Municipal Wi-Fi Networks: The Goals, Practices, and Policy Implications of the US Case

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In the wake of WiFi's spectacular rise during the past ten years, a new twist has emerged: the recent few years have seen a growing number of municipal governments deploy Wi-Fi networks, in the US and abroad. According to Vos (2005), there were 82 municipal Wi-Fi networks in the US as of July 2005, an increase from 44 the previous year (Vos, 2004). In addition, another 35 municipalities are currently planning to deploy such networks (Vos, 2005). Outside the US, at the same period, the number has increased from 40 to 69 (Vos, 2005). Such municipal enthusiasm for deploying and operating telecommunication networks comes as somewhat of a surprise given the prevailing trend of deregulation and privatization in public utilities.

This paper explores three broad questions about municipal Wi-Fi networks in the US: why are cities getting involved, how do they go about deploying these networks, and what policy issues does this new trend raise. We first examine the reasons why local governments are suddenly keen to deploy Wi-Fi networks. Local governments' involvement in the deployment and operation of telecommunications networks or public utilities is not entirely a new phenomenon. Their direct involvement with public utilities such as electricity, water, or gas goes back more than one hundred years, and cities have owned cable networks since the late 1980s (for a review of municipal entry into the cable market, see Carlson, 1999; Tongue, 2001). With Wi-Fi, they now have access to a relatively cheap technology that leverages other municipal assets such as the many antenna site locations cities control –such as street lights and traffic signals–. However, set against the prevailing deregulation and privatization of the telecommunications marketplace, local governments' involvement in the deployment of Wi-Fi networks

introduces a new element in the broadband Internet[1] service market. Therefore, we need to understand the reasons why local governments have now decided to enter the fray.

Second, we explore the various ways in which U.S. cities are pursuing construction and operation of municipal Wi-Fi networks. Some municipalities are building and managing public "hotzones," which provide wireless Internet access in downtown or public parks, while others plan to provide wireless access simply for governmental uses for police or fire departments, or for city employees. Yet other local governments pursue broader goals through the deployment of citywide Wi-Fi networks. Local governments propose to play various roles ranging from simply financing networks to building and operating them (Gillett, Lehr, & Osorio, 2003). Although Wi-Fi networks require less capital than their wired counterparts, they still have to be funded and maintained. Cities are pursuing a variety of business models to support their efforts, ranging from subsidized free nets to advertising-supported or various forms of fee collection. This raises questions about capital investment to cover construction costs, revenue streams to cover operations and customer service, even the possibility that municipalities may use the new networks as a revenue source. These business models in turn promise to shape the long-term sustainability and future evolution paths of the municipal Wi-Fi networks. Where cities choose to charge citizens for Wi-Fi service, they come in direct competition with industrial actors, including incumbent wired network providers.

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[1] The term broadband is commonly used to refer to "data services that are fast, always available, and capable of supporting advanced applications requiring substantial bandwidth" (FCC, 2005, p. 11). More specifically, however, it means "an advanced telecommunications service that has the capability of supporting, in both downstream and upstream directions, a transmission speed in excess of 200 kilobits per second (kbps)" (FCC, 2004, p. 12).

Finally, the approach cities decide to follow will shape to a large extent the local policy goals they might pursue through their Wi-Fi networking activities. For example, it will affect their ability to explore synergies between the provision of traditional city services and network access, the extent to which they can use Wi-Fi as a tool for economic development, or whether Wi-Fi can help them bridge the local digital divide. These local issues form the backdrop of intensifying state and national policy debates with regard to whether local governments should be allowed or not to provide wireless Internet services. The paper's third section explores the arguments on both side of this debate.

Altogether, the current wave of municipal Wi-Fi deployment unleashes a wide variety of technology, application, organizational and policy experiments. Behind the current nationwide debate about the proper role for cities with respect to broadband network deployment and operation, one particularly interesting policy question is whether these multiple experiments should be allowed to proceed, or whether they represent wasteful, duplicative, un-coordinated efforts. We argue that there is much to be learned from letting these local stories unfold, so that we can explore a variety of deployment trajectories for Wi-Fi. Relying simply on nationwide carriers following a nationwide coordinated blueprint might be more efficient in the short-term pursuit of known opportunities, but at the cost of discovering possibly richer alternatives through multiple local experiments. Given its low deployment cost and technical features, Wi-Fi makes sense for limited scale deployments and constitutes an ideal platform to engage in such multiple simultaneous experiments.

Why Municipal Wi-Fi networks?

Two main forces fuel the current wave of municipal Wi-Fi deployment. First, with mass-produced low-cost unlicensed wireless technology, municipality have easy access to the *means*: Wi-Fi networks are relatively cheap to deploy and operate, and they take advantage of available city assets such as street lights and urban furniture which make ideal antenna sites. Second, municipal governments point to a growing list of *motives*: Wi-Fi networks can help them to provide connectivity for city employees, entice businesses to locate in their downtowns, make their local convention centers more desirables, and offer broadband internet access to citizens whose homes were beyond DSL's reach.

The mass-market development of Wi-Fi technology has given local governments the means to deploy pervasive local broadband networks that are relatively cheap when compared to earlier wired alternatives. The technology's success resulted from three main forces that lead to its wide-spread diffusion (Bar & Galperin, 2004). First, the absence of license requirement on the 2.4Ghz and 5Ghz spectrum in which Wi-Fi operates has led to wide-ranging participation in the technology's development. Second, industry-led standardization of the technology through the IEEE and the Wi-Fi Alliance has ensured broad interoperability. Finally, the resulting large scale production of Wi-Fi chipsets resulted in very low unit costs for Wi-Fi equipment, fueling the technology's integration as standard equipment in laptop computers and allowing wide diffusion of Wi-Fi access points for private and public use. The availability of unlicensed spectrum and the low equipment costs have spurred new demand from households, businesses and

government agencies for wireless Internet access, thus motivating local governments to explore wireless broadband provision as part of their commitment to serve their communities.

Furthermore, the related development of new mesh wireless architectures gives cities a distinct advantage. Early uses of Wi-Fi mainly saw the connection of access points at the end of broadband lines, offering a 'cordless Ethernet' for data access reminiscent of cordless phones for voice. Mesh architectures allow data to bounce from one Wi-Fi device to the next, reaching its ultimate destination through a series of wireless hops. Importantly, while cordless Ethernet deployments required each access point to be wired to the network, meshed devices only need a power source and self-organize into an alternative network. This gives municipalities a distinctive advantage since they control a large number of powered locations dispersed throughout urban areas –street lights, traffic signals, municipal buildings, police and fire stations that can all serve as excellent sites for mesh devices. Maintenance of the mesh network can become part of on-going maintenance of these facilities, allowing cities to benefit from economies of scale and scope in their operations (Lehr, Sirbu, & Gillett, 2004). By contrast, private carriers who have attempted to build public urban Wi-Fi networks have had to negotiate access rights to sites, and have largely resorted to making deal with store chains such as Starbucks coffee shops and Kinko's copy centers. Moreover, local governments that own public utilities have decades of experience in operating complex technologies, serving customers of many kinds, managing billing and collection systems, and providing technical support (Baller & Stokes, 2001; Bar & Galperin, 2005). As a result, many

municipalities have come to see Wi-Fi networks as a natural extension of their on-going activities.

Not only do municipal governments have the means to deploy Wi-Fi networks, they also have a number of key motivations for doing so. First, local governments need broadband networks to support their internal operations and deliver services to their citizens. Networks are essential for government to provide services such as code enforcement, utility monitoring, meter reading, police or fire protection, and cities operate internal networks to support their employees in all those tasks, as well as inter-governmental communications (Gillett, Lehr, & Osorio, 2003). To the extent that Wi-Fi technology allows them to deploy these networks more cheaply and to offer better network coverage throughout urban areas, they help enhance government work performance and lower provision costs for those services. Furthermore, governments are increasingly eager to provide on-line services to residents and businesses, ranging from building permit applications, access to government meetings or municipal databases such as property information and crime statistics, and on-line participation in civic debate. Second, local governments see the provision of broadband wireless access as a way to promote local economic development. They believe that pervasive broadband access can create significant incentives for businesses to locate in a particular area, and can attract business visitors and conventions. The third rationale is about providing universal and affordable broadband Internet access to their residents – thus bridging the digital divide. Internet access and ICTs are important for people to sustain and enhance their social, economic, educational, and cultural lives in the Information Society. However, recent reports indicate that US broadband penetration has fallen from third to sixteenth in the

world during the last four years and broadband access for American citizens continue to lag behind most other industrialized countries (Turner, 2005.)   Some local governments, faced with what they perceive as lukewarm private sector efforts to solve this problem, seek to provide "public information utilities" as they did in the past with essential public utilities such as electricity or water (Sackman & Boehm, 1972; Sackman & Nie, 1973.)

Parsing through the various justifications for municipal Wi-Fi deployment projects, we find evidence of these three rationales.   Municipal Wi-Fi networks serve to increase the effectiveness of government service delivery in many public safety networks. For instance, the police department of San Mateo, CA, claims it was able to improve the productivity of its officers without increasing the number of patrols on the street by giving them better access to police resources through a metro-scale Wi-Fi network. Municipal deployments are pursued for economic development goals in Metropolitan cities such as Philadelphia, Los Angeles, or San Francisco, which are currently planning to construct citywide Wi-Fi networks or providing free broadband access in hotzones. In the case of Philadelphia, the city government decided early this year to spend an estimated $10 million to build a Wi-Fi network which would cover the entire 135-square-mile city area as a way to remain a competitive location for businesses and an attraction for visitors (The Wireless Philadelphia Executive Committee, 2005). In a plan to deploy a citywide Wi-Fi network, the city government of Los Angeles also claims that it is essential to have a reliable, affordable and accessible broadband network in order to maintain and enhance the economic activities of the city (Mayor's WiFi & Beyond Executive Advisory Panel, 2005).

Small counties where other broadband services have not been available are also considering citywide Wi-Fi networks or hotzones in order to entice businesses to locate in their community or keep them from leaving. For instance, some local governments have built Wi-Fi networks in an effort to meet the needs of businesses that require high speed communication facilities. The city government of Scottsburg, IN, which has a population of 8,000, decided to build its own Wi-Fi network in response to local auto dealerships' request for broadband Internet service provision. In order not to lose approximately 70 jobs provided by the local dealerships, the city government has invested $385,000 for the construction of a Wi-Fi network (Reardon, 2005a), which currently has more than 400 customers (Muniwireless.com, 2005). Long Beach, CA, provides free wireless Internet access in its downtown and convention center in an effort to attract visitors and convention organizers (Bar & Galperin, 2004.)

Many local governments seek to provide universal and affordable broadband Internet access to underserved areas and to residents who cannot afford to pay high prices for commercial internet service (cable modem or DSL.) For example, before the city of Chaska, MN built its own Wi-Fi network, the local phone company, Sprint, provided DSL service for $40-45 per month, and the local cable company, Time Warner, offered cable modem service at $45-50 (Reardon, 2005a). Now the city-owned ChaskaNet offers Wi-Fi Internet service for $15.99 a month (Tropos Networks, 2004a), and more than 2,000 of its citizens were paying subscribers as of October 2004 (Cox, 2004). In the case of Cerritos, CA, before the city government built its municipal Wi-Fi network, no area of the city was covered by cable modem, and only a small portion was served by DSL with inconsistent access at best (Tropos Networks, 2004b). Since the inception of the network,

the residents of the city have enjoyed Internet access at about $30 per month (Pronto Networks, 2004).

Some local governments also hope their Wi-Fi networks will generate additional revenues, but these may be a long time off. It is projected that it would take a few more years for local government to reach a break-even point, since they have invested a considerable amount of funds in the construction of Wi-Fi networks. Even one of the most ambitious municipal Wi-Fi network, in Philadelphia, anticipates that it will not break even until its fourth year of operation (The Wireless Philadelphia Executive Committee, 2005). Especially in cases where cities provide free access to users, relying on advertising revenues from local businesses to recoup their expenses, additional revenues in a short term look harder to achieve. One case in point is the recent cancellation of Orlando's city Wi-Fi network where wireless access was free. The city government of Orlando anticipated as many as 200 users a day, but only 27 users per day showed up, forcing the network to shut down because the city could not justify spending $1,800 per month to keep the system running (Ewalt, 2005). Thus, whether or not municipal Wi-Fi networks can provide additional revenues to local governments still remains to be seen.

Searching for viable business models

In their efforts to deploy municipal Wi-Fi networks, local governments have proposed a wide array of organizational structures and business models. Various proposals have discussed structures such as private consortium, public community enterprise, cooperative wholesale, public authority, nonprofit, private sector partnership,

and it can be confusing to sort through the multiple options. Fundamentally, two

questions guide our analysis of the various options under discussion: who would own the

network? and who would operate it? For each of these two questions, there are

essentially three answers proposed – the same set of three for both questions–: the city,

one private actor (usually a Telco or an ISP, or a company like Google in San Francisco),

or multiple others (a set that can include local merchants, Wi-Fi cooperatives, multiple

ISPs, or community organizations.)   The resulting nine possible options are mapped out

in table 1, each one leading to a unique set of policy issues. Of course, these nine options

are not mutually incompatible and local governments can elect to combine several of

them. Each however represents an archetype, useful to explore specific policy issues.

We review the three ownership options in turn, examining the implications of different

operating arrangements.

Who owns? / Who operates?	City	One private actor	Multiple others
City	Public utility	Hosted services	Public overlay
One Private actor	Wholesale	Franchise	Private overlay
Multiple others	Wholesale Open platform	Common carrier	Organic mesh

Table 1: muni Wi-Fi business models

City-owned networks

In a first set of cities, local governments choose to own the Wi-Fi network

infrastructure. This option is often chosen in cities where the initial motivation is to

provide communication facilities for the city's internal needs. They typically contract

with an equipment maker to install network equipment on city-owned sites. When their plans go beyond internal use to include offering Wi-Fi service to the public, municipalities have three main choices.

The first is for the city itself to operate the service and retail it, through a public utility along the lines of municipal water or power utilities. The most prominent reason for adopting this model is to take advantage of the past experience of public utility companies in provision of other infrastructure. Through such an arrangement, cities can leverage their existing resources for subscriber acquisition, customer service, technical support, and billing. The city of Owensboro, KY, has adopted this model. Owensboro Municipal Utilities contracted with Alvarion Networks to build the network it owns and operates. Alvarion Networks also built Wi-Fi networks in Scottsburg, IN, and Island Pond, VT, the cities own and operate their citywide municipal network with service fees of $35 and $30, respectively. The city of Chaska, MN, is another example, where Chaska.net, a city-owned ISP hired Tropos to built the Wi-Fi network it owns and operates, charging residents $16 per month.   Thus far, only a few cities have adopted this business model. These have typically been relatively small cities, ones where private Telcos and cable companies were not providing broadband internet access.   The advantage of the public utility model is that it gives cities the greatest control over the network, its operation and the services it provides.

A second option is for the city to act as a wholesaler, reselling excess capacity in the network to a private operator, usually a telecom company or an internet service provider, who then retails Wi-Fi service to the city residents.   In this model, while a city funds the design, construction and operation of a municipal Wi-Fi network, service

providers perform customer acquisition, customer service, technical support, and billing. The city can receive benefits through reduced telecommunication costs by owning the network, instead of leasing it from private companies. The city of Pasco, WA, follows that approach, where the city's utility company owns the network while a private ISP is in charge of the network operation, charging residents $25-75 per month. The Wi-Fi network of Long Beach, CA, is another example, where the city government contracted with a private vendor, Venier Networks, to build the network while Color Broadband and G-Site are responsible for operation of the network and management of login website, respectively. In Hermosa Beach, CA, the city hired Strix Systems for the construction of the network, leaving LA Unplugged in charge of its operation. The planned Philadelphia network adopts this model and the city recently appointed a commercial ISP, Earthlink, as the service provider.

A third option offers a variant on the wholesaler model in which the city offers excess capacity in its network to several ISPs, as an open platform. No city has followed that path so far, although this model is one of those under consideration in San Francisco for the city's upcoming Wi-Fi deployment. It will be particularly interesting to follow the development of such an arrangement, now that DSL is moving away from providing an open network for ISPs (cable has always been closed.)

In all three operation approaches, a city's ownership of the network gives it substantial control over its deployment, coverage and service conditions. However, these modes put the city in direct competition with private telcos and cable companies for the provision of internet service.

Single Private owner

In a second set of cities, local governments are making agreements with one private company to build and own the network, under an agreement that allows them to use city-owned antenna sites. In that case the same three options exist for network operation.

The first option, municipal operation of hosted services on that private infrastructure, is possible in theory but unlikely in practice. A city choosing that approach would essentially set up a municipally-controlled ISP offering services on privately-owned Wi-Fi facilities. So far, no city has explored that avenue.

The second, and by far the most prevalent option is for the private network owner to operate the Wi-Fi service as well and sell it directly to consumers.   This arrangement mimics the franchising of cable systems operators, and cities can structure agreements that carve out city benefits similar to the public/education/government (PEG) access channels in addition to eventual franchise fees and access fees for antenna siting. In most of these cases, the city is the private concern's main customer, in effect the "anchor tenant" of that Wi-Fi system.   In many cases also, the city uses its control over right of access to antenna sites to negotiate provision conditions with the network provider. These can range from limits on monthly fees (for all subscribers or specifically targeted to economically disadvantaged city residents), or requirements insuring network coverage throughout the city. The city of Cerritos, CA, was one of the first to adopt this business model for its Wi-Fi network. In this case, equipment makers Tropos Networks and Pronto Networks built the citywide network, which Aiirmesh then owned and operated. The city provided access to municipal buildings and intersection signal light structures for antenna

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installation (Pronto Networks, 2004). After its construction, the Wi-Fi service is now available to more than 50,000 city residents (Pronto Networks, 2004). The city is Aiirmesh's largest customer and engaged in negotiations that resulted in Aiirmesh offering a range of service levels such as Aiirmesh Home for local residents, Aiirmesh In-Town for visitors, and Aiirmesh BusinessPro for business use.

A number of cities have adopted this franchise model largely because, by delegating the deployment and operation to private vendors and ISPs, local governments simply take on the role of organizer, and thus rely on the franchisee for the construction, operation and administrative tasks. Their control over city-owned rights of way allows local governments to influence the shape and character of Wi-Fi service, to receive revenue as they charge for access to this physical infrastructure, and to negotiate terms of access to the network for their internal use. This business model does not require the city to invest up-front in the construction of the network and the franchisee has incentives to operate the network efficiently to generate profits and compete with other forms of internet service.

In a number of smaller cities that have adopted this model, such as Cerritos, CA, there was no alternative broadband service available. The project unfolded smoothly as residents directly benefited from newfound internet access, while there where no existing broadband providers to complain about unfair competition. However, the way in which cities use their power over antenna location sites to choose specific network operators seems bound to raise controversy, especially as larger cities adopt this model. For instance, the city government of Milwaukee, WI, recently declared that it would follow such an approach for the construction of its citywide municipal network, at no cost to city

tax-payers. Critical concerns have been raised about how much the local government would charge for the use of city infrastructures, how it would control ISP rates, and how it would go about selecting the franchisee.

The third option, one also that is theoretically possible but so far not implemented in practice, would see the private network owner function as a <u>common carrier</u>, making its Wi-Fi network infrastructure available to multiple ISPs, city services, and possibly others such as private networks. They may choose to do so because of requirements imposed by the city (for example in exchange for access rights to antenna sites) or because it makes business sense to have others retail the service to individual customers. This is one of the options currently under discussion in the city of San Francisco.

Multiple private owners

Finally, cities may choose to encourage construction of Wi-Fi networks by multiple actors. This could include local Wi-Fi co-operatives, retail businesses (in shopping districts for example), or community organizations, in addition to for-profit network providers. In a sense, this constitutes a continuation of the current deployment mode for Wi-Fi, where a number of independent private and public efforts have led to the deployment of un-coordinated Wi-Fi coverage areas. As local governments ponder their options to foster more consistent coverage and services, one of their options is to use their authority to promote greater coordination among these various efforts and to encourage more consistent coverage within municipal areas. Here again, there are multiple options for network operation.

A first option is for municipalities to offer a common public overlay to these multiple networks, that could provide features ranging from a common city 'branding' to uniform login and authentication. A similar concept has been promoted by wireless community activist project "NoCat.net" in the form of a suite of software services including NoCatAuth (a centralized authentication system that works across multiple independent co-op networks), NoCatSplash (a user front-end for access authentication) and NoCatMaps (a free node database and mapping tool).[2] This approach is very closely related to the way in which the city of Austin, TX, has encouraged the coordinated deployment of multiple independent Wi-Fi systems through the Austin Wireless City project (Fuentes-Bautista and Inagaki, 2005.)

A second option would be for the multiple network owners to outsource service provision and retail/billing operation to a private overlay operator such as Boingo or iPass: this is currently one of the prevailing models for commercial public Wi-Fi provision in coffee shop and hotels, a model that could conceivably be extended to other types of venues. For example, Boingo currently lists free networks on its Wi-Fi location finder interface, although it obviously doesn't charge for access through them.

The third option, a set of diversely-owned network facilities operated by multiple players would provide an interesting test of the self-organizing, organic mesh envisioned by proponents of a broadly open spectrum common (see Benkler, 2003 and Reed, 2002)

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[2] For more information, see http://nocat.net. The project, hosted by O'Reilly and associates in Sebastopol, CA, takes its name from a quote attributed to Albert Einstein, who is said to have described radio in the following way: "You see, wire telegraph is a kind of a very, very long cat. You pull his tail in New York and his head is meowing in Los Angeles. Do you understand this? And radio operates exactly the same way: you send signals here, they receive them there. The only difference is that there is no cat."

Optimistic visions expect that current Wi-Fi deployments might naturally emerge into a more ubiquitous self-organizing coherent mesh network, where the multiple players seek interconnection or collaboration arrangements as they see fit. However, one could envision a local government taking an active role to usher in such an outcome, for example by promoting broader Wi-Fi deployment in city-owned buildings such as libraries and municipal offices, or by making antenna sites available in exchange for a commitment to cooperate with other Wi-Fi networks in the area.

The debate about municipal Wi-Fi

Opponents of municipal Wi-Fi deployments raise three main objections. First, they claim, cities' involvement represents unfair competition for private carriers because they can use public assets. Second, they argue that municipal governments have no particular technological expertise and are likely to prove incompetent in selecting technological approaches, applications and business models. Third, they believe that government intervention, favoring one specific technology creates distortion by foreclosing competition among alternatives in the marketplace. The debate quickly turn to quasi-ideological fights about the proper place of government in modern society.

Perhaps more productively, it would be useful to clearly examine the four key government roles that underlie the various business models and the policy arguments explored in this paper and articulate the policy rationale for specific kinds of government

involvement in Wi-Fi deployment.[3] We sketch these here, leaving a full development of the related arguments for another paper.

(1)   Use of city-owned structures. A recurring theme in the reasons invoked by cities to justify their Wi-Fi deployments (and a core gripe of the private actors they then compete with) is the free access cities have to ideal antenna sites. Rather than questioning the right of cities to deploy Wi-Fi, it would be more useful to examine the conditions under which public and private actors alike should be able to gain access to these facilities.

(2)   City use of the network. Local governments often stand to become the principal user of the Wi-Fi network. The question then is whether the most efficient way for cities to serve their own networking needs should be to in-source or out-source the Wi-Fi infrastructure and its operation. One important related factor that should be included in that analysis is the potential for synergies that could be open by having a single actor, the local government, be both provider and user of the network, which open useful avenues for virtuous learning cycles.

(3)   City funding of the network. In many cases, municipal involvement in Wi-Fi deployment has an important financial component –cities might propose to fund the network's construction or subsidize its operations. In such cases, it is important to examine the two underlying rationales for such use of taxpayers money. First, it might be argued that private parties would be short-sighted, or their capital too "impatient" to wait for long-term returns. A second argument would encourage the inclusion of social goals

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[3] These four issues were among the points highlighted by Douglas Lichtman in his remarks at "Wireless Broadband: Is the U.S. Lagging? Markets, Technologies, and Public Policy in a 21st Century Wireless World", Rayburn House Office Building on Capitol Hill, Washington, D.C., October 25, 2005

such as bridging the digital divide in the evaluation of such funding decisions. In both cases, the underlying political debates should be confronted directly.

(4)   City regulation of prices. Finally, some local governments seek to justify their involvement on the grounds that there is a social need for them to influence the service's pricing level and structure, so as to encourage access by certain population categories. Some critics have pointed out that providing target user populations with vouchers toward commercial internet access may be a more effective way to achieve these goals (Thierer, 2005.) Here again, the underlying social policy deserves to be debated directly, and its mechanisms clearly articulated.

The deployment of municipal networks has provoked a political and legal fight with regard local governments' right to build those networks. Confronted with the increase of municipal Wi-Fi networks, legacy network providers (telecom and cable companies) and their supporters argue that cities and municipalities have unfair advantages over private companies, because they regulate those private companies, avoid fees and taxes, obtain low cost finances, and utilize public work forces and facilities. They argue that cities and municipalities subsidies allow them to offer network access at below-cost prices, which in turn distorts fair competition and puts private companies format a serious disadvantage. Telcos Verizon and SBC initially led the battle, but they were recently joined by cable companies such as Comcast. Recently, after the announcement from the city government of Philadelphia that Earthlink would be the ISP for Philadelphia's citywide Wi-Fi network, Comcast argued that the role of local governments should be limited to that of a disinterested arbiter, and that they should not be the ones to pick Wi-Fi winners (Cooper, 2005). Carriers have successfully lobbied for

state and federal legislation to prohibit local governments from providing broadband Internet services.

Thus far, at least 14 states including Texas, Virginia, and Missouri have enacted laws that would prohibit municipal provision of broadband Internet services, while Nebraska explicitly allowed local governments to provide such services. The debate has now extended beyond the States to the national level. Early this year, Texas Senator Pete Session introduced a bill that would effectively prohibit state and local governments from providing the Internet, telecommunications, or cable service if a private company offers a substantially similar service. Senators John McCain and Frank Lautenberg introduced a opposite bill, the so-called "Community Broadband Act of 2005", which would by contrast explicitly authorize local governments to deploy broadband networks. Later, Senator John Ensign introduced another bill, the "Broadband Investment and Consumer Choice Act of 2005", suggesting that local governments must first notify carriers and allow them to bid for the provision of broadband services if they want to offer the services to their residents. While Ensign's bill does not abolish municipal governments' right to deploy broadband networks, it places heavy administrative burdens in their way making it fairly close to Session's bill (Tapia, Stone, & Maitland, 2005.) The debate with respect to the municipalities' provision of broadband Internet access is ongoing in the US Congress.

Conclusion

Part of the excitement surrounding the current wave of municipal Wi-Fi in the United States stems from the wide-ranging experimentation that accompanies these

deployments, in areas ranging from technology and applications to institutional

arrangements and policy approaches.   From a technological standpoint, municipal Wi-Fi

networks represent the largest deployment of mesh architecture, a chance to test in a real-

life environment whether this promising architectural approach is indeed as resilient as

expected, and how it truly scales.   From an applications standpoint, we can expect

fascinating experimentation to result from the municipal governments combined roles as

user and provider of networking applications, one that allows them to leverage synergies

associated with simultaneously learning "by using" and "by doing" Wi-Fi networking, as

well as the development of a new class of civic applications that could potentially

transform the relationship between citizens and their governments.   Equally interesting

will be the institutional experimentation. Diverse cities, pursuing a variety of

organizational arrangements and business models, will constitute many testing grounds

for policies exploring alternative allocations of roles and responsibilities, diverse

combinations of public and private incentives. If only to learn the lessons from these

technological, applications and institutional experiments, the municipal Wi-Fi movement

should be allowed to proceed without federal restrictions. Because of its local character

and relatively small minimum efficient scale, Wi-Fi networking is perfectly adapted to

experimentation at the municipal scale.

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