and approved this final report at a meeting in July 2007.

Wireless initiatives are being researched and implemented throughout the country. According to Muniwireless.com, as of June 2007, 88 regional and citywide networks were in some stage of implementation, 63 had established hot zones, 39 had established public safety – including Lincoln, NE - or municipal only networks and 195 were in the process of establishing a city or countywide project. Clearly, the goal of citywide wireless access is achievable, but the questions are – who will the system serve and at what cost?

The establishment of a wireless system that would provide free access to the Internet throughout the community is comparable to creating a utility or infrastructure system in terms of physical investment and financial commitment. It is daunting in terms of its scope and the financial investment required to not only establish the system, but also maintain its operation on a 24/7 basis. In order to assure the success of the project, significant support from elected officials, economic development professionals and other interest groups is critical.

The Commission examined the issue of wireless service with one basic question in mind - who do we intend to serve? The answer to this question dictates the governmental role with relation to the establishment of a public wireless access network including the regulatory authority and necessary financial investment.

Based on the research gathered by the Commission, there are three distinct groups that could be served by the establishment of a citywide wireless network:

- Enhanced City Services – Law Enforcement/Public Works/Emergency Services: The City of Lincoln utilizes wireless technology to support many city functions. If our goal were to enhance their capability, a system that utilizes a WiMAX solution, a high-frequency bandwidth to support video and other data streaming, would need to be established. This would require spectrum ownership and other enhanced technological solutions.

- Business / Travel Consumer: The business consumer working outside the office or the highway traveler that might stop in Lincoln because of wireless access would not require advanced broadband technology. In general, their usage would fall into the 802.11 spectrum, essentially a hot spot, coffee shop type model that could be coordinated with other locations to create destination service.

- General Public – Casual User: The establishment of a system that provides general wireless web access for visitors and the general population would only require broadband access provided through a WiFi network. Currently, Lincoln has a great deal of general wireless access available throughout the community that is not organized. A special

category of casual user is the low-income citizen. There is a population of citizens that could benefit from Internet access, but lack the hardware needed to utilize wireless networks. The establishment of wireless access will not enhance their quality of life until they obtain access to a computer or PDA that contains a wireless card allowing them access to the Internet. Many municipalities around the country have prioritized providing access to the working poor as the impetus for establishing a wireless network in their community. However, this public policy goal requires more creative partnerships and a commitment from private partners to develop such programs.

The Role of Government

The dilemma that must be addressed by our public policy makers, if they choose to move forward with a government-supported or administered wireless public access network, is this – communities that have established municipal networks are subsidizing the service with significant tax dollars on an annual basis. Others have contracted with private providers to establish a network, but many are now having those private contractors come back to them for public financing to support the system. In other communities, government is using a tiered-fee financing strategy to offset the investment of tax dollars.

In Nebraska, there is ambiguity regarding the ability of a municipality to establish a community-wide network for use by the general public. Current state law (LB 645), adopted in 2005, states that government entities cannot provide a retail sales point for telecommunications in Nebraska. In fact, recent testimony regarding the existing ban[1] indicates that even if the city established a municipal wireless network for public use at no cost to the consumer, it could be legally challenged.

Without the ability to establish a tiered system of user fees to support the establishment and use of the system and very limited or no support for public financing, the Commission was left with the following question – how can the City of Lincoln support the development of a citywide public wireless access network?

RECOMMENDATION #1: At this time, **the Commission recommends that the City of Lincoln DOES NOT move forward to establish a citywide public wireless access network**. The Commission believes that it is not practical to utilize scarce resources to create a citywide public access network. In addition, no clear results from other community implementations are known at this time. What is known is that such a system, operated under the control of government, similar to a utility, is financially burdensome. Under the current legal constraints established by the Nebraska Legislature, it seems a fool's errand to pursue development of a system without the ability to establish user fees to support the operation of such a network.

RECOMMENDATION #2: Despite the fact that the Commission does not recommend that a public wireless network be established at this time, it is important that the City continue to take steps to **create a better urban amenity**. This can be accomplished by pursuing the following:

[1] Greg Barton, Nebraska Telecommunications Association, LR 181 Hearing before the Nebraska Legislature's Transportation and Telecommunications Committee, Monday, July 16, 2007

Champion. The Commission recommends the creation or designation of a coordinator that will be needed to move a future initiative forward. It will be imperative that a point person or coalition be established to champion any wireless Internet access project, to coordinate implementation and coordination of wireless access in areas throughout the city working with economic development professionals and public officials. Lincoln's champion needs to create a sense of partnership between city government, local business, the education sector and the general public in order to create a successful program.

The work of the coordinator would include the following:

2A. **Marketing and Public Awareness.** It is important to note that there is significant proliferation of wireless access throughout Lincoln today. The Community Research and Analysis team developed a map of wireless access establishments throughout the city (see Appendix) that can be found on the city website. The continued publication and update of this information could be a useful tool for all citizens.

Some communities have developed non-profit organizations that champion the expansion of wireless service without taxpayer support. Of note, Lily Pad is a 100% volunteer initiative, led by Give Back Cincinnati and supported by key business partners, government leaders and academic representatives. According to their website at www.lilypadusa.org, Project Lily Pad establishes private-public partnerships to subsidize the costs for free wireless. Corporations, individuals and organizations can sponsor "Lily Pads". Lily Pad websites and signage promote the area as a free wireless zone and recognize sponsors, enabling them to promote their products to users and inquirers. The tax-deductible sponsorship covers costs of installation, data access, maintenance, and marketing of the Lily Pad. In a slightly altered version of this model, businesses could sponsor wireless hot spots and be provided advertising on the home page accessed on site or have their business website listed as a web link on the home page.

2B. **Coordination Project: Enhanced City Service Areas.** As a step toward the establishment of a broadband wireless system for Lincoln, we recommend creating some level of integration among all the owners of systems within certain geographic corridors to enhance economic development, education or other public policy interests. The Commission believes that any of the following geographic corridors could qualify: Haymarket/Downtown, Antelope Valley, and Interstate 80 Interchanges.

In the Haymarket/Downtown area specifically, coordination could resolve issues related to overlapping systems that interfere with one another today. It would be a great amenity without much monetary investment. This coordination could prove to be relatively small in terms of financial investment, but enhance the wireless signal for users throughout this important economic sector of the community.

2C. **Integration/Coordination.** Two distinct areas of coordination need to be addressed to enhance the implementation of any future wireless access system in Lincoln.

Inter-Governmental Cooperation. The needs for enhanced wireless data capability to support a variety of critical city services are clear. The City of Lincoln has implemented award-winning wireless solutions to support these needs. However, the needs of our growing city will demand additional technological solutions to support these critical services.

City government is not the only governmental subdivision utilizing wireless technology to provide service to citizens. Other governmental entities are incorporating wireless technologies into their daily operation. Cooperation with other government entities (LPS, etc.) to establish hot spots throughout the city that are password protected for use by public employees creating access points for public safety use. This could limit the needed financial investment required to enhance city service, especially for law enforcement and emergency service personnel. Coordinating the creation of such a system would need to minimize any disruption of current usage by governmental entities hosting the system.

Economic Development. The value of a public wireless access network to enhance Lincoln's efforts to create new jobs or impress site selectors considering Nebraska's Capital City for location or relocation of their businesses is unclear. Wireless service has not been a prerequisite by site selectors visiting Lincoln in recent years. However, some believe this amenity can enhance the basic package of selection needs. Additional coordination among the public and private economic development professionals about how to implement a network that could become an asset for this purpose would guide the implementation of the network in a positive way.

Conclusion

The support of our local government to ensure that these small steps be implemented is vitally important. The Commission is sure that no progress will be made regarding this issue without additional support from the City of Lincoln in terms of staff time, a willingness to participate in the coordination of services between local governmental subdivisions and the private sector. With these small steps, a better urban amenity can be established, in the future that will enhance city services and the quality of life for Lincoln residents and visitors to the Capital City.

City government has a significant role to play in the future evolution of wireless services in Lincoln. Policy makers should balance the strong support for enhancing the availability of free or low-cost wireless Internet access by individual citizens with the current demands for city tax dollars and the current regulatory environment. The Commission believes that progress toward that goal can be made with limited investment on the City's part.

Introduction

The establishment of wireless networks across the country has mushroomed in recent years. The establishment of consumer access to broadband Internet service is a critical public policy decision, now in the hands of local elected officials.

In "A New Generation of Economic Innovation 2004," published by The White House, President George W. Bush called for universal, affordable access for broadband technology by the year 2007 and supported efforts to make sure Americans are given plenty of technology choices when it comes to purchasing broadband. According to the report, "Broadband technology will enhance our Nation's economic competitiveness and will help improve education and health care for all Americans. Broadband provides Americans with high-speed Internet access connections that improve the Nation's economic productivity and offer life-enhancing applications, such as distance learning, remote medical diagnostics, and the ability to work from home more effectively."

Upon establishing the WI-LINC Commission last fall, Lincoln Councilperson Jonathan Cook stated, **"**The Internet is a key component of our daily lives. Providing wireless Internet access throughout the City can have the potential to strengthen our public safety response and communication, enhance our economic development efforts, augment travel and tourism revenues and improve the quality of life for all Lincoln citizens."

The WI-LINC Commission Goal is to examine the viability of wireless Internet for Lincoln and what role the government should play in facilitating such access.

Chairman Ken Doty of Triadix, Inc. stressed **five core objectives for the WI-LINC Commission**:

1. Review what other communities are doing regarding wireless Internet access.
2. Determine possible revenue and cost options
3. Detail the options available to Lincoln, Nebraska
4. Determine the pros and cons of each option
5. Make recommendations to the Lincoln City Council and other local elected officials

Subcommittee Structure – Process

The WI-LINC Commission established three subcommittees to complete needed research and review of relevant material: Community Research and Analysis, Technology and Legal. The following summarizes the work of each committee during the past six months.

Community Research and Analysis Subcommittee

The Community Research and Analysis Subcommittee met during the fall of 2006 to gather information regarding the interest of Lincoln citizens and business; to identify existing free and fee-based wireless service in Lincoln; and review current research regarding other

community wireless initiatives. The following research was completed by the Subcommittee (see appendices):

- Public Survey on City website: nearly 1000 responses received (summary)
- Business Survey on City website: nearly 500 responses received (summary)
- Lincoln Hot-Spot map development
- Municipal Wireless Initiatives in other communities (summary page)

CURRENT CITY SERVICE WIRELESS USAGE

The City of Lincoln has maintained a position at the forefront of communities implementing digital technology to enhance municipal services. In December of 2006, the Center for Digital Government, a national research and advisory institute on information technology in government and education named Lincoln one of the top "digital cities" in the nation.

Earlier this year, the City equipped the new Government Square Park at 10th & "O" Streets, with free wireless Internet connectivity. The County-City Building and all of the public libraries also offer free wireless Internet capability.

The City of Lincoln recently received the Laureate Gold Medal from the Computerworld Honors Program. This significant award was in recognition for the work that the Information Services staff has done in developing wireless applications that utilized Palm Treo Smartphones. The variety of software applications range from a Parking Ticket Issuance System to the County Weed Control Inspection System.

Current wireless usage by law enforcement, public safety and other emergency services was reviewed by the Commission at their January 2007 meeting, including presentations by the Lincoln Police Department, Lancaster County Sheriff's Office, Lincoln Fire and Rescue, Lincoln-Lancaster County Health Department and the Lincoln Public Works Department.

Law Enforcement and Public Safety. The Lincoln Police Department foresees future needs with regard to mobile broadband: greater access to the RMS (records management system) and other high bandwidth applications (photos, maps, and video). Reliability is critical. In general, the Department anticipates continuing to own and operate their own RF backbone for their mobile data needs. They are currently upgrading from EDACS (9600) to the OpenSky network (19.2), which doubles their throughput. Cost will continue to be the major factor limiting their access to broadband. The Police Department uses a few commercial wireless cards and devices, primarily Alltel EVDO, but the current quote for monthly service for each workstation is nearly $60. With 125 mobile units, the cost puts such accessibility out of reach.

The Sheriff's Office operates 37 Mobile Data Terminals in their patrol vehicles, which are on the same network as the Police Department. The Sheriff's Office also has 25-30 employees within the Justice and Law Enforcement Center who operate off of several handhelds. These handhelds operate off the 802.11 system within the Justice and Law Enforcement Center. They also have 5

civil process deputies using commercial Palm units and 2 additional employees using Blackberry's. The Palm units and Blackberry's are linked through Cingular and Alltel. The Sheriff's Office also foresees future needs with regard to mobile broadband but reliability is a must.

The Lincoln Public Works Department is currently installing EVDO cards to track the location of every StarTran vehicle. This is a federal requirement and is being implemented with a federal grant. As required by the Federal Intelligent Transportation System Regional Architecture, once StarTran AVL project is complete the open system will be available to the City/County.

Lincoln Fire and Rescue is examining wireless access as an enhancement for their ambulance service more than the fire service. Ambulances could contact doctors in route. Right now it is up to the medic to relay information to the doctor and interpret what he is saying. As medics do reports, they could type things into a computer and have it transmitted directly to the hospital. Currently, they must write on paper and then type in the same information when they arrive at the hospital, where it is then transmitted to the doctor. They are examining the possibility of utilizing tablet PCs.

The Health Department is currently using commercial mobile data resources. Usage is prioritized based on cost. Three priorities:

- Emergency response team (i.e. responses to unknown substances)
- Animal Control officers – operating out of their trucks
- Disease Control staff: communicable disease outbreaks. Currently, nurses are sent to affected individuals where they collect information and must return to the office to updating other field staff.

Access to bandwidth similar to that of law enforcement agencies (police, sheriff, etc.) is needed to share streaming video and receive maps, as well as receive plume modeling from the field. Beyond these areas, other field staff are on predictable schedules and they have routines established to download needed information. Other resources could use good mobile access if budgetary dollars were available. 8 palm devices used amongst staff.

Lincoln Electric System noted that they have a mobile radio system that is becoming less congested all the time, as day-to-day work migrates to cell phone operation. They will always maintain a mobile operation, in case of emergency to maintain ongoing communication with crews. They also deploying aerial photography on local machines.

Public Works. Public Works utilizes several “wireless” functions in their day-to-day operation. They currently have 33 Wireless systems in place (25 "Point to Point" & 8 "Point to Multi-Point). They have implemented 58.3 miles of Dark Fiber, including 17.6 miles of Information Systems Fiber and have 15.5 miles of empty conduit ready to receive fiber. They have 27 traffic cameras and connect 14 offices and all city parking garages through wireless systems.

Economic Development. City efforts regarding economic development focus on four areas: start-up business or entrepreneurship, existing business retention or expansion, business recruitment, and community development and marketing. Wireless access can be of great assistance in start-up business and entrepreneurship area.

Economic development occurs with the combined efforts of lots of partners: LES, LPED, City of Lincoln, Aquila and other communication partners. The internal operation and integration of information sharing between entities, including business retention surveys, can be shared with other entities to follow-up.

Wireless enhancements can be helpful with business recruitment – selling the community to potential employers. Developing infrastructure is the main challenge facing our economic development efforts; wireless could be considered "intelligent infrastructure". When comparisons of communities are made, such an amenity could create an advantage for Lincoln.

Technology Subcommittee

The Community Research and Analysis Subcommittee submitted information to the Commission regarding the success and challenges faced by municipalities throughout the country related to their establishment of municipal wireless systems. Many municipalities are implementing a combination or "hybrid" solution to provide wireless access throughout the community.

Based on the findings of the CRA Subcommittee, the Technology Subcommittee limited their review to three different systems:

- Wi-Fi/MESH Networks
- WiMAX
- 2-Way radios (The radio system was reviewed in order to better understand the current system utilized by most of the public safety system users.)

Wi-Fi/MESH Networks

The effort required to formulate an all-encompassing opinion of cost is quite formidable. There are a very large number of variables that have not been addressed. In our cursory examination of the Wi-Fi technology, the following assumptions were made:

- First and foremost is that there is no way to guarantee WI-FI service to the interior of all houses and buildings without the use of some additional external device that would rebroadcast the signal to the interior of the facility.

- Second, there will always be some dead spots. Even the cellular providers in Lincoln have dead spots and are continually upgrading their level of service by creating additional cellular sites.

- Third, a desire to provide a good amount of bandwidth with the least amount of lag time (latency/ number of hops) will determine the number of radio sites required to cover a square mile. If we reduce the number of radio sites and increase the power of the radios to compensate, we will provide less bandwidth and serve a slightly smaller percentage of citizens.

- Fourth, the design of a municipal WI-FI system would leverage a variety of technologies to provide the prescribed level of service. A municipal WI-FI system would consist of a number of communication layers, fiber inventories of both the City of Lincoln and the Lincoln Electric System would need to play a vital role.

- Lastly, we have no real way of knowing what public and private systems are currently in place utilizing these unlicensed frequencies. This could pose a problem with our system functionality, however it is more likely that a municipal system would have enough presence to render a smaller system inoperable.

Installation costs based on these assumptions would be $230,000 to $300,000 per square mile. In simple terms, to build a WI FI solution to cover the area of the City of Lincoln would require approximately 40 – 60 lower power radio sites per square mile depending on the number of subscribers and the challenges to communicating.

This would place the cost at $230,000 - $300,000 dollars per square mile. The City of Lincoln is approximately 90 square miles. This places the estimated cost somewhere in the 20 – 27 million-dollar range. Operational costs would require additional ongoing investment. According to Steve Blum of Tellus Venture Associates, these costs are estimated to be 30% of the capital expenditure operating expense (from presentation at the 2006 Fall ISPCON on his involvement in the Folsom, CA and Lompoc, CA wireless initiatives).

Wi-Max

- Most deployment progress in less-developed nations and for rural broadband initiatives
    - Exception in Canada where Rogers Cable and Bell Canada have a WiMAX joint venture with extensive licensed spectrum holdings at 2.5GHz and 5.0GHz
- Main acceptance in US from wireless Internet service providers.
    - Clearwire is most notable, available in 27 markets, significant 2.5GHz spectrum holdings
- Majority of established cellular companies unlikely to embrace. Important US players will be those holding licenses in the 2.5GHz spectrum – this is predominantly Sprint

The problem with getting WiMAX estimates is because all current WiMAX equipment is for licensed spectrum only.

The only provider that is billing anything as WiMAX-like gear in the unlicensed spectrum is Axxcelera. It is considered WiMAX-like because while the 802.16-2004 profile does cover 5.8GHz, the WiMAX certification lab currently does not have testing in place for this band. There is also the additional complication of interference mitigation in the unlicensed spectrum.

Since the 802.16(d/e) specifications were designed for licensed operation interference mitigation was not designed into the specification.

The general consensus is that WiMAX operating in the unlicensed bands will generally perform on par with other non-WiFi unlicensed gear (Motorola, Trango, Alvarion). The distance will be greatly reduced due to the FCC EIRP limits and the throughput will be reduced due to the lower modulation required for interference mitigation. The issue of licensing is at the core of any concerns about WiMAX.

2-Way Radio

Compared with other services in the wireless spectrum, two way radio, particularly public safety two-way radio has design considerations that make it stand apart in many important ways. Subscriber density, subscriber authentication, and spectral coordination are by far the most important. Beyond those design differences, entire standards have been developed for two-way radio systems used for public safety[2].

Subscriber density is a measure of how many devices are using, or at least trying to use, a given resource. On a two-way radio system, the number of subscribers is known because of licensing requirements. Licensing, and digital identification on a trunking system not only allows the subscriber density to be known, but also the authentication of subscribers as well. In this way, access to critical resources is restricted to those with a need for such services.

Again, like Wi-Fi and proposed Wi-Max technologies, cellular services use a technique to allow many subscribers to use the same carrier. Alltel, US Cellular, and Verizon all use a spread-spectrum technique called CDMA. CDMA, the technology also used for Wi-Fi/Wi-Max, is an extremely efficient method of allowing many devices to use the same carrier without interfering with each other.

But unlike cellular topologies which use licensed (coordinated) spectrum, Wi-Fi systems use uncoordinated spectrum typically in what is known as the industrial, scientific, and medical (ISM) bands. This is the same area of the RF spectrum that cordless phones, Bluetooth personal area networks and microwave ovens use. Because the spectrum is uncoordinated (and because of health effects) devices must be restricted to relatively low power so as to minimize interference. Because of the likelihood of interference, devices that utilize uncoordinated ISM spectrum must be error tolerant. Anyone who has tried to use Wi-Fi service on a mobile computer while talking on a modern cordless phone knows this first hand.

It is important to acknowledge that the radio system does not operate like a data hauling system. They do operate in a different world than that of broadband access. However, it is abundantly clear that public safety agencies will prioritize reliability over speed in most instances.

[2] Notably, APCO 16 dictates such features as queuing, caller ID, emergency signaling, and fail-soft operations along with many other features.

Legal Subcommittee

In 2006, the Nebraska Legislature passed LB 645, which prohibits political subdivisions from offering telecommunications services. It also established the Broadband Services Task Force that issued a final report in November 2006, recommending that the establishment of broadband access currently available in Nebraska is sufficient to satisfy consumer demand.

Senator Deb Fischer has introduced LR 181 this session that will examine the current municipal-provided wireless Internet services, their overall success, as well as the advantages and disadvantages of providing such a system. It will also consider the implications of LB 645 and what restrictions current law places on municipal-provided wireless Internet service.

In general, the ability of the City of Lincoln to establish a municipal network will be dictated by the constraints established by the Nebraska Legislature. It is clear that as state law exists today, government entities cannot provide a retail sales point for telecommunications in Nebraska. To wit, if the city establishes a municipal wireless network at no cost to the user, then it is probable that no restrictions exist. However, if the network established by the City requires a user fee for access, then they are prohibited from providing the service. Absent a change from the Legislature, a moratorium on municipalities providing wholesale service will end in December of this year.

- Commission Membership/Participation

Ken Doty, Triadix, Inc., Chair - WI-LINC Commission
Bruce Bohrer, Senior Vice President & General Counsel - Lincoln Chamber of Commerce
Tom Casady, Chief - Lincoln Police Department
Carol Connor, Director -Lincoln City Libraries
Lisa Darlington-Johnson, Director of Research & Information – Lincoln Chamber of Commerce
Eric Erlandson, President/CEO – Internet Nebraska
Doug Harris, Vice-President - Time Warner Cable
John Huff, Assistant Chief - Lincoln Fire and Rescue
Steve Huggenberger, Assistant City Attorney – City of Lincoln Law Department
Chris Hunt, Communications Manager - Windstream
Bill Jarrett, Chief Deputy - Lancaster County Sheriff's Office
Glen Louch, Lincoln Fire and Rescue
Terry Lowe, Systems Coordinator – City of Lincoln Information Services
Paul Marsolek, Triadix, Inc.
Don Mayhew, President - Lincoln School Board, Owner – Innovation Corp
Darl Naumann, Economic Development Director – Lincoln-Lancaster County Economic Development
Tim Pratt, CEIS Manager - Lincoln Public Works Department
Dan Pudenz, Vice President, Engineering - Lincoln Electric System
Julie Righter, Communications Coordinator - Lincoln Emergency Communications Center/911
Shelley Sahling-Zart, Vice President & Assistance Counsel - Lincoln Electric System
Beth Scarborough, Nebraska Division President - Time Warner Cable
Bob Sundquist, ABLE
Sam Tetherow, CEO - Sandhills Wireless
Doug Thomas, Information Services Manager – City of Lincoln
Dan Wright, Interim Chief - Lincoln Fire and Rescue

Invited Members:

Kent Hendrickson, Associate Vice Chancellor for Information Services – University of Nebraska-Lincoln
Alan Hersch, Customer Relations Manager - Aquila
Jack Huck, President – Southeast Community College
Bob Workman, Lancaster County Board of Commissioners

Other Presenters:

James Baird, Technical Investigator - Lancaster County Sheriff's Office
James Bare, Lincoln-Lancaster County Health Department
Kathy Cook, Lincoln-Lancaster County Health Department
Pete Crawford, Radio shop at City of Lincoln

Other participants:

Terry Bundy, CEO – Lincoln Electric System
Bob Eades, MicroLnk
Rich Furasek, Lincoln Fire and Rescue
John Lemen, Motorola
Steve Meradith, Vice President – State Government Affairs - Windstream
Doug Ostergard, D&D Communications
Patricia Owen, Public Policy Coordinator – Lincoln Chamber of Commerce
Steve Weaver, Internet Nebraska

WI-LINC Commission Meeting

June 27, 2007
1:00 – 2:30 p.m.
Lincoln Chamber of Commerce, 1135 M Street

AGENDA

Welcome – Ken Doty, Chair

1. Introductions: Commission members and participants present were -

Ken Doty, Triadix, Inc., Chair - WI-LINC Commission
Jim Baird, Lancaster County Sheriff's Office
Jill Becker, Aquila
Bruce Bohrer, Senior Vice President & General Counsel - Lincoln Chamber of Commerce
Tom Casady, Chief - Lincoln Police Department
Carol Connor, Director -Lincoln City Libraries
Lisa Darlington-Johnson, Director of Research & Information – Lincoln Chamber of Commerce
Eric Erlandson, President/CEO – Internet Nebraska
Doug Harris, Vice-President - Time Warner Cable
Steve Huggenberger, Assistant City Attorney – City of Lincoln Law Department
Chris Hunt, Communications Manager - Windstream
Glen Louch, Lincoln Fire and Rescue
Terry Lowe, Systems Coordinator – City of Lincoln Information Services
Paul Marsolek - Triadix, Inc.
Steve Meradith, Windstream
Darl Naumann, Economic Development Director – Lincoln-Lancaster County Economic Development
Tim Pratt, CEIS Manager - Lincoln Public Works Department
Dan Pudenz, Vice President, Engineering - Lincoln Electric System
Sam Tetherow, CEO - Sandhills Wireless
Doug Thomas, Information Services Manager – City of Lincoln

Doty extended his thanks to the Chamber of Commerce for hosting Commission meetings over the last nine months and for being our host again today. He also thanked Terry Lowe with the City of Lincoln Information Services Department for the research and expertise he provided to the Community Research and Analysis and Technology Subcommittees.

2. Guidelines for approval of the Final Report of the WI-LINC Commission

Without any procedures suggested prior to the meeting, Doty suggested that the participants attempt to come to a consensus regarding the language of paragraphs included in the Executive Summary of the report. Discussion of the current concepts included in the draft report would provide a sense of any serious disagreements among Commission members.

3. Discussion of changes to the draft Final Report of the Commission

a. Pre-Meeting proposed changes (see attachment)

The proposed changes included in the attachment were accepted by the participants present as proposed with the following change: The last three sentences of the paragraph added in "2." were deleted.

b. Other proposed changes

Discussion of the draft report began with a discussion of the order of recommendations from the Commission. Is it more important to have a champion in place to facilitate the rest of the recommendations or suggest that establishment of service parameters might dictate the work of the champion for this issue? Is recommending further review of service parameters by elected officials shirking our responsibility to make recommendations about the steps they should take on this issue?

Clearly, funding and legal considerations dictate the logical scope and target users for a municipal wireless system. When we discuss potential users in the report we haven't identified the general public or "casual user" – ordinary citizens accessing Internet information - as a target audience for this service.

As discussion continued, the question was posed – should the City be competing with the private sector to provide service that exists for a fee? All participants could agree that the City should not pursue the establishment of a municipal wireless network for general citizen use at this time. It was agreed that the report would be revised to reflect this consensus as Recommendation #1 and a second Recommendation would encourage the City to create a better urban amenity by assisting with the coordination of existing resources, including the establishment of a champion, coordination of small pockets of network accessibility and regular facilitation and communication between the public and private sector on this issue.

4. Next Steps

a. Vote regarding approval of the Final Report

A vote on the final report will be held Thursday, July 19th, from 1:00 to 3:00 p.m. at the Lincoln Chamber of Commerce.

b. Report release to the public

This will be discussed at the final Commission meeting on July 19th.

5. Adjournment

Proposed Changes to First Draft of the WI-LINC Commission Report

1. Page 1, "RECOMMENDATION #1", Paragraph 1, Line 2, change "many" to "several", so it reads, "…wireless system, several questions will need…"

2. Page 2, Add the following after paragraph titled, "Low-Income Citizens":

"In most cases, there are private sector solutions to increasing service to each of these populations, but cost is the issue. With specific regard to city staff, wireless carriers typically charge about $60/month for each handset, although large-scale purchases bring reduced cost. So what needs to be known is whether launching a wireless solution would be more or less expensive than purchasing an existing solution. ~~For example, providing an EV-DO to 120 police cruisers in Lincoln would cost about $7,200 per month, at least without negotiating a better price. That would be $86,400 a year or roughly $860,000 over a decade of use. The City would need to determine if it is cheaper to pursue that route or build its own network."~~

3. Page 4, Delete last paragraph and replace with, "If the City believes continuing efforts should be made to monitor and then implement a network in the future, the champion role identified in our recommendations could become part of the work of a city employee, contract employee or part of the economic development efforts driven by the City and their partner agencies. This type of support would enhance additional efforts to review the possible costs and infrastructure investment needed to create a successful network."

4. Page 7, "Current City Service Wireless Usage", Paragraph 3, Delete last line and replace with the following, "The variety of software applications range from a Parking Ticket Issuance System to the County Weed Control Inspection System."

5. Page 8, Delete 1st Paragraph ("The Sheriff's Office…") and replace with, "The Sheriff's Office operates 37 Mobile Data Terminals in their patrol vehicles which are on the same network as the Police Department. The Sheriff's Office also has 25-30 employees within the Justice and Law Enforcement Center who operate off of several handhelds. These handhelds operate off the 802.11 system within the Justice and Law Enforcement Center. They also have 5 civil process deputies using commercial Palm units and 2 additional employees using Blackberry's. The Palm units and Blackberry's are linked through Cingular and Alltel. The Sheriff's Office also foresees future needs with regard to mobile broadband but reliability is a must."

6. Page 10. "Wi-Fi/MESH Networks." Last paragraph, Replace "Blue" with "Blum".

7. Page 12, Legal Subcommittee, Paragraph 3, add the following to the beginning of the 2nd sentence, "It is clear that as state law exists today, government entities cannot provide a retail sales point for telecommunications in Nebraska. To wit,…"

Delete "more than likely" from the 3rd sentence, so it reads, "…requires a user fee for access, then they are prohibited from providing the service."

Add the following sentence to the end of the paragraph, “Absent a change from the Legislature, a moratorium on municipalities providing wholesale service will end in December of this year.”

WI-LINC Commission

January 16, 2007
9:30 – 11:30 a.m.

AGENDA

Welcome – Ken Doty, Chair

1. Introductions

The Commission meeting was called to order at 9:35 a.m. by Chair, Ken Doty. Introductions by those present were made. (See below for list of those present.)

2. Community Research and Analysis Subcommittee Update – Ken Doty

Ken Doty reviewed the work of the Community Research and Analysis Subcommittee, including the results of the general public survey and a separate business survey that were made available on the City of Lincoln website. The Subcommittee reviewed several publications, news articles and contacted municipalities that have implemented or are considering implementation of wireless initiatives. (See attached Power Point presentation.)

3. Presentations

   a. Public Safety
      i. Lincoln Police Department: Tom Casady

The Lincoln Police Department foresees future needs with regard to mobile broadband: greater access to the RMS (records management system) and other high bandwidth applications (photos, maps, and video). Reliability is critical. In general, the Department anticipates continuing to own and operate their own RF backbone for their mobile data needs. They are currently upgrading from EDACS (9600) to the OpenSky network (19.2), which doubles their throughput. Cost will continue to be the major factor limiting their access to broadband. The Police Department uses a few commercial wireless cards and devices, primarily Alltel EVDO, but the current quote for monthly service for each workstation is nearly $60. With 125 mobile units, the cost puts such accessibility out of reach. (For additional information, see attached Power Point presentation.)

"A luxury once tasted becomes a necessity" – T. Casady

ii. Lancaster County Sheriff's Office: Jim Baird

The Sheriff's Office operates on the same network as the Police Department. The Court Security Division (25-30 employees) operates in the Justice and Law Enforcement Center using handhelds in the Hall of Justice. They have 5 civil processors and deputies using commercial wireless to service processing and access the imaging system. The Office uses a combination of Blackberry devices, handheld PDAs with service through Cingular or Alltel, as well. These employees could benefit from a more comprehensive wireless plan.

Their goals are similar to those of the Police Department. They need increased bandwidth available throughout the county so that officers in a cruiser can utilize a 19.2 connection or DSL connection to access the Nebraska Criminal Justice System (NCJS) system. They use it extensively in the office but can't do it in the cruisers.

Although they have 95% coverage in the county with the technology present in their command vehicle, providing the same access in every cruiser would be cost prohibitive. Alltel coverage is the only game in town at $60 per month. Cingular does not provide service in the county. They also pay $25 per data radio in use.

Tim Pratt, Lincoln Public Works Department interjected that his department is currently installing EVDO cards to track the location of every StarTran vehicle. This is a federal requirement and is being implemented with a federal grant. As required by the Federal Intelligent Transportation System Regional Architecture, once StarTran AVL project is complete the open system will be available to the City/County.

In general, it appears that law enforcement organizations will continue to utilize hybrid solutions to support their work.

On a side note, many noted that all Lincoln Public Schools utilize wireless within their school buildings. If access to their signal was made available, it could enhance the work of law enforcement affording them access in every LPS parking lot throughout the city.

iii. Lincoln Fire and Rescue: Glen Louch

The Fire Department is examining wireless access as an enhancement for their ambulance service more than the fire service. Ambulances could contact doctors in route. Right now it is up to the medic to relay information to the doctor and interpret what he is saying. As medics do reports, they could type things into a computer and have it transmitted directly to the hospital. Currently, they must write on paper and then type in the same information when they arrive at the hospital, where it is then transmitted to the doctor. They are examining the possibility of utilizing tablet PCs.

As far as engines and trucks are concerned, they do not feel a need for pre-access. In an ideal world, they could access maps of every major building for use in fire emergencies. Command

units utilize information loaded on laptops to take to the scene. AVL is being examined to assist in determining "closest unit."

Tim Pratt added that Intelligent Transportation Systems (ITS) federal guidelines could be used by Fire, but they would need to purchase equipment. Currently, all trucks have mobile data terminals. However, their use is undetermined.

Computer aided dispatch – critical to work of all public safety units.

iv. Lincoln-Lancaster County Health Department: James Bare and Kathy Cook

The Health Department is currently using commercial mobile data resources. Usage is prioritized based on cost. Three priorities:

- Emergency response team (i.e. responses to unknown substances)
- Animal Control officers – operating out of their trucks
- Disease Control staff: communicable disease outbreaks. Currently, nurses are sent to affected individuals where they collect information and must return to the office to updating other field staff.

Access to bandwidth similar to that of law enforcement agencies (police, sheriff, etc.) is needed to share streaming video and receive maps, as well as receive plume modeling from the field. Beyond these areas, other field staff are on predictable schedules and they have routines established to download needed information. Other resources could use good mobile access if budgetary dollars were available. 8 palm devices used amongst staff.

Lincoln Electric System noted that they have a mobile radio system that is becoming less congested all the time, as day-to-day work migrates to cell phone operation. They will always maintain a mobile operation, in case of emergency to maintain ongoing communication with crews. They also deploying aerial photography on local machines.

LES does have some dark fiber (unlit or unused) in the system. Not all stations are connected by fiber, but that will occur in the future, most likely. Many communication networks are used by LES. Substations are spaced 2 to 2.5 miles apart, that's how loading occurs. Some are used for cellular tower locations today. They serve Waverly and beyond the city limits about 1 to 1.5 miles. Norris Public Power surrounds the LES service area in the remainder of Lancaster County.

Public Works. Tim Pratt reported that Public Works utilizes several "wireless" functions in their day-to-day operation. They currently have 33 Wireless systems in place (25 "Point to Point" & 8 "Point to Multi-Point). They have implemented 58.3 miles of Dark Fiber, including 17.6 miles of Information Systems Fiber and have 15.5 miles of empty conduit ready to receive fiber. They have 27 traffic cameras and connect 14 offices and all city parking garages through wireless systems.

b. Economic Development: Darl Naumann, Lincoln-Lancaster Economic Development

City efforts regarding economic development focus on four areas: start-up business or entrepreneurship, **existing business retention or expansion**, **business recruitment**, and community development and marketing.

Wireless access can be of great assistance in start-up business and entrepreneurship area.

Economic development occurs with the combined efforts of lots of partners: LES, LPED, City of Lincoln, Aquila and other communication partners. The internal operation and integration of information sharing between entities, including business retention surveys, can be shared with other entities to follow-up.

Wireless enhancements can be helpful with business recruitment – selling the community to potential employers. Developing infrastructure is the main challenge facing our economic development efforts; wireless could be considered "intelligent infrastructure". When comparisons of communities are made, such an amenity could create an advantage for Lincoln.

c. Education Discussion

It is believed that Lincoln Public Schools is hot throughout the City. It is possible that their network could serve as a backbone for other wireless use.

Libraries are gradually adding wireless service to the general public at their branches as funding becomes available.

Terry Lowe reported that in the past, the City wired all recreation centers and senior centers in the county. (For additional information, see Community Research Subcommittee minutes)

4. Technology Subcommittee Update

Ken Doty reported that the committee is ready to meet: Wi-Fi Mesh, WiMAX and Wi-Fi zones will be discussed as possible options. The subcommittee will be tasked with reviewing cost options and how those costs would be meted out for start-up and ongoing operation.

5. Nebraska Unicameral Legislative Update

Ken Doty will be talking to the Governor's Office about any statewide initiatives, with specific interest in any Homeland Security issues. No legislation has been introduced regarding the recommendations of the State Task Force. Today is the last day for bill introduction.

6. Next Steps:

a. Assignment Review

b. Next meeting of the Full Commission

The full commission will meet following the Technology and Legal Subcommittee work, most likely within the next four to six weeks

The meeting was adjourned at 11:15 a.m.

Attendance List:

Jim Baird, Lancaster County Sheriff's Office
James Bare, Lincoln-Lancaster County Health Department
Bruce Bohrer, Lincoln Chamber of Commerce
Tom Casady, Lincoln Police Department
Carol Connor, Lincoln City Libraries
Kathy Cook, Lincoln-Lancaster County Health Department
Lisa Darlington-Johnson, LPED
Ken Doty, Triadix, Inc. – Chair
Eric Erlandson, Internet Nebraska
Steve Huggenberger, City Law Department
Glen Louch, Lincoln Fire and Rescue
Terry Lowe, City of Lincoln Information Services
Paul Marsolek
Steve Meradith, Windstream
Darl Naumann, Lincoln-Lancaster Economic Development
Patricia Owen, Lincoln Chamber of Commerce – Public Policy
Tim Pratt, Public Works Department – Engineering Services
Dan Pudenz, Lincoln Electric System
Shelly Sahling-Zart, Lincoln Electric System
Bob Sundquist, ABLE
Doug Thomas, City of Lincoln Information Services

Submitted by Jennifer Brinkman, Staff

WI-LINC Commission Meeting
September 28, 2006
3:30 p.m.
Lincoln Chamber of Commerce

Attendance

Name	Title	Organization
Jonathan Cook		Lincoln City Council
Ken Doty	Chair	WI-LINC Commission; Triadix,Inc.
Bruce Bohrer		Lincoln Chamber of Commerce
Terry Bundy	CEO	Lincoln Electric System
Tom Casady	Chief	Lincoln Police Department
Pete Crawford		Lincoln/Lancaster County 911 Center
Bob Eades		MicroLnk
Eric Erlandson		Internet Nebraska
Rich Furasek	Assistant Chief	Lincoln Fire and Rescue
Doug Harris		Time Warner Cable
Steve Huggenberger		City of Lincoln Law Department
Chris Hunt		Windstream
Bill Jarrett		Lancaster County Sheriff's Department
Terry Lowe		City of Lincoln Information Services
Don Mayhew		Lincoln Public Schools; Innovation Corp.
Doug Ostergard		
Beth Scarborough		Time Warner Cable
Doug Thomas		City of Lincoln Information Services
Hadley Richters	Staff	Alchemy Associates, LLC

Jonathan Cook, Lincoln City Council, made introductions and thanked everyone for coming. Chairman Ken Doty reviewed the agenda.

Doty briefly discussed the proposed overview and goal of the commission and also talked about the opportunities that wireless service could provide in Lincoln, such as economic development.

Members present discussed possible changes to the proposed goal. Beth Scarborough questioned why we would be examining the viability of providing wireless Internet access. She thought it was already clear that it was viable. Doty suggested that we we examine what and where service could or should be provided in Lincoln and explained we would be examining options. Bruce Bohrer suggested adding "*and* Private Sector" to the goal.

Revised Goal: "Examine the viability of wireless Internet access for Lincoln and surrounding areas and define what role government and private business should
play in facilitating such access."

Doty gave a brief review of the objectives for the Commission and opened the floor for comments and questions.

- Terry Lowe suggested that we re-open the survey.
- Tom Casady suggested addressing people's specific needs from quality of life to public safety.
- Terry Bundy suggested that the LES substation could possibly create a county-wide option. He suggested that LES itself would benefit in its internal operations.
- Chris Hunt suggested adding need as an objective, reviewing multiple needs and sectors.

Doty reviewed the proposed subcommittees/working groups and asked each person present to select a subcommittee to serve on. The following assignments were made:

Community Research and Analysis: Bruce Bohrer, Terry Bundy, Eric Erlandson, Rich Furasek, Bill Jarrett, Terry Lowe and Beth Scarborough.

Tech Research and Review: Terry Bundy, Tom Casady, Bob Eades, Eric Erlandson, Doug Harris, Chris Hunt, Terry Lowe, Don Mayhew, Doug Ostergard, Beth Scarborough

Legal Review: Bruce Bohrer, Terry Bundy, Steve Huggenberger, Chris Hunt, Doug Thomas

Members will be contacted in the coming weeks to provide contact information and identify resources they, their company or organizations or colleagues might be able to provide to the Commission. Ken Doty will be asking individuals to serve as chairpersons for the three subcommittees and another meeting of the Commission will be scheduled as the work of the subcommittees progresses.

AGENDA

WI-LINC Technology Subcommittee Meeting

March 8, 2007
11:30 a.m. – 1:00 p.m.
Lincoln Chamber of Commerce, Piedmont Room

1. Welcome – Don Mayhew, Chair

The meeting was called to order at 11:36 a.m.

2. Introductions (Name, Company, Title)

Present: Don Mayhew, Chair
Pete Crawford, City of Lincoln Radio Shop
Doug Harris, Time Warner Cable
Glen Louch, Lincoln Fire and Rescue
Terry Lowe, Information Services, City of Lincoln
Tim Pratt, City of Lincoln Public Works Department
Dan Pudenz, Lincoln Electric System
Julie Righter, 911 Center
Steve Weaver, Internet Nebraska

3. Review Research Assignments

- Wi-Fi: Tim Pratt, Dan Pudenz

The effort required to formulate an all-encompassing opinion of cost is quite formidable. There are a very large number of variables that have not been addressed. If a true opinion of cost is desired, Pratt and Pudenz recommend that the larger committee work to identify and reduce the number of undefined variables. The following opinion of cost is presented for discussion purposes only. (See attached report).

Installation costs of $230,000 to $300,000 per square mile. Within a ½ mile section of town, we don't know how much capacity we will need. This cost estimate would apply for a WiFi/WiMAX hybrid solution. Operational costs would require additional ongoing investment.

At this point, estimates are just that. Realistically, how many access points do we need to provide the type of service/bandwidth we want to provide to those that connect? Does it need to be available 24/7?

It is important to note that we would be impacting the services that have been established to date – LPS, etc.

- Wi-MAX: Sam Tetherow, Doug Harris

WiMAX is used most prevalently in rural areas with limited access to the Internet. Cellular companies are using other technologies (like EVDO), with the exception of Sprint (2.5 GHrz). Who is the license holder for that in Lincoln?

Mobile WiMAX is on the horizon, but isn't ready for primetime yet. Intel is weaving into the discussions on WiMAX. Motorola is developing a hybrid phone to utilize all signals.

Base stations costs included in the report. The issue of licensing is at the core of any concerns about WiMAX and problems with interference. Most of the time we won't see 10 MGHrz, but more like 3.5 or 5.

Could we cherry-pick off certain regions to support economic development plans (Cincinnati, OH)? In general, it would make sense to light up certain areas without the expectation of meshing all areas together across the city. What if we light up downtown – do a pilot project? How could we obtain seed money to try it out? The costs included in the report do not include installation of the tower. (See attached report).

- 2-Way Radios: Julie Righter, Pete Crawford

There are trade-offs that occur in a very available 2-way radio system, compared to using lots of different units to access information. The subscriber density is key to the success of the system. The number of subscribers will affect the quality of the coverage and access.

The radio system does not operate like a data hauling system. They do operate in a different world than that of broadband access.

Lots of employees carry a city radio and a city cell phone. With a budget crunch, some are making a choice between them to cut costs. 911 has cautioned employees not to build their emergency plans based around cell phones. The city could develop a voice over IP service for city communications.

Prioritization of data needs is a difficult process. Right now, Fire Department wants to do AVL and field reporting. Police want to use mobile data. At this point, the license we use has very limited data capability.

4. Facilitated Pros and Cons Discussion

- What additional research do we need to gather?

Operational costs need to be obtained from communities that have implemented municipal solutions to date.

Lilypad – Non-profit service in heavily trafficked areas (Cincinnati, OH)

WI-FI/WI-MAX hybrid solution seems like the recommendation to make.

How much does it cost to implement the coffee shop model?

Possible models for topic covered – pricing examples: assumptions and approximate costs:

Doug Harris – Lilypad model (Cincinnati, OH)
Tim Pratt – Citywide coverage, this is what installation would cost, costing model for operational costs. 20 to 30 radios

These possible model costs should be forwarded to Jennifer/Don by March 31.

- Subcommittee report to Full Commission

It will be imperative that a point person be established to champion the Wireless Internet Access project, to coordinate implementation and coordination of wireless access in areas throughout the city working with economic development and public officials.

5. Next Steps

Don and Jennifer will draft a report for review at the beginning of April to distribute to the subcommittee that will be reviewed and reported to the full Commission. No other Technology Subcommittee meetings will be scheduled.

Contact Information:

Don Mayhew	(402) 730-0370	don@innovationcorp.com
Ken Doty	(402) 438.3103	kdoty@triadix.com
Jennifer Brinkman	(402) 525.3958	jennifer.brinkman@alchemyassociates.com

WI-LINC Technology Subcommittee Meeting

February 8, 2007
11:30 a.m. – 1:00 p.m.
Lincoln Chamber of Commerce, Williamsburg Conference Room

1. Welcome – Don Mayhew, Chair

   The meeting was called to order at 11:32 a.m.

2. Introductions (Name, Company, Title, Experience with Wireless)

   The following members were present:

   Don Mayhew, President - Lincoln School Board, Owner – Innovation Corp
   Tom Casady, Chief - Lincoln Police Department
   Pete Crawford, Radio shop at City of Lincoln
   Ken Doty, Triadix, Inc., Chair - WI-LINC Commission
   Rich Furasek, Lincoln Fire and Rescue
   Doug Harris, Vice-President - Time Warner Cable
   John Huff, Lincoln Fire and Rescue
   John Lemen, Motorola
   Glen Louch, Lincoln Fire and Rescue
   Terry Lowe, City Information Services
   Paul Marsolek
   Steve Meradith, Windstream
   Doug Ostergard, D&D Communications
   Tim Pratt, Lincoln Public Works Department
   Dan Pudenz, Lincoln Electric System
   Julie Righter, Lincoln 911 Emergency System
   Dan Wright, Interim Chief - Lincoln Fire and Rescue

3. Review WI-LINC

   WI-LINC Goal Review – "Examine the viability of wireless Internet for Lincoln and what role the government should play in facilitating such access."

   Objectives Review

   - Review what other communities are doing regarding wireless Internet access.
   - Determine possible revenue and cost options
   - Detail the options available to Lincoln, Nebraska
   - Determine the pros and cons of each option (benefits)
   - Examine barriers, including legal issues

4. Community Research Discussion based on Technology

Ken Doty briefly reviewed the findings of the Community Research and Analysis Committee, with regard to specific technologies.

- Wi-Fi: 802.11 The Community Research Subcommittee discovered that there have been mixed results with the implementation of Wi-Fi across the nation. Many municipalities are implementing a combination or hybrid solutions to provide wireless access community-wide. However, signal blockage is an issue with the "hot spot/coffee shop" model

- MESH Networks: 802.11 – This version of implementation will give you access throughout a large area with a structured network of hot zones.

- WiMAX: 802.16e Faster, more robust than 802.11. "Back cell." Saturation.

- 2-Way Radios: Utilized by police/fire extensively throughout Lancaster County today.

- Wi-Zones: Another potential solution. Usually part of a hybrid solution.

In reality, for each community, there is a different wireless technology model being implemented. With an EVDO card, Sprint and Alltel can provide a very fast data network to customers, but price is an issue ($60/month/user).

Public Safety will prioritize reliability over speed in most instances. There are some law enforcement agencies that have the budget to provide their own high-speed network (New York City is implementing such a network with cell phone technology).

5. Define Goal and Objectives of Subcommittee (example of areas to address Wi-Fi, WiMax and Wi-Zones comparison with the questions why, what works, how it works, cost, structure, available resources)

To jump-start the work of the committee, the following individuals will provide a one-page synopsis of three technology systems at our next meeting:

Wi-Fi: Tim Pratt, Dan Pudenz
Wi-MAX: Sam Tetherow, Doug Harris
2-Way Radios: Julie Righter, Pete Crawford

After review at our next meeting, costing, needed infrastructure and pros and cons related to each technology option will be researched and reviewed by the committee to be forwarded to the full commission.

Additional discussion:

Representatives from Motorola and D&D Communications are interested in providing information about specific products that may be used to implement wireless system access at a later date.

In general, the subcommittee needs to decide: What level of service are we talking about? Is a dead spot acceptable?

Chief Casady posited that discussion about general wireless web access for visitors and the general population is essentially an amenity that would only require 802.11 access. That is entirely different than providing a mobile data backbone for law enforcement. Currently, we have a great deal of general wireless access available throughout the community that is not very organized.

The committee may want to examine creating some level of integration among all the owners that we have in the downtown core of Lincoln that provide open access. The City could bring those businesses together to create a single encryption key with SSID. We could create basic roamer service with great coverage. The more people that agree to participate in that, would create a great amenity without much monetary investment.

The next task for the subcommittee: Map up what the no-cost options are to the most expensive (there is no limit).

Marsolek asked the question: Whom do we serve? Our report should utilize metrics (public safety, economic development, etc.) and then plug in which technology solution serves that customer.

6. Next Steps

Next meeting: March 8th, 11:30 a.m. – 1:00 p.m.

Draft
Municipal Wireless

WI-FI

System

Opinion of Cost

Presented by
Dan Pudenz and Tim Pratt

The effort required to formulate an all-encompassing opinion of cost is quite formidable. There are a very large number of variables that have not been addressed. If a true opinion of cost is desired it is our recommendation that the larger committee work to identify and reduce the number of undefined variables. The following opinion of cost is presented for discussion purposes only.

There are a number of assumptions that have been used to determine this opinion of cost. There are a very large number of technical variables involved that would need to be determined to guarantee an accurate estimate and more important, a viable solution.

First and foremost is that there is no way to guarantee WI-FI service to the interior of all houses and buildings without the use of some additional eternal device that would rebroadcast the signal to the interior of the facility.

Second, there will always be some dead spots. Even the cellular providers in Lincoln have dead spots and are continually upgrading their level of service by creating additional cellular sites.

Third, a desire to provide a good amount of bandwidth with the least amount of lag time (latency/ number of hops) will determine the number of radio sites required to cover a square mile. If we reduce the number of radio sites and increase the power of the radios to compensate, we will provide less bandwidth and serve a slightly smaller percentage of citizens.

Fourth, the design of a municipal WI-FI system would leverage a variety of technologies to provide the prescribed level of service. A municipal WI-FI system would consist of a number of communication layers, fiber inventories of both the City of Lincoln and the Lincoln Electric System would need to play a vital role.

Lastly, we have no real way of knowing what public and private systems are currently in place utilizing these unlicensed frequencies. This could pose a problem with our system functionality, however it is more likely that a municipal system would have enough presence to render a smaller system in operable.

WI FI Solution

In simple terms to build a WI FI solution to cover the area of the City of Lincoln, would require approximately 40 – 60 lower power radio sites per square mile depending on the number of subscribers and the challenges to communicating.

This would place the cost at $230,000 - $300,000 dollars per square mile. The City of Lincoln is approximately 90 square miles. This places the estimated cost somewhere in the 20 – 27 million-dollar range.

Again, these numbers are not based on an in depth investigation rather a cursory review of the level of service we would want to provide and the technology available.

WI-LINC Technical Subcommittee
WiMAX Summary
March 8, 2007

Market Overview

- Most deployment progress in less-developed nations and for rural broadband initiatives
  - Exception in Canada where Rogers Cable and Bell Canada have a WiMAX joint venture with extensive licensed spectrum holdings at 2.5GHz and 5.0GHz
- Main acceptance in US from wireless Internet service providers.
  - Clearwire is most notable, available in 27 markets, significant 2.5GHz spectrum holdings
- Majority of established cellular companies unlikely to embrace. Important US players will be those holding licenses in the 2.5GHz spectrum – this is predominantly Sprint

Mobile WiMAX

- Specifications are finalized, but some major concerns about having limited mobility and certification profiles. Some talks of Sprint/Nextel's spectrum at 2.3GHz and 2.5GHz.
- Deployments delayed into Q3 2007.
  - Intel introducing WiMAX/Wi-Fi laptop cards
  - Motorola developing WiMAX/Wi-Fi/Cellular phones
- Base station costs similar to 3G/4G cellular. $40K-$60K for electronics, $10-$15K for shelter, $10-$15K for civil work & installation, commissioning…

Spectrum and Regulation

- Licensed and unlicensed will be allowed. Minimum bandwidth is at 1.75MHz and 10MHz is considered optimum.
- 2.4GHz and 5GHz non-licensed could be limited due to risk of interference
- 2.5GHz and 3.5GHz licensed will be most common

Performance

- WiMAX has good range and good performance but not both. Distance, line of sight (LOS), near line of sight (NLOS), and channel bandwidth are determinants

Environment	Typical Cell Size	Sector Throughput
Suburban Indoor (NLOS)	1.5 Miles	22MB/s w/10GHz channel
Suburban Outdoor (LOS)	4 Miles	22MB/s w/10GHz channel
Rural Indoor (NLOS)	3 Miles	4.5MB/s w/3.5 MHz channel
Rural Outdoor (LOS)	9 Miles	4.5MB/s w/3.5MHz channel

Two-Way Radio Systems

Peter Crawford, Lead Radio Technician
City of Lincoln

The differences between today's two-way radio systems and other wireless services such as broadband data are significant. The most important difference between any wireless services, whether a farmer is using the GPS service to determine his crop acreage, a parent listening to their infant on a baby monitor, or a police officer calling for additional assistance, is the method in which each service utilizes a scarce resource: the electromagnetic spectrum. A continuum of methods are used to manage the radio-frequency (RF) portion of the electromagnetic spectrum with two-way radio roughly at one end of the continuum, modern cellular services such as CDMA[3] in the middle, and at the opposite end, services such as Wi-Fi, Wi-Max etc.

The entire RF spectrum is utilized by a diverse number of applications. Each portion of the spectrum has differing qualities which make it suited to certain applications. Low frequencies work well for penetrating ocean depths to communicate to submarines, high frequencies work well for such tasks as air traffic control radar. Most of us know this first-hand by the broadcast radio we have in our homes and cars. Most music stations today reside in the FM band which is much higher in frequency and takes up relatively more of the RF spectrum to produce the stereo hi-fi signal, than the AM band. On the other hand, anyone who has traveled in rural America knows that there are many places you can receive an AM signal but no FM channels. This has little to do with the differences between AM and FM modulation but much more importantly, the fact that AM signals are in a much lower portion of the RF spectrum. Lower frequencies travel further, whereas higher frequencies do not. Also, AM uses much less

[3] Code Division Multiple Access—a spread spectrum method of sharing bandwidth. This is the method used by commercial cell carriers such as Alltel, Verizon, and US Cellular.

bandwidth (smaller portion of the RF spectrum) which makes AM ideally suited to talk shows and sports broadcasting.

With the exception of the Nebraska State Patrol[4], virtually all two-way radio systems utilize frequencies much higher than FM broadcast. The VHF (about 150 MHz), UHF (450 MHz) and 800 (806 to 870 MHz) bands are the most common bands used by commercial, state, and local government two-way systems. These bands are divided into a limited number of available channels. In the past, each of these channels was a 25 kHz wide piece of the RF spectrum—enough for good quality human speech and not much more. Increasing demand has required, and better technology has allowed the FCC to force the VHF and UHF bands to use 12.5 kHz channels decreasing the bandwidth to licensees, but effectively doubling the number of channels available for use. As a further measure to address demand, the FCC is reallocating (commonly referred to as refarming) the 700 MHz band. This will increase channel availability, and radio equipment manufacturers will be able to build one radio platform capable of operating both in the existing 800 MHz band and the new 700 band.

In order to utilize a channel in one of the mentioned bands, an individual must obtain a license from the FCC. The FCC records the transmitter location(s) and the amount of power radiated by the transmitters. The FCC requires anyone applying for a license to work with a 3rd party frequency coordinator. In the case of public safety radio in Nebraska, license application must go through the State of Nebraska[5], and the Association of Public Safety Officials (APCO) for coordination. It is the FCC's task to promulgate regulations and keep the license database, and it is up to the frequency coordinator(s) to ensure that the applicant's proposed system is designed according to these regulations, and additionally not interfere with other license-holders

[4] NSP uses a simplex system (discussed later) in the 40 MHz band.
[5] State of Nebraska Office of the CIO

on adjacent channels or agencies in other states, or as in many cases, counties within the same state that are licensed on the same channel.

As mentioned earlier, by utilizing a sufficiently high frequency, the coverage of a radio system can be limited and contoured to meet the needs of its particular application. Because the behavior of frequencies above 100 Mhz or so do not vary much with atmospheric conditions or diurnal variations, in essence, these signals "stay put" where they are engineered to stay. This allows the same frequency to be utilized in Kansas City, MO[6] and Lincoln, NE without any interference to each other. A key tool in contouring two-way radio coverage is the location of a piece of equipment called a repeater.

While some systems like the Nebraska State Patrol work more like a CB radio, talking directly from one radio unit to another, the repeater is the basic building block of virtually every modern two-way system. A repeater could be located in a highway tunnel, a naval destroyer[7], or a tall tower—wherever radio coverage needs to be designed. A repeater is licensed to transmit on one channel while receiving signals from other radios in the coverage area on a separate channel. As such, in order to utilize a repeater, the licensee must obtain licenses to utilize two separate frequencies: one channel for repeater transmit, and one channel for mobile/portable transmit.

A repeater is necessary because laws of physics limit how weak a signal a receiver can decode. Advances are constantly making wireless receivers more sensitive, but at some point, noise[8] becomes dominant. A busy restaurant works well to illustrate this. When there are only a

---

[6] When KCPD helicopter interfered with Lincoln's radio system, it was discovered that KC and Lincoln had a few overlapping channels licensed.

[7] Radio systems similar to the City of Lincoln's are deployed in submarines and aircraft carrier groups—literally floating cities in the ocean.

[8] Noise (static) comes from many sources. Above 100 MHz most noise is man-made such as florescent lighting, and computers are frequent noise sources.

few people in a restaurant, you may be able to understand the conversation a few tables down, but you probably will not hear what the staff in the kitchen are saying. As the restaurant becomes busy, it may become difficult to hear a person sitting across from you much less the people three tables down. Much the same, radio receivers are limited by the how weak the signal is (the staff in the kitchen) and what is known as the noise floor (the effect of the ambient noise in our restaurant). Therefore, critical to the design of a radio system is being aware of the relative weakness of the signal, and the presence of devices creating noise.

A repeater addresses these problems by placing a sensitive antenna in a location well suited for weak signal reception such as on a tall tower away from other sources of RF noise. The repeater also retransmits the signal at a much higher power and into a much more efficient antenna than would be feasible in a mobile device. For that reason, the key to designing a two-way system, or any wireless system, is the location of and the efficiency of antennas, the radiated power of each transmitter, and the smallest signal is usable by any receiver.

In the past decade, many two-way systems, particularly in public safety have been designed into so-called trunked radio systems. Trunking is a term borrowed from the telecommunications service denoting that the channels (or trunks) are not dedicated to a particular agency, but rather pooled together. Rather than having a frequency devoted only to one consumer, such as a police team, the frequency is shared by primary consumers while also being used by others as well. In that way, others can also utilize the same channel during times that others are not using it. Because no consumers require 100% of the availability of any one channel, it can be effectively shared. Many applications such as transit buses and street sweeping crews need only communicate for a few seconds a day: with trunking systems, a

specific portion of the spectrum is not consumed for such limited uses, and yet these subscribers still enjoy their own virtual channel[9].

In addition to the efficient use of the RF spectrum (through sharing), trunking systems also create a high level of fault tolerance. A channel that fails in a trunking system is simply unavailable to all subscribers. Provided a sufficient number of channels are on-line, maintenance personnel are the only ones to know a failure even occurred.

The power of trunking comes at the cost of relatively complex, proprietary, computational power embedded in both the mobile devices, and the pool of repeaters used in a trunked radio system. Typically, the additional complexity increases the cost of trunking radio equipment by a factor of ten compared to radios used on conventional two-way systems. While computational power is added to these radio systems, most systems distribute this processing evenly throughout the radio system using embedded processing using real-time operating systems or no operating system at all. This bolsters fault-tolerance by reducing/eliminating centralized single point failures well known to scheduled operating systems such as MS Windows.

Radios used on trunking systems are, by their very nature, digital radios and must use telemetry to negotiate with the repeaters. All trunking radios use some type of modem to communicate with site resources to request a channel and/or proceed to an assigned channel to listen to a call. After a request is made and granted by the trunking system, a call may proceed on the system using analog FM signaling like conventional radio systems, or using a vocoder, voice can be transmitted digitally. Since all trunking channels use digital telemetry, they can

[9] The term “talkgroup” denotes these virtual channels. For instance, the Custodians at North Star High School are given their own talkgroup.

also be used for other applications requiring digital transport such as mobile data and SCADA[10] provided that enough channels are available to accommodate the additional demand.

As mentioned earlier, a channel is constrained by its licensed bandwidth. Currently, most two-way systems are using 25 kHz with VHF and UHF soon being forced into 12.5 kHz. Another law of physics dictates a relationship between a channel's bandwidth and the maximum data-rate possible. Even today, with a 25 kHz channel, 19.2Kb/s is about the fastest reliable data rate possible. By current standards, this data rate is prohibitive, but by the combination of relatively low data rates, low subscriber densities (explained below) and efficiencies gained though trunked radio systems, systems can achieve high availability in a wide area utilizing licensed 25 kHz channels—provided that mobile applications are well groomed for bandwidth optimization.

Another important relationship is between the data-rate, and the ability of a radio to decode a weak signal. With a signal approaching the weakest signal usable by a receiver, a radio may be able to reliably decode 9.6 kb/s while unable to decode data at a higher rate. When engineering any digital transport, whether it is wireless, fiber, copper etc, the amount a signal available to a receiver always equates to some measure of availability/outage. In designing microwave paths used from public safety communications for instance, it is common to accept no more than a few minutes per year of outage on a link. Accordingly, systems must be designed to ensure the signal available to a receiver is greater than the lowest useable signal for that radio.

Compared with other services in the wireless spectrum, two way radio, particularly public safety two-way radio has design considerations that make it stand apart in many important ways. Subscriber density, subscriber authentication, and spectral coordination are by far the most

[10] Supervisory Control and Data Acquisition-such as the City interrogates stream gauges in the floodplain using the radio system for collection by the NRD.

important. Beyond those design differences, entire standards have been developed for two-way radio systems used for public safety[11].

Subscriber density is a measure of how many devices are using, or at least trying to use, a given resource. On a two-way radio system, the number of subscribers is known because of licensing requirements. Licensing, and digital identification on a trunking system not only allows the subscriber density to be known, but also the authentication of subscribers as well. In this way, access to critical resources is restricted to those with a need for such services.

Two-way radio systems, like the City of Lincoln's 800 MHz trunking system, typically use a high-power high-tower topology because of the relatively small subscriber density. This allows mobile coverage even in adjacent counties for the small number of subscribers using the system[12]. With only about three thousand subscribers, and a small percentage of those powered-up at any given time, a two-way system can dependably provide service to all of Lancaster Country with twenty trunked repeater channels placed on a 400 foot tower.

Cellular phone systems have many times the number of subscribers in the same coverage area as the Lincoln and Lancaster County radio system. Even in one square mile, it would not be unreasonable to have several thousand subscribers all powered-on. At any given time, many cell subscribers are simply waiting for calls, and not actively consuming system resources. Still, the subscriber density of cell phones would not work with a high-power high-tower topology: there simply is not enough RF spectrum available. Similar in ways to Wi-Fi/Wi-Max, cellular services address subscriber density issues by employing low-power and low or no tower topologies. This

[11] Notably, APCO 16 dictates such features as queuing, caller ID, emergency signaling, and fail-soft operations along with many other features.

[12] Mobile coverage is always greater than portable coverage. Again, laws of physics dictate that antennas used on portable devices are not as efficient as an antenna system can be made on a vehicle. Further, vehicles rarely enter into buildings which further reduce the signal available to a receiver.

is done by dividing markets such as Lincoln into many small geographic areas to limiting subscriber density to a level usually manageable by the resources at the site.

Cellular phone spectrum is licensed, and licenses are auctioned off by the FCC usually at extremely high costs. By comparison, a license gives a company the right to use a particular "carrier" in a given market. Carriers are about 1 MHz wide (forty times the bandwidth of two-way channels) and can accommodate perhaps 30-35 calls occurring simultaneously. In markets with high subscriber densities such as Lincoln many of the cellular tower sites will use several carriers to accommodate the potential traffic. There are times, such as during periods of high demand and high subscriber density such as Husker football games at Memorial Stadium, that providing enough carriers becomes a challenge for those companies providing cellular service.

Again, like Wi-Fi and proposed Wi-Max technologies, cellular services use a technique to allow many subscribers to use the same carrier. Alltel, US Cellular, and Verizon all use a spread-spectrum technique called CDMA. CDMA, the technology also used for Wi-Fi/Wi-Max, is an extremely efficient method of allowing many devices to use the same carrier without interfering with each other.

The best way to grasp CDMA for non-engineer/mathematicians is to think of our restaurant again except with everyone but you and the table next to you speaking Portuguese. Chances are the entire room will be unintelligible for you with the exception of the one other table speaking the same language. In CDMA, each subscriber is assigned a code, and only understands messages using that code. The rest of the activity on the carrier is simply unintelligible noise.

But unlike cellular topologies which use licensed (coordinated) spectrum, Wi-Fi and Wi Max systems use uncoordinated spectrum typically in what is known as the industrial, scientific,

and medical (ISM) bands. This is the same area of the RF spectrum that cordless phones, Bluetooth personal area networks and microwave ovens use. Because the spectrum is uncoordinated (and because of health effects) devices must be restricted to relatively low power so as to minimize interference. Because of the likelihood of interference, devices that utilize uncoordinated ISM spectrum must be error tolerant. Anyone who has tried to use their Wi-fi service on a mobile computer while talking on a modern cordless phone knows this first hand.

Essential complexities exist in the designs of two-way radio systems vis-à-vis wireless broadband data. At the foundation of the latter is an open-standard in which ubiquitous devices have an equal access right to a myriad of digital services using at minimum a 22 MHz[13] portion of shared spectrum. The former is designed to optimize bandwidth for mission-critical human voice applications where high-availability is required and must be restricted to subscribers that are licensed and validated on the particular system. Commercial two-way systems utilize radiated power levels of several hundred watts in order to provide coverage to wide area with a minimal number of sites while wireless broadband must interconnect numerous access points all restricted to less than 1 watt to provide coverage for bandwidth intensive applications such as file downloads to even a small service area. While there is potential for tangential voice applications, such as cell-phone use reduction/elimination, it appears unlikely that the two services will ever completely overlap.

[13] 22 MHz is the minimum quiet bandwidth required for a Wi-Fi device to transmit.

Works Cited:

Woodings, Ryan and Gerrior, M. Avoiding Interference in the 2.4 GHz ISM Band. 2005 Microwave Engineering Online. http://www.mwee.com/showArticle.jhtml?articleID=163700631 accessed March 6, 2007.

- Research Bibliography

Dell, Kristina, "Welcome to Wi-Fi-Ville: Pop. 300 towns and growing," Time January 15, 2007: 52-55.

Duffy, Jim, "Report: Municipal Wi-Fi not just another utility," Yahoo! News December 6, 2006.

Federal Trade Commission Staff Report, "Municipal Provision of Wireless Internet" September 2006.

Kolko, Jed, "Why Should Cities Provide Wireless Broadband Access?" Public Policy Institute of California, presented at the Telecommunications Policy Research Conference, August 2006.

Muniwireless LLC Home Page. June 19, 2007. Esme Vos. June 19, 2007.

Research Reports International, "The Growth of Municipal Wireless Networks," 1st Edition, August 2006.

State of Nebraska, "The Broadband Services Taskforce Final Report," November 22, 2006.

Young, Shawn, "Telecommunications: Civic Lessons," The Wall Street Journal [New York], October 23, 2006: The Journal Report: Technology, R6.

Lincoln Wireless Initiative "WI-LINC"

The City of Lincoln plans to examine the viability of wireless Internet access for Lincoln and the role government should play in facilitating a wireless service. As we analyze and review the possibilities, we think it is important to know how Lincoln citizens feel about the topic. The first four questions are optional and will be used for statistical purposes only.

1. Please identify your gender.	597	Male	63%
	322	Female	34%
	919		**97%**
2. Age	4	Under 18	0%
	248	18-29	26%
	304	30-39	32%
	179	40-49	19%
	137	50-59	15%
	20	60-64	2%
	27	65+	3%
	919		**97%**
3. What level of education have you completed?	8	Did not graduate from high school	1%
	50	High School graduate	5%
	312	Some college/technical school	33%
	340	College graduate	36%
	210	Education/Training beyond college degree	22%
	920		**97%**
4. Please identify which of the following categories best describes your annual income.	121	Under $25,000	13%
	366	$25,000 - $50,000	39%
	251	$50,000 - $75,000	27%
	102	$75,000 - $100,000	11%
	41	$100,000 - $125,000	4%
	30	Above $125,000	3%
	911		**97%**
5. Do you have Internet access in your home?	854	Yes	90%
	75	No	8%
	929		**98%**
6. Do you have a laptop or notebook computer?	629	Yes	67%
	277	No	29%
	906		**96%**
7. Do you have a wireless networking card for your computer?	645	Yes	68%
	259	No	27%
	904		**96%**

8. Where are you usually located when you use the Internet?	96	At Work	10%
	220	At Home	23%
	537	Both Work and Home	57%
	16	Public library	2%
	14	Commercial/Retail estabishments (i.e. hotels, restaurants, coffee houses, etc.)	1%
	22	Other	2%
	905		**96%**
9. How much do you pay for Internet access?	97	Nothing	10%
	63	Less than $19.99 per month	7%
	182	$20 - $29.99 per month	19%
	164	$30 - $39.99 per month	17%
	313	$40 - $49.99 per month	33%
	66	$50 - $59.99 per month	7%
	9	$60 - $69.99 per month	1%
	10	More than $70 per month	1%
	904		**96%**
10. How much would you pay for city-wide wireless access to the Internet?	267	Nothing	28%
	300	Less than $19.99 per month	32%
	196	$20 - $29.99 per month	21%
	73	$30 - $39.99 per month	8%
	48	$40 - $49.99 per month	5%
	9	$50 - $59.99 per month	1%
	0	$60 - $69.99 per month	0%
	1	More than $70 per month	0%
	894		**95%**
11. Have you paid for wireless Internet access away from your home or office?	222	Yes	24%
	611	No	65%
	833		**88%**
12. Should Lincoln review options for subsidizing Internet access in designated low-income areas?	478	Yes	51%
	349	No	37%
	827		**88%**

13. Please rate the importance of establishing wireless Internet access in each of the following sectors.

Government buildings	268	Very High Importance	28%
	180	High Importance	19%
	175	Relatively High Importance	19%
	107	Relatively Low Importance	11%
	45	Low Importance	5%
	56	Very Low Importance	6%
	831		**88%**
Public spaces (i.e. parks)	233	Very High Importance	25%
	186	High Importance	20%
	174	Relatively High Importance	18%
	100	Relatively Low Importance	11%
	37	Low Importance	4%
	102	Very Low Importance	11%
	832		**88%**
Retail/Shopping areas	124	Very High Importance	13%
	152	High Importance	16%
	207	Relatively High Importance	22%
	163	Relatively Low Importance	17%
	65	Low Importance	7%
	117	Very Low Importance	12%
	828		**88%**
Low-income areas	187	Very High Importance	20%
	140	High Importance	15%
	184	Relatively High Importance	19%
	129	Relatively Low Importance	14%
	43	Low Importance	5%
	138	Very Low Importance	15%
	821		**87%**
Interstate Exit Areas	176	Very High Importance	19%
	191	High Importance	20%
	177	Relatively High Importance	19%
	116	Relatively Low Importance	12%
	60	Low Importance	6%
	106	Very Low Importance	11%
	826		**88%**

14. Please rate the importance of the following reasons for establishing a wireless Internet access service in Lincoln.

Economic Development	332	Very High Importance	35%
	207	High Importance	22%
	138	Relatively High Importance	15%
	52	Relatively Low Importance	6%
	19	Low Importance	2%
	80	Very Low Importance	8%
	828		**88%**
Entertainment (for mobile devices)	155	Very High Importance	16%
	199	High Importance	21%
	183	Relatively High Importance	19%
	139	Relatively Low Importance	15%
	50	Low Importance	5%
	99	Very Low Importance	10%
	825		**87%**
Job Creation	289	Very High Importance	31%
	206	High Importance	22%
	145	Relatively High Importance	15%
	70	Relatively Low Importance	7%
	31	Low Importance	3%
	81	Very Low Importance	9%
	822		**87%**
Public Safety (improved communication for police, fire and other rescue vehicles)	406	Very High Importance	43%
	190	High Importance	20%
	103	Relatively High Importance	11%
	39	Relatively Low Importance	4%
	17	Low Importance	2%
	70	Very Low Importance	7%
	825		**87%**
Quality of Life for all citizens	313	Very High Importance	33%
	236	High Importance	25%
	138	Relatively High Importance	15%
	46	Relatively Low Importance	5%
	19	Low Importance	2%
	72	Very Low Importance	8%
	824		**87%**
Travel and Tourism	278	Very High Importance	29%
	237	High Importance	25%
	159	Relatively High Importance	17%
	51	Relatively Low Importance	5%
	23	Low Importance	2%
	74	Very Low Importance	8%
	822		**87%**

15. Please rate your level of agreement with the statements below, using the scale provided.

The City should consider economic growth a high priority.	525	Strongly Agree	56%
	215	Agree	23%
	64	Somewhat Agree	7%
	14	Somewhat Disagree	1%
	5	Disagree	1%
	5	Strongly Disagree	1%
	828		**88%**
The City should examine options for providing wireless Internet access to the public.	456	Strongly Agree	48%
	180	Agree	19%
	68	Somewhat Agree	7%
	19	Somewhat Disagree	2%
	23	Disagree	2%
	78	Strongly Disagree	8%
	824		**87%**
Internet access is vital to supporting economic growth and will make Lincoln more attractive to new businesses.	400	Strongly Agree	42%
	212	Agree	22%
	110	Somewhat Agree	12%
	21	Somewhat Disagree	2%
	25	Disagree	3%
	55	Strongly Disagree	6%
	823		**87%**
Wireless Internet access for travelers will help promote established businesses in Lincoln.	302	Strongly Agree	32%
	266	Agree	28%
	128	Somewhat Agree	14%
	26	Somewhat Disagree	3%
	34	Disagree	4%
	68	Strongly Disagree	7%
	824		**87%**
Lincoln should provide wireless Internet access in low-income areas.	244	Strongly Agree	26%
	198	Agree	21%
	149	Somewhat Agree	16%
	55	Somewhat Disagree	6%
	50	Disagree	5%
	121	Strongly Disagree	13%
	817		**87%**
I am in favor of establishing a wireless Internet access service in Lincoln if the cost to subscribers is minimal.	406	Strongly Agree	43%
	215	Agree	23%
	73	Somewhat Agree	8%
	21	Somewhat Disagree	2%
	33	Disagree	3%
	74	Strongly Disagree	8%
	822		**87%**

I am in favor of establishing a wireless Internet access service in Lincoln if the cost to the taxpayer is negligible.	347	Strongly Agree	37%
	236	Agree	25%
	101	Somewhat Agree	11%
	26	Somewhat Disagree	3%
	31	Disagree	3%
	77	Strongly Disagree	8%
	818		**87%**

Business Wi Fi

The City of Lincoln is examining the viability of wireless Internet access for Lincoln and the role government should play in facilitating a wireless service. As we analyze and review the possibilities, we think it is important to know how the business community of Lincoln feels about the topic. The first two questions are optional and will be used for statistical purposes only.

1. Please classify your business industry:	54	Banking/Financial	10%
	25	Education	5%
	20	Government	4%
	27	Health/Medical	5%
	41	Information Technology	8%
	32	Insurance	6%
	18	Manufacturing	3%
	132	Professional	26%
	7	Restaurant	1%
	44	Retail	9%
	400		**78%**
2. Number of employees:	143	1 - 9	28%
	57	10 - 19	11%
	36	20 - 29	7%
	38	30 - 49	7%
	46	50 - 99	9%
	41	100 - 149	8%
	15	150 - 199	3%
	117	200+	23%
	493		**96%**
3. How did you learn about this survey	359	Lincoln Chamber of Commerce	70%
	17	Lincoln Independent Business Association (LIBA)	3%
	0	Nebraska Retail Federation	0%
	0	Nebraska Restaurant Association	0%
	4	Women Business Owners Network (WBON)	1%
	2	American Business Women's Association (ABWA)	0%
	105	Other	20%
	487		**95%**
4. Does your company provide wireless Internet access?	196	Yes	38%
	300	No	58%
	496		**96%**
5. Do you use wireless Internet access in your business?	287	Yes	56%
	210	No	41%
	497		**97%**
6. Do your employees utilize laptop computers?	385	Yes	75%
	73	No	14%
	458		**89%**

7. Does your business use wireless service to access the web?	257	Yes	50%
	198	No	38%
	455		**88%**
8. Do your employees access the Internet as part of their daily work?	441	Yes	86%
	16	No	3%
	457		**89%**
9. How much do you pay for Internet access?	51	Nothing	10%
	23	Less than $19.99 per month	4%
	49	$20.00 - $29.99 per month	10%
	45	$30.00 - $39.99 per month	9%
	64	$40.00 - $49.99 per month	12%
	37	$50.00 - $59.99 per month	7%
	14	$60.00 - $69.99 per month	3%
	130	More than $70 per month	25%
	413		**80%**
10. How much would you pay for city-wide wireless access?	140	Nothing	27%
	76	Less than $19.99 per month	15%
	79	$20.00 - $29.99 per month	15%
	33	$30.00 - $39.99 per month	6%
	32	$40.00 - $49.99 per month	6%
	9	$50.00 - $59.99 per month	2%
	8	$60.00 - $69.99 per month	2%
	37	More than $70 per month	7%
	414		**80%**
11. Have you paid for wireless web access away from your home or office?	187	Yes	36%
	234	No	45%
	421		**82%**
12. Should Lincoln review and encourage the establishment of wireless web access options?	367	Yes	71%
	51	No	10%
	418		**81%**
13. Where would you prefer to see wireless web access available?	213	Within government buildings	41%
	290	In public spaces, i.e. parks	56%
	250	Retail/Shopping areas	49%
	148	Low-income areas	29%
	103	Other	20%
	1004		
14. Should the City subsidize wireless web access in designated low-income areas?	175	Yes	34%
	234	No	45%
	409		**79%**

15. Which of the following issues do you believe are the most important in creating a wireless web access system? Please rank in order the importance from 1 to 6, with 1 being most important.

Economic Development and Job Creation	167 – 1 Most Important	32%
	117 – 2	23%
	61 _ 3	12%
	27 – 4	5%
	17 – 5	3%
	22 – 6 Least Important	4%
	411	**80%**
Entertainment (for mobile devices)	16 – 1 Most Important	3%
	53 – 2	10%
	77 _ 3	15%
	95 – 4	18%
	82 – 5	16%
	86 – 6 Least Important	17%
	409	**79%**
Public Safety (improved communication for police, fire and other rescue vehicles)	165 – 1 Most Important	32%
	116 – 2	23%
	64 _ 3	12%
	28 – 4	5%
	17 – 5	3%
	20 – 6 Least Important	4%
	410	**80%**
Quality of Life for all citizens	101 – 1 Most Important	20%
	118 – 2	23%
	104 _ 3	20%
	44 – 4	9%
	21 – 5	4%
	22 – 6 Least Important	4%
	410	**80%**
Travel and Tourism	64 – 1 Most Important	12%
	109 – 2	21%
	82 _ 3	16%
	60 – 4	12%
	71 – 5	14%
	25 – 6 Least Important	5%
	411	**80%**

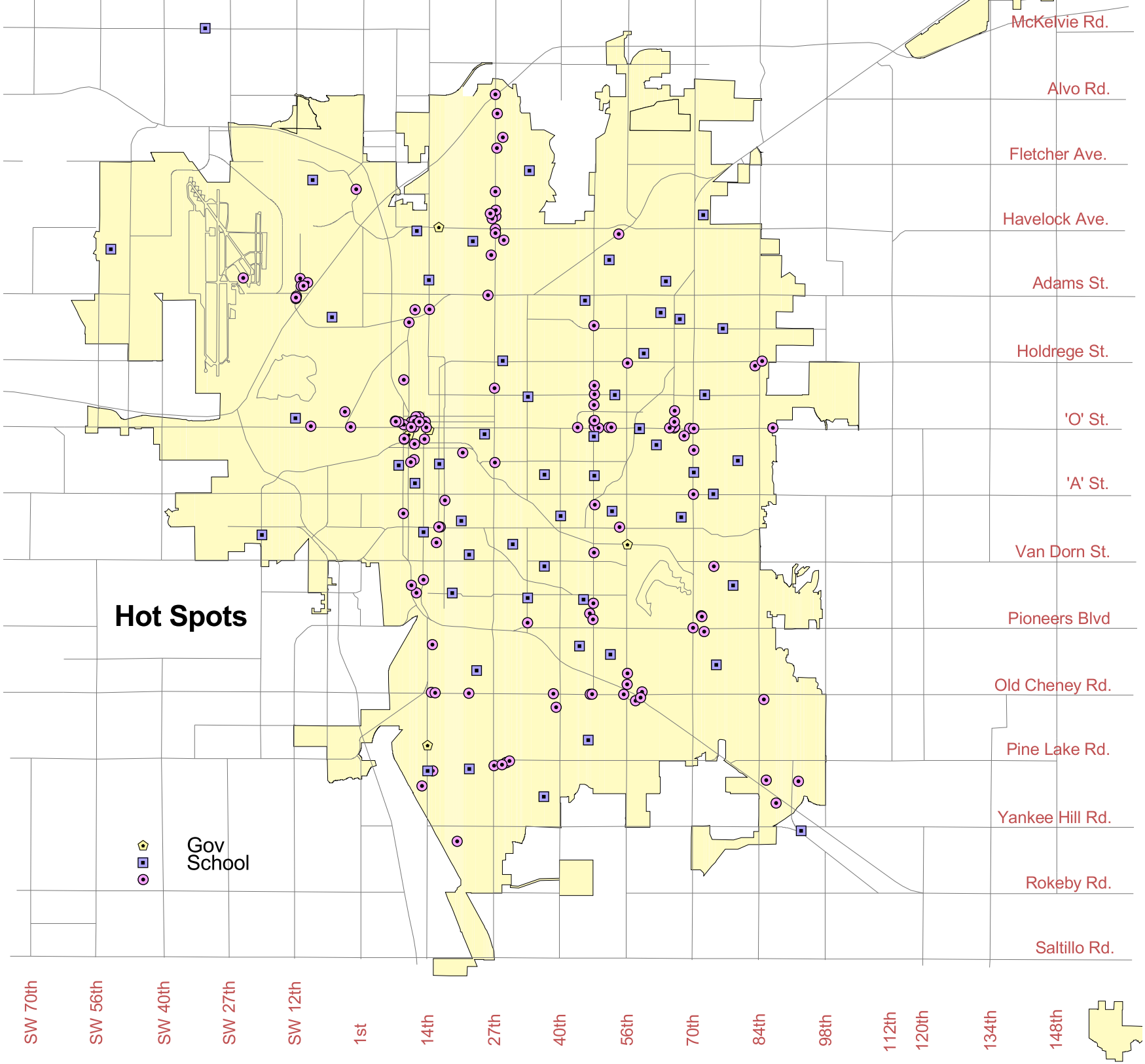
16. Please indicate your level of agreement (on a scale of 1 to 6, with 1 being strongly agree) with the statements below.

The City should consider economic growth a high priority.	334 – 1 (Strongly Agree)	65%
	51 – 2	10%
	15 _ 3	3%
	1 – 4	0%
	0 – 5	0%
	4 – 6 (Strongly Disagree)	1%

	405	**79%**
The City should examine providing wireless web access to the public.	203 – 1 (Strongly Agree)	39%
	82 – 2	16%
	58 _ 3	11%
	17 – 4	3%
	15 – 5	3%
	30 – 6 (Strongly Disagree)	6%
	405	**79%**
Wireless web access is vital to supporting economic growth and will make Lincoln more attractive to new businesses.	187 – 1 (Strongly Agree)	36%
	88 – 2	17%
	69 _ 3	13%
	18 – 4	3%
	20 – 5	4%
	21 – 6 (Strongly Disagree)	4%
	403	**78%**
Wireless web access for travelers will help promote established Lincoln businesses.	144 – 1 (Strongly Agree)	28%
	106 – 2	21%
	86 _ 3	17%
	30 – 4	6%
	22 – 5	4%
	16 – 6 (Strongly Disagree)	3%
	404	**78%**
Lincoln should provide wireless web access in low-income areas.	79 – 1 (Strongly Agree)	15%
	49 – 2	10%
	115 _ 3	22%
	58 – 4	11%
	46 – 5	9%
	56 – 6 (Strongly Disagree)	11%
	403	**78%**
I would be in favor of establishing a wireless web access system in Lincoln if the cost to subscribers was minimal.	207 – 1 (Strongly Agree)	40%
	88 – 2	17%
	48 _ 3	9%
	18 – 4	3%
	15 – 5	3%
	28 – 6 (Strongly Disagree)	5%
	404	**78%**
I would be in favor of establishing a wireless web access system in Lincoln if the cost to the taxpayer was negligible.	220 – 1 (Strongly Agree)	43%
	82 – 2	16%
	39 _ 3	8%
	16 – 4	3%
	18 – 5	3%
	28 – 6 (Strongly Disagree)	5%
	403	**78%**

Lincoln should review and encourage the creation of wireless web access system for the public.	212	1 (Strongly Agree)	41%
	89	2	17%
	43	3	8%
	20	4	4%
	12	5	2%
	26	6 (Strongly Disagree)	5%
	402		**78%**

17. Do you provide wireless Internet access to your customers for	7	a fee.	1%
	68	no cost.	13%
	328	N/A	64%
	403		**78%**


Hot Spots
Gov
School
McKelvie Rd.
Alvo Rd.
Fletcher Ave.
Havelock Ave.
Adams St.
Holdrege St.
'O' St.
'A' St.
Van Dorn St.
Pioneers Blvd
Old Cheney Rd.
Pine Lake Rd.
Yankee Hill Rd.
Rokeby Rd.
Saltillo Rd.
SW 70th
SW 56th
SW 40th
SW 27th
SW 12th
1st
14th
27th
40th
56th
70th
84th
98th
112th
120th
134th
148th

WI-LINC Community Review

Mesa, Arizona

1 **Name of City/County.** Mesa, Arizona

2 **Effected Population.** 450,000

3 **Effected area (in square miles).** 135

4 **Project Name.** Mesa Wi-Fi Mesh Network

5 **Goals (check all that apply).**

- Economic Development ☑
- Travel & Tourism ☐
- Education ☑
- Public Safety ☑
- Quality of Life ☑

Comments.

A key goal is to reduce reliance on cellular data services for wireless connectivity and move to Wi-Fi and save money. Related to that is to enable more field use where connectivity costs were previously cost prohibitive.

6 **Technology Components.**

- Wi Fi Zones ☐
- Wi Fi Mesh ☑
- Wi Max ☐
- Hybrid ☐

Comments (Include # of Hotspots, # of nodes)

Expected there will be 3,400+ nodes

7 **Funding Model/Source.**

- Bonds ☐
- Subscription fees ☐
- Public/Private funding ☐
- Other ☑

Comments.

We will contract with a private service provider. That provider is expected to give the City needed services in exchange for mounting rights to streetlight poles and other assets.

8 **Start up costs.**

9 **Annual operating costs.**

10 Project status.

- [x] Planning Stage
- [ ] Pilot Project
- [ ] Partially deployed
- [ ] Fully deployed

Comments (Results, goals achieved, public opinion).

We are not negotiating an contract/lease.

11 Contact Information.

Eric Norenberg
IT Services Leader
City of Mesa, Information Services Division
200 S. Center Street, Mesa, AZ 85210
eric.norenberg@cityofmesa.org
office: 480.644.2569 fax: 480.644.3158

12 Informational links.

City of Philadelphia

1	**Name of City/County.**	City of Philadelphia	
2	**Effected Population.**	1,500,000	
3	**Effected area (in square miles).**	135	
4	**Project Name.**	Wireless Philadelphia	
5	**Goals (check all that apply).**	Economic Development	☑
		Travel & Tourism	☑
		Education	☑
		Public Safety	☐
		Quality of Life	☑
	Comments.		
6	**Technology Components.**	Wi Fi Zones	☐
		Wi Fi Mesh	☑
		Wi Max	☐
		Hybrid	☐
	Comments (Include # of Hotspots, # of nodes)		
		Approx. 3500-4000 nodes	
7	**Funding Model/Source.**	Bonds	☐
		Subscription fees	☐
		Public/Private funding	☐
		Other	☑
	Comments.		
		Vendor funded	
8	**Start up costs.**	$0	
9	**Annual operating costs.**	$0	

10 Project status.

- [ ] Planning Stage
- [x] Pilot Project
- [x] Partially deployed
- [ ] Fully deployed

Comments (Results, goals achieved, public opinion).

11 Contact Information.

Varinia C. Robinson
Program Director
City of Philadelphia/MOIS
215-686-5975
varinia.robinson@phila.gov

12 Informational links.

www.wirelessphiladelphia.org

Washtenaw County, Michigan

1 **Name of City/County.** Washtenaw County, Michigan

2 **Effected Population.** 322,000

3 **Effected area (in square miles).** 721

4 **Project Name.** Wireless Washtenaw

5 **Goals (check all that apply).**

- Economic Development ☑
- Travel & Tourism ☑
- Education ☑
- Public Safety ☑
- Quality of Life ☑

Comments.

6 **Technology Components.**

- Wi Fi Zones ☐
- Wi Fi Mesh ☐
- Wi Max ☐
- Hybrid ☑

Comments (Include # of Hotspots, # of nodes)

Approximately 5,000 - 6,000 access points, with mix of Wi-Fi and Pre Wi-Max technology.

7 **Funding Model/Source.**

- Bonds ☐
- Subscription fees ☑
- Public/Private funding ☐
- Other ☐

Comments.

Public - Private Partnership. Washtenaw County is working to streamline access to public assets throughout to County for a private sector partner (or PSP). The PSP is ultimately responsible for owning, operating and maintaining the network. The PSP will fund the approximate 26 - 42 million to deploy services.

8 **Start up costs.**

9 **Annual operating costs.**

10 Project status.

- [ ] Planning Stage
- [x] Pilot Project
- [ ] Partially deployed
- [ ] Fully deployed

Comments (Results, goals achieved, public opinion).

Pilots have been deployed and are undergoing internal acceptance testing before being made available to residents. Our rural community is particularly exciting and anxious to receive service.

11 Contact Information.

James McFarlane - Project Manager, WC - (734) 222-6587
Uma Harithsa - Project Manager, WC - (734) 222-3578
Jason Kalmbach - Washtenaw County - (734) 222-6825

12 Informational links.

http://wireless.ewashtenaw.org/

City of Overland Park, Kansas

1 **Name of City/County.** City of Overland Park, Kansas

2 **Effected Population.** 500,000

3 **Effected area (in square miles).** 400

4 **Project Name.** Johnson County Municipal Wireless

5 **Goals (check all that apply).**

- Economic Development ☑
- Travel & Tourism ☑
- Education ☐
- Public Safety ☑
- Quality of Life ☑

Comments.

6 **Technology Components.**

- Wi Fi Zones ☐
- Wi Fi Mesh ☐
- Wi Max ☐
- Hybrid ☐

Comments (Include # of Hotspots, # of nodes)

Specific technology is yet to be determined. Probably a hybrid. We will use as much WiMax as we can.

7 **Funding Model/Source.**

- Bonds ☐
- Subscription fees ☐
- Public/Private funding ☐
- Other ☐

Comments.

We are still putting together our RFP (due by 12/30) and are evaluating funding models.

8 **Start up costs.** $40,000,000

9 **Annual operating costs.**

10 Project status.

- [x] Planning Stage
- [ ] Pilot Project
- [ ] Partially deployed
- [ ] Fully deployed

Comments (Results, goals achieved, public opinion).

All costs are estimated until we complete and receive responses to our RFP.

11 Contact Information.

Hannes Zacharias
Deputy County Manager
Johnson County
(913) 715-0725
hannes.zacharias@jocogov.org

12 Informational links.

City of Corpus Christi

1 **Name of City/County.**	City of Corpus Christi	
2 **Effected Population.**	300,000	
3 **Effected area (in square miles).**	147	
4 **Project Name.**	C. C. Digital Community Development Corporation	
5 **Goals (check all that apply).**	Economic Development	☑
	Travel & Tourism	☑
	Education	☑
	Public Safety	☑
	Quality of Life	☑
Comments.		
6 **Technology Components.**	Wi Fi Zones	☐
	Wi Fi Mesh	☑
	Wi Max	☑
	Hybrid	☐
Comments (Include # of Hotspots, # of nodes)		
7 **Funding Model/Source.**	Bonds	☑
	Subscription fees	☐
	Public/Private funding	☐
	Other	☐
Comments.		
8 **Start up costs.**	$7,100,000	
9 **Annual operating costs.**	$500,000	

10 Project status.

- [ ] Planning Stage
- [ ] Pilot Project
- [ ] Partially deployed
- [x] Fully deployed

Comments (Results, goals achieved, public opinion).

11 Contact Information.

Leonard Scott
MIS Business Unit Manager
City of Corpus Christi
leonard@cctexas.com
361-826-3772

12 Informational links.

www.cctexas.com

San Carlos, California

1 **Name of City/County.**	San Carlos, California	
2 **Effected Population.**	28,000	
3 **Effected area (in square miles).**	5	
4 **Project Name.**	Wireless Silicon Valley	
5 **Goals (check all that apply).**	Economic Development	☑
	Travel & Tourism	☑
	Education	☑
	Public Safety	☑
	Quality of Life	☑
Comments.		
6 **Technology Components.**	Wi Fi Zones	☑
	Wi Fi Mesh	☐
	Wi Max	☑
	Hybrid	☐
Comments (Include # of Hotspots, # of nodes)		
	1500 square miles, urban, suburban, farming	
7 **Funding Model/Source.**	Bonds	☐
	Subscription fees	☐
	Public/Private funding	☑
	Other	☐
Comments.		
8 **Start up costs.**	$0	
9 **Annual operating costs.**	$0	

10 Project status.	Planning Stage	☑
	Pilot Project	☐
	Partially deployed	☐
	Fully deployed	☐

Comments (Results, goals achieved, public opinion).

11 Contact Information.	Brian Moura, Assistant City Manager 650 802-4210
12 Informational links.	http://www.jointventure.org/programs-initiatives/smartvalley/projects/wirelesssv/wirelesssv.html