What's Wrong with City Wireless Infrastructure?

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ABSTRACT

As cities saw the need to improve communication capabilities for their employees and to serve economically disadvantaged residents, several U.S. municipalities responded by deploying a city-wide WiFi network. Nevertheless, the cost and the price of municipal wireless service is a major factor in the transition to e-government. A problem for municipal wireless providers is competition from commercial broadband providers. The authors surveyed the current status of municipal wireless networks and compared it to the introduction and adoption rate of commercial 3G technologies. Game theory analysis was used to determine an effective and competitive price.

Keywords: E-government, Municipal Wireless, 3G, WiFi, Mobile Internet, Pricing

1. Introduction

Compared to other developed countries in the world, deployment of broadband Internet access networks in the U.S. has been very slow. Even though the Federal Communications Commission (FCC) (2007) announced that as of June 2007 the number of broadband access lines (residential) were 65.9 million and that 99% of Zip Code areas were covered by broadband service providers, the U.S. lags with a ranking of 15^{th} in the broadband penetration rate in the ITU report (2007). The Department of Commerce (2004) reported that in 112.6 million households in the U.S., the residential broadband penetration rate is 58.5%. The phenomenon of low penetration rates and slow network deployment has caused many localities to consider the development of municipal wireless networks as a form of utility service. For the last decade, WiFi technology has been successful in college campuses. The campus-wide WiFi network has been a conceptual idea for a citywide WiFi network. According to Daggett (2007), many U.S. cities are currently developing citywide broadband networks, especially large cities such as Philadelphia, San Francisco, Minneapolis, Boston, Houston, and Seattle. Given the level of interest there is a strong possibility for municipal wireless to prevail in the U.S. as a preferred Internet access platform as well as a bridge to transit from e-government to m-government.

Philadelphia, Pennsylvania is one of the major U.S. cities to announce the development of a municipal wireless network using WiFi and is the case in point for this article because WiFi is well known as one of the national public wireless access Hot-Spots. Earthlink was a contractor to build the Philadelphia citywide WiFi wireless Internet access system, but now the project has been stopped in 2008. At the time of this writing, many municipal wireless projects have been delayed or canceled. One of the reasons is a business model of municipal wireless project. The business model for municipal wireless Internet access is somewhat different from that of traditional telecommunications Internet access providers. The traditional telecommunication providers built telecommunications infrastructure with an enormous investment and sold telecommunication access and usage to their customers with an unlimited access monthly billing approach (Daggett, 2007). Municipal authorities, which are not for-profit-entities, require a steady stream of revenue to maintain their business operation and run the real risk of encountering competition from private Internet service providers. Accordingly, one of the most popular business models for municipal wireless systems is a hybrid (private-public) system in which the city owns the network infrastructure and a private company builds the network using city owned assets. The private company then operates the network with the city being one of the largest customers of the wireless service. In the case of Philadelphia, using this approach, Philadelphia used a low cost pricing strategy equivalent to traditional dial-up access monthly pricing. Accordingly, under this business model an appropriate pricing level is one of the key factors for both the financial success of the municipal wireless service and a sensitive political issue for the governing municipal wireless authority. However, when the project forecasted future market penetration rate, it omitted the need to compete with other wired or wireless broadband services which are run by other private companies.

In this paper we survey the current status of WiFi municipal wireless networks and demonstrate an appropriate pricing level based upon a market penetration rate projections, which is the pattern followed by most municipal wireless projects. As an alternate method, we built a game model with 3G wireless Internet access, which is a one of the emerging means of differentiation and competing in the municipal wireless market using Philadelphia as the case point. It is our objective that this will then provide a foundation and proper guideline for other municipalities considering citywide wireless Internet access service.

2. Literature Review

2. 1 Current Status of Municipal Wireless

In an effort to boost the city's economy, the City of Philadelphia in 2004 announced its intention to provide wireless Internet access service throughout the city. Using street lights as WiFi access points, the City wanted to offer a low-cost (dial-up Internet access price equivalent of $20/month), ubiquitous broadband wireless connectivity to all points (every house and business) within the city of Philadelphia (Wireless Philadelphia Executive Committee, 2007). It was believed that the "Wireless Philadelphia" project would provide a competitive economic development advantage to the city of Philadelphia, while at the same time, reducing the city's telecommunication cost including 3G wireless service for field employees. Scott (2005) also identified that it was expected to reduce the "digital divide" (the gap between those who can afford access to the Internet and those who can't) by providing inexpensive wireless Internet access and by the pressure of price competition to other wireless or wire line broadband providers, such as DSL and Cable providers.

According to the Wireless Philadelphia's web site[1], 15 square miles of Philadelphia would be available for city wireless Internet in January 2007 within the Proof of Concept Zone. The Proof of Concept Zone encompasses a large section on North Philadelphia. Upon completion of the testing phase, the service provider Earthlink would build out the network to cover the entire city providing citywide WiFi service to all 135 square miles of the city by the end of 2007. But by May 2008, Earthlink announced that it was out of the "Wireless Philadelphia" project.

The Census Bureau in 2002 reported that there are 19,429 municipal governments in the U.S. Of these, some 312 municipalities either have their own wireless network or in the process of building a city owned wireless network in the report of Muniwireless.com. (2007). While some

[1] http:// www.wirelessphiladelphia.org

municipalities like those in western Utah and Windom, MN (Daggett, 2007) have chosen fiber optic technology for their municipal broadband and Manassas, VA has chosen BPL (Broadband over Power Line) technology (City of Manassas, 2005), it is expected that many other municipalities will opt for the WiFi technology when it is price competitive. The number of municipalities that have announced their intention to provide their own wireless networks is very small, representing only 1.6% of all municipalities. While public WiFi Internet service has not been very successful in larger metropolitan areas in the U.S., there are many successful stories in small town U.S.A. The following table is the summary of U.S. cities which started their wireless municipal project by the end of 2006.

[Table 1] Number of U.S. cities of Wireless Internet Access

CityWide/Region	City Hotzones	Public Safety Only	Planned Deployment	Total
79	48	36	149	312

* Source: Muniwireless (2007)

2.2 Business Model and Pricing

According to Daggett (2006), there are two kinds of business models for municipal wireless: the franchise model and the anchor tenant model. In the franchise model, a city grants the private company use of public assets for some period of time and a franchisee builds a network using the public assets and then operates the network paying a franchise fee to the city. In this case, the city is not the major customer. An example of this model is an agreement between Anaheim, CA and Earthlink. In the anchor tenant model, the city becomes a major customer and guarantees a minimum level of revenue to a contractor. An example of this model is an agreement between Minneapolis, MN and U.S. Internet. The city of Minneapolis guarantees $1.25 million annually over 10 years, while the contractor provides 5% of net revenues to a digital inclusion fund and provides free wireless Internet access in parks and technology centers. The City of Philadelphia chose the anchor tenant model (Kim, et al., 2008). The city established a non-profit organization named Wireless Philadelphia. Wireless Philadelphia then entered into an agreement with the private company Earthlink, where they would construct and operate a citywide wireless network then sell access to the network for a “low wholesale fee” to seven ISPs (Scott, 2005). The city’s objective is to offer citywide wireless service to their residents and local businesses at a reasonable monthly subscription fee while at the same time offering WiFi service to lower income populations who could not otherwise afford broadband Internet access.

It is difficult for municipalities to establish a price level for municipal wireless service, because by its very nature it is a public-private partnership. From the public perspective, municipalities wish to maximize the wireless Internet access for its residents and businesses by offering the wireless service at the lowest possible price. From the private sector perspective, the wireless Internet partner requires a price that will not only provide break-even within an accepted period of time, but also offer competitive profit opportunities. Accordingly, the price should be high enough to pay for and maintain the city wireless network while returning a reasonable profit to the Internet providing partner, but at the same time the price should be low enough to allow as many citizens as possible to access the Internet and to benefit from the city wireless service. Setting a price level is a strategy that cannot succeed if wholly considered from the public perspective, but municipalities must take into account the private sector perspective of pricing in a competitive environment with choices available to the consuming market.

Municipal wireless does, however, have a mobility advantage against fixed broadband service like DSL and cable modem technology and a bandwidth advantage against 3G wireless broadband service. According to the broadband service survey of Philadelphia in 2005 (Scott), there are 15.7% broadband subscribers (3G, DSL, and cable modem) and 29.4% dialup subscribers in the city of Philadelphia, which represents a 45.1% on-line penetration rate in 2004. Among the three broadband services, 3G service was the most expensive ($60 / month), Cable is next ($40 ~ $45), and DXL is the cheapest broadband service ($34 ~ $37). Of course each service has a different bandwidth and its own specific features. Setting an appropriate price level is an important factor to the success of municipal wireless service. The following is a municipal WiFi price survey for selected U.S. cities that offer municipal wireless service.

[Table 2] Pricing for Municipal Wireless in Some U.S. Cities

Cities	Pricing / Month	Population	Size (Mile^2)
St. Anthony Village, MN	$24.95 / 1Mbps	8,000	2.3
Granbury, TX	$19.99 / Mbps	6,400	10
Chaska, MN	$16.99 / 1Mbps (Residential) $25.99 / 1 Mbps (Mobile)	18,000	13.7
Saint Louis Park, MN	$19.99 / 1Mbps $14.99 / 128 Kbps	45,000	10.7
Philadelphia, PA	$21.95 / 1Mbps $9.95 / Digital Inclusion	1.5 millions	135

Source: Web Site of Each City

3. Methodology: Scenario-Based Forecasting

3. 1 Demand for Municipal Wireless

In order to address the question of an appropriate pricing level and strategy for municipalities, the authors present a scenario-based forecasting methodology. The scenario is made by expected market penetration rate. This approach uses survey data collected for wireless applications in St. Paul, MN and apply them to the City of Philadelphia case. The reason St. Paul, MN was selected is the similarity in service area (square miles) and population to Philadelphia, PA.

St. Paul, the second largest city in Minnesota (287,000 population, 52.8 Sq. Miles) had a study in 2006 to consider the development of a municipal wireless service. As part of the study a survey of city residents' willingness-to-pay for a municipal wireless service was conducted. In its final report (City of St. Paul, 2006), the following table of survey results was presented.

[Table 3] Willingness-to-Pay Survey Data for Municipal Wireless (St. Paul, MN)

Price Range	$15 - $19	$20 - $29	$30-$39	$40 - $49	$50 -
%	28%	36%	11%	11%	11%

Source: City of St. Paul (2006)

To estimate a demand curve from the above willingness-to-pay data, we modified the above table into a table presenting a mean price value for each price range category and the response rates into a cumulative percentage beginning with the highest price range category. The results of these calculations are presented below.

[Table 4] Modified Table for Willingness-to-Pay Survey Data (St. Paul)

Mean Price	$17.5	$25	$35	$45	$55*
Cumulative %	97%	69%	33%	22%	11%

* assuming the highest price in this category $60

Based on the above modified willingness-to-pay table, we estimated a demand curve through linear regression. The following is the result of the estimated demand curve.

$$P = 54.3 - 0.4 * Q \ (R^2 = 92.3) \qquad \text{(Equation 1)}$$

Where *P* is a price of municipal wireless service and *Q* is number of subscribers.

3. 2 Cost for Municipal Wireless

Building a telecommunication network is capital intensive. A WiFi access network, however, is a relatively low cost technology compared to the FTTH (Fiber-to-the-Home) or BPL technology, which are used by some municipalities to provide Internet access service. Key components of the WiFi infrastructure are the WiFi access point and its backbone network. Currently wireless backbone networks using WiMAX are in the experimental stage (and reportedly underutilized in countries where current systems are in operation[2]). A fiber optic backbone network, for most cities, currently is the only cost effective solution. Therefore, whether a city has an existing fiber optic backbone network, or not, is a major factor when considering project cost. The size of the backbone network and the number of WiFi access points are based on the population, geographic size of the city, and topographical features such as rivers, mountains, and similar obstacles. In the St. Anthony Village, MN case, 35 access points are used per square mile and in the final report of municipal wireless for St. Paul, MN (2005), 20 access points (typically up to 20 users simultaneously per point limitations) are used per square miles. According to the Martin's web blog (Sauter, 2007), the average number of access points for municipal wireless is 25 access points per square mile. The rule of thumb in estimating WiFi municipal capital costs is $200,000 per square mile to cover 90% to 95% of homes and residents in a city (Daggett, 2007).

Operating costs are the second largest cost after capital costs. Operating costs include the cost of operating the network full time (24 hours a day/7 days a week), pole attachment fees, electricity, hardware maintenance, software upgrades, and Internet interconnection fees. Operating costs for wholesale networks are estimated to be approximately 15% of the capital network annually, however, estimated operating costs for retail networks increases to around 30% including billing and marketing fees (Daggett, 2007). Whether municipal wireless is to be operated as a wholesale or retail venture is a non sequitur since the price which subscribers have to pay is the same. This is true whether the user access fees are paid to the city or paid to an Internet Service Provider. Accordingly, we assume operating costs at 30% of annual network capital cost in the model. The following table shows the cost assumptions of a WiFi municipal network in the first five years that are used in the pricing model in the next section.

[Table 5] Cost assumption of WiFi Municipal Network

Year	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Capital Cost	$200,000 / sq. mile	-	-	-	-	$200,000 / sq. mile
Operating Cost	$60,000	$60,000	$60,000	$60,000	$60,000	$300,000

For calculation purposes, the size of the City of Philadelphia is 135 square miles in area, has a population of 1.5 million, and has 560,500 households (The Wireless Philadelphia Executive Committee, 2005). In this paper, calculations are based on only resident users, because the number of business units and their size is not available.

[2] Korea is a leading country to use Wibro, which is similar to WiMAX.

3. 3 Profit Function

The profit function of this model is defined as revenue minus cost. The authors calculated profit based on annual revenue and cost. The revenue is defined by the number of subscribers (Q) times the monthly price (P) of the city WiFi service. The potential number of subscribers is assumed to be limited to the number of households (560,500) even though the City of Philadelphia has many visitors, both tourists and business (Scott, 2005). As noted earlier, in 2004 Philadelphia had a 15.7% broadband penetration rate with DSL and cable modem technologies (Scott, 2005). In our model we assume the remaining 84.3% of total households in Philadelphia represent the target market for municipal wireless service in the Philadelphia case. We further assume that WiFi operators in the City of Philadelphia should pay 5% of their net profits to a digital inclusion fund (that is a part of contract), which would be used to supply a digital package (hardware, software, and wireless Internet service) to low income households.

The following is the profit equation which is used in the pricing decision. According to the demand equation (Equation 1), Q in the profit equation will be given by Q = (54.3 – P) / 0.04. The coefficient, (1-0.05), in the revenue function means 5% payback as a digital inclusion fund.

$$\text{Profit} = (1-0.05)*\{P/\text{month}*Q*\ 12\ \text{Months}\} - \{135\ \text{Sq. miles} * \$200{,}000/\text{sq. mile} + \$60{,}000/\text{year}\} \quad \text{(Equation 2)}$$

where $Q = (54.3 - P) / 0.04$

3. 4 Revenue Projection

In the above model the profit is a one-time calculation using a static approach although it is assumed that the entire potential target market should take four to five years to reach saturation. Such an approach is realistic, however, given that the adoption process for municipal wireless service should be similar to other related telecommunications services and will likely project a similar product life cycle. Most cities either have, or are contemplating a municipal wireless service and realistically target the 4th or 5th year as their breakeven year. According to the Wireless Philadelphia business plan (The Wireless Philadelphia Executive Committee, 2005), the following table presents the estimated market penetration rate which begins in the first year with 13.9% of the potential target market and increasing to 23.1% of the total potential target market in year 5.

[Table 6] Change of Profit with a Market Approach

Year	Year 1	Year 2	Year 3	Year 4	Year 5
Penetration Rate**	13.9%	19.3%	20.9%	22.2%	23.1.%
Number of Residential Subscribers	77.9 K	108.0 K	117.3 K	124.3 K	129.6 K*

K* = 1,000 subscribers, ** Based on the total households is 560,500
Source: The Wireless Philadelphia Executive Committee Report (2005)

On the cost side, as presented earlier, a typical telecommunication project has a large, up-front capital cost with a relatively small marginal operating cost. According to the business project of Chaska, MN (Tropos Networks, 2007), the incremental operating cost (including marketing and sales) per subscriber per month is assumed to drop from $13.5 in the first year to $6.72 in the fifth year. Building on the Chaska, MN case, we believe that it is reasonable to assume a smooth linear decline in the average operating cost per subscriber for a five year period. Based upon this assumption, the following presents the schedule of the average operating cost per subscriber per month.

[Table 7] Change of Average Operating Cost per Subscriber per Month

Year	Year 1	Year 2	Year 3	Year 4	Year 5
Average Cost	$13.5	$10.5	$8	$7	$6.72

Source: Tropos Networks, 2007

Based on the above cost and demand assumptions, a profit projection without knowing the demand elasticity is presented below for monthly WiFi service price levels ranging from $5 to $25.

[Table 8] Change of Profit with a Market Approach

Price	$5	$10	$15	$20	$25
Profit for 5 years	-20.9 M	$6 M	$33 M	$60 M	$87 M
Annual Average Profit	-4.2 M	$1.2 M	6.6 M	$12 M	$17.4 M

In this approach, a breakeven price level for the five years operation is $9 per subscriber per month. In this model, the planned monthly price level of $21.95 in Philadelphia provides an estimated $70.5 million in total profit for the 5 years and a $14 million average annual profit with a zero interest rate (internally self-financed projects).

4. Finding: Strategic Pricing with a Game Theory Approach

According to the FCC's statistics,[3] four to nineteen broadband service providers are available in each of the zip codes of city of Philadelphia at the time of June 30, 2006, which means there are as many as nineteen broadband Internet access service providers. Philadelphia Wireless is seen as the 20th broadband provider in the city. However, 3G wireless service is an emerging service and although its characteristics are similar to WiFi, it could be a potential substitute for WiFi service. Mobility is the key differentiation criteria when considering 3G's advantages over WiFi. Because of the ability to differentiate itself on this unique feature, 3G wireless Internet access service is introduced in the game scenario as a competitor to WiFi service. In this model, it is assumed that there are two service providers in the mobile broadband market without the possibility of new entrants. The two types of services are (1) a CDMA-based 3G operator and (2) a WiFi based municipal wireless providers. Even if the mobile broadband services are not perfectly homogeneous, the authors used a Bertrand price competition game model because the services can be substituted for each other. Therefore, a rational user is not expected to buy both mobile broadband services at the same time.

The following table is an output of survey about the willingness-to-pay for 3G Internet service (Henkel, 2002). Because the data was relatively old, the market situation is much different, and user's perceptions are changing, we decide to modify its price range downward 20%. In Henkel's original survey the price range for 3G service was $50 to $100 but readily available on-the-market prices today are from $40 to $80 monthly.

[Table 9] Willingness-to-pay for WiFi & 3G

[3] http://www.fcc.gov/Bureaus/Common_Carrier/Reports/FCC-State_Link/IAD/hzip0607.pdf

3G Price	**$50**	**$60**	**$75**	**$100**
Subscriber (%)	77%	26%	9%	2%

(Source: Henkel, et al. 2002)

[Table 10] Modified Willingness-to-pay for 3G Service

3G Price	**$40**	**$48**	**$60**	**$80**
Subscriber (%)	77%	26%	9%	2%

According to the above modified data, we do a piecewise linear regression because of lower R^2 value of simple linear regression ($R^2 = .687$). The following equation is an estimated demand function for 3G service.

$$P_{3G} = \begin{cases} 52.1 - 0.157 * Q_{3G} \text{ when } 40\% \leq P_{3G} < 48\% \\ 65.3 - 0.667 * Q_{3G} \text{ when } 48\% \leq P_{3G} < 60\% \\ 86.7 - 3.333 * Q_{3G} \text{ when } 60\% \leq P_{3G} < 80\% \end{cases} \quad \text{(Equation 3)}$$

Where P_{3G} = Price for 3G, Q_{3G} = Market Penetration Rate for 3G Subscribers.

The 3G cell size is determined by population density and geographic features. According to Qualcomm's white paper (2004), the radius of a 3G cell is 0.5 miles in dense urban areas, which means one 3G cell can cover 0.785 square miles. The area of the city of Philadelphia is 135 square miles. Therefore, 172 3G cell sites are needed for the city of Philadelphia. For the 3G provider, the authors assume that the provider has an existing infrastructure for the 2.5G wireless data service. The providers also have an advantage in using exiting base stations, which it could share the allotted spectrum band for its 2G voice service. The upgrade cost of a base station to 3G from 2.5G is expected to be approximately $250,000 (Bakhshi, 2001). Based on the above assumption, the following is a profit function of 3G provider.

$$Pf_{3G} = P_{3G} * Q_{3G} * 12 \text{ months} - \{(\text{Upgrade Cost to 3G}) * (\text{Number of Base Stations})\} \quad \text{(Equation 4)}$$

$$\text{Where } P_{3G} = \begin{cases} 52.1 - 0.157 * Q_{3G} \text{ when } 0\% \leq Q_{3G} < 50\% \\ 65.3 - 0.667 * Q_{3G} \text{ when } 50\% \leq Q_{3G} < 60\% \\ 86.7 - 3.333 * Q_{3G} \text{ when } 60\% \leq Q_{3G} < 100\% \end{cases}$$

Using profit equations (2) and (4), WiFi and 3G providers are assumed to try to find an optimal price level to maximize their payoffs under the assumption that the competitor's price is constant. As we mentioned earlier, the 3G provider tries to find its optimal price level within $40 ~ $80, which is user's response range and WiFi provider tries to find its optimal price level within $17.5 ~ $55 i.e. they try to find an optimal pricing which gives them higher profit than any other level of pricing. Since potential subscribers are forced to choose between the two wireless Internet access technologies, the total market shares of both technologies cannot exceed 100%. Additionally, once each competitor arrives at the equilibrium point, they cannot increase their profit by changing their price level. The following table summarizes the equilibrium prices of both providers. In this output, the 3G provider chooses its optimal price $47, $50, or $60, which is dependent on the market share of 3G service provider, as a result, the optimal price of municipal WiFi is always $27.15. Of course, it is not a negotiated price with municipalities but an optimal price for municipal WiFi provider's maximal profit. Comparing the price set by the City of Philadelphia, $27.15 is much higher. But City of Philadelphia considered $21.95 as high enough to generate sufficient revenue to the contracted WiFi network providers.

[Table 11] Equilibrium Price of 3G and Muni WiFi

	P^*_{3G}	P^*_{WF}
Case I: $0\% \leq Q_{3G} < 50\%$	\$47	\$27.15
Case II: $50\% \leq Q_{3G} < 60\%$	\$50	\$27.15
Case III: $60\% \leq Q_{3G} < 100\%$	\$60	\$27.15

5. Conclusion

Broadband Internet networks are becoming an essential public infrastructure. By using WiFi based municipal wireless service, a city can improve municipal government services such as police, fire, emergency services, remote metering, traffic monitoring, and emergency alerts to its residents in times of disasters. Therefore municipal wireless service not only offers enhanced value and satisfaction for its residents but also the municipality can "piggy-back" needed infrastructure to improve its intra-city communication.

There are 312 municipal wireless projects. We categorized the size of cities based on their population. We surveyed the 312 municipals and their municipal WiFi prices. We found that the smaller the city is, the monthly subscription fee is higher. This fact alone explains why a larger percentage of smaller municipalities are successful at operating and maintaining their systems for their citizens. As stated earlier in the paper, the number of competitors in smaller markets declines sharply. Although the FCC has identified broad coverage across the United States, if there is only one high-speed provider in a regional zip code, it is believed that all population can have access. Due to a lack of competition, and increasing demand for high speed service, it is much easier for smaller municipalities to set a price point higher than a larger municipality.

[Table 12] Municipal Wireless Pricing

Category	Population	Number of Projects	Avg \$/ 512 kbps	Avg \$ /1Mbps	Avg Population	Avg Size ($mile^2$)
Towns	0 ~ 9,999	21	\$23.28	\$46.56	3,585	7.36
Cities	10,000 ~ 99,999	35	\$11.02	\$22.04	37,495	23.22
Metro Area	100,000 +	13	\$9.16	\$18.30	357,557	146.72

Source: Each Municipal Web Site

A second caveat is that these are not 100% private company projects of municipal wireless, and as such, pricing is not determined by maximizing the WiFi operator's profit. While appropriate pricing for municipal wireless is not simple, this paper presents an approach that municipalities can use to negotiate price levels with private provider companies for municipal wireless service.

Using Philadelphia's motto 'broadband speed at dialup rates" as an example illustrates how competitive pricing strategy is being played out by providers. The following table shows the price of accelerated dialup Internet connection service by some of the major national Internet Service Providers (ISPs) in 2007. Without a one-year contract, the price range is \$14.95 ~ \$25.90 per month and with a one-year contract it is \$10.95 ~ \$14.95 per month. When negotiating municipal WiFi pricing, dialup pricing (\$10 ~\$15) would be characterized as low margin and a price generated using the game approach (\$27.15) would be characterized as high margin.

[Table 13] Accelerated Dialup Internet Connection Monthly Price

AOL	EarthLink	MSN	People PC	NetZero
$25.90	$21.95 $14.95 / 1 year contract	$21.95	$10.95 with 1 year contract	$14.95

As presented in the paper, among the 19,429 municipal governments in the U.S., only 79 had their own municipal wireless network at the end of 2006 (MuniWireless, 2007). For those that do not have a municipal wireless internet service, this paper provides a good guide for business planning and negotiating with those private companies wishing to serve as the municipalities' operating provider.

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