

Wireless Broadband from Backhaul to Community Service:
Cooperative Provision and Related Models
of Local Signal Access.

Matthew Wong

Faculty of Information Studies,
University of Toronto,
140 St. George Street, Rm. 310
Toronto, Ontario, M5S 3G6
Canada

matthewa.wong@utoronto.ca

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1 From Backhaul to Community Service

For many cities, the current availability of broadband Internet coupled with affordable wireless networking technology creates an environment of great community broadband potential. With many homes and businesses connecting to the Internet via high bandwidth broadband services and using standard wireless technologies, it is now common to detect wireless signals in public and private spaces. While many wireless signals are often protected to block unauthorized access, others are left in an unprotected or “open” state. Whether intentional or not, it creates an abundance of disorganized, but accessible, high-speed wireless connections that blanket parts of these urban areas. A variety of different wireless groups have recognized the potential for this broadband “backhaul” to be transformed into some form of community service. These groups typically differ from each other in their vision for what these services could be, how they might be organized, and what philosophies drive their work. However, these groups are unified in their goals for value-added access and infrastructure for individuals and communities.

In this paper I will explore the theme of converting this existing wireless broadband backhaul into services designed to benefit communities. This paper will be primarily based on case study research conducted on Wireless Nomad, a Toronto, Canada-based Internet Service Provider (ISP). I will rely on qualitative and quantitative research conducted into wireless Internet use practices and attitudes among urban users in Toronto. For comparison, other examples of community wireless service will also be explored. These services will be discussed in light of several different dimensions, including type of service, location of service, ownership/governance, ideology, and business model. In addition to Wireless Nomad, FON, a worldwide personal sharing organization, and *Ile Sans Fils* and Wireless Toronto, two similar Canadian community groups, will be studied. Through this discussion and analysis, this paper will highlight some key issues for wireless networking deployment such as addressing user needs and demand for wireless Internet, and long-term sustainability. The paper will also consider the ways in which

these organized possibilities for signal sharing can be further explored in practical, economical, technical, organizational, and legal terms.

2 Broadband Service and Internet Clouds

Over the last decade, Internet use in countries around the world has grown dramatically, particularly in large Canadian cities, such as Toronto and Montreal. Canada is widely acknowledged as having strong broadband penetration rates (Frieden, 2005; Chukwuma, Furnell & Ghita, 2002; Wu, 2004) and the statistics available from Canadian census data suggest Internet growth across the country. In urban centres like Toronto and Montreal, 75% and 68% respectively of adults over the age of 18 were using the Internet, overwhelmingly via broadband connections (Statistics Canada, 2006). Users are increasingly using the Internet for many facets of their lives including communication, entertainment, and information seeking.

One possible influence in the growing use of Internet services is the standardization of wireless Internet technology. Wireless networking is being used as a way to provide access in new places and the effect that this growth has had around the world is striking. It is roughly estimated that some 200 million Wi-Fi chipsets had been sold in 2005 (Shah & Sandvig, 2005, pg.7). With wireless, individuals can now create opportunities for Internet use without being tethered to a wired location. Wireless Internet, commonly abbreviated as WiFi for “wireless fidelity,” is based on the IEEE 802.11 protocols. WiFi was introduced as the 802.11 ‘b’ protocol in 1999, primarily for extending or replacing traditional wired networks with a wireless equivalent (Varshney & Vetter, 2000, pg.74). Even now, WiFi is still commonly used simply as an alternative to wiring Ethernet cables, irrespective of other unique mobile-enabled applications. Since 1999, there has been rapid growth and development in wireless technology with products such as routers and laptops becoming both abundant and affordable for the home consumer. Schmidt and Townsend (2003) noted that in 1999 wireless base stations cost as much as \$1000,

but only four years later had dropped to \$100. Some have attributed this drop in consumer cost with the explosion in home networking (Damsgaard, Parikh & Rao, 2006). Wireless “hotspots” (intentional access points) in public spaces such as cafes, airports, and on university campuses have also become more widely available (Battiti et al., 2005, pg.278).

Wireless signals, being radio waves, often overlap one another and create dense “clouds” of wireless coverage¹. When left in an open state, other wireless devices can detect the signal and use it to access the Internet. Alternatively, shared access can be granted by providing users of the signal with the Wired Equivalent Privacy (WEP) key that corresponds to the particular Service Set Identifier (SSID). Another form of intentional sharing uses captive portal technology, where users are redirected to a log-in page requiring a password. Both of these approaches have been employed by individuals and organizations in order to explore opportunities for sharing.

Andersen (2003) described this evolving ubiquitous use of wireless networks as a new paradigm and speculated that “the future belongs to small, connected devices that will wirelessly allow the user – and the technology – to self-organize, creating something smart out of many small and simple nodes and connections” (para.12). However, WiFi signal sharing is often the result of networks being left inadvertently open. Users are often cautioned about leaving their networks unprotected for fear of hacking, privacy invasion, or unauthorized use (Shah & Sandvig, 2005). In this environment of wariness towards sharing and presumed unwanted contact, exploring sharing as a service can be daunting. Sharing one’s connection with others where fair access, usage, and payment may all be in question can present an unappealing proposition. Furthermore, given that 802.11 networks operate in the license-exempt 2.4 GHz Industrial, Scientific, and Medical (ISM) band which is crowded with a multitude of commercial devices

¹ Sandvig (2004) also uses the term cloud in this sense, suggesting that these clouds are composed of “heterogeneous networks that interoperate by accident as often as by intent” (pg.583)

(e.g. microwave ovens, etc.), interference often creates signal reliability issues that reduces longer ranged WiFi appeal. Yet, with the abundance of wireless signals carrying high-bandwidth broadband, and the motivation to create something “smart”, there is a clear potential for uniting even some of these signals into greater Internet projects. Creating a network that is more than the sum of the individual, disparate parts. These disparate network nodes have been described as “islands”, an accurate moniker despite their eventual collective connection to the Internet (Sandvig, Young, & Meinrath, 2004).

3 Approaches to Transforming Backhaul into Community Service

Sandvig (2004) noted that in 2003 there were dozens of WiFi co-operatives in the world, and Tapia and Ortiz (2006) identified nearly 360 municipal wireless projects in the United States alone. There are probably also many smaller, less formalized, grassroots community initiatives as well. The interests and objectives of community and municipal wireless Internet projects can be loosely grouped into two broad goals – improving access through wider availability and lower costs, and improving democratic ownership over public goods, in part by gaining control of communications infrastructure that would otherwise be in the hands of private telecommunications companies (Wong, 2006; Gibbons & Ruth, 2006; Goth, 2005; Lentz, 1998). However, not all groups interested in utilizing WiFi for their various purposes are the same, with distinctions between even broad categories of description. Cho (2006) noted, “there is an obvious difference between [community wireless networks] that focus on providing residential access and those that focus on general public access, and those that are in urban and non-urban locales” (pg.9). There are also groups interested in opening hotspots, as well as those interested in social and community technology (Powell & Shade, 2005, pg.6). It would be an extensive project in itself to create a complete and accurate typology of all community wireless organizations. Especially given the variety of ways in which they could differ from each other, for example, in their choice of wireless technology. However, several dimensions of categorization exist that are more obvious and clearly defined for describing these groups.

3.1 Type of Service Offered

The type of service offered refers to what the community organizations choose to do with the wireless technology. It can be taken for granted that at a minimum, the organization will offer wireless Internet connectivity via access points. In addition to regular Internet access (i.e. surfing and email) the service may be supplemented with additional features and content. It may also be the other way around, in that the main function is the additional features and content, while basic Internet access is simply the medium. This might be consistent with the current age of the Internet, what some have called “Web 2.0,” where community, collaboration, and user-generated content are the order of the day (Boll, 2007).

How the wireless technology is implemented also varies between groups. For example, it is typical among wireless groups to reprogram existing commercial wireless routers with customized software². Other groups have created their own hardware for wireless broadcasting or use third-party devices. In fact, for larger scale municipal deployments, there are a whole host of technology companies offering wireless devices, such as Tropos Networks, BelAir Networks, Motorola, and Trango Broadband, to name a few³.

3.2 Location of Service Offered

The location of the service does not necessarily refer to a specific geographical location (although many are based in particular cities), but rather the general description of the location, such as urban or rural, sub-urban or inner city, residential or business, and so on. Another important location identifier is whether the deployment is in public spaces, such as parks or libraries, or in private spaces, such as coffee shops, or even people’s homes. While the community groups studied in this particular paper are generally based in urban, mixed residential and business locations, wireless community groups are frequently associated with rural

² For example, OpenWRT is a third-party Linux distribution for embedded devices frequently used in Linksys WRT54G routers. See <http://openwrt.org>

³ There are numerous other companies offering wireless products, the listed examples were highlighted as all prominent sponsors and presenters at the 2007 Wireless Cities Summit.

deployments. WiFi has been shown to be very useful as a means of connecting disadvantaged, rural, isolated, or smaller communities where cabling costs may be prohibitive (James, 2001; Tully & Riekstins, 1999;).

3.3 Ownership and Governance

Ownership and governance are a related concept that refers to who owns the network, as well as who or what body of people make the decisions for the group. This has different influences on the various community groups. For example, users might own the equipment they use by virtue of having paid the organization for it, but may not actually have much or any control over how the device is used in the network. On the other hand, individuals may be renting or borrowing the equipment from the group while retaining complete control over how it is used. Community groups that resell Internet connections may themselves be at the mercy of their bandwidth or line suppliers. In terms of governance, community groups might be organized around a co-operative or other democratically oriented model. Or more similar to conventional service providers, users might be customers (rather than members) and have little input into the decision making process of the provider.

3.4 Ideology

Ideology and a philosophical position or motivation can play an important role in community groups. Organizational goals and objectives may go above and beyond simply providing wireless Internet access. For example, a wireless community group may exist to challenge existing providers. Powell (2006) noted that many community wireless networks “were founded or organized around the idea that they could provide an infrastructure alternative to that of the increasingly commercialized internet” (pg.4). Wireless groups may also exist to promote local interests or support community ventures in entertainment, art, or politics. Or, a wireless group may be born out of an interest in the technology and opportunities that arise from it. Indeed, as Verrill said in 1922 (as quoted in Sandvig, Young, and Meinrath, 2004), “it is highly probable

that many of the greatest inventions and improvements of the future will come from amateurs who, by experimenting, chance upon undreamed of things” (pg.3). Irrespective of the particular ideology motivating community groups, it is certain that many of these groups exist because of a perception that wireless technology is a means to achieve greater goals.

3.5 Business Model

The business model dimension is used somewhat loosely here to refer not to a specific kind of business plan, but rather to better understand costs and organizational structure. Given that many community groups exist to provide both payment and infrastructure alternatives approaches to the consumer/provider Internet service subscription model of business, the term “business model” should be interpreted correspondingly in a less formal way. In particular, given that many of these community groups are volunteer-based and disorganized, formal business modelling might not be very effective at describing how these groups operate. Municipal groups, on the other hand, in particular those organized by city governments, are probably much more rigorously modelled and requests for proposals from consultants and third-party providers would likely demand all the details and processes.

4 Putting Wireless Use in Context

It is instructive to first provide some context behind both the perception of wireless Internet use as well as its actual use. After all, wireless groups are ultimately providing a service to individual users who may care a great deal about the kind of Internet services they are receiving and what it might be able to do for them. Particularly in cases where a community group’s service may be replacing a traditional ISP, there may be a number of requirements the user might have, such as reliability and speed. Furthermore, expectations may change if the user is paying for the service. Sharing can play an important role in a community group’s plans, yet the perception among users of the risks and benefits of sharing will play a key role in their decision to adopt such a system. For example, there may be issues of trust if a connection is being

shared with neighbours, other members of the community, or strangers. Individuals may not want to share with others because they are wary of these people might use their connection, or because of concerns about computer privacy and security. On the other hand, individuals may be encouraged to share to help out others in their community, such as those who might not be able to afford Internet otherwise.

4.1 Methodology and Results

Our research into wireless use employed both qualitative and quantitative data collection. We first conducted radio surveys of wireless signals in two urban Toronto neighbourhoods in October and November of 2005. Between November 2005 and May 2006 we then recruited current wireless users for two successive questionnaires, followed by in-depth interviews with selected questionnaire respondents. The following presents some selected results and analysis synthesized from a larger body of work we conducted as part of a research study (Wong, 2006; Wong and Clement, 2007).

Radio surveys were conducted in order to assess the number and kinds of wireless networks present in the two neighbourhoods. The surveys consisted of the author carrying around a wireless-enabled laptop, a GPS receiver, and the network detection software NetStumbler⁴. Walking around these neighbourhoods, the laptop was able to detect the signals that were being broadcast by the various wireless routers located in the homes lining the streets. Whether encrypted or not, many of these signals were detectable right to the street level, suggesting coverage that extended all around the houses that contained these devices. In these two neighbourhoods, areas of roughly 1 square kilometre and 0.16 square kilometres were surveyed, with 219 and 77 (respectively) networks detected. In the first neighbourhood, 20% (N=219) of

⁴ www.netstumbler.com

the networks were unencrypted and had the default⁵ SSID which suggests routers that were operating “fresh out of the box.” In the second neighbourhood, 25% (N=77) of the networks were in this state. The results from these surveys, while not necessarily representative of neighbourhoods in Toronto, suggest both a high density of wireless signals with a percentage of open networks.

The questionnaires were conducted online and designed to explore wireless use and practices, particularly related to sharing. The first questionnaire was a short, 15 question survey pertaining to Internet and wireless use. This was followed up by a longer, in depth survey with 42 questions that probed more deeply into issues related to usage, such as attitudes towards sharing and personal behaviour with open wireless signals. 58 people responded to the first questionnaire, and 33 individuals followed up on the second questionnaire. The questionnaires were solicited to individuals in the University of Toronto community, as well as in the neighbourhoods where the radio surveys were conducted. Since many of the questions on the second survey featured queries about opinions and attitudes, hour-long, semi-structured interviews were conducted with nine participants from the second questionnaire group to further explore these questions. Respondents from the questionnaires can be characterized as predominantly young, affluent, educated males. While the results are far from characteristic of the general Toronto population, the results may speak towards the kinds of individuals who use wireless Internet on a regular basis.

4.1.1 Attitudes About Internet Connections

There were a number of key results that came out of this research. Reliability was identified as one of the most important characteristics of an Internet connection, whether wired or wireless. Respondents expressed a strong attachment to their Internet connection, given its

⁵ Default SSIDs were interpreted from known manufacturer names such as Linksys, DLink, SMC, and ‘default’; therefore, these numbers should not be interpreted as definitive

prominence in their daily life, and had little tolerance for service outages. Furthermore, many respondents felt that they would have a hard time adjusting to life without Internet access.

Technical support was considered one of the least important characteristics of their Internet connection. Many participants indicated that they would rather fix a problem themselves than call technical support. Other participants, even those who identified themselves as not technically savvy, suggested that they would rather call a friend than use technical support. In a possibly related way, participants indicated that which ISP they were using was only important insofar as that provider's reliability was concerned. This is an important finding for local, small service providers as it suggests that at least for some individuals, subscribing to a major telephone or cable company is not necessarily a requirement.

When questioned about participating in a network where a signal was shared among other users, respondents expressed a number of concerns. A key concern was that when sharing, one's own connection speed would be impaired. A second concern with wireless was the increased exposure of one's Internet activities (e.g. banking, surfing, etc.) to others, as well as the increased risk of being 'hacked' by malicious individuals. Finally, there was the perception that wireless connections were more likely to be 'broken' than wired connections. These results may help to explain why many participants reported only sharing with known parties, such as family members and roommates. There is a strong element of trust, since a trusted party would likely moderate their own Internet use and present a low risk of malicious hacking or spying activities. There seemed to be the perception that strangers participating on the network could not generally be counted on to respect the same boundaries.

However, respondents did identify some positive aspects about wireless Internet sharing that would interest them in future projects. The two most reported characteristics were reduced

monthly costs due to sharing with others and the ability to access free signals from home. These characteristics, which might be classified as somewhat selfish, go hand in hand with another key finding from this research. On the one hand, 65% (N=28) of respondents felt little guilt about using other people's wireless signals without permission. On the other, 55% (N=33) disagreed with other people using their signal without permission. This suggests an approach to wireless where personal use and gain were valued, and potential for personal loss was disapproved of. Consider also that less supported wireless connection characteristics were membership in a co-operative, promotion of access for others, and local or community Internet content.

4.2 Implications for Community Wireless Groups

The results from the study, although a slightly small and not necessarily representative sample size, nevertheless provide important data on the subject of wireless Internet access and use. In particular, technically savvy users of wireless technology who may have been using the technology for some time may be considered influential change agents amongst their peers (Rogers, 2006). Such individuals might play an important role in advocating or opposing new wireless networks and services to their peers, for example if the service is very good and beneficial, or potentially harmful or a nuisance.

More generally, the results help to provide some context and background for community groups which might hope to develop and promote their wireless services. Consider that while the more selfish characteristics of wireless services were clearly better supported, there was still some interest in promoting other aspects of shared or community Internet access. This suggests that wireless services that can promote the characteristics that interest users while addressing their concerns might have some success. The following section will begin discussing these community services, first with Wireless Nomad, one of our partners throughout this study.

5 Wireless Nomad Co-operative, Incorporated

Wireless Nomad (WN) is a wireless Internet service provider of DSL connections based in Toronto. WN is a co-operative where each subscriber is an equal member of the organization. However, most of the management of the business and technical sides of the operation are run by two key members, Damien Fox and Steve Wilton⁶, who began Wireless Nomad in 2005.

Damien and Steve originally met in late 2004 at a WiFi meet up group in Toronto. Steve, who had spent some time working as a network administrator, and Damien, a law student with an interest in Internet law, both shared a mutual attraction to wireless networking and its potential. With guidance and advice from a local business development center, Steve began working on a business plan for a wireless Internet company and came up with a name: Wireless Nomad. In January 2005, they incorporated Wireless Nomad Co-operative, with the original idea that Damien would help organize the co-op and Steve would run the technology. There were to be two business streams: a residential DSL service, and “Hot Wireless”, a brand name for business DSL service. Some of the original premises for the co-op were laid down at this stage:

- Full user access, such as the ability to run servers (commonly prohibited by ISPs) and not blocking ports (e.g. email protocol ports)
- Free accounts for wireless access within the network
- Revenue would be reinvested in the co-operative and the network

Their original plan also included providing customized wireless hardware which would run WN’s software. Linksys WRT54G routers would be reprogrammed to use the OpenWRT Linux-based platform. These customized routers would then be enclosed in all-weather housings to be mounted outside the subscriber’s homes for increased signal accessibility. The equipment

⁶ Names used with permission.

setup would also include a DSL modem. The original subscription model would have subscribers pay a \$150⁷ fee for ownership of the equipment.

It was not until September 2005 that WN started to sign up their first customers for 1 mbps DSL service. The original rate they charged for this service was \$30/month. Even at this early stage of the co-op's life, it was evident that the business plan was flawed. They realized that the people in the business development center that they had relied on for input lacked experience in the Internet provider market. As Damien would recall⁸:

I think that they might help out a lot with certain kinds of businesses but I don't think they understood what [Steve] was talking about. They didn't understand the technology, they didn't understand it as a small business. They just basically said that whatever [Steve] was doing was good, but they had no way of telling [Steve] if it was right (6:39).

For example, their original plan to sell their equipment as a one-time \$150 equipment cost was ill-conceived. Damien would add that:

So you have this thing where you're trying to charge the same rate as Bell or Rogers [the dominant telephone and cable companies], plus 150 bucks up front, plus you got to share your connection, and nobody was buying. Even friends were reluctant to get involved because I mean, what's the point? I mean, why should I spend 150 bucks or whatever, pay the same [as Bell or Rogers], and get less because I have to share? [Our] answer was always 'well you know, eventually we're going to be a big network and you're going to be able to share with all the other ones.' Well, until I get so many people to buy into something that doesn't exist yet, right... (6:54)

At this point, WN changed the equipment sale to a deposit and started investigating the use of mesh network technology in order to broaden their network while reducing some of the expensive DSL connection costs. In October 2005 they ended up dropping the Hot Wireless business connection side of their operation all together after little success with it.

⁷ Unless indicated otherwise, all subsequent dollar amounts are in Canadian currency.

⁸ A two hour long interview was recently conducted with Damien to help supplement many of the notes gathered from two years of researching and working with Wireless Nomad. The interview was recorded digitally and the time stamps indicate at which point in the interview the quote was made.

In late 2005, after some experimentation with modified, two-radio routers, WN deployed an experimental mesh network⁹ in the neighbourhood located around Damien's house. In the first quarter of 2006, more nodes were deployed until eventually a peak of seven mesh nodes were operating with five DSL connections as backhaul. Unfortunately, despite this initial successful foray into mesh networking, two things eventually doomed the mesh project. Firstly, a combination of people moving away or abandoning the service dropped the number of active nodes to only two or three. Secondly, outdoor deployment of the routers started to become a problem due to inclement weather, the necessity of having a vehicle for the installations, and the placement of the drilled holes in the house (i.e. the location of the hole was not necessarily aesthetically compatible with the best signal position). In fact, since this was a problem with the regular routers as well as the mesh routers, WN discontinued outdoor deployment altogether during this period as well. Damien and Steve were both quite disappointed with this outcome, particularly as they had had some success in a neighbourhood where they had not anticipated it. Damien commented that

With outdoor mounts, we came really close [to succeeding with mesh], in really the worst possible neighbourhood, just south of here near my parent's place. With nothing but cheap flyers I made at home and crappy posters I put up on poles, we got seven people in my parent's neighbourhood to subscribe. And this company was now getting like subscriber 20, 21...I mean, it was brand new. We had a really second rate website, it had no history, it had no fancy advertising, it had nothing, right? Really homebrewed flyers, and in a neighbourhood where it's generally a bunch of older, semi-affluent, people that aren't the young, hip, WiFi crowd. (9:42)

By March 2006, things were looking bleak for WN. They looked at different ways to try and change the organization and decided on three major things. Firstly, they increased the price of the service by 10% to \$33 per month. Secondly, they got rid of the deposit system (this was a problem when people moved and the equipment needed to be recovered) and switched back to selling the equipment. Thirdly, they got rid of the small office they had been renting at a cost of \$600 per month. Finally, they cut what little advertising they had been doing.

⁹ For more information on mesh networking see O'Brien, 2003; and Xue & Ganz, 2002.

In May 2006 the co-operative was surviving, but Damien and Steve were looking at alternative ways to generate new business. While they were both leaning a lot about the Internet business, they were also in a lot of debt. They identified two specific areas where they could find new subscribers. One area was people who did not own a landline phone but still wanted an Internet connection. The other was for “budget retail” locations, such as the small businesses in their neighbourhoods. These businesses might not be able to spend \$100 per month for a typical business connection, but might be interested in paying \$10-20 per month for lower speed wireless access. Unfortunately, the duo was thwarted again. Individuals without a phone line turned out to be a dead-end since they primarily seemed to be students who were only looking for limited, short-term connections. Furthermore, Bell, the owner of the lines, would charge an additional \$10 per month to maintain the “dry-line” (the DSL connection without an accompanying phone service). As for the wireless service for the budget retail locations, Damien admitted that

In the end, I think we had some really good ideas and the technology, I think, would have worked. But there was no way to prove it, and without a very good degree of certainty there was no way I was going to try and get money from people and there was no way I was going to spend another six months on it. You know, I think it had a shot, but it wasn't a sure enough thing for us to continue on with that. (23:04)

Around late-May and early June 2006, Damien met with the author and other researchers associated with the University of Toronto. Damien sadly noted that WN had seemed to have run its course. It was increasingly becoming too much work for the pair of them to continue operations with very little pay-off (they were in considerable debt at this point). However, they did not want to strand their current subscribers, which at this point numbered around 50-60 subscribers. As a result, they tried to find alternative providers, such as National Capital Freenet, that they could shift their subscribers over to. The future looked rather bleak for WN at this point.

Surprisingly, in what Damien considered a series of “miracles”, WN’s fortunes seemed to turn around. Despite a higher price and being required to buy the equipment once again, people kept signing up for the service. Also, in a major improvement, they switched their bandwidth wholesaler to a different company. Previously they were being charged \$23/month per DSL circuit (one per subscriber) plus an additional \$2 per gigabyte of transfer. This pricing plan was considered prohibitively expensive. Their new wholesaler was instead charging \$26/month per circuit plus the first ten gigabytes of transfer were free and pooled. This meant that they collectively had a pool of ten gigabytes per month per circuit that they could draw from, meaning that high capacity users were balanced out by lower capacity ones. While they still owed thousands of dollars to the old wholesaler, they felt that at least under the new plan they had a chance. For the next several months, until November 2006, the co-operative remained afloat. However, things were getting so tenuous financially that Damien and Steve both found full-time jobs and switched to running WN on the side.

In December 2006 disaster struck when a massive server failure severely affected WN’s service. Users lost the ability to log-in because the authentication server was down and voicemail and email services stopped functioning. To make matters worse, Steve was out of the country during this time and even when he returned, did not have reliable Internet access to interface and repair the server. After several days of down service, subscribers started to leave.

By January 2007, Damien and Steve thought that WN was finished. However, the problems were eventually resolved as Steve was able to find some time to work with the server. WN did stop signing up new subscribers though. The following month they had a meeting with their co-operative members in order to discuss the future of WN. Much to Steve and Damien’s surprise, the meeting was well attended and suggestions were offered by the members. They decided to raise the price to \$36.95/month for the now up to 3 mbps connection, contract the

bandwidth wholesaler to also provide 9 am-9 pm technical support (previously Steve had been answering all the calls on his cell phone), and they began to finally collect on some of the previous outstanding bills they were owed (due to billing errors, some individuals had not been charged for various legitimate fees for months at a time). Currently, the co-operative is operational, although new subscriptions are still offline while they fine tune their billing services (e.g. switch to online billing, credit card only transactions, etc.). Damien indicates that the co-op is taking it 90 days at a time, reassessing as they go and making incremental changes to the system. He says that barring any major problems, WN seems sustainable right now.

5.1 Type of Service

WN offers a standard DSL connection to the Internet at speeds up to 3 mbps. Subscribers can connect via a wired connection directly to the WN router or they can connect to the WN wireless network. When a wireless session is started, subscribers log-in with their WN username and password, which is authenticated with WN's servers. In addition to paid service, WN also offers a free service to everyone. Individuals can create a WN free account which can be used to log-in to any WN network signal that they detect. Free accounts are limited to 128 kbps and the common email ports, POP and SMTP, are blocked. However, access is otherwise unrestricted, including web-based email and general surfing. Paid account users can also log into any WN node they can detect and while they have increased access compared to the free account, bandwidth priority is still given to the node owner. WN currently (as of April 2007) has 123 network nodes and a total of 4038 user accounts (includes both paid and free).

5.2 Location of Service

Since WN is primarily a residential service, virtually all of their network nodes are located in residential homes in and around the Greater Toronto Area (GTA). Unfortunately, residential membership has the effect of limiting the spaces for free access to areas around the homes that contain the nodes. This is likely problematic for most free users since connecting to

the free signals would entail standing around outside the home in order to detect the signal, unless one was fortunate enough to be in a house or establishment beside the broadcasting node.

5.3 Ownership and Governance

As a co-operative, WN is technically owned and operated by the members (subscribers, not free account users). However, in practice, WN is predominantly run by Damien and Steve and a small group of dedicated volunteers that help out with some of the networking aspects of the operation. Damien noted that if they were making more money, one of the first things they would like to do is to start paying their volunteers for some of their work which often includes fairly intensive server maintenance and technical support.

5.4 Ideology

Damien has summed up the general ideology of the organization as “user empowerment first”, where users can control their Internet resource, meaning that they can run a server, not have ports blocked, and have their privacy and legal rights protected as much as possible. When asked about the co-op’s feelings towards sharing, which is mandatory, Damien added

Selfish user aims are being denied, whereas user aims that contribute towards [the co-op are promoted]...it’s sort of trying to avoid the prisoner’s dilemma situation. No one is allowed to rat out, no one is allowed to not share. Because if everybody else shares and I don’t, I’m ahead. I get all this sharing but I don’t have to deal with sharing, my sharing. We don’t allow that. Everybody has got to contribute back. (60:58)

This perspective highlights their philosophy towards forced sharing, in that they recognized that if provided an opportunity to not share but still reap the benefits of a shared network, there would be no incentive for anyone to participate. To avoid this problem, everyone is required to participate in the sharing network. In terms of having the free accounts, Damien’s reasons for that are quite pragmatic, if not altruistic. He stated that “free accounts are important to us because if you don’t have that [then] people who aren’t willing to pay are shut out and letting them in doesn’t cost anything...so why not let that happen?” (62:46). Consistent with this notion of fairness to others, Damien believes that it is fair to charge users a fee if they are going above

and beyond occasionally checking email using one of their free accounts. He suggests that there needs to be an acknowledgment that the service is not free. Damien succinctly noted that “some philosophical commitment to free Internet is not going to change [the costs]...someone has to lay a cable, someone has to pay guys like Steve to run servers...and you want people who are good at it, or else what happens is that half the time [the network] doesn’t work” (63:42). However, Damien is quick to point out that there is some middle ground (presumably WN’s position) between having a service that maximizes profit and a service that tries to make the service entirely free. This is what Damien considers their “fair and reasonable” philosophy, in that there are kinds of services that are free but there are also kinds of services worth paying for.

5.5 Business Model

WN’s business model is based around the standard monthly subscription practice that most ISPs rely on. Every month subscribers pay a monthly fee, currently \$36.95. Given that they have 123 nodes and there is one node per subscription, an estimate would put their monthly income at about \$4500 a month which presumably goes towards paying for the bandwidth costs (approximately \$3200 a month), with the rest towards paying down WN’s debt, which is (anecdotally) several thousand dollars.

6 Other Community Wireless Organizations and Related Models

WN was primarily focused on for this research due to our extensive background information on them and a working relationship spanning over two years. WN provided an in depth look at one particular approach to community wireless. However, it is important to compare and contrast it with some other kinds of wireless community networking organizations to observe other approaches in practice.

6.1 FON

FON, a Spanish-based worldwide organization, is the most similar to WN, a point recognized by Damien himself. FON is one of the largest of the community groups that will be

subsequently examined, and certainly the most well funded. After receiving \$22 million USD from Google, Skype, and various venture capital firms, FON went live in November 2006 (“Global wi-fi plan gets \$22m boost”, 2006).

6.1.1 Type of Service

FON’s service comes in two configurations. The first is when a user is already a member or customer of another ISP’s service and they purchase a specialized FON router called *La Fonera* for approximately \$40 USD. These individuals are called a *Fonero* and are presented with two further options. By becoming a *Linus*, Foneros freely share their connection with other members of the FON network. In exchange, they may in turn access any other FON node that they can detect. Alternatively, Foneros may become a *Bill*, where access to their wireless node costs money to external users (administered by the FON network). In exchange, they receive 50% of the money generated from use of their node. However, unlike Linuses, Bills must pay for any use of the FON network beyond their own node. Bills and Linuses are able to restrict the amount of bandwidth available for communal connections. The second service configuration creates individuals known as *Aliens* (external users), who are free-floating pay-as-you-go users. Aliens can access the FON network \$3 USD per day.

FON service is similar to WN in that sharing is promoted through the use of one’s own network connection. Also like WN, roaming users are able to connect to network nodes wherever they can find them, which would likely be near residential homes (FON makes use of existing broadband connections after all). However, while WN provides these roaming users limited access free of charge, FON charges a daily rate for limited access (limited by the connection owner). Notably in both cases, there is a strong requirement for a large, extensive network in order for the roaming service to maximize usefulness. Clearly, the goal of the FON network is to increasingly build the network to not only provide greater access, but to encourage more users.

6.1.2 Location of Service

FON is a worldwide organization operating primarily throughout Europe. In June 2006, the BBC reported that FON had some 54,000 people signed up worldwide, primarily in cities (“Wi-fi pioneers offer cheap router”, 2006, para.4). The same article quoted the General Manager of FON North America as aiming to have 50,000 hotspots by September 2006, 150,000 by year-end, and one million by the end of 2007¹⁰. According to the founder of FON, Martin Varsavsky, one of FON’s dreams is “a unified global broadband wireless signal” (“Global wi-fi plan gets \$22m boost”, 2006, para.16).

6.1.3 Ownership and Governance

While FON describes itself in terms of a community approach as well as calling its participants “members”, it is unclear as to whether or not the members have much say in the operations of the greater FON network. However, it is true that Foneros retain elements of control on their own connections, such as limiting the bandwidth or even the choice between being a Bill or a Linus. Otherwise, FON appears to operate much like a regular ISP in that they sell the hardware as well as administer the network, particularly the payment schemes.

An interesting aspect about FON ownership is that they do not actually provide the broadband connection themselves, but rather the ISPs who the Foneros subscribe to own the connection and the bandwidth. This can be problematic because many ISPs prohibit individuals from reselling their Internet connections or sharing it without authorization. Indeed, as one analyst described it, “[FON is] treating wi-fi as communal property when it is not” (“Global wi-fi plan gets \$22m boost”, 2006, para.21). FON’s response has been to try and receive explicit authorization from local ISPs but otherwise suggest that Foneros check and comply with their ISP’s terms and conditions. FON believes that they can create workable relationships with ISPs because, as a FON France representative said, “we tell the ISP...basically ‘come with us, let’s

¹⁰ It is unclear the precise numbers of existing Foneros and nodes at this time.

strike a deal...because you, as an ISP, can benefit from something you never thought of” (Reid, 2006, para.21).

6.1.4 Ideology

FON considers itself a community as well as a social movement. However, it is unique as a movement because while its prime motivation is to possess a wide-spread sharing network, it sells itself to individuals by catering to selfish interests. For example, one FON executive said

when we are trying to sell the idea of FON, we are not telling people ‘share your WiFi because it is good for your community, it is good for your neighbourhood, it is good for your country...we are saying ‘share your WiFi because it is good for you because, when you’re going to move around, when you’re going to leave your home and you want to connect to the internet, you can. (Reid, 2006, para.7)

This is an interesting twist on trying to promote their service because it specifically addresses a very powerful motivator in Internet use: personal gain. It also, however, clearly forces their hand when it comes to their underlying community motives. It is a bit suspect to promote the community and social movement notion when it is based primarily on selfish aims. However, ultimately, if it allows them to achieve their desired worldwide network, then perhaps it is a merely a means to an end.

6.1.5 Business Model

The FON business model is based on piggy-backing off of existing ISPs bandwidth and connections. FON appears to generate revenue off of its pay-as-you-go customers as well as from the sale of their equipment. However, much to their advantage, since they do not own or maintain the backhaul network equipment their obligations and responsibilities from a financial perspective are rather limited compared to most other ISPs. The General Manager of FON North America described this as “changing the economics of Wi-Fi” (“Wi-fi pioneers offer cheap router”, 2006, para.10).

6.2 Wireless Toronto and Ile Sans Fils

Wireless Toronto (WT) and *Ile Sans Fils* (ISF) are two similar, community wireless networking organizations based in Toronto, Ontario and Montreal, Quebec, respectively. Since in many ways, WT is based on the ISF model and approach to wireless, it is useful to describe these projects together.

ISF, which means “Wireless Island” in French and refers to the island of Montreal, is currently one of the largest and most well-developed wireless projects in the Canada. Wireless Toronto (WT) is another wireless networking group in Toronto that operates within the city, although more towards the urban core as opposed to the GTA. It was founded in April 2005 as an all volunteer, not-for-profit community group. Like WN, WT formed as a result of a meeting among interested parties, in this case, at Social Tech Brewing, a forum promoting communities and technology. At this particular meeting, one of the co-founders of ISF was present, and explained how this community organization worked and how a similar one might operate in Toronto (Cho, 2006, pg.15). Soon after, WT was formed.

6.2.1 Type of Service

Both ISF and WT operate on a hotspot model of access. At a chosen hotspot, a router is placed that is reprogrammed with the custom software known as WiFiDog. WiFiDog is an open-source, captive portal software that was developed in-house by ISF volunteers. When a user starts a wireless session on a router running WiFiDog, they are redirected to a log-in page that takes their information and authenticates it with a server. The router uses conventional 802.11g technology and relies on the broadband backhaul provided by the location (e.g. a DSL or cable Internet connection of some sort). The service is free for users, who have generally unlimited access, although the network is monitored for abuse such as using too much bandwidth or illegal activities (Powell and Shade, 2005, pg.9). In addition to Internet access, ISF and WT also

provides a number of other artistic and community services that host and promote various projects such as artwork, music, virtual space, and information.

6.2.2 Location of Service

Given the hotspot model of access, ISF and WT routers are usually found in public establishments like cafes, bars, and restaurants, but also in parks, public libraries, and community centres (Powell, 2006, pg.8). ISF, as of April 2007, had 133 open hotspots in Montreal, while WT had 33 open hotspots¹¹. In contrast to WN and FON, ISF and WT are not residential services and do not promote their network nodes for homes.

6.2.3 Ownership and Governance

ISF and WT are both volunteer operations at their core and some academic research has been done studying the volunteers and their work with the respective organizations¹². Additionally, a forthcoming study by Bina and Giaglis (2006) may also help shed some light on the motivations of volunteers in community wireless projects. For both ISF and WT, their volunteers come from a variety of backgrounds but commonly in computer networking and computer science, the arts, academic and social justice backgrounds. The volunteers meet up regularly to discuss new projects and current issues faced by their respective organizations.

In terms of ownership, much of the technology, while developed in house, remains “open” and very much part of the Free/Open Source Software movement. For example, the WiFiDog software developed by the ISF volunteers remains freely accessible under a general public licensing agreement. As for the connection and the equipment itself, this becomes the property of the hotspot once they sign up with ISF or WT. The reprogrammed router typically costs between \$80-100 and there is also a yearly fee of \$50. The hotspot is also responsible for

¹¹ ISF’s hotspot status can be retrieved online here: http://auth.ilesansfil.org/hotspot_status.php
And WT’s at: http://auth.wirelesstoronto.ca/hotspot_status.php

¹² For ISF see Powell, 2006; Powell & Shade, 2005; for WT see Cho, 2006.

subscribing to an ISP and paying for the connection. ISF or WT volunteers donate their expertise in setting up the equipment and connection and getting the hotspot up and running.

6.2.4 Ideology

Ideology plays a large role in both the ISF and WT projects as both share strong goals and values when it comes to community wireless networking and access. For example, one of WT's goals is "to facilitate public awareness over the social and economic benefits of non-commercial, community-based provision of wireless internet, as well as encourage new and innovative approaches to building community with the technology" (Cho, 2006, pg.16). Similarly, Powell (2006) wrote that ISF's goals include creating "wireless internet access points accessible free of charge in public places, and...[using] emerging technologies to build communities" (pg.8). These goals clearly suggest a strong allegiance to promoting communities, and to this end, both groups work hard to incorporate local interests, arts, and media in their projects. Also, the commitment to free access is very important to both groups. For example, hotspot owners are required to sign a social contract with ISF or WT which "codifies the relationship between the host, ISF [or WT], and the end users as social rather than commercial" (Powell, 2006, pg.8). This contract also specifies that the hotspot owner cannot run ads on the router. In order to maintain the principle of free access, hotspot owners are also not allowed to charge users for the use of the Internet. That is, presumably not more than the cost of a cup of coffee or a snack.

6.2.5 Business Model

Both ISF and WT are fully volunteer driven, non-profit organizations. As a result, they rely on the hotspots to cover things like equipment costs, the Internet connection, and a yearly fee to help pay for server costs and other maintenance. All of the labour to setup the devices and maintain the network, including tech support at the hotspots, is provided on a volunteer basis. Since there are always other costs involved, both groups are also dependent on grants and sponsorship to help support their activities. To date, ISF has received limited funding from the

Federal Government (Canadian Heritage) through an affiliated partner project on art, as well as some small research related grants. However, both groups could probably use a much greater influx of funding to help better support their work.

7. Reviewing the Different Approaches to Community Wireless

The preceding discussion highlighted a number of community wireless groups and their various approaches to transforming Internet backhaul into a community service. With groups like WN and FON, their approach relied on sharing for transforming what would otherwise be personal broadband access into a service that others could use. In WN's case, this was the use of their free and paid accounts for connecting to WN nodes that were dispersed throughout the city. In FON's case, while the approach was similar, their connections were based on paid service, whether by daily pass or as a member who shared the connection they were paying for. This approach, via sharing, presents opportunities and challenges for both providers. First, a significant hurdle for them, and one that WN clearly experienced, is that any network of this type has a benefit for users proportional to the size of the network. In other words, both services would need to achieve a critical mass of users and network nodes. It does no good for a WN or FON customer to have access to a network that is limited to a few sporadic houses in locations all over a city. This is particularly the case when there might not be a suitable location to sit or stop while you are using this connection. Furthermore, there is the added concern that if you happen to be the node located in a popular location, for example near a downtown square or café, you could very well be overwhelmed with connection requests. Another challenge is ownership of the network connection. In WN's case, they became the ISP to address this challenge, but in FON's case, they are relying on "donated" bandwidth from Foneros' pre-existing broadband subscriptions. It is unclear whether this is sustainable from a legal perspective as well as an industry perspective. That is, until explicit arrangements are made between ISPs and FON, it is unclear whether it is legal to resell or share a wireless connection in such a systematic way. Furthermore, while it is experimental right now, it is uncertain how long ISPs will tolerate the FON approach. After all, it

is the ISP who is bearing the costs of bandwidth and maintenance, and the portion of the daily rate earned from FON might not be enough or simply undesirable. However, the sharing approach does present some opportunities for success as well. Firstly, by forcing sharing on the users, it levels the playing field between subscribers in that everyone has to share. This might be one of the only ways to ensure sharing between participants and to ensure the growth of a shared network when participants might otherwise elect not to. Secondly, an administrated shared network addresses many of the concerns individuals may have with sharing. For example, addressing security and privacy (mandatory authentication), fair usage (controlled communal bandwidth), cost sharing, and access to a wider network of coverage. FON may have also had the right idea about how to market sharing: *that it is good for the user*. This might be the best way to build critical mass as it is likely an ideology that people can identify with. WN's pragmatic approach, as indicated by Damien, as to what is fair and worth paying for might also resonate with individuals, particularly those already paying for Internet.

In comparison, the approaches by ISF and WT that are technically hotspot oriented, but socially more progressive and less commercial, present a different perspective. There is a notable distinction that these groups are not aiming for residential access, but rather to improve Internet accessibility in public locations and the content available there. In fact, the distinction that these groups aim to provide not just access but community relevant content is an important one to make. Whereas FON and WN would likely be best described as access providers, ISF and WT would likely prefer to be considered more community development enablers. ISF and WT are very ideologically driven, with commitments to both free wireless and promoting local interests in the arts, media, and information. As Powell (2006) studied, for many of these community groups, it is more than just providing an opportunity for people to surf and check email, but rather an emerging form of civic participation. However, it is possible that this ideology might be less appealing for some, particularly with wariness surrounding "free" wireless. Our own research

found less interest in the community aspects of wireless compared to the individual benefits. However, this is not to suggest that community aspects are problematic or even off-putting, but rather, it is relevant to consider if some of the strong messages of community growth may fall on deaf ears. This is particularly important for non-profit and volunteer groups like ISF and WT that rely on community support for their sustainability. Then again, since many of these groups are located in large urban environments like Toronto and Montreal, it is more than likely that there are enough interested individuals for whom these messages inspire and excite. Certainly this suggests that it is possible for both personal benefit and community oriented organizations to co-exist in the same locations.

8. Conclusion and Future Prospects

This paper began by exploring the concept of urban wireless Internet clouds of access, the result of many individual wireless nodes broadcasting broadband connections in wide areas throughout cities. These clouds of access are a source of great potential for a number of wireless community groups who seek to turn this broadband backhaul into community services. To provide some context in this wireless discussion, the results of a study conducted into wireless use and behaviour was presented. The results suggested some concerns about wireless Internet use, including reliability, security and privacy, and fair use, but highlighted the potential for shared or community wireless to succeed if these concerns were addressed. This was followed by the presentation of a case study of Wireless Nomad Co-operative, as well as synopses of other wireless groups including FON, Ile Sans Fils, and Wireless Toronto.

The conclusions one might draw from the successes and challenges that all of these groups face is that while wireless Internet is here to stay, what individuals have to come expect from it and what they wish to do with it is still in flux. In particular, there are unanswered questions about how people perceive their wireless connections in terms of ownership and sharing. For example, is one's home Internet connection an extension of their personal property?

Is it perceived as a home service much like phone or television access? In which case, how much appeal to sharing might there be? Extending this to public spaces, what value is there to users beyond the ability to have access? Do individuals expect or want more from their connection than just access? Or does community and local content really resonate with the users? The groups reviewed here, among many others, seek to answer just those questions as they aim to transform some of these perceptions of Internet access into their own vision of community service. With a variety of different approaches and motivations available, it seems likely that the project of transformation will succeed to varying degrees.

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