Chapter Four: The Fred-eZone, "intellectual infrastructure" and the public service model for WiFi

After two hours on the tiny Dash 8 plane, watching the propellers spin over a wintry forest criss-crossed by logging roads and highways, I landed in Fredericton. I ran across the snowy tarmac to the terminal. Just inside the door, on the wall facing the single baggage claim carousel was a poster showing a middle-aged professional woman sitting on a park bench with a laptop. "Connect to the Fred-eZone," it read, above instructions on how to find a WiFi signal, identify the eZone network, and connect to it. The poster next to it advertised the next game of the local minor hockey team. While I waited for my bags, I wondered how much these two posters told me about the city I was going to explore.

The cab ride into town took fifteen minutes, winding along the river. Fredericton itself was a small and bustling city of 50,000. Downtown on a winter morning sidewalks were full, skaters turned circles on the rink, and people used laptops in cafes. I stayed for three weeks, exploring a city marketed as one of the "world's most intelligent communities." I visited the National Research Council's offices and stayed on-campus at the University of New Brunswick, which instituted the first computer science program in Canada. I cross-country skied on tidily groomed trails, took inexpensive, reliable public transportation, attended film nights and dance performances, went to the farmer's market on Saturday and Superbowl Sunday at the pub. I interviewed friendly, well-educated employees of small companies who traded worldwide, and many members of the municipal government. I wanted to find out why and how this city, surrounded by forest, came to

create North America's first free WiFi network, and what – if anything – it had meant to the Fredericton community[i].

Introduction

As I discovered, the people who designed Fredericton's WiFi network enshrined it as part of their city's innovative disruption of existing telecommunications systems, and a means of making their city appear "smart" or "connected" through ubiquitous communication services. These perspectives align with two diverging interpretations of WiFi's impact. The first evokes the *disruptive* quality of WiFi technology and its potential to create new social and technical configurations that challenge existing structures. The second channels the excitement about the possibility of using WiFi to provide more *ubiquitous* access to the internet and other networks. As we saw in the previous chapters, the *disruptive* interpretation of WiFi can be linked to the development of a geek-public of experts. This interpretation contrasts with a focus on the potential of WiFi to facilitate ubiquitous connectivity and inspire a community-public to develop.

In Fredericton, it was a group of elected officials and managers working in the city's technology department who developed one of the first municipal WiFi networks in North America – and one of the most successful in terms of its scale and longevity. The "community WiFi network" is a free public network provided on city-owned property and in publicly-accessible spaces. In its own particular context, Fredericton's Fred-eZone project represents WiFi as both disruptive and ubiquitous. In 1999, the city created its own utility telecommunications company and built a substantial fibre network operated

as a co-operative with other local partners. The excess bandwidth from this network provisions the free WiFi network.

The Fred-eZone fits into a larger strategy that the municipal government has developed, which leverages the symbolic association between WiFi networks and innovation to brand Fredericton as a "smart" or "connected" city despite its small size and relative isolation from major cities in Canada and the Eastern United States. The Fred-eZone project primarily defines WiFi as a ubiquitous "intellectual infrastructure" according to the city's Chief Information Officer (Gallant 2004) that provides connectivity across the city. However, the design of the network and its use by Fredericton residents and visitors suggest that this ubiquity has not been fully developed in the network's structure. Instead, the eZone has drawn on the disruptive representation of WiFi as an emerging technology to develop the city's branding strategy.

Compared to the distributed, hotspot-based distribution model that ISF used, the Fredericton model integrates WiFi technology into an existing communications infrastructure, and creates a cultural context where the city's economic development goals are tied to its provision of internet connectivity. The success of the Fred-eZone WiFi network depends on the fact that the city purchases trunk line connections to the main internet traffic routes (also referred to as "backhaul") at wholesale cost, using the bandwidth not devoted to connecting its offices as a free "gift" to its citizens. Like the ISF project, the Fred-eZone's success levers the integration of WiFi technology into a specific local cultural, social, and political-economic culture. The key difference is that

Fredericton has integrated "community WiFi" into municipal government and economic development institutions: organizationally, the network is run by city employees, and symbolically, the WiFi network helps to represent Fredericton's innovative character within its economic development strategy.

Institutionalizing "Community WiFi" – the Municipal Case

This chapter uses the Fred-eZone case to explain how 'community WiFi' becomes more institutionalized, and how expertise, network structure and connections to other infrastructures, as well as to local culture, influence the development of institutions. The chapter also examines how ideas about WiFi's potential to disrupt existing organizational and technical structures influence the development of the Fred-eZone. A brief discussion of literature on communication infrastructure development opens the chapter. Insights from infrastructure development literature illustrate this institutionalizing process, describing how disruptive technologies like WiFi become framed as infrastructures. I argue that the way Fredericton city officials describe Fred-eZone as an "intellectual infrastructure" is an important indication of the social and cultural impact of the network.

Following this brief discussion of infrastructure development literature, the three main sections in this chapter discuss how the eZone was developed and built. Once again, the relationship between visions of WiFi's impact and the reality of its social impact form the basis of the analysis. The first section of this chapter describes how the eZone's developers envisioned this network contributing to their city based on what they perceived as its existing technological and cultural capacity. The second section focuses on how these visions of the network accorded with real experience, both in terms of

managing uses of the network that were "disruptive" – unexpected or threatening to pre-existing expectations – and in encountering the limits of the network's ubiquity. The third section considers the process of institutionalization in more detail, summarizing how both disruptive and ubiquitous elements of WiFi were represented in Fredericton, and situating this negotiation as continuing the dialectic of computerization movements as they become more institutionalized. The conclusion points to some of the paradoxes inherent in the Fred-eZone's evocation of WiFi as disruptive and ubiquitous – in particular, the ambivalent status of a "connected community" that remains geographically isolated from larger business and knowledge centres. Fredericton must maintain a symbolic connection to a globalized world while developing its own local identity. As in Montreal, the Fredericton community WiFi project co-constructs ideal forms of community and public. Fredericton thus defines a city as a community, and WiFi as public infrastructure.

Methods: Shifting Perspectives from the Grassroots to the Elite

In researching this chapter I continued to pursue a situated perspective on the social and technical development of a WiFi system. I interviewed the people involved in designing and building the system, as well as decision-makers who worked at integrating connectivity issues into local policy[ii]. Over a three week period in February, 2007 I visited Fredericton and conducted twelve in-depth interviews with elected officials, municipal managers, business people and university researchers and administrators, which I transcribed and analyzed. The process of transcription and analysis investigated similar themes to those developed in the ISF chapter. The key themes for analysis included the ideas of community and public, as well as perceptions of WiFi as disruptive

or ubiquitous. To balance this elite perspective I conducted informal, in situ interviews with ten people I observed using the eZone in public places. An online survey of users similar to the one distributed to Île Sans Fil users was conducted in March 2008.[iii] To participate in the local culture, I attended theatre, dance, and cinema, participated in local sports, spent time at the mall and in cafes where the eZone was available, and chatted with locals in pubs and bars. For a period of a few days I worked from the offices of the City of Fredericton IT department. I also conducted a review of technology and innovation coverage in the local media, as well as a network survey of the number of wireless networks active in downtown Fredericton. I obtained network management data of the use of the eZone for 24 hours on February 9, 2007, and aggregate measurements from November 2006 to September 2007.

The limitations of this approach, which was constrained by the relatively short period of time I spent in Fredericton, and the fact that I visited during the coldest part of the winter, are evident in the bias towards elite informants from large institutions. Several interviewees reiterated that the eZone was used more often during the summer months when tourism increased, and when more local residents used outdoor spaces. The cold winter weather I experienced during my fieldwork meant that fewer people were outdoors or in public places in Fredericton. My perspective of the Fredericton community is therefore shaped by my contacts and experience. Still, within the trajectory of the socio-technical construction of WiFi, this perspective provides insight into how decision-makers discuss and understand new technology. It also testifies to the openness of individuals and institutions in Fredericton. As one of the people I interviewed said,

"Because it's a small province it's relatively easy to go to the president of the university, to the Premier" (Greg Sprague, Project Manager, National Research Council, Interview Feb 10, 2007). This element of Fredericton's culture shaped my fieldwork, but perhaps it also influenced the city's innovation by facilitating collaborations and favouring the development of close working relationships.

Sites of Innovation in Infrastructure Development

Fredericton's WiFi innovations are configured by the city's identity as a relatively small, isolated community with a wealthy, educated workforce and a desire to retain citizens and businesses in the face of global competitiveness. The Atlantic region of Canada has historically struggled to retain and expand its workforce, and Fredericton's innovative branding has thus responded to the challenges of attracting and retaining young workers to the region. The city government's autonomy in establishing its own telecommunications operations resonates with the actions of previous non-commercial actors in establishing communications infrastructure – including the grassroots actions of Île Sans Fil. The difference between the ISF project and the Fred-eZone is not so much a difference of scale, but one of institutionalization. One way of institutionalizing technology is by thinking about it as infrastructure. Bowker and Star (1999) claim that infrastructure is embedded within other structures and technologies and that it only becomes visible when it breaks down. Furthermore, they note that infrastructure can be learned: for example, classification systems are taught and learned within communities of practice. Studies of infrastructure building describe how new technologies transform from exceptional phenomena to practice, becoming nearly invisible in the process. This

process is not smooth, as not all infrastructural technologies develop into embedded infrastructures – and certainly not in the same ways.

In North America, communications infrastructures have grown sporadically and organically. In the United States context, Sandvig (2006) notes that the establishment of a nationwide telephone infrastructure was disorderly in its beginnings, with local, often rural, co-operatives creating a patchwork of different systems, some of which required participants to provide their own pole and wire. He argues that the role of local governments in the first stages of development of technologies like WiFi is to:

> [S]erve the forgotten and the dispossessed, to experiment and pioneer systems that meet overlooked local needs, to partner with enthusiasts in ways that push the technology forward, to apply pressure to legacy carriers by investing in alternative networks, and to foster competition by insisting on widespread service, reasonable rates, compatibility, and interconnection on reasonable terms. (p. 505-506)

In the Canadian context, Martin (1991) details how in the early 20th century, several alternative possibilities for telephones were negotiated through the gendered conflict between telephone designers and telephone operators and users. Telephone companies had not expected to see demand for telephones grow outside of business districts in major cities, since the telephone was imagined as a technology for businessmen. Instead, social use of the telephone expanded its potential market to women – and eventually Canadians in all parts of the country. As these examples demonstrate, the early and nascent development of infrastructures can permit social and political negotiations.

Sandvig's argument draws from studies of the railroad (Hughes 1983) and the telephone system (Fischer 1992) that indicate that infrastructures are built on a small scale, often in

a disorderly manner, before they are built out to larger scales and made available to more people. This suggests that a perception of new technologies as disruptive persists until technologies can be institutionalized. Often this institutionalization defines the infrastructure as a public good. For example, after the period of proliferating local telephone infrastructures resulted in large telephone companies offering reliable service, the Canadian government mandated universal basic telephone connectivity. Hughes (1987) also argues that cultural and political-economic variables influence the form of large infrastructures like electrical systems: technical and political-economic contexts meant that electrical power systems in the United States, Great Britain, and Germany developed differently. However, the scale of the researcher's analysis, as well as the scale of the infrastructure, may impact how messily contextual or systematically smooth these infrastructures appear to be as they develop. As Edwards (2002) notes, studying infrastructure development on different scales can provide different insights into the nature of changes: while meso-scale studies of institutions like regulatory bodies or governments can describe infrastructures as transcending individual control, and macro-scale studies abstract infrastructure into broad roles (for example, studies of airline travel infrastructure or shipping), small scale studies can instead reveal active appropriation of infrastructure and the evolving design of emerging technologies by the people who design and build them.

Fredericton's broadband and WiFi projects provide an example of community-based innovation that is more institutionalized than the grassroots actions of ISF. In this thesis, the Fred-eZone case acts as a bridge between my discussion of oppositional technology

development cultures like ISF and the focus in the following chapters on how actions connected with community WiFi bridge towards policy advocacy. Because Fredericton is a small community, it cannot provide an example of what Edwards would call meso-level changes or what Touraine (1988) calls diachronic or state-level change, but a close investigation can provide insights into community WiFi's institutionalization, as well as the factors that characterize successful municipal networking projects. The project reveals that municipal explorations of emerging technology like WiFi do not necessarily "serve the forgotten and the dispossessed" (Sandvig, 2002 p. 505). Instead, the new technology can be integrated into a new set of visions that help Fredericton to brand itself as a city that is "smart" and "connected."

Preconditions for developing a WiFi network: The Knowledge Community and 'Knowledge Infrastructure'

For three hundred years Fredericton's main employers were the provincial government, and its two universities: the University of New Brunswick, with approximately 7,500 students and St. Thomas University, with approximately 3,000 students, as well as the local military base. University graduates could expect to walk down the hill from the campus to take up offices in the government buildings by the river. A prosperous community developed; when I visited in 2007 the average household income was $70,000 per year (Team Fredericton 2008), compared to Montreal's average household income of $48,000 (Statistics Canada, 2007). In the late 1990s the provincial government began to downsize and the municipal government began to explore how to prevent a collapse of its economic base. In 2000 it developed an economic development strategy that focused on knowledge work and knowledge industries. The mayor says, "We didn't want to have to be dependent on government, or so dependent on universities, which had

served us well, but we wanted to diversify, and we had decided that information technology was the way to go" (Brad Woodside, Mayor of Fredericton, Interview Feb 3, 2007). At the same time, an economic development coalition was created that made municipal government and business leaders part of "Team Fredericton." Drawing from the tight connections between municipal and business leaders who wanted to shift the economic base away from reliance on universities and governments, this cross-cutting strategy focused on branding Fredericton as an innovative 'knowledge-based community' to distinguish it from other cities in the Atlantic Canada region, all of whom were competing to retain young workers, increase immigration, and build strong economies (Atlantic Canada Opportunities Agency 2006).

However, delivering on the promise of being a knowledge-based community meant improving internet connectivity. Until 2001 only one internet service provider (ISP) – Aliant, owned by Bell Canada – served the city. Broadband connectivity was only available in certain areas. The cost of bandwidth was at least twice as expensive as in major centres: some businesses paid $800 a month for dedicated broadband lines. The market was small enough that large providers did not want to sell in it, and one small operator even went bankrupt. After realizing that the incumbents were unwilling to provide broadband coverage over the entire city, the city technology department, which had been laying fibre to connect its own city offices to a local area network, created the Fredericton Community Network, a consortium of local businesses including the city government, who partnered to buy wholesale bandwidth delivered over infrastructure owned by a non-profit, city owned company called E-Novations. E-novations obtained a

license as a non-dominant telecommunications operator[iv] and the company began operating as an ISP. City staff explain that prior to the city's investment in this fibre infrastructure, some businesses paid up to $3000 a month for a T1 backhaul internet line. Currently, the average price is $250. The fibre "Community Network", allowed the municipal government and other local businesses to aggregate their demand for bandwidth. E-Novations bought bulk bandwidth from wholesale providers, and resold it at 1:1, meaning that service was always as fast as promised. This lowered the costs for businesses significantly, and also incited other ISPs to provide connectivity in more areas of the city as a means of achieving greater market share. As a result, more areas of the city received broadband connectivity, either offered by e-Novations, Aliant, or by other providers at market price.

In 2003, the director of Team Fredericton submitted a plan for a small demonstration WiFi network to the municipal government. The same plan had already been submitted to the federal "Smart Communities" program, but had been rejected. The federal program, begun in 1998, defined a Smart Community as "a community with a vision of the future that involves the use of information and communication technologies in new and innovative ways to empower its residents, institutions, and regions as a whole" (Industry Canada 2004). Although Fredericton's application to host New Brunswick's official project was rejected, the city council backed the project anyway. Fredericton's broad tax base, balanced budget, and interest in carving out a niche as a well-connected knowledge hub made a WiFi network an attractive investment. The presence of the existing fibre Community Network cut the costs for the project significantly, since the

WiFi network could draw from the internet connectivity provided through the fibre ring. The development of a city WiFi network was presented as a kind of inevitability: "Look, we provide tennis courts, all other kinds of infrastructure, so this makes sense. At the same time as we were doing this the Team Fredericton infrastructure was also being developed. It's a way of distinguishing us from all the other little cities in the middle of nowhere . . . If you had the opportunity to do this, why wouldn't you?" (Jane Blakely, Director of Corporate Services, City of Fredericton, Interview Feb 10, 2007).

Visions of Community

That Fredericton is in many ways as Blakely describes – a "little city in the middle of nowhere" – may hold a key to its self-definition as a community. Compared to the more fluid conceptions of community and public explored through the ISF case study, this specific geographic location for community holds more in common with traditional sociological definitions of community (Burt 1992; Tönnies 1887, trans. 1955). According to 2006 census data Fredericton has a growing but not particularly mobile population: a large majority has not moved from their homes in the past two years. Of the population of 49,980, fewer than 1,500 are recent immigrants within the past five years or non-permanent residents. Compared to the Canadian average, Fredericton residents are slightly younger, and 30 per cent have post-secondary degrees – the third-highest rate in the country after Ottawa and Toronto. Sales and service, business and finance, and management are the most popular occupations. Compared to the New Brunswick overall unemployment rate of ten per cent, Fredericton's 6.6 per cent unemployment rate is very low. The vast majority of Fredericton residents speak English at home (Statistics Canada 2007). These statistics present a picture of a stable, well-

educated community of service workers and professionals: relatively homogenous, but thriving.

Fredericton's tightly-knit community develops through close social and professional relationships as well as a sense of common character. Fredericton's network builders envisioned their network as contributing to a community defined both by its geographic location as well as its local culture. In terms of the definitions of community presented in Chapter 1, Fredericton's community combines symbolic and personal elements (Day and Murdoch 1993) that Fred-eZone developers build through technology. The city's economic development officer reflected on the scale and nature of community as it influenced the eZone project:

> I found it interesting that the first hotels or motels to deliver WiFi were the "Country Inn and Suites" and "Comfort Inns" of the world . . . the smaller, more flexible, more nimble places to stay. Not the Sheraton Inn in Toronto, who still want me to plug in a cable and pay $4.95 a day. So is it any wonder that Fredericton was way ahead of Toronto when the Country Inn and Suites was way in front of the Sheraton Inn in Toronto. I think the bigger you are, the more trouble you have wrapping your head around this" (Don Fitzgerald, Interview Feb 3, 2007).

The head of the city's corporate services felt that a smaller city encouraged elected officials to consider the entire community as opposed to their local electorate: "It's small enough that council members can't be parochial. They have to think in terms of the benefit of the whole city and not limit themselves to twelve square blocks" (Jane Blakely, Interview Feb 10, 2007).

Civil Servants, Not Geeks

The Fred-eZone's developers, colleagues and friends including the city's chief information officer, the manager of the city IT department and the director of Team

Fredericton, felt strongly about using technology to promote their city. They knew each other well and had previous interest and expertise in high-tech. It is unlikely that any of them would describe themselves as geeks, although all of them said that they learned about networking technology "on the ground," "through trial and error," and "by doing." Of the three none trained as engineers. Mike Richard, the Vice President of Operations at E-Novations and a manager in the information and communication technology division of the Fredericton municipal government, was a police officer for 15 years in Fredericton's municipal police force. Maurice Gallant, the city's Chief Information Officer, worked for the Conference Board of Canada in Ottawa, before returning to Fredericton, and Don Fitzgerald, the executive director of Team Fredericton, the city's economic development agency, ran an internet service provider before joining the public sector. All of them had worked together for at least five years by the time the Fred-eZone project began. Their approach to connecting community and WiFi was much more pragmatic than the grassroots explorations at ISF. These examples illustrate well what Bar and Galpernin (2005) point out, which is that following the explosion of geek-produced WiFi projects follows the age of the bureaucrats, who may have different visions of how to use WiFi.

Developer's Visions of Community Networks

The composition of the fibre "Community Network" that supported the WiFi network illustrates how network developers and advocates envisioned technology as contributing to their community. The Community Network is owned and operated by the municipality, and delivers high bandwidth to businesses at reasonable wholesale cost. Building the network was an act of resistance by the municipal government to the

incumbent telecommunications company's disinterest in the city's small market, and its local development was a point of pride. Maurice Gallant explains how the incumbent ISFP resisted the city's construction of the fibre network:

> This was not something they wanted us to do. They tried to dissuade our councilors, our managers, that we shouldn't be doing this … that this was unfairly competitive, that there was a commercial offering out there, that we should be using that. But we had done our research, we knew what the price points were, we knew what the price points could be. (Maurice Gallant, CIO City of Fredericton, Interview Feb 14, 2007)

The success in developing the fibre network autonomously instead of depending on incumbent providers reinforced the idea that Fredericton's civic character was resourceful, innovative, entrepreneurial, and self-sufficient. The description of the development of the eZone reiterated these values as characteristic of the Fredericton community:

> It tells a lot about our council and about our community. We went and said, we'd like to do this, here's what it would cost, here's the area it would cover. And I guess we got a no. . . . [Then] council said can you come back. And we were back at the very next meeting. Okay, we like this idea, but the area that you are going to cover is too small. And the delivery time is too long. And you didn't ask for enough money. So here's more money than you asked for, so go do much more than you planned for and by the way do it in less time. So, collectively at this time we are the dog that caught the parked car. Because we had mapped out a small, relatively easy to do project that wouldn't interrupt what let's call our day jobs. But our council saw the correctness of this kind of tool in this kind of community. (Don Fitzgerald, Interview February 3, 2007)

The development of the eZone evoked a particular vision of the Fredericton community as resourceful, business-minded innovators who could develop a free WiFi network without increasing residential tax rates. The mayor describes the competitive nature of this innovation: "it was like we were in a race with a lot of other people but we got a really good start. And of course money is part of that. To be able to do this, and not to

have taxes go up because this is part of the basic tax package. And I think now people are starting to see the benefits. People are doing business downtown on our system." (Brad Woodside, Mayor of Fredericton, Interview February 3, 2007).

For the mayor, as well as for other municipal departments including the tourism department, the WiFi network is a way of branding Fredericton as high-tech and innovative, linking this innovation with the city's government, education, technology and geomatics industries: "We use it as a kind of mind flip – to get away from the perception of Atlantic Canada, backwards, welfare bums, to say that the whole city is under a WiFi umbrella but that you could still sit down by the river and get some of what you associate with Atlantic Canada. It changes your perspective. [We show] hiking trails and then right away the smart city message" (David Seabrook, Manager, Fredericton Tourism, Interview Feb 13, 2007). This "mind flip" is part of an overall communications and branding message that attempts to position Fredericton competitively with relation to other cities. Lovink and Rossiter (2007) argue that cities are agents within a "communicational economy" of creative industries. Each city attempts to communicate its own status as a locus of creativity. Furthermore, "creative industries has an ambition to hardwire its concepts into infrastructure. Policy leads to urban development, employment conditions, flows of economic investment, border movements, and so on" (p. 18). Fredericton attempts to institutionalize the creative, innovative symbolism of the WiFi network while streamlining images of WiFi-linked creativity and innovation into its marketing and tourism material.

Fredericton's vision of WiFi differs from that of ISF. The WiFi network initially formed a natural extension to the fibre Community Network, which had lowered business costs and creating competition in the residential broadband market. Instead of being seen as a community media platform, the Fred-eZone's developers thought of it as a municipal public service for mobile knowledge workers, business people, and visitors. Having a WiFi network was envisioned as easily branding Fredericton as a community of innovators who would support increased connectivity and choose to live in a place with established "intellectual infrastructure."

Intellectual Infrastructure

With the development of the economic development strategy focusing on knowledge industries, Fredericton's decision-makers have invested in intellectual infrastructure including network hardware and software, but also institutions. In 2003, Fredericton put in a bid to act as the home for the National Research Council's Institute for Information Technology (NRC IIT[v]), a federally-funded research institution that conducts research, develops technology, and incubates technology-focused businesses. The NRC IIT is now located on the campus of the University of New Brunswick. The Fredericton city council's bid specifically referred to the innovative connectivity infrastructure developed by the municipal government, but also to the fact that the city had an educated workforce and was open to research. In a way, the NRC IIT is itself a form of intellectual infrastructure.

Greg Sprague, a project manager at the NRC IIT and the former CIO of the University of New Brunswick said: "in a province like New Brunswick we have to go find people, get

them to come here and get them to stay. Networks are an important piece of the economy. We do try and sell NB as a test bed. Distributed, educated, bilingual population. Perfect place to do a pilot project" (Interview February 13, 2007). A representative of a successful local software development business selling on the global market describes the business advantages of Fredericton beginning with, "the broadband; the ability to connect to the world from here" (Sandi MacKinnon, Interview Feb 11, 2007). Broadening the definition of infrastructure to include network connectivity infrastructure extends the definition of public infrastructure. The director of Fredericton's economic development organization comments: "normally if you talk to someone about the definition of infrastructure it's going to be roads and streets, water and sewer. But cities are about a whole lot more than that now. They're about parks, cultural institutions. They are about the different levels of infrastructure. Council sees this as intellectual infrastructure, something that will allow the people and the firms that live here to succeed and prosper here" (Don Fitzgerald, Interview February 2, 2007). In order to inspire local success and prosperity, the municipal government envisioned the WiFi network as symbolizing a vibrant community that could retain young people and attract new immigrants.

As an infrastructure for connectivity and connection, the WiFi network also meant to compensate for weaknesses in previous generations of infrastructures. For example, the city's director of information technology described how a WiFi hotspot provided a symbolic link between the transcontinental highway, which had bypassed the central city, and the downtown core:

> When the four-lane highway came through here a few years ago it was going to bypass the whole city, and there was a lot of concern about that. The old highway there were 4 or 5 exits off the road, directly to downtown. Now we have the Big Stop, the truck stop that is the major point on the highway, and so we covered that with wireless. (Mike Richard, interview Feb 03, 2007)

Discussing the city's assets as "intellectual infrastructure" suggests that Fredericton possesses greater infrastructural resources than similarly sized or located cities, a claim that underpins its branding strategy as a "smart" knowledge centre. This claim also gestures at how the WiFi network was built on existing city-owned infrastructure like street signs, lampposts, and water towers. However, the Fred-eZone was not built based entirely on public investment. When the city technical office began developing the eZone in 2003, WiFi technology was still relatively unstable and had only recently begun to be used to cover wide areas. The city agreed to act as a demonstration project for Cisco Systems in exchange for in-kind equipment donations and shared expertise. The demonstration project cut the costs for the original deployment of the network, since Cisco donated much of the backhaul equipment. In turn, Fredericton appeared in Cisco promotional material[vi].

Like ISF, the Fred-eZone concentrated on providing connectivity in places away from work or home. The Zone was supposed to appeal to visitors and to "knowledge workers" who would want to be connected when at other locations besides work and home. This meant covering the entire downtown core, with a focus on places like bars or cafes that these workers and visitors might visit. Other public areas were also included, like the boardroom of the local electrical utility, whose executives wanted shareholders and members of the public to be able to access the internet without going through the

company's internal network, and all of the city's parks, arenas, and sports centres. The network design focused on the integration of WiFi as one public service among others, linking it to the municipal institutions and infrastructures already in place. Also, because the WiFi network was meant to illustrate the innovative character of the Fredericton community, its design evolved as the network expanded. Its coverage has remained concentrated on city-owned property, in the downtown business core and other commercial corridors including the Knowledge Park industrial estate and a suburban commercial strip (see Appendix Eight for coverage maps). Wade Kierstad, the Fred-eZone's network architect noted: "WiFi was never meant to replace home or business connections but to work in-between these areas. The initial vision was not to replace the providers of home or business service" (February 3, 2007). One of the city councilors who voted to support the construction of the eZone reiterated that the network had grown out of the need for municipal employees to be linked together, and had never been planned to operate separately from the municipal government.

Managing Disruptive Technology

The symbolic link between WiFi and innovation draws on the representation of WiFi as a disruptive technology. In Fredericton, aspects of the network also disrupted the expectations of the network's developers. The first disruption was the fact that the WiFi technology did not work reliably when the network development began. Changes in the network design during the design and deployment process indicate how designers' visions of how the network should be used contributed to the technical and architectural choices they made. Even after the Fred-eZone received sustainable funding to expand past the state of a demonstration project, the network was still designed to provide "best

effort" service rather than reliable connectivity. The expectations of the project's designers were always tempered by the fact that they were working with new, untested, and unstable technology that they were attempting to manage and integrate into their existing ICT infrastructure.

The evolution of the network architecture reflects how the eZone's designers integrated their visions for WiFi into their existing networking structures. At the time of writing, the Fred-eZone network consists of three virtual networks (VLANS), each of which is connected to the city's fibre backbone and to the city's server where a firewall and network management software are also located. The three virtual networks prevent interference from too many radios operating on the same network. Wireless backhaul is used to connect tower sites with connections to the fibre network to the individual WiFi access points. The access points are equipped with radios that link to the main tower sites wirelessly, broadcasting WiFi signals to receivers in the area. Unlike the ISF network, there is no e-mail authentication process for using the Fred-eZone. Instead, a splash page shows the terms and conditions for use of the network, which users must accept before connecting to the network. The MAC addresses (unique addresses identifying a single physical computer) are logged, and MAC addresses associated with abuse are blocked. During the day, the bandwidth allocated to the eZone is limited; at night, it is unlimited. Peer-to-peer network traffic is throttled (that is to say, the amount of traffic it is allowed to use is severely restricted), and sending of e-mails is limited.

This architecture was the result of modifications made in the first two years of the Fred-eZone's development, and addressed both technical malfunctions and the behaviour of the people using the network. The nature of these modifications indicates how the eZone was integrated with other municipal infrastructures as a public service, but also the influence of the network builders' conceptions of community. The initial design for the eZone was as a series of point-to-multipoint WiFi transmitters (or antennas) mounted on locations with backhaul connectivity to the internet. All network traffic was routed to the city's central authorization server, which managed the radio connections and authenticated the people using the network. The network was "pretty well completely open" (Mike Richard, Interview Feb 06 2008). The uses of this "open" network included some practices that disrupted the network developers' initial visions, inciting them to restructure the network based on this experience.

Aligning Visions and Experience

Disruptive Uses

The eZone is designed to permit free WiFi access using the excess bandwidth purchased, but not used by, the members of the fibre Community Network. Initially, network planners felt that there was sufficient bandwidth to have the eZone provide high-speed WiFi to anyone who wanted to use it, at any time. However, this bandwidth was not sufficient for providing unlimited peer-to-peer transfers, or ways of transferring large files by distributing them across a network. Peer-to-peer traffic often uses different protocols than other internet traffic like web browsing. In 2004 BitTorrent peer-to-peer transfers accounted for so much network traffic that the eZone was beginning to encroach on bandwidth allocated to other Community Network members. The network designers

responded by shaping the network traffic. They limited the speed of transfer of peer-to-peer traffic and prioritized web-based HTTP traffic. This move thus makes it difficult to use the eZone for purposes other than visiting web pages and checking e-mail.

Shortly after this incident, the network managers received a notification from anti-spam service SpamAssassin that messages originating from their network had been blacklisted because so much spam was being sent from the Fred-eZone. The managers responded by blocking known virus ports, and by installing a mail proxy server that intercepts e-mail messages and runs them through an anti-virus program. Computers connected to the eZone are permitted to send only 10 e-mail messages using SMTP (Simple Mail Transfer Protocol -the standard message delivery protocol) per connection. These measures have configured the eZone into a network that is difficult to use for purposes other than the occasional web searching and e-mailing that its designers imagined. In fact, survey data from March 2008, which is discussed in more detail below, indicates that the Fred-eZone is used most often for occasional access to e-mail, web searching, and instant messaging. These uses are very close to the uses anticipated by the Fred-eZone's developers, who eventually created a closed, tightly managed network that is accessible free of charge and without authentication. Even though the network is highly managed and many uses (like voice over internet protocol or VOIP) are discouraged, the designers feel that this increased control is justified because access is offered free of charge.

Designing a network to favour the uses imagined by its designers is an example of what Akrich (1992) refers to as "configuring the user" where designers of technologies

imagine potential users as being similar to themselves. Designers configure the eventual users based on how they envision their products contributing to the world. These visions are often based in designers' own experiences. In many ways, the Fred-eZone's designers envision their ideal users as being like themselves: professionals who find it useful to be connected to the internet for work and pleasure. The homes of several city technology employees also host eZone nodes, one of which is among the ten most frequently used hotspots. However, this could be an overly simplistic view. It is not so much that the eZone developers design for users they believe are like them, as it is that they are developing for an ideal Fredericton inhabited by mobile professionals drawing on the city's intellectual infrastructure and contributing to its purported innovative culture. This process of configuration is more similar to that of the Amsterdam Digital City, where designers imagined the future users of their technology in terms of their own experiences (Oudshoorn, Rommes, and Stienstra 2004).[vii] Managing the network by responding to unexpected uses of it reinforces a specific vision of community, in which the community using the eZone shares a common identity with the designers. At the same time, the modified network's structure configures the possibilities of use to more closely align with the designer's visions.

Managing the structure of the eZone to configure more desirable types of use is a means by which the network's designers attempt to capitalize on their vision of how the network should represent their community. Sandvig (2002) notes that visions are ways of thinking about the use of communication technology when no deep thinking has occurred: visions are a partial narrative conceptualizing who should use technology, in

what circumstances, in what way, what such use of the technology should mean, and what consequences this use is intended to have. The visions of the eZone as potentially improving the quality of life in the city are sustained through the way the network has been structured and modified by its developers.

What kind of Ubiquity?

Digital Divides

The modifications of the eZone and the choices made about how to frame its builders' visions of an appropriate WiFi network and its most desirable uses demonstrate how specific interpretations of technology highlight some social concerns and leave aside others. For example, Fredericton's high-tech development is never discussed in terms of bridging internal digital divides within the community itself: only in terms of competitively positioning Fredericton with relation to other cities as a site for business development and immigration. The fibre network provides commodity bandwidth to businesses and institutions, while the eZone provides public access to WiFi for those with the appropriate equipment. While the WiFi signals extend across most of the downtown core (one of the city's least wealthy neighbourhoods where many university students rent accommodation) using the eZone indoors requires installing additional antennas. One University of New Brunswick student I spoke to described the efforts he went to in order to use the eZone at home:

> We have this long antenna that goes out to the shed, that's where the signal is. It was either this or spend $600 a year on internet – it's 50 bucks a month. But we have this antenna; it has to work on USB, and this long tail. We did a lot of research, read everything that we were supposed to do, but we bought a D-link antenna, and it really doesn't work with Macs, that's what we have, a Mac. And the equipment to work with Macs isn't readily available in this area. So it doesn't work that well. It's a bit buggy. (Male e-Zone user, Interview Feb 3, 2007)

Not everyone living in the area covered by the eZone would have the research experience or technical skill to make these kinds of efforts to use the eZone at home. Indeed, another student who was using her laptop during our interview said that she connects to the internet using DSL at home – "I have a little connection that goes in here . . .[points to the port on the side of her laptop]" (Female eZone user, Interview Feb 3, 2007). Her laptop was a new Mac IBook with a built-in wireless card, and our interview was being conducted in a Fred-eZone equipped café.

According to Rideout and Reddick (2005), Canadian communities and especially communities in Atlantic Canada still experience a "dual digital divide" encompassing not only differences in "technical access" consisting of a connection to the internet, but also the experience and interest that would make using this technology relevant. They argue that because it concerns the delivery of public information and services, community networking should be a government initiative. In Fredericton, the provincial government provides a community access program (CAP) that funds computer centres in public libraries and other public places. The CAP formed part of a 1990s federal government initiative to increase broadband connectivity and digital skills that also included the Smart Communities program. It established community based public internet access facilities to help communities in rural and remote areas get access to the internet and develop the skills to use it effectively (Industry Canada 2004).

At the main library in Fredericton, both the computer lab and the eZone provide internet connectivity, although no specific training programs are associated with either of them.

Librarians I interviewed said that around five people bring laptops to the library each day, and that the computer room was regularly used, if not necessarily for education and training: "If there are 50 a day, 40 of them will be the same people every day. Playing games, you know . . . In the summer we get lots of tourists, people who need to tell folks at home where they are." (Head Research Librarian, Fredericton Public Library, Interview Feb 7, 2007). At another CAP site in the science museum, the manager stated that the computers had been purchased for use in educational programs but that members of the local community never use them. The CAP programs in Fredericton, like those in the rest of the country, have been without stable funding since 2001. Without support of training and community content development, the CAP sites – and the eZone as well – support only technical internet access, which is not necessarily used to gain access to government information or community content.

The "Information Super-Sidewalk"

The CAP program and other Canadian government programs like Smart Communities promoting ICT connectivity and training define access to information and communication technologies as a public responsibility because of their ability to deliver public information and services. The policy rationale for these funding programs was that training needed to be provided in order to help Canadians access government information online. If Canadians were going to access government information online, then the government should be responsible for ensuring that everyone could have access to this information using the internet as a platform. Rideout and Reddick's arguments for government responsibility for bridging the digital divide draw from this logic (Rideout and Reddick, 2003). In contrast, the framing of the eZone as "public infrastructure" has

focused on the network's ubiquitous presence, rather than its potential uses. Don Fitzgerald described the eZone as "the equivalent of the information super-sidewalk. We put the sidewalks up, we say walk up and down them, this is your transportation infrastructure. As long as you don't ride your bike or break any of the bylaws, we leave them alone" (Interview Feb 3, 2007). Symbolically, the eZone is deeply integrated into the image of an innovative community that the city's municipal and business community has developed. Practically, it is not intended to provide regular connectivity. The role of the network in providing any kind of public information or community content is secondary, although the municipal government has begun to experiment with delivering location-specific tourist information that could potentially include descriptions of historic buildings delivered using captive portal pages similar to those that ISF uses at each of its hotspots. At present the opening page on the Fred-eZone is the same no matter which network node is being accessed. Figure 6 shows how the Fred-eZone designers expected users would gain access to the network, as well as a small image of the opening page.

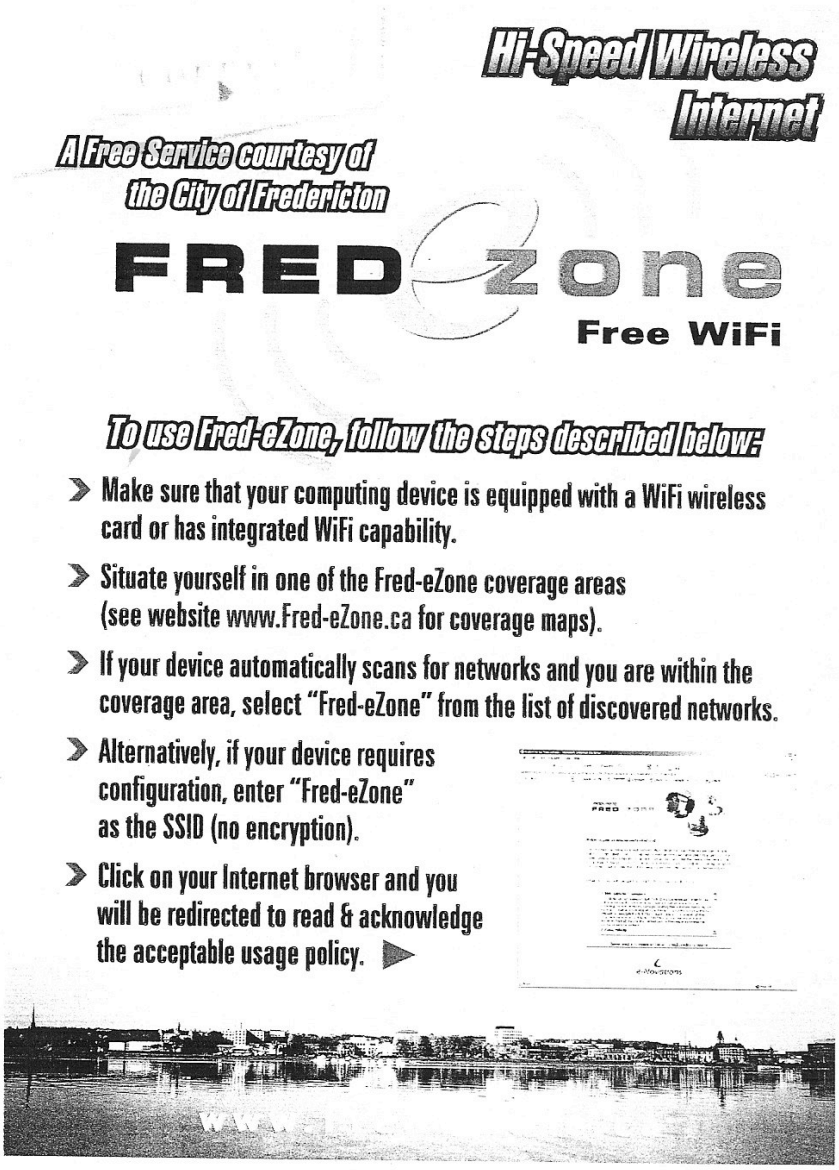

Figure 1: Flyer describing how to access the Fred-eZone. Fredericton Tourism.

Unlike the ISF network, the Fred-eZone was not designed with any specific communication purpose in mind. Initially a demonstration project, it later became framed as a public service that would illustrate the city's connected, forward-thinking nature. As imagined by its designers, the media, and marketers, the eZone would promote ubiquitous connectivity: "Always connected, at high speeds, anywhere in the

city and what's more – for free . . . Fredericton now boasts omnipresent broadband service, a truly connected business community and an extensive WiFi zone, which allows individuals to connect to the world free of charge" (Gallant, 2004). Promotional material for Fredericton's tourist market, as Figure 7 suggests, highlights the image of Fredericton as a typically picturesque Maritime community with global connectivity.

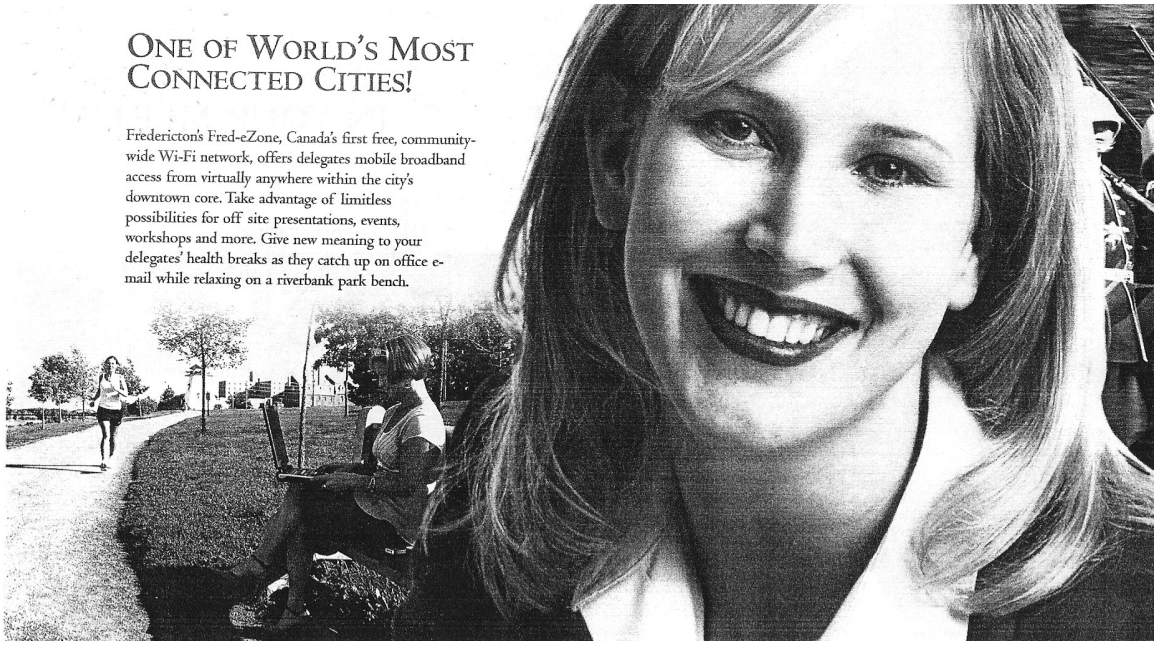

Figure 2: Tourist brochure for conference market, Fredericton Tourism

These representations highlight the ubiquitous potential of the network without making any claims about how it might or should be used. Even considered as intellectual infrastructure – or as "information super-sidewalks" the eZone has a restrained footprint. The wireless "sidewalks" cover 40% of the city's municipal wards although network coverage maps, which measure the coverage under ideal situations, suggest a much greater coverage as Figures 9 and 10 indicate.

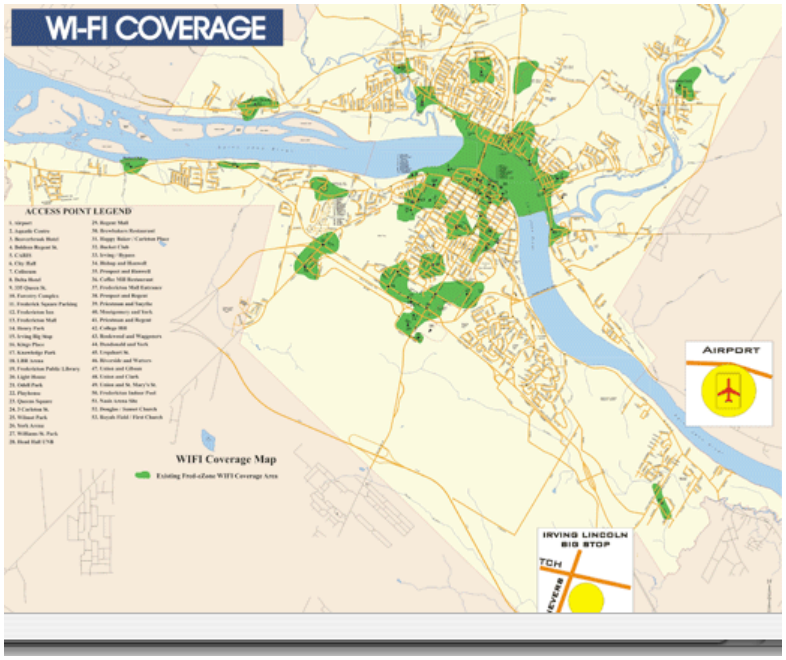

Figure 3: Fred-eZone coverage as of December 2005

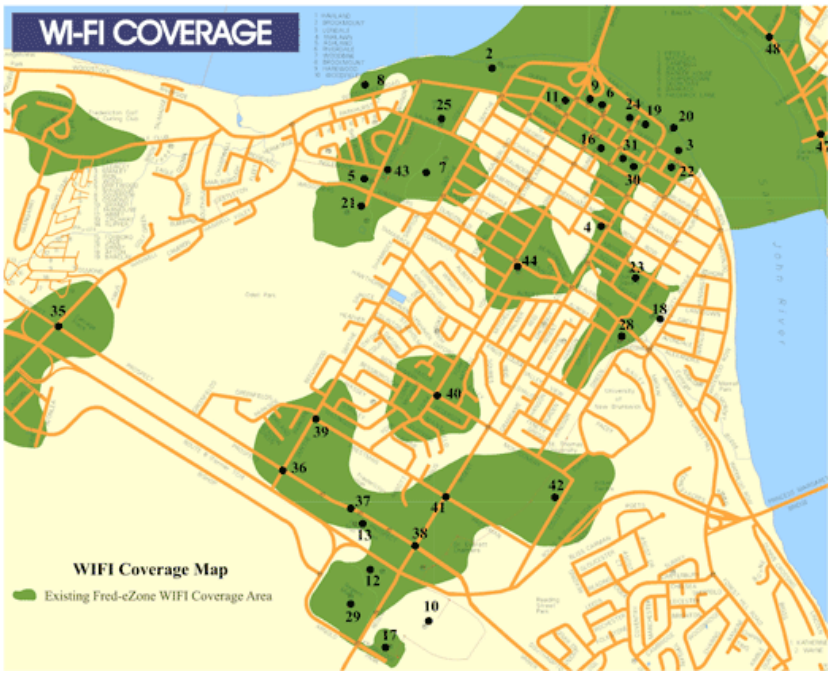

Figure 4: Downtown coverage of Fred-eZone, 2005

Jane Blakely notes that this creates "the illusion of connectivity everywhere, for free" (Jane Blakely, Interview Feb 10, 2007). In addition to the downtown core, there are hotspots at many of the city's major churches (some of them used as antenna sites), on some parts of the university campus, over the parking lots and inside two shopping malls, at the trailer park and truck stop, and at rinks, pools, and recreation centres. Most antennas are located in the downtown core, where interference with other WiFi access points has reduced the effectiveness of the network. The vision of outdoor or mobile use is not well supported in practice: the eZone works well outdoors in the winter months, but during the summer months the leaves on the trees downtown cause interference, which may undermine the potential for the increased outdoor use that eZone developers assured me occurred over the summer. Mobile use is not possible because the network requires a new authorization at each individual access point. Given these constraints, it is important to assess how the Fred-eZone has been used, in comparison to how it was conceived or designed.

Using the eZone

Since its launch in 2004, use of the eZone has grown slowly and steadily. Network management logs obtained from the city in February 2007 indicate that several hundred users are online at any time, with peaks in usage in morning and at noon, when office workers are likely to be away from their desks. Tests inside two residential houses in Fredericton revealed weak signals that could not be reliably used to access web browsers. As of February 2007, the eZone locations with the highest number of clients were the Playhouse Performing Arts Centre, where municipal employees use the eZone to gain access to the city network, at a hotel ballroom where a conference was taking place, and

at a downtown café. The access points with the highest traffic rate included the Chapters bookstore in the suburban mall, the University of New Brunswick computer lab, and the Irving Big Stop truck stop on the Trans-Canada Highway. From November 2006 to September 2007, an average of over 11,000 active sessions occurred, or an average of around 400 sessions per day. However, out of 21,000 clients who connected over this period, 24.9% connected only once, and 13.8% connected only twice: nearly half of the repeat users of the eZone thus connected fewer than three times. This suggests that the primary users of the network are short-term visitors to Fredericton.

The online survey that ran during the month of March 2008 revealed use in line with what the designers of the Fred-eZone had imagined, with some unexpected surprises. Receiving 155 responses, the survey indicated that two thirds of eZone users were men between 35 and 44 years old. Half were university graduates, and most were full-time employees. Like the network management statistics, the survey indicated that the downtown cafes, the Irving Big Stop truck stop, and the airport were the most popular location of access. Hotels were also popular access locations. Half of the people who responded to the survey were not Fredericton residents. This supports the findings reported above that suggest that most Fred-eZone users are visitors to Fredericton. Several responses to the question "what do you like most about wireless internet" received responses from truckers using the eZone from the truck stop, including this one: "this relevies (sic) a lot of the stress involved with having to be away from home, thank you for this service. ask any trucker (sic)." Other comments described using the eZone in parking lots from inside parked cars. One respondent described using the internet from a

parked car while waiting for a child to finish band practice and another described the advantage of "the privacy of my vehicle" as a reason to use the eZone in the location where he or she uses the network most often.

The uses most frequently reported by survey respondents were sending and receiving e-mail (77.9%), "going online for fun or to pass the time" (53%) and sending and receiving instant messages (45.6%). Only three per cent of respondents had used the Fred-eZone to make a voice over IP call, suggesting that the throttled network effectively limits this type of use. Furthermore, most of the activities on the eZone were "consumption" activities: getting news and weather updates, searching for information or downloading music and videos.

The main advantage of the Fred-eZone, according to most survey respondents, is that it is free. However, forty per cent of respondents indicated that they would be willing to watch an advertisement in exchange for free WiFi access. Still, eighty-seven per cent of survey respondents strongly agreed with the Fredericton municipal government's decision to fund the network. As the survey indicates, the Fred-eZone is used in many of the ways imagined by its designers: as an occasional service for business travellers, truckers, and other visitors to the city. For more regular use, or to provide alternatives to expensive long distance telephone calls through voice over IP, the Fred-eZone would have to be a more open network and not constrained by the bandwidth limits currently in force during the day.

Best Effort

The Fred-eZone is a "best effort" network. The users I spoke to in February 2007 were pleased to be able to use the eZone for free, but noted that it was not very reliable: "Normally it works fine but today it is as slow as dialup . . . it's great, it's really great. But I wish it were in more places. It's only here and sometimes up on the hill at Starbucks, but I can't always access it there, it depends what server you are using" (Male eZone user, Interview Feb. 12, 2007). The Fred-eZone's developers concentrated on creating a ubiquitous public infrastructure to provide technical access to the internet, rather than public information or community-based content. Although this technical access is provided free of charge, it does not provide the reliability or broad coverage that would make it truly ubiquitous. Considering that it is "best-effort," few users expect much reliability from the Fred-eZone. However, it is the only WiFi service available in Fredericton, and it is publicly funded. The following section discusses the implications of Fredericton's framing of the eZone as a public service, in the context of computerization movements.

Institutionalizing WiFi

Thus far in this chapter I have considered how the visions of the Fred-eZone's developers drew on the newness and potential disruptive quality of WiFi to represent it as a component of a smart, innovative community, and described the reality of the uses of the network. I have also examined the network's design, and the way that its intended uses focused on the potential of WiFi to be a ubiquitous public service connecting Fredericton to the world. The next section analyses how the symbolic ideas of WiFi as disruptive or ubiquitous were developed and integrated into Fredericton's civic culture and economic development strategies.

Institutionalizing Disruptive Technology – WiFi as Innovative

WiFi's disruptive potential is integrated into the city's branding strategy that presents it as innovative and "smart." The WiFi champions in Fredericton allude to the "underground" identity of WiFi technology as a way of highlighting their city's innovative decision to develop a free WiFi network: "You know, WiFi started with people writing a big W in chalk on the sidewalk. This is the underground" (Don Fitzgerald, Interview Feb. 3, 2007). Could the municipal managers who designed the Fred-eZone claim any relationship to the technology "underground" of warchalkers indicating free WiFi with symbols on the sidewalk[viii] (or even ISF's geeks)?

Fredericton's network is one of the first examples of WiFi institutionalized at the municipal (rather than the university or corporate) level. Subsequent municipal WiFi projects, especially the hundreds of North American projects launched in 2006 and 2007 (Tapia, Maitland, and Stone 2006; Tapia and Oritz 2006; Muniwireless 2008) have not been able to capitalize on the symbolic value attached to early adoption of WiFi. Based on readings of the Muniwireless.com web site[ix] from 2004 to 2008, the representation of municipal wireless networks has shifted from an excitement about being "unwired" towards a focus on municipal applications such as meter reading and public safety to WiFi as a public utility that could meet municipal needs. This suggests a broad symbolic and cultural shift away from a focus on the disruptive potential of WiFi in the municipal context. In keeping with this, Fredericton's engagement with the disruptive potential of WiFi has focused on the significance of its network as one of the first in North America, rather than on the undesired disruptions of its network by spammers and file-sharing. Gallant (2004) writes, "Fred-eZone, Fredericton's free WiFi hot-zone has quickly

become the envy of many other Cities [sic] in Canada, the U.S. and, in fact throughout the world. We receive weekly calls from other Cities [sic] wanting to emulate the project" (p. 7). Having been the first to successfully deploy and manage a disruptive new technology thus implies, according to city administrators, innovativeness. Although the WiFi network is meant to indicate Fredericton's innovative character and inspire progressive policy strategies like the local ownership of the fibre network, using technical innovation as a means to brand Fredericton as progressive and cool can also be interpreted as technocentric.

Fredericton's economic development strategy depends upon making the city an attractive location for greater private investment. The city's choice to structure the fibre network as a cost-saving measure for local businesses and the municipal government rather than as a public service suggests that the Fred-eZone's contribution to promoting innovation is considered primarily in terms of its ability to help businesses develop. Investing in a disruptive technology provides cachet to Fredericton's government by tapping into the symbolic association between new technology, innovativeness, and creativity.

Institutionalizing Ubiquitous Technology – WiFi as a Public Service

If the disruptive cachet of WiFi could be integrated into Fredericton's economic development strategies as a means of evoking the city's innovative, smart identity, the potential for WiFi to add to its existing fibre network could expand the city's range of public services. Various conceptualizations of "public" are associated with the provision of internet and network connectivity. Clement and Potter (2007) construct a "desiderata" for public broadband connectivity, which, while not arguing for ubiquitous

connectivity, posits that connectivity should be universal and available to "every household, business, organization, public space, tourist destination, and public transit corridor in the network's coverage area . . . that is, it should reach every person when and where they need it" (Clement and Potter 2007). This understanding of universality suggests that public WiFi could be considered a public utility like water and sewer service – or sidewalks.

In contrast to Clement and Potter's evocation of universality as an important criterion for public WiFi networking, Stewart et al (2004) use the concept of the public park to make an argument for public appropriation of the internet. They argue that the understanding of the city park as a public good can be used as a reference for internet policy-making. This argument supports public provision of internet services, especially when they are explicitly represented as public goods. Stewart et al. argue that as a city becomes commercialized, some spaces must be set aside for social integration and citizen engagement. These spaces parallel city parks, which the authors define as public goods. They write:

> In spite of its essential economic nature, the term 'public goods' finds its early roots in western philosophical notions of the 'common good'. Indeed, while the latter is conceived as a set of ultimate goals of collective well-being and harmonic existence among the members of a community, the former represents – albeit expressed in different ways by different social contracts – part of the means required for achieving such a situation of collective well-being and prosperity. Thus, the notion of public goods is associated, since its origins, with the collective or public provision of both material resources (such as roads, lighthouses, bridges, sewers, mail service) and non-material conditions (such as national defense, a legal system, universal education, a domestic currency or collective health) (p. 346).

The metaphor of the public park is an evocative one for a public network. Public parks are shared spaces set aside from the commercial city, where sociability, relaxation, play, and public participation occur. Such a metaphor might describe a network like the one proposed by the partnership between ISF and the City of Montreal, where WiFi hotspots are publicly available for a variety of uses. Fredericton's Community Network fibre ring and Fred-eZone wireless project have also evoked the idea of communications infrastructure as a public good but have framed it in terms of infrastructure.

Currently, the Fred-eZone is neither a public utility nor a public park, and in many ways it is not a very good infrastructure either. City officials I spoke to used not only the metaphors of sidewalks but also water services and health care to define their WiFi network. Although these metaphors suggest that WiFi and communications infrastructure are perceived as public goods by Fredericton's decision-makers, the network is only available in a relatively limited area and can only be used for a limited number of purposes. Officials also acknowledged that WiFi is not essential: "Well, you could probably do without it" (Jane Blakely, Interview Feb 10, 2007); "It's a little bit tricky, sometimes you are blocked by a building or something" (David Seabrook, Interview Feb 13, 2007). These comments resonate with those of the eZone users who responded to the survey, and who would like to see the network expand and provide more reliable and faster service, but who are still pleased that it is available for free. The Fred-eZone introduces a very basic level of public accessibility, but does not reliably provide a public service.

Despite creating an "illusion of being everywhere" the eZone is only available in specific public places. Furthermore, sidewalks or roads are expected to be maintained and usable, not 'best effort'. The Fred-eZone clearly requires conceptualization as a public service other than a sidewalk or water system. Stewart et al's suggestion of a public park may make sense, but as of yet the way that the eZone has been integrated into the municipality's existing communications infrastructure has not developed the potential for WiFi to operate as a community media, or to provide content or information to engage its citizens like the ISF portal pages attempt to do. As a public park, the Fred-eZone is a piece of bare ground.

Stages in Computerization Movements: Institutionalization

Touraine (1977) argues that social movements end in institutionalization, and Lovink and Rossiter (2007) note that institutions are essential for the development of creative industries. Therefore, struggles over symbolic meaning eventually result in interpretations that have been viewed as radical, becoming more acceptable. Like ISF, the Fred-eZone developed around a specific local culture and operated within the expectations of its developers. Much of the value of the e Zone is located at what Touraine calls the synchronic – symbolic – level: it is an international prize-winner and provides the economic development and tourism office with examples of the city's vibrancy and innovativeness. However, the decision of the municipal government to license its own competitive telecommunications provider has also influenced policy and regulation of telecommunications within the local region. Thus, some parts of Fredericton's overall innovation strategy operate at the diachronic – state and regulation – level by changing the expected relationship of a municipality to telecommunications

provision. Still, the WiFi network has not yet been integrated into this broader pattern of change. It is symbolically imagined as providing ubiquitous coverage across the city, yet it has not been designed to provide broadly accessible coverage.

As part of an institutionalizing trajectory within computerization movements, the Fred-eZone suggests an intermediate state that is more formal than grassroots experimentation like Île Sans Fil and more flexible than large institutions like nationwide telecommunications infrastructures. The small scale and local culture of Fredericton are still important elements of their innovative practices, but they are beginning to challenge expectations of what kinds of infrastructures city governments should provide. As Strover and Mun (2006) point out, the role of North American cities as defined in the 19th century was as an executor of specific powers as defined by the state. Cities' responsibility for communications had been limited to rights of way such as streets and roads, canals, and conduits for telephone lines and fibre optics. The expansion of ICT infrastructures used for transferring information as well as for communication potentially expands the responsibility of cities to provide communications infrastructure. Fredericton's locally scaled interventions in policy and infrastructure do have precedents in other infrastructural technologies. As Fischer (1992) describes, the early telephone infrastructure often depended on autonomous local governments to create co-ops in order to aggregate enough demand to build higher-capacity trunk lines. Yet the integration of the local fibre network and WiFi indicates a new focus on integrating the development and management of communication infrastructures under municipal responsibility.

Integrating Infrastructures

Sawhney (1992) also argues that large-scale infrastructural developments including communication infrastructures begin as experimental islands unconnected to previous infrastructures, and then begin to connect to them, eventually complementing the previous infrastructure and then, after long-distance links formed, transcending it. Although it elegantly describes how some infrastructures replace others, this system-level explanation fails to explore how specific social, cultural, and political-economic contexts contribute to the shift from "islands" to "systems." In the same vein, Sawhney (2003) argues that wireless and WiFi technologies rerun the cycle of infrastructural innovation. While wireless technologies may be building into a broad infrastructure for internet connectivity and communication, the process of transforming isolated islands into a cohesive system involves a great amount of cultural variation. Like many other observers of the WiFi phenomenon he notes that non-commercial actors like grassroots citizen groups initially participated in promoting WiFi innovation, setting the groundwork for the development of new infrastructures once they could offer service superior to the existing infrastructures.

However, Sawnhey's framework glosses over the role of local cultures and institutions in shaping how WiFi systems are adopted. As the Fredericton case illuminates, the symbolic aspects of an infrastructure – in this case an 'intellectual infrastructure' – become integrated into the city's self-presentation, even as the new technical infrastructure becomes embedded into an existing installed base. The integration of discourses about WiFi as 'intellectual infrastructure' into Fredericton's municipal government concurrently with the integration of the WiFi network into its municipally-

owned communication infrastructure suggests that infrastructures integrate not just technically but also into social and cultural frames.

Conventional histories of infrastructure normally situate involvement by communities at the beginning stages of development before institutionalization begins. Fredericton's Fred-eZone demonstrates how the community scale, where the community is the city as a whole, creates a very specific contextualization for WiFi. This municipal network occupies the space between the grassroots, user-generated innovation of ISF's geeks and the state-level decisions that regulate information infrastructure. However, there are no geek-publics in Fredericton. The Fred-eZone's civil servant developers already had expertise and influence, as well as a mandate to develop public services. Unfortunately, there is no community-public either. Although the Fred-eZone succeeds in establishing a new institutional framework for community WiFi, it seems useful to the city primarily as a part of its branding strategy rather than as a platform for community engagement. This suggests that as WiFi networks become infrastructure, they may still struggle to serve their communities.

Conclusion

Fredericton's integration of its networking projects into its branding as a "smart community" highlights how institutions can build around not just the symbolic aspects of new technologies but their material aspects. Although the government began developing ICT infrastructure as a response to a lack of connectivity, the WiFi project was intended not to solve a practical problem but to demonstrate the city's innovativeness. However, the WiFi project was also structured in some ways as a public service: it was integrated

into an institutional framework where the municipal government managed technical infrastructures and provided connectivity. Technical choices, like the decision to run network traffic through the city's own firewall and servers, as well as to block ports and throttle speeds during the day limited the openness of the Fredericton network, configuring the most desirable uses.

Framing the Fred-eZone as part of a branding strategy that markets Fredericton as a connected, "smart community" boasting an "intellectual infrastructure" presents a paradox. More communication links may make Fredericton more visible when compared with other cities, as evidenced by the international recognition the city has received,[x] but the visions of using WiFi to symbolize an intelligent, creative city obscure the realities of how connectivity is integrated into local culture. Expanded networking does not automatically inspire global competitiveness. Sassen (2001; 2002) argues that increased availability of communications has bolstered the dominance of cities that were already major hubs of finance capital and communication infrastructure. Connectivity has not "flattened the world", she argues, and each individual city is not made equally competitive merely because of better communications infrastructure. Instead, high-tech clusters emerge and create cities with desirable cultural attributes (including connectivity), which motivates the development of subsequent communications infrastructures (Zook 2004). Florida's (2002) notion that a "creative class" of innovators contributes to the development of creative cities links cultural attributes (including both creativity and connectivity) to the concentration of talent in particular locations. Florida claims "technology, talent, and tolerance" as key indicators of increased creativity may

have inspired technology projects like the Fred-eZone, and help to explain why these kinds of projects are used to symbolize innovativeness and creativity. Both Fredericton and Montreal attempted to use WiFi technology projects to differentiate their cities from others by evoking "intelligence," "innovativeness," or "creativity."

In an era of competing "creative cities" (Lovink and Rossiter, 2007), connectivity alone may not be enough to distinguish Fredericton. The city must integrate its ICT projects into broader social and economic development, which could include developing applications for the city's WiFi network. People working in Fredericton's technology-sector already focus on the city's culture. A CEO of an online rights management company described a shift from "being anywhere, and doing your job from anywhere" (Barry Friedman, Interview Feb 15, 2007) to being part of a cohesive strategy for attracting and maintaining high-tech businesses and educated workers. Although Fredericton (and to an extent, Montreal) draw on their WiFi networks as means of creating positive images of their cities as innovative, the networks they develop are most useful to residents themselves, since they reflect local priorities and contexts. Because of this, creating and maintaining a cohesive IT sector cannot begin and end with providing the technical connectivity. A Fredericton city councilor describes why he feels that the city has not developed an IT sector: "there are lots of little things going on here and there, but they are not necessarily connected to one another" (Tommy Jelnik, City Councillor, interview Feb 18, 2007). Developing local capacity must continue beyond building networks and branding them as innovative. For the Fredericton municipal government's evocation of WiFi as a public service to move beyond the purely

metaphorical level, choices may have to be made, especially as the disruptive cachet of WiFi diminishes.

Fredericton's municipal government has institutionalized discourses and practices related to WiFi, and changed the landscape for provision of network connectivity within its municipal area. It has also established a WiFi network that represents the city as a smart community and a knowledge centre within its own region. The city's approach to developing these identities has been to use WiFi to indicate city-owned property, and to encourage occasional use of the internet not only in "third spaces" between work and home but also in hotels, truck stops, and parking lots. This approach concentrates on Fredericton's image as a knowledge centre, in comparison with other cities, as part of an overall economic development strategy designed to boost business development, immigration, and retention of skilled workers. This approach positions WiFi as a symbolic marker of innovation rather than a means of bridging the digital divide or offering an alternative to commercial residential internet services. The Fred-eZone is one small symbolic element of a broader "intellectual infrastructure" made up of ICT infrastructure, research institutions, business development, and transportation links like the airport and highway system. While the concept of "intellectual infrastructure" suggests that WiFi will be a public service or broadly accessible, the Fred-eZone has not been specifically associated with strategies for bridging the digital divide.

The Fred-eZone project presents an alternative to the paradigm of corporate ownership and delivery of telecommunications. It can therefore be understood as an example of how contemporary computerization movements become more institutionalized while retaining

their local impact. This is not the only possible way for computerization movements to develop: in the next chapter I explore how community wireless networking became framed as part of a broad national – even international – movement. For a computerization movement that focuses on the importance of local community, this requires a consideration of how communities and publics might influence the policy-making process. The next chapter examines how the communities and publics involved in CWN create forums for knowledge exchange that also establish new opportunities for policy development.

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Notes

[i] My travel to Fredericton was supported by the CWIRP project. For a full list of the research projects I was involved in during the production of this thesis, see Appendix One.

[ii] For a full list of interviewees for the thesis, see Appendix Two, for summary ethics protocols and interview guides see Appendix Three, and for surveys Appendix Four.

[iii] The development of this survey was supported by the CWIRP project and data will, in principle be shared with the CWIRP project leaders and with the members of the Fredericton municipal government who were partners on this project. The data from the survey was presented in Fredericton during the 2008 IEEE Society on Social Implications of Technology Conference, June 26-28, 2008.

[iv] According to the Canadian Radio-Television Commission (the CRTC) a non-dominant telecommunications operator is not required to file tariffs for telecommunications activity such as data transfer. This means that operators like E-Novation are not subject to government regulation of their data transfer (internet) services.

[v] See http://iit-iti.nrc-cnrc.gc.ca/index_e.html

[vi] See http://www.cisco.com/en/US/prod/collateral/wireless/ps5678/ps6521/prod_case_study0900aecd8031b969_ps430_Products_Case_Study.html

[vii] Oudshoorn et. al described how designers creating the online Amsterdam Digital City project, charged with creating an interface and experience in which every citizen could participate. However, the designers failed to account for the diversity of users, instead using their own experiences to create a more homogenous identity for the users, who were supposed to include "everybody."

[viii] Warchalking, as Sandvig (2004) explains, was a means of indicating unsecured WiFi networks using chalk symbols on the sidewalk. It was a popular pastime in the early 2000s. The markings were thought to have been inspired by the chalk symbols left by hobos in the 1930s to indicate where to find free meals.

[ix] Muniwireless.com is owned by Esme Vos, a consultant based in Amsterdam. It began in 2003 by cataloguing the beginning of the municipal WiFi phenomenon in the United States and has since developed into a clearinghouse of surveys and white papers discussing municipal wireless business models and success stories.

[x] In 2008 the city was ranked as one of the world's "Top Seven Intelligent Communities" according to the Intelligent Community Forum. See http://www.intelligentcommunity.org